City & Guilds Level 3 Diploma in Maritime Defence (Development Competence) (4615-03)

Version 2.2 (July 2022)

Qualification Handbook

Qualification at a glance

Subject area	Mechanical
Age group approved	16-19, 19+
Entry requirements	Level 2
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
City & Guilds Level 3 Diploma in Maritime Defence (Development Competence)	1482	1563	4615-03	603/2423/5

Version and date	Change detail	Section
V2.0 April 2018	Units added: 321-334, 336-339, 356 Barring of units added to this documentation	Structure, Units Structure
V2.2 July 2022	LO4 corrected in Unit 310 LO4 corrected in Unit 315	Units

Contents

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 Maintenance and Engineering sector in general.
What opportunities for progression are there?	Upon completion of this qualification learners will have developed the skills and competence required during their development phase of the Apprenticeship and will enable them to progress into further training. Learners can progress to various roles within the sector.
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 and SEMTA.
Is it part of an apprenticeship framework or initiative?	Yes. This qualification forms part of the mandatory development phase for the on-programme section of the new Engineering Technician Standard.

Structure

Learners must complete 86 GLH from (301-303) plus a further 1400 GLH from (304-356).

The following units are barred combinations:

353 against 354	353 against 355	354 against 355
332 against 333	332 against 334	333 against 334

City & Guilds unit number	Unit title	GLH
Mandatory		
301	Complying with statutory regulations and organisational safety requirements	18
302	Using and interpreting engineering data and documentation	18
303	Working efficiently and effectively in advanced manufacturing and engineering	50
Optional		
304	Bending and forming marine pipe using bending machines and hand methods	700
305	Assembling marine pipework	600
306	Installing marine pipework, components and systems	460
307	Preparing and testing marine pipework systems	400
308	Joining marine pipework by manual torch brazing and soldering	350
309	Surveying marine pipework systems	180
310	Producing socket and flange fillet welded joints in pipe using a manual welding process	860
311	Marking off marine structural steelwork components	210
312	Assembling fabricated components to produce marine sub-assemblies	460
313	Cutting and shaping materials using portable thermal cutting equipment	350
314	Assembling sub-assemblies and components to produce major marine structural assemblies	530

315	Cutting materials using hand and machine tools	400
316	Forming marine components using power rolling machines	350
317	Forming marine components using a power press	350
318	Operating CNC fabrication machines	630
319	Outfitting marine steelwork	480
320	Tack welding marine plate using a manual welding process	350
321	Carrying out pattern development for marine applications	400
322	Marking out components for metalwork	210
323	Developing and marking out templates for metalwork	280
324	Cutting and shaping materials using portable thermal cutting equipment	280
325	Producing and finishing holes using drilling machines	140
326	Producing platework assemblies	350
327	Joining fabricated components using mechanical fasteners	210
328	Producing fillet welded joints using a manual welding process	760
329	Restoring marine mechanical components to usable condition by repair	460
330	Dismantling and removing marine mechanical equipment	700
331	Reassembling and refitting marine mechanical equipment	700
332	Overhauling marine propulsion systems	1135
333	Overhauling marine hydraulic systems and equipment	1135
334	Overhauling marine systems plant and equipment	1700
335	Handing over and confirming completion of maintenance activities	200
336	Carrying out fault diagnosis on mechanical equipment	500
337	Maintaining mechanical equipment	700

338	Carrying out preventative planned maintenance on mechanical equipment	380
339	Carrying out condition monitoring of plant and equipment	390
340	Carrying out fault diagnosis on electronic equipment and circuits	500
341	Testing electronic equipment and circuits	500
342	Repairing electronic equipment	620
343	Carrying out fault diagnosis on engineered systems	530
344	Carrying out preventative planned maintenance on engineered systems	380
345	Maintaining mechanical equipment within an engineered system	810
346	Maintaining electrical equipment within an engineered system	810
347	Maintaining fluid power equipment within an engineered system	810
348	Maintaining process controller equipment within an engineered system	810
349	Assembling mechanical products	700
350	Repairing and modifying mechanical assemblies	700
351	Checking that completed assemblies comply with specification	300
352	Installing cable runs and circuits in marine structures	700
353	Installing marine power generation and distribution equipment and systems	860
354	Installing marine lighting, alarm, detection and monitoring equipment and systems	860
355	Installing marine electrical/electronic equipment and systems	1300
356	Overhauling marine electrical/electronic plant, equipment and systems	860

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
City & Guilds Level 3 Diploma in Maritime Defence (Development Competence)	1482	1563

2 Centre requirements

Approval

If your centre is approved to offer the following qualifications:

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 3 Diploma in Maritime Defence (Development 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 development 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[s], 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 Development 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.

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 301 Complying with statutory regulations and organisational safety requirements

Unit level:	Level 3
GLH:	18
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Advanced Manufacturing and 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 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 must also be able to identify the relevant qualified first aiders or appointed person, and 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 that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the way in which they carry out the required manufacturing/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, and will know about the safety requirements in adequate depth to provide a sound basis for carrying out the activities safely and correctly. They will be able to apply the occupational behaviours required in the workplace to meet the job profile and overall company objectives, including being able to demonstrate personal responsibility and resilience, working effectively in teams, effective communication and interpersonal skills, focus on quality and problem solving and continuous development.
Relationship to NOS:	EUCL3D-001
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner 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 occupational 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 understanding of their duties and obligations to health and safety by carrying out **all** of the following:

2.1 apply in principle their duties and responsibilities as an individual under the Health and Safety at Work Act and relevant current legislation

2.2 Identifying within their organisation, appropriate sources or information and guidance on health and safety issues, to include eye protection and personal protective equipment, COSHH regulations, 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

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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 self or others

3.3 following organisational procedures in the event of fire and the evacuation of premises

3.4 identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions

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Learning outcome

The learner will:

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

4.1 the working environment

4.2 the tools and equipment that they use

4.3 materials and substances that they use

4.4 using working practices that do not follow laid down procedures

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Learning outcome

The learner will:

5 Demonstrate **two** of the following methods of manual lifting and carrying techniques:

5.1 lifting alone

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 by any work they are carrying out

Unit 301 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 out in the relevant Qualification Assessment Strategy available from Semta. Please contact customer.services@semta.org.uk quoting Advanced Manufacturing and Engineering Qualification Assessment Strategy and specify 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 302 Using and interpreting engineering data and documentation

Unit level:	Level 3
GLH:	18
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Advanced Manufacturing and 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 make effective use of text, numeric and graphical information by interpreting and using technical information extracted from engineering drawings, technical manuals, reference tables, specifications and charts, in accordance with approved procedures. They will be required to carry out the maintenance requirements and to make valid decisions about the quality and accuracy of the equipment being maintained. Their responsibilities will require them to comply with organisational policy and procedures for obtaining and using the drawings and related specifications. They will be expected to report any problems with the use and interpretation of the drawings and specifications that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of the types of drawings and documents used within a maintenance environment, and will provide an informed approach to applying instructions and procedures. They will be able to read and interpret the drawing and documents used and will know about the conventions, symbols and abbreviations, in adequate depth to provide a sound basis for carrying out the maintenance activities to the required specification. They will be able to apply the occupational behaviours required in the workplace to meet the job profile and overall company objectives, including being able to demonstrate personal responsibility and resilience, working effectively in teams, effective

	communication and interpersonal skills, focus on quality and problem solving and continuous development.
Relationship to NOS:	EUCL3D-002
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

1.1 use the approved source to obtain the required data, documentations or specifications.
1.2 demonstrate the required occupational behaviours in line with the job role and company objectives
1.3 extract and interpret the required information from the data, documentation or specifications
1.4 use the information obtained to establish work requirements
1.5 deal promptly and effectively with any problems within their control and report those which cannot be solved
1.6 record and/or communicate technical data and information using approved methods
1.7 report any inaccuracies or discrepancies in drawings and specifications
1.8 use the approved source to obtain the required data, documentation or specifications

Learning outcome

The learner will:

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

2.1 check the currency and validity of the documentation used
2.2 exercise care and control over the documentation 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 and/or report any problems found with the data and documentation
2.6 make valid decisions based on the evaluations of the information extracted from the documentation
2.7 return all documentation to the approved location on completion of the work
2.8 complete all necessary work related documentation such as production documentation, planning documentation

Learning outcome

The learner will:

3 Use information extracted from engineering drawings and related documentation, to include **two** of the following:

3.1 drawings (such as component drawings, general assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)

3.2 diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit, layout diagrams)

3.3 manufacturers manuals/drawings

3.4 approved sketches

3.5 technical illustrations

3.6 photographic images/representations

3.7 visual display screen information

3.8 technical sales/marketing documentation

3.9 contractual documentation

3.10 other specific drawings/documents

Learning outcome

The learner will:

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

4.1 standard operating procedures

4.2 instructions (such as job instructions, drawing instructions, manufacturer's instructions)

4.3 specifications (such as material, finish, process, contractual, calibration)

4.4 reference materials (such as manuals, tables, charts, fault diagnosis guides)

4.5 schedules

4.6 operation sheets

4.7 maintenance log reports

4.8 service/test information/schedules/results

4.9 planning documentation

4.10 quality control documents

4.11 company specific technical instructions

4.12 national, international and organisational standards

4.13 health and safety standards relating to the activity (such as COSHH)

4.14 environmental requirements/information

4.15 other specific related documentation

Learning outcome

The learner will:

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

5.1 materials and components required
5.2 dimension
5.3 tolerances
5.4 quality requirements
5.5 installation requirements
5.6 customer requirements
5.7 time scales
5.8 financial information
5.9 operating parameters
5.10 surface texture requirements
5.11 location/orientation of parts
5.12 process or treatments required
5.13 dismantling/assembly sequence
5.14 inspection/testing requirements
5.15 number/volumes required
5.16 repair/service methods
5.17 method of manufacture
5.18 weld type and size
5.19 operations required
5.20 connections to be made
5.21 surface finish required
5.22 shape or profiles
5.23 fault finding procedures
5.24 test points
5.25 safety/risk factors
5.26 environmental controls
5.27 technical data (such as component data, maintenance data, electrical data, fluid data)
5.28 resources (such as tools, equipment, personnel)
5.29 utility supply details (such as electricity, water, gas, air)
5.30 location of services, including standby and emergency backup systems
5.31 circuit characteristics (such as pressure, flow, current, voltage, speed)
5.32 protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
5.33 other specific related information (such as financial delivery or contractual data)

Learning outcome

6 Knowledge and understanding -The learner must know and understand:

6.1 the information sources used for the documentation and specifications that they use in their work activities

6.2 how the required documentation is obtained, and how to check that it is current and valid

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

6.4 how to use other sources of information to support the activity (such as manuals, table, charts, planning and quality documentation, national and international standards)

6.5 the procedure for reporting discrepancies, lost or damaged documentation

6.6 care and control procedures for the documentation, and the importance of returning them to the designated location on completion of the work activities

6.7 the basic drawing conventions that are used, and why there needs to be different types of drawings

6.8 the types of drawings/diagrams used, and how they interrelate (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)

6.9 why technical information is presented in different forms

6.10 the meaning of common symbols and abbreviations used within the working environment/work area

6.11 imperial and metric systems of measurement, tolerancing and fixed reference points

6.12 the meaning of the different symbols and abbreviations found on the documentation that they use (such as wiring and component symbols, surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)

6.13 the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve

Unit 302 Using and interpreting engineering data and documentation

Supporting Information

Unit guidance

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Unit 303 Working efficiently and effectively in advanced manufacturing and engineering

Unit level:	Level 3
GLH:	50
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Advanced Manufacturing and Engineering Sector and is part of an overall development programme designed to meet the requirements of the Sector, the 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: - Work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the manufacturing/engineering activity, they will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition. On completion of the manufacturing/engineering activity, they will be required to return their immediate work area to an acceptable condition before recommencing further work requirements. This may involve placing completed work in the correct location, returning and/or storing any tools and equipment in the correct area, identifying any waste and/or scrapped materials and arranging for their disposal, and reporting any defects or damage to tools and equipment used. Their responsibilities will require them to comply with organisational policy and procedures for the manufacturing/engineering activities undertaken, and to report any problems with the activities, tools or equipment that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to take personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out and to identify and make recommendations where improvements could be made in their working area. Their underpinning knowledge will provide a good understanding

	of their work, and will provide an informed approach to working efficiently and effectively in a manufacturing/engineering environment. They will understand the need to work efficiently and effectively, and will know about the things they need to consider when preparing and tidying up the work area, how to contribute to improvements, deal with problems, maintain effective working relationships, and agree their development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly. They will understand the safety precautions required when carrying out manufacturing/engineering activities. 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 occupational behaviours required in the workplace to meet the job profile and overall company objectives, including being able to demonstrate; personal responsibility and resilience, working effectively in teams, effective communication and interpersonal skills, focus on quality and problem solving and continuous development.
Relationship to NOS:	EUCL3D-003
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner 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 occupational behaviours in line with the job role and company objectives/values

1.3 plan the manufacturing/engineering activities before they start them

1.4 prepare the work area for carrying out the manufacturing/engineering activity

1.5 obtain all necessary consumables, tools and equipment and check that they are in a safe and usable condition

1.6 deal promptly and effectively with any manufacturing/engineering problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.7 contribute to the business by identifying possible opportunities for improving working practices, processes and/or procedures

1.8 maintain effective working relationships with colleagues and supervisors

1.9 review personal training and development, as appropriate to the job role

1.10 clean, tidy up and restore the work area on completion of the manufacturing/engineering activity.

Learning outcome

The learner will:

2 Ensure that they apply all the following checks and practices at all times:

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

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Learning outcome

The learner will:

3 Demonstrate and apply **all** the following occupational behaviours:

Personal responsibility and resilience

3.1 comply with health and safety guidance and procedures

3.2 be disciplined and have a responsible approach to risk

3.3 work diligently regardless of how much they are being supervised

3.4 accept responsibility for managing time and workload

3.5 stay motivated and committed when facing challenges

Working effectively in teams

3.6 make an effort to integrate with the team

3.7 support other people

3.8 consider implications of their own actions on other people and activities

3.9 work effectively to get the task completed

Effective communication and interpersonal skills

3.10 is an open and honest communicator

3.11 communicate clearly using appropriate methods

3.12 listen well to others

3.13 have a positive and respectful attitude

Focus on quality and problem solving

3.14 follow instructions and guidance

3.15 demonstrates attention to detail

3.16 follow a logical approach to problem solving

3.17 seek opportunities to improve quality, speed and efficiency

Continuous development

3.18 reflect on skills, knowledge and behaviours and seeks opportunities to develop

3.19 adapt to different situations, environments or technologies

3.20 has a positive attitude to feedback and advice

Learning outcome

The learner will:

4 Prepare to carry out the manufacturing/engineering activity, ensuring all the following as applicable to the activity to be undertaken:

4.1 the work area is free from hazards and is suitably prepared for the activities to be undertaken.

4.2 any required safety procedures are implemented

4.3 any necessary personal protection equipment is obtained, and is in a usable condition

4.4 all necessary drawings, specifications and associated documents are obtained

4.5 job instructions are obtained and understood

4.6 tools and equipment required are obtained and checked that they are in a safe and useable condition

4.7 the correct materials or components are obtained

4.8 appropriate authorisation to carry out the work is obtained

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Learning outcome

The learner will:

5 Complete the work activities to include **all** of the following:

5.1 returning tools and equipment to the designated location

5.2 returning drawings and work instructions

5.3 disposing of waste materials, in line with organisational and environmental requirements

5.4 completing all necessary documentation accurately and legibly

5.5 identifying, where appropriate, any damaged or unusable tools or equipment

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Learning outcome

The learner will:

6 Recognise and deal with problems affecting the manufacturing/engineering activity to include **four** of the following:

6.1 materials

6.2 job specification

6.3 timescales
6.4 tools and equipment
6.5 quality
6.6 safety
6.7 drawings
6.8 people
6.9 work activities
6.10 other (to be specified)

Learning outcome

The learner will:

7 Contribute to the business by identifying possible opportunities for improving working practices and/or processes that will impact on **one** of the following:

7.1 standard operating procedures
7.2 quality
7.3 cost
7.4 time such as lead or processing time
7.5 waste
7.6 energy utilisation
7.7 equipment performance or condition
7.8 resource
7.9 engineering designs

Plus one from the following:

7.10 health and safety
7.11 customer service
7.12 training and development
7.13 regulatory compliance
7.14 supplier relationships
7.15 communication (internal and/or external)
7.16 team working
7.17 other improvement to be specified by the employer

Learning outcome

The learner will:

8 Contribute to developing their own Continuous Development Plan (CPD) relevant to their career aspirations to include **all** 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 development and performance objectives

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Learning outcome

9 Knowledge and understanding -The learner 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 occupational 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

9.13 the need to be flexible in their approach to work, responding positively to changes or amendments to work requirements

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

9.15 their individual responsibility to work in an ethical manner and the organisation's policies relating to ethical working and behaviours

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

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

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

9.19 planning and preparing to carry out the manufacturing/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)

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

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

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

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

9.24 how to deal effectively with problems that could arise with areas such as quality, safety, people, drawings and other documentation, tools and equipment or if material are incomplete or do not meet the requirements of the activity and the action that should be taken

9.25 the process and procedure used for making suggestions for improving the business

9.26 the importance of taking responsibility for identifying and making suggestions for making business improvements

9.27 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 required to achieve; the safety points to be aware of and the skills and knowledge you will need to develop)

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

9.29 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

9.30 their responsibilities for providing evidence of your performance and progress (such as submitting work assessment or the completing of assignments or tests)

9.31 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)

9.32 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)

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

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

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

9.36 the current legislation covering discrimination in the workplace on the ground of race, religion, sex, age and disability

9.37 the need to dispose of waste materials and consumable (such as oils and chemicals) in a safe and environmentally friendly way

9.38 where tools and equipment should be stored and located, and the importance or returning all tools and documentation to their designated area on completion of your work activities

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

9.40 the importance of leaving the work area in a safe condition on completion of your activities (such as equipment correctly isolated, cleaning the work area and removing and disposing of waste)

Unit 303 Working efficiently and effectively in advanced manufacturing and engineering

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 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.

The Automotive Trailblazer Employer Group have published a separate Behavioural Framework and Assessment recording document that should be used alongside this unit and the technical units selected from the qualification pathway for the following Apprenticeship Standards:

- Mechatronics Maintenance Technician Level 3
- Product Design and Development Technician Level 3
- Electrical/Electronic Support Engineer Level 6
- Manufacturing Engineer Level 6
- Product Design and Development Engineer Level 6

Unit 304 Bending and forming marine pipe using bending machines and hand methods

Unit level:	Level 3
GLH:	700
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 bend and form pipe for marine applications, using bending machines and hand methods, in accordance with approved procedures. The types of pipe to be bent and formed could include ferrous, non-ferrous and non-metallic pipe. In producing pipe bends and forms, they will be expected to select and use a range of tools, forming equipment, and techniques, appropriate to the type of material and operations being performed. Activities could include cutting the pipes to the required lengths using power and hand saws or pipe/tube cutting machines, bending pipes using springs, fillers, hand bending machines, hydraulic bending machines or power operated equipment such as presses, the use of heating techniques to aid the bending process and the use of templates or set wires to check bend profiles. The pipework produced could have features that include angular bends, offsets, bridge sets and expansion loops. Their responsibilities will require them to comply with organisational policy and procedures for the marine pipe bending and forming activities undertaken and to report any problems with the equipment, materials, pipe bending activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying pipe bending and forming procedures using machines. They will understand the pipe bending and forming activities used and their

	application and will know about the bending and forming equipment and techniques, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and for ensuring that the work output is completed to the required specification. They will understand the safety precautions required when carrying out the marine pipe bending 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:	EUCL3D-04
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the correct component drawing and any other related specifications for the component to be produced

1.4 determine what has to be done and how this will be achieved

1.5 confirm that the equipment is set up correctly and is ready for use

1.6 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition in line with operational procedures

1.7 produce components to the required specification using appropriate methods and techniques

1.8 check that all the required operations have been completed to the required standard

1.9 carry out quality sampling check at suitable intervals

1.10 identify and assess any defects or variations from the specification and take appropriate action

1.11 deal promptly and effectively with problems within their control and report those that cannot be solved

1.12 shut down any equipment to a safe condition on conclusion of the bending/forming activity (where applicable)

1.13 complete relevant documentation in line with company procedure

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Learning outcome

The learner will:

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

2.1 use the correct issue of drawings, specifications, job instructions and quality documentation
2.2 check that the bending and forming equipment is in a safe and usable condition
2.3 obtain suitable formers for the type and size of pipe to be bent/formed
2.4 apply safe working practices at all times
2.5 return all tools and equipment to the correct location on completion of the activities
2.6 leave the work area in a safe condition

Learning outcome

The learner will:

3 Mark out the pipework using **two** of the following methods:

3.1 direct marking using tapes and markers
3.2 producing and using set wires
3.3 set-outs of pipework using templates
3.4 set-outs of pipework onto floor

Learning outcome

The learner will:

4 Bend and form **three** of the following types of pipe:

4.1 alloy (such as nickel-aluminium, silicon-brass, cupro-nickel)
4.2 copper
4.3 aluminium
4.4 plastic
4.5 carbon steel
4.6 stainless steel

Learning outcome

The learner will:

5 Cut and prepare pipework using **four** of the following

5.1 pipe cutting machine
5.2 pipe/tube cutter
5.3 hacksaws
5.4 abrasive discs
5.5 power saw
5.6 gas cutting equipment
5.7 de-burring tools
5.8 chemical cleaning
5.9 polishing tools/equipment

Learning outcome

The learner will:

6 Bend and form the pipe using **five** of the following methods:

6.1 hand operated pipe bender
6.2 bending springs
6.3 pipe expander
6.4 swaging kit
6.5 fillers
6.6 crimped fittings
6.7 pushed fittings
6.8 heating methods
6.9 hydraulic pipe bending equipment
6.10 power operated equipment (such as presses)

Learning outcome

The learner will:

7 Produce pipework forms that include **five** of the following:

7.1 angular bends
7.2 bridge sets
7.3 flat offsets
7.4 rolled offsets
7.5 expansion loops
7.6 radii
7.7 external swaged ends
7.8 internal swaged ends

Learning outcome

The learner will:

8 Produce pipe bends and forms which comply with **one** of the following standards:

8.1 BS or ISO standards and procedures

8.2 customer (contractual) standards and requirements

8.3 company standards and procedures

8.4 specific system requirements

8.5 recognised compliance agency/body's standards

8.6 other accepted international standards

Learning outcome

9 Knowledge and understanding -The learner must know and understand

9.1 the specific safety precautions to be taken when working with marine pipe bending and cutting equipment

9.2 the specific personal protective equipment (PPE) to be worn when carrying out the marine pipe bending activities

9.3 the hazards associated with carrying out the marine pipe bending activities (such as handling long pipe lengths, using power operated bending equipment, using heating equipment) 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 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

9.6 the colour code standard used for identifying pipes and why it is important

9.7 how to carry out currency/issue checks of the specifications they are working with

9.8 how to interpret isometric, first and third angle drawings, imperial and metric systems of measurement, workplace reference points and system of tolerancing

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

9.10 how to prepare the pipes in readiness for the marking out activities (such as visually checking for defect, cleaning the materials, removing burrs and sharp edges)

9.11 methods of holding and supporting pipework during the marking out activities and the equipment that can be used

9.12 allowances that need to be made in the marking out, for bending or the assembly of the various fittings that will be used

9.13 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 or hot air to aid the bending process

9.14 the methods used to bend and form the pipe (including the use of bending springs, fillers, hand bending machines, hydraulic bending equipment, power operated equipment and heating methods)

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

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

9.17 the tools and equipment used in the cutting, bending and forming process

9.18 recognition of contaminants and the problems they can create and the effects and likely symptoms of contamination in the pipe system

9.19 where applicable, how to prepare the pipes in readiness for the surveying activities (including visually checking for defects, using abrasive discs, chemical cleaning, de-burring tools, polishing tools, pipe cutting equipment and hand tools)

9.20 the types of checks to be made on Marine pipework, including the equipment to be used

9.21 the procedure for the safe disposal of waste materials

9.22 the recording documentation to be completed for the marine pipe bending and forming activities undertaken and where appropriate, the importance of marking and identifying specific pieces of work relation to the documentation

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

Unit 304 Bending and forming marine pipe using bending machines and hand methods

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 305 Assembling marine pipework

Unit level:	Level 3
GLH:	600
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 assemble ferrous marine pipework by mechanical means, assemble non-ferrous marine pipework, prepare pipework for surveying and make a visual assessment of the condition of marine pipework or pipework system, in accordance with approved procedures. The pipework systems being assembled could include main steam, auxiliary steam, main feed, steam drains, fuel systems, drain systems, high and low pressure air, hydraulics, sea water, hot and cold fresh water, refrigeration gas, fuel gas and other non-ferrous pipework systems. In producing the assemblies, they will be expected to select and use a range of equipment, hand tools and techniques, appropriate to the operations being performed. The assembly activities could include producing soft soldered joints, compression joints, threads on the external ends of the pipe, using stocks and dies or threading machines and joining the pipes using a range of fittings, which could include flanges and gaskets, straight couplings, elbows, tee pieces, reduction pieces. The pipe assemblies produced will use a range of fittings, including straight connectors, elbows, tee pieces, reduction pieces, tank connectors, tap connectors, valves and other fittings, as appropriate to the application. - Their responsibilities will require them to comply with organisational policy and procedures for the pipework assembly activities undertaken and to report any problems with the equipment, materials or assembly activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying marine pipework assembly procedures. They will have an understanding of the marine pipework systems being installed and their application and will know about the various methods of

	assembling the pipework using threading, soldering/brazing, compression joints, pipe components and other materials, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, recognising defects and ensuring that the work output is produced to the required specifications. They will understand the safety precautions required when working on the pipework assembly activities 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, both ashore and on board vessels. 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:	EUCL3D-05
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant instructions, assembly drawings and any other specifications

1.4 ensure that the specified components are available and that they are in a usable condition

1.5 use the appropriate methods and techniques to assemble components

1.6 secure the components using the specified methods

1.7 use the appropriate tools and equipment to prepare and assemble pipework and check that they are in a useable and safe condition

1.8 carry out quality checks in an appropriate sequence using approved methods and procedures.

1.9 identify and assess where applicable any defects or variations from the specification and take appropriate action

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

1.11 report completion of the assembly activities in line with organisational procedures

1.12 deal promptly and effectively with problems within their control and report those that cannot be solved

1.13 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

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

2.1 use the correct issue of drawings, specifications or job instructions and quality documentation
2.2 ensure that appropriate COSHH regulations are adhered to
2.3 check that all tools and equipment are in a safe and usable condition
2.4 ensure that components and pipes are free from foreign objects, dirt or other contamination.
2.5 apply safe working practices at all times
2.6 return all tools and equipment to the correct location on completion of the assembly activities
2.7 leave the work area in a safe and tidy condition on completion of the activities

Learning outcome

The learner will:

3 Prepare and assemble **both** the following types of pipe:

3.1 ferrous
3.2 non ferrous

Learning outcome

The learner will:

4 Assemble pipes and pipe components for **five** of the following pipework systems:

4.1 high pressure
4.2 low pressure
4.3 air system
4.4 fluid system
4.5 gas system
4.6 stream system

Learning outcome

The learner will:

5 Cut pipes to length and assemble them, using **three** of the following methods:

5.1 compression fittings

5.2 snap-on/push fittings
5.3 soldered fittings
5.4 welded
5.5 threaded
5.6 jointing compound
5.7 brazing
5.8 other, specified by the employer

Learning outcome

The learner will:

6 Prepare for the pipe assembly activities, to include carrying out **three** of the following:

6.1 cutting pipes to length, with appropriate allowance (such as for threading, flaring and wall forming)
6.2 selecting and setting up dies in stocks or forming machines
6.3 cutting form ends on pipe ends to the appropriate length
6.4 checking that the completed forms have the required thread, radius or flange

Learning outcome

The learner will:

7 Prepare pipework for assembly using **two** of the following:

7.1 de-burring tools
7.2 abrasive discs
7.3 chemical cleaning
7.4 polishing tools/equipment
7.5 pipe cutting tools

Learning outcome

The learner will:

8 Produce pipework assemblies which contain **eight** of the following types of fitting:

8.1 straight couplings
8.2 valves
8.3 elbows
8.4 blanking caps
8.5 tee pieces

8.6 reduction pieces
8.7 drain/bleeding devices
8.8 screwed fittings (tank, tap, pump, gauges)
8.9 flanges
8.10 couplings
8.11 unions
8.12 pipe clips/supports

Learning outcome

The learner will:

9 Produce assembled pipework which contains **three** of the following features:

9.1 angular bends
9.2 offsets
9.3 bridge sets
9.4 expansion loops

Learning outcome

The learner will:

10 Assemble pipework, to include carrying out **all** of the following:

10.1 connecting pipe to pipe
10.2 connecting pipe to the vessel equipment
10.3 alignment and levelling of pipework
10.4 securing and fitting pipework supports to ship structures
10.5 torque loading of bolts and connections (where applicable)
10.6 attaching identification markers of pipe contents (such as colour coding, labels)

Learning outcome

The learner will:

11 Check pipework assemblies using **three** of the following methods:

11.1 visually (both internally and externally)
11.2 using liquid dye penetrant
11.3 checking pipe-bore ovality
11.4 gauging wall thickness

Learning outcome

The learner will:

12 Produce pipework assemblies which comply with **one** of the following standards:

12.1 BS or ISO standards and procedures

12.2 customer (contractual) standards and requirements

12.3 company standards and procedures

12.4 specific system requirements

12.5 recognised compliance agency/body's standards

12.6 other accepted international standards

Learning outcome

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

13.1 the specific safety precautions to be taken when assembling non-ferrous marine pipework and with the tools and equipment that are used, both on land and on-board vessels/craft/marine structure (including general workshop and site safety, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)

13.2 the specific safety precautions to be taken when working with pipework and associated equipment

13.3 the importance of ship boundaries and the tag-out system

13.4 the personal protective equipment (PPE) to be used when assembling non-ferrous and ferrous marine pipework

13.5 the personal protective equipment (PPE) to be worn whilst assembling pipework

13.6 the hazards associated with the non-ferrous marine pipework assembly activities (such as handling long lengths of pipe, using gas torches and brazing equipment, handling sealing agents and fluxes) and how they can be minimised

13.7 the hazards associated with the ferrous marine threaded pipework assembly activities (such as handling long lengths of pipe, using pipe threading machinery, handling of sealing agents) and how they can be minimised

13.8 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

13.9 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

13.10 the colour code standard used for identifying pipes and why it is important

13.11 how to interpret isometric, first and third angle drawings, imperial and metric systems of measurement, work reference points and system of tolerancing

13.12 how to carry out currency/issue checks of the specifications they are working with

13.13 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)

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

13.15 the different types of fittings available (such as soldered fittings (solder ring types and capillary), compression fittings and push fit fittings)

13.16 how to determine the overall length of the pipework required, taking into account allowances for pipe fittings and threaded connections

13.17 how to produce threads on the pipe ends and the tools and equipment that can be used (to include stocks and dies, pipe threading machines)

13.18 methods used to seal threaded joints (such as tapes and sealing compounds)

13.19 the use of flanges to connect pipes; use of gaskets; and torque loading of flange bolts

13.20 how to identify the correct orientation of fittings with regard to flow

13.21 how to identify the correct orientation of fittings with regard to flow and the consequences of incorrectly orientating the fitting

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

13.23 the tools and equipment used when assembling ferrous and non ferrous pipework

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

13.25 the precautions to be taken when using gas torches to form the joint and the effect of overheating the joint

13.26 the principles of sealing and use of compression fittings and the effects of over-tightening the fittings

13.27 the use of push-fit connectors and their advantages and disadvantages

13.28 the methods used to handle and support pipework during assembly

13.29 the methods, techniques and equipment used to check pipework assembles

13.30 the quality standards to be attained and company quality procedures

13.31 the procedure for the safe disposal of waste materials

13.32 the recording documentation to be completed for the marine pipe bending and forming activities undertaken and where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

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

Unit 305 Assembling marine pipework

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 306 Installing marine pipework components and systems

Unit level:	Level 3
GLH:	460
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 install marine pipework and associated components on board vessels, in accordance with approved procedures. The marine pipework systems to be installed could include fresh water, chilled water, air conditioning, lubricating oil, waste water, steam drains, sea water and other salvage drainage systems. In installing the marine pipe-work, they will be expected to select and use a range of equipment, hand tools and techniques, appropriate to the operations being performed. The installation activities could include producing cemented/glued joints, hot welded plastic joints, compression joints, threaded joints, flanged joints and push-fit joints. The marine pipe installations will use a range of fittings, which could include straight connectors, elbows, tee pieces, reduction pieces, flanges, tank connectors, tap connectors, valves and other fittings, as appropriate to the application. Their responsibilities will require them to comply with organisational policy and procedures for the marine pipework installation activities undertaken and to report any problems with the equipment, materials or installation activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to installing marine pipework and associated components on board vessels. They will understand marine pipework system being installed and its application and will know about the installation techniques, pipe components and materials used, in adequate depth to provide

	a sound basis for carrying out the activities, correcting faults and ensuring that the work output is produced to the required specification. They will understand the safety precautions required when working on the installation of the marine pipework 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 on board the vessel. 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:	EUCL3D-06
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow all relevant drawings and specifications for the installation being carried out

1.4 use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition

1.5 install, position and secure the equipment for the installation operations and check that they are in a safe and usable condition

1.6 ensure that all necessary connections to the equipment are complete

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 check that the installation is complete and that all components are free from damage

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the marine pipework installation activities:

2.1 plan the installation activities prior to beginning the work

2.2 keep the site accessible and free from obstructions or hazards

2.3 use the correct marine pipework installation drawings, specifications or job instructions

2.4 ensure that components and pipes are free from foreign objects, dirt or other contamination

2.5 check that all tools are in a safe and usable condition (such as calibration/care and control procedures)

2.6 ensure that tag-out systems are in place before removal of any blanks prior to installation

2.7 ensure appropriate COSHH regulations are adhered to (such as safety and environmental conditions maintained)

2.8 leave the work area in a safe condition and to the prescribed category of cleanliness

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Learning outcome

The learner will:

3 Install marine pipework which contain **six** of the following types of fittings:

3.1 straight couplings

3.2 valves

3.3 elbows

3.4 blanking caps

3.5 tee pieces

3.6 pipe clips/supports

3.7 reduction pieces

3.8 drain/bleeding devices

3.9 screwed fittings (such as tank, tap, pump, gauges)

3.10 flanged fittings

Learning outcome

The learner will:

4 Install marine pipework which contains **two** of the following jointing methods:

4.1 nut and ferrule

4.2 bolted flanges

4.3 screwed fittings

4.4 snap-on/push fittings

4.5 compression fittings

4.6 cemented/glued joints

4.7 plastic hot welding

Learning outcome

The learner will:

5 Install marine pipework, to include carrying out all the following:

5.1 securing pipework supports to vessel structures
5.2 connecting pipe to pipe
5.3 making bulkhead penetrations
5.4 connecting pipe to vessel's equipment
5.5 using gaskets, seals or jointing compounds
5.6 aligning and levelling equipment
5.7 torque loading of bolts

Learning outcome

The learner will:

6 Install marine pipes and components to form **five** of the following marine pipework systems:

6.1 high pressure
6.2 low pressure
6.3 air system
6.4 fluid system
6.5 gas system
6.6 steam system

Learning outcome

The learner will:

7 Produce marine pipework assemblies which comply with **one** of the following standards:

7.1 BS or ISO standards and procedures
7.2 customer (contractual) standards and requirements
7.3 company standards and procedures
7.4 specific system requirements
7.5 recognised compliance agency/body's standards
7.6 other accepted international standards

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the specific safety precautions to be taken when installing marine pipework on-board vessels and with the tools and equipment used (including general workshop and site safety, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)

8.2 the personal protective equipment (PPE) to be used when installing marine pipework

8.3 the hazards associated with carrying out marine pipework installation activities (including tag-out systems and how they operate, ship boundaries and handling long lengths of pipe in confined spaces, working with heating elements for plastic welding) and how they can be minimised

8.4 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

8.5 the procedures to be carried out before starting work on the installation (such as obtaining permits to work, obtaining and complying with risk assessments and other health and safety requirements)

8.6 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

8.7 how to interpret installation drawings, using both imperial and metric systems of measurement

8.8 how to carry out currency/issue checks of the specifications they are working with

8.9 the preparation of pipework and fittings for the installation operation (including checking for damage, removing foreign objects, dirt and swarf from bore of pipe, removing burrs)

8.10 the range of marine pipe fittings that can be used and how to identify them (including straight connectors, elbows, tee pieces, reduction pieces, tank fittings, flanged fittings, valves, plastic hot welding fittings, blanking pieces/cap ends)

8.11 the different methods of connecting pipework (such as bolted flanges, screwed couplings, nut and ferrules, compression fittings and push-fit fitting)

8.12 how to ensure alignment and identify the correct orientation of fittings with regard to flow and the consequences of incorrectly orientating the fitting

8.13 the methods used to prepare pipe ends and why it is necessary to ensure that these preparations are carried out

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

8.15 the use of flanged fittings, jointing materials, fasteners and the effect of over-tightening fasteners

8.16 the use of push-fit connectors and their advantages and disadvantages

8.17 the use of threaded connections and their advantages and disadvantages

8.18 methods of fastening pipe supports to the vessel structure and the need to protect the integrity of the vessel at all times

8.19 methods of supporting pipework and the type of fittings that are used

8.20 the importance of ensuring that the completed installation is free from dirt, swarf and foreign object damage and of ensuring that any exposed components or pipe ends are correctly covered/protected

8.21 the procedure for the safe disposal of waste materials

8.22 the tools and equipment used when installing marine pipework

8.23 the standards to be attained and company quality procedures

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

Unit 306 Installing marine pipework components and systems

Supporting Information

Unit guidance

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Unit 307 Preparing and testing marine pipework systems

Unit level:	Level 3
GLH:	400
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 and test marine pipework systems. The will be required to select appropriate tools and test equipment to be used, based on the pipework system being tested and the test procedures being carried out. Pipework systems to be tested could include high pressure/low pressure air, hydraulics, lubricating oil, fresh water, distilled water, waste water, chilled water, main service, fuel, steam, refrigeration gases, salvage. In preparing and testing the pipework system, they will be expected to use a range of hand tools, test equipment and techniques, as required by the test procedures. These activities will include such items as purging equipment and materials, using appropriate test equipment (such as hydraulic, compressed air, gas and water) and the use of pressure gauges and leak repair equipment and materials. Their responsibilities will require them to comply with organisational policy and procedures for the preparation and testing of marine pipework activities undertaken and to report any problems that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying marine pipework preparation and testing procedures. They will have an understanding of the marine pipework equipment and systems being tested and their applications. They will understand the pipework system being tested and its application and will know about the preparations required, the equipment to be used and tests to be carried out, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that

	the completed system performs to the required specification. They will understand the safety precautions required when working on testing the pipework 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, both ashore and on board vessels. 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:	EUCL3D-07
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests

1.4 set up and carry out the tests using the correct procedures and within agreed timescales

1.5 record the results of the tests in the appropriate format

1.6 review the results and carry out further tests if necessary

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

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

2.1 use the correct test procedures and specifications

2.2 check that all tools and test equipment are within calibration date

2.3 obtain clearance/ authority/ permit to pressure-test the installation

2.4 ensure that isolation and tag-out procedures are followed

2.5 ensure that safe working distance procedures are set up

2.6 erect relevant warning notices or safety signs

2.7 ensure that appropriate safety measures are taken to protect test personnel (such as guards, distance, incremental pressure tests)

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

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

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Learning outcome

The learner will:

3 Carry out tests on **both** of the following types of pipework:

3.1 ferrous

3.2 non ferrous

Learning outcome

The learner will:

4 Carry out tests on **three** of the following pipework systems:

4.1 fresh water

4.2 salt/ raw water

4.3 chilled water

4.4 waste water

4.5 deck drains

4.6 fuel

4.7 air conditioning

4.8 lubricating oil

4.9 steam drains

4.10 hydraulic

4.11 fire main

4.12 refrigeration gas

4.13 distilled

4.14 main services

4.15 high pressure/ low pressure air

4.16 other salvage drainage systems

Learning outcome

The learner will:

5 Prepare the installation for testing by carrying out **all** of the following:

5.1 checking security of all joints
5.2 purging or flushing the system (as appropriate)
5.3 fitting appropriate blanking plugs/ plates to exposed ends of pipe or equipment
5.4 connecting an appropriate test source
5.5 fitting leak detection equipment and/ or pressure gauges

Learning outcome

The learner will:

6 Use **one** of the following methods of testing:

6.1 hydraulic test equipment
6.2 compressed air test equipment
6.3 gas test equipment
6.4 water test equipment
6.5 non destructive testing (such as dye penetration)

Learning outcome

The learner will:

7 Deal with **all** the following:

7.1 systems with no fault
7.2 systems with faults
7.3 systems with intermittent faults

Learning outcome

The learner will:

8 During tests, use **two** of the following fault finding techniques:

8.1 half-split technique
8.2 input/ output technique
8.3 six point technique
8.4 unit substitution.

Learning outcome

The learner will:

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

9.1 filling the system with appropriate test medium
9.2 venting air from the system (where appropriate)
9.3 applying test pressures in incremental stages
9.4 checking for leaks at each stage
9.5 depressurising the system
9.6 draining down the system (where appropriate)

Learning outcome

The learner will:

10 Record the test results in an appropriate format, to include **one** from the following:

10.1 system/ installation test documentation
10.2 vessel/ craft/ structure log
10.3 job sheet
10.4 handover report
10.5 corrective action report
10.6 other specific reporting method

Learning outcome

The learner will:

11 Carry out the testing activities in line with **one** of the following standards:

11.1 BS or ISO standards and procedures
11.2 customer (contractual) standards and requirements
11.3 company standards and procedures
11.4 specific system requirements
11.5 recognised compliance agency/body's standards
11.6 other accepted international standards

Learning outcome

12 Knowledge and understanding -The learner must know and understand:

12.1 the specific safety precautions to be taken when carrying out test procedures on pipework systems, used both on land and on board vessels (including general workshop and site safety, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)

12.2 the importance of vessels boundaries to testing and the tag-out system

12.3 the reasons for a 'permit to pressure-test' certificate prior to testing on board a vessel

12.4 the personal protective equipment (PPE) to be worn whilst carrying out the testing activities

12.5 the hazards associated with the testing activities and how they can be minimised

12.6 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

12.7 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

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

12.9 how to carry out currency/ issue checks of the specifications you are working with

12.10 the colour code standard used for identifying pipes and why it is important to adhere to these standards

12.11 the importance of using the correct type of pipe material

12.12 the basic principles of operation of the pipework system to be tested and the function of the various components within the system

12.13 the various pressure test methods used on ferrous, small-bore non-ferrous and non-metallic pipelines

12.14 the importance of components being fitted in the correct relation to the direction of flow

12.15 the reasons for purging and venting pipework systems and the consequences of not purging the system

12.16 how to identify the fluids that can be used for flushing pipework systems

12.17 the consequences of not flushing or of using the incorrect flushing agent

12.18 methods of testing the system and the need to gradually increase pressure in the pipework system

12.19 the methods used to isolate parts of the pipework system for testing and how this can be achieved

12.20 how the amount of test fluid for the pipework system is determined and what problems would be caused if the incorrect amount were used

12.21 the factors that govern the choice of test equipment used in pressure testing of pipework systems and the importance of equipment being calibrated

12.22 how the test pressures are determined

12.23 the reasons for maintaining test pressures for specific times

12.24 how the results of the pressure test are analysed and why this is important

12.25 how pipework systems are depressurised and what environmental precautions must be taken, especially in confined spaces on board vessels

12.26 the procedures for recording and reporting test results to the relevant people

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

Unit 307 Preparing and testing marine pipework systems

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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Unit 308 Joining marine pipework by manual torch brazing and soldering

Unit level:	Level 3
GLH:	350
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 set up and use manual torch brazing and soldering equipment to produce socket and flange joints in marine pipework, in accordance with approved instructions or procedures. They will be required to check that all the hoses and equipment are correctly connected, are free from leaks or damage and are ready for use. They will be required to set and adjust the brazing/soldering conditions, in line with the specification. They will also need to select and use workholding and manipulating devices, appropriate to the size and shape of materials and the joint configuration being produced. They must operate the equipment safely and correctly and make any adjustments to settings, in order to produce the joints to the required specification. Their responsibilities will require them to comply with organisational policy and procedures for carrying out the brazing and soldering activities and to report any problems with the activities or equipment that they cannot resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will be sufficient to provide a sound basis for their work, and will provide an understanding of how the torch brazing and soldering process works. They will know about the equipment, materials and consumables, in adequate depth to provide a sound background for the brazing/soldering operations to be performed and for ensuring that the work output is produced to the required specification. They will understand the safety precautions required when working with the brazing 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, both ashore and on board vessels. 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:	EUCL3D-08
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant joining procedure and job instructions

1.4 check that the joint preparation complies with the specification

1.5 check that joining and related equipment and consumables are as specified and fit for purpose

1.6 make the joints as specified using the appropriate thermal joining technique

1.7 produce joints of the required quality and of specified dimensional accuracy

1.8 shut down the equipment to a safe condition on completion of joining activities

1.9 deal promptly with excess and waste materials and temporary attachments, in line with approved and agreed procedures

1.10 deal promptly and effectively with problems within their control and report those that cannot be solved

1.11 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Prepare for the manual torch brazing and soldering activities, to include carrying out **all** of the following:

2.1 obtaining the appropriate equipment for the brazing or soldering activities to be carried out

2.2 correctly handling and storing gas cylinders (where appropriate)

2.3 checking the condition of, and correctly connecting, hoses and valves

2.4 connecting the brazing/soldering torch and selecting and fitting the correct size nozzle

2.5 fitting a flashback arrestor (where applicable)

2.6 setting appropriate gas pressures

2.7 using the correct procedure for lighting, adjusting and extinguishing the flame

2.8 preparing the work area for the brazing or soldering activities (such as placing protective screens, positioning fume extraction equipment and arranging fire sentries, as appropriate)

2.9 ensuring that the workpiece is correctly set up with regard to specified joint preparation and is secure

2.10 obtaining and wearing appropriate personal protective equipment

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Learning outcome

The learner will:

3 Use **one** of the following processes and related equipment:

3.1 brazing

3.2 soldering

Learning outcome

The learner will:

4 Use specified consumable appropriate to the parent metals, to include **both** of the following:

4.1 two different filler metals

4.2 appropriate fluxes

Learning outcome

The learner will:

5 Produce brazed or soldered joints, according to work procedures, covering **two** of the following:

4.1 small bore pipe (30mm outside diameter or less)

4.2 large bore pipe (above 30mm outside diameter)

4.3 two different parent metal groups (such as copper/brass)

Learning outcome

The learner will:

6 Produce brazed or soldered pipes which meet **all** of the following quality and accuracy standards:

6.1 achieve the specified joint quality equivalent to the level given in the relevant and current European/International standard required by the application standard or specification

6.2 meet the required dimensional accuracy within specified tolerance

6.3 are of good appearance, free from flux residues and excess filler metal

Learning outcome

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

7.1 the safe working practices and procedures to be observed when working with gas brazing and soldering equipment, used both on land and on board vessels (including general workshop and site safety, appropriate personal protective equipment (PPE), fire and explosion prevention, fume extraction, protecting other workers, safety in enclosed/confined spaces, statutory regulations, risk assessment procedures and COSHH regulations)

7.2 the hazards associated with torch brazing and soldering (such as naked flames, explosive gas mixes, oxygen enrichment, fumes and gases, hot metal, enclosed/confined spaces, tag-out systems and how they operate) and how they can be minimised, especially on board vessels

7.3 the correct handling and storage of gas cylinders (to include manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features, emergency shutdown procedures)

7.4 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

7.5 the torch brazing and soldering process (including basic principles of the process, wetting and capillary flow, role of fluxes, equipment type and its care)

7.6 types of filler metal and fluxes; forms of filler metal

7.7 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)

7.8 the types of joints to be produced

7.9 setting up and locating the joint (including methods of cleaning joint faces; use of jigs and fixtures, restraining devices; self-locating joints; pre-placement of filler metal and flux)

7.10 how to prepare to braze or solder (including checks to confirm the correct set-up and cleanliness; use of gauges, setting up the equipment, checking connections for leaks, checking operating parameters)

7.11 the techniques of operating the equipment to produce a range of joints (including selection of nozzle and flame adjustment, application of flux, correct manipulation of torch and filler wire, safe closing down of the equipment)

7.12 the importance of complying with job instructions and the joining procedure specification

7.13 problems that can occur with the joining activities and how these can be overcome (such as causes of distortion and methods of control; effects of heat on materials and sources of defects; methods of prevention)

7.14 methods of removing flux residues and cleaning the finished joint

7.15 organisational quality control systems and standards to be achieved; visual and non-destructive tests

7.16 personal approval tests and their applicability to their work

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

Unit 308 Joining marine pipework by manual torch brazing and soldering

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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Unit 309 Surveying marine pipework systems

Unit level:	Level 3
GLH:	180
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 make a visual assessment of the condition of marine pipework or pipework system, in accordance with approved procedures. They will be expected to prepare the pipe, ready for the survey and this could include the use of abrasive discs, chemical cleaning, de-burring and polishing tools and pipe cutting equipment. In producing pipe surveys, they would be expected to select and use a range of equipment and techniques, appropriate to the types of material and operations being performed. Survey activities could include using liquid dye penetrant to determine the condition of the pipework and visual inspection, both internally and externally, for cracking, erosion and corrosion. Their responsibilities will require them to comply with organisational policy and procedures for the marine pipework surveying activities undertaken and to report any problems with the surveying equipment or materials used, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying surveying procedures to marine pipework and pipework systems. They will understand the pipework system being surveyed and its application and will know about the surveying activities, equipment to be used and inspections to be carried out, in adequate depth to provide a sound basis for carrying out the activities, recognising defects and ensuring that the survey is completed to the required specification. They will understand the safety precautions required when carrying out the pipework surveying activities 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, both ashore and on board vessels. 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:	EUCL3D–09
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow and make appropriate use of the specifications for the product or asset being checked

1.4 use all the correct tools and inspection equipment and check that they are in useable condition

1.5 carry out the checks in an appropriate sequence using approved methods and procedures

1.6 identify and assess any defects or variations from the specification and take appropriate action

1.7 report completion of compliance activities in line with organisational procedures

Learning outcome

The learner will:

2 Carry out **all** of the following activities during the surveying process:

2.1 use the correct issue of drawings, specifications and quality documentation

2.2 check that the surveying equipment is in a safe and usable condition

2.3 apply safe working practices at all times

2.4 return all tools and equipment to the correct location on completion of the surveying activities

2.5 leave the work area in a safe and tidy condition

Learning outcome

The learner will:

3 Prepare pipework for surveying, using **two** of the following:

3.1 de-burring tools
3.2 abrasive discs
3.3 chemical cleaning
3.4 polishing tools
3.5 pipe cutting tools

Learning outcome

The learner will:

4 Survey **three** of the following types of pipe:

4.1 carbon steel
4.2 stainless steel
4.3 copper
4.4 cupro-nickel
4.5 aluminium
4.6 plastic
4.7 alloy (such as nickel-aluminium, silicon brass, cupro-nickel, carbon-steel or stainless-steel)

Learning outcome

The learner will:

5 Survey pipework using **two** of the following methods:

5.1 visually (both internally and externally)
5.2 using liquid dye penetrant
5.3 checking pipe-bore ovality
5.4 gauging wall thickness

Learning outcome

The learner will:

6 Survey pipework systems that include **three** of the following features:

6.1 angular bends
6.2 offsets

6.3 bridge sets
6.4 expansion loops
6.5 radii
6.6 pipes
6.7 external swaged ends
6.8 internal swaged ends

Learning outcome

The learner will:

7 Produce survey reports, which establish the state of completeness of the pipes in **all** of the following categories:

7.1 acceptable pipes
7.2 defective pipes
7.3 pipes that require further work or examination

Learning outcome

The learner will:

8 Carry out surveys which comply with **one** or more of the following standards:

8.1 BS or ISO standards and procedures
8.2 customer (contractual) standards and requirements
8.3 company standards and procedures (such as fit for service forms)
8.4 specific system requirements
8.5 recognised compliance agency/body's standards
8.6 other accepted international standards

Learning outcome

9 Knowledge and understanding -The learner must know and understand

9.1 the specific safety precautions to be taken when working with pipework surveying equipment on board vessels
9.2 the importance of ship boundaries and the tag-out system
9.3 the personal protective equipment (PPE) to be worn whilst carrying out the pipework surveying activities
9.4 the hazards associated with the pipework surveying activities and how they can be minimised
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

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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 the colour code standard used for identifying pipes and why it is important

9.8 how to interpret first and third angle drawings, imperial and metric systems of measurement

9.9 how to carry out currency/issue checks of the specifications they are working with

9.10 principles and methods of surveying pipework and the type of equipment that is used

9.11 how to prepare the pipes in readiness for the surveying activities (including visually checking for defects, using abrasive discs, chemical cleaning, de-burring tools, polishing tools, pipe cutting equipment and hand tools)

9.12 how to evaluate the pipe materials that are surveyed (with regard to pits, cracks and sharp indentations) and how to determine which must be evaluated by further non-destructive testing (NDT) or examination

9.13 the tools and equipment used in the pipe surveying process and the calibration/care and control procedures

9.14 how to carry out pipe ovality checks and wall thickness gauging

9.15 the methods used for surveying pipework systems that are likely to have undergone particular internal corrosion or erosion

9.16 how to produce survey reports which establish the state of completeness of the pipework systems in the following three categories: pipes in serviceable condition; defective items/pipes; and pipes that require further work or examination

9.17 the reasons for producing comprehensive, accurate and unambiguous survey reports (integrity of the vessel)

9.18 the procedure for the safe disposal of waste materials

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

Unit 309 Surveying marine pipework systems

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 310 Producing socket and flange fillet welded joints in pipe using a manual welding process

Unit level:	Level 3
GLH:	860
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 produce socket and flange fillet welded joints in pipe, using a manual welding process, such as manual metal arc (MMA), MIG, MAG, TIG, flux cored wire, plasma or oxy/fuel gas welding equipment, in accordance with instructions and/or approved welding procedures. They will be required to check that all the workholding equipment and manipulating devices required are available and in a usable condition. They will be expected to check the welding equipment to ensure that all the leads/cables, hoses and wire feed mechanisms are securely connected and free from damage. In preparing to weld, they will need to set and adjust the welding conditions, in line with the instructions or 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. They will be required to demonstrate their capability to produce the fillet welds to the required quality, and this could be through tests according to BS 4872, EN 287 or EN 9606-1 (for aluminium) Their responsibilities will require them to comply with organisational policy and procedures for the welding activities undertaken, and to report any problems with the welding equipment or welding activities that they cannot resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will be sufficient to provide a sound basis for their work, and will provide an understanding of how the

	particular welding process works. They will know about the equipment, materials and consumables, in adequate depth to provide a sound background for the welding operations to be performed, and for ensuring the work output is produced to the required specification. They will understand the safety precautions required when working with the welding 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:	EUCL3D–10
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant joining procedure and job instructions

1.4 check that the joint preparation complies with the specification

1.5 check that joining and related equipment and consumables are as specified and fit for purpose

1.6 make the joints as specified using the appropriate thermal joining technique

1.7 produce joints of the required quality and of specified dimensional accuracy

1.8 shut down the equipment to a safe condition on completion of joining activities

1.9 deal promptly with excess and waste materials and temporary attachments, in line with approved and agreed procedures

1.10 deal promptly and effectively with problems within their control and report those that cannot be solved

1.11 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the pipe welding activities:

2.1 obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)

2.2 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.3 follow safe practice/approved pipe welding techniques and procedures at all times

2.4 check that all tools and equipment are in a safe and usable condition

2.5 ensure that the components and pipes used are free from damage, foreign objects, dirt or other contamination before welding them

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

2.7 leave the work area in a safe and appropriate condition on completion of the activities

Learning outcome

The learner will:

3 Set up, check, adjust and use welding and related equipment for **one** of the following welding processes:

3.1 manual meter arc

3.2 cored wire

3.3 MIG/MAG

3.4 plasma

3.5 TIG

3.6 Oxy/fuel gas welding.

Learning outcome

The learner will:

4 Use consumables appropriate to the material and application, to include **either**:

Two types of electrode from:

4.1 rutile

4.2 cellulosic

4.3 aluminium

4.4 basic

4.5 nickel alloy

4.6 stainless

4.7 other type

OR

4.8 **Two** types of filler wire from different material groups

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Learning outcome

The learner will:

5 Produce socket and flange fillet welded joints in **one** of the following:

5.1 small bore pipe (50mm outside diameter or less)

5.2 large bore pipe (above 50mm outside diameter)

Learning outcome

The learner will:

6 Weld joints according to approved welding procedures in good access situations in **four** of the following BS EN ISO 6947, positions:

6.1 flat (PA) rotating

6.2 vertical upwards (PF) fixed

6.3 horizontal vertical (PB) fixed

6.4 vertical down (PG) fixed

6.5 horizontal vertical (PB) rotating

6.6 horizontal overhead (PD) fixed

Learning outcome

The learner will:

7 Produce welded pipes which meet **both** of the following:

7.1 achieve minimum weld quality requirements applicable to fillet welds equivalent to those given in relevant and current European/International Standards as required by the application standard or specification

7.2 meet the required dimensional accuracy within specified tolerance

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Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the safe working practices and procedures to be observed when working with the selected welding equipment (such as general workshop and site safety, appropriate personal

protective equipment (PPE), fire prevention, protecting other workers from arc eye, safety in enclosed/confined spaces, fume control, accident procedure, accident procedure; risk assessment; statutory requirements; relevant requirements of HASAWA, COSHH, Work Equipment Regulations and other relevant legislation and regulations; safe disposal of waste materials)

8.2 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, emergency shutdown procedures)

8.3 the hazards associated with the selected welding process (such as live electrical components, poor earthing, arc radiation, fumes and gases, gas supply leaks, spatter, hot slag and metal, elevated working, grinding and mechanical metal/slag removal, enclosed spaces, slips, trips and falls), and how to minimise them and reduce any risks

8.4 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

8.5 the manual welding process selected, and an awareness of the different types of welding equipment (such as basic principles of fusion welding, AC and DC power sources, ancillary equipment, power ranges, care of equipment, terminology used in welding, flame setting)

8.6 how to extract information required from drawings and welding procedure specifications (such as interpretation of welding symbols, scope, content and application of the welding procedure specification) to appropriate British, European or relevant International standards in relation to work undertaken

8.9 methods of setting up and restraining the joint, to achieve correct location of components and control of distortion (such as edge preparation, use of jigs and fixtures, manipulators and positioners, tack welding size and spacing in relationship to material thickness and component size, use of temporary attachments, pre-setting)

8.10 preparing the welding equipment, and the checks to be made to ensure that it is safe and ready to use (such as electrical connections, earthing arrangements, equipment calibration, setting welding parameters)

8.11 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as fine tuning parameters, correct manipulation of the welding gun or electrode, safe closing down of the welding equipment)

8.12 the importance of complying with job instructions and the welding procedure specification

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

8.14 the organisational quality systems used and weld standards to be achieved; weld inspection and test procedures used, including visual and non-destructive tests

8.15 personal approval tests and their applicability to their work

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

Unit 310 Producing socket and flange fillet welded joints in pipe using a manual welding process

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 311 Marking off marine structural steelwork components

Unit level:	Level 3
GLH:	210
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 mark off plate and rolled sections, in accordance with approved procedures. They will be required to select the materials, the appropriate marking out tools and equipment, based on the information presented to them and the accuracy to be achieved. Marking out will be the preparation required for cutting, shaping and forming of plate and sections, as appropriate to the application and could include marking out workpiece datums, centre lines, angles, curved details, bending details including bending allowances and hole centring and outlining details. Materials to be marked out may include ferrous, non-ferrous and non-metallic. Certain materials may require them to take the grain flow into account, to avoid later production process problems. Their responsibilities will require them to comply with organisational policy and procedures for the marking-off activities undertaken and to report any problems with the materials, equipment or marking-off activities that they cannot resolve themselves, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying marking-off procedures in a marine fabrication environment. They will understand the marking-off process, and its application and will know about the materials as well as the care and use of tools, in adequate depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety procedures required when using

	marking mediums and when carrying out the marking-off activities. They will be required to demonstrate safe working practices throughout and will understand the responsibilities 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:	EUCL3D-11
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

1.1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 obtain and use the correct information for marking out
1.4 obtain the appropriate marking out equipment and check that it is in a usable condition
1.5 prepare suitable datum's and marking out surfaces
1.6 mark out using appropriate methods
1.7 check that the marking out complies with the specification
1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved
1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Mark off marine components on **two** materials from the following:

2.1 carbon steel plate
2.2 carbon steel sections/bars
2.3 aluminium
2.4 stainless steel
2.5 non-metallic materials
2.6 other specific materials.

Learning outcome

The learner will:

3 Mark off plate or sections for **four** of the following components:

3.1 deck plates
3.2 shell plates
3.3 transverse/longitudinal girders
3.4 frames/longitudinals/stiffeners
3.5 bulkheads
3.6 intercostals/wash plates
3.7 bean knees/brackets
3.8 web supports

Learning outcome

The learner will:

4 Mark off plate or section, using **eight** of the following:

4.1 scriber
4.2 punch
4.3 rule and tape
4.4 straight edge
4.5 square
4.6 protractor
4.7 dividers or trammels
4.8 chalk line
4.9 templates
4.10 laser
4.11 combination/tri squares
4.12 bevel gauge
4.13 profile gauges
4.14 French chalk
4.15 marker pen
4.16 other specific marking off process

Learning outcome

The learner will:

5 Mark off material to include **five** of the following features:

5.1 datum and centre lines
5.2 square/rectangular profiles
5.3 irregular shapes
5.4 circles
5.5 curved profiles
5.6 bend guide lines
5.7 angles
5.8 hole centring and outlining (linear)
5.9 hole centring and outlining (circular)

Learning outcome

The learner will:

6 Produce marked-off components which meet **all** of the following standards:

6.1 company/client standards
6.2 dimensionally accurate (to drawing or specification)
6.3 clearly defines for required processes
6.4 use recognised marking out conventions

Learning outcome

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

7.1 the specific safety precautions to be taken when carrying out marking-off activities in a marine fabrication environment and when using plate or rolled section materials, both on land and on board vessels (including general workshop and site safety, appropriate personal protective equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
7.2 the personal protective clothing and equipment (PPE) that needs to be worn when carrying out the marking-off activities
7.3 the correct methods of moving or lifting plate and rolled section materials
7.4 the hazards associated with marking off fabricated components (such as working in a marine fabrication environment, lifting and handling plate/fabricated components, slivers/burrs on plate materials, using marking-out mediums, using laser marking-out equipment) and how they can be minimised

7.5 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

7.6 the procedures to be adopted to obtain the necessary drawings and job instructions

7.7 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

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

7.9 how to carry out currency/issue checks of the specifications they are working with

7.10 how to produce a three dimensional shape from the two dimensional material

7.11 the preparations to be carried out on the material prior to marking out, to enhance clarity, accuracy and safety

7.12 principles of marking out; developing basic shapes (including flat, rectangular and cylindrical) from flat plate or rolled section materials

7.13 the various marking-out tools and equipment that can be used to mark off straight lines, angles, circles and profiles

7.14 use of marking-out conventions, datum edges/lines and centre lines

7.15 ways of laying out the shapes/patterns to maximise the use of plate or sheet material

7.16 methods of marking out large or long shapes

7.17 marking out and transferring information from templates

7.18 the calibration/care and control procedures for tools and equipment

7.19 the need for clear and dimensional accuracy in marking out to specifications/drawings

7.20 the problems that can occur in marking out the marine components and how these can be avoided

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

Unit 311 Marking off marine structural steelwork components

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 312 Assembling fabricated components to produce marine sub-assemblies

Unit level:	Level 3
GLH:	460
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 produce heavy platework (3mm thick plate and above) and rolled section, minor sub-assemblies, in accordance with instructions and approved procedures. They will be required to interpret specifications and drawings correctly, to identify and select the correct components, to lay out and follow the build-strategy procedures, to bring together, prepare for joining and assemble in the right order, platework and rolled section components, in order to produce marine minor sub-assemblies. The sub-assemblies produced could cover such items as deck components, shell/cover plates, girders/beams/transverses, seating/platforms, tanks, tube/pipe trusses, guards/uptakes, floor components, brackets and stiffener structures, posts/pillars/columns and cylindrical structures. They will be required lay out and secure the various component parts of the structure, using mechanical fastenings, temporary tack welding or adhesive bonding techniques, in the correct order and ensuring that the components are assembled in a manner that is fit for purpose. Their responsibilities will require them to comply with organisational policy and procedures for the marine sub-assembly activities to be undertaken and to report any problems with the activities, tools, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will be sufficient to provide a good understanding of their work and will provide an informed approach to applying fabrication techniques, assembly and fixing procedures

	to marine sub-assemblies. They will understand the assembly techniques used and the requirements of the manufacturing and assembling procedures and their application. They will know about the methods of assembly and the role of the components, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the sub-assemblies are produced to the required specification. They will understand the safety precautions required when lifting and handling marine platework and rolled section components 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:	EUCL3D–12
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant instructions, assembly drawings and any other specifications

1.4 ensure that the specified components are available and that they are in a usable condition

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 the finished assembly meets the required specification

1.8 deal promptly and effectively with problems within their control and report those that cannot be solved

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the marine sub-assembly operations:

2.1 correctly prepare and set up the components and faces to be joined
2.2 use the correct datum faces
2.3 correctly align the components and faces to be joined
2.4 assemble/fabricate the platework components in the correct order or manner
2.5 produce an assembly which meets the required specification

Learning outcome

The learner will:

3 Produce **five** of the following minor sub-assemblies:

3.1 deck assemblies
3.2 shell and cover plates
3.3 girders/beams/transverses
3.4 seating/platforms
3.5 tanks
3.6 tube/pipe trusses
3.7 guards/uptakes
3.8 floor/bracket/stiffener structures
3.9 posts/spillers/columns
3.10 bulkhead
3.11 cylindrical structures

Learning outcome

The learner will:

4 Use **four** of the following types of components in the sub-assemblies produced:

4.1 rolled sections
4.2 tubes/pipes
4.3 stiffeners
4.4 brackets/beam knees
4.5 flat plates
4.6 pressed plates
4.7 rolled plates

4.8 pre-fabricated components

Learning outcome

The learner will:

5 Assemble platework components, using **two** of the following methods:

5.1 temporary tack welding
5.2 pin-table jig
5.3 panel line fabrication
5.4 riveting
5.5 mechanically fastened (nuts and bolts)
5.6 adhesive bonding
5.7 fairing aids

Learning outcome

The learner will:

6 Produce marine sub-assemblies which meet **all** of the following standards:

6.1 all components are correctly assembled and aligned in accordance with the specification
6.2 overall dimensions are within specification tolerances
6.3 assemblies meet appropriate geometric tolerances (square, straight, angles, free from twists)
6.4 where appropriate, pitches of erection holes meet specification requirements
6.5 completed sub-assemblies have secure and firm joints and are clean and free from burrs or flash

Learning outcome

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

7.1 the specific safety precautions to be taken when working in a marine fabrication environment and when producing marine platework assemblies (general workshop and site safety, appropriate personal protective equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations; safe disposal of waste materials)
7.2 the personal protective clothing and equipment (PPE) to be worn when carrying out the sub-assembly activities (including leather gloves, eye protection, safety helmets and ear protection)
7.3 safe working practices and procedures for producing marine sub-assemblies
7.4 the correct methods of moving or lifting bulky and heavy components and fabrications

7.5 the hazards associated with marine platework fabrication and assembly activities (such as using dangerous or badly maintained tools and equipment; lifting and handling long and heavy components; cuts, slips trips and falls) and how they can be minimised

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 how to obtain the necessary drawings and build specifications

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

7.9 how to carry out currency/issue checks of the specifications they are working with

7.10 how to interpret marking out conventions (such as cutting lines, centre lines)

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

7.12 the various methods of securing the assembled components (including threaded fasteners, tack welding methods and techniques, riveting, adhesive bonding of components)

7.13 how to set up and align the various components and the tools and equipment to be used

7.14 methods of temporarily holding the joints together to aid the assembly activities (such as jigs, clamps, rivet clamps, jacks and wedges)

7.15 the use and care of tools and equipment and their control procedures

7.16 the importance of using tools or equipment only for the purpose intended

7.17 the care that is required when using the tools or equipment and the proper way of preserving tools or equipment between operations

7.18 the problems that can occur when producing marine sub-assemblies and how these can be avoided

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

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

Unit 312 Assembling fabricated components to produce marine sub-assemblies

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 313 Cutting and shaping materials using portable thermal cutting equipment

Unit level:	Level 3
GLH:	350
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 cut and shape plate (3mm thickness and above), rolled sections, pipe and tube for marine fabrications, using portable thermal cutting equipment, in accordance with approved procedures. The equipment to be used will include hand-held oxy-fuel gas cutting equipment, plasma cutting equipment and simple portable machines running on tracks. 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 required 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 and demolition work, as appropriate. This will call for care in selecting the right equipment and tools, so as to avoid damage to the material and tools and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures for the cutting operations, to seek out relevant information for the thermal cutting activities undertaken and to report any problems with the equipment, materials, consumables or cutting activities that they cannot resolve themselves, or are outside their responsibilities, to the relevant authority. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying thermal cutting procedures in a marine environment. They will understand the processes and will know about the equipment and its application and the materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the

	required specification. They will need to understand the safety precautions required when working with the thermal cutting equipment, especially those with regard to fire and potential explosion, and the safeguards necessary for undertaking the activities safely and correctly. They will be expected to demonstrate safe working practices throughout, and will understand the responsibilities 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:	EUCL3D–13
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 confirm that the machine is set up and ready for the machining activities to be carried out

1.4 manipulate the machine tool controls safely and correctly in line with operational procedures

1.5 produce components to the required quality and within the specified dimensional accuracy

1.6 carry out quality sampling checks at suitable intervals

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 shut down the equipment to a safe condition on conclusion of the machining activities

1.9 complete relevant documentation in line with company procedure

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 the equipment selected is suitable for the operations to be performed

2.2 regulators, hoses and valves are securely connected and free from leaks and damage

2.3 the correct gas nozzle is fitted to the cutting torch

2.4 a flashback arrestor has been correctly fitted to the gas equipment and has been tested by authorised personnel

2.5 appropriate gas pressures are set

2.6 the correct procedure is used for lighting, adjusting and extinguishing the cutting flame

2.7 hoses are safely routed and protected at all times

2.8 gas cylinders are handled and stored safely and correctly (where applicable)

Learning outcome

The learner will:

3 Use **two** of the following thermal cutting methods:

3.1 hand-held oxy-fuel gas cutting equipment

3.2 hand-held oxy-fuel gas cutting equipment

3.3 simple, portable, track-driven cutting equipment (electrical or mechanical)

Learning outcome

The learner will:

4 Perform thermal cutting operations, to produce **six** of the following features:

4.1 down-hand straight cuts (freehand)

4.2 straight cuts (track guided)

4.3 vertical cuts

4.4 overhead cuts

4.5 regular shapes

4.6 irregular shapes

4.7 angled cuts

4.8 radial cuts

4.9 rough cutting (demolition)

4.10 chamfers

4.11 gouging/flushing

4.12 bevelled edge -weld preparations

Learning outcome

The learner will:

5 Produce thermal cuts in **three** of the following forms of material (metal of 3mm and above) and **two** different thicknesses:

5.1 plate

5.2 rolled sections

5.3 pipe/tube

5.4 structures

Learning outcome

The learner will:

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

6.1 mild steel

6.2 high tensile steel

6.3 other specific metal

Learning outcome

The learner will:

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

7.1 dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 3mm

7.2 angled/radial cuts are within specification requirements (perpendicular/angularity/elliptical/parabolic)

7.3 cuts are clean and smooth, with minimal drag lines

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the specific safety precautions to be taken when working with thermal cutting equipment in a marine fabrication environment, both on land and on board vessels (including general workshop and site safety, appropriate personal protective equipment, fire and explosion prevention, protecting other workers, safety in enclosed/confined spaces; fume control; accident procedure; statutory regulations)

8.2 the personal protective clothing and equipment (PPE) to be worn when working with fabrications and thermal cutting equipment (including leather aprons and gloves, eye/ear protection and safety helmets)

8.3 the correct methods of moving or lifting plate materials and components

8.4 the hazards associated with thermal cutting (including naked flames, fumes and gases, explosive gas mixtures, oxygen enrichment, spatter, hot metal, elevated working, enclosed spaces) and how they can be minimised

8.5 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, permit-to-work procedures and emergency shutdown procedures)

8.6 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

8.7 how to obtain the necessary drawings and thermal cutting specifications

8.8 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

8.9 how to carry out currency/issue checks of the specifications they are working with

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

8.11 basic principles of thermal cutting and related equipment; the various techniques and their limitation; care of the equipment to ensure that it is safe and ready to use

8.12 the various types of thermal cutting equipment available and typical applications

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

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

8.15 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)

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

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

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

8.19 the correct procedure for lighting and extinguishing the flame and the importance of following the procedure

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

8.21 material thermal cutting characteristics and material preparation requirements

8.22 the terminology used in thermal cutting, in relation to the operations being performed

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

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

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

8.26 quality requirements of the type of work being undertaken

8.27 the calibration/care and control procedures for tools and equipment

8.28 the procedure for the safe disposal of waste materials

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

Unit 313 Cutting and shaping materials using portable thermal cutting equipment

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 314 Assembling sub-assemblies and components to produce major marine structural assemblies

Unit level:	Level 3
GLH:	530
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 assemble major marine structural assemblies, in accordance with instructions and approved procedures. They will be required to interpret specifications and drawings correctly, to identify and select the correct sub-assemblies and components, to lay out and follow the build-strategy procedures, to bring together, prepare for joining and assemble in the right order sub-assemblies and components, in order to produce marine major marine structural assemblies. The major assemblies produced will cover such items as decks (plate or lattice), hull unit structures, shell/cover units, tube/pipe trusses, tanks and containers, bulkheads and firewalls, support structures, platforms and seating. They will be required lay out and secure the various component parts of the structure, using mechanical fastenings and temporary tack welding in the correct order and to ensure that the structures are assembled in a manner that is fit for purpose. Their responsibilities will require them to comply with organisational policy and procedures for the marine major structural assembly activities to be undertaken and to report any problems with the activities, tools, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will be sufficient to provide a good understanding of their work and will provide an informed approach to applying marine major structural assembly fabrication techniques and fixing procedures. They will have an understanding of the assembly techniques used, the requirements of the manufacturing and assembling procedures and their application.

	They will know about the methods of assembly and the role of the sub-assemblies and components, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the major structural assemblies are produced to the required specification. They will understand the safety precautions required when lifting and handling marine sub-assemblies and components 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:	EUCL3D–14
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant instructions, assembly drawings and any other specifications

1.4 ensure that the specified components are available and that they are in a usable condition

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 the finished assembly meets the required specification

1.8 deal promptly and effectively with problems within their control and report those that cannot be solved

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the major marine structural assembly operations:

2.1 correctly prepare and set up the components and faces to be joined
2.2 use the correct datum faces
2.3 correctly align the components and faces to be joined
2.4 assemble the structural components and sub-assemblies in the correct order or manner
2.5 produce major structural assemblies which meet the required specification

Learning outcome

The learner will:

3 Produce **three** of the following major marine assemblies:

3.1 decks (plate or lattice)
3.2 hull unit structure sections
3.3 shell and cover units
3.4 tube/pipe trusses
3.5 bulkheads and firewalls
2.6 support structures
2.7 tanks or containers
2.6 seating/platforms

Learning outcome

The learner will:

4 Use **two** of the following types of assemblies/components in the assemblies produced:

4.1 minor assemblies
4.2 sub-assemblies
4.3 pre-fabricated components

Learning outcome

The learner will:

5 Assemble the parts using **two** of the following methods:

5.1 temporary tack welding
5.2 use of fairing aids
5.3 riveting

5.4 mechanically fastened (nuts and bolts)

5.5 use of jig/framework

Learning outcome

The learner will:

6 Produce major marine structural assemblies which meet **all** of the following standards:

6.1 all minor/sub-assemblies are correctly assembled and aligned in accordance with the specification

6.2 overall dimensions are within specification tolerances

6.3 major structural assemblies meet appropriate geometric tolerances (square, straight, angles, free from twists)

6.4 where appropriate, pitches of erection holes meet specification requirements

6.5 completed assemblies have secure and firm joints and are clean and free from burrs or flash

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Learning outcome

The learner will:

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

7.1 the specific safety precautions to be taken when working in a marine fabrication environment and when producing major marine structural assemblies (including general workshop and site safety, appropriate personal protective equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)

7.2 the personal protective clothing and equipment (PPE) to be worn when carrying out the major structural assembly activities (such as leather gloves, eye protection, safety helmets and ear protection)

7.3 safe working practices and procedures for producing marine major structural assemblies

7.4 the correct methods of moving or lifting bulky and heavy components and fabrications

7.5 the hazards associated with marine plate-work fabrication and structural assembly activities (such as using dangerous or badly maintained tools and equipment; lifting and handling long and heavy components; cuts, slips trips and falls) and how they can be minimised

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 how to obtain the necessary drawings and build specifications

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

7.9 how to carry out currency/issue checks of the specifications they are working with

7.10 how to interpret marking-out conventions (including cutting lines, centre lines)

7.11 the various stages of assembly of the major marine structures and the terminology used

7.12 the preparations to be carried out on the components, prior to assembling them

7.13 the various methods of securing the assembled components (including threaded fasteners; tack welding methods and techniques; riveting)

7.14 how to set up and align the various components and the tools and equipment to be used

7.15 methods of temporarily holding the joints together to aid the assembly activities (such as jigs, clamps, rivet clamps, jacks and wedges)

7.16 the use and care of tools and equipment and their control procedures

7.17 the importance of using tools or equipment only for the purpose intended

7.18 the care that is required when using the tools or equipment and the proper way of preserving tools or equipment between operations

7.19 the problems that can occur when producing major marine structural assemblies and how these can be avoided

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

7.21 the procedure for the safe disposal of waste materials

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

Unit 314 Assembling sub-assemblies and components to produce major marine structural assemblies

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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Unit 315 Cutting materials using hand and machine tools

Unit level:	Level 3
GLH:	400
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 cut and shape material, in order to fabricate clips, brackets, covers, trunking and similar components (including templates), in accordance with approved procedures. They will be required to select the appropriate equipment to use for the material, thickness and accuracy required and they will be expected to use hand tools, hand power tools and machinery, as applicable. The cutting and shaping will involve producing straight cuts, curved contours, cut-ins, notches and circular holes. Materials to be cut and shaped may include ferrous and non-ferrous. This will call for care in selecting the right tools, so as to avoid damage to the tools and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures, to seek out relevant information and to report any problems with the cutting activities, equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant person. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying sheet metal cutting and shaping procedures. They will understand the processes, the equipment and its application and will know about the materials, in adequate 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 fabrication tools and machinery. 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:	EUCL3D–15
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow relevant specifications for the component to be produced

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

1.5 shape the materials using appropriate methods and techniques

1.6 check that all the required shaping operations have been completed to the required specification

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the cutting and shaping activities:

2.1 select the appropriate hand tool or machine for the operation being performed

2.2 check that machine guards and safety devices are in position and function correctly

2.3 check that cutting discs/blades are in a serviceable condition (free from damage or chips and are sharp)

2.4 isolate the equipment from its power supply whilst changing blades and discs

2.5 use the equipment safely and correctly and only for its intended purpose

Learning outcome

The learner will:

3 Cut and finish material to the marked-out shape, using **six** of the following tools and equipment:

3.1 bench shears
3.2 guillotine
3.3 hacksaw
3.4 band saw
3.5 portable drill
3.6 pillar drill
3.7 files
3.8 abrasive disc cutting machines
3.9 punch/cropping machine
3.10 trepanning
3.11 nibbling machine

Learning outcome

The learner will:

4 Cut and shape **three** of the following forms of material:

4.1 flat plate
4.2 pipe and tube
4.3 rolled sections/bar (such as angle, RSJ, tee bar, bulb bar)
4.4 solid bar (such as square, round)
4.5 rail section
4.6 non-ferrous material

Learning outcome

The learner will:

5 Perform operations to produce **four** of the following shapes:

5.1 straight cuts
5.2 angled/mitre cuts
5.3 irregular shapes
5.4 curved contours
5.5 notches

5.6 circular holes

5.7 chamfers

Learning outcome

The learner will:

6 Produce cut and shaped components which meet **all** of the following standards:

6.1 dimensional accuracy is within specification tolerance

6.2 angled cuts are within specification requirements

6.3 cuts are clean and free from excessive burrs or slivers

6.4 components are free from distortion

Learning outcome

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

7.1 the specific safety precautions to be taken when working in a marine fabrication environment and when working with power operated saws and abrasive disc cutting machines, both on land and on board vessels (including general workshop and site safety, statutory regulations, accident procedure, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)

7.2 the personal protective clothing and equipment (PPE) to be worn when carrying out the fabrication activities (such as leather gloves, eye/ear protection and safety helmets)

7.3 the correct methods of moving or lifting heavy plate, bar and rolled sections

7.4 safe working practices and procedures to be observed when using manual and power operated tools (including emergency shutdown procedures)

7.5 the hazards associated with marine fabrication work (such as using dangerous or badly maintained tools and equipment, operating guillotines, using hand and bench shears, airborne particles, hot metal, burrs and sharp edges) and how they can be minimised

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 procedures for obtaining the necessary drawings and specifications, and how to check that they are the latest issue

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 the 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 how to interpret the marking out conventions on the materials to be cut and shaped (such as cutting lines, centre lines)

7.11 the range of machine saws available (such as power hacksaws, circular saws and band saws)

7.12 the abrasive cutting equipment available (to include hand-held portable machines and bench type radiac cutting machines)

7.13 the selection and fitting or abrasive cutting discs; cutting disc identification markings and how to identify the correct type of disc of the type of material being cut

7.14 statutory regulations regarding the fitting and use of abrasive discs

7.15 the material cutting characteristics and process considerations to be taken into account when cutting materials

7.16 the preparations that they may have to carry out on the material prior to cutting it

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

7.18 setting and adjusting tools and equipment (such as the use of backstops on guillotines)

7.19 the use of safety screens to protect other users from flying sparks whilst using abrasive cutting discs

7.20 the importance of ensuring that the machine guards are correctly fitted and positioned before using the equipment

7.21 how to set and adjust power saws for the various operations being performed

7.22 the importance of using tools or equipment only for the purpose intended

7.23 the care that is required when using the tools or equipment and the proper way of preserving tools or equipment between operations

7.24 the calibration/care and control procedures for tools and equipment

7.25 the problems that can occur when cutting materials using saws or abrasive discs and how these can be avoided

7.26 inspection techniques that can be applied to check that shape and dimensional accuracy are to specification and within acceptable limits

7.27 the procedure for the safe disposal of waste materials

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

Unit 315 Cutting materials using hand and machine tools

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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Unit 316 Forming marine components using power rolling machines

Unit level:	Level 3
GLH:	350
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 form plate for fabrications, in accordance with approved procedures, using power-operated pinch or pyramid rolls, which may be hand adjusted or console controlled. They will be required to operate the power rolling machine, according to the operations to be performed and the thickness and size of the material to be rolled. Preparing the rolls will involve setting and adjusting the gap between feed and forming rolls to suit plate thickness, positioning side roller(s) and adjusting to suit the required radius, checking and setting parallelism of rollers and applying suitable pressure to rollers throughout the forming operation. They will be expected to carry out the rolling operation in a manner which ensures that the material is formed to the required profile, without flats or deformities. They will also need to ensure that all the required safety devices are operating correctly and that the machine guards are in place and correctly adjusted. Items to be rolled will include carbon steel, stainless steel and aluminium and will involve operations such as producing shell plates, mast sections, crane pedestals, save-alls and guards, uptakes, vents, main exhaust units, bollards and funnel plates. This will call for care in using the right machine for the job and using it in the correct way, so as to avoid damage to the tools and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures for the activities undertaken and to report any problems with the equipment, materials, or rolling activities that they cannot resolve, or are outside their authority, to the relevant people. They will be expected to work to instructions, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will be sufficient to provide a good understanding of their work and will provide an informed approach to applying the required power rolling procedures. They will have an understanding of the rolling process and its application and will know about the equipment and materials, in adequate 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 power rolls, and the safeguards necessary for undertaking the activities safely and correctly. They will be required to demonstrate safe working practices and procedures throughout, and will understand the responsibilities 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:	EUCL3D–16
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 confirm that the equipment is set up correctly and is ready for use

1.4 manipulate the machine controls safely and correctly in line with operational procedures

1.5 produce components to the required specification

1.6 carry out quality sampling checks at suitable intervals

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 shut down the equipment to a safe condition on conclusion of the machining activities

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

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

2.1 the rolls are appropriate for the material used

2.2 the machine guards and safety devices are in position and operating correctly

2.3 rolls are appropriate for the operation and are in a serviceable condition (suitable diameter, free from damage)

2.4 roll settings are suitable for the material thickness and operations to be performed

2.5 equipment for supporting the plate at the start of the rolling operations is in place

Learning outcome

The learner will:

3 Use **one** of the following types of power rolling machine:

3.1 small rolls (hand adjusted)

3.2 large rolls (console adjusted)

3.3 variable rolls

Learning outcome

The learner will:

4 Perform rolling operations that produce **three** of the following marine components:

4.1 shell plates (curvatures)

4.2 mast sections

4.3 crane pedestals

4.4 collars/save-alls/guards

4.5 main exhaust units

4.6 uptakes/vents

4.7 bollards

4.8 funnel plates

4.9 pipe sections

4.10 flattening or straightening plate

4.11 other specific marine component

Learning outcome

The learner will:

5 Carry out rolling operations on **one** type of material (of 3 mm thickness or more) from the following:

5.1 carbon steel

5.2 stainless steel

5.3 aluminium

5.4 other specific material

Learning outcome

The learner will:

6 Produce rolled marine components that conform to **all** of the following standards:

6.1 dimensional accuracy is within the specification tolerances

6.2 the rolled plate conforms to best practice and/or specification, without deformation or cracking

6.3 the component conforms to the required shape/geometry (to the template profile)

Learning outcome

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

7.1 the specific safety precautions to be taken when working with rolling machines in a marine fabrication environment, both on land and on board vessels (including general workshop and site safety, appropriate personal protective equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)

7.2 checks to be carried out to ensure that the power rolls are safe and are in a fit condition to use

7.3 the personal protective clothing and equipment (PPE) to be worn when working with heavy platework (such as gloves, eye/ear protection, safety helmets)

7.4 the handling precautions and correct methods of moving or lifting sheet or plate materials

7.5 the hazards associated with marine fabrication work (such as handling sheet/fabricated components, using hot metal techniques, using dangerous or badly maintained tools and equipment, moving parts of power rolling machines) and how they can be minimised

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 how to obtain the necessary drawings, specifications and job instructions

7.7 how to obtain the necessary drawings, specifications and job instructions

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 carry out currency/issue checks of the specifications they are working with

7.10 marking out conventions used in marine platework and how to recognise the bending, forming and cutting lines

7.11 the basic principle of operation of the power rolling machine used and the type of work it can perform

7.12 how to set up the machine to produce the required form (such as mast sections, crane pedestals, bollards, straightening plates)

7.13 techniques of rolling (including pre-setting plate edges, adjusting pressure throughout the rolling operations, checking the component for parallelism or form throughout the operations)

7.14 how to release the rolls and remove the workpiece when rolling cylindrical and conical sections

7.15 ways of limiting distortion, marks, creases and flats in curved sections

7.16 how the materials need to be prepared prior to rolling and the effects of raw material scale or burrs on the finished article

7.17 material characteristics with regard to forming by using rolling machines

7.18 the care and maintenance procedures to be observed to ensure that the machines are in a serviceable condition

7.19 the organisational quality control procedures and how to recognise rolling defects

7.20 the inspection checks to be carried out and the tools and equipment that are used

7.21 the accuracy that can be achieved by rolling and limitations of the rolling processes

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

Unit 316 Forming marine components using power rolling machines

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 317 Forming marine components using a power press

Unit level:	Level 3
GLH:	350
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 bend and form plate (of 3mm and above) for marine fabrications, using power operated equipment such as press brakes, bending machines and power presses, in accordance with approved procedures. They will be required to operate the appropriate bending and forming equipment, in accordance with the instructions for the operations being performed. They will need to ensure that all the required safety devices are operating correctly and that the machine guards are in place and correctly adjusted. Items to be bent and formed may include ferrous and non-ferrous materials and tasks will include producing bends of various angles, setting plate ends for rolling operations and producing curved sections. This will call for care in selecting the right tools, so as to avoid damage to the tools and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures for the activities undertaken and to report any problems with the equipment, materials, tooling or bending activities that they cannot resolve, or are outside their authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will be sufficient to provide a good understanding of their work and will provide an informed approach to applying the required power pressing procedures. They will have an understanding of the bending processes and will know about the equipment and its application, in adequate depth to provide a sound basis for carrying out the activities, correcting

	faults and ensuring that the completed work is to the required specification. They will understand the safety precautions required when working with power operated presses and the safeguards necessary for undertaking the activities safely and correctly. They will be required to demonstrate safe working practices and procedures throughout and will understand the responsibilities 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:	EUCL3D–17
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 confirm that the equipment is set up correctly and is ready for use

1.4 manipulate the machine controls safely and correctly in line with operational procedures

1.5 produce components to the required specification

1.6 carry out quality sampling checks at suitable intervals

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 shut down the equipment to a safe condition on conclusion of the machining activities

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

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

2.1 the press is appropriate for the material used and operation being performed

2.2 the machine guards and safety devices are in position and function correctly

2.3 the press is in a safe and serviceable condition

2.4 press settings are suitable for the material thickness and operation to be performed

2.5 equipment for supporting the plate at the start of the pressing operations is in place

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Learning outcome

The learner will:

3 Use **one** of the following types of power operated bending equipment:

3.1 press brakes

3.2 powered bending machine

3.3 power press

3.4 variable power press.

Learning outcome

The learner will:

4 Perform operations that produce **four** of the following:

4.1 bends at 90°

4.2 bends of various angles, knuckles, cambers or strakes

4.3 set plate ends for rolling

4.4 box, square and rectangular sections, bulkheads

4.5 swaging bulkheads, walls or partitions

4.6 multi-bend platework, bulkheads or walls

4.7 curved plates, bollards, hawse-pipes

Learning outcome

The learner will:

5 Bend and form metal plate (of 3mm or greater thickness), for **one** appropriate material and **two** thicknesses:

5.1 carbon steel

5.2 stainless steel

5.3 aluminium

5.4 special metals

Learning outcome

The learner will:

6 Produce pressed components that conform to **all** of the following standards:

6.1 bend position and dimensional accuracy is within the specification tolerances

6.2 the pressed plate conforms to best practice and or specification, without deformation or cracking

6.3 the component conforms to the required shape/geometry (to the template profile)

Learning outcome

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

7.1 the specific safety precautions to be taken when working with power-operated bending and forming equipment such as press brakes and/or bending machines in a marine fabrication environment, both on land and on board vessels (including general workshop and site safety, appropriate personal protective equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)

7.2 the correct personal protective equipment (PPE) and handling precautions to be taken when working with heavy platework

7.3 the correct methods of moving or lifting sheet or plate materials

7.4 the hazards associated with power operated bending and forming processes (such as handling heavy sheet plate materials and components, operating moving equipment, using faulty or badly maintained tools and equipment) and how they can be minimised

7.5 the safe working practices and procedures required for operating power presses and bending machines

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 how to obtain the necessary drawings and bending 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 carry out currency/issue checks of the specifications they are working with

7.10 marking out conventions applicable to the bending process (including centre lines and bending lines)

7.11 the various types of power-operated bending machines that are used and their typical applications

7.12 the methods and techniques that are used to obtain the required shape and size

7.13 ways of limiting distortion, marks and creases in the finished workpiece

7.14 the preparations to be carried out on the materials, prior to bending them

7.15 the basic characteristics of the materials with regard to the bending operations undertaken

7.16 the need to take care of the bending tools and equipment and how to recognise faulty or damaged forming tools

7.17 how bending and forming tools should be stored

7.18 the problems that can occur with the bending and forming activities and how they can be avoided

7.19 the organisational quality control procedures that are used and how to recognise defects in the bends that they produce

7.20 how to make dimensional and forming inspection checks and the tools and equipment that can be used

7.21 accuracy and limitations of processes

7.22 the procedure for the safe disposal of waste materials

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

Unit 317 Forming marine components using a power press

Supporting Information

Unit guidance

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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 318 Operating CNC fabrication machines

Unit level:	Level 3
GLH:	630
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 operate computer numerically controlled (CNC) fabrication machines, such as shearing machines, gas, laser, water jet or plasma cutting, punching, bending and forming machines, in accordance with approved procedures. They will be expected to take charge of the prepared machine and to check that it is ready for the machining operations to be performed. This will involve checking that all the required materials and consumables are present and that the machine has been approved for production. In operating the machine, they will be expected to follow the correct procedures for calling up the operating program, dealing with any error messages and executing the program activities safely and correctly. They will be required to monitor the cutting or forming operations continuously, making any necessary adjustments to machine parameters in line with their permitted authority. Meeting production targets will be an important issue and their production records must show consistent and satisfactory performance. Their responsibilities will require them to comply with organisational policy and procedures for the CNC machining activities undertaken and to report any problems with the equipment, tooling, program, materials or activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will be sufficient to provide a good understanding of their work and will enable them to adopt an informed approach to applying CNC machining procedures. They will have an understanding of the CNC machining process used and its application and will know about the machine, tooling, materials,

	machining activities and consumables, in adequate depth to provide a sound background to machine operation and for carrying out the activities to the required specification. They will understand the safety precautions required when working with the machine and with its 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:	EUCL3D–18
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 confirm that the equipment is set up and ready for operation

1.4 follow the defined procedures for starting and running the operating system

1.5 deal promptly and effectively with error messages or equipment faults that are within their control and report those that cannot be solved

1.6 monitor the computer process and ensure that the production output is to the required specification

1.7 shut down the equipment to a safe condition on conclusion of the activities

1.8 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Ensure that the machine is ready for operation, by carrying out **all** of the following:

2.1 checking that the correct operating program is loaded and is at the correct start point

2.2 ensuring that machine guards are in place and correctly adjusted

2.3 positioning and securing material/components without distortion

2.4 checking that cutting tools/tooling/consumables are in a suitable condition

2.5 setting plate/section datums and positioning the machine
2.6 updating the program tool data, as applicable
2.7 ensuring that start-up procedures are observed
2.8 adjusting machine settings, as required, to maintain accuracy

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Learning outcome

The learner will:

3 Operate **one** of the following CNC fabrication machines:

3.1 shearing machine
3.2 punching machine
3.3 forming machine
3.4 bending machine
3.5 plasma cutting
3.6 laser cutting
3.7 gas cutting
3.8 water jet cutting

Learning outcome

The learner will:

4 Position and secure the workpiece, using **two** of the following holding methods/devices:

4.1 jigs and fixtures
4.2 clamps and stops
4.3 pneumatic clamps
4.4 other workholding devices

Learning outcome

The learner will:

5 Produce components which combine several different operations and which cover **five** of the following:

5.1 straight cuts
5.2 square/rectangular profiles
5.3 curved profiles
5.4 internal profiles
5.5 holes linearly pitched
5.6 holes radially pitched

5.7 louvres
5.8 swages
5.9 bends at 90°
5.10 bends of various angles
5.11 muilti-bend platework
5.12 curved plates
5.13 other specific operations

Learning outcome

The learner will:

6 Produce components for **four** of the following:

6.1 deck plates
6.2 shell plates
6.3 transverses/longitudinals/stiffeners
6.4 frames/longitudinals/stiffeners
6.5 bulkheads
6.6 intercostals/wash plates
6.7 beam knees/brackets
6.8 web/cantilevers

Learning outcome

The learner will:

7 Produce components using **one** of the following types of material:

7.1 ferrous
7.2 non-ferrous
7.3 stainless
7.4 special alloys

Learning outcome

The learner will:

8 Carry out the necessary checks during production, for accuracy of **four** of the following:

8.1 linear dimensions
8.2 position of features
8.3 accuracy of profiles
8.4 flatness/freedom from excessive distortion

8.5 accuracy of louvres and swages

Learning outcome

The learner will:

9 Produce components which meet **all** of the following standards:

9.1 dimensional accuracy is within the specification tolerances

9.2 the plate conforms to best practice and/or specification, without deformation or cracking

9.3 the component conforms to the required shape/geometry (to the template profile)

9.4 components are free from deformity, burrs and sharp edges

Learning outcome

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

10.1 the specific safety precautions to be taken when working with CNC fabrication machines and equipment

10.2 the safety mechanisms on the machine and the procedures for checking that they are operating correctly

10.3 the hazards associated with working on CNC cutting and forming machines (such as moving machinery, automatic machine operation, handling of cutting tools, lifting and handling workholding devices, handling sheet materials)

10.4 how to start and stop the machine, in both normal and emergency situations

10.5 the importance of wearing the appropriate protective clothing and equipment (PPE) and of keeping the work area clean 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 application of the CNC machine and the range of operations it can perform

10.8 where to obtain component drawings, specifications and/or job instructions required for the components being machined

10.9 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

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

10.11 how to interpret the visual display and the various messages displayed

10.12 the function of error messages and what to do when an error message is displayed

10.13 how to find the correct restart point in the program, when the machine has been stopped before completion of the program

10.14 the operation of the various hand and automatic modes of machine control (such as program operating and control buttons)

10.15 how to operate the machine using single-block run, full program run and feed/speed override controls

10.16 how to make adjustments to the program operating parameters

10.17 how to set and secure the workpiece to the machine; the effects of clamping the workpiece; and how material removal can cause warping/distortion of the finished workpiece

10.18 the problems that can occur with the cutting and forming activities and how these can be overcome

10.19 the quality control procedures used, inspection checks that need to be carried out and the equipment to be used

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

Unit 318 Operating CNC fabrication machines

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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Unit 319 Outfitting marine steelwork

Unit level:	Level 3
GLH:	480
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 outfit marine steelwork components/structural units, in accordance with approved procedures. They will be required to use appropriate installation drawings, specifications and documentation to install the various components and sub-assemblies. They will be expected to select the appropriate equipment and outfitting/installation techniques, based on the operations to be carried out and the components to be installed. The marine steelwork components/structural units to be installed will include flat plate and bar, pipes and tubes, rolled plate and section frames, pressed plates and fabricated units, lifeboat davits, hatch/deck covers and other appropriate outfit work. The steelwork outfitting activities will include making all necessary checks and adjustments, to ensure that components are correctly positioned, aligned, locked and fastened and that correct sealants are used, as and when appropriate. Their responsibilities will require them to comply with organisational policy and procedures for the steelwork outfitting activities undertaken and to report any problems with the outfitting activities, equipment or components used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying marine steelwork outfitting techniques and procedures. They will understand the marine steelwork being installed and its application and will know about the outfitting/installation techniques, tools and methods, in adequate depth to provide a

	sound basis for carrying out the activities, correcting faults and ensuring that the completed installation is to the required specification. They will understand the safety precautions required when carrying out the marine steelwork outfitting operations. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace, both ashore and afloat. 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:	EUCL3D–19
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow all relevant drawings and specifications for the installation being carried out

1.4 use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition

1.5 install, position and secure the equipment and components in accordance with the specification

1.6 ensure that all necessary connections to the equipment are complete

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 check that the installation is complete and that all components are free from damage

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the steelwork outfitting activities:

2.1 interpret the drawings and identify and obtain the correct parts/components to outfit

2.2 correctly prepare the component for positioning
2.3 use safe and approved installation/outfitting techniques and procedures at all times
2.4 mark off positions of steelwork parts/components, using datum lines
2.5 correctly position and align components, as required from the drawing
2.6 assemble the steelwork parts/components to the specified build strategy
2.7 use the appropriate fixing methods to secure the various parts
2.8 check that the finished steelwork assembly meets the required specifications

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Learning outcome

The learner will:

3 Position and install **six** of the following steelwork units:

3.1 lifeboat davits
3.2 exhaust/uptake units
3.3 auxiliary seatings
3.4 guards
3.5 bollards
3.6 tanks
3.7 hatch/deck covers
3.8 doors/jalousies
3.9 masts
3.10 deck cranes
3.11 platforms
3.12 ladders
3.13 gratings
3.14 hand rails
3.15 racks and storage assemblies
3.16 other specific outfitting items.

Learning outcome

The learner will:

4 Use **four** of the following types of components during the outfitting process:

4.1 plates/flat bar
4.2 tubes/pipes
4.3 section/bar frames
4.4 rolled plates
4.5 pressed plates

4.6 pre-fabricated units

Learning outcome

The learner will:

5 Use **three** of the following installation methods and techniques:

5.1 levelling and aligning
5.2 sealing
5.3 securing and locking
5.4 torque loading

Learning outcome

The learner will:

6 Position and secure the outfit steelwork, using **three** of the following:

6.1 tack welding
6.2 threaded fasteners
6.3 fairing aids
6.4 lifting equipment
6.5 clamps and jigs
6.6 support frames

Learning outcome

The learner will:

7 Produce steelwork outfit installations which comply with **all** of the following standards:

7.1 all outfit units are correctly assembled and aligned, in accordance with the specification
7.2 overall dimensions are within specification tolerances
7.3 installed units meet geometric tolerances (square, straight, angles, free from twist)
7.4 where appropriate, the pitches of erection holes meet specification
7.5 completed units have secure joints and are clean and free from burrs

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the specific safety practices and procedures that they need to observe when undertaking the outfitting of marine steelwork, both on land and on board vessels (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

8.2 the health and safety requirements of the work area where they are carrying out the outfitting activities and the responsibility they place on them

8.3 the hazards associated with outfitting marine steelwork and with the tools and equipment used and how these can be minimised

8.4 the personal protective equipment (PPE) that they need to use whilst carrying out the outfitting activities

8.5 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

8.6 the interpretation of drawings, standards, quality control procedures and specifications used for the outfitting activities and the symbols and terminology used in outfitting

8.7 how to carry out currency/issue checks of the specifications they are working with

8.8 the steelwork components to be installed and their function within the particular structure

8.9 methods of positioning, aligning and adjusting the outfit steelwork, without damage and the tools and equipment that are used

8.10 methods of lifting, handling and supporting the components/equipment during the outfitting activities

8.11 the various mechanical fasteners that will be used and their method of installation (including threaded fasteners, special securing and locking devices)

8.12 the importance of using the specified fasteners and locking devices for the particular installation and why they must not substitute others

8.13 the torque loading requirements on the fasteners and what to do if these loadings are exceeded or not achieved

8.14 the quality control procedures to be followed during the steelwork outfitting operations

8.15 procedures for ensuring that they have the correct tools and equipment for the activities

8.16 how to conduct any necessary checks to ensure the accuracy and quality of the installation

8.17 how to recognise outfitting defects (such as misalignment, ineffective fasteners and damage or distortion)

8.18 the importance of ensuring that the completed installation is free from foreign object debris, and that any exposed components or pipe ends are correctly covered/protected

8.19 the problems that can occur with the outfitting operations and how these can be overcome

8.20 the procedure for the safe disposal of waste materials

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

Unit 319 Outfitting marine steelwork

Supporting Information

Unit guidance

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Unit 320 Tack welding marine plate using a manual/semi-automatic welding process

Unit level:	Level 3
GLH:	350
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 produce fillet and butt tack welds in plate or section materials, using manual welding processes such as manual metal arc (MMA), MIG, MAG, TIG, Plasma or cored wire welding equipment, in a marine environment, in accordance with instructions and/or approved welding procedures. They will be expected to produce welds using one welding process. They will be required to check that all the workholding equipment and manipulating devices required are available and are in a usable condition. They will be expected to set up the welding equipment, ensuring that all the leads/cables, hoses and wire feed mechanisms are securely connected and free from damage. In preparing to weld, they will need to set and adjust the welding conditions, in line with the welding procedure specification. They must operate the equipment safely and correctly and make any necessary adjustments to settings in order to produce the welded joints to the required specification. The tack welds produced will satisfy the requirements of BS EN 287. Their responsibilities will require them to comply with organisational policy and procedures for the welding activities undertaken and to report any problems with the welding equipment, or welding activities, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying manual arc welding procedures and instructions. They will

	understand the welding process used and its application and will know about the equipment, materials and consumables used, in adequate depth to provide a sound basis for setting up and operating the equipment, recognising and correcting faults and ensuring that the work output is to the required specification. They will understand the safety precautions required when working with the welding 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:	EUCL3D–20
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant joining procedure and job instructions

1.4 check that the joint preparation complies with the specification

1.5 check that joining and related equipment and consumables are as specified and fit for purpose

1.6 make the joints as specified using the appropriate thermal joining technique

1.7 produce joints of the required quality and of specified dimensional accuracy

1.8 shut down the equipment to a safe condition on completion of joining activities

1.9 deal promptly with excess and waste materials and temporary attachments, in line with approved and agreed procedures

1.10 deal promptly and effectively with problems within their control and report those that cannot be solved

1.11 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Prepare for the manual welding process, to include carrying out **all** of the following:

2.1 obtaining the appropriate equipment for the welding activities to be carried out (such as type, current capacity)

2.2 checking condition of and correctly connecting, welding leads, earthing arrangements and electrode holder

2.3 connecting all required hoses, regulators and/or flow meters and safety devices (where applicable)

2.4 setting and adjusting welding conditions/parameters, in accordance with welding procedure specification

2.5 preparing the work area for the welding activities (such as placing welding screens, positioning fume extraction equipment)

2.6 ensuring that the workpiece/component is correctly set up with regard to the specified joint preparation and that it is secure

2.7 obtaining and wearing appropriate personal protective equipment

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Learning outcome

The learner will:

3 Use **one** of the following manual/semi-automatic welding processes:

3.1 manual metal arc

3.2 MIG/MAG

3.3 TIG

3.4 cored wire

Learning outcome

The learner will:

4 Use consumables specified in the welding procedure specification for **one** of the following:

4.1 butt welds (single sided or double sided)

4.2 fillet welds

Learning outcome

The learner will:

5 Produce butt or fillet tack welds in **one** of the following types of material:

5.1 carbon range of steel plate

5.2 stainless plate

5.3 non-ferrous

Learning outcome

The learner will:

6 Produce tack welded joints, according to approved welding procedures, in the following BS EN ISO 6947 positions:

6.1 vertical upwards (PF)
6.2 flat (PA)
6.3 horizontal (PC)
6.4 horizontal vertical (PB)
6.5 vertical downwards (PG)
6.6 overhead (PE or PD)

Learning outcome

The learner will:

7 Produce tack welded components which include **both** of the following:

7.1 achieve a minimum tack weld quality requirements equivalent to those given in the relevant and current European/International Standards as required by the application standard or specification
7.2 meet the required dimensional accuracy, within specified tolerance

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the safe working practices and procedures to be observed when working with the selected welding equipment (such as general workshop and site safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume control; accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)
8.2 the correct handling and storage of gas cylinders (to include manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features, emergency shutdown procedures)
8.3 the hazards associated with the selected welding process (such as live electrical components, poor earthing, arc radiation, fumes and gases, gas supply leaks, 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

8.4 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

8.5 the manual/semi-automatic welding process selected and the different types of welding equipment (such as basic principles of fusion welding, AC and DC power sources, ancillary equipment, power ranges, care of equipment, terminology used in welding, flame setting)

8.6 extracting information required from drawings and welding procedure specifications (to include interpretation of welding symbols, scope, content and application of the welding procedure specification)

8.7 the consumables associated with the chosen welding process (to include types of electrodes and or filler metal and their application; types of shielding gas and their application, gas supply and control; correct control, storage and drying of electrodes and filler wire)

8.8 the types and features of tack welded joints in plate, fillet and butt welds (such as single and multi-run welds, welding positions, weld quality)

8.9 methods of setting up and restraining the joint, to achieve correct location of components and control of distortion (such as edge preparation, use of jigs and fixtures, manipulators and positioners, tack welding size and spacing in relationship to material thickness and component size, use of temporary attachments, pre-setting)

8.10 preparing the welding equipment and the checks to be made to ensure that it is safe and ready to use (to include electrical connections, power return and earthing arrangements; equipment calibration, setting welding parameters)

8.11 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (to include fine tuning parameters, correct manipulation of the welding gun or electrode, safe closing down of the welding equipment)

8.12 the importance of complying with job instructions and the welding procedure specification

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

8.14 the organisational quality systems used and weld standards to be achieved

8.15 the weld inspection and test procedures used (including visual and non-destructive tests)

8.16 personal approval tests and their applicability to their work

8.17 the procedure for the safe disposal of waste materials

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

Unit 320 Tack welding marine plate using a manual/semi-automatic welding process

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 321 Carrying out pattern development for marine applications

Unit level:	Level 3
GLH:	400
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 carry out pattern developments and marking out of templates, prior to cutting and/or shaping plate material, in accordance with approved procedures. They will be required to select the appropriate materials and equipment to use, based on the information presented to them and the accuracy to be achieved. Pattern development techniques used will include parallel line, triangulation and radial line methods. Components to be marked out and developed will include irregular shapes, pipe elbows, segmented pipe bends, square-to-round transformers, T pieces, conical and elliptical sections. Their responsibilities will require them to comply with organisational policy and procedures for the marking out and pattern development activities undertaken and to report any problems with the equipment, materials or pattern development activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to pattern development activities. They will understand the marking out and pattern development process and its application and will know about the equipment, materials and processes to be carried out, in sufficient depth to provide a sound basis for carrying out the activities, correcting faults and producing the patterns and templates to the required specification. They will understand the safety precautions required when carrying out the pattern development 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:	EUCL3D–21
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

1.1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 obtain and use the correct information for marking out
1.4 obtain the appropriate marking out equipment and check that it is in a usable condition
1.5 prepare suitable datum's and marking out surfaces
1.6 mark out using appropriate methods
1.7 check that the marking out complies with the specification
1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved
1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Mark off developed shapes, using **two** types of pattern material from the following:

2.1 template paper
2.2 wood
2.3 sheet metal
2.4 cardboard
2.5 other specific material

Learning outcome

The learner will:

3 Develop patterns for plates and cylindrical shapes, for **five** of the following:

3.1 elbows for pipe bends
3.2 segment pipe bends
3.3 hoppers (square-to-round)
3.4 irregular shapes
3.5 tee-pieces
3.6 concentric cones
3.7 offset cones
3.8 truncated cones
3.9 elliptical forms
3.10 ball corner or spherical section
3.11 fishplates
3.12 bed plates
3.13 gusset plates
3.14 structural components

Learning outcome

The learner will:

4 Mark off the developed shapes, using **all** of the following tools and instruments:

4.1 scriber
4.2 punch
4.3 rule or tape
4.4 straight edge
4.5 square
4.6 protractor
4.7 dividers or trammels
4.8 compass
4.9 angle sets

Learning outcome

The learner will:

5 Develop shapes, to include **four** of the following features:

5.1 datums and centre lines
5.2 square and rectangular shapes

5.3 irregular shapes

5.4 angles

5.5 cutting and shaping detail and allowances

5.6 circles

5.7 bend/fold allowances

5.8 hole centres and outlining

Learning outcome

The learner will:

6 Produce developed patterns which meet **all** of the following standards:

6.1 company/client specifications

6.2 clearly defined work instructions

6.3 dimensional accuracy meets drawing/specification tolerances

6.4 marking out uses recognised conventions

Learning outcome

7 Knowledge and understanding – The learner must know and understand:

7.1 the specific safety precautions to be taken when working in a marine fabrication environment, with sheet or plate materials, both on land and on board vessels (such as general workshop and site safety, appropriate personal protective equipment, accident procedure; statutory regulations, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)

7.2 the personal protective equipment (PPE) to be worn when carrying out the pattern development activities (such as leather gloves, eye/ear protection, safety helmets)

7.3 the correct methods of moving or lifting sheet or plate materials

7.4 the hazards associated with marine fabrication work (such as handling sheet/fabricated components; using dangerous or badly maintained tools and equipment) and how they can be minimised

7.5 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

7.6 how to obtain the necessary drawings, template specifications and job instructions

7.7 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

7.8 how to carry out currency/issue checks of the specifications they are working with

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 principles and techniques for pattern development (to include parallel line, radial line and triangulation methods)

7.11 geometrical methods for developing of complex shapes (such as square-to-round, lobsterback sections) from sheet metal

7.12 use of marking out conventions, datum edges/lines and centre lines

7.13 the preparations to be carried out on the material prior to marking out, to enhance clarity, accuracy and safety

7.14 the component material characteristics and process considerations to be taken into account when marking out templates

7.15 allowances for joint and weld preparations for different materials and thicknesses

7.16 how to calculate true lengths, bend allowances and circumferences

7.17 the effective use and care of tools/instruments

7.18 how to mark out and preserve the template for maximum clarity, accuracy and ease of transfer

7.19 ways of laying out the shapes/patterns to maximise the use of plate or sheet material

7.20 setting and adjusting tools (such as squares and protractors)

7.21 how to transfer information to the underside of the sheet or plate

7.22 the importance of checking the marked-out shape for dimensional accuracy before cutting the material

7.23 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 preserving and storing tools and equipment between operations

7.24 the importance of clearly identifying the material part number and the manufacturing details on the marked out material or template

7.25 the problems that can occur in marking out pattern developments and how these can be avoided

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

Unit 321 Carrying out pattern development for marine 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.

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 322 Marking out components for metalwork

Unit level:	Level 3
GLH:	210
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 mark out sheet and plate work (including simple templates), and rolled sections in accordance with approved procedures. They will be required to select the required materials to use and the appropriate marking out tools and equipment based on the information presented to them and the accuracy to be achieved. Marking out will be the preparation required for cutting, shaping and forming sheet materials, plate and sections as appropriate to the application and will include marking out workpiece datums, centre lines, angles and curved details, cutting and bending details including bending allowances and hole centring and outlining details. Materials to be marked out may include ferrous and non-ferrous. Certain materials will require them to take the grain flow or rolling direction into account to avoid later production process problems. This will call for care in selecting the right equipment and tools so as to avoid damage to the material and tools, and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures for the marking out operations, seeking out relevant information and to report any problems with the equipment, materials, consumables or activities that they cannot personally resolve themselves, or are outside their personal responsibilities, to the relevant authority. They will be expected to work with minimum supervision, taking personal responsibility for their own actions and the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work, and provide an informed approach to applying marking out procedures. They will understand the processes, and will know about the equipment and its application, and the equipment, materials and consumables, in adequate depth to

	provide a sound basis for carrying out the activities to the required specification. They will need to understand the safety precautions required especially if using marking out mediums. They will be expected to demonstrate safe working practices throughout, and will understand the responsibilities 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:	EUCL3D–22
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 obtain and use the correct information for marking out
1.4 obtain the appropriate marking out equipment and check that it is in a usable condition
1.5 prepare suitable datums and marking out surfaces
1.6 produce marked out components using appropriate methods
1.7 check that the marking out complies with the specification
1.8 complete relevant paperwork in accordance with organisational requirements
1.9 deal promptly and effectively with problems within their control and report those that cannot be solved
1.10 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Mark out sheet or plate for **three** of the following forms/shapes of component:

2.1 flat covers and plates
2.2 fish plates, gussets
2.3 square and radial bends
2.4 brackets

2.5 square/rectangular/box sections
2.6 structural support pads, bed plates
2.7 cylindrical sections (such as trunking, pipes, tanks)
2.8 columns, beams or struts
2.9 frames or structures
2.10 simple seatings (such as boiler saddles, tank cradles)

Learning outcome

The learner will:

3 Mark out directly onto sheet or plate from drawings using **six** of the following tools and instruments:

3.1 scriber
3.2 protractor
3.3 centre punch
3.4 dividers or trammels
3.5 rule and tape
3.6 chalk, bluing or paint
3.7 straight edge
3.8 etching
3.9 laser
3.10 square

Learning outcome

The learner will:

4 Mark out material to include **five** of the following features:

4.1 datum and centre lines
4.2 curved profiles
4.3 square/rectangular profiles
4.4 cutting and bending details (including allowances)
4.5 angles
4.6 hole centring and outlining (circular and linear)
4.7 circles

Learning outcome

The learner will:

5 Produce marked out component which meet **all** of the following quality and accuracy standards:

5.1 company/customer standards and codes of practice

5.2 dimensionally accurate (drawing or specification)

5.3 clearly defined for required processes

5.4 uses recognised marking out conventions

Learning outcome

6 Knowledge and understanding – The learner must know and understand:

6.1 the specific safety precautions to be taken when working in a fabrication environment with sheet, plate or rolled section materials (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)

6.2 the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye/ear protection, safety helmets)

6.3 the correct methods of moving or lifting sheet, plate and rolled section materials

6.4 the hazards associated with marking out fabricated components and how they can be minimised (such as working in a fabrication environment, lifting and handling sheet/fabricated components, slivers/burrs on sheet materials, using marking out mediums, using laser marking out equipment)

6.5 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

6.6 the procedures to be adopted to obtain the necessary drawings and job instructions

6.7 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)

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

6.9 visualising how to produce a three dimensional shape from the two dimensional material

6.10 the preparations that need to be carried out on the material prior to marking out to enhance clarity and accuracy, and safety

6.11 principles of marking out, developing basic shapes (flat, rectangular and cylindrical) from flat sheet, plate or rolled section materials

6.12 the effective use and care of tools/instruments

6.13 use of marking out conventions (such as datum edges/lines, centre lines)

6.14 the material characteristics and process considerations that need to be taken into account when marking out sheet, plate or rolled section materials

6.15 how to calculate and mark out true lengths, bend allowances and circumferences

6.16 geometrical construction methods for straight and radius bends, curved or circumference sections, pyramid or cone sections

6.17 ways of laying out the shapes/patterns to maximise the use of plate or sheet material

6.18 setting and adjusting tools, such as squares and protractors

6.19 methods of marking out large or long shapes

6.20 marking out and transferring information from templates

6.21 how to transfer information to the underside of the sheet or plate

6.22 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 preserving and storing tools and equipment between operations.

6.23 the need for clear and dimensional accuracy in marking out to specifications/drawings

6.24 the problems that can occur in marking out components, and how these can be avoided

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

Unit 322 Marking out components for metalwork

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 323 Developing and marking out templates for metalwork

Unit level:	Level 3
GLH:	280
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 develop and mark out templates prior to cutting and/or shaping the material in accordance with approved procedures. They will be required to select the appropriate materials and equipment to use based on the information presented to you and the accuracy required to be achieved. The templates produced may be used for marking out, setting of fabrications or pipe arrangements or preparing (setting) heavy plate for rolling. This will call for care in selecting the right equipment and tools so as to avoid damage to the material and tools, and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures for the development and marking out of templates, seeking out relevant information for the activities undertaken and to report any problems with the equipment, materials, and consumables that they cannot personally resolve themselves, or are outside their personal responsibilities, to the relevant authority. They will be expected to work with minimum supervision, taking personal responsibility for their own actions and the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work, and provide an informed approach to applying template development and marking out procedures. They will understand the processes, and will know about the equipment and its application, and the materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification. They will need to understand the safety precautions required when working with the required equipment. They will be expected to demonstrate safe working practices throughout, and will understand the responsibilities 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:	EUCL3D–23
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 obtain and use the correct information for marking out
1.4 obtain the appropriate marking out equipment and check that it is in a usable condition
1.5 prepare suitable datums and marking out surfaces
1.6 develop templates that comply with quality and accuracy standards
1.7 mark out using appropriate methods
1.8 check that the marking out complies with the specification
1.9 deal promptly and effectively with problems within your control and report those that cannot be resolved
1.10 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 mark out plate or pipe for **two** of the following:

2.1 angular setting
2.2 large radius section
2.3 plate setting
2.4 burner template

Learning outcome

The learner will:

3 mark out templates for **six** of the following:

3.1 radiused and mitred corners
3.2 ball corner or spherical section
3.3 concentric cones
3.4 fish plates
3.5 offset cones
3.6 bed plates
3.7 truncated cones
3.8 gusset plates
3.9 square/rectangular to round
3.10 structural components
3.11 fishtail
3.12 simple seating (tank cradles)
3.13 segmented bends (lobsterback)
3.14 box edges
3.15 other specific shapes

Learning outcome

The learner will:

4 use **all** of the following tools and instruments to mark out directly from drawings onto sheetmetal:

4.1 scriber
4.2 square
4.3 centre punch
4.4 protractor
4.5 rule or tape
4.6 dividers or trammels
4.7 straight edge
4.8 chalk, bluing or other medium
4.9 laser (where applicable)

Learning outcome

The learner will:

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

5.1 datums and centre-lines
5.2 cutting details and allowances
5.3 square and rectangular profiles
5.4 bend/fold allowances

5.5 angles

5.6 hole centres and outlining (linear)

5.7 circles and curved profiles

5.8 hole centres and outlining (on pitch circles)

Learning outcome

The learner will:

6 Develop templates that meet all the following quality and accuracy standards:

6.1 template profile complies with drawing or job requirements

6.2 dimensional accuracy meets drawing/specification tolerances

6.3 suitably marked or labelled to identify purpose

6.4 marking out uses recognised conventions

6.5 template profile complies with drawing or job requirements

Learning outcome

7 Knowledge and understanding – The learner must know and understand:

7.1 the specific safety precautions to be taken when working in a fabrication environment with sheet or plate materials (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)

7.2 the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye/ear protection, safety helmets)

7.3 the correct methods of moving or lifting sheet or plate materials

7.4 the hazards associated with fabrication work and how they can be minimised (such as handling sheet/fabricated components; using dangerous or badly maintained tools and equipment)

7.5 how to obtain the necessary drawings, template specifications and job instructions

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 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)

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

7.9 principles and techniques for marking out templates

7.10 geometrical methods for developing of complex shapes (such as square to round, lobsterback sections) from sheet metal

7.11 how to produce a three dimensional shape from the two dimensional material

7.12 use of marking out conventions (such as datum edges/lines, centre lines)

7.13 the preparations that need to be carried out on the material prior to marking out to enhance clarity and accuracy, and safety

7.14 the component material characteristics and process considerations that need to be taken into account when marking out templates

7.15 allowances for joint and weld preparations for different materials and thicknesses

7.16 how to calculate true lengths, bend allowances and circumferences

7.17 the effective use and care of tools/instruments

7.18 how to mark out and preserve the template for maximum clarity, accuracy and ease of transfer

7.19 ways of laying out the shapes/patterns to maximise the use of plate or sheet material

7.20 setting and adjusting tools, such as squares and protractors

7.21 how to transfer information to the underside of the sheet or plate

7.22 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 preserving and storing tools and equipment between operations

7.23 the need for clear and dimensional accuracy in marking out to specifications/drawings

7.24 the problems that can occur in marking out templates and how these can be avoided

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

Unit 323 Developing and marking out templates for metalwork

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 324 Cutting and shaping materials using portable thermal cutting equipment

Unit level:	Level 3
GLH:	280
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 cut and shape plate (3mm thickness and above), rolled sections, pipe and tube for fabrications using portable thermal cutting equipment in accordance with approved procedures. The equipment to be used will include hand held oxy/fuel gas cutting equipment, plasma cutting equipment and simple portable machines running on tracks. They will be required to assemble and set up the appropriate equipment to be used for the material and thickness to be cut, the type of operation to be carried out and the accuracy required to be achieved. Materials to be cut and shaped may include mild steel, stainless steel, special steels and other appropriate materials and will include guided cuts, vertical cuts, overhead cuts, external curved contours, round and square holes as appropriate. This will call for care in selecting the right equipment and tools so as to avoid damage to the material and tools, and danger to oneself. Their responsibilities will require them to comply with organisational policy and procedures for the cutting operations, seeking out relevant information for the thermal cutting activities undertaken and to report any problems with the equipment, materials, consumables or cutting activities that they cannot personally resolve themselves, or are outside their personal responsibilities, to the relevant authority. They will be expected to work with minimum supervision, taking personal responsibility for their own actions and the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work, and provide an informed approach to applying thermal-cutting procedures. They will understand the processes, and will know about the equipment and its application, and the materials and consumables, in adequate depth to provide a sound

	basis for carrying out the activities to the required specification. They will need to understand the safety precautions required when working with the thermal cutting equipment, especially those with regard to fire and potential explosion, and the safeguards necessary for undertaking the activities safely and correctly. They will be expected to demonstrate safe working practices throughout, and will understand the responsibilities 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:	EUCL3D–24
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 confirm that the machine is set up and ready for the machining activities to be carried out
1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
1.5 produce components to the required quality and within the specified dimensional accuracy
1.6 carry out quality sampling checks at suitable intervals
1.7 deal promptly and effectively with problems within their control and report those that cannot be solved
1.8 shut down the equipment to a safe condition on conclusion of the machining activities
1.9 complete relevant documentation in line with company procedure

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 the equipment selected is suitable for the operations to be performed
2.2 regulators, hoses and valves are securely connected and free from leaks and damage
2.3 the correct gas nozzle is fitted to the cutting torch

2.4 that a flash back arrestor is fitted to gas equipment

2.5 appropriate gas pressures are set

2.6 the correct procedure is used for lighting, adjusting and extinguishing the cutting flame

2.7 hoses are safely routed and protected at all times

2.8 gas cylinders are handled and stored safely and correctly

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Learning outcome

The learner will:

3 Use **two** of the following thermal cutting methods:

3.1 hand held oxy-fuel-gas-cutting equipment

3.2 hand held plasma gas-cutting equipment

3.3 simple portable track driven cutting equipment (electrical or mechanical)

Learning outcome

The learner will:

4 Perform thermal cutting operations to produce **six** of the following features:

4.1 down-hand straight cuts freehand

4.2 square/rectangular shapes

4.3 round holes

4.4 straight cuts track guided

4.5 irregular shapes

4.6 square holes

4.7 vertical cuts

4.8 angled cuts

4.9 rough cutting

4.10 overhead cuts

4.11 external curved contours

4.12 bevelled edge – weld preparations

Learning outcome

The learner will:

5 Produce thermal cuts in **four** of the following forms of material (metal of 3mm and above and two different thickness):

5.1 plate

5.2 rolled sections

5.3 fabricated sections

5.4 extrusions

5.5 bar

5.6 pipe/tube

Learning outcome

The learner will:

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

6.1 mild steel

6.2 special steel

6.3 stainless steel

6.4 other appropriate material

Learning outcome

The learner will:

7 Produce thermally cut components which meet **all** of the following quality and accuracy standards:

7.1 dimensional accuracy is within the tolerances specified on the drawing/specification or within +/- 1.5mm

7.2 angled cuts are within specification requirements (perpendicular/angularity)

7.3 cuts are clean and smooth with minimal drag lines

Learning outcome

8 Knowledge and understanding – The learner must know and understand:

Assessment criteria

8.1 the specific safety precautions to be taken when working with thermal cutting equipment in a fabrication environment (general workshop and site safety, appropriate personal protective equipment (PPE), fire and explosion prevention, protecting other workers, safety in enclosed/confined spaces; fume control; accident procedure; statutory regulations)

8.2 the personal protective clothing and equipment that needs to be worn when working with fabrications and thermal cutting equipment (such as leather aprons and gloves, eye/ear protection, safety helmets)

8.3 the correct methods of moving or lifting plate materials and components

8.4 the hazards associated with thermal cutting and how they can be minimised (naked flames, fumes and gases, explosive gas mixtures, oxygen enrichment, spatter, hot metal, elevated working, enclosed spaces)

8.5 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, permit to work procedures and emergency shut down procedures

8.6 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

8.7 how to obtain the necessary drawings and thermal cutting specifications

8.8 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)

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

8.10 the thermal cutting process (basic principles of thermal cutting and related equipment; the various techniques and their limitation; care of the equipment to ensure that it is safe and ready to use)

8.11 the various types of thermal cutting equipment available and typical applications

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

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

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

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

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

8.17 setting of operating conditions; flame control and the effects of mixtures and pressures associated with thermal cutting.

8.18 the correct procedure for lighting and extinguishing the flame, and the importance of following the procedure

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

8.20 material thermal cutting characteristics and material preparation requirements

8.21 the terminology used in thermal cutting in relation to the operations being performed

8.22 the problems that can occur with thermal cutting and how they can be avoided; causes of distortion during thermal cutting and methods of controlling distortion

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

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

8.25 quality requirements of the type of work being undertaken

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

Unit 324 Cutting and shaping materials using portable thermal cutting equipment

Supporting Information

Unit guidance

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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 325 Producing and finishing holes using drilling machines

Unit level:	Level 3
GLH:	140
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 produce holes using drilling machines in sheet, plate, rolled section or pipe in accordance with approved procedures. They will be required to select the appropriate drilling equipment to use based on the operations to be performed and the size of the component worked on. They will be expected to use appropriate workholding methods and techniques to secure the workpiece for the drilling operations and this will include the use of jigs, clamps, machine vice and other appropriate holding devices. In drilling the holes they will need to accurately position the drill bits and use appropriate speeds and feeds to drill and finish the holes to the required specification. Drilling and finishing operations will include through holes, blind holes, counter-bored holes, countersunk holes, spot facing, reaming and tapping. Their responsibilities will require them to comply with organisational policy and procedures for the drilling activities undertaken and to report any problems with the equipment or drilling 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 the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work, and provide an informed approach to applying the drilling and finishing procedures. They will understand the drilling equipment used and its application, together with the material characteristics and the appropriate tooling for carrying out the drilling and finishing process. They will know about the basic principles and requirements of securing the work piece prior to carrying out the process in adequate depth to provide a sound basis for carrying out the drilling activities, correcting faults and

	ensuring the work output meets the required specification. They will understand the safety precautions required when carrying out the drilling and finishing activities. 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:	EUCL3D–25
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 confirm that the machine is set up and ready for the machining activities to be carried out
1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
1.5 produce components to the required quality and within the specified dimensional accuracy
1.6 carry out quality sampling checks at suitable intervals
1.7 deal promptly and effectively with problems within their control and report those that cannot be solved
1.8 shut down the equipment to a safe condition on conclusion of the machining activities
1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Ensure that the equipment is fit for purpose and used safely by carrying out **all** of the following:

2.1 selecting the appropriate drilling equipment/machine for the operation being performed
2.2 checking the machine guards and safety devices are in position and function correctly
2.3 checking drill bits and cutting tools are in a serviceable condition (free from damage or chips; sharp)
2.4 sharpen drill bits by hand or machine tool (where applicable)
2.5 isolating the equipment from its power supply whilst changing drill bits

2.6 securely clamping/restraining the components during the drilling operations

2.7 using the equipment safely and correctly and only for its intended purpose

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Learning outcome

The learner will:

3 Use **two** of the following drilling machines:

3.1 hand held drilling machine

3.2 pillar/bench drill

3.3 radial arm drill

3.4 other types of clamped drills (such as magnetic, vacuum)

Learning outcome

The learner will:

4 Use **two** of the following workholding devices:

The learner can:

4.1 jigs/fixtures

4.2 machine vice

4.3 clamps

4.4 other types of clamps (such as magnetic, vacuum)

Learning outcome

The learner will:

5 Carry out **five** of the following drilling and finishing operations:

The learner can:

5.1 drilling through holes

5.2 centre drilling

5.3 drilling holes to a depth

5.4 spot facing

5.5 counter-boring holes

5.6 trepanning holes

5.7 countersinking holes

5.8 tapping holes

5.9 reaming holes

5.10 jig or template drilling

5.11 tapered reaming

5.12 component alignment drilling

Learning outcome

The learner will:

6 Produce drilled and finished components which meet **all** of the following quality and accuracy standards as is applicable to the process:

6.1 dimensional and positional accuracy is within specification tolerances
6.2 drilled holes are correctly formed and free from excessive tool marks
6.3 reamed holes are of the correct fit and have a smooth surface finish free from tool marks
6.4 tapped holes are of the correct type, threads are correctly formed and have a good fit
6.5 counter-bores, countersinks and spot facings meet job requirements

Learning outcome

The learner will:

7 Produce drilled holes in **three** of the following material types:

7.1 ferrous sheet metal
7.2 stainless steel plate or components
7.3 stainless steel sheet metal
7.4 non-ferrous plate or components
7.5 non-ferrous sheet metal
7.6 non-metallic materials
7.7 ferrous plate or components
7.8 composite materials

Learning outcome

The learner will:

7 Knowledge and understanding – The learner must know and understand:

7.1 the specific safety precautions to be taken when working in a fabrication environment and when carrying out drilling and finishing operations on materials used in fabricating (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
7.2 the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye/ear protection, safety helmets)
7.3 the correct methods of moving or lifting materials
7.4 the safe working practices and procedures to be used when using portable power operated tools and drilling machines, including emergency stop procedures for the machines

7.5 the hazards associated with drilling work and how they can be minimised (such as using dangerous or badly maintained tools and equipment; insecure or poorly clamped workpieces; airborne metal particles; sharp edges and splinters)

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 how to obtain the necessary drawings, specifications and work instructions

7.8 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International 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 how to interpret marking out conventions (such as cutting lines; centre lines)

7.11 the various types and application of drilling machines (including portable power tools, bench and pedestal machines and radial arm machines)

7.12 the range of drilling and hole finishing tools available (including twist drills, reamers, counter-bore tools, countersink tools, spot facing tools, taps) and how to check their serviceability

7.13 how to sharpen drill bits by hand or machine tool and the importance of having the correct cutting angle and clearance for the material being drilled

7.14 the methods of holding and securing the drills and finishing tools into the machine spindle (chucks, taper shank sleeves, collet chucks)

7.15 the methods of holding and securing workpieces for drilling (including jigs and fixtures, machine vices, clamps and restraining devices)

7.16 methods used to align the drill with the workpiece and the use of centre drills and pilot drills

7.17 how to check that the drill hole is in the correct position before drilling to the full diameter, and how to correct a drill that has been started off centre

7.18 the selection of speeds and feeds for drilling, reaming and finishing operations

7.19 the selection of cutting fluids and compounds for drilling, reaming and tapping of holes

7.20 setting and adjusting tools and equipment such as the use of depth stops

7.21 the material characteristics and process considerations that need to be taken into account when carrying out drilling operations

7.22 the care and control of tools and equipment; checking portable power tool leads, plugs and sockets are in a safe and usable condition

7.23 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

7.24 the problems that can occur with drilling operations, and how these can be avoided

7.25 inspection techniques that can be applied to check the dimensional accuracy and finish is to specification and within acceptable limits

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

7.27 reporting lines and procedures, line supervision and technical experts

Unit 325 Producing and finishing holes using drilling machines

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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Unit 326 Producing platework assemblies

Unit level:	Level 3
GLH:	350
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 produce heavy platework (3mm thick plate and above) assemblies in accordance with approved procedures. They will be required to correctly interpret specifications and drawings, bring together and assemble and join, in the right order, plate work components and sections in order to construct completed fabricated assemblies or sub-assemblies such as square and rectangular plate structures, covers and side plates, tanks, pressure vessels, cylindrical sections, conical sections, reduction pieces, simple and complex boiler seatings. They will be required lay out and secure the various component parts of the structure using mechanical fastenings, temporary tack welding, flanged and mechanically fastened or adhesive bonding techniques in the correct order and ensuring they are assembled in a manner that is fit for purpose. Their responsibilities will require them to comply with organisational policy and procedures for the platework fabrication activities to be undertaken and to report any problems with the activities, tools and equipment or materials 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 the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and provide an informed approach to applying platework fabrication techniques and their assembly and fixing procedures. They will understand the techniques used and the requirements of the manufacturing and assembling procedures, and their application. They will know about the methods of assembling the components of the required strength, that are fit for purpose, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is produced to the required specification. They will

	understand the safety precautions required when working with heavy platework components and their 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:	EUCL3D–26
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements – The learner must be able to:

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

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

1.3 follow the relevant instructions, assembly drawings and any other specifications

1.4 ensure that the specified components are available and that they are in a usable condition

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 the finished assembly meets the required specification

1.8 deal promptly and effectively with problems within their control and report those that cannot be solved

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the platework assembly operations:

2.1 correctly prepare and set-up the components and faces to be joined

2.2 use the correct datum faces

2.3 use the specified or appropriate fixing method

2.4 correctly align the components and faces to be joined

2.5 assemble/fabricate the platework components in the correct order or manner

2.6 produce an assembly which meets the required specification

Learning outcome

The learner will:

3 Produce **five** of the following platework assemblies:

3.1 frames

3.2 reduction pieces

3.3 tanks

3.4 transformers

3.5 covers and side plates

3.6 segmented bends

3.7 square, rectangular and box sections

3.8 steel and composite material assemblies

3.9 cylindrical

3.10 conical

3.11 simple or complicated seatings (tank or boiler seats)

Learning outcome

The learner will:

4 Use **four** of the following types of components in the assemblies produced:

4.1 plates or covers

4.2 flanges

4.3 pre-fabricated square/rectangular components

4.4 pipes

4.5 pre-fabricated cylindrical/conical components

4.6 rolled section components (angle, channel or tee section)

4.7 brackets

Learning outcome

The learner will:

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

5.1 temporary tack welding

5.2 riveting (hot or cold)

5.3 flanged and mechanically fastened (nuts and bolts)

5.4 adhesive bonding

Learning outcome

The learner will:

6 Produce platework assemblies which meet **all** of the following quality and accuracy standards:

6.1 all components are correctly assembled and aligned in accordance with the specification
6.2 overall dimensions are within specification tolerances
6.3 assemblies meet appropriate geometric tolerances
6.4 where appropriate, pitch or erection holes meet specification requirements
6.5 completed assemblies have secure and firm joints, and are clean and free from burrs or flash

Learning outcome

The learner will:

7 Knowledge and understanding – The learner must know and understand:

7.1 the specific safety precautions to be taken when working in a fabrication environment and when producing platework assemblies (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
7.2 the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye protection, safety helmets, ear protection)
7.3 safe working practices and procedures needed for producing platework assemblies
7.4 the correct methods of moving or lifting bulky and heavy fabrications
7.5 the hazards associated with platework fabrication and assembly work and how they can be minimised (such using dangerous or badly maintained tools and equipment; lifting and handling long and heavy components; cuts, slips trips and falls)
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 how to obtain the necessary drawings and joining specifications
7.8 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International 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 how to interpret marking out conventions (such as cutting lines, centre lines)
7.11 the preparations that need to be carried out on the components prior to assembling them
7.12 the various methods of securing the assembled components (nuts and bolts; tack welding methods and techniques; hot and cold riveting; adhesive bonding of components)
7.13 how to set up and align the various components and the tools and equipment that is used

7.14 methods of temporarily holding the joints together to aid the assembly activities (clamps, rivet clamps, jacks and wedges)

7.15 the use and care of tools and equipment, and control procedures

7.16 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

7.17 the problems that can occur when producing platework assemblies, and how these can be avoided

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

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

7.20 reporting lines and procedures, line supervision and technical experts

Unit 326 Producing platework assemblies

Supporting Information

Unit guidance

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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 327 Joining fabricated components using mechanical fasteners

Unit level:	Level 3
GLH:	210
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 undertake the preparation and making of joints between fabricated components using mechanical means in accordance with approved procedures. They will be required to produce suitable and appropriate joints using appropriate methods for the materials to be joined that meet the specified conditions and subsequent operating conditions to be demanded of the joint. Particular attention will be needed in the preparation and finishing of the materials so that the finished component is fit for purpose and meets the level of accuracy required. The mechanical fastenings used will include rivets, self-tapping screws, bolts and screwed fittings, anchor nuts and proprietary fasteners as is appropriate to the application and/or specification. The joint will be of two or more materials and may include non-metallic materials and joints of dissimilar metals. Their responsibilities will require them to comply with organisational policy and procedures, or those of the fastener manufacturers. They will be expected to seek out the relevant information and to report any problems with the mechanical fasteners or the joining activities that they cannot 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 actions and the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work, and provide an informed approach to the joining activities carried out. They will understand the basic characteristics of the materials to be joined, the various processes used and the appropriate procedures that go with them in adequate depth to provide a sound basis for achieving a sound and cohesive joint that is fit for purpose.

	They will understand the safety precautions required when working with the tools and equipment, especially those for use in hot metal processes and the safeguards necessary for undertaking the using processes. They will be required to demonstrate safe working practices throughout, and will understand the responsibilities 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:	EUCL3D–27
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

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

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

1.3 follow the relevant instructions, assembly drawings and any other specifications

1.4 ensure that the specified components are available and that they are in a usable condition

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

1.6 secure the components using the specified fasteners and securing devices

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

1.8 deal promptly and effectively with problems within their control and report those that cannot be solved

1.9 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Carry out **all** of the following during the joining process:

2.1 correctly prepare the faces of the materials to be joined

2.2 select the appropriate/specified fixings

2.3 select the correct tools appropriate to the joining activity undertaken
2.4 correctly align the materials and faces to be joined
2.5 assemble the components in the correct order or manner
2.6 produce a joint that meets the requirements of the specification

Learning outcome

The learner will:

3 Produce assemblies which include **six** of the following:

3.1 flat and flanged joints on flat or curved surfaces
3.2 joints with gasket or sealant
3.3 square/rectangular trunking
3.4 pipes
3.5 circular trunking
3.6 structural components
3.7 access flanges and cover plates
3.8 long or critical alignments
3.9 tank and tank covers
3.10 permanent and temporary assemblies

Learning outcome

The learner will:

4 Use **four** of the following assembly methods and techniques:

4.1 riveting using solid rivets
4.2 assembling using bolt fittings
4.3 riveting using pop/blind rivets
4.4 using screw fitting to tapped components
4.5 self-tapping screws
4.6 nuts and (spot welded) screw studs
4.7 use of proprietary fasteners
4.8 locking methods and devices
4.9 crimping
4.10 clinching

Learning outcome

The learner will:

5 Join the components in **three** of the following joining positions, access and environmental conditions:

5.1 horizontal

5.2 vertical

5.3 overhead

5.4 in workshop conditions

5.5 internal and confined spaces

Learning outcome

The learner will:

6 Produce joints to **all** of the following quality and accuracy standards as is applicable to the applications:

6.1 joints are accurately assembled and aligned in accordance with the specifications

6.2 joints are secure and firm

6.3 bolted and screwed joints are tightened to the correct torque

6.4 riveted joints are free from excessive material deformation and hammer marks

6.5 pitch of holes meet the specification

6.6 completed joints are clean and free from burrs

Learning outcome

7 Knowledge and understanding – The learner must know and understand:

7.1 the specific safety precautions to be followed when working in a fabrication environment and when carrying out joining activities using fabricated components (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)

7.2 the personal protective clothing and equipment that needs to be worn when carrying out the joining activities (such as leather gloves, eye/ear protection, safety helmets)

7.3 the hazards associated with the joining operations and how they can be minimised (such as handling sheet/fabricated components, using hot metal riveting techniques, handling and using sealants and cleaning agents, dangerous or badly maintained tools and equipment)

7.4 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

7.5 how to obtain the necessary drawings and joining procedure specifications

7.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken)

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

7.8 the use of manufacturers' specifications for the types of fasteners used

7.9 the advantages and disadvantages of the different forms and methods of mechanical join

7.10 the various joining processes that are used and the tools and equipment that is required

7.11 the preparations that need to be carried out on the materials/components prior to joining them (such as, materials to be degreased, dry and clean, with hole and flanges de-burred)

7.12 how to set up and align the joints prior to fixing and the tools and the methods that can be used (such as clamps, rivet gripping tools, temporary fixings, jacking and supporting devices)

7.13 how to produce a secure joint using blind rivets and the type of riveting tools that are available

7.14 how to produce a good solid riveted joint and the use of the various riveting tools

7.15 how to determine the length of the rivets required to give a properly formed rivet hear

7.16 the range of bolts and screwed fasteners that are to be used; why it is important to use the correct type of washer; sequence of tightening bolts on flanged joints; and the tools and equipment used to ensure they are tightened to the required torque

7.17 the various types of proprietary fasteners that are used on fabricated assemblies (such as anchor nuts, clinch nuts, welded studs, etc.)

7.18 the materials used and their joining characteristics, electrochemical reaction between dissimilar metals and means of reducing the effects, use of gasket material

7.19 checks that need to be carried out on the tools and equipment prior to use to ensure that they are in a safe and usable condition (such as condition of plugs and leads on power tools, condition of striking faces on hammers, condition of riveting tools and rivet snaps and calibrated such as torque wrenches)

7.20 equipment setting, operating and care procedures; why equipment and tools need to be correctly set up and in good condition

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

7.22 quality control and test procedures for detection of defects in joints, visual, feel and measurement checks

7.23 the problems that can occur with the joining operations and how these can be avoided

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

7.25 reporting lines and procedures, line supervision and technical experts

Unit 327 Joining fabricated components using mechanical fasteners

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 328 Producing fillet welded joints using a manual welding process

Unit level:	Level 3
GLH:	760
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 produce fillet welds in plate, sheet or sections and/or fillet welded joints in pipe/tube using a manual welding process such as manual metal arc, MIG, MAG, TIG, flux cored wire, inert shield or oxy/fuel gas welding equipment in accordance with instructions and/or approved welding procedures. They will be required to check that all the workholding equipment and manipulating devices required are available and in a usable condition. They will be expected to check the welding equipment to ensure that all the leads/cables, hoses and wire feed mechanisms are securely connected and free from damage. In preparing to weld they will need to set and adjust the welding conditions in line with the instructions or 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. They will be required to demonstrate their capability to produce the fillet welds of the required quality and this could be through tests according to BS 4872 or EN 287 Part 1 and EN 9696 Part 1 (for aluminium). Their responsibilities will require them to comply with organisational policy and procedures for the welding activities undertaken and to report any problems with the welding equipment or welding activities that they cannot resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a sound basis for their work, and will provide an understanding of how the particular

	welding process works. They will know about the equipment, materials and consumables in adequate depth to provide a sound background for the welding operations to be performed, and for ensuring the work output is produced to the required specification. They will understand the safety precautions required when working with the welding 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:	EUCL3D–28
Endorsed by	Semta

Learning outcome

1 Performance Requirements – The learner must be able to:

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

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

1.3 follow the relevant joining procedure and job instructions

1.4 check that the joint preparation complies with the specification

1.5 check that joining and related equipment and consumables are as specified and fit for purpose

1.6 make the joints as specified using the appropriate thermal joining technique

1.7 produce joints of the required quality and of specified dimensional accuracy

1.8 shut down the equipment to a safe condition on completion of joining activities

1.9 deal promptly with excess and waste materials and temporary attachments, in line with approved and agreed procedures

1.10 deal promptly and effectively with problems within their control and report those that cannot be solved

1.11 complete relevant documentation in line with company procedure

Learning outcome

The learner will:

2 Set up, check, adjust and use welding and related equipment for **one** of the following welding processes:

2.1 Manual Metal Arc
2.2 TIG
2.3 Cored wire
2.4 MIG/MAG
2.5 Oxy/fuel Gas welding

Learning outcome

The learner will:

3 Use consumables as specified in the welding procedure specification covering either:

two types of electrode from:

3.1 rutile
3.2 basic
3.3 cellulosic
3.4 nickel alloy
3.5 stainless steel
3.6 other electrode type

Or

3.7 **two** types of filler wire from different material groups

Learning outcome

The learner will:

4 Produce fillet welded joints in **two** of the following forms of material:

4.1 plate
4.2 sheet
4.3 sections
4.4 pipe/tube
4.5 other specific form

Learning outcome

The learner will:

5 weld joints according to approved welding procedures in good access situations in **two** of the following BS EN ISO 6947 positions:

5.1 flat (PA)
5.2 horizontal (PC)
5.3 horizontal vertical (VB)
5.4 vertical upwards (PF
5.5 vertical downwards (PG)
5.6 overhead (PE or PD)

Learning outcome

The learner will:

6 Produce fillet welded joints which:

6.1 achieve a minimum weld quality requirements applicable to fillet welds equivalent to those given in the relevant and current European/International Standards as required by the application standard or specification
6.2 meet the required dimensional accuracy within specified tolerance

Learning outcome

7 Knowledge and understanding – The learner must know and understand:

7.1 the safe working practices and procedures to be observed when working with the selected welding equipment (general workshop and site safety, appropriate personal protective equipment (PPE), fire prevention, protecting other workers from arc eye, safety in enclosed/confined spaces; fume control; accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations; safe disposal of waste materials)
7.2 the correct handling and storage of gas cylinders (manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features, emergency shutdown procedures)
7.3 the hazards associated with the selected welding process and how they can be minimised (live electrical components, poor earthing, arc radiation, fumes and gases, gas supply leaks, spatter, hot slag and metal, grinding and mechanical metal/slag removal; elevated working, enclosed spaces, slips, trips and falls)
7.4 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

7.5 the manual welding process selected and an awareness of the different types of welding equipment (basic principles of fusion welding, AC and DC power sources, ancillary equipment, power ranges, care of equipment, terminology used in welding, flame setting)

7.6 extracting information required from drawings and welding procedure specifications (interpretation of welding symbols, scope, content and application of the welding procedure specification) to include symbols and conventions to appropriate British, European or relevant International standards in relation to work undertaken

7.7 the consumables associated with the chosen welding process (types of electrodes and or filler metal and their application, types of shielding gas and their application, gas supply and control; correct control, storage and drying of electrodes and filler wire)

7.8 the types and features of welded joints in pipe (fillet and butt welds, single and multi-run welds, welding positions, weld quality)

7.9 methods of setting up and restraining the joint to achieve correct location of components and control of distortion (edge preparation, use of jigs and fixtures, manipulators and positioners, tack welding size and spacing in relationship to material thickness and component size, use of temporary attachments, pre-setting)

7.10 preparing the welding equipment and checks that need to be made to ensure that it is safe and ready to use (electrical connections, power return and earthing arrangements; equipment calibration before use, setting welding parameters, care and maintenance of the equipment)

7.11 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (fine tuning parameters, correct manipulation of the welding gun or electrode, safe closing down of the welding equipment)

7.12 the importance of complying with job instructions and the welding procedure specification

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

7.14 the organisational quality systems used and weld standards to be achieved; weld inspection and test procedures used including visual and non-destructive tests

7.15 personal approval tests and their applicability to their work

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

Unit 328 Producing fillet welded joints using a manual welding process

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 329 Restoring marine mechanical components to usable condition by repair

Unit level:	Level 3
GLH:	460
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 restore marine mechanical components to usable condition by repair, in accordance with approved procedures. They will be required to restore a range of marine mechanical components and equipment to operational condition, by repairing assemblies/sub-assemblies and components, by reforming, reworking the surface, replacing threads or the replacement of worn parts. They will also be required to select the appropriate equipment to use, based on the nature of the repair required, the operations that will need to be carried out and the accuracy required. In producing the components, they will be expected to use a range of hand tools, machine tools, portable power tools and shaping and fitting techniques, appropriate to the type of material and repair being performed. These activities will include such processes as sawing (hand or machine), drilling, reaming, grinding (hand or machine), filing, scrapping or lapping, threading internal, threading external, turning, milling and thermal processes. Materials to be used may include ferrous, non-ferrous, non-metallic and composites, which may be in sheet form, bar sections (such as square/rectangular, round, angle) and part-machined components. Their responsibilities will require them to comply with organisational policy and procedures for the repairing activities undertaken and to report any problems with these activities or with the tools, equipment or materials used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying repair procedures to marine mechanical components. They will understand the function and operating conditions of the components being repaired, in sufficient depth to determine a suitable repair sequence and to ensure that the repairs carried out are safe and practical in operation. They will also understand the organisational policy on repairing components and its application. They will understand the safety precautions required when carrying out the repair activities, especially those for isolating 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, both ashore and afloat. 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:	EUCL3D-29
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant specifications for the component to be repaired

1.4 prepare the component for repair

1.5 carry out the repairs within agreed timescale using approved materials and components and methods and procedures

1.6 ensure that the repaired component meets the specified operating conditions

1.7 produce accurate and complete records of all repair work carried out

Learning outcome

The learner will:

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

2.1 plan the repair activities to cause minimal disruption to normal working

2.2 adhere to risk assessment, COSHH and other relevant safety standards

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

2.4 provide safe access and working arrangements for the maintenance area

2.5 record the repair using appropriate methods or documentation

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

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Learning outcome

The learner will:

3 Use appropriate techniques to carry out **six** of the following types of repair:

3.1 reforming the component surface by adding metal or metal sub strates

3.2 replacement of internal thread (thread inserts)

3.3 recondition a unit by replacement of worn components

3.4 reworking fit (shimming)

3.5 sleeving worn components

3.6 replacement/ reworking of worn keys/ keyways

3.7 replacing flexible mounts

3.8 making stepped dowels or studs

3.9 replacing damaged or missing gear teeth

3.10 cutting new keyways

3.11 plugging holes

3.12 making a temporary fix

3.13 stopping cracks running and filling them

3.14 bushing worn holes

3.15 reworking the surface finish (using techniques such as filing, scraping, lapping, grinding)

3.16 other specific repair procedure

Learning outcome

The learner will:

4 Use a range of methods and techniques to repair components, to include **six** of the following:

4.1 sawing (hand, machine)

4.2 filing

4.3 turning

4.4 drilling

4.5 scraping or lapping

4.6 milling

4.7 reaming

4.8 threading external

4.9 thermal processes

4.10 grinding (hand or machine)

4.11 threading internal

4.12 cleaning processes such as chemical and shot blasting

Learning outcome

The learner will:

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

5.1 low carbon steel

5.2 aluminium

5.3 plastic/ synthetic

5.4 high carbon steel

5.5 brass/ bronze

5.6 composite

5.7 cast iron

5.8 stainless steel

Learning outcome

The learner will:

6 Carry out repairs to marine mechanical equipment which complies with **one** of the following standards:

6.1 BS or ISO standards and procedures

6.2 company standards and procedures

6.3 specific system requirements

6.4 customer (contractual) standards and requirements

6.5 recognised compliance agency/ body's standards

6.6 other accepted international standards

Learning outcome

7 Knowledge and understanding – The learner must know and understand:

7.1 the health and safety requirements of the area in which the repairing activity is to take place and the responsibility they place on them

7.2 the isolation procedures or permit-to-work procedure that applies

7.3 the specific health and safety precautions to be applied during the repairing procedure and their effects on others

7.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

7.5 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the repair process

7.6 the hazards associated with the operations being carried out (sawing: hand or machine; drilling; reaming; grinding; hand or machine; filing; scraping or lapping; threading internal; threading external; turning; milling; and thermal processes) and how they can be minimised

7.7 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

7.8 where to obtain and how to interpret drawings, specifications, manufacturers' manuals, maintenance schedules and other documents identifying parameters of the equipment being repaired

7.9 how to carry out currency/ issue checks of the specifications they are working with

7.10 the methods and techniques to be followed for repairing marine mechanical equipment, in compliance with company procedures

7.11 the types of repair that can be made to components in order to prolong their useful life (such as bushing worn holes, fitting thread inserts, building up surfaces by thermal process or metal spraying, making stepped keys, cutting new keyways, making stepped/ oversize dowels or studs)

7.12 the factors to be taken into account when deciding if a repair is practical and possible (such as replacement component availability, cost of replacing, safety of repair, age and condition of equipment)

7.13 the need to liaise with other departments in order to have specialised operations carried out on the components (such as thermal processes, metal spraying)

7.14 how to use filing, scraping and lapping to achieve the required surface finish (such as various types of files/ scrapers, ensuring that file/ scraper handles are in good condition, selection and use of lapping mediums)

7.15 how to cut internal and external threads (such as by using hand dies and taps, machine cutting)

7.16 how to produce a sliding or mating fit and the techniques to be adopted

7.17 how to select saw blades for different materials and different operations

7.18 the types and application of portable power tools that can be used for the repair operations

7.19 how to check that portable power tools and extension cables are in a safe, tested and usable condition

7.20 how to use hand power tools and specialist equipment (such as electrical, pneumatic, lifting equipment) correctly

7.21 the operating requirements of the machine tools and accessories being used (such as guards, workholding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations, abrasive wheels regulations)

7.22 the various shapes and types of tooling that can be used (such as solid, high-speed tooling, brazed-tip tooling, interchangeable-tipped tooling)

7.23 how to handle and store tools and equipment, safely and correctly

7.24 factors which affect the selection of cutting feeds and speeds and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)

7.25 the application of cutting fluids with regard to a range of different materials and processes

7.26 the clamping of a workpiece in a chuck/ workholding device (including safely secured for the process, not causing distortion in the finished components)

7.27 how to recognise machining faults and how to identify when tools need re-sharpening/ dressing

7.28 the operating requirements of the thermal processes and accessories being used (including any statutory regulations and quality standards to be observed, guards, workholding devices, fume extraction, gas storage)

7.29 the methods that can be used to position the workpiece in relation to the cutting tools

7.30 the effects of backlash in the machine slides and how this can be overcome

7.31 the company recording procedures to be used following a repair and how to apply them

7.32 the procedure for the safe disposal of waste materials

7.33 the sorts of problem associated with repairs and how to resolve them

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

Unit 329 Restoring marine mechanical components to usable condition by repair

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 330 Dismantling and removing marine mechanical equipment

Unit level:	Level 3
GLH:	700
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 dismantle and remove marine mechanical equipment, in preparation for complete overhaul or refit activities, which may be carried out in a shipyard or may be returned to the manufacturer for overhaul. This will involve dismantling and removing equipment at component or unit level on a variety of different types of marine mechanical assemblies and sub-assemblies, such as propulsion and transmission, fluid power, steering and control, lifting equipment, refrigeration and air conditioning, fire main equipment and pantry and galley equipment. Their responsibilities will require them to comply with organisational policy and procedures for the dismantling and removal of the marine mechanical equipment and to report any problems with the dismantling activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the activities are removed from the work area on completion of the activities and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their 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 applying dismantling and removal techniques on marine mechanical equipment. They will understand the dismantling and removal methods and procedures used and their application. They will know about the mechanical equipment being removed, in adequate depth to provide a sound basis for carrying out the dismantling and removal activities to the required specification.

	They will understand the safety precautions required when carrying out the dismantling and removal activities, especially those for isolating the 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, both ashore and afloat. 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:	EUCL3D-30
Endorsed by	Semta

Learning outcome

Performance Requirements - The learner must be able to:

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

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

1.3 establish and where appropriate mark component for re-assembly

1.4 ensure that any stored energy or substances are released safely and correctly

1.5 make all isolations and disconnections to the equipment in line with approved procedures

1.6 carry out the dismantling to the agreed level using correct tools and techniques

1.7 store components for re-use in approved locations

1.8 dispose of unwanted components and substances in accordance with approved procedures and regulations

1.9 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome

The learner will:

2 Carry out **all** of the following during the dismantling and removal of the marine mechanical equipment:

2.1 plan the dismantling and removal activities to cause minimum disruption to normal working

2.2 use the correct issue of structure/ vessel/ craft system drawings and dismantling documentation

2.3 adhere to risk assessment, COSHH and other relevant safety standards

2.4 obtain clearance to work on the system and observe the appropriate power isolation and safety procedures

2.5 provide safe access and working arrangements for the maintenance area

2.6 carry out the dismantling and removal activities using appropriate techniques and procedures

2.7 leave the work area in the prescribed category of cleanliness on completion of the activities

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Learning outcome

The learner will:

3 Carry out dismantling and removal activities on **three** of the following types of marine mechanical equipment:

3.1 propulsion

3.2 auxiliary power units

3.3 weapons launchers

3.4 transmission

3.5 fire main equipment

3.6 liquid oxygen equipment

3.7 fuel

3.8 ballast arrangements

3.9 steam plant and equipment

3.10 hydraulic

3.11 compressors (high or low pressure)

3.12 pantry and galley equipment

3.13 pneumatic

3.14 weapons hoists

3.15 refrigeration and air conditioning

3.16 stern seals, stabilisers and shock mounts

3.17 control valves (such as throttle, isolating, reducing and ported)

3.18 pumps (such as centrifugal and positive displacement)

3.19 steering and rudder arrangements

3.20 processing plant (such as sewage treatment and reverse osmosis)

3.21 propeller shafts and drives (such as Z, V and inline, plummer blocks)

3.22 lifting and handling equipment (such as replenishment at sea rigs, aircraft lifts, davit, windlasses and capstans)

3.23 other specific marine mechanical equipment

Learning outcome

The learner will:

4 Carry out **nine** of the following dismantling and removal activities:

4.1 isolating and locking-off equipment
4.2 dismantling equipment to unit/ sub-assembly level
4.3 bringing the system to atmospheric pressure
4.4 making safe all disconnected service supplies
4.5 draining off fluids
4.6 supporting the equipment to be removed
4.7 disconnecting wires and cables
4.8 removing mechanical fastening devices
4.9 attaching suitable cable identification markers
4.10 proof marking/ labelling of components for re-assembly
4.11 securing or safely storing all peripheral units which are not part of the overhaul process
4.12 protecting and preparing removed components for transportation for overhaul
4.13 fitting blanks to open systems to prevent entry of contaminating debris

Learning outcome

The learner will:

5 Dismantle and remove marine mechanical equipment which complies with **one** of the following standards:

5.1 customer (contractual) standards and requirements
5.2 company standards and procedures
5.3 specific equipment requirements/ manufacturer's data
5.4 recognised compliance agency/ body's standards

Learning outcome

The learner will:

6 Complete the relevant documentation, to include **one** of the following and pass it to the appropriate people:

6.1 job cards
6.2 system log
6.3 maintenance logs or reports
6.4 work authorisation documents
6.5 other specific reporting method (such as accident/ incident/ near missing reporting)

Learning outcome

7 Knowledge and understanding – The learner must know and understand:

7.1 the specific safety practices and procedures that they need to observe when dismantling and removing marine mechanical equipment (including any specific legislation, regulations/ codes of practice for the activities, equipment or materials)

7.2 the health and safety requirements of the area in which the marine mechanical dismantling activity is to take place and the responsibility these requirements place on them

7.3 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

7.4 the isolation and lock-off procedure or permit-to-work procedure that applies to the dismantling and removal activities (such as electrical isolation, depressurisation of system, draining fluids, placing maintenance warning notices, blanking off open systems to prevent the ingress of contaminants such as lagging and other compartment debris and proving isolations have been achieved and secured)

7.5 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the mechanical dismantling activities

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 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/ maintenance reports and other documents needed in the dismantling process

7.8 how to carry out currency/ issue checks of the specifications they are working with

7.9 the extent to which the equipment is to be dismantled for transportation

7.10 the techniques used to dismantle the mechanical equipment (such as making electrical disconnections, proof marking components to aid reassembly, removing assemblies requiring pressure/ force, removing mechanical locking and securing mechanisms/ devices)

7.11 methods of removing assemblies and sub-assemblies without causing damage to surrounding structures

7.12 methods of supporting and lifting the equipment being removed

7.13 the need to ensure that lifting and handling equipment is within its current test dates

7.14 the tools and equipment used in the dismantling activities and how to check that they are in a safe and usable condition

7.15 the storage requirements of removed units and assemblies which are not part of the overhaul process

7.16 the procedure for the safe disposal of waste materials and environmental regulations

7.17 the methods used to protect and prepare the removed equipment during transportation to the place of overhaul

7.18 the generation of maintenance documentation and/ or reports following the dismantling activity

7.19 the problems that can occur during the dismantling and removal activity and how they can be overcome

7.20 the extent of their own authority and whom they should report to if they have a problem that they cannot resolve

Unit 330 Dismantling and removing marine mechanical equipment

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 331 Reassembling and refitting marine mechanical equipment

Unit level:	Level 3
GLH:	700
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 carry out and complete reassembly and refitting activities on marine mechanical equipment, in accordance with approved procedures. This will involve reassembling and refitting equipment at component or unit level on a variety of different types of marine mechanical assemblies and sub-assemblies, such as propulsion and transmission, fluid power, steering and control, lifting equipment, refrigeration and air conditioning, fire main equipment and pantry and galley equipment. Their responsibilities will require them to comply with organisational policy and procedures for the reassembly and refitting tasks undertaken and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the reassembly and refitting activities are removed from the work area on completion of the activities and that all necessary job/ task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying reassembly and refitting procedures on marine mechanical equipment. They will understand the dismantling and reassembly methods and procedures used and their application. They will know how the equipment functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the reassembly and refitting activities, correcting faults and ensuring that the equipment functions to the required specification. In addition, they will have

	sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly and refitting activity. They will understand the safety precautions required when carrying out the reassembly and refitting activities associated with marine mechanical equipment, especially those for lifting and handling the 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, both ashore and/or afloat. 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:	EUCL3D-31
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow all relevant drawings and specifications for the activity being carried out

1.4 use the correct tools and equipment for the reassembling and refitting operations and check that they are in a safe and usable condition

1.5 reassemble, refit, position and secure the equipment and components in accordance with the specification

1.6 ensure that all necessary connections to the equipment are complete

1.7 deal promptly and effectively with problems within your control and report those that cannot be solved

1.8 check that the assembly/ refitting activity is complete and that all components are free from damage

1.9 complete relevant work records accurately and pass them on to the appropriate people

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

Learning outcome

The learner will:

2 Carry out **all** of the following during the reassembling and refitting of the marine mechanical equipment:

2.1 plan the reassembling and refitting activities to cause minimum disruption to normal working

2.2 use the correct issue of structure/ vessel/ craft system drawings and documentation

2.3 adhere to risk assessment, COSHH and other relevant safety standards

2.4 obtain clearance to work on the system and observe the appropriate power isolation and safety procedures

2.5 provide safe access and working arrangements for the maintenance area

2.6 carry out the reassembling and refitting activities using appropriate techniques and procedures

2.7 leave the work area in the prescribed category of cleanliness on completion of the activities

Learning outcome

The learner will:

3 Carry out assembling and refitting activities on **four** of the following types of marine mechanical equipment:

3.1 propulsion

3.2 auxiliary power units

3.3 weapons launchers

3.4 transmission

3.5 fire main equipment

3.6 liquid oxygen equipment

3.7 fuel

3.8 ballast arrangements

3.9 steam plant and equipment

3.10 hydraulic

3.11 compressors (high or low pressure)

3.12 pantry and galley equipment

3.13 pneumatic

3.14 weapons hoists

3.15 refrigeration and air conditioning

3.16 stern seals, stabilisers and shock mounts

3.17 control valves (such as throttle, isolating, reducing and ported)

3.18 pumps (such as centrifugal and positive displacement)

3.19 steering and rudder arrangements

3.20 processing plant (such as sewage treatment and reverse osmosis)

3.21 propeller shafts and drives (such as Z, V and inline, plummer blocks)

3.22 lifting and handling equipment (such as replenishment at sea rigs, aircraft lifts, davit, windlasses and capstans)

3.23 other specific marine mechanical equipment

Learning outcome

The learner will:

4 Carry out **twelve** of the following reassembly and refitting methods and techniques:

4.1 marking/ setting out of locating and securing positions

4.2 preparing holes (such as drilling, cleaning out threads)

4.3 positioning equipment/ components

4.4 levelling of equipment

4.5 aligning of equipment

4.6 assembly/ connection of components or sub-assemblies

4.7 setting travel

4.8 setting timings

4.9 setting and adjusting working clearances

4.10 torque setting of mechanical fasteners

4.11 tensioning cables

4.12 making pipe connections

4.13 lubricating

4.14 replace fluids

4.15 lifting and handling

4.16 connecting wires and cables

4.17 securing by using mechanical fixings

4.18 securing by using adhesives

4.19 sealing

4.20 applying fastener locking devices

4.21 earth bonding

4.22 ensuring the equipment cleanliness (such as covering exposed pie ends or components)

Learning outcome

The learner will:

5 Use **six** of the following types of fasteners and securing devices:

5.1 swing bolts

5.2 screws including set screws

5.3 dowels

5.4 quick release fasteners

5.5 studs with nuts
5.6 wing nuts
5.7 bolts including u bolts
5.8 taper lock coupling
5.9 rivets
5.10 locking devices (such as split, parallel, clevis or taper pins)
5.11 keys/ keyways (such as slotted, semi-circular, woodruff, taper)

Learning outcome

The learner will:

6 Reassemble and refit marine mechanical equipment which complies with **one** of the following:

6.1 BS or ISO standards and procedures
6.2 customer (contractual) standards and requirements
6.3 company standards and procedures
6.4 specific equipment requirements/ manufacturer's data
6.5 recognised compliance agency/ body's standards
6.6 other accepted international standards

Learning outcome

The learner will:

7 Complete relevant documentation to include **one** of the following and pass onto the appropriate people:

7.1 job cards
7.2 system log
7.3 maintenance logs or reports
7.4 installation records
7.5 work acceptance documentation
7.6 other specific reporting method

Learning outcome

8 Knowledge and understanding – The learner must know and understand:

8.1 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility they place on them
8.2 the specific health and safety precautions needed to be applied during the reassembly and refitting procedure and their effects on others
8.3 hazards associated with carrying out reassembly and refitting activities on marine mechanical equipment (such as using lifting and handling equipment, handling oils, releasing stored

pressure/ fluids, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures)

8.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

8.5 the procedures to be carried out before starting work on the equipment (such as obtaining permits to work, obtaining and complying with risk assessments and other health and safety requirements)

8.6 the hazards associated with reassembling and refitting marine mechanical equipment and with the tools and equipment used and how they can be minimised

8.7 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the mechanical reassembling activities

8.8 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

8.9 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/ maintenance reports and other documents needed in the reassembly process

8.10 how to carry out currency/ issue checks of the specifications you are working with

8.11 the mechanical equipment to be reassembled/ refitted and its function within the vessel

8.12 the techniques used to reassemble the mechanical equipment (such as making electrical connections, aligning components, refitting assemblies requiring pressure/ force, refitting mechanical locking and securing mechanisms/ devices)

8.13 methods of refitting assemblies and sub-assemblies without causing damage to surrounding structures

8.14 how to carry out currency/ issue checks of the specifications you are working with

8.15 why securing devices need to be locked and the different methods that are used

8.16 the torque loading requirements on the fasteners and what to do if these loadings are exceeded or not achieved

8.17 the quality control procedures to be followed during the reassembling and refitting operations

8.18 procedures for ensuring that you have the correct tools, equipment, components and fasteners for the activities

8.19 the techniques used to position, align, adjust, and secure the equipment to the vessel without damage

8.20 the procedure for the safe disposal of waste materials

8.21 how to conduct any necessary checks to ensure the equipment's integrity, functionality, accuracy and quality of the installation

8.22 how to recognise installation defects (such as poor seals, misalignment, ineffective fasteners or contamination)

8.23 the importance of ensuring that the refitted equipment is free from foreign object debris and that any exposed components or pipe ends are correctly covered/ protected

8.24 why tool/ equipment control is critical

8.25 the generation of documentation and/ or reports following the reassembling and refitting activity

8.26 the problems that can occur during the reassembling and refitting activity and how they can be overcome

8.27 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 331 Reassembling and refitting marine mechanical equipment

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 332 Overhauling marine propulsion systems

Unit level:	Level 3
GLH:	1135
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 carry out a complete overhaul of marine propulsion systems, in accordance with approved procedures. The equipment to be overhauled will have been removed from the vessel or craft and the overhauling activities may take place in a shipyard or manufacturer's workshops. The marine propulsion equipment covered by this standard includes alternating and direct current motors, steam turbines, gas turbines, two-stroke and four-stroke internal combustion engines. The overhauling activities will involve stripping the equipment down to component level, cleaning and inspecting the components for wear, replacing all defective and `lifed' components and rebuilding the equipment in line with the overhauling specification. The marine propulsion units to be overhauled will include turbo blowers, air intakes, combustion system, engine control units/nozzle boxes, fuel systems, fire detection systems, exhaust units and other associated mechanical equipment. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened and that the correct sealants are used. Their responsibilities will require them to comply with organisational policy and procedures for the marine equipment overhauling activities undertaken and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area and equipment on completion of the activities and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will provide a good understanding of their work and provide an informed approach to applying overhauling procedures to marine propulsion equipment. They will understand the dismantling and reassembly methods and procedures used and their application. They will know how the equipment functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, they will have sufficient in-depth knowledge of these components, to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly. They will understand the safety precautions required when carrying out the overhauling activities associated with marine propulsion equipment, especially those for lifting and handling the 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, both ashore and afloat. 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:	EUCL3D-32
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed time scale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

2 Carry out **all** of the following during the overhaul of the marine propulsion equipment:

2.1 use the correct issue of company and/ or manufacturers' drawings and overhauling documentation
2.2 adhere to risk assessment, COSHH and other relevant safety standards
2.3 ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids, steam)
2.4 provide safe access and working arrangements for the overhauling area
2.5 use lifting and handling equipment, in accordance with health and safety guidelines and procedures
2.6 carry out the overhauling activities using appropriate techniques and procedures
2.7 comply with organisational requirements with regard to renewal or replacement of existing components
2.8 ensure that the overhauled equipment meets the required specification
2.9 ensure that there are no foreign objects left in the completed equipment

Learning outcome

The learner will:

3 Carry out overhauling activities on **one** of the following types of marine propulsion equipment:

3.1 direct current electric motor
3.2 steam turbine
3.3 alternating current electric motor
3.4 gas turbine
3.5 two-stroke turbine/ mechanically/ naturally aspirated diesel engine
3.6 four-stroke turbine/ mechanically/ naturally aspirated diesel engine

Learning outcome

The learner will:

4 Carry out overhauling activities on **four** of the following marine propulsion system components:

4.1 air Intake
4.2 engine control unit
4.3 air start system

4.4 air charger
4.5 cylinder head
4.6 fuel system
4.7 shafts
4.8 combustion system
4.9 turbine
4.10 fire extinguishing system
4.11 bearings
4.12 exhaust system
4.13 electrical start system

Learning outcome

The learner will:

5 Carry out **eighteen** of the following activities on the equipment being overhauled:

5.1 dismantling equipment to unit/sub-assembly level
5.2 draining fluids
5.3 flushing out and cleaning
5.4 removing and refitting cylinder liners
5.5 dismantling units to component level
5.6 bedding in of white metal bearings
5.7 proof-marking/labelling of components
5.8 lapping in valves
5.9 checking components for wear and serviceability
5.10 pre-loading bearings
5.11 replacing all `lifed' items (such as seals, bearings, gaskets)
5.12 setting backlash in gears
5.13 replacing all damaged or defective components
5.14 electrical bonding of components
5.15 setting timings and adjusting replaced components
5.16 applying gaskets and sealant/adhesives
5.17 re-assembling components to sub-assembly level
5.18 tightening fastenings to the required torque
5.19 balancing of rotating components (such as armatures and turbines)
5.20 re-assembling sub-assemblies to unit level
5.21 carrying out crankshaft deflection
5.22 re fill system fluids to the correct level
5.23 securing components using mechanical fasteners and threaded devices
5.24 applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)

5.25 carrying out any required tests on the completed equipment

Learning outcome

The learner will:

6 Replace a range of propulsion system components, to include **sixteen** of the following:

6.1 shafts
6.2 shell bearings
6.3 slides
6.4 couplings
6.5 bearing housings
6.6 rollers
6.7 gears
6.8 fitting keys
6.9 static and dynamic seals
6.10 clutches
6.11 springs
6.12 housings
6.13 brakes
6.14 diaphragms
6.15 actuating mechanisms
6.16 valves and seats
6.17 injectors
6.18 pumps
6.19 burners
6.20 chambers (such as combustion)
6.21 cams and followers
6.22 structural components
6.23 pistons
6.24 chains and sprockets
6.25 wire thread inserts
6.26 splines
6.27 pulleys and belts
6.28 shims and packing
6.29 roller or ball bearings
6.30 levers and links
6.31 pipes and unions
6.32 locking and retaining devices (such as circlips, pins)
6.33 other specific components

Learning outcome

The learner will:

7 Overhaul marine propulsion equipment, in compliance with **one** of the following standards:

7.1 BS or ISO standards and procedures
7.2 customer (contractual) standards and requirements
7.3 company standards and procedures
7.4 specific system requirements
7.5 recognised compliance agency/ body's standards
7.6 other accepted international standards

Learning outcome

The learner will:

8 Complete the relevant documentation, to include **one** of the following and pass it to the appropriate people:

8.1 job cards
8.2 permit to work/ formal risk assessment
8.3 overhaul log or report
8.4 chart of dimensional inspection
8.5 other specific reporting method

Learning outcome

9 Knowledge and understanding – The learner must know and understand:

9.1 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility they place on them
9.2 the specific health and safety precautions to be applied during the overhaul procedure and their effects on others
9.3 hazards associated with carrying out overhaul activities on marine propulsion equipment (such as using lifting and handling equipment, handling oils, greases, release of stored pressure/ force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures)
9.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the overhaul
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 overhauling process
9.7 how to carry out currency/ issue checks of the specifications they are working with

9.8 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul

9.9 company policy on the repair/ replacement of components during the overhauling process

9.10 the sequence to be adopted for the dismantling/ reassembling of various types of assemblies

9.11 the methods and techniques used to dismantle/ reassemble marine propulsion systems (such as release of pressures/ force, proof-marking, extraction, pressing, alignment)

9.12 methods of checking that components are fit for purpose, how to identify defects and wear characteristics and the need to replace `lifed' items (such as seals, belts and gaskets)

9.13 how to make adjustments to components/ assemblies to ensure that they function correctly (such as bedding in of white metal bearings, laser alignment of propeller shafts, balancing of rotating components such as armatures and turbines, setting working clearance, setting travel, setting backlash in gears, pre-loading bearings)

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

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

9.16 methods and techniques of fitting keys and splines

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

9.18 how to set up timing marks and position and set the tension of belts and chains, correctly

9.19 the identification and application of different types of locking devices

9.20 the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)

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

9.22 the generation of technical documentation and/ or reports following completion of the overhauling activity

9.23 the equipment operating and control procedures to be applied during the overhauling activity

9.24 how to use lifting and handling equipment in the overhauling activity

9.25 the problems associated with the overhauling of marine propulsion equipment and how they can be overcome

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

9.27 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 332 Overhauling marine propulsion systems

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 333 Overhauling marine hydraulic systems and equipment

Unit level:	Level 3
GLH:	1135
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 carry out a complete overhaul of marine hydraulic systems and equipment, in accordance with approved procedures. The equipment to be overhauled will have been removed from the vessel or craft and the overhauling activities may take place in a shipyard or manufacturer's workshops. The marine hydraulic systems and equipment covered by this standard include items such as davits, weapon hoists, stores lifts, hatches, planes, cranes, aerials, periscopes, stabilisers, vehicle ramps, ramp locking systems and steering gear. The overhauling activities will involve stripping the equipment down to component level, cleaning and inspecting the components for wear, replacing all defective and `lifed' components and rebuilding the equipment in line with the overhauling specification. The marine hydraulic systems and equipment to be overhauled will include pipework, hoses, control valves, cables, pulleys, actuating mechanisms, stops, lubrication systems, indication, mechanical and electrical controls, safety devices and other associated mechanical equipment. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened and that the correct sealants are used. Their responsibilities will require them to comply with organisational policy and procedures for the marine hydraulic systems and equipment overhauling activities undertaken and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on

	completion of the activities and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying overhauling procedures to marine hydraulic systems and equipment. They will understand the dismantling and reassembly methods and procedures used and their application. They will know how the equipment functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities, correcting faults and ensuring that the repaired equipment functions to the required specification. In addition, they will have sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly. They will understand the safety precautions required when carrying out the maintenance activities associated with marine hydraulic systems and equipment, especially those for lifting and handling the 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, both ashore and afloat. 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:	EUCL3D-33
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed time scale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

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Learning outcome

The learner will:

2 Carry out **all** of the following during the overhaul of the marine hydraulic systems and equipment:

2.1 use the correct issue of company and/ or manufacturers' drawings and overhaul documentation

2.2 adhere to risk assessment, COSHH and other relevant safety standards

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

2.4 provide safe access and working arrangements for the overhauling area

2.5 use lifting and handling equipment, in accordance with health and safety guidelines and procedures

2.6 carry out the overhauling activities using appropriate techniques and procedures

2.7 comply with organisational requirements with regard to renewal or replacement of existing components

2.8 ensure that the overhauled components meet the required specification

2.9 ensure that there are no foreign objects left in the completed equipment

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Learning outcome

The learner will:

3 Carry out overhauling activities on **one** of the following types of marine hydraulic systems and equipment:

3.1 electro-hydraulic (such as davit, crane, capstan, windlass, aerial, winch, weapon hoist, derrick, vehicle ramp)

3.2 manual-hydraulic (such as davit, hatch, vehicle ramp, steering mechanism)

3.3 mechanical-hydraulic (winch, hoist, gantry)

Learning outcome

The learner will:

4 Carry out overhauling activities on **four** of the following marine hydraulic system and equipment components:

4.1 davit
4.2 gangway
4.3 weapon hoist
4.4 derrick
4.5 platform
4.6 crane
4.7 planes
4.8 hatch hoist
4.9 vehicle ramp
4.10 periscope
4.11 capstan
4.12 aerial hoist
4.13 aircraft lift
4.14 gantry
4.15 windlass
4.16 winch
4.17 steering gear
4.18 weapons systems
4.19 compactors (such as waste management)
4.20 lifts (such as goods, dumb waiter)
4.21 other specific hydraulic system

Learning outcome

The learner will:

5 Carry out **eighteen** of the following activities on the hydraulic equipment being overhauled:

5.1 chocking/ supporting cylinders/ rams/ components
5.2 disconnecting and removing hoses and pipes
5.3 de-pressurising the system
5.4 draining system fluids
5.5 flushing out and cleaning the system
5.6 electrical bonding of components
5.7 dismantling equipment to unit/ sub-assembly level
5.8 visually checking components for serviceability
5.9 filing and re-pressurising the system
5.10 adding preservation fluids
5.11 dismantling units to component level
5.12 making 'off-load' checks before starting up
5.13 proof-marking/ labelling of components

5.14 replenishing oils and greases
5.15 checking components for serviceability
5.16 recording information on lifted components
5.17 applying gaskets and sealant/ adhesives
5.18 replacing all damaged or defective components
5.19 tightening fastenings to the required torque
5.20 setting timings and adjusting replaced components
5.21 lapping in valves
5.22 re-assembling sub-assemblies to unit level
5.23 re-assembling components to sub-assembly level
5.24 replacing all 'lifted' items (such as piston seals, dust caps, filters, gaskets)
5.25 securing components using mechanical fasteners and threaded devices
5.26 applying bolt locking methods (such as split pins, wire locking)
5.27 functionally testing the completed system

Learning outcome

The learner will:

6 Replace a range of marine hydraulic systems and equipment components, to include **sixteen** of the following:

6.1 shafts
6.2 pumps
6.3 cams and followers
6.4 static and dynamic seals
6.5 couplings
6.6 spools
6.7 chains and sprockets
6.8 housings
6.9 gears
6.10 roller or ball bearings
6.11 pulleys and belts
6.12 actuating mechanisms
6.13 clutches
6.14 pipes/ hoses and unions
6.15 levers and links
6.16 structural components
6.17 brakes
6.18 bearing housings
6.19 shims and packing
6.20 wire thread inserts

6.21 valves and seats
6.22 keys
6.23 slides
6.24 sensors
6.25 pistons
6.26 springs
6.27 rollers
6.28 regulators
6.29 splines
6.30 diaphragms
6.31 receivers
6.32 switches and trips
6.33 cylinders
6.34 rams
6.35 bladders
6.36 backing rings
6.37 banjo bolts
6.38 spring mechanisms
6.39 gaskets
6.40 lubricators/ filters
6.41 reservoirs
6.42 accumulators
6.43 locking and retaining devices (such as circlips, pins)
6.44 other specific hydraulic components

Learning outcome

The learner will:

7 Overhaul marine hydraulic systems and equipment, in compliance with **one** of the following standards:

7.1 BS or ISO standards and procedures
7.2 customer (contractual) standards and requirements
7.3 company standards and procedures
7.4 specific system requirements
7.5 recognised compliance agency/ body's standards
7.6 other accepted international standards

Learning outcome

The learner will:

8 Complete the relevant documentation, to include **one** of the following and pass it to the appropriate people:

8.1 job cards

8.2 permit to work/ formal risk assessment

8.3 maintenance log or report

8.4 chart of dimensional inspection

8.5 other specific reporting method

Learning outcome

9 Knowledge and understanding – The learner must know and understand:

9.1 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility they place on them

9.2 the specific health and safety precautions needed to be applied during the overhauling procedure and their effects on others

9.3 hazards associated with carrying out overhauling activities on marine hydraulic systems and equipment (such as using lifting and handling equipment, handling hydraulic oils, releasing stored pressure/ fluids, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures)

9.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the overhaul

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, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used in fluid power and other documents needed in the overhauling process

9.7 how to carry out currency/ issue checks of the specifications they are working with

9.8 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul

9.9 company policy on the repair/ replacement of components during the overhauling process

9.10 the sequence to be adopted for the dismantling/ reassembling of various types of assemblies

9.11 the methods and techniques used to dismantle/ reassemble marine hydraulic systems and equipment (such as release of pressures/ force, proof-marking, extraction, pressing, alignment)

9.12 methods of checking that components are fit for purpose, how to identify defects and wear characteristics and the need to replace 'lifted' items (such as filters, seals and gaskets)

9.13 how to make adjustments to components/ assemblies to ensure that they function correctly (such as setting working clearance, setting travel)

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

9.15 the selection of hydraulic fluids for the system

9.16 how to determine pressure settings and their effect on the system

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

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

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

9.20 the identification and application of different types of cylinders (such as single acting, double acting)

9.21 the identification and application of different types of pumps (such as positive and non-positive displacement)

9.22 the application and fitting of static and dynamic seals

9.23 recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the system

9.24 the identification and application of different types of locking devices

9.25 the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)

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

9.27 the generation of technical documentation and/ or reports following completion of the overhauling activity

9.28 the equipment operating and control procedures to be applied during the overhauling activity

9.29 how to use lifting and handling equipment in the overhaul activity

9.30 the problems associated with the overhauling of marine hydraulic systems and equipment and how they can be overcome

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

9.32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 333 Overhauling marine hydraulic systems and equipment

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 334 Overhauling marine systems plant and equipment

Unit level:	Level 3
GLH:	1700
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 carry out a complete overhaul of marine systems, plant and equipment, in accordance with approved procedures. The equipment to be overhauled will have been removed from the vessel or craft and the overhauling activities may take place in a shipyard or manufacturer's workshops. The marine systems, plant and equipment includes areas such as propulsion, power transmission, fuel, hydraulic, pneumatic, auxiliary power, mechanical control, steering gear, lifting equipment, weapons equipment, ancillary plant, steam, liquid ballast, fire, refrigeration, air conditioning, pantry and galley. The overhauling activities will involve stripping the equipment down to component level, cleaning and inspecting the components for wear, replacing all defective and `lifed' components and rebuilding the equipment in line with the overhauling specification. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened and where applicable the correct sealants are used. Their responsibilities will require them to comply with organisational policy and procedures for the overhauling activities undertaken and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying overhauling procedures to marine systems, plant and equipment. They will understand the dismantling and reassembly methods and procedures used and their application. They will know how the equipment functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities, correcting faults and ensuring that the equipment functions to the required specification. In addition, they will have sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the overhaul activity. They will understand the safety precautions required when carrying out the overhaul activities associated with marine systems, plant and equipment, especially those for lifting and handling the 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, both ashore and afloat. 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:	EUCL3D-34
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed time scale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

2 Carry out **all** of the following during the overhaul of marine systems, plant and equipment:

2.1 use the correct issue of company and/ or manufacturers' drawings and overhaul documentation
2.2 adhere to risk assessment, COSHH and other relevant safety standards
2.3 ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids, steam)
2.4 provide safe access and working arrangement for the overhauling area
2.5 use lifting and handling equipment, in accordance with health and safety guidelines and procedures
2.6 carry out the overhauling activities using appropriate techniques and procedures
2.7 comply with organisational requirements with regard to renewal or replacement of existing components
2.8 ensure that the overhauled components meet the required specification
2.9 ensure that there are no foreign objects left in the completed equipment

Learning outcome

The learner will:

3 Carry out overhauling activities on **one** of the following types of marine hydraulic systems and equipment:

3.1 propulsion systems
3.2 power transmission systems
3.3 fuel system and equipment
3.4 hydraulic systems and equipment
3.5 pneumatic systems and equipment
3.6 mechanical control systems and equipment
3.7 steering gear, control systems and equipment
3.8 auxiliary power units
3.9 lifting equipment
3.10 weapons systems and equipment
3.11 ancillary plant and equipment (such as laundry, garbage, osmosis, hospital)
3.12 steam plant and equipment
3.13 liquid ballast arrangements
3.14 fire main systems and equipment

3.15 refrigeration and air conditioning systems and equipment

3.16 pantry and gallery equipment

Learning outcome

The learner will:

4 Carry out **eighteen** of the following activities on marine, systems, plant and equipment:

4.1 de-pressurising the system/ equipment

4.2 draining system/ equipment/ component fluids

4.3 dismantling equipment to unit/ sub-assembly level

4.4 dismantling equipment to component level

4.5 flushing out and cleaning the system/ equipment/ components

4.6 proof-marking/ labelling of components

4.7 checking components for wear and/ or serviceability

4.8 replacing all 'lifed' items (such as seals, filters, gaskets)

4.9 recording information on lifed components

4.10 applying gaskets and sealants/ adhesives

4.11 replacing all damaged or defective components

4.12 setting, aligning and adjusting replaced components

4.13 bedding in any new components

4.14 balancing components

4.15 chocking/ supporting equipment/ components

4.16 disconnecting and removing hoses and pipes

4.17 blanking pipes/ hoses/ components to prevent contamination or to provide isolation

4.18 replenishing oils and greases

4.19 filing and re-pressurising the system

4.20 adding preservation fluids

4.21 electrical bonding of components

4.22 re-assembling sub-assemblies to unit level

4.23 re-assembling components to sub-assembly level

4.24 electrical bonding of equipment

4.25 securing components using mechanical fasteners and threaded devices

4.26 applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)

4.27 tightening fastenings to the required torque

4.28 making 'off load' checks before starting up

4.29 carry out any required tests or checks before powering up

4.30 functionally testing the completed system

Learning outcome

The learner will:

5 Remove and replace a range of marine systems plant and equipment components to include **twenty** of the following:

5.1 shafts
5.2 pumps
5.3 cams and followers
5.4 static/ dynamic seals
5.5 couplings
5.6 spools
5.7 chains and sprockets
5.8 housings
5.9 gears
5.10 bearings
5.11 pulleys, belts or cables
5.12 actuating mechanisms
5.13 clutches
5.14 pipes/ hoses and unions
5.15 levers and linkages
5.16 structural components
5.17 brakes
5.18 housings
5.19 bushes
5.20 wire thread inserts
5.21 valves and seats
5.22 keys
5.23 slides
5.24 sensors
5.25 pistons
5.26 springs
5.27 rollers
5.28 regulators
5.29 splines
5.30 diaphragms
5.31 receivers
5.32 switches and trips
5.33 cylinders
5.34 rams
5.35 bladders

5.36 backing rings
5.37 gaskets
5.38 lubricators/ filters
5.39 reservoirs
5.40 accumulators
5.41 locking and retaining devices (such as circlips, pins)
5.42 seats
5.43 gauges/ instrumentation
5.44 site glasses
5.45 connecting rods
5.46 rack/ pinion
5.47 lubricators
5.48 shackles
5.49 cranks
5.50 rods
5.51 struts
5.52 mounts
5.53 doors/ shutters
5.54 glands
5.55 bellows
5.56 venturis
5.57 manifolds
5.58 strainers
5.59 guards/ safety devices
5.60 flanges
5.61 impellers
5.62 chambers
5.63 burners
5.64 other specific components

Learning outcome

The learner will:

6 Overhaul marine systems, plant and equipment in compliance with **one** of the following:

6.1 BS or ISO standards and procedures
6.2 customer (contractual) standards and requirements
6.3 company standards and procedures
6.4 specific system requirements
6.5 recognised compliance agency/ body's standards
6.6 other accepted international standards

Learning outcome

The learner will:

7 Complete relevant documentation to include **one** of the following and pass onto the appropriate people:

7.1 job cards

7.2 permit to work/ formal risk assessment

7.3 maintenance/ overhaul log or report

7.4 chart of dimensional inspection

7.5 other specific reporting method

Learning outcome

8 Knowledge and understanding – The learner must know and understand:

8.1 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility they place on them

8.2 the specific health and safety precautions needed to be applied during the overhauling procedure and their effects on others

8.3 hazards associated with carrying out overhauling activities on marine systems, plant and equipment (such as using lifting and handling equipment, handling hydraulic oils, releasing stored pressure/ fluids, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures)

8.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the overhaul

8.5 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

8.6 how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used in documents needed in the overhauling process

8.7 how to carry out currency/ issue checks of the specifications you are working with

8.8 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul

8.9 company policy on the repair/ replacement of components during the overhauling process

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

8.11 the equipment operating and control procedures to be applied during the overhauling activity

8.12 how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used in documents needed in the overhauling process

8.13 the sequence to be adopted for the dismantling/ reassembling of various types of equipment, assemblies and components

8.14 the methods and techniques used to dismantle/ reassemble marine systems, plant and equipment components (such as release of pressures/ force, proof-marking, extraction, pressing, alignment)

8.15 methods of checking that components are fit for purpose, how to identify defects and wear characteristics and the need to replace 'lifed' items (such as filters, seals and gaskets)

8.16 the process used to identify any contaminants in the equipment/ system

8.17 the damage that can be caused if any contaminants or foreign objects are not removed

8.18 how to make adjustments to components/ assemblies to ensure that they function correctly (such as setting working clearance, bedding in new components, setting travel, alignment)

8.19 the importance of ensuring that fasteners are tightened to the required torque

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

8.21 the identification and application of different types of locking and securing devices

8.22 how to identify the different types and uses of different system components (such as shafts, bearings, gears, keys, belts, pumps)

8.23 the uses of measuring equipment (such as micrometers, veniers, expansion indicators and other measuring devices)

8.24 how to use lifting and handling equipment in the overhaul activity

8.25 the problems associated with the overhauling of marine systems plant and equipment and how they can be overcome

8.26 the generation of technical documentation and/ or reports following completion of the overhauling activity

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

8.28 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 334 Overhauling marine systems plant and equipment

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 335 Handing over and confirming completion of maintenance activities

Unit level:	Level 3
GLH:	200
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 hand over equipment that has been repaired, or on which some form of maintenance activity has taken place, and to confirm that the equipment is now ready to return to service. Following the maintenance activity, they will be required to, either set up the equipment and hand it over to a another person to complete the required start-up procedures, or complete the run-up operation themselves, ensuring that the equipment is ready for operation before handover. This will involve checking that all the required equipment and safety devices are operable and correctly set and/or calibrated, and that the equipment functions safely and correctly to the required specification. On handing over the equipment, they will be expected to highlight any new, current or changed operating features of the equipment, and to inform the appropriate person of any future maintenance requirements. They must also ensure that they receive confirmation that everyone involved in the handover accepts that the maintained equipment is in a satisfactory condition to return to service. Their responsibilities will require them to comply with organisational policy and procedures for the handover activities undertaken, and to report any problems with the handing over procedure that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance handover procedures. They will understand the

	equipment being handed over, and its application, and will know about the operating procedures and potential problems, in adequate depth to provide a sound basis for carrying out the activities safely and correctly. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the 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.
Relationship to NOS:	EUCL3D-35
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 confirm that everyone involved accepts the product or asset is in a satisfactory condition for handover to take place

1.4 clearly identify any unusual features of the condition of the product or asset

1.5 make the handover and obtain agreement between everyone involved on the precise moment of transfer of responsibility

1.6 deal promptly and effectively with problems within their control and report those that they cannot solve

1.7 make sure that clear, accurate and complete records of the handover are made

Learning outcome

The learner will:

2 Confirm that the equipment is ready for restart by carrying out **all** of the following checks, as applicable to the equipment being handed over:

2.1 the maintenance activity has been completed and the equipment functions to specification

2.2 all safety systems or features are functioning correctly

2.3 any waste materials, safety barriers and warning signs have been removed (where appropriate)

2.4 any auxiliary systems or equipment involved are connected and operable

2.5 any environmental controls are operable (where appropriate)

2.6 others involved in using the equipment are aware that the equipment is about to be operated/ used

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Learning outcome

The learner will:

3 Carry out correct handover procedures for **one** type of equipment/ service from the following:

3.1 manual

3.2 process/ control

3.3 medical equipment

3.4 semi-automatic

3.5 computer controlled

3.6 fully automatic

3.7 engineering services

3.8 other specific equipment

Learning outcome

The learner will:

4 Carry out **all** of the following during the handover procedures:

4.1 operate/ use the maintained equipment through a complete cycle in the presence of the appropriate person

4.2 confirm that the other person accepts that the equipment functions satisfactorily to specification

4.3 highlight to the appropriate person any modifications that would result in unusual features in the operating procedure

4.4 inform the appropriate person of any future maintenance activities that may be required

4.5 obtain agreement from the other person that they now accept responsibility for the equipment to be returned to service

4.6 complete any necessary handover documentation

4.7 confirm the other person knows how and who to contact for future maintenance requirements

Learning outcome

The learner will:

5 Carry out handover procedures to **one** of the following:

5.1 production/ process operator
5.2 maintenance supervisor
5.3 supervisor of production/ process
5.4 other specific person

Learning outcome

The learner will:

6 Carry out the handover following **two** of the following maintenance activities:

6.1 breakdown
6.2 scheduled servicing
6.3 preventative maintenance activity
6.4 modification to equipment

Learning outcome

The learner will:

7 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

7.1 job card
7.2 company-specific documentation
7.3 maintenance log or report
7.4 other handover paperwork

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the health and safety requirements of the area in which the handover is to take place, and the responsibility they place on them
8.2 the isolation and lock-off procedure or permit-to-work procedure that applies to the equipment being maintained
8.3 the specific health and safety precautions to be applied during the handover procedure, and their effects on others

8.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) whilst operating/ using the equipment during the handover operations and where it may be obtained

8.5 the checking process to be followed before handing over the equipment (such as are the safety and quality systems operable, does the equipment function to specification)

8.6 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

8.7 the appropriate handover procedure, depending on the maintenance activity carried out (repair, modification, preventative maintenance, scheduled servicing)

8.8 the procedure for involving the appropriate people when operating/ using the equipment

8.9 the need to highlight, where appropriate, any new, current or changed operating features of the maintained or installed equipment

8.10 the importance of informing the appropriate person of any future maintenance requirements

8.11 the need to confirm that the other person understands how to use/ operate the equipment before handing the equipment over to them

8.12 the need to ensure that the person they are handing over the equipment to accepts that it is in a satisfactory condition

8.13 the organisational documentation procedures to be used with regard to the handover

8.14 how to create and maintain effective working relationships with appropriate people (such as encouraging, helping, politeness, open discussions both ways)

8.15 the problems that can occur during handover, and how they can be overcome

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

Unit 335 Handing over and confirming completion of maintenance activities

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 336 Carrying out fault diagnosis on mechanical equipment

Unit level:	Level 3
GLH:	500
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 carry out efficient and effective fault diagnosis on mechanical equipment, in accordance with approved procedures. They will be required to diagnose faults on a range of mechanical equipment, both at assembly and component level. This will include equipment such as machine tools, gearboxes, processing plant, engines, pumps, process control valves, compressors, transfer equipment, lifting and handling equipment, mechanical structures and other company-specific equipment. They will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, they will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem. Their responsibilities will require them to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used, that they cannot personally resolve or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on mechanical equipment. They will understand the various fault diagnosis methods and techniques used, and their application. They will also know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

	They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. They will also understand their responsibilities for safety and the importance of 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.
Relationship to NOS:	EUCL3D-36
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements - The learner must be able to:

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

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

1.3 review and use all relevant information on the symptoms and problems associated with the products or assets

1.4 investigate and establish the most likely causes of the faults

1.5 select, use and apply diagnostic techniques, tools and aids to locate faults

1.6 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved

1.7 determine the implications of the fault for other work and for safety considerations

1.8 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault

1.9 record details on the extent and location of the faults in an appropriate format

Learning outcome

The learner will:

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

2.1 plan the fault diagnosis prior to beginning the work

2.2 obtain and use the correct issue of company and/ or manufacturer's drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the fault diagnostic activities using approved procedures

2.7 identify the fault and determine appropriate corrective action

2.8 dispose of waste items in a safe and environmentally acceptable manner, and leave work area in a safe condition

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Learning outcome

The learner will:

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

3.1 gearboxes

3.2 process control valves

3.3 machine tools

3.4 compressors

3.5 lifting and handling equipment

3.6 workholding devices

3.7 processing plant

3.8 transfer equipment

3.9 engines

3.10 mechanical structures

3.11 pumps

3.12 company-specific equipment

Learning outcome

The learner will:

4 Collect evidence regarding the fault from **four** of the following sources:

4.1 person or operator who reported the fault

4.2 sensory input (such as sight, sound, smell, touch)

4.3 monitoring equipment or gauges

4.4 plant/ machinery records

4.5 recording devices

4.6 condition of end product

Learning outcome

The learner will:

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

5.1 half-split technique
5.2 emergent sequence
5.3 unit substitution
5.4 input/ output
5.5 function/ performance testing
5.6 six point technique
5.7 injection and sampling
5.8 equipment self-diagnostics

Learning outcome

The learner will:

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

6.1 manufacturer's manual
6.2 physical layout diagrams
6.3 algorithms
6.4 flow charts
6.5 probability charts/ reports
6.6 fault analysis charts (such as fault trees)
6.7 equipment self-diagnostics
6.8 trouble shooting guides

Learning outcome

The learner will:

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

7.1 alignment checks
7.2 force/ pressure checks (such as spring pressure, hydraulic or pneumatic pressures)
7.3 leakage
7.4 vibration
7.5 thermal checks (such as bearings, friction surfaces)
7.6 movement checks (such as travel, clearance, levers and links)

Learning outcome

The learner will:

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

8.1 measuring instruments/ devices
8.2 thermal indicators
8.3 dial test indicators
8.4 audio test devices
8.5 torque measuring devices
8.6 self-diagnostic equipment
8.7 other specific test equipment

Learning outcome

The learner will:

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

9.1 intermittent problem
9.2 partial failure/ out-of-specification output
9.3 complete breakdowns

Learning outcome

The learner will:

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

10.1 step-by-step analytical report
10.2 preventative maintenance log/ report
10.3 corrective action report
10.4 company-specific reporting procedure

Learning outcome

11 Knowledge and understanding – The learner must know and understand:

11.1 the health and safety requirements of the area in which they are carrying out the fault diagnosis activities, and the responsibility these requirements place on them
11.2 the specific safety precautions to be taken when carrying out fault diagnosis of the specific piece of equipment
11.3 the isolation and lock-off procedure or permit-to-work procedure that applies
11.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the fault diagnosis activities

11.5 hazards associated with carrying out fault diagnosis on mechanical equipment (such as moving machinery, handling oils and greases, stored pressure/ force, misuse of tools, using practices or procedures that do not follow laid-down procedures), and how to minimise these and reduce any risks

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 where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals and other documents needed in the fault diagnosis process

11.8 the procedure to be adopted to establish the background of the fault

11.9 how to evaluate various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory information, machinery history records and condition of end product)

11.10 the various fault finding techniques that can be used, and how they are applied (such as half-split, input/ output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)

11.11 how to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, torque and run-out devices)

11.12 how to use various items of test equipment, and how to calibrate it and check that it is free from damage and defects

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

11.14 the procedure(s) to be followed for investigating the faults, and how to deal with intermittent faults

11.15 how to analyse and evaluate possible characteristics and causes of specific faults/ problems

11.16 how to relate previous reports/ records of similar fault conditions

11.17 how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system

11.18 how to prepare and produce a risk analysis report (where appropriate)

11.19 how to prepare a report and take follow-up action which satisfies the company policy on concluding fault diagnosis

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

Unit 336 Carrying out fault diagnosis on mechanical equipment

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 337 Maintaining mechanical equipment

Unit level:	Level 3
GLH:	700
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 carry out corrective maintenance activities on mechanical equipment, in accordance with approved procedures. They will be required to maintain a range of mechanical equipment, such as gear boxes, pumps, machine tools, conveyor systems, workholding arrangements, engines, processing plant and equipment, and other organisation-specific equipment. This will involve dismantling, removing and replacing faulty equipment at component or unit level on a variety of different types of mechanical assemblies and sub-assemblies. They will be expected to apply a range of dismantling and assembling methods and techniques, such as proof marking to aid reassembly, dismantling components requiring pressure or expansion/contraction techniques, setting, aligning and adjusting components, torque loading components and making `off-load' checks before starting up the maintained equipment. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities or the tools and equipment used, that they cannot personally resolve or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment, and materials used in the maintenance activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying mechanical maintenance procedures. They will understand the dismantling and reassembly methods and procedures, and their

	application. They will know how the equipment functions and the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring the repaired equipment functions to the required specification and remains compliant with all standards and regulations. In addition, they will have sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. They will also understand their responsibilities for safety and the importance of 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.
Relationship to NOS:	EUCL3D-37
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

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

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturer's drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

2.7 record the results of the maintenance activity and report any defects found

2.8 re-connect and return the system to service on completion of activities

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

Learning outcome

The learner will:

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

3.1 gearboxes

3.2 engines

3.3 transfer equipment

3.4 machine tools

3.5 pumps

3.6 mechanical structures

3.7 lifting and handling equipment

3.8 process control valves

3.9 workholding devices

3.10 processing plant

3.11 compressors

3.12 company-specific equipment

Learning outcome

The learner will:

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

4.1 dismantling equipment to unit/ sub-assembly level
4.2 setting, aligning and adjusting replaced components
4.3 proof marking/ labelling of components
4.4 dismantling units to component level
4.5 checking components for serviceability
4.6 replacing all lifed items (such as seals, bearings, gaskets)
4.7 replacing damaged/ defective components
4.8 tightening fastenings to the required torque
4.9 replenishing oils and greases
4.10 safety system checks
4.11 Making 'off-load' checks before starting up
4.12 functionally testing the completed system

Learning outcome

The learner will:

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

5.1 shafts
5.2 brakes
5.3 cams and followers
5.4 wire ropes/ cables
5.5 couplings
5.6 bearing and seals
5.7 chains & sprockets
5.8 housings
5.9 gears
5.10 seals
5.11 pulleys and belts
5.12 actual mechanisms
5.13 clutches
5.14 fitting keys
5.15 levers and links
5.16 structural components
5.17 valves and seats

5.18 springs
5.19 slides
5.20 locking and retaining devices (such as circlips, pins, lock nuts)
5.21 pistons
5.22 diaphragms
5.23 rollers
5.24 splined components
5.25 other specific components

Learning outcome

The learner will:

6 Maintain mechanical equipment which complies with **one** of the following:

6.1 organisational guidelines and codes of practice
6.2 equipment manufacturer's operation range
6.3 BS, ISO and/ or BSEN standards

Learning outcome

The learner will:

7 Complete the relevant documentation, to include **one** from the following, and pass it to the appropriate people:

7.1 job cards
7.2 permit to work/ formal risk assessment and/ or sign-on/ off procedures
7.3 maintenance log or report
7.4 company-specific documentation

Learning outcome

The learner will:

8 Knowledge and understanding – The learner must know and understand:

8.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them
8.2 the isolation and lock-off procedures or permit-to-work procedure that applies
8.3 the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
8.4 hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure /force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks

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8.5 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during maintenance process

8.6 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

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

8.8 the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities

8.9 company policy on repair/ replacement of components during the maintenance process

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

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

8.12 methods of checking components are fit for purpose, and how to identify defects and wear characteristics

8.13 the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/ components and how they interact

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

8.15 methods and techniques of fitting keys and splined components

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

8.17 how to correctly tension belts and chains

8.18 the identification and application of different types of locking devices

8.19 methods of checking that removed components are fit for purpose, and the need to replace `lifed' items (such as seals and gaskets)

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

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

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

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

8.24 the importance of maintenance documentation and/ or reports following the maintenance activity, and how to generate them

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

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

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

8.28 the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials

8.29 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 337 Maintaining mechanical equipment

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 338 Carrying out preventative planned maintenance on mechanical equipment

Unit level:	Level 3
GLH:	380
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 carry out preventative planned maintenance activities on mechanical equipment, in accordance with approved procedures. They will be required to carry out planned maintenance activities on a range of mechanical equipment, such as machine tools, processing plant and equipment, transfer devices, gear mechanisms, mechanical control devices, pumps, compressors, valves, lifting and handling equipment, and mechanical structures, in order to minimise down time and ensure that they perform at optimum level and function to specification. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance process, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment, and materials used in the maintenance activities are removed from the work area on completion of the activities, and that all necessary job/ task documentation is completed accurately and legibly. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures to mechanical equipment. They will understand the process of developing planned maintenance, and its application, and will know about the maintenance criteria in adequate depth to provide a sound basis for carrying out the activities safely and effectively, and for ensuring that the system is maintained to the required specification and remains compliant with all standards and regulations. It should also be recognised

	that planned maintenance is part of the 8 pillar approach to total productive maintenance (TPM). In addition, they will be expected to report where the outcome identifies further investigation or maintenance work. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. They will also understand their responsibilities for safety and the importance of 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.
Relationship to NOS:	EUCL3D-38
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

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

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

2.7 functionally test and adjust equipment to specification

2.8 re-connect and return the system to service on completion of the maintenance activities

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

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Learning outcome

The learner will:

3 Carry out planned maintenance activities on **three** of the following:

3.1 gearboxes

3.2 engines

3.3 workholding devices

3.4 machine tools

3.5 pumps

3.6 transfer equipment

3.7 lifting and handling equipment

3.8 process control valves

3.9 mechanical structures

3.10 processing plant

3.11 compressors

3.12 company-specific equipment

Learning outcome

The learner will:

4 Follow planned maintenance activities using **one** of the following types of maintenance schedules:

4.1 condition based maintenance

4.2 scheduled maintenance

4.3 preventative planned maintenance (PM)

4.4 total preventative maintenance (TPM)

Learning outcome

The learner will:

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

5.1 visual examination and testing of equipment against maintenance schedule
5.2 removing excessive dirt and grime
5.3 replacing `lifed' consumables (such as oils, grease, belts, gaskets and seals)
5.4 checking condition of drive belts, chains, bearings, seals, guards
5.5 checking operation of all gauges and sensors
5.6 checking alignment of running/ sliding components
5.7 monitoring component condition/ deterioration
5.8 making routine adjustments
5.9 making sensory checks (such as sight, sound, smell, touch)
5.10 carrying out leak checks on all connections
5.11 testing and reviewing system operation
5.12 carrying out equipment self- analysis checks
5.13 recording the results of the maintenance and reporting any defects found

Learning outcome

The learner will:

6 Ensure that the maintained equipment meets **all** of the following:

6.1 all maintenance activities have been completed to the required schedule
6.2 equipment operates within acceptable limits for successful continuous operation to meet output specification and demonstrate improvements to overall equipment effectiveness (OEE)
6.3 equipment remains compliant with appropriate regulations and safety requirements
6.4 any potential defects are identified and reported for future action

Learning outcome

The learner will:

7 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

7.1 job cards
7.2 maintenance log or report
7.3 permit to work/ formal risk assessment and/ or sign-on/ off procedures

7.4 company-specific documentation

Learning outcome

8 Knowledge and understanding – The learner must know and understand:

8.1 the health and safety requirements of the area in which the preventative maintenance activity is to take place, and the responsibility these requirements place on them

8.2 the isolation procedures or permit-to-work procedure that applies to the equipment being maintained

8.3 the specific health and safety precautions to be applied during the planned maintenance activity, and their effects on others

8.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the maintenance activities

8.5 hazards associated with carrying out planned maintenance activities on mechanical equipment (such as handling oils/ greases, stored pressure/ force, misuse of tools), and how to minimise these and reduce any risks

8.6 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

8.7 where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals, maintenance schedules and other relevant documents

8.8 the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance (TPM))

8.9 how to calculate overall equipment effectiveness (OEE) and use this information to show the benefits of planned maintenance on relevant items where it has been applied

8.10 the procedure for obtaining consumables to be used during the planned maintenance activity

8.11 how to make appropriate sensory checks (such as sight, sound, smell and touch)

8.12 the appropriate testing procedures to be adopted during the maintenance activity

8.13 how to make adjustments to components/ assemblies to ensure they function to specification

8.14 the functionality of various mechanical components and their interrelationship with other components and assemblies

8.15 how to compile planned maintenance records/ logs/ reports in accordance with company policy and procedures

8.16 the equipment operating and control procedures, and how to apply them in order to carry out planned maintenance

8.17 the problems that can occur whilst carrying out the planned maintenance activities, and how they can be avoided

8.18 the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials

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

Unit 338 Carrying out preventative planned maintenance on mechanical equipment

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 339 Carrying out condition monitoring of plant and equipment

Unit level:	Level 3
GLH:	390
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 carry out condition monitoring of plant and equipment, in accordance with approved procedures. They will be required to select the appropriate monitoring equipment to use, based on the type of plant or equipment being monitored and the conditions they wish to check. They will be expected to check that the equipment is in a suitable condition to use (such as undamaged, correctly calibrated, appropriate range) and set up the equipment ready for use. They will then use this equipment to carry out diagnostic condition monitoring (fault diagnosis or prognosis) on a range of equipment such as mechanical, electrical, process controller, fluid power or integrated systems. Their responsibilities will require them to comply with organisational policy and procedures for the condition monitoring activities undertaken, and to report any problems with the diagnostic equipment or monitoring activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying condition monitoring techniques. They will understand the monitoring methods and procedures used, and their application, and will know about the various monitoring units, and peripheral components, in adequate depth to provide a sound basis for carrying out the monitoring activities safely and correctly. They will understand the safety precautions required when carrying out the monitoring activities, especially those for isolating the equipment. They will also understand their responsibilities for

	safety, and the importance of 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.
Relationship to NOS:	EUCL3D-39
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 correctly set up and check-calibrate the equipment required for the monitoring being carried out

1.4 carry out the monitoring activities with the minimum disruption to normal activities

1.5 record and review the outcomes and take appropriate actions

Learning outcome

The learner will:

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

2.1 plan and communicate the condition monitoring activities so as to minimise disruption to normal working

2.2 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.3 select the appropriate condition monitoring equipment for the intended purpose

2.4 check the calibration of the monitoring equipment before use

2.5 set up the monitoring equipment in accordance with the appropriate procedures

2.6 check that the monitoring equipment is functioning correctly

2.7 carry out the monitoring activities, using appropriate techniques and procedures

2.8 apply safe working practices and procedures at all times

Learning outcome

The learner will:

3 Use appropriate monitoring techniques to set up equipment protection systems, or predictive maintenance system monitoring techniques, on **two** of the following types of equipment:

3.1 engines (such as piston or turbine)
3.2 rotating or reciprocating machinery (such as pumps, compressors)
3.3 mechanical equipment (such as cyclic and rotational devices, gearboxes, drives and linkages)
3.4 production machinery (such as machine tools, presses, transfer mechanisms)
3.5 process equipment (such as furnaces, chemical baths)
3.6 rotating electrical machinery (such as generators, motors)
3.7 stationary electrical equipment (such as transformers, switchgear)
3.8 stationary plant and equipment (such as air receivers, accumulators, tanks, piping)
3.9 emergency standby or alarm/ warning systems and equipment
3.10 fluid power equipment (such as pipework, cylinders and actuators and pumps)
3.11 process controller (such as program controller, input/ output interfacing, wiring/ cabling, monitoring sensors)
3.12 electrical components (such as power supplies, switchgear and distribution panels, control systems)
3.13 environmental systems (such as air conditioning, fume extraction)

Learning outcome

The learner will:

4 Use **two** of the following condition monitoring methods:

4.1 off-line/ portable monitoring
4.2 protection monitoring
4.3 sampled monitoring
4.4 human sensory monitoring (sight, sound, touch, smell)
4.5 continuous monitoring

Learning outcome

The learner will:

5 Use **two** of the following monitoring techniques:

5.1 vibration analysis
5.2 pressure analysis
5.3 temperature analysis
5.4 voltage/ current analysis

5.5 flow analysis
5.6 radio telemetry analysis
5.7 particle analysis
5.8 thickness analysis
5.9 crack detection analysis
5.10 oil analysis
5.11 leak detection analysis
5.12 corrosion detection
5.13 humidity analysis
5.14 environmental pollutant analysis

Learning outcome

The learner will:

6 Use monitoring systems in **one** of the following monitoring conditions:

6.1 equipment operating under the effects of weather, natural hazards, temperature or pressure
6.2 equipment operating in environments with potential flammable or explosive conditions (such as dust, vapours, liquids or gases)
6.3 equipment working in wet, dirty, dusty or corrosive conditions
6.4 equipment operating in a benign or clean room environment

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Learning outcome

The learner will:

7 Carry out **all** of the following on completion of the condition monitoring activities:

7.1 validation and evaluation of the condition monitoring systems and procedures used
7.2 suggested improvements to the process of condition monitoring
7.3 draw valid conclusions, based on the information gained from the condition monitoring activities
7.4 recommend actions to be taken in respect of the engineering plant and equipment being monitored

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Learning outcome

The learner will:

8 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

8.1 job cards
8.2 predictive maintenance log or report

8.3 permit to work/ formal risk assessment and/ or sign on/ off procedures

8.4 company-specific documentation

Learning outcome

9 Knowledge and understanding – The learner must know and understand:

9.1 the specific health and safety precautions to be applied during the monitoring procedure, and their effects on others

9.2 the health and safety requirements of the area in which the monitoring activity is to take place, and the responsibility these requirements place on them

9.3 hazards associated with carrying out monitoring activities on plant and equipment (such as electrical supplies, moving machinery, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down procedures), and how to minimise these and reduce any risks

9.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the monitoring activities

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, charts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used on monitoring instrument documents, and other documents needed in the monitoring/ maintenance process

9.7 the basic principles of how the plant or equipment to be monitored functions, its operating sequence, the working purpose of individual units/ components and how they interact

9.8 the basic principles of condition monitoring, and how it helps prevent equipment failure

9.9 the different types of monitoring component or sensor (such as temperature, force, pressure, vibration, rotational, voltage, current), their fittings, and their application

9.10 the various monitoring systems, and the methods that can be employed to make test measurements for the purposes of machinery protection or predictive maintenance

9.11 methods of attaching monitoring components to different parts of the plant, equipment or system

9.12 the need to check that monitoring instruments are fit for purpose, undamaged, and have a suitable monitoring range and value

9.13 the importance of monitoring equipment calibration and authorisation procedures

9.14 the need to set up and operate condition monitoring equipment correctly

9.15 care and control procedures for condition monitoring equipment

9.16 the problems that can occur during the monitoring activity, and how they can be overcome

9.17 recording the results from conditioning monitoring, and the documentation to be used

9.18 control procedures for reporting the results from condition monitoring

9.19 the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials

9.20 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 339 Carrying out condition monitoring of plant and equipment

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 340 Carrying out fault diagnosis on electronic equipment and circuits

Unit level:	Level 3
GLH:	500
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 carry out efficient and effective fault diagnosis on electronic equipment/circuits, in accordance with approved procedures. They will be required to diagnose faults on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, and hybrid circuits and systems, both at assembly and component level. They will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, they will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem. Their responsibilities will require them to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on electronic equipment and circuits. They will understand the various fault diagnosis methods and techniques used, and their application. They will also know how to interpret and apply information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

	They will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. They will also understand their responsibilities for safety and the importance of 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.
Relationship to NOS:	EUCL3D-40
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 review and use all relevant information on the symptoms and problems associated with the products or assets

1.4 investigate and establish the most likely causes of the faults

1.5 select, use and apply diagnostic techniques, tools and aids to locate faults

1.6 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved

1.7 determine the implications of the fault for other work and for safety considerations

1.8 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault

1.9 record details on the extent and location of the faults in an appropriate format

Learning outcome

The learner will:

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

2.1 plan the fault diagnosis using available information about the fault

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.4 ensure the safe isolation of equipment

2.5 provide and maintain safe access and working arrangements for the fault finding/ maintenance area

2.6 use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate

2.7 carry out the fault diagnostic activities using appropriate procedures

2.8 collect equipment fault diagnostic evidence from `live' and isolated circuits

2.9 disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis

2.10 identify the fault and determine the appropriate corrective action

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

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Learning outcome

The learner will:

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

3.1 power supply systems (such as switched mode, series regulation, shunt regulation)

3.2 motor control systems (such as closed-loop servo/ proportional, inverter control)

3.3 sensors and actuators (such as linear, rotational, temperature, level, photo-optic, pressure, flow)

3.4 digital circuits and systems (such as programmable controller, microprocessor, ROM/ RAM, logic gates)

3.5 analogue circuits and systems (such as frequency modulation/ demodulation, amplifiers, filters, oscillators)

3.6 hybrid circuits and systems (such as analogue to digital convertors (ADC), d-to-a convertors (DAC)

Learning outcome

The learner will:

4 Collect fault diagnosis evidence from **four** of the following sources:

4.1 the person or operator who reported the fault

4.2 equipment self-diagnosis

4.3 test instrument measurements (such as multimeter, oscilloscope, logic probe, signal tracer, signal generator)

4.4 recording devices

4.5 sensory input (sight, sound, smell, touch)

4.6 plant/ equipment records

4.7 circuit meters (such as voltmeter, power factor meter, ammeter)

4.8 equipment outputs.

Learning outcome

The learner will:

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

5.1 half-split technique

5.2 input/ output technique

5.3 injection and sampling

5.4 six point technique

5.5 emergent sequence

5.6 unit substitution

5.7 function/ performance testing

5.8 equipment self-diagnostics

Learning outcome

The learner will:

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

6.1 logic diagrams

6.2 fault analysis charts (such as fault trees)

6.3 flow charts or algorithms

6.4 manufacturers' manuals

6.5 probability charts/ reports

6.6 troubleshooting guides

6.7 computer-aided test equipment

6.8 electronic aids

Learning outcome

The learner will:

7 Use **all** of the following fault diagnostic procedures:

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

7.2 operation (such as manual switching off and on, automatic switching/ timing/ sequencing, outputs)

7.3 measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)

Learning outcome

The learner will:

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

8.1 oscilloscope

8.2 multimeter

8.3 logic probe

8.4 signal tracer

8.5 signal generator

8.6 other specific test equipment

Learning outcome

The learner will:

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

9.1 intermittent action or circuit failure

9.2 partial failure or reduced performance

9.3 complete breakdown

Learning outcome

The learner will:

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

10.1 step-by-step analytical report

10.2 preventative maintenance log/ report

10.3 corrective action report

10.4 company-specific reporting procedure

Learning outcome

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

11.1 the health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility these requirements place on them

11.2 the isolation and lock-off procedure or permit-to-work procedure that applies

11.3 what constitutes a hazardous voltage and how to recognise victims of electric shock

11.4 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

11.5 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the fault diagnosis activities

11.6 hazards associated with carrying out fault diagnosis on electronic equipment (such as mains electricity, stored capacitive/ inductive/ electrostatic energy, misuse of tools), and how to minimise these and reduce any risks

11.7 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

11.8 the procedure to be adopted to establish the background of the fault

11.9 how to evaluate the various types of information available for fault diagnosis

11.10 how to use the various aids and reports available for fault diagnosis

11.11 how to use various types of fault diagnostic equipment needed to investigate the problem

11.12 digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT and EXCLUSIVE-OR gates)

11.13 the various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)

11.14 how to evaluate sensory conditions (by sight, sound, smell, touch)

11.15 how to analyse evidence and evaluate possible characteristics and causes of specific faults/ problems

11.16 how to relate previous reports/ records of similar fault conditions

11.17 the care, handling and application of electronic test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)

11.18 how to calibrate electronic test instruments and check that they are free from damage and defects

11.19 the precautions (such as use of wrist straps, special packaging and handling areas) to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components

11.20 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/ maintenance reports, graphical electronic/ electrical symbols, wiring regulations, and other documents needed in the fault diagnosis activities

11.21 the basic principles of how the circuit functions, its operating sequence, the function/ purpose of individual units/ components, and how they interact

11.22 the different types of cabling (such as multicore, single core, ribbon, screened cables), fittings/ connectors (including insulation displacement), and their application

11.23 the different types of control systems and components, and their operation

11.24 the functions of different types of electronic components (analogue and digital), and their operation

11.25 how to evaluate the likely risk to themselves and others, and the effects the fault could have on the overall system or process

11.26 how to prepare and produce a risk analysis report, where appropriate

11.27 how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy

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

Unit 340 Carrying out fault diagnosis on electronic equipment and circuits

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 341 Testing electronic equipment and circuits

Unit level:	Level 3
GLH:	500
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 carry out inspections and tests on electronic equipment and circuits, in accordance with approved procedures. They will be required to carry out tests on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, hybrid circuits and systems, to establish that they functioning at optimal level and to specification. They will be required to carry out inspections and tests which will include voltage and current levels, resistance values, waveform, clock/timer switching, pulse width/rise time, open/short circuit, logic state, frequency modulation/demodulation, and signal-to-noise ratio / interference levels. Their responsibilities will require them to comply with organisational policy and procedures for carrying out the testing activities, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of the procedures for carrying out the required inspections and tests, and will provide an informed approach to applying the necessary test procedures. They will understand the equipment being worked on, the test equipment being used, and the various testing procedures and their application, in adequate depth to provide a sound basis for carrying out the activities safely and correctly and ensuring that the equipment remains compliant with all standards and regulations. In addition, they will be expected to review the outcome of the tests, compare the results with appropriate specifications, determine the action required, and record/report the results in the appropriate format.

	They will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment and taking the necessary safeguards to protect themselves and others against direct and indirect electric shock. 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:	EUCL3D-41
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests

1.4 set up and carry out the tests using the correct procedures and within agreed timescales

1.5 record the results of the tests in the appropriate format

1.6 review the results and carry out further tests if necessary

Learning outcome

The learner will:

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

2.1 plan the inspection and testing activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.4 ensure the safe isolation of equipment

2.5 provide and maintain safe access and working arrangements for the testing area

2.6 carry out the inspection and testing activities using appropriate techniques and procedures

2.7 take electrostatic precautions when handling sensitive components and circuit boards

2.8 re-connect and return the equipment to service on completion of the testing activities

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

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Learning outcome

The learner will:

3 Carry out inspections and tests on **four** of the following types of electronic equipment:

3.1 power supplies (such as switch mode, series regulation, shunt regulation)

3.2 motor control systems (such as closed loop servo/ proportion, inverter control)

3.3 sensor/ actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure)

3.4 digital circuit (such as process control, microprocessor, logic devices, display devices)

3.5 signal processing circuit (such as frequency modulating/ demodulating, amplifiers, filters)

3.6 alarms and protection circuits

3.7 ADC and DAC hybrid circuits

Learning outcome

The learner will:

4 Carry out tests using a range of tools and test equipment, to include **four** of the following:

4.1 oscilloscope

4.2 signal tracer

4.3 computer-aided diagnostic equipment

4.4 ammeter

4.5 signal generator

4.6 special purpose testing equipment

4.7 logic analyser

4.8 multimeter

4.9 temperature measuring devices

4.10 logic probe

4.11 automatic test equipment

Learning outcome

The learner will:

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

5.1 logic states
5.2 pulse width/ rise time
5.3 frequency modulation/ demodulation
5.4 DC voltage/ current levels
5.5 open/ short circuit
5.6 performance of circuit
5.7 AC voltage/ current levels
5.8 resistance
5.9 condition of assemblies and components
5.10 clock/ timer switching
5.11 heat dissipation
5.12 signal noise/ interference levels

Learning outcome

The learner will:

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

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

Learning outcome

The learner will:

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

7.1 preventative maintenance log/report
7.2 inspection schedule
7.3 company-specific reporting procedure
7.4 specific test report

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the health and safety requirements of the area in which the testing activity is to take place, and the responsibility these requirements place on them

8.2 their responsibilities under regulations relevant to the electronic testing activities being undertaken

8.3 the isolation and lock-off procedure or permit-to-work procedure that applies to the testing activities (such as electrical isolation, locking off switchgear, removal of fuses, placing of warning notices, proving the isolation has been achieved and secured)

8.4 the isolation procedure(s) unique or specific to the electronic circuits

8.5 the specific safety precautions to be taken when carrying out formal inspection, safety and circuit testing of electronic equipment

8.6 the hazards associated with testing electronic equipment and circuits, and with the equipment that is used, and how to minimise these and reduce any risks

8.7 what constitutes a hazardous voltage and how to recognise victims of electric shock

8.8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

8.9 the importance of wearing protective clothing, and other appropriate safety equipment (PPE) during the testing activities

8.10 the importance of keeping the work area clean, tidy and free from waste and surplus materials

8.11 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

8.12 how the testing activities may affect the work of others, and the procedure for informing them of the work to be carried out

8.13 the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD)

8.14 how to obtain and interpret drawings, Boolean algebra, truth tables, logic symbols, circuit diagrams, specifications, manufacturers' manuals, test procedures and documents needed to carry out the tests

8.15 the basic principles of how the electronic circuit functions, the operation sequence, the function/purpose of individual units/components, and how they interact

8.16 how to determine the most suitable test points within the circuit

8.17 how to set up and apply the appropriate test equipment

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

8.19 how to ensure that test equipment is correctly calibrated

8.20 the various testing methods and procedures, and how to apply them to different operating conditions

8.21 how to analyse test results, and use comparison and sequential techniques

8.22 the environmental control requirements and company operating procedures relating to functional testing

8.23 the documentation required, and the procedures to be followed, at the conclusion of the test

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

Unit 341 Testing electronic equipment and circuits

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 342 Repairing electronic equipment

Unit level:	Level 3
GLH:	620
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 carry out repairs on electronic equipment, in accordance with approved procedures. They will be required to carry out repairs on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, and hybrid circuits and systems. This will involve dismantling, removing and replacing faulty items at board and component level, on a variety of different types of electronic assemblies and sub-assemblies. They will be expected to apply a number of dismantling and reassembly methods and techniques, such as soldering, de-soldering, crimping, harnessing, and securing cables and components. They will be expected to take care that they do not cause further damage to the equipment/circuit during the repair activities and, therefore, the application of electrostatic discharge procedures will be a critical part of their role. Their responsibilities will require them to comply with organisational policy and procedures for carrying out the repair activities, and to report any problems with these activities or the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying electronic repair procedures. They will understand the various repair procedures used, and their application, and will know about the tools and techniques used, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the repaired equipment functions to the required specification and remains compliant with all standards and regulations.

	They will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment and taking the necessary safeguards to protect themselves, and others, against direct and indirect electric shock. 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:	EUCL3D-42
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

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

2.1 plan and communicate the repair activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.4 ensure the safe isolation of equipment

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

2.6 carry out the repair activities using appropriate techniques and procedures

2.7 take electrostatic discharge precautions when handling sensitive components and circuit boards

2.8 re-connect and return the system to service on completion of the repair activities

2.9 record the results of the maintenance activity and report any defects found

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

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Learning outcome

The learner will:

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

3.1 power supplies (such as switch mode, series regulation, parallel regulation)

3.2 motor control systems (such as closed loop servo systems, solid state drives, inverter control)

3.3 sensor/ actuator circuits (such as linear, temperature, photo-optic, flow, rotational, level, pressure, mass/ weight)

3.4 digital circuits (such as process control, microprocessor-based, logic devices, display devices)

3.5 signal processing circuits (such as frequency modulating/ demodulating, oscillators, amplifiers, filters)

3.6 alarms and protection circuits

3.7 ADC and DAC hybrid circuits

Learning outcome

The learner will:

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

4.1 applying electrostatic discharge (ESD) precautions

4.2 preparation of areas for repairing

4.3 disconnection/ dismantling of required units/ components

4.4 replacement of faulty units/ components

4.5 reassembly of components/ equipment in line with specification

4.6 making any adjustments required

4.7 functionally testing completed equipment

Learning outcome

The learner will:

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

5.1 cables and connectors
5.2 capacitors
5.3 sensors
5.4 encoders or resolvers
5.5 printed circuit boards
5.6 rectifiers
5.7 heat sinks
5.8 inverters or servo controllers
5.9 transformers
5.10 thermistors
5.11 protection devices
5.12 fixed resistors
5.13 transistors
5.14 decoders
5.15 analog or digital integrated circuits
5.16 variable resistors
5.17 diodes
5.18 regulator ICs
5.19 other specific electronic components

Learning outcome

The learner will:

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

6.1 push-fit connectors
6.2 crimped connections
6.3 soldering or desoldering
6.4 zero insertion force (ZIF) connectors
6.5 clip assemblies
6.6 adhesive joints/ assemblies
6.7 threaded connections
6.8 edge connectors

Learning outcome

The learner will:

7 Maintain electronic equipment, in compliance with **one** of the following:

7.1 organisational guidelines and codes of practice

7.2 equipment manufacturer's operation range

7.3 BS, ISO and/ or BSEN standards

Learning outcome

The learner will:

8 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

8.1 job cards

8.2 permits to work/ formal risk assessment and/ or sign on/ off procedures

8.3 maintenance logs or reports

8.4 company-specific documentation

Learning outcome

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

9.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them

9.2 their responsibilities under regulations that apply to the electronic repair activities being undertaken

9.3 the isolation and lock-off procedure or permit-to-work procedure that applies to the maintenance activities (such as electrical isolation, locking off switchgear, removal of fuses, placing maintenance warning notices, proving the isolation has been achieved and secured)

9.4 isolation procedure and safety precautions unique to the electronic equipment or circuits being worked on

9.5 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during maintenance activities

9.6 the hazards associated with repairing electronic equipment, and with the materials, tools and equipment that are used (such as live electrical components, capacitor discharge), and how to minimise these and reduce any risks

9.7 what constitutes a hazardous voltage and how to recognise victims of electric shock

9.8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

9.9 the importance of keeping the work area clean and tidy, and free from waste and surplus materials

9.10 how the maintenance activities may affect the work of others, and the procedure for informing them of the work to be carried out

9.11 the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD) hazards

9.12 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

9.13 how to obtain and interpret drawings, boolean algebra, truth tables, logic symbols, circuit diagrams, specifications, manufacturers' manuals, test procedures and other documents needed to carry out repairs

9.14 the basic principles of how the electronic circuit functions, its operation sequence, the working purpose of individual units/ components and how they interact

9.15 organisational policy on the repair or replacement of faulty components during the maintenance process

9.16 how to check that the replacement components meet the required specification/ operating conditions (such as values, tolerance, current-carrying capacity, temperature ranges)

9.17 methods of removing and replacing the faulty components from the equipment (such as unplugging, de-soldering, removal of screwed, clamped, edge connected, zero insertion force, and crimped connections)

9.18 the importance of removing faulty components, without causing damage to other components, wiring, or the surrounding structure

9.19 methods of attaching identification marks/ labels to removed components or connections, in order to assist with re-assembly

9.20 the tools and equipment used in the maintenance activities (including the use of wire-stripping tools, crimping tools, soldering irons, insertion devices and connecting tools)

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

9.22 the sequence for reconnecting the equipment, and checks to be made prior to restoring power (such as checking components for correct polarity, ensuring that there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws, wire ends or solder blobs that could cause short circuits, and all fuses/ protection devices are installed)

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

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

9.25 the maintenance documentation and/ or reports to be completed following the maintenance activity, and the importance of ensuring that these reports are completed accurately and legibly

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

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

9.28 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 342 Repairing electronic equipment

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 343 Carrying out fault diagnosis on engineered systems

Unit level:	Level 3
GLH:	530
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 carry out fault diagnosis on engineered systems, in accordance with approved procedures. They will be required to diagnose faults on an engineered system involving two of the following interactive technologies: mechanical, electrical, fluid power or process controller, at sub-assembly/ component level. They will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, they will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem. Their responsibilities will require them to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures within an integrated system. They will understand the various fault diagnosis methods and techniques used, and their application. They will know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and identifying faults or conditions that are outside the required specification. They will know about the interaction of the other associated integrated technologies, and will have sufficient knowledge to carry out effective fault diagnosis of the Integrated system.

	They will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment and for taking the necessary safeguards to protect themselves and others in the workplace. They will be required to demonstrate safe working practices throughout. 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:	EUCL3D-43
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 review and use all relevant information on the symptoms and problems associated with the products or assets

1.4 investigate and establish the most likely causes of the faults

1.5 select, use and apply diagnostic techniques, tools and aids to locate faults

1.6 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved

1.7 determine the implications of the fault for other work and for safety considerations

1.8 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault

1.9 record details on the extent and location of the faults in an appropriate format

Learning outcome

The learner will:

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

2.1 plan the fault diagnosis activities prior to beginning the work

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the fault diagnostic activities using approved procedures

2.7 collect equipment fault diagnosis evidence from live and isolated systems

2.8 disconnect or isolate components or parts of the system, when appropriate, to confirm diagnosis

2.9 identify the fault and determine appropriate corrective action

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

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Learning outcome

The learner will:

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

3.1 mechanical

3.2 electrical

3.3 fluid power

3.4 process controller

Learning outcome

The learner will:

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

4.1 the person or operator who reported the fault

4.2 sensory (such as sight, sound, smell, touch)

4.3 monitoring equipment or gauges

4.4 plant or machinery records/ history

4.5 recording devices

4.6 condition of the end product

Learning outcome

The learner will:

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

5.1 half-split technique
5.2 emergent problem sequence
5.3 functional/ performance testing
5.4 input/ output
5.5 six point technique
5.6 injection and sampling
5.7 unit substitution.
5.8 equipment self-diagnostics

Learning outcome

The learner will:

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

6.1 manufacturer's manual
6.2 logic diagrams
6.3 algorithms
6.4 flow charts
6.5 probability charts/ reports
6.6 fault analysis charts (such as fault trees)
6.7 equipment self-diagnostics
6.8 troubleshooting guides
6.9 circuit diagrams/ specifications

Learning outcome

The learner will:

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

7.1 mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
7.2 electrical/ electronic measuring instruments (such as multimeters, logic probes)
7.3 fluid power test equipment (such as test rigs, flow meters, pressure gauges)

Learning outcome

The learner will:

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

8.1 intermittent problem

8.2 partial failure or reduced performance/ out of specification product

8.3 complete breakdown

Learning outcome

The learner will:

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

9.1 step-by-step analytical report

9.2 preventative maintenance log/ report

9.3 corrective action report

9.4 company-specific reporting procedure

Learning outcome

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

10.1 the health and safety requirements of the area in which they are carrying out the fault diagnosis activities, and the responsibility these requirements place on them

10.2 the specific safety precautions to be taken when carrying out the fault diagnosis of the particular engineered system

10.3 the isolation and lock-off procedures or permit-to-work procedure that applies

10.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the fault diagnosis activities, the type of safety equipment to be used and where to obtain it

10.5 hazards associated with carrying out fault diagnosis on engineered systems (such as handling fluids, stored pressure/ force, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices and procedures that do not follow laid-down procedures), and how to minimise these and reduce any risks

10.6 what constitutes a hazardous voltage and how to recognise victims of electric shock

10.7 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

10.8 the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD) hazards

10.9 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

10.10 where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed for the fault diagnosis activities

10.11 the basic principles of how the system functions, and the working purpose of the various integrated systems

10.12 the various fault finding techniques that can be used, and how they are applied (such as half-split, input/ output, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)

10.13 how to evaluate the various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory inputs, machinery history records, and condition of the end product)

10.14 how to evaluate sensory information from sight, sound, smell, touch

10.15 the procedures to be followed to investigate faults, and how to deal with intermittent conditions

10.16 how to use the various aids and reports available for fault diagnosis

10.17 the types of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments, test rigs, and pressure and flow devices), and how to check the equipment is calibrated or configured correctly for the intended use, and that it is free from damage and defects

10.18 the application of specific fault finding methods and techniques that are best suited to the problem

10.19 how to analyse and evaluate possible characteristics and causes of specific faults/ problems

10.20 how to make use of previous reports/ records of similar fault conditions

10.21 how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on the overall process

10.22 how to prepare a report which complies with the company policy on fault diagnosis

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

Unit 343 Carrying out fault diagnosis on engineered systems

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 344 Carrying out preventative planned maintenance on engineered systems

Unit level:	Level 3
Credit value:	380
GLH:	380
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 carry out preventative planned maintenance activities on engineered systems, in accordance with approved procedures. They will be required to carry out the maintenance activities on engineered systems involving at least two of the following interactive technologies: mechanical, electrical, fluid power or process controller. They will need to organise and carry out the maintenance activities to minimise down time, and ensure that the maintained system performs at optimal level and functions to the required specification. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment, and materials used in the maintenance activities are removed from the work area on completion of the work, and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures within an engineered system. They will know about the integrated technologies within the system, how the system functions, and potential problems or defects that may occur. They will understand the process of developing planned maintenance, and its application, and will know about the maintenance criteria, in adequate depth to provide a sound basis for carrying out the activities safely and effectively, and for ensuring that the system is maintained to the required specification and remains compliant with all standards

	and regulations. In addition, they will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and taking the necessary safeguards to protect themselves and others in the workplace. They will be required to demonstrate safe working practices throughout. 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:	EUCL3D-44
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements – The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

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

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

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

2.8 record the results of the maintenance activity and report any defects found

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

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Learning outcome

The learner will:

3 Carry out planned maintenance activities on engineered systems, involving **two** of the following interactive technologies, to sub-assembly/ component level:

3.1 mechanical

3.2 fluid power

3.3 electrical

3.4 process control

Learning outcome

The learner will:

4 Follow planned maintenance activities based on **one** of the following types of maintenance schedule:

4.1 condition based maintenance

4.2 total preventative maintenance (TPM)

4.3 scheduled maintenance

4.4 preventative planned maintenance

Learning outcome

The learner will:

5 Carry out **ten** of the following planned maintenance activities:

5.1 visual examination and testing of the system against the maintenance schedule

5.2 checking operation of all gauges and sensors

5.3 removing excessive dirt and grime

5.4 monitoring component condition/ deterioration

5.5 checking condition of belts, bearings, seals
5.6 making sensory checks (such as sight, sound, smell, touch)
5.7 making routine adjustments
5.8 carrying out leak checks on all connections
5.9 replacing 'lifed' consumables (such as filters, fluids)
5.10 testing and reviewing system operation
5.11 carrying out system self-analysis checks

Learning outcome

The learner will:

6 Ensure the maintained equipment/ system meets **all** of the following:

6.1 all maintenance activities have been completed to the required schedule
6.2 equipment operates within acceptable limits for successful continuous operation to meet output specification
6.3 equipment remains compliant with appropriate regulations and safety requirements
6.4 any potential defects are identified and reported for future action

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Learning outcome

The learner will:

7 Complete the relevant documentation from **one** of the following and pass it to the appropriate people:

7.1 job cards
7.2 permit to work/ formal risk assessment and/ or sign on/ off procedures
7.3 maintenance log or report
7.4 company-specific documentation

Learning outcome

8 Knowledge and understanding – The learner must know and understand

8.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them
8.2 the isolation and lock-off procedure or permit-to-work procedure that applies to the system being maintained
8.3 the specific health and safety precautions to be applied during the maintenance activities, and their effects on others
8.4 what constitutes a hazardous voltage and how to recognise victims of electric shock
8.5 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

8.6 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the maintenance activities, and where it may be obtained

8.7 hazards associated with carrying out maintenance activities on an integrated system (handling fluids, stored pressure/ force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks

8.8 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

8.9 how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/ maintenance reports and other documents needed for the maintenance activities

8.10 the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance (TPM))

8.11 the basic principles of how the system functions, its operation sequence, the working purpose of individual units/ components, and how they interact

8.12 the equipment operating and control procedures, and how to apply them in order to carry out the planned maintenance activities

8.13 the testing methods and procedures to be used to check that the system conforms to acceptable limits

8.14 how to make sensory checks by sight, sound, smell, touch

8.15 the procedure for obtaining consumables and 'lifed' items that will require replacing during the maintenance activity

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

8.17 methods of checking that components are fit for purpose, and the need to replace 'lifed' items such as filters, seals, gaskets, belts, chains and bearings

8.18 how to make adjustments to components and assemblies to ensure they function correctly

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

8.20 the problems that can occur during the planned maintenance activity, and how they can be overcome

8.21 the organisational procedure to be adopted for the safe disposal of waste of all types on materials

8.22 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 344 Carrying out preventative planned maintenance on engineered systems

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 345 Maintaining mechanical equipment within an engineered system

Unit level:	Level 3
GLH:	810
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 carry out corrective maintenance on mechanical equipment within an engineered system, in accordance with approved procedures. They will be required to maintain a range of mechanical equipment, such as gearboxes, pumps, machine tools, conveyor systems, workholding arrangements, engines, processing plant and equipment, which are working in an integrated system involving two of the following interactive technologies: electrical, fluid power or process controller. They will be expected to isolate and disconnect items and components of the interactive technologies in order to gain access to and remove the mechanical units and components that require replacing or repair. This will involve dismantling and reassembling a variety of different types of assemblies and sub-assemblies which, in some instances, will need to be dismantled to component level. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the maintenance activities are removed from the work area on completion of the work, and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying

	mechanical maintenance procedures within an engineered system. They will know about the integrated technology assemblies and sub-assemblies, and their properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling and reassembly process safely and effectively. They will also understand the maintenance methods and procedures used, and their application within the engineered system, in sufficient depth to be able to carry out the maintenance activities, correct faults, and ensure that the maintained equipment functions to specification and remains compliant with all standards and regulations. They will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly safely and effectively. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and taking the necessary safeguards to protect themselves and others in the workplace. They will be required to demonstrate safe working practices throughout. 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:	EUCL3D-45
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

2 Carry out **all** of the following during the maintenance activity as applicable to the equipment being maintained:

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

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

2.8 record the results of the maintenance activity and report any defects found

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

Learning outcome

The learner will:

3 Use appropriate dismantling and re-assembly techniques to deal with **seven** of the following components:

fluid power components:

3.1 releasing stored pressure

3.2 chocking/ supporting cylinders/ rams/ components

3.3 disconnecting/ removing hoses and pipes

3.4 removing and replacing units/ components (such as pumps, valves, actuators)

electrical components:

3.5 check isolation of the power

3.6 removing/ replacing minor electrical components(such as relays, sensing devices, limit switches)

3.7 disconnecting and reconnecting wires/ cables

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

3.9 removing and replacing wiring enclosures (such as conduit, trunking and traywork)

process controller components:

3.10 de-activating program controller

3.11 resetting program controller
3.12 disconnecting/ reconnecting wires/ cables
3.13 re-loading programs
3.14 make minor program amendments
3.15 removing and replacing program logic peripherals
3.16 removing and replacing input/ output interfacing

Learning outcome

The learner will:

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

4.1 gearboxes
4.2 processing plant
4.3 mechanical structures
4.4 engines
4.5 machine tools
4.6 pumps
4.7 conveyors/ elevators
4.8 lifting and handling equipment
4.9 compressors
4.10 workholding arrangements
4.11 transfer equipment
4.12 process control valves
4.13 other specific equipment

Learning outcome

The learner will:

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

5.1 draining and removing fluids
5.2 proofmarking/ labelling of components
5.3 dismantling equipment to unit/ sub-assembly level
5.4 dismantling units to component level
5.5 replacing damaged/ defective components
5.6 replacing all `lifed' items (such as seals, bearings, gaskets)
5.7 checking components for serviceability
5.8 tightening fastenings to the required torque

5.9 setting, aligning and adjusting replaced components
5.10 replenishing oils and greases
5.11 making `off-load' checks before powering up
5.12 functionally testing the complete system

Learning outcome

The learner will:

6 Replace/ refit a range of mechanical components, to include **seven** of the following:

6.1 shafts
6.2 valves and seats
6.3 cams and followers
6.4 pulleys and belts
6.5 couplings
6.6 brakes
6.7 springs
6.8 slides
6.9 gears
6.10 bearing and seals
6.11 chains and sprockets
6.12 levers and links
6.13 clutches
6.14 fitting keys
6.15 locking and retaining devices (such as circlips, pins)

Learning outcome

The learner will:

7 Ensure that the maintenance activities comply with **one** of the following:

7.1 organisational guidelines and codes of practice
7.2 equipment manufacturer's operation range
7.3 BS, ISO and/ or BSEN standards

Learning outcome

The learner will:

8 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

8.1 job cards

8.2 permits to work/ formal risk assessment and/ or sign on/ off procedures

8.3 maintenance log or report

8.4 company-specific documentation

Learning outcome

9 Knowledge and understanding -The learner must know and understand

9.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them

9.2 the isolation and lock-off procedure or permit-to-work procedure that applies to the system

9.3 the specific health and safety precautions to be applied during the maintenance activity, and their effects on others

9.4 what constitutes a hazardous voltage and how to recognise victims of electric shock

9.5 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

9.6 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the maintenance activities

9.7 hazards associated with carrying out maintenance activities on an integrated system (such as handling fluids, stored pressure/ force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks

9.8 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

9.9 how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/ maintenance reports and other documents needed for the maintenance activities

9.10 the basic principles of how the system functions, its operation sequence, the working purpose of individual units/ components, and how they interact

9.11 the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance

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

9.13 the sequence to be adopted for dismantling and reassembling the equipment, to both sub-assembly and individual component level

9.14 methods of removing components that have interference fits (expansion, contraction or pressure)

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

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

9.17 methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as seals, gaskets and bearings)

9.18 how to make adjustments to components/ assemblies, to ensure they function correctly

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

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

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

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

9.23 how to use lifting and handling equipment safely and correctly in the maintenance activity

9.24 the problems that can occur during the maintenance activity, and how they can be overcome

9.25 the organisational procedure to be adopted for the safe disposal of waste of all types of material

9.26 the extent of their authority and to whom they should report if they have a problem that they cannot resolve

Unit 345 Maintaining mechanical equipment within an engineered system

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 346 Maintaining electrical equipment within an engineered system

Unit level:	Level 3
GLH:	810
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 carry out corrective maintenance activities on electrical equipment within an engineered system, in accordance with approved procedures. They will be required to maintain a range of electrical equipment, such as single and three-phase power supplies, motors and starters, switchgear and distribution panels, electrical plant, control systems and equipment, and luminaries, which are working in an integrated system involving two of the following interactive technologies: mechanical systems, fluid power or process controller. They will be expected to isolate and disconnect items and components of the interactive technologies, in order to gain access to and remove the electrical units and components that require replacing or repair. This will involve dismantling and reassembling a variety of different types of electrical equipment which, in some instances, will need to be dismantled to component level. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment, and materials used in the maintenance activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying

	electrical maintenance procedures. They will also know about the integrated technology assemblies and sub- assemblies, their properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling and reassembly process effectively. They will understand the maintenance methods and procedures used, and their application within an engineered system, in sufficient depth to be able to carry out the maintenance activities, correct faults, and ensure that the repaired equipment functions to specification and remains compliant with all standards and regulations. They will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly safely and effectively. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and for taking the necessary safeguards to protect themselves and others in the workplace. They will be required to demonstrate safe working practices throughout. 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:	EUCL3D-46
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

2 Carry out **all** of the following during the maintenance activity as applicable to the equipment being maintained:

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

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

2.8 record the results of the maintenance activity and report any defects found

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

Learning outcome

The learner will:

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

fluid power components:

3.1 releasing stored pressure

3.2 chocking/ supporting cylinders/ rams/ components

3.3 disconnecting/ removing hoses/ pipes

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

mechanical components:

3.5 draining and replenishing fluids

3.6 removing major mechanical units (such as gear boxes, pumps, workholding/ transfer equipment).

3.7 removing and refitting locking and retaining devices

3.8 removing minor mechanical units/ sub-assemblies (such as guards, structures)

3.9 proofmarking components to aid reassembly

3.10 setting, aligning and adjusting replaced units.

process controller components:

3.11 de-activating and resetting program controller

3.12 disconnecting/ reconnecting wires/ cables

3.13 reloading programs and making minor amendments

3.14 removing and replacing program logic peripherals

3.15 removing and replacing input/ output interfacing

Learning outcome

The learner will:

4 Carry out maintenance activities on **six** of the following types of electrical equipment:

4.1 single-phase power supplies

4.2 control systems and components

4.3 three-phase power supplies

4.4 electrical plant

4.5 direct current power supplies

4.6 wiring enclosures

4.7 motors and starters

4.8 luminaires

4.9 switchgear and distribution panels

4.10 other specific electrical equipment

Learning outcome

The learner will:

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

5.1 isolating and locking off equipment

5.2 removing and replacing damaged wires/ cables

5.3 disconnecting/ reconnecting wires and cables

5.4 removing and replacing wiring enclosures

5.5 attaching suitable cable identification markers

5.6 replacing damaged/ defective components

5.7 setting and adjusting replaced components

5.8 removing electrical units/ components

5.9 making `off-load' checks before powering up

5.10 checking components for serviceability

5.11 functionally testing completed system

Learning outcome

The learner will:

6 Replace/ refit a range of electrical components, to include **eight** of the following:

6.1 cables and connectors
6.2 switches and sensors
6.3 invertors and servo controllers
6.4 contactors
6.5 solenoids
6.6 circuit boards
6.7 relay components
6.8 capacitors
6.9 lighting fixtures
6.10 transformers
6.11 rectifiers
6.12 batteries
6.13 overload protection devices
6.14 encoders or resolvers
6.15 locking and retaining devices (such as cable ties, clips, proprietary fasteners)

Learning outcome

The learner will:

7 Ensure that maintenance activities comply with **one** of the following:

7.1 organisational guidelines and codes of practice
7.2 BS7671/ IET wiring regulations
7.3 equipment manufacturer's operation range
7.4 BS, ISO and/ or BSEN standards

Learning outcome

The learner will:

8 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

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

Learning outcome

9 Knowledge and understanding -The learner must know and understand

9.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them

9.2 the isolation and lock-off procedure or permit-to-work procedure that applies to the system

9.3 the specific health and safety precautions to be applied during the maintenance activity, and their effects on others

9.4 what constitutes a hazardous voltage and how to recognise victims of electric shock

9.5 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

9.6 the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities

9.7 hazards associated with carrying out electrical maintenance activities on an integrated system (such as handling fluids, stored pressure/ force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks

9.8 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

9.9 how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/ maintenance reports, graphical electrical symbols, BS7671/ IET wiring regulations and other documents needed for the maintenance activities

9.10 the basic principles of how the system functions, its operation sequence, the working purpose of individual units/ components, and how they interact

9.11 the different types of cabling and their application (such as multi-core cables, single-core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables)

9.12 the different types of electric motors and motor starters

9.13 the different types of control systems and their various components

9.14 the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units)

9.15 the various lighting systems used including tungsten, sodium, mercury vapour and fluorescent

9.16 the different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)

9.17 the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments

9.18 the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities

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

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

9.21 methods of removing and replacing cables and wires in wiring enclosures, without causing damage to existing cables

9.22 the use of BS7671/ IET and other regulations when selecting wires and cables, and when carrying out tests on systems

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

9.24 methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as motor brushes, seals and gaskets, and overload protection devices)

9.25 how to make adjustments to components/ assemblies to ensure they function correctly

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

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

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

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

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

9.31 the problems that can occur during the electrical maintenance activity, and how they can be overcome

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

9.33 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 346 Maintaining electrical equipment within an engineered system

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 347 Maintaining fluid power equipment within an engineered system

Unit level:	Level 3
GLH:	810
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 carry out corrective maintenance activities on fluid power equipment within an engineered system, in accordance with approved procedures. They will be required to maintain a range of equipment, such as pumps, valves, actuators, sensors, compressors and other fluid power equipment, which are working in an integrated system on mobile or static plant involving two of the following interactive technologies: mechanical, electrical, or process controller. They will be expected to isolate and disconnect items and components of the interactive technologies in order to gain access to and remove the fluid power units and components that require replacing or repair. This will involve dismantling and reassembling a variety of different types of assemblies and sub-assemblies which, in some instances, will need to be dismantled to component level. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the maintenance activities are removed from the work area on completion of the work, and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying

	fluid power maintenance procedures. They will also know about the integrated technology assemblies and sub-assemblies, their properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling and reassembly process safely and effectively. They will understand the maintenance methods and procedures used, and their application within an engineered system, in sufficient depth to enable them to carry out the maintenance activities, correct faults, and ensure that the maintained equipment functions to specification and remains compliant with all standards and regulations. They will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly safely and effectively. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and for taking the necessary safeguards to protect themselves and others in the workplace. They will be required to demonstrate safe working practices throughout. 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:	EUCL3D-47
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

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

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

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

2.8 record the results of the maintenance activity and report any defects found

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

Learning outcome

The learner will:

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

mechanical components:

3.1 draining and replenishing fluids

3.2 removing major mechanical units (gear boxes, pumps, workholding/ transfer equipment)

3.3 removing and refitting locking and retaining devices

3.4 removing minor mechanical units/ sub-assemblies(such as guards, structures)

3.5 proofmarking components to aid re-assembly

3.6 setting, aligning and adjusting replaced units

electrical components:

3.7 isolating power supply

3.8 removing/ replacing minor electrical components (such as relays, sensing devices, limit switches)

3.9 disconnecting and reconnecting wires/ cables

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

3.11 removing and replacing wiring enclosures (such as conduit, trunking, traywork and cable ways)

programmable controller components:

3.12 de-activating and resetting program controller

3.13 disconnecting/ re-connecting wires/ cables

3.14 reloading programs and making minor amendments

3.15 removing and replacing programming devices (such as laptop, programmer, PDA)

3.16 removing and replacing input/ output interfacing

Learning outcome

The learner will:

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

4.1 pneumatic

4.2 hydraulic

4.3 vacuum

Learning outcome

The learner will:

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

5.1 chocking/ supporting actuators/ rams/ component

5.2 releasing stored pressure

5.3 draining, removing and replacing oil/ fluids (as applicable)

5.4 replacing damaged/ defective components

5.5 disconnecting/ removing hoses, pipes and tubing

5.6 replacing all `lifed' items (seals, filters, gaskets, hoses)

5.7 proofmarking/ labelling of removed components

5.8 checking components for serviceability

5.9 tightening fastenings to the required torque

5.10 removing and replacing units/ components (such as pumps, cylinders, valves, actuators)

5.11 setting, aligning and adjusting replaced components

5.12 making `off-load' checks before re-pressurising system

5.13 priming and bleeding the system (where applicable)

5.14 functional/ performance testing of the maintained system

Learning outcome

The learner will:

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

6.1 pumps

6.2 valves

6.3 motors

6.4 actuators

Learning outcome

The learner will:

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

7.1 pumps

7.2 bearings

7.3 compressors

7.4 sensors

7.5 pistons

7.6 reservoirs

7.7 receivers

7.8 lubricators/ filters

7.9 spools

7.10 accumulators

7.11 gaskets and seals

7.12 regulators

7.13 valves

7.14 pressure intensifiers

7.15 pipework and hoses

7.16 actuators/ cylinders

7.17 switches

7.18 other specific components

Learning outcome

The learner will:

8 Ensure that maintenance activities comply with **one** of the following:

8.1 organisational guidelines and codes of practice

8.2 equipment manufacturer's operation range

8.3 BS, ISO and/ or BSEN standards

Learning outcome

The learner will:

9 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

9.1 job cards

9.2 maintenance log or report

9.3 permit to work/ formal risk assessment and/ or sign on/ off procedures

9.4 company-specific documentation

Learning outcome

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

10.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them

10.2 the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on

10.3 the specific health and safety precautions to be taken during the maintenance activities, and their effects on others

10.4 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the maintenance activities, and where to obtain it

10.5 hazards associated with carrying out maintenance activities on an integrated system (such as handling fluids, stored pressure/ force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks

10.6 regulations and codes of practice that apply to working with fluid power equipment

10.7 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

10.8 how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used in fluid power, and other documents needed for the maintenance activities

10.9 the basic principles of operation of the equipment to be maintained

10.10 the importance of following the correct de-contamination procedures

10.11 principles and theories associated with fluid power equipment (such as cascading and truth tables, logic/ ladder diagrams)

10.12 how to construct and apply ladder logic, sequential charts/ tables or functional diagrams

10.13 dry and lubricated systems and their application

10.14 selection, types and characteristics of fluids for the system

10.15 the effects of pressure and flow on the performance of the system

10.16 the identification of different compressors (such as screw piston, rotary vane)

10.17 the identification of different hydraulic motors (such as piston, gear, vane)

10.18 the effects, and likely symptoms, of contamination in the system

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

10.20 the identification, application, function and operation of different types of valves (such as poppet, spool, piston, disc and slide)

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

10.22 the identification, application function and operation of different types of actuators/ cylinders (such as single acting, double acting and telescopic)

10.23 the identification and application of different types of pumps (positive, gear vane and piston)

10.24 the application and fitting of static and dynamic seals

10.25 company policy on repair/ replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities

10.26 the sequence to be adopted for the dismantling and reassembling of the equipment, to both sub-assembly and individual component level

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

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

10.29 methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as seals, gaskets, filters, pistons, spools and bearings)

10.30 how to make adjustments to components/ assemblies, to ensure they function correctly

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

10.32 the importance of making `off-load' checks before applying full pressure

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

10.34 the manufacturer's equipment operating and control procedures to be applied during the maintenance activity

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

10.36 the problems that can occur during the maintenance activity, and how they can be overcome

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

10.38 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 347 Maintaining fluid power equipment within an engineered system

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 348 Maintaining process controller equipment within an engineered system

Unit level:	Level 3
GLH:	810
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 carry out corrective maintenance to process controller equipment within an engineered system, in accordance with approved procedures. They will be required to maintain a range of process controller equipment that typically includes process controllers or sequential controllers (such as programmable logic controllers (PLCs), robots) which are working in an integrated system involving two of the following interactive technologies: mechanical, electrical or fluid power. This will involve dismantling, removing and replacing faulty peripheral components, process controller units, and components, down to board level on `unitary' or `rack' type process controller systems. They will also need to be able to load and download process controller programs, check them for errors, make alterations to programs, and create and maintain back-up copies of completed programs. Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities, process control system, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their actions, and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on process controller systems within an integrated system. They will understand the maintenance methods and procedures used, and their application, and will know

	about the various process controller units and peripheral components, their functions and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring that the equipment operates to the required specification and remains compliant with all standards and regulations. They will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly of the process controller system safely and effectively. They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and for taking the necessary safeguards to protect themselves and others in the workplace. They will be required to demonstrate safe working practices throughout. 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:	EUCL3D-48
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

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

2.1 plan and communicate the maintenance activities to cause minimal disruption to normal working

2.2 obtain and use the correct issue of company and/ or manufacturers' drawings and maintenance documentation

2.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

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

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

2.6 carry out the maintenance activities using appropriate techniques and procedures

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

2.8 record the results of the maintenance activity and report any defects found

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

Learning outcome

The learner will:

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

mechanical components:

3.1 draining and replenishing of fluids

3.2 removing and refitting locking and retaining devices

3.3 removing minor mechanical units/ sub-assemblies (such as guards, structures)

3.4 removing major mechanical units (such as gear boxes, pumps, mechanical handling, workholding/ transfer equipment)

3.5 proofmarking components to aid reassembly

3.6 setting, aligning and adjusting replaced units

electrical components:

3.7 isolating the power supply using correct lock-off communication procedure

3.8 disconnecting and re-connecting wires/ cables

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

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

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

fluid power components:

3.12 releasing stored pressure

3.13 chocking/ supporting cylinders/ rams/ components

3.14 disconnecting/ removing hoses/ pipes

3.15 removing and replacing units/ components (such as pumps, valves, actuators)

Learning outcome

The learner will:

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

4.1 fixed inputs/ outputs (I/O)

4.2 modular

4.3 rack mount

Learning outcome

The learner will:

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

5.1 select and use appropriate programming devices (such as terminals, handheld programmers and personal computers)

5.2 use ladder logic, statement lists, or system flowcharts

5.3 force contacts on and off

5.4 edit, enter and remove contacts from lines of logic

5.5 alter counter and timer settings

5.6 use `on' and `off-line' programming

5.7 carry out on-line monitoring of programs

5.8 load, read and save programs

5.9 produce back-ups of completed programs

5.10 programme by computer based authoring (to include sub-routines)

5.11 use single-step mode of operation.

Learning outcome

The learner will:

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

6.1 take electrostatic discharge (ESD) precautions when working on or close to sensitive components and circuit boards

6.2 proofmark or label removed wires and components

6.3 inspect and/ or test components for serviceability

6.4 use program full-run modes of operation

6.5 change or add circuit boards
6.6 replace power supplies
6.7 replace peripherals (such as sensors, actuators, relays, switches)
6.8 replace process controller units
6.9 replace back-up batteries
6.10 functionally test the system

Learning outcome

The learner will:

7 Ensure maintenance activities comply with **one** of the following:

7.1 organisational guidelines and codes of practice
7.2 BS, ISO and/ or BSEN standards
7.3 equipment manufacturer's operation range

Learning outcome

The learner will:

8 Complete the relevant documentation from **one** of the following, and pass it to the appropriate people:

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

Learning outcome

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

9.1 the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on them
9.2 the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on
9.3 the isolation procedure which is specific to the process controller system being worked on
9.4 the specific health and safety precautions that need to be applied during the maintenance activities, and their effects on others
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 mating and isolating transformers)

9.7 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the maintenance activities, and where this can be obtained

9.8 the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD) hazards

9.9 hazards associated with carrying out maintenance activities on a process controlled integrated system (such as handling fluids, stored pressure/ force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks

9.10 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

9.11 how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used on process controller documents, and other documents needed for the maintenance activities

9.12 the basic principles of how the system functions, its operation sequence, the working purpose of individual units/ components, and how they interact

9.13 the devices and systems for storing programmes

9.14 procedures to be applied to storage, location and method of backing up programmes

9.15 the different types of interface cards, and their application

9.16 the procedures for the application of computer-based authoring software for design and development

9.17 the numbering system and codes used for identification inputs and outputs

9.18 how to search a programme within the process controller for specific elements

9.19 programming techniques and codes used (such as interlocking, timers, counters, sub-routines)

9.20 the techniques involved in editing, entering and removing contacts from lines of logic and, where applicable, the procedure to be followed for `on' and `off-line' programming

9.21 the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process

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

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

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

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

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

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

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

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

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

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

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

9.33 the extent of their own authority and to whom they should report if they have a problem they cannot resolve

Unit 348 Maintaining process controller equipment within an engineered system

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 349 Assembling mechanical products

Unit level:	Level 3
GLH:	700
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 carry out assembly operations to produce mechanical assemblies, in accordance with approved procedures. They will be required to prepare the work area, and ensure it is safe and free from hazards. They will also be required to check the specified components are available and fit for purpose, to obtain all relevant and current documentation, to obtain the tools and equipment required for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, they will be required to follow company procedures and specified assembly techniques, in order to assemble the mechanical product. The assembly activities will also include making all necessary checks and adjustments, to ensure the components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, all fasteners are tightened to the correct torque, and that the assembled parts are checked for completeness and function as per the specification. Their responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying the assembly techniques and procedures. They will understand the mechanical product being assembled, and its application, and will know about the equipment, relevant components and joining techniques, in adequate 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. 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:	EUCL3D-49
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant instructions, assembly drawings and any other specifications

1.4 check that the specified components are available and that they are in a usable condition

1.5 assemble the components in their correct positions using the appropriate methods and techniques

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 the finished assembly meets the required specification

1.8 complete the required production documentation

1.9 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome

The learner will:

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

2.1 obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)

2.2 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.3 follow safe practice/approved fitting procedures at all times

2.4 check that all cables, extension leads or air supply hoses are in a serviceable condition

2.5 check that all tools and measuring equipment are within current calibration/certification dates

2.6 use lifting and slinging equipment in accordance with health and safety guidelines and procedures

2.7 ensure that the components and pipes used are free from foreign objects, dirt or other contamination before assembling them

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

2.9 leave the work area and machine in a safe and appropriate condition on completion of the activities

Learning outcome

The learner will:

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

3.1 assembling of components by expansion/ contraction

3.2 applying sealants/ adhesives

3.3 fitting (such as filing, scraping, lapping or polishing)

3.4 electrical bonding of components

3.5 securing using mechanical fasteners/ threaded devices

3.6 assembling of products by pressure

3.7 setting working clearances

3.8 drilling

3.9 reaming

3.10 balancing components

3.11 applying bolt locking methods

3.12 shimming and packing

3.13 blue-bedding of components

3.14 aligning components

3.15 torque setting

3.16 soldering/ brazing

3.17 fusion (non-critical joints)

3.18 riveting

Learning outcome

The learner will:

4 Assemble products to meet the required specification, using **seven** of the following components:

4.1 assembly structure (such as framework, support, casings, panels)
4.2 fabricated components
4.3 pre-machined components
4.4 levers/ linkages
4.5 pipework/ hoses
4.6 cams and followers
4.7 bearings
4.8 bushes
4.9 shafts
4.10 couplings
4.11 keys
4.12 gears
4.13 belts
4.14 seals
4.15 gaskets
4.16 chains
4.17 sprockets
4.18 pulleys
4.19 springs
4.20 other specific component

Learning outcome

The learner will:

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

5.1 workholding devices
5.2 lifting and moving equipment
5.3 specialised assembly tools/equipment
5.4 jigs and fixtures
5.5 shims and packing
5.6 rollers or wedges
5.7 supporting equipment

Learning outcome

The learner will:

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

6.1 positional accuracy
6.2 freedom of movement
6.3 component security
6.4 completeness
6.5 dimensions
6.6 orientation
6.7 alignment
6.8 function
6.9 bearing end float
6.10 operating/ working clearances
6.11 free from damage or foreign objects

Learning outcome

The learner will:

7 Produce mechanical assemblies which comply with **one** of the following quality and accuracy standards:

7.1 company standards and procedures
7.2 BS, ISO or BSEN standards and procedures
7.3 specific system requirements
7.4 customer standards and requirements

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the specific safety precautions to be taken whilst carrying out the mechanical assembly, including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials
8.2 the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them
8.3 COSHH Regulations with regard to the substances used in the assembly process
8.4 the hazards associated with producing mechanical assemblies, and how to minimise them and reduce any risks

8.5 the personal protective equipment and clothing (PPE) to be worn during the assembly activities

8.6 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

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

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

8.9 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)

8.10 preparations that need to be undertaken on the components prior to fitting them into the assembly

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

8.12 how the components are to be aligned, adjusted and positioned prior to securing, and the tools and equipment that is used

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

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

8.15 the quality control procedures to be followed during the assembly operations

8.16 how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the assembly

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

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

8.19 how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition

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

8.21 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

8.22 problems with the assembly operations, and the importance of informing appropriate people of non-conformances

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

Unit 349 Assembling mechanical products

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 350 Repairing and modifying mechanical assemblies

Unit level:	Level 3
GLH:	700
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 and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. The EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out modifications on mechanical assemblies, in accordance with approved procedures. The assembly may have to be modified for a number of reasons, which could include performance out of specification, inherent design problems, changes to customer specification, or assembly problems. They will be required to prepare the work area, ensuring it is safe and free from hazards, to check the correct component parts requiring modification are available, to obtain all relevant and current documentation, and to obtain the tools and equipment required for the modification, checking that they are in a safe and usable condition. In carrying out the modification, they will be required to follow the appropriate company procedures and specified techniques. The assembly and its components could be modified using a number of methods and techniques including, where appropriate, adjusting, removing and replacing, or repairing, or by manufacturing new components by machining, welding, fabricating or bonding. Component parts that are modified must be checked for accuracy, security, completeness, and that they function as per the specification. Their responsibilities will require them to comply with organisational policy and procedures for the modification activities undertaken, and to report any problems with the modification activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to ensure that all tools, equipment and materials used in the modification are correctly accounted for on completion of the activities, and to complete all necessary job/

	task documentation accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying the modification methods, techniques and procedures. They will understand the mechanical product being modified, including its application and reason for the modification, and will know about the tools and equipment required, in adequate 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 modification activities. 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:	EUCL3D-50
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements - The learner must be able to:

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

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

1.3 obtain the relevant specification and job instructions for the modification being performed

1.4 confirm and agree what modification is to be carried out to meet the specification

1.5 determine how the assembly will be prepared for the modification

1.6 check that any materials and equipment required are available and that they are suitable for the work to be carried out

1.7 carry out the modification to achieve the required changes, in line with agreed instructions and specifications

1.8 complete relevant documentation in accordance with organisational requirements

1.9 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome

The learner will:

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

2.1 obtain and use the appropriate documentation (such as job instructions, modification drawings, quality control documentation, planning documentation)

2.2 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.3 follow safe practice/ approved modification and repair techniques at all times

2.4 check that all cables, extension leads or air supply hoses are in a serviceable condition

2.5 check that all tools and measuring equipment are within current calibration/ certification dates

2.6 use lifting and slinging equipment in accordance with health and safety guidelines and procedures

2.7 ensure that all components to be assembled are free from damage, foreign objects, dirt or other contamination before assembling them

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

2.9 leave the work area and assembly in a safe and appropriate condition on completion of the activities

Learning outcome

The learner will:

3 Carry out the modification, using **two** of the following methods:

3.1 adjustment

3.2 modify existing components

3.3 remove and replace with new components

3.4 manufacture of new components

Learning outcome

The learner will:

4 Complete the modification, using **two** of the following techniques:

4.1 dismantling and re-assembling
4.2 fluid power fitting and assembly
4.3 welding
4.4 hand fitting
4.5 bonding
4.6 fabrication
4.7 electrical fitting and assembly
4.8 adjusting
4.9 machining

Learning outcome

The learner will:

5 Carry out modifications on **one** of the following parts of the assembly:

5.1 holding mechanism
5.2 drive mechanism
5.3 transfer system
5.4 operating system
5.5 fluid power system
5.6 pipework system
5.7 control mechanism
5.8 delivery system
5.9 safety mechanism
5.10 assembly structure (such as framework, casings, panels)
5.11 other specific assembly

Learning outcome

The learner will:

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

6.1 dimensions
6.2 orientation
6.3 bearing end float
6.4 positional accuracy
6.5 alignment
6.6 function
6.7 freedom of movement

6.8 completeness

6.9 earth bonding and electrical continuity

6.10 operating/ working clearances

6.11 component security

6.12 free from damage or foreign objects

Learning outcome

The learner will:

7 Ensure that the repairs and modifications comply with **one** of the following quality and accuracy standards:

7.1 BS, ISO or BSEN standards and procedures

7.2 company standards and procedures

7.3 customer standards and requirements

7.4 specific system requirements

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the specific safety precautions to be taken while carrying out modifications on mechanical assemblies (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)

8.2 the health and safety requirements of the work area in which they are carrying out the modification activities, and the responsibility these requirements place on them

8.3 COSHH regulations with regard to the substances used in the modification process

8.4 the hazards associated with modifying mechanical assemblies, and how to minimise them and reduce any risks

8.5 the personal protective equipment and clothing (PPE) to be worn during the modification activities

8.6 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

8.7 the various types of drawing and specifications that are used during the modification

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

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

8.10 the reasons why mechanical assemblies may require modification

8.11 preparations to be undertaken on the components prior to carrying out the modification

8.12 the various methods that could be used to modify assemblies (such as adjust, remove and replace, repair, modify or manufacture new parts)

8.13 the basic concepts and techniques that can be used, where appropriate, to modify the assembly (such as machining, welding, fabrication, bonding, mechanical fitting, electrical and electronic fitting)

8.14 the quality control procedures to be followed during the modification, and the importance of adhering to them

8.15 how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the modification

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

8.17 how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition

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

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

8.20 problems associated with carrying out modifications on mechanical assemblies, and the importance of informing appropriate people of non-conformances

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

Unit 350 Repairing and modifying mechanical assemblies

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 351 Checking that completed assemblies comply with specification

Unit level:	Level 3
GLH:	300
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 carry out checks on mechanical assemblies, in accordance with approved procedures. They will be required to prepare the work area, ensuring it is safe and free from hazards, to obtain all relevant and current documentation, and to obtain the tools and equipment required for the checking of mechanical assemblies, making sure that they are calibrated and in a safe and usable condition. They will be expected to conduct ongoing trials, manual checks and operational checks throughout the assembly operations, and checks on component parts and sub-assemblies will also be carried out, where appropriate. They will be responsible for confirming the assembly is complete, fit for purpose, and meets the operational performance required by the specification. In carrying out checks on mechanical assemblies, they will also be required to complete any relevant documentation accurately and legibly. Their responsibilities will require them to comply with organisational policy and procedures for checking the mechanical assembly, and to report any problems with the assembly they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to ensure that all tools and equipment used in checking the assembly are correctly accounted for on completion of the activities and returned to the correct location. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying quality control techniques and procedures including, where appropriate, British, European and International standards. They

	will understand the mechanical product being assembled, and its application, and will know about the tools and equipment used to check the assembly, in adequate depth to provide a sound basis for carrying out the activities to the required specification. They will understand the types of defect that can be found on the assembly, and how critical these defects are in determining the satisfactory performance of the completed product. They will understand the safety precautions required when carrying out the assembly activities. 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:	EUCL3D-51
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow and make appropriate use of the specifications for the product or asset being checked

1.4 use all the correct tools and inspection equipment and check that they are in useable condition

1.5 carry out the checks in an appropriate sequence using approved methods and procedures

1.6 identify and assess any defects or variations from the specification and take appropriate action

1.7 report completion of compliance activities in line with organisational procedures

Learning outcome

The learner will:

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

2.1 obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation, specifications)

2.2 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

2.3 follow safe practice/ approved inspection and checking techniques at all times

2.4 check that all tools and measuring equipment are within current calibration/ certification dates

2.5 use lifting and slinging equipment in accordance with health and safety guidelines and procedures

2.6 ensure that all exposed openings are maintained free from foreign objects, dirt or other contamination

2.7 return all tools and equipment to the correct location on completion of the inspection activities

2.8 leave the work area in a safe and appropriate condition on completion of the activities

Learning outcome

The learner will:

3 Check the mechanical assembly using **twelve** of the following instruments and gauges:

3.1 rule or tape

3.2 micrometers

3.3 vernier gauges

3.4 protractors

3.5 dial test indicator

3.6 levels

3.7 feeler gauges

3.8 slip gauges

3.9 squares

3.10 temperature gauges

3.11 straight edges

3.12 gauges

3.13 torque wrench

3.14 flow meters

3.15 optical equipment

3.16 electrical measuring equipment

3.17 pressure gauges

3.18 other specific equipment

Learning outcome

The learner will:

4 Use the relevant equipment to measure and check **seven** of the following features:

4.1 flatness
4.2 alignment
4.3 fit/ working clearance
4.4 parallelism
4.5 distortion
4.6 squareness
4.7 level
4.8 angles
4.9 position/ location
4.10 torque
4.11 concentricity
4.12 verticality
4.13 dimensions
4.14 bonding strength

Learning outcome

The learner will:

5 Check the operational functions of the mechanical assembly, to include **ten** of the following:

5.1 rotation
5.2 speed
5.3 movement
5.4 tension
5.5 sequence
5.6 direction
5.7 pressure
5.8 balance
5.9 electrical in/ outputs
5.10 distance/ travel
5.11 sliding
5.12 flow
5.13 vibration
5.14 fluid power in/ outputs
5.15 noise

5.16 timing
5.17 reciprocation
5.18 temperature
5.19 safety mechanisms
5.20 leakage
5.21 power
5.22 service supplies (such as water, gas, air, electrical supply)

Learning outcome

The learner will:

6 Ensure that the completed assembly meets the specification, using **two** of the following checks:

6.1 trial
6.2 under power
6.3 fully operational
6.4 manual check

Learning outcome

The learner will:

7 Check that mechanical assemblies comply with **one** of the following quality and accuracy standards:

7.1 BS, ISO or BSEN standards and procedures
7.2 customer standards and requirements
7.3 company standards and procedures
7.4 specific system requirements

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the specific safety precautions to be taken while carrying out the mechanical assembly checks (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
8.2 the health and safety requirements of the work area in which they are carrying out the assembly checking activities, and the responsibility these requirements place on them
8.3 COSHH Regulations with regard to the substances used in the assembly process
8.4 the hazards associated with checking mechanical assemblies, and how to minimise them and reduce any risks

8.5 the personal protective equipment and clothing (PPE) to be worn during the assembly checking activities

8.6 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

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

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

8.9 the use of British, European and international standards used in determining if components and products are fit for purpose

8.10 the general principles of quality assurance systems and procedures

8.11 the various stages when the assembly should be checked, and to what level

8.12 preparations to be undertaken before the assembly is checked

8.13 the application of the various tools and equipment used to check the assembly

8.14 the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition

8.15 the procedure and methods used to check that tools and equipment are within calibration date

8.16 the quality control procedures to be followed when checking the assembly

8.17 how to conduct any necessary checks to ensure the safety, accuracy, position, security, function and completeness of the assembly

8.18 the types of defect that can be found on mechanical assemblies, and why they occur

8.19 how to detect assembly defects, and what to do to rectify them

8.20 the factors to be considered when determining if assembly components or products should be scrapped or modified

8.21 the documentation to be completed to confirm that the assembly has been properly checked

8.22 the importance of ensuring that all tools and equipment are returned to their correct location on completion of the assembly checking activities

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

Unit 351 Checking that completed assemblies comply with specification

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 352 Installing cable runs and circuits in marine structures

Unit level:	Level 3
GLH:	700
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 install and secure cable runs/circuits in marine structures, in accordance with approved procedures. They will be required to use appropriate installation drawings, specifications and documentation to install the various types of cabling/circuit. They will install the appropriate cable enclosures which could include conduit systems, trunking and traywork systems and they will be expected to position, align and secure these in the correct locations, using the specified/appropriate techniques and bulkhead/screen penetration and fastening devices. The circuitry could include vessel system cable assemblies, high voltage, medium voltage and low voltage power supply cables, internal and external lighting cables, components and appropriate screening techniques. They will be expected to terminate these cables to the relevant circuit breaker panels, distribution panels and relay panels. Their responsibilities will require them to comply with organisational policy and procedures for the electrical installation activities undertaken and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying electrical cable installation techniques and procedures. They will understand the circuits being installed and their application and will know about the installation methods, tools and techniques used, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the completed

	installation is to the required specification. They will understand the safety precautions required when carrying out the electrical installations. 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:	EUCL3D-52
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements - The apprentice must be able to:

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

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

1.3 follow all relevant drawings and specifications for the installation being carried out

1.4 use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition

1.5 install, position and secure the cabling and components in accordance with the specification

1.6 ensure that all necessary connections and terminations are complete

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 check that the installation is complete and that all components are fit for purpose

Learning outcome

The learner will:

2 Carry out **all** of the following during the electrical cable installation activities:

2.1 use the correct issue of structure/ vessel/ craft system installation drawings and technical documentation

2.2 use copies of relevant COSHH sheets, risk assessment, IET regulations and corporate procedures

2.3 check the calibration dates of tools to be used

2.4 obtain clearance to work on the system and observe the power isolation and safety procedures

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

2.6 leave the system in a recognised condition with any incomplete terminations clearly identified

2.7 leave the work area in a safe condition and to the prescribed category of cleanliness

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Learning outcome

The learner will:

3 Install **four** of the following types of wiring enclosures:

3.1 non-metallic conduit systems

3.2 metal trunking system

3.3 metal conduit systems

3.4 traywork systems

3.5 non-metallic trunking systems

3.6 bulkhead/ screen/ deck penetration

3.7 ladder racking

3.8 other (such as flat bar wireways)

Learning outcome

The learner will:

4 Apply **all** of the following installation methods and techniques:

4.1 marking out of location of trunking/ traywork/ conduit

4.2 positioning and securing trunking/ traywork/ conduit using mechanical fixings

4.3 drilling and hole preparation

4.4 levelling and alignment

Learning outcome

The learner will:

5 Install cable runs in support of **three** of the following types of marine electrical systems/ equipment:

5.1 three-phase power circuits

5.2 weapons systems

5.3 single phase power circuits
5.4 computer control equipment
5.5 direct current power circuits
5.6 high voltage/ power distribution supply/ system
5.7 rotating electrical equipment
5.8 communications systems
5.9 domestic electrical equipment
5.10 navigation systems
5.11 lighting and alarm systems
5.12 sensor systems (RADAR/ SONAR)
5.13 emergency/ temporary power supplies

Learning outcome

The learner will:

6 Install **four** of the following types of cable run:

6.1 multicore cables
6.2 mineral insulated (MI) cables
6.3 single core cables
6.4 screened cables
6.5 steel wire armoured (SWA) cables
6.6 fibre-optic cables
6.7 wiring looms

Learning outcome

The learner will:

7 Apply **three** of the following installation methods and techniques:

7.1 bending and forming conduit
7.2 bending and forming trays
7.3 bending and forming trunking
7.4 through-bulkhead penetration
7.5 other

Plus **four** more from the following:

7.6 allocating identification markings
7.7 heat shrinking

7.8 cable banding

7.9 sealing and protecting cable connections

7.10 earth bonding

7.11 taking electrostatic discharge (ESD) precautions

7.12 screening

Learning outcome

The learner will:

8 Make **six** of the following types of electrical connection:

8.1 module blocks
8.2 free plugs and sockets
8.3 terminal blocks
8.4 tray-mount sockets
8.5 earth bonding points
8.6 overall screened
8.7 soldered connections
8.8 fibre-optic terminations
8.9 multi-pin plugs and sockets
8.10 armoured (SWA) cable terminations
8.11 crimped connections
8.12 mineral insulated (MI) cable terminations
8.13 co-axial cable

Learning outcome

The learner will:

9 Produce electrical installations which comply with **one** of the following standards:

9.1 BS or ISO standards and procedures
9.2 customer (contractual) standards and requirements
9.3 company standards and procedures
9.4 specific system requirements
9.5 IET Regulations (current issue)
9.6 recognised compliance agency/ body's standards
9.7 other accepted international standards

Learning outcome

The learner will:

10 Complete the relevant documentation, to include **one** from the following and pass it to the appropriate people:

10.1 installation records
10.2 system log

10.3 job cards

10.4 vessel wiring documentation

10.5 system authorisation documentation

10.6 other specific recording method

Learning outcome

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

11.1 the specific safety practices and procedures that they need to observe when installing cable runs/ circuits in marine structures (including any specific legislation, regulations/ codes of practice for the activities, equipment or materials, particularly where the systems remain live whilst work is in hand)

11.2 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them

11.3 the hazards and risks associated with installing cable runs/ circuits in marine structures and with the tools and equipment used and how they can be minimised

11.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

11.5 the protective equipment that they need to use for both personal protection (PPE) and protection of the vessel/ equipment

11.6 the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps)

11.7 what constitutes a hazardous voltage and how to recognise victims of electric shock

11.8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

11.9 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

11.10 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers manuals, IET wiring regulations and other documentation used during the installation process (including BS and ISO schematics, symbols and terminology)

11.11 currency/ issue checks of the specifications they are working with

11.12 the cable runs/ circuits to be installed and their function within the particular system

11.13 the different types of cabling (multicore cables, single-core cables, SWA cables, MI cables, screened cables), fittings and their application

11.14 the different types of electrical components (plugs, switches, lighting and fittings, junction boxes, consumer units)

11.15 the techniques used to position, align, adjust carry, support, secure and distribute the cabling through the vessel

11.16 how to extract and insert cables in wiring enclosures (such as conduit, trunking, traywork and through-bulkhead penetration) without causing damage to cables or components

11.17 the methods and techniques to be used for soldering and de-soldering and the importance of adhering to these procedures

11.18 the methods and techniques to be used for crimping and heat-shrinking and the importance of adhering to these procedures

11.19 the various mechanical fasteners/ termination that will be used and their method of installation

11.20 the importance of ensuring that the completed installation is free from damage and of ensuring that any exposed components are protected and advisory notices are placed

11.21 how to conduct any necessary checks to ensure that the completed wiring complies with all required standards

11.22 the quality control procedures to be followed during the installation operations

11.23 the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities

11.24 methods of lifting, handling and supporting the cabling/ equipment during the installation activities

11.25 the use of seals, sealants, adhesives and anti-electrolysis barriers and the precautions that need to be taken

11.26 why electrical bonding is critical and why it must be both mechanically and electrically secure

11.27 the procedure for the safe disposal of waste materials

11.28 the tools and equipment used in the installation activities and their calibration/ care and control procedures

11.29 why tool/ equipment control is critical and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

11.30 the problems that can occur with the electrical wiring installation operations and how these can be overcome

11.31 the recording documentation to be completed for the activities undertaken

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

Unit 352 Installing cable runs and circuits in marine structures

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 353 Installing marine power generation and distribution equipment and systems

Unit level:	Level 3
GLH:	860
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 install marine power generation and distribution systems, in accordance with approved procedures. They will be required to use appropriate installation drawings, specifications and documentation to install the various items of equipment. They will be expected to position, align and secure equipment in its correct locations, using the specified/appropriate techniques and termination devices. The equipment will include batteries, generators, alternators, regulators, invertors, transformers, rectifier units, automatic voltage regulators and main contactors/circuit breakers. Their responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken and to report any problems with the installation that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality, accuracy and safety 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 applying installation techniques and procedures to marine power generation and distribution. They will understand the power supplies being installed and their application and will know about the installation tools, techniques and methods, in adequate 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 installation operations. 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:	EUCL3D-53
Endorsed by	Semta

Learning outcome

The learner will:

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow all relevant drawings and specifications for the installation being carried out

1.4 use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition

1.5 install, position and secure the equipment and components in accordance with the specification

1.6 ensure that all necessary connections to the equipment are complete

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 check that the installation is complete and that all components are free from damage

Learning outcome

The learner will:

2 Carry out **all** of the following during the installation of the power generation and distribution equipment:

2.1 use the correct issue of vessel/ craft/ structure installation drawings and technical documentation

2.2 use copies of relevant COSHH sheets, risk assessment and marine engineering standards

2.3 check the calibration dates of tools to be used

2.4 obtain clearance to work on the system and observe the power isolation and safety procedures

2.5 return all tools and equipment to the correct location on completion of the installation activities

2.6 leave the work area in a safe condition and to the prescribed category of cleanliness

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Learning outcome

The learner will:

3 Install marine electrical power generation and distribution equipment, which includes **four** of the following:

3.1 batteries

3.2 regulators

3.3 rectifier units

3.4 generators

3.5 inverters

3.6 main contactors/ breakers

3.7 alternators

3.8 transformers

3.9 change-over relays

3.10 starters and control gear

3.11 automatic voltage regulators (AVRs)

3.12 static frequency changers

3.13 junction boxes

Learning outcome

The learner will:

4 Use **all** of the following installation methods and techniques:

4.1 levelling and aligning

4.2 continuity checks

4.3 securing and locking

4.4 earth bonding

4.5 taking electrostatic discharge (ESD) precautions

Learning outcome

The learner will:

5 Use **three** of the following types of mechanical securing connections:

5.1 threaded fasteners

5.2 screws
5.3 quick release fasteners
5.4 locking devices
5.5 torque loaded bolts
5.6 other (to be specified by employer)

Learning outcome

The learner will:

6 Make **three** of the following types of electrical connection:

6.1 module blocks
6.2 free plugs
6.3 soldering/ brazing
6.4 terminal blocks
6.5 earth bonding points
6.6 tray-mounted sockets
6.7 crimping
6.8 other (to be specified by employer)

Learning outcome

The learner will:

7 Produce installations which comply with **one** of the following standards:

7.1 BS or ISO standards and procedures
7.2 company standards and procedures
7.3 specific system requirements
7.4 customer (contractual) standards and requirements
7.5 IET Regulations (current issue)
7.6 recognised compliance agency/ body's standards
7.7 other accepted international standards

Learning outcome

The learner will:

8 Complete the relevant documentation, to include **one** from the following, and pass it to the appropriate people:

8.1 installation records

8.2 system log

8.3 job cards

8.4 work authorisation documents

8.5 acceptance documentation

8.6 other specific recording method

Learning outcome

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

9.1 the specific safety practices and procedures that they need to observe when working with marine electrical power generation and distribution systems (including any specific legislation, regulations/ codes of practice for the activities, equipment or materials)

9.2 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them

9.3 the hazards associated with installing marine power generation and distribution systems and with the tools and equipment used and how they can be minimised

9.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

9.5 the protective equipment that they need to use for both personal protection (PPE) and protection of the vessel

9.6 the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps)

9.7 what constitutes a hazardous voltage and how to recognise victims of electric shock

9.8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

9.9 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

9.10 the interpretation of drawings, standards, quality control procedures and specifications used for the installation (including BS and ISO schematics, symbols and terminology)

9.11 how to carry out currency/ issue checks of the specifications they are working with

9.12 the components to be installed and their function within the particular power distribution system

9.13 the various mechanical fasteners that will be used and their method of installation (including threaded fasteners, special securing and locking devices)

9.14 the importance of using the specified fasteners for the particular installation and why they must not substitute others

9.15 why securing devices need to be locked and identified and the different methods that are used

9.16 the quality control procedures to be followed during the installation operations

9.17 the procedures for ensuring that they have the correct type of tools, equipment, electrical components and fasteners for the activities

9.18 the techniques used to position, align, adjust and secure the components to the system, without damage

9.19 methods of lifting, handling and supporting the components/ equipment during the installation activities

9.20 the use of seals, sealants, adhesives and anti-electrolysis barriers and the precautions that need to be taken

9.21 why unit electrical bonding and continuity is critical and why it must be both mechanically and electrically secure

9.22 the procedure for the safe disposal of waste materials

9.23 how to conduct any necessary checks to ensure the system integrity, functionality, accuracy and quality of the installation

9.24 how to recognise installation defects (such as misalignment, ineffective fasteners or terminations, damage or contamination)

9.25 the importance of ensuring that the completed installation is to the category of cleanliness prescribed and of ensuring that any exposed components or pipe ends are correctly covered/ protected and warning notices are fitted

9.26 the tools and equipment used in the installation activities and their calibration/ care and control procedures

9.27 why tool/ equipment control is critical and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

9.28 the problems that can occur with the installation operations and how these can be overcome

9.29 the recording documentation to be completed for the activities undertaken and where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

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

Unit 353 Installing marine power generation and distribution equipment and systems

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 354 Installing marine lighting, alarm, detection and monitoring equipment and systems

Unit level:	Level 3
GLH:	860
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 install marine lighting, alarm, detection and monitoring systems, in accordance with approved procedures. They will be required to use appropriate installation drawings, specifications and documentation to install the various types of equipment, modules and circuits. They will be expected to position, align and secure the equipment and circuits in the correct locations, using the specified/appropriate techniques and terminating devices. The equipment to be installed will include lighting arrangements (such as general domestic, underwater, floodlighting, and intrinsically safe systems) fire, flood, chemical and biological detection and warning systems. Their responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken and to report any problems with the installation activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying installation techniques and procedures to marine lighting, alarm, detection and monitoring systems. They will understand the systems or equipment being installed and their application and will know about the installation techniques, tools and methods, in adequate depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the installation operations. 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:	EUCL3D-54
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow all relevant drawings and specifications for the installation being carried out

1.4 use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition

1.5 install, position and secure the equipment and components in accordance with the specification

1.6 ensure that all necessary connections to the equipment are complete

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 check that the installation is complete and that all components are free from damage

Learning outcome

The learner will:

2 Carry out **all** of the following during the installation of the lighting, alarm, detection and monitoring equipment:

2.1 use the correct issue of vessel/ craft/ structure installation drawings and technical documentation

2.2 use copies of relevant COSHH sheets, risk assessment and marine engineering standards

2.3 check the calibration validity of tools and meters to be used

2.4 obtain clearance to work on the equipment/ system and observe the power isolation and safety procedures

2.5 carry out the appropriate tests on the installed system

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

2.7 leave the work area in a safe condition and to the prescribed category of cleanliness

Learning outcome

The learner will:

3 Install **two** of the following marine lighting systems:

3.1 domestic

3.2 general

3.3 discreet

3.4 emergency

3.5 navigational

3.6 underwater

3.7 magazine

3.8 operating theatre

3.9 floodlighting

3.10 high risk zone

3.11 portable

Learning outcome

The learner will:

4 Install **one** of the following marine detection, warning and monitoring systems:

4.1 flood and liquid level detection

4.2 chemical detection

4.3 nuclear radiation detection

4.4 security/ intruder detection

4.5 biological detection

4.6 fire detection

4.7 plant and equipment monitoring systems

4.8 machinery control and surveillance systems (MYCAS)

4.9 other indicators and / or alarm systems

Learning outcome

The learner will:

5 Use **all** of the following installation methods and techniques:

5.1 levelling and aligning
5.2 screening
5.3 earth bonding
5.4 continuity checks
5.5 securing and locking
5.6 taking ESD precautions
5.7 electrical isolation and protection

Learning outcome

The learner will:

6 Use **three** of the following types of mechanical securing connections:

6.1 threaded fasteners
6.2 locking devices
6.3 screws
6.4 torque loaded bolts
6.5 quick-release fasteners

Learning outcome

The learner will:

7 Make **five** of the following types of electrical connection:

7.1 co-axial
7.2 overall screened
7.3 terminal blocks
7.4 tray-mounted sockets
7.5 tri-axial
7.6 module blocks
7.7 multi pin plugs/ sockets
7.8 earth bonding points
7.9 multicore cables
7.10 fibre optics
7.11 crimping
7.12 soldering/ brazing
7.13 other (to be specified by the employer).

Learning outcome

The learner will:

8 Produce installations which comply with **one** of the following standards:

8.1 BS or ISO standards and procedures
8.2 specific system requirements
8.3 IET Regulations (current issue)
8.4 customer (contractual) standards and requirements
8.5 company standards and procedures
8.6 recognised compliance agency/ body's standards
8.7 other accepted international standards

Learning outcome

The learner will:

9 Complete the relevant documentation, to include **one** from the following and pass it to the appropriate people:

9.1 installation records
9.2 job cards
9.3 system log
9.4 work authorisation documents
9.5 vessel wiring documentation
9.6 other specific recording method

Learning outcome

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

10.1 the specific safety practices and procedures that they need to observe when working with marine lighting/ alarm systems (including any specific legislation, regulations/ codes of practice for the activities, equipment or materials)
10.2 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
10.3 the hazards associated with the installation of marine lighting/ alarm systems and with the tools and equipment used and how they can be minimised
10.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

10.5 the protective equipment that they need to use for both personal and environmental protection (PPE) and that of the equipment/ system being installed

10.6 the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps)

10.7 what constitutes a hazardous voltage and how to recognise victims of electric shock

10.8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

10.9 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

10.10 the interpretation of drawings, standards, quality control procedures and specifications used for the installation (including BS and ISO schematics, symbols and terminology)

10.11 how to carry out currency/ issue checks of the specifications they are working with

10.12 the items, circuits and components to be installed and their function within the particular marine lighting or alarm system

10.13 the various mechanical fasteners that will be used and their method of installation (including threaded fasteners, special securing and locking devices)

10.14 the importance of using the specified electrical terminations/ connections/ fasteners for the particular installation process and why they must not substitute others

10.15 why securing devices need to be locked and identified and the different methods that are used

10.16 the torque loading requirements on the fasteners and what to do if these loadings are exceeded or not achieved

10.17 the quality control procedures to be followed during the installation operations

10.18 the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities

10.19 the techniques used to position, align, adjust and secure the equipment, components and circuitry to the vessel/ compartment structure, without damage

10.20 methods of lifting, handling and supporting the components/ equipment during the installation activities

10.21 the use of seals, sealants, adhesives and anti-electrolysis barriers and the precautions that need to be taken

10.22 why unit electrical bonding/ earth prevention and continuity is critical and why it must be both mechanically and electrically secure

10.23 how to conduct any necessary checks to ensure the system integrity, functionality, accuracy and quality of the installation

10.24 how to recognise equipment defects (such as degradation of finish, wear, misalignment, ineffective fasteners, damage or contamination, lack of fitness for purpose)

10.25 the importance of ensuring that the completed installation is to the category of cleanliness prescribed and that any exposed components or pipe ends are correctly covered/ protected and warning notices are fitted

10.26 the procedure for the safe disposal of waste materials

10.27 the tools equipment and measuring devices used in the installation activities and their calibration/ care and control procedures

10.28 why tool/ equipment control is critical and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

10.29 the problems that can occur with the installation operations and how these can be overcome

10.30 the recording documentation to be completed for the activities undertaken and where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

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

Unit 354 Installing marine lighting, alarm, detection and monitoring equipment and systems

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 355 Installing marine electrical/ electronic equipment and systems

Unit level:	Level 3
GLH:	1300
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 install marine electrical/electronic equipment and systems, in accordance with approved procedures. They will be required to use appropriate installation drawings, specifications and documentation to install the various items of equipment. They will be expected to position, align and secure equipment in its correct locations, using the specified/appropriate techniques and termination devices. The equipment and systems include power generation and distribution, navigation, computer, communication, weapons, electrical rotating, domestic, lighting, alarm, detection and monitoring Their responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken and to report any problems with the installation that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality, accuracy and safety 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 applying installation techniques and procedures on marine electrical/electronic equipment and systems. They will understand the equipment and systems being installed and their application and will know about the installation tools, techniques and methods, in adequate 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 installation operations. 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:	EUCL3D-55
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow all relevant drawings and specifications for the installation being carried out

1.4 use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition

1.5 install, position and secure the equipment and components in accordance with the specification

1.6 ensure that all necessary connections to the equipment are complete

1.7 deal promptly and effectively with problems within their control and report those that cannot be solved

1.8 check that the installation is complete and that all components are free from damage

Learning outcome

The learner will:

2 Carry out **all** of the following during the installation of the power generation and distribution equipment:

2.1 use the correct issue of vessel/ craft/ structure installation drawings and technical documentation

2.2 use copies of relevant COSHH sheets, risk assessment and marine engineering standards

2.3 check the calibration dates of tools and equipment to be used

2.4 obtain clearance to work on the system and observe the power isolation and safety procedures

2.5 return all tools and equipment to the correct location on completion of the installation activities

2.6 leave the work area in a safe condition and to the prescribed category of cleanliness

Learning outcome

The learner will:

3 Carry out installation activities on **two** of the following types of marine electrical/electronic systems and equipment:

3.1 power generation and distribution equipment and systems

3.2 navigational equipment and systems

3.3 sensor equipment and systems

3.4 computer equipment and systems

3.5 weapons equipment and equipment

3.6 electrical rotating machines and domestic equipment

3.7 lighting, alarm, detection and monitoring equipment and systems

3.8 communication equipment and systems

Learning outcome

The learner will:

4 Install **twelve** of the following marine electrical/ electronic components/ equipment:

4.1 junction boxes

4.2 wiring looms

4.3 cables and wires

4.4 single phase motors

4.5 direct current motors

4.6 three phase motors

4.7 fans/ extractors

4.8 lighting (such as general, domestic, emergency, navigational, underwater etc)

4.9 alarm/ detection/ monitoring equipment and sensors (such as fire, liquid, chemical, radiation, intruder, biological and obstacle)

4.10 radio/ intercom/ recording units

4.11 in board entertainment systems

4.12 switches

4.13 batteries

4.14 regulators

4.15 rectifier units

4.16 generators

4.17 inverters
4.18 contactors/ breakers
4.19 alternators
4.20 transformers
4.21 starters and control gear
4.22 change over relays
4.23 automatic voltage regulators (AVRs)
4.24 static frequency changers
4.25 aerials
4.26 receiver units
4.27 control panels/ units
4.28 transmitter units
4.29 indicator units
4.30 interface network units
4.31 scanners
4.32 power supply units
4.33 processors
4.34 Intermediate frequency unit (IFU)
4.35 microwave generators
4.36 wave guides
4.37 transducers
4.38 computer mainframe
4.39 linking highways
4.40 highway remote controls
4.41 digital data links
4.42 personal computers
4.43 peripheral devices (such as printers and plotters)
4.44 laser guidance units
4.45 heat seeking units
4.46 radar units
4.47 sonar equipment
4.48 weapon fusing units
4.49 weapon firing units
4.50 other employer specific equipment

Learning outcome

The learner will:

5 Use **twelve** of the following installation methods and techniques:

5.1 electrical isolation/ protection checks
5.2 marking/ setting out of locating and securing positions
5.3 preparing holes (such as drilling, inserting grommets, protection inserts)
5.4 positioning equipment/ components
5.5 tagging/ labelling of components
5.6 cable spacing/ tensioning
5.7 connecting wires and cables
5.8 levelling and aligning
5.9 setting/ adjusting clearances
5.10 securing and locking
5.11 earth bonding
5.12 taking electrostatic discharge (ESD) precautions
5.13 screening
5.14 torque setting
5.15 replacing all damaged or defective components
5.16 carry out any required tests or checks before powering up
5.17 functionally testing the completed system
5.18 other (to be specified by employer)

Learning outcome

The learner will:

6 Make **ten** of the following types of electrical and mechanical connections:

6.1 module blocks
6.2 terminal blocks
6.3 free plugs and sockets
6.4 soldering/ brazing
6.5 terminal blocks
6.6 earth bonding points
6.7 tray-mounted sockets
6.8 crimping
6.9 co-axiel
6.10 tri-axial
6.11 multicore cable
6.12 fibre-optic
6.13 multi-pin plugs/ sockets
6.14 specific radio and video connections
6.15 threaded fasteners

6.16 quick release fasteners
6.17 locking devices
6.18 torque loaded bolts
6.19 wire locking
6.20 other (to be specified by employer)

Learning outcome

The learner will:

7 Produce installations which comply with **one** of the following standards:

7.1 BS or ISO standards and procedures
7.2 company standards and procedures
7.3 specific system requirements
7.4 customer (contractual) standards and requirements
7.5 current IET Regulations
7.6 recognised compliance agency/ body's standards
7.7 other accepted international standards

Learning outcome

The learner will:

8 Complete the relevant documentation, to include **one** from the following:

8.1 installation record
8.2 system log
8.3 job cards
8.4 acceptance documentation
8.5 set to work test/ performance log
8.6 other specific documentation

Learning outcome

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

9.1 the specific safety practices and procedures that they need to observe when installing marine electrical/ electronic components, equipment and systems (including any specific legislation, regulations/ codes of practice for the activities, equipment or materials)
9.2 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them

9.3 the hazards associated with installing marine electrical/ electronic components, equipment and systems and with the tools and equipment used and how they can be minimised

9.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

9.5 the protective equipment that they need to use for both personal protection (PPE) and protection of the vessel

9.6 the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps)

9.7 what constitutes a hazardous voltage and how to recognise victims of electric shock

9.8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

9.9 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

9.10 the interpretation of drawings, standards, quality control procedures and specifications used for the installation (including BS and ISO schematics, symbols and terminology)

9.11 how to carry out currency/ issue checks of the specifications/ drawings/ documentation they are working with

9.12 the components/ equipment to be installed and their function within vessel system

9.13 the various mechanical fasteners that will be used and their method of installation (including threaded fasteners, special securing and locking devices)

9.14 the importance of using the specified fasteners for the particular installation and why they must not substitute others

9.15 why securing devices need to be locked and identified and the different methods that are used

9.16 the quality control procedures to be followed during the installation operations

9.17 the procedures for ensuring that they have the correct type of tools, equipment, electrical components and fasteners for the activities

9.18 the techniques used to position, align, adjust and secure the components to the system, without damage

9.19 methods of lifting, handling and supporting the components/ equipment during the installation activities

9.20 the use of seals, sealants, adhesives and anti-electrolysis barriers and the precautions that need to be taken

9.21 why unit electrical bonding and continuity is critical and why it must be both mechanically and electrically secure

9.22 the procedure for the safe disposal of waste materials

9.23 how to conduct any necessary checks to ensure the system integrity, functionality, accuracy and quality of the installation

9.24 how to recognise installation defects (such as misalignment, ineffective fasteners or terminations, damage or contamination)

9.25 the importance of ensuring that the completed installation is to the category of cleanliness prescribed and of ensuring that any exposed components are correctly covered/ protected and warning notices are fitted

9.26 the tools and equipment used in the installation activities and their calibration/ care and control procedures

9.27 why tool/ equipment control is critical and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

9.28 the problems that can occur with the installation operations and how these can be overcome

9.29 the recording documentation to be completed for the activities undertaken and where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

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

Unit 355 Installing marine electrical/ electronic equipment and systems

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 356 Overhauling marine electrical/ electronic plant, equipment and systems

Unit level:	Level 3
GLH:	860
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 carry out a complete overhaul of marine electrical/electronic plant, equipment and systems, in accordance with approved procedures. The overhauling activity can take place on-board the vessel or in a workshop. The marine electrical/electronic plant, equipment and systems includes areas such as power generation and distribution, navigational, sensors, computer, weapons, electrical rotating machines, domestic, lighting alarm, detection and monitoring and communication. The overhauling activities will involve stripping the equipment down to component level, cleaning and inspecting the components for wear, replacing all defective and `lifed' components and rebuilding the equipment in line with the overhauling specification. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, secured, adjusted and the overhauled plant, equipment and system is functionally tested. Their responsibilities will require them to comply with organisational policy and procedures for the overhauling activities undertaken and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding

	of their work and will provide an informed approach to applying overhauling procedures to marine electrical/electronic plant, equipment and systems. They will understand the dismantling and reassembly methods and procedures used and their application. They will know how the equipment functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities, correcting faults and ensuring that the equipment functions to the required specification. In addition, they will have sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the overhaul activity. They will understand the safety precautions required when carrying out the overhaul activities associated with marine electrical/electronic plant, equipment and systems, including those for handling, moving and lifting the 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, both ashore and afloat. 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:	EUCL3D-56
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The learner must be able to:

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

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

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out the maintenance activities in the specified sequence and in an agreed time scale

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

1.7 complete relevant maintenance records accurately and pass them on to the appropriate person

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

Learning outcome

The learner will:

2 Carry out **all** of the following during the overhaul of marine electrical/electronic plant, equipment and systems:

2.1 use the correct issue of company and/ or manufacturers' drawings and overhaul documentation
2.2 adhere to risk assessment, COSHH and other relevant safety standards
2.3 adhere to the appropriate safe isolation of equipment/ system procedures (such as mechanical, electricity, gas, air or fluids, steam)
2.4 confirm and check that all appropriate equipment/ systems have been isolated prior to undertaking any overhaul activities
2.5 take all necessary ESSD precautions where required
2.6 provide safe access and working arrangements for the overhauling area
2.7 use lifting and handling equipment, in accordance with health and safety guidelines and procedures
2.8 carry out the overhauling activities using appropriate tools, techniques and procedures
2.9 comply with organisational requirements with regard to renewal or replacement of existing components
2.10 ensure that the overhauled components meet the required specification
2.11 ensure that there are no foreign objects left in the completed equipment

Learning outcome

The learner will:

3 Carry out overhauling activities on **six** of the following types of marine electrical/electronic plant systems and equipment:

3.1 power generation equipment and systems
3.2 power distribution equipment and systems
3.3 navigational equipment and systems
3.4 sensor equipment and systems
3.5 computer equipment and systems
3.6 weapons equipment and systems
3.7 electrical rotating machines and equipment
3.8 domestic equipment
3.9 lighting, equipment and systems

3.10 alarm, detection and monitoring equipment and systems

3.11 communication equipment and systems

3.12 renewable energy equipment and systems

3.13 other employer specific equipment

Learning outcome

The learner will:

4 Carry out **twelve** of the following activities on equipment being overhauled:

4.1 apply appropriate and approved fault finding techniques

4.2 use diagnostic aids (such as manuals, flow charts, troubleshooting guides, electronic aids, equipment records)

4.3 disconnecting and re connecting wires and cables

4.4 dismantling equipment to unit/ sub-assembly level

4.5 dismantling units to component level

4.6 proof-marking/ labelling of components

4.7 checking components for wear and serviceability

4.8 replacing all 'lifed' items (such as seals, contacts, screws)

4.9 replacing all damaged or defective components

4.10 setting, aligning and adjusting replaced components

4.11 re-assembling components to sub-assembly level

4.12 applying gaskets and sealants/ adhesives

4.13 measure and check operating clearances

4.14 removing and refitting electrical components

4.15 bedding in motors/ brushes

4.16 remove oil samples for testing

4.17 applying torque settings

4.18 stting/ adjusting control equipment

4.19 electrical bonding of components

4.20 tightening fastenings in the correct sequence to the required torque

4.21 balancing of rotating components (such as armatures and turbines)

4.22 taking and recording critical measurements

4.23 re-assembling sub-assemblies to unit level

4.24 securing components using mechanical fasteners and threaded devices

4.25 applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)

4.26 making `off-load' checks before starting up

4.27 carry out any required tests or checks before powering up

4.28 functionally testing the plant, equipment or system including safety devices

4.29 other employer specific equipment

Learning outcome

The learner will:

5 Replace a range of components to include **twenty** of the following:

5.1 junction boxes
5.2 wiring looms
5.3 cables and wires
5.4 electrical connectors
5.5 single phase motors
5.6 direct current motors
5.7 three phase motors
5.8 motor brushes
5.9 shafts
5.10 couplings
5.11 bearings
5.12 fans/ extractors
5.13 casings and covers
5.14 radio/ intercom/ recording units
5.15 in board entertainment system modules
5.16 circuit boards
5.17 electronic modules/ components
5.18 switches
5.19 sensors
5.20 batteries including those used for emergency supplies
5.21 regulators
5.22 rectifier units
5.23 circuit protection devices
5.24 generators
5.25 inverters
5.26 contactors/ breakers
5.27 alternators
5.28 transformers
5.29 starters and control gear
5.30 change over relays
5.31 automatic voltage regulators (AVRs)
5.32 static frequency changers
5.33 aerials
5.34 receiver units
5.35 control panels/ units

5.36 transmitter units
5.37 indicator units
5.38 interface network units
5.39 scanners
5.40 power supply units
5.41 processors
5.42 intermediate frequency unit (IFU)
5.43 microwave generators
5.44 wave guides
5.45 transducers
5.46 linking highways
5.47 highway remote controls
5.48 digital data links
5.49 peripheral devices (such as printers and plotters)
5.50 laser guidance units
5.51 heat seeking units
5.52 radar units
5.53 sonar equipment
5.54 weapon fusing units
5.55 weapon firing units
5.56 mechanical fasteners/ retaining/ locking devices
5.57 conduit/ trunking
5.58 pipes/ hoses
5.59 other employer specific equipment

Learning outcome

The learner will:

6 Overhaul marine electrical/ electronic plant, equipment and systems in compliance with **one** of the following:

6.1 BS or ISO standards and procedures
6.2 customer (contractual) standards and requirements
6.3 company standards and procedures
6.4 specific system requirements
6.5 recognised compliance agency/ body's standards
6.6 other accepted international standards

Learning outcome

The learner will:

7 Complete relevant documentation to include **one** of the following and pass onto the appropriate people:

7.1 job cards

7.2 permit to work/ formal risk/ COSHH assessment

7.3 maintenance/ overhaul log or report

7.4 measurement/ inspection record

7.5 other specific reporting method

Learning outcome

8 Knowledge and understanding -The learner must know and understand:

8.1 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility they place on them

8.2 the specific health and safety precautions needed to be applied during the overhauling procedure and their effects on others

8.3 hazards associated with carrying out overhauling activities on marine electrical/ electronic plant equipment and systems

8.4 how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire-fighting and resuscitation of personnel)

8.5 the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the overhaul

8.6 The importance of using anti-electrolysis precautions/ barriers and the risks if these are not adhered to

8.7 the precautions to be taken to prevent electrostatic discharge (ESSD) damage to circuits and sensitive components (such as use of earthed wrist straps)

8.8 what constitutes a hazardous voltage and how to recognise victims of electric shock

8.9 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

8.10 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

8.11 how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/ maintenance reports, symbols used in documents needed in the overhauling process

8.12 how to carry out currency/ issue checks of the documentation/ specifications you are working with

8.13 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul

8.14 company policy on the repair/ replacement of components during the overhauling process

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

8.16 the equipment operating and control procedures to be applied during the overhauling activity

8.17 the sequence to be adopted for the dismantling/ reassembling of various types of marine electrical/ electronic equipment, assemblies and components

8.18 the methods and techniques used to dismantle/ reassemble marine electrical/ electronic systems, plant and equipment components

8.19 methods of checking that components are fit for purpose, how to identify defects and wear characteristics and the need to replace `lifed' items (such as filters, seals and gaskets)

8.20 the process used to identify any contaminants in the equipment/ system

8.21 the damage that can be caused if any contaminants or foreign objects are not removed

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

8.23 the importance of ensuring that fasteners are tightened to the required torque

8.24 the importance of using the specified electrical terminations/ connections and why they must not substitute others

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

8.26 the identification and application of different types of locking and securing devices

8.27 how to identify the different types and uses of different system components

8.28 the type and uses of measuring and test equipment

8.29 how to use lifting and handling equipment in the overhaul activity

8.30 the problems associated with the overhauling of marine electrical/ electronic systems plant and equipment and how they can be overcome

8.31 the generation of technical documentation and/ or reports following completion of the overhauling activity

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

8.33 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

Unit 356 Overhauling marine electrical/ electronic plant, equipment and systems

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.

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**
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City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

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City & Guilds

1 Giltspur Street

London EC1A 9DD

T +44 (0)844 543 0000

F +44 (0)20 7294 2413

www.cityandguilds.com