

# Level 3 NVQ Diploma in Fabrication and Welding – Welding Machine Setting and Operating (1782-30)

September 2018 version 1.2



## Qualification at a glance

<b>Subject area</b>	<b>Engineering</b>
<b>City &amp; Guilds number</b>	1782-30
<b>Age group approved</b>	16+
<b>Entry requirements</b>	None
<b>Assessment</b>	Portfolio of evidence
<b>Automatic approval</b>	Available
<b>Support materials</b>	Centre handbook
<b>Registration/ certification dates</b>	See City & Guilds website for details

<b>Title and level</b>	<b>GLH</b>	<b>TQT</b>	<b>City &amp; Guilds number</b>	<b>Accreditation number</b>
Level 3 NVQ Diploma in Fabrication and Welding Engineering – Welding Machine Setting and Operating	393	1240	1782-30	601/0078/3

<b>Version and date</b>	<b>Change detail</b>	<b>Section</b>
1.1 August 2017	Added TQT details	<b>Qualification at a glance, Structure</b>
	Deleted QCF	<b>Throughout</b>
1.2 September 2018	Changed from a seven to a nine	<b>Unit 201 Assessment criteria 2.3</b>



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# 1 Introduction

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

<b>Area</b>	<b>Description</b>
Who is the qualification for?	It is for learners who work or want to work as fabrication and welding engineers in the engineering sector.
What does the qualification cover?	It allows learners to learn, develop and practise the skills required for employment and/or career progression in the fabrication and welding engineering sector.
Is the qualification part of a framework or initiative?	It serves as a competence qualification, in the Engineering Apprenticeship framework.
Who did we develop the qualification with?	It was developed in association with SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
What opportunities for progression are there?	It allows learners to progress into employment or to the following City & Guilds qualifications: <ul style="list-style-type: none"><li>• Level 3 NVQ Extended Diploma in Fabrication and Welding Engineering</li></ul>

## Structures

The minimum credit required to achieve this qualification is **160 credits**.

To achieve the **Level 3 NVQ Diploma in Fabrication and Welding Engineering (Welding Machine Setting and Operating)**, learners **must** achieve **15** credits from the mandatory units (201-202, 303) and **must** achieve a minimum of **80** credits from any **two** of the optional group A (units 367-369), plus a minimum of **45** credits and **one** more unit from optional group B (units 310-315) plus a minimum of **20** credits and **one** unit from optional group C, units (209-213, 321).

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
<b>Mandatory</b>			
A/601/5013	201	Complying with statutory regulations and organisational safety requirements	5
Y/601/5102	202	Using and interpreting engineering data and documentation	5
K/601/5055	303	Working efficiently and effectively in engineering	5
<b>Optional group A</b>			
K/600/5755	367	Resolving Engineering Problems	40
J/600/5763	368	Implementing Engineering Activities	40
D/600/5767	369	Monitoring Engineering Activities	40
<b>Optional group B</b>			
K/504/9177	310	Preparing Mechanised Arc Welding Equipment for Production	70
M/504/9178	311	Preparing Resistance Spot, Seam and Projection Welding Machines for Production	45
T/504/9179	312	Preparing Laser Welding Machines for Production	70
K/504/9180	313	Preparing Electron Beam Welding Machines for Production	70
M/504/9181	314	Preparing Friction Welding Machines for Production	65
T/504/9182	315	Preparing Brazing Machines for Production	45
<b>Optional group C</b>			
H/504/9212	209	Welding Materials with Mechanised Arc Welding Equipment	37
K/504/9213	210	Welding Materials using Resistance Spot, Seam and Projection Welding Machines	35

M/504/9214	211	Welding Materials using Laser Welding Machines	37
T/504/9215	212	Welding Materials using Electron Beam Welding Machines	37
A/504/9216	213	Welding Materials using Friction Welding Machines	35
A/504/9183	321	Joining Materials using Brazing Machines	20

- If the learner is undertaking this pathway as part of the Extended Diploma, the Extended Diploma handbook must be referred to in order to determine the additional qualification and credit requirements.

### Total Qualification Time

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT
Level 3 NVQ Diploma in Fabrication and Welding Engineering – Welding Machine Setting and Operating	393	1240



## 2 Centre requirements

### Approval

Centres currently offering the City & Guilds Level 3 NVQ in Fabrication and Welding Engineering (1781) will be automatically approved to run this new qualification.

To offer this qualification 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 qualification before designing a course programme.

### Resource requirements

#### Centre staffing

Staff delivering this qualification 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.

#### Assessors and internal verifier

##### Assessor Requirements to Demonstrate Effective Assessment Practice

Assessment must be carried out by competent Assessors that as a minimum must hold the Level 3 Award in Assessing Competence in the Work Environment. Current and operational assessors that hold units D32 and/or D33 or A1 and/or A2 as appropriate for the assessment requirements set out in this Unit Assessment Strategy. However, they will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace assessment to the most up to date National Occupational Standards (NOS)

##### Assessor Technical Requirements

Assessors must be able to demonstrate that they have verifiable, relevant and sufficient technical competence to evaluate and judge performance and knowledge evidence requirements as set out in the relevant unit learning outcomes and associated assessment criteria.

This will be demonstrated either by holding a relevant technical qualification or by proven industrial experience of the technical areas to be assessed. The assessor's competence must, at the very least, be at the same level as that required of the learner(s) in the units being assessed.

Assessors must also be:

Fully conversant with the Awarding Organisation's assessment recording documentation used for the NVQ units against which the assessments and verification are to be carried out, other relevant documentation and system and procedures to support the QA process.

### **Verifier Requirements (internal and external)**

Internal quality assurance (Internal Verification) must be carried out by competent Verifiers that as a minimum must hold the Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practices. Current and operational Internal Verifiers that hold internal verification units V1 or D34 will not be required to achieve the Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the Level 3 Award in Assessing Competence in the Work Environment.

External quality assurance (**External Verification**) must be carried out by competent External Verifiers that as a minimum must hold the Level 4 Award in the External Quality Assurance of Assessment Processes and Practices. Current and operational External Verifiers that hold external verification units V2 or D35 will not be required to achieve the Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the Level 3 Award in Assessing Competence in the Work Environment

External and Internal Verifiers will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace Quality Assurance (verification) of Assessment Processes and Practices to the most up to date National Occupational Standards (NOS) Verifiers, both Internal and External, will also be expected to be fully conversant with the terminology used in the NVQ units against which the assessments and verification are to be carried out, the appropriate Regulatory Body's systems and procedures and the relevant Awarding Organisation's documentation,

### **Continuing professional development (CPD)**

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice, and that it takes account of any national or legislative developments.

### **Candidate entry requirements**

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and



opportunity to gain the qualification successfully so should have the opportunity to gather work based evidence.

The SEMTA Engineering Manufacture apprenticeship framework suggests that:

Employers would be interested in candidates that:

- Are keen and motivated to work in an engineering environment
- Are willing to undertake a course of training both on-the-job and off-the-job and apply this learning in the workplace
- Have previous work experience or employment in the sector
- Have completed a 14 to 19 Diploma in Engineering or Manufacturing
- Have completed a Young Apprenticeship in Engineering or other related area
- Have GCSEs in English, Maths and Science
- Have completed tests in basic numeracy, literacy and communication skills and have spatial awareness.

As a guide, the Engineering Manufacturing framework is suitable for applicants who have five GCSEs grades D to E in English, Maths and Science. The selection process on behalf of employers may include initial assessment where applicants will be asked if they have any qualifications or experience that can be accredited against the requirements of the apprenticeship. They may also be required to take tests in basic numeracy and literacy, communications skills and spatial awareness. There may also be an interview to ensure applicants have selected the right occupational sector and are motivated to become an apprentice, as undertaking an apprenticeship is a major commitment for both the individual and the employer.'

**Assessment Environment** (extract from SEMTA Unit Assessment Strategy 1 January 2011)

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

- The use of high quality, realistic simulations/replication, which impose pressures which are consistent with workplace expectations, should only be used in relation to the assessment of the following:-
  - rare or dangerous occurrences, such as those associated with health, safety and the environment issues, emergency scenarios and rare operations at work;
  - the response to faults and problems for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence;
  - aspects of working relationships and communications for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence.

Simulations/replications will require prior approval from centres City & Guilds external verifier/qualification consultant and should be designed in relation to the following parameters: -

- the environment in which simulations take place must be designed to match the characteristics of the working environment
- competencies achieved via simulation/replication must be transferable to the working environment
- simulations which are designed to assess competence in dealing with emergencies, accidents and incidents must be verified as complying with relevant health, safety and environmental legislation by a competent health and safety/environmental control officer before being used
- simulated activities should place learners under the same pressures of time, access to resources and access to information as would be expected if the activity was real
- simulated activities should require learners to demonstrate their competence using plant and/or equipment used in the working environment
- simulated activities which require interaction with colleagues and contacts should require the learner to use the communication media that would be expected at the workplace
- for health and safety reason simulations need not involve the use of genuine substances/materials. Any simulations which require the learner to handle or otherwise deal with materials substances/should ensure that the substitute takes the same form as in the workplace

### **Age restrictions**

City & Guilds cannot accept any registrations for candidates under 16 as this qualification is not approved for under 16s.

Legal restrictions apply to candidates under the age of 18 working unsupervised with children. Centres and candidates should be fully aware of minimum age requirements in their home nation and any implications for completing assessments.



## 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 qualification[s].
- any units they have already completed, or credit they have accumulated which is relevant to the qualification[s].
- 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.

### Recommended delivery strategies

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

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their candidates
- satisfies the requirements of the qualifications.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualifications. This might include the following:

- literacy, language and/or numeracy
- personal learning and thinking
- personal and social development
- employability

Where applicable, this could involve enabling the candidate to access relevant qualifications covering these skills.

### Recording documents

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

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

### Assessment of the qualification

Candidates must:

- have a completed portfolio of evidence for each unit chosen

### Time constraints

The following must be applied to the assessment of this qualification:

- Candidates must finish their assessment within the period of registration

### Evidence requirements

#### Carrying Out Assessments

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

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

#### Minimum Performance Evidence Requirements

Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent, competent performance for a unit, a minimum of 3 different examples of performance must be provided, and must be sufficient to show that the assessment criteria have been achieved to the prescribed standards. It is possible that some of the bulleted items in the assessment criteria may be covered more than once. The assessor and learner need to devise an assessment plan to ensure that performance evidence is sufficient to cover all the specified assessment criteria and which maximises the opportunities to gather evidence. Where applicable, performance evidence may be used for more than one unit.

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

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

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

Performance evidence must be a combination of:

- outputs of the learner's work, such as items that have been manufactured, installed, maintained, designed, planned or quality assured, and documents produced as part of a work activity together with:
- evidence of the way the learner carried out the activities such as witness testimonies, assessor observations or authenticated learner reports, records or photographs of the work/activity carried out, etc.

Competent performance is more than just carrying out a series of individual set tasks. Many of the units contain statements that require the learner to provide evidence that proves they are capable of combining the various features and techniques. Where this is the case, separate fragments of evidence would not provide this combination of features and techniques and will not, therefore, be acceptable as demonstrating competent performance.

If there is any doubt as to what constitutes valid, authentic and reliable evidence, the internal and/or external verifier (qualifications consultant) should be consulted.

### **Assessing knowledge and understanding**

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

Knowledge and understanding can be demonstrated in a number of different ways. Semta (the Sector Skills Council) expects oral questioning and practical demonstrations to be used, as these are considered the most appropriate for these units. Assessors should ask enough questions to make sure that the learner has an appropriate level of knowledge and understanding, as required by the unit.

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

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

### **Witness testimony**

Where 'observation is used to obtain performance evidence, this must be carried out against the unit assessment criteria. Best practice would

require that such observation is carried out by a qualified Assessor. If this is not practicable, then alternative sources of evidence may be used.

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

### **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 allowed and is also sector specific.



## 5 Units

### Availability of units

The following units can also be obtained from The Register of Regulated Qualifications: <http://registerofqual.gov.uk/Unit>

### Structure of units

These units each have the following:

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



## Unit 201

# Complying with statutory regulations and organisational safety requirements

<b>UAN:</b>	<b>A/601/5013</b>
<b>Level:</b>	2
<b>Credit value:</b>	5
<b>GLH:</b>	35
<b>Relationship to NOS:</b>	This unit has been derived from SEMTA national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.</p> <p>The learner will be expected to comply with all relevant regulations that apply to their area of work, as well as their general responsibilities as defined in the Health and Safety at Work Act. The learner will need to be able to identify the relevant qualified first aiders and know the location of the first aid facilities. The learner will have a knowledge and understanding of the procedures to be adopted in the case of accidents involving injury and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. The learner will also need to be fully conversant with their organisation's procedures for fire alerts and the evacuation of premises.</p> <p>The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual lifting and carrying techniques.</p>

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

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

<b>Learning outcome</b>	<b>The learner will:</b>
1. comply with statutory regulations and organisational safety requirements	
<b>Assessment criteria</b>	
The learner can:	
1.1 comply with their duties and obligations as defined in the Health and Safety at Work Act	
1.2 demonstrate their understanding of their duties and obligations to health and safety by:	
a. applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act	
b. identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as:	
i. eye protection and personal protective equipment (PPE)	
ii. COSHH regulations	
iii. risk assessments	
c. identifying the warning signs and labels of the main groups of hazardous or dangerous substances	
d. complying with the appropriate statutory regulations at all times	
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 comply with emergency requirements, to include:	
a. identifying the appropriate qualified first aiders and the location of first aid facilities	
b. identifying the procedures to be followed in the event of injury to themselves or others	
c. following organisational procedures in the event of fire and the evacuation of premises	

- d. identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment
- 1.6 recognise and control hazards in the workplace
- 1.7 identify the hazards and risks that are associated with the following:
  - a. their working environment
  - b. the equipment that they use
  - c. materials and substances (where appropriate) that they use
  - d. working practices that do not follow laid-down procedures
- 1.8 use correct manual lifting and carrying techniques
- 1.9 demonstrate one of the following methods of manual lifting and carrying:
  - a. lifting alone
  - b. with assistance of others
  - c. with mechanical assistance
- 1.10 apply safe working practices and procedures to include:
  - a. maintaining a tidy workplace, with exits and gangways free from obstruction
  - b. using equipment safely and only for the purpose intended
  - c. observing organisational safety rules, signs and hazard warnings
  - d. taking measures to protect others from any harm resulting from the work that they are carrying out.

<b>Learning outcome</b>	<b>The learner will:</b>
2.	know how to comply with statutory regulations and organisational safety requirements
<b>Assessment criteria</b>	
The learner can:	
2.1	describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as The Management of Health and Safety at Work Regulations, Workplace Health and Safety and Welfare Regulations, Personal Protective Equipment at Work Regulations, Manual Handling Operations Regulations, Provision and Use of Work Equipment Regulations, Display Screen at Work Regulations, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)
2.2	describe the specific regulations and safe working practices and procedures that apply to their work activities
2.3	describe the warning signs for the nine main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations
2.4	explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed
2.5	explain what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, poorly placed equipment, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile, flammable or toxic materials, unshielded processes, working in confined spaces)

- 2.6 describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace
- 2.7 describe the risks associated with their working environment (such as the tools, materials and equipment that they use, spillages of oil, chemicals and other substances, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures)
- 2.8 describe the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard checklists, carrying out risk assessments, COSHH assessments)
- 2.9 describe the first aid facilities that exist within their work area and within the organisation in general; the procedures to be followed in the case of accidents involving injury
- 2.10 explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no-one is injured
- 2.11 describe the procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used, and the need to report their presence at the appropriate assembly point
- 2.12 describe the organisational policy with regard to fire fighting procedures; the common causes of fire and what they can do to help prevent them
- 2.13 describe the protective clothing and equipment that is available for their areas of activity
- 2.14 explain how to safely lift and carry loads, and the manual and mechanical aids available
- 2.15 explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping
- 2.16 describe the importance of safe storage of tools, equipment, materials and products
- 2.17 describe the extent of their own authority, and to whom they should report in the event of problems that they cannot resolve.

## Unit 202

## Using and interpreting engineering data and documentation

<b>UAN:</b>	<b>Y/601/5102</b>
<b>Level:</b>	2
<b>Credit value:</b>	5
<b>GLH:</b>	25
<b>Relationship to NOS:</b>	This unit has been derived from SEMTA national occupational standard: Using and interpreting engineering data and documentation (Suite 2).
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from documents such as engineering drawings, technical manuals, reference tables, specifications, technical sales/marketing documentation, charts or electronic displays, in accordance with approved procedures. The learner will be required to extract the necessary information from the various documents, in order to establish and carry out the work requirements, and to make valid decisions about the work activities based on the information extracted.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for obtaining and using the documentation applicable to the activity. They will be expected to report any problems with the use and interpretation of the documents that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions if necessary, with an appropriate level of supervision or as a member of a team, and take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p>

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

<b>Learning outcome</b>	<b>The learner will:</b>
1.	use and interpret engineering data and documentation
<b>Assessment criteria</b>	
The learner can:	
1.1	use the approved source to obtain the required data and documentation
1.2	use the data and documentation and carry out all of the following: <ol style="list-style-type: none"> <li>a. check the currency and validity of the data and documentation used</li> <li>b. exercise care and control over the documents at all times</li> <li>c. correctly extract all necessary data in order to carry out the required tasks</li> <li>d. seek out additional information where there are gaps or deficiencies in the information obtained</li> <li>e. deal with or report any problems found with the data and documentation</li> <li>f. make valid decisions based on the evaluation of the engineering information extracted from the documents</li> <li>g. return all documents to the approved location on completion of the work</li> <li>h. complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation</li> </ol>
1.3	correctly identify, interpret and extract the required information
1.4	extract information that includes three of the following: <ol style="list-style-type: none"> <li>a. materials or components required</li> <li>b. dimensions</li> <li>c. tolerances</li> <li>d. build quality</li> <li>e. installation requirements</li> <li>f. customer requirements</li> <li>g. time scales</li> <li>h. financial information</li> <li>i. operating parameters</li> <li>j. surface texture requirements</li> <li>k. location/orientation of parts</li> <li>l. process or treatments required</li> <li>m. dismantling/assembly sequence</li> <li>n. inspection/testing requirements</li> </ol>

- o. number/volumes required
  - p. repair/service methods
  - q. method of manufacture
  - r. weld type and size
  - s. operations required
  - t. connections to be made
  - u. surface finish required
  - v. shape or profiles
  - w. fault finding procedures
  - x. safety/risk factors
  - y. environmental controls
  - z. specific data (such as component data, maintenance data, electrical data, fluid data)
  - aa. resources (such as tools, equipment, personnel)
  - bb. utility supply details (such as electricity, water, gas, air)
  - cc. location of services, including standby and emergency backup systems
  - dd. circuit characteristics (such as pressure, flow, current, voltage, speed)
  - ee. protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
  - ff. other specific related information
- 1.5 use the information obtained to ensure that work output meets the specification
- 1.6 use information extracted from documents to include one from the following:
- a. drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)
  - b. diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams)
  - c. manufacturers manuals/drawings
  - d. approved sketches
  - e. technical illustrations
  - f. photographic representations
  - g. visual display screen information
  - h. technical sales/marketing documentation
  - i. contractual documentation
  - j. other specific drawings/documents
- 1.7 use information extracted from related documentation, to include two from the following:
- a. instructions (such as job instructions, drawing instructions, manufacturers instructions)
  - b. specifications (such as material, finish, process, contractual, calibration)
  - c. reference materials (such as manuals, tables, charts, guides, notes)
  - d. schedules
  - e. operation sheets
  - f. service/test information
  - g. planning documentation
  - h. quality control documents

<ul style="list-style-type: none"> <li>i. company specific technical instructions</li> <li>j. national, international and organisational standards</li> <li>k. health and safety standards relating to the activity (such as COSHH)</li> <li>l. other specific related documentation</li> </ul> <p>1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved</p> <p>1.9 report any inaccuracies or discrepancies in documentation and specifications.</p>
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<b>Learning outcome</b>	<b>The learner will:</b>
2.	know how to use and interpret engineering data and documentation
<b>Assessment criteria</b>	
The learner can:	
2.1	explain what information sources are used for the data and documentation that they use in their work activities
2.2	explain how documents are obtained, and how to check that they are current and valid
2.3	explain the basic principles of confidentiality (including what information should be available and to whom)
2.4	describe the different ways/formats that data and documentation can be presented (such as drawings, job instructions product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information)
2.5	explain how to use other sources of information to support the data (such as electronic component pin configuration specifications, reference charts, standards, bend allowances required for material thickness, electrical conditions required for specific welding rods, mixing ratios for bonding and finishing materials, metal specifications and inspection requirements, health and safety documentation)
2.6	describe the importance of differentiating fact from opinion when reviewing data and documentation
2.7	describe the importance of analysing all available data and documentation before decisions are made
2.8	describe the different ways of storing and organising data and documentation to ensure easy access
2.9	describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents
2.10	describe the importance of keeping all data and documentation up to date during the work activity, and the implications of this not being done
2.11	explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work
2.12	explain the importance of returning documents to the designated location on completion of the work activities
2.13	explain what basic drawing conventions are used and why there needs to be different types of drawings (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
2.14	explain what types of documentation are used and how they interrelate (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)



- 2.15 explain the imperial and metric systems of measurement; tolerancing and fixed reference points
- 2.16 describe the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)
- 2.17 describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve.

## Unit 303

## Working efficiently and effectively in engineering

<b>UAN:</b>	<b>K/601/5055</b>
<b>Level:</b>	3
<b>Credit value:</b>	5
<b>GLH:</b>	25
<b>Relationship to NOS:</b>	This unit has been derived from SEMTA national occupational standard: Working efficiently and effectively in engineering (Suite 3).
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, the learner will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition.</p> <p>On completion of the engineering activity, the learner will be required to return their immediate work area to an acceptable condition before recommencing further work requirements. This may involve placing completed work in the correct location, returning and/or storing any tools and equipment in the correct area, identifying any waste and/or scrapped materials and arranging for their disposal, and reporting any defects or damage to tools and equipment used.</p> <p>In order to be efficient and effective in the workplace, the learner will also be required to demonstrate that they can create and maintain effective working relationships with colleagues and line management. The learner will also be expected to review</p>

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objectives and targets for their personal development and make recommendations to, and communicate any opportunities for, improvements that could be made to working practices and procedures.

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to working efficiently and effectively in an engineering environment. The learner will understand the need to work efficiently and effectively, and will know about the areas they need to consider when preparing and tidying up the work area, how to contribute to improvements, deal with problems, maintain effective working relationships and agree their development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

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

Learning outcome	The learner will:
1. work efficiently and effectively in engineering	
<b>Assessment criteria</b>	
<p>The learner can:</p> <ol style="list-style-type: none"> <li>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines</li> <li>1.2 prepare the work area to carry out the engineering activity</li> <li>1.3 prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be undertaken: <ol style="list-style-type: none"> <li>a. the work area is free from hazards and is suitably prepared for the activities to be undertaken</li> <li>b. any required safety procedures are implemented</li> <li>c. any necessary personal protection equipment is obtained and is in a usable condition</li> <li>d. tools and equipment required are obtained and checked that they are in a safe and useable condition</li> <li>e. all necessary drawings, specifications and associated documentation is obtained</li> <li>f. job instructions are obtained and understood</li> <li>g. the correct materials or components are obtained</li> <li>h. storage arrangements for work are appropriate</li> <li>i. appropriate authorisation to carry out the work is obtained</li> </ol> </li> <li>1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements</li> <li>1.5 ensure that completed products or resources are stored in the appropriate location on completion of the activities</li> <li>1.6 complete work activities, to include all of the following: <ol style="list-style-type: none"> <li>a. completing all necessary documentation accurately and legibly</li> <li>b. returning tools and equipment</li> <li>c. returning drawings and work instructions</li> <li>d. identifying, where appropriate, any unusable tools, equipment or components</li> <li>e. arranging for disposal of waste materials</li> </ol> </li> <li>1.7 tidy up the work area on completion of the engineering activity</li> <li>1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved</li> <li>1.9 deal with problems affecting the engineering process, to include two of the following: <ol style="list-style-type: none"> <li>a. materials</li> <li>b. tools and equipment</li> <li>c. drawings</li> <li>d. job specification</li> <li>e. quality</li> <li>f. people</li> <li>g. timescales</li> <li>h. safety</li> <li>i. activities or procedures</li> </ol> </li> <li>1.10 contribute to and communicate opportunities for improvement to working practices and procedures</li> </ol>	

- 1.11 make recommendations for improving to two of the following:
  - a. working practices
  - b. working methods
  - c. quality
  - d. safety
  - e. tools and equipment
  - f. supplier relationships
  - g. internal communication
  - h. customer service
  - i. training and development
  - j. teamwork
  - k. other
- 1.12 maintain effective working relationships with colleagues to include two of the following:
  - a. colleagues within own working group
  - b. colleagues outside normal working group
  - c. line management
  - d. external contacts
- 1.13 review personal training and development as appropriate to the job role
- 1.14 review personal development objectives and targets to include one of the following:
  - a. dual or multi-skilling
  - b. training on new equipment / technology
  - c. increased responsibility
  - d. understanding of company working practices, procedures, plans and policies
  - e. other specific requirements.

Learning outcome	The learner will:
2.	know how to work efficiently and effectively in engineering
<b>Assessment criteria</b>	
The learner can:	
2.1	describe the safe working practices and procedures to be followed whilst preparing and tidying up their work area
2.2	describe the correct use of any equipment used to protect the health and safety of themselves and their colleagues
2.3	describe the procedure for ensuring that all documentation relating to the work being carried out is available and current, prior to starting the activity
2.4	describe the action that should be taken if documentation received is incomplete and/or incorrect
2.5	describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity
2.6	describe the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity
2.7	describe the action that should be taken if tools and equipment are not in full working order
2.8	describe the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity
2.9	describe the action that should be taken if materials do not meet the requirements of the activity
2.10	explain whom to inform when the work activity has been completed
2.11	describe the information and/or documentation required to confirm that the activity has been completed
2.12	explain what materials, equipment and tools can be reused
2.13	explain how any waste materials and/or products are transferred, stored and disposed of
2.14	explain where tools and equipment should be stored and located
2.15	describe the importance of making recommendations for improving working practices
2.16	describe the procedure and format for making suggestions for improvements
2.17	describe the benefits to organisations if improvements can be identified
2.18	describe the importance of maintaining effective working relationships within the workplace
2.19	describe the procedures to deal with and report any problems that can affect working relationships
2.20	describe the difficulties that can occur in working relationships
2.21	describe the regulations that affect how they should be treated at work (such as equal opportunities act, race and sex discrimination, working time directive)
2.22	describe the benefits of continuous personal development
2.23	describe the training opportunities that are available in the workplace
2.24	describe the importance of reviewing their training and development
2.25	explain with whom to discuss training and development issues
2.26	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

## Unit 209

# Welding materials with mechanised arc welding equipment

<b>UAN:</b>	<b>H/504/9212</b>
<b>Level:</b>	2
<b>Credit value:</b>	37
<b>GLH:</b>	140
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 9: Welding Materials with Mechanised Arc Welding Equipment (Suite 2)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to operate one type of mechanised MIG/MAG, flux cored wire, submerged arc, TIG, or plasma arc welding installation, which has already been prepared for production, in accordance with approved instructions or welding procedures. The learner will be expected to check that the equipment has been approved for production, and that sufficient supplies of all the required materials and consumables are present and correct, and ready for production operations to be performed.</p> <p>The learner must operate the installation safely and correctly, in accordance with instructions and approved procedures, and achieve a weld quality and tolerances that meet the product specification. The production output may be inspected by visual and non-destructive testing methods, to check that the specified quality is being achieved. The learner must continuously monitor the operation of the installation and make any necessary adjustments to equipment settings, in line with their permitted authority, in order to produce the welded joints to the required specification. Meeting production requirements will be an important issue, and their production records must show consistent and</p>

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satisfactory performance.

The learner's responsibilities will require them to comply with organisational policy and procedures for operating the welding installation, and to report any problems or adjustments to the installation that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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 produce.

The learner's knowledge will be sufficient to provide a sound basis for their work, enabling them to adopt an informed approach to applying welding procedures and instructions. The learner will have an understanding of how the welding process works and is applied in mechanised form, and will know about the equipment, materials and consumables, in adequate depth to provide a sound background to the process operation and for carrying out the welding activities to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. weld materials with mechanised arc welding equipment
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure and work instructions 1.3 operate one of the following mechanised arc welding processes in the specified materials, forms and positions: a. MIG/MAG b. cored wire c. TIG d. submerged arc e. plasma arc 1.4 confirm that the machine is set up and operating correctly, ready



- for the joining operations to be carried out
- 1.5 check all of the following before starting production:
    - a. the installation has been approved for production
    - b. supplies of components and consumables are adequate and correctly prepared
    - c. machine settings comply with instructions and the welding procedure specification
    - d. jigs and fixtures are in place and operate correctly
    - e. all machine functions operate correctly
    - f. all safety equipment is in place and functioning correctly
  - 1.6 check that the parent material, components, consumables and joint preparation comply with specifications
  - 1.7 produce welded components covering both of the following:
    - a. two different joint configurations
    - b. two different material groups
  - 1.8 carry out and monitor the machine operations in accordance with specifications and job instructions
  - 1.9 monitor the process operation and machine functions, and make adjustments as required to parameters and mechanisms within their permitted authority and tolerances, to include adjusting all of the following:
    - a. electrical parameters
    - b. welding speed
    - c. flux dispensing and recovery mechanisms
    - d. safety devices
    - e. wire feed rate
    - f. gas shielding system
    - g. mechanical functions (handling, loading, workholding, transfer)
  - 1.10 achieve joints of the required quality and specified dimensional accuracy which:
    - a. achieve a weld quality equivalent to the relevant level of BS EN ISO 5817, as required by the application standard (for aluminium, EN 30042/ISO 10042 applies)
    - b. meet and verify the required dimensional accuracy within specified tolerances
  - 1.11 achieve the rate of output as specified
  - 1.12 deal promptly and effectively with problems within their control and report those that they cannot solve
  - 1.13 shut down the equipment to a safe condition on conclusion of the joining activities

<b>Learning outcome</b>
The learner will: 2. know how to weld materials with mechanised arc welding equipment
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when operating mechanised arc welding installations (working with machinery; the use of personal protective equipment (PPE); protecting others from the effects of the electric arc; appropriate machine guards; operation of machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with arc welding machines (dangers from the electric arc; live electrical components; fumes and gases; hot metal; grinding and mechanical metal/slag removal; moving parts of machinery), and how they can be minimised 2.3 describe the basic principles of mechanised and automated welding (types of installations; machine functions; control systems; safety features) 2.4 describe the key components and features of the equipment used (power source; electrical parameters such as arc voltage, current, wire dispensing and feed mechanisms; flux dispensing and recovery; shielding gas supply; control and storage of consumables; how variations in the parameters influence weld features, quality and output) 2.5 explain how to extract the necessary information from drawings and welding procedure specifications; welding symbols and abbreviations used (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.6 explain the operation of the machine controls and their function 2.7 describe how to care for the welding equipment used 2.8 describe how to set up and align the workpiece, and the equipment to be used 2.9 describe how to monitor the installation during the welding process; how to recognise problems and action to be taken 2.10 describe the problems that can occur with the welding activities (distortion, material and weld defects) 2.11 describe the self inspection of completed work, methods and equipment to be used 2.12 describe the organisational quality systems (standards to be achieved; production records to be kept) 2.13 describe the personal approval tests and their applicability to their work 2.14 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve 2.15 explain the reporting lines and procedures, line supervision and technical experts

## Unit 210

# Welding materials using resistance spot, seam and projection welding machines

<b>UAN:</b>	<b>K/504/9213</b>
<b>Level:</b>	2
<b>Credit value:</b>	35
<b>GLH:</b>	129
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 10: Welding Materials using Resistance Spot, Seam and Projection Welding Machines (Suite 2)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to operate resistance spot, seam or projection welding installations, which have already been prepared for production, in accordance with approved instructions or welding procedures. The learner will be expected to check that the installation has been approved for production, and that sufficient supplies of all required materials and consumables are present and correct, and ready for production operations to be performed.</p> <p>The learner must operate the installation safely and correctly, in accordance with instructions and approved procedures, and achieve a weld quality and tolerances that meet the product specification. The production output may be inspected by visual and non-destructive testing methods, to check that the specified quality is being achieved. The learner must continuously monitor the operation of the installation and make any necessary adjustments to equipment settings, in line with their permitted authority, in order to produce the welded joints to the required specification. Meeting production requirements will be an important issue, and their production records must show consistent and</p>

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satisfactory performance.

The learner's responsibilities will require them to comply with organisational policy and procedures for operating the welding installation, and to report any problems or adjustments to the installation that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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 produce.

The learner's knowledge will provide a sound basis for their work, enabling them to adopt an informed approach to applying welding procedures and instructions. The learner will have an understanding of how the resistance welding process works and is applied in mechanised form, and will know about the equipment, materials and consumables, in adequate depth to provide a sound background to the process operation and for carrying out the activities to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. weld materials using resistance spot, seam and projection welding machines
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure and work instructions 1.3 operate one of the following resistance welding installations: a. spot welding b. seam welding c. projection welding 1.4 confirm that the machine is set up and operating correctly, ready for the joining operations to be carried out 1.5 check all of the following before starting production: a. the installation has been approved for production

- b. supplies of components and consumables are adequate and correctly prepared
  - c. machine settings comply with instructions and the welding procedure specification
  - d. jigs and fixtures are in place and operate correctly
  - e. all machine functions operate correctly
  - f. all safety equipment is in place and functioning correctly
- 1.6 check that the parent material, components, consumables and joint preparation comply with specifications
- 1.7 produce welded components in the specified materials and forms that cover both of the following:
- a. two different material thicknesses
  - b. two different joint configurations
- 1.8 carry out and monitor the machine operations in accordance with specifications and job instructions
- 1.9 monitor the process operation, electrode condition and machine function and make adjustments to required parameters and mechanisms, to include all of the following as appropriate to the machine type:
- a. welding current
  - b. welding and squeeze times
  - c. electrode pressure cycle
  - d. welding speed (seam)
  - e. weld pitch (spot)
  - f. mechanical functions
- 1.10 achieve joints of the required quality and specified dimensional accuracy which:
- a. achieve a weld quality as specified in the application standard
  - b. spot and projection welds are correctly located
  - c. seam welds are of the correct dimensions
  - d. meet the required dimensional accuracy within specified tolerance
- 1.11 achieve the rate of output as specified
- 1.12 deal promptly and effectively with problems within their control and report those that they cannot solve
- 1.13 shut down the equipment to a safe condition on conclusion of the joining activities

<b>Learning outcome</b>
The learner will: 2. know how to weld materials using resistance spot, seam and projection welding machines
<b>Assessment criteria</b>
The learner can: 2.1 explain the specific safety precautions to be taken when operating resistance welding installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; operation of machine safety devices; stopping the machine in an emergency; closing down the machine on completion of the welding activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with resistance welding machines (dangers from live internal electrical components, fumes, hot metal, expulsion of hot particles, moving parts of machines), and how they can be minimised 2.3 describe the basic principles of resistance welding and the terminology used in welding 2.4 describe the basic principles of mechanised and automated welding (types of installation; machine functions; control systems; safety features) 2.5 describe the key components and features of the equipment used (power source; electrical parameters such as arc voltage, current, electrode pressure and welding time; systems for parameter control; how variation in the parameters influence weld features, quality and output) 2.6 explain how to extract the information required from drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.7 describe the operation of the machine controls and their function; clamping and transfer of components; equipment care procedures 2.8 describe how to set up and align the workpiece 2.9 describe how to monitor the installation during the welding process; how to recognise problems, and action to be taken 2.10 describe the problems that can occur with the welding activities, materials and weld defects 2.11 explain the self inspection of completed work 2.12 describe the organisational quality systems (standards to be achieved; production records to be kept) 2.13 describe the personal approval tests and their applicability to their work 2.14 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve 2.15 explain the reporting lines and procedures, line supervision and technical experts

## Unit 211

## Welding materials using laser welding machines

<b>UAN:</b>	<b>M/504/9214</b>
<b>Level:</b>	2
<b>Credit value:</b>	37
<b>GLH:</b>	140
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 11: Welding Materials using Laser Welding Machines (Suite 2)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to operate laser welding installations that have already been prepared for production, in accordance with approved instructions or welding procedures. The learner will be expected to check that the installation has been approved for production and that sufficient supplies of all required materials and consumables are present and correct, and ready for production operations to be performed.</p> <p>The learner must operate the installation safely and correctly, in accordance with instructions and approved procedures, and achieve a weld quality and tolerances that meet the product specification. The production output may be inspected by visual and non-destructive testing methods to check that the specified quality is being achieved. The learner must continuously monitor the operation of the installation and make any necessary adjustments to equipment settings, in line with their permitted authority, in order to produce the welded joints to the required specification. Meeting production requirements will be an important issue, and their production records must show consistent and satisfactory performance.</p>

The learner's responsibilities will require

them to comply with organisational policy and procedures for operating the welding installation, and to report any problems or adjustments to the installation that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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.

The learner's knowledge will be sufficient to provide a sound basis for their work, enabling them to adopt an informed approach to applying welding procedures and instructions. The learner will have an understanding of how the laser welding process works and is applied in mechanised form, and will know about the equipment, materials and consumables, in adequate depth to provide a sound background to the process operation and for carrying out the activities to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. weld materials using laser welding machines
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure and work instructions 1.3 confirm that the machine is set up and operating correctly, ready for the joining operations to be carried out 1.4 check all of the following before starting production: a. the installation has been approved for production b. supplies of components and consumables are adequate and correctly prepared c. machine settings comply with instructions and the welding procedure specification d. all machine functions operate correctly e. all safety equipment is in place and functioning correctly 1.5 check that the parent material, components, consumables and joint preparation comply with specifications



- 1.6 produce welded components covering both of the following:
  - a. two different components
  - b. two different material groups
- 1.7 carry out and monitor the machine operations in accordance with specifications and job instructions
- 1.8 monitor the process operation and machine function and make adjustments as required to parameters and mechanisms, to include all of the following, as appropriate to the machine type:
  - a. electrical parameters
  - b. welding speed
  - c. weld alignment and characteristics
  - d. beam tracking
  - e. beam characteristics (focal spot)
  - f. gas shielding (where applicable)
  - g. mechanical mechanisms for workholding, traversing and transfer
- 1.9 achieve joints of the required quality and specified dimensional accuracy which:
  - a. achieve a weld quality equivalent to the relevant level of BS EN/ISO 13919 standards or relevant international standard, as required by the application standard
  - b. meet the required dimensional accuracy within specified tolerances
- 1.10 achieve the rate of output as specified
- 1.11 deal promptly and effectively with problems within their control and report those that they cannot solve
- 1.12 shut down the equipment to a safe condition on conclusion of the joining activities

<b>Learning outcome</b>
The learner will: 2. know how to weld materials using laser welding machines
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when operating laser welding installations (working with machinery; care when working with laser beams; the use of appropriate personal protective equipment (PPE); protecting other workers; machine guards; operation of machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with laser welding machines (dangers from the laser beam; live electrical components; fumes and gases; hot metal; moving parts of machinery), and how they can be minimised 2.3 describe the basic principles of laser welding and the terminology used in welding 2.4 describe the key components and features of the equipment (types of laser beam generators, beam characteristics, power ranges; beam guiding and focussing arrangements; power sources; materials and thickness capabilities; facilities for manipulating the components for welding; safety features; shielding gas supply and control) 2.5 describe the basic principles of mechanised and automated welding (types of installations; machine functions; safety features) 2.6 explain how to extract the information required from drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.7 describe the operation of the machine; controls and their function; care of equipment 2.8 describe how to set up and align the workpiece 2.9 describe how to monitor the installation during the welding process; how to recognise problems, and action to be taken 2.10 describe the problems that can occur with the welding activities, materials and weld defects 2.11 explain the self inspection of completed work 2.12 describe the organisational quality systems (standards to be achieved; production records to be kept) 2.13 describe the personal approval tests and their applicability to their work 2.14 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve 2.15 explain the reporting lines and procedures, line supervision and technical experts

## Unit 212

## Welding materials using electron beam welding machines

<b>UAN:</b>	<b>T/504/9215</b>
<b>Level:</b>	2
<b>Credit value:</b>	37
<b>GLH:</b>	140
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 12: Welding Materials using Electron Beam Welding Machines (Suite 2)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to operate electron beam welding installations that have already been prepared for production, in accordance with approved instructions or welding procedures. The learner will be expected to check that the installation has been approved for production and that sufficient supplies of all required materials and consumables are present and correct, and are ready for production operations to be performed.</p> <p>The learner must operate the installation safely and correctly, in accordance with instructions and approved procedures, and achieve a weld quality and tolerances that meet the product specification. The production output may be inspected by visual and non-destructive testing methods, to check that the specified quality is being achieved. The learner must continuously monitor the operation of the installation and make any necessary adjustments to equipment settings, in line with their permitted authority, in order to produce the welded joints to the required specification. Meeting production requirements will be an important issue, and their production records must show consistent and</p>

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satisfactory performance.

The learner's responsibilities will require them to comply with organisational policy and procedures for operating the welding installation, and to report any problems or adjustments to the installation that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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.

The learner's knowledge will be sufficient to provide a sound basis for their work, enabling them to adopt an informed approach to applying welding procedures and instructions. The learner will have an understanding of how the electron beam welding process works and is applied in mechanised form, and will know about the equipment, materials and consumables, in adequate depth to provide a sound background to the process operation and for carrying out the activities to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. weld materials using electron beam welding machines
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure and work instructions 1.3 confirm that the machine is set up and operating correctly, ready for the joining operations to be carried out 1.4 check all of the following before starting production: a. the installation has been approved for production b. supplies of components and consumables are adequate and correctly prepared c. machine settings comply with instructions and the welding procedure specification

- d. chamber pressures checked
- e. all machine functions operate correctly
- f. all safety equipment is in place and functioning correctly
- 1.5 check that the parent material, components, consumables and joint preparation comply with specifications
- 1.6 produce welded components covering both of the following:
  - a. two different components
  - b. two different material groups
- 1.7 carry out and monitor the machine operations in accordance with specifications and job instructions
- 1.8 monitor the process operation and machine function and make adjustments as required to parameters and mechanisms, to include all of the following, as appropriate to the machine type:
  - a. electrical parameters
  - b. welding speed
  - c. chamber pressure
  - d. weld alignment and characteristics
  - e. beam tracking
  - f. mechanical functions
- 1.9 achieve joints of the required quality and specified dimensional accuracy which:
  - a. achieve a weld quality equivalent to the relevant level of BS EN/ISO 13919 standards or relevant international standards, as required by the application standard
  - b. meet the required dimensional accuracy within specified tolerances
- 1.10 achieve the rate of output as specified
- 1.11 deal promptly and effectively with problems within their control and report those that they cannot solve
- 1.12 shut down the equipment to a safe condition on conclusion of the joining activities

<b>Learning outcome</b>
The learner will: 2. know how to weld materials using electron beam welding machines
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when operating electron beam welding installations (working with machinery; care in presence of high voltage; the use of appropriate personal protective equipment (PPE); protecting other workers; machine guards; operation of machine safety devices; x-ray dosimeters; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with electron beam welding machines (dangers from the mains and high voltage supplies; live electrical components; emission of x-rays, fumes and gases; hot metal; moving parts of machinery), and how they can be minimised 2.3 describe the principles of electron-beam welding and the terminology used in welding 2.4 describe the key components and features of the equipment (electron gun and control of beam power and characteristics; vacuum chamber and its construction; vacuum system and controls; in-chamber manipulating equipment; power sources and power range; material and thickness capabilities; safety features; facilities for loading chamber and work handling) 2.5 explain how to extract the information required from drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.6 describe the operation of the machine; controls and their function; care of equipment 2.7 describe how to set up and align the workpiece 2.8 describe how to monitor the installation during the welding process; how to recognise problems, and action to be taken 2.9 describe the problems that can occur with the welding activities (materials and weld defects; beam instability, loss of alignment, increase in chamber pressure) 2.10 explain the self inspection of completed work 2.11 describe the organisational quality systems (standards to be achieved; production records to be kept) 2.12 describe the personal approval tests and their applicability to their work 2.13 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve 2.14 explain the reporting lines and procedures, line supervision and technical experts

## Unit 213

## Welding materials using friction welding machines

<b>UAN:</b>	<b>A/504/9216</b>
<b>Level:</b>	2
<b>Credit value:</b>	35
<b>GLH:</b>	129
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 13: Welding Materials using Friction Welding Machines (Suite 2)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to operate friction welding installations that have already been prepared for production, in accordance with approved instructions or welding procedures. The learner will be expected to check that the installation has been approved for production and that sufficient supplies of all required materials and consumables are present and correct, and are ready for production operations to be performed.</p> <p>The learner must operate the installation safely and correctly, in accordance with instructions and approved procedures, and achieve a weld quality and tolerances that meet the product specification. The production output may be inspected by visual and non-destructive testing methods, to check that the specified quality is being achieved. The learner must continuously monitor the operation of the installation, using the in-process monitoring features of the welding machine, and make any necessary adjustments to equipment settings, in line with their permitted authority, in order to produce the welded joints to the required specification. Meeting production requirements will be an important issue, and their production records must show consistent and satisfactory performance.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for operating the welding installation, and to report any problems or adjustments to the installation that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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.

The learner's knowledge will be sufficient to provide a sound basis for their work, enabling them to adopt an informed approach to applying welding procedures and instructions. The learner will have an understanding of how the friction welding process works and is applied in mechanised form, and will know about the equipment, materials and consumables, in adequate depth to provide a sound background to the process operation and for carrying out the activities to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. weld materials using friction welding machines
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure and work instructions 1.3 confirm that the machine is set up and operating correctly, ready for the joining operations to be carried out 1.4 check all of the following before starting production: a. the installation has been approved for production b. supplies of components and consumables are adequate and correctly prepared c. machine settings comply with instructions and the welding procedure specification d. all machine functions operate correctly e. all safety equipment is in place and functioning correctly



- 1.5 check that the parent material, components, consumables and joint preparation comply with specifications
- 1.6 produce welded components covering both of the following:
  - a. two different components
  - b. two different material groups
- 1.7 carry out and monitor the machine operations in accordance with specifications and job instructions
- 1.8 monitor the process operation and machine functions and make adjustments as required to settings and mechanisms, to include all of the following, as appropriate to the machine type:
  - a. friction and forge cycle time
  - b. friction and forge loads (forces)
  - c. rotational speed or other friction conditions (such as orbital)
  - d. frictional burn-off characteristics and forge displacement
  - e. weld appearance (correct up-set)
  - f. braking effort
- 1.9 achieve joints of the required quality and specified dimensional accuracy which:
  - a. achieve a weld quality as specified in the application standard or specification
  - b. meet the required dimensional accuracy within specified tolerances
- 1.10 achieve the rate of output as specified
- 1.11 deal promptly and effectively with problems within their control and report those that they cannot solve
- 1.12 shut down the equipment to a safe condition on conclusion of the joining activities

<b>Learning outcome</b>
The learner will: 2. know how to weld materials using friction welding machines
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when operating friction welding installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; operation of machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with friction welding machines (dangers from live electrical components; fumes; hot metal; moving parts of machinery and components), and how they can be minimised 2.3 describe the principles of friction welding and the terminology used in welding 2.4 describe the key components and features of the equipment (types of machines; constructional features, mechanical features, drive train, driven and stationary component holding devices, force generation and control systems, braking systems; welding cycle control; feedback and recording) 2.5 describe the basic principles of mechanised and automated welding; types of installations; machine functions; safety features 2.6 explain how to extract the information required from drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.7 describe the operation of the machine; controls and their function; care of equipment 2.8 describe how to set up and align the workpiece 2.9 describe how to monitor the installation during the welding process; the various types of monitoring features used on friction welding machines; how to recognise problems, and action to be taken 2.10 describe the problems that can occur with the welding activities, materials and weld defects 2.11 explain self inspection of the completed work 2.12 describe the organisational quality systems (standards to be achieved; feedback from machine; corrective actions; production records to be kept) 2.13 describe the personal approval tests and their applicability to their work 2.14 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve 2.15 explain the reporting lines and procedures, line supervision and technical experts

## Unit 310

# Preparing mechanised arc welding equipment for production

<b>UAN:</b>	<b>K/504/9177</b>
<b>Level:</b>	3
<b>Credit value:</b>	70
<b>GLH:</b>	245
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 10: Preparing Mechanised Arc Welding Equipment for Production (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare a mechanised MIG/MAG, cored wire, Submerged Arc, TIG or Plasma Arc welding installation for production in accordance with approved procedures. The learner will be required to set up and check both the welding installation and all associated mechanical and electrical apparatus forming part of the mechanised or automated installation. This will include setting up of handling and loading equipment, workholding arrangements, traversing mechanisms, transfer mechanisms and safety equipment as is applicable to the machine type. In setting up the welding conditions the learner will be expected to set the electrical conditions, wire feed rate, welding speed, shielding gas supply system and, where applicable, flux dispensing and recovery mechanisms. The learner must produce trial welds and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification and solving machine related problems during production will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for setting up the welding</p>

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

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying mechanised welding procedures. The learner will understand the welding process carried out, and its application, and will know about the equipment, relevant materials and consumables in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. prepare mechanised arc welding equipment for production
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure specification and job instructions for the work to be produced 1.3 check that the equipment is as specified and in usable condition 1.4 prepare and set-up one of the following arc welding installations for two different joint configurations in the specified materials, forms and positions, according to work instructions and the welding procedure specification: a. MIG/MAG b. Cored wire c. TIG d. Submerged Arc e. Plasma Arc 1.5 confirm the arc welding equipment is suitable for production by carrying out all of the following checks: a. the equipment is correctly maintained and in a safe and usable

- condition
- b. the equipment is correctly calibrated
- c. all electrical and mechanical systems function smoothly
- d. equipment shut down systems function correctly
- 1.6 obtain the required components and check that the joint preparation complies with the specification
- 1.7 set up the work piece to achieve correct joint fit-up and alignment to include setting and checking all of the following as is applicable to the machine type:
  - a. handling and loading equipment
  - b. workholding arrangements
  - c. transfer mechanisms
  - d. preparation of materials and joint faces is to specification
  - e. traversing mechanisms
  - f. safety mechanisms
- 1.8 select and prepare the appropriate consumables in line with the joining procedure specification
- 1.9 set and adjust the machine operating conditions to achieve joints of the required quality and within specified dimensional accuracy
- 1.10 set up the welding equipment and parameters in accordance with the welding procedure specification to include setting all of the following as is applicable to the machine type:
  - a. electrical parameters
  - b. wire feed rate
  - c. safety devices
  - d. welding speed
  - e. consumables
  - f. shielding gas supply system
  - g. flux dispensing and recovery mechanisms
- 1.11 set up the handling, work-holding and associated equipment to achieve correct joint positioning
- 1.12 check that all safety mechanisms are in place and that the equipment is operating satisfactorily
- 1.13 prove the installation is operating correctly and is ready for production by producing specified trial welds and checking all of the following:
  - a. visual appearance of weld
  - b. dimensional accuracy
  - c. quality of weld
  - d. machine settings are as specified
- 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.15 solve problems in production relating to two of the following:
  - a. machine performance
  - b. joint set-up
  - c. condition of materials being joined
  - d. consumables

<b>Learning outcome</b>
The learner will: 2. know how to prepare mechanised arc welding equipment for production
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when setting and operating arc welding installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; ventilation and fume extraction; protecting other workers from the effects of the welding arc; machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with mechanised arc welding machines and explain how they can be minimised (dangers from the electric arc; live electrical components; fumes and gases; hot slag and metal; grinding and mechanical metal/slag removal; moving parts of machinery) 2.3 explain the basic principles of the relevant mechanised arc welding process (using heat to join metals by fusion; forming a weld; use of filler metal; principal features of a welded joint; process principles, parameters, heat input; how variation in the parameters influences the weld features, quality and output; terminology used in welding) 2.4 describe the key components and features of the equipment (power source; power range; electrical parameters such as arc voltage, current, and duty cycle; wire dispensing and feed mechanisms; flux dispensing and recovery and shielding gas supply; calibration of equipment) 2.5 explain the basic principles of mechanised and automated welding (types of installations; machine functions: loading, handling, clamping and transfer of components; traversing components or welding head) 2.6 explain how to extract the necessary information from the component drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.7 explain what are non-consumable electrodes, their types, sizes, profiles, selection and maintenance 2.8 explain the types and application of electrodes; the selection, control, handling and storage of filler wires, fluxes and shielding gases 2.9 describe the types of joints applicable and the edge preparation that is required 2.10 describe the problems that can occur with the welding activities and explain how these can be overcome (causes of distortion and methods of control, welding characteristics of parent metals and sources of weld defects; methods of prevention) 2.11 explain the methods used to set up and restrain the joint to achieve correct location of components and control of distortion (work holding methods such as use of jigs/fixtures; component alignment; joint setting to give correct penetration)

- 2.12 explain how to setup the welding equipment to the welding procedure specification (setting electrical conditions and filler wire feed rate; flux dispensing rate; gas flow; welding speed)
- 2.13 explain how to check that the machine functions to the required specification (running pre-production trials to prove that the installation is working satisfactorily)
- 2.14 describe the organisational quality systems (standards to be achieved; production records to be kept)
- 2.15 explain the personal approval tests and their applicability to their work
- 2.16 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

## Unit 311

# Preparing resistance spot, seam and projection welding machines for production

<b>UAN:</b>	<b>M/504/9178</b>
<b>Level:</b>	3
<b>Credit value:</b>	45
<b>GLH:</b>	147
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 11: Preparing Resistance Spot, Seam and Projection Welding Machines for Production (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare a resistance spot, seam or projection welding installation for production in accordance with approved procedures. The learner will be required to set up and check both the welding equipment and all associated mechanical and electrical apparatus forming part of the mechanised or automated installation. This will include setting up of handling and loading equipment, workholding arrangements, traversing mechanisms, transfer mechanisms and safety equipment as is applicable to the machine type. In setting up the welding conditions the learner will be expected to set the welding current, welding and squeeze times, electrode pressure cycle, and welding speed for seam or spot pitch. The learner must produce trial welds and prove the machine is working satisfactorily before declaring the equipment ready for production. Making adjustments to settings to achieve specification and solving machine related problems during production will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for setting up the welding installation and to report any problems with the welding equipment or the welding</p>



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activities that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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.

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying resistance-welding procedures. The learner will understand the welding process carried out, and its application, and will know about the equipment, relevant materials and consumables in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. prepare resistance spot, seam and projection welding machines for production
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure specification and job instructions for the work to be produced 1.3 check that the equipment is as specified and in usable condition 1.4 set up, check, adjust and use one of the following types of resistance welding installations: a. spot welding b. seam welding c. projection welding 1.5 confirm the resistance welding equipment is suitable for production by carrying out all of the following checks: a. the equipment is correctly maintained and in a safe and usable condition b. the equipment is correctly calibrated c. all electrical and mechanical systems function smoothly d. equipment shut down systems function correctly 1.6 obtain the required components and check that the joint

- preparation complies with the specification
- 1.7 set up the handling, work-holding and associated equipment to achieve correct joint positioning
  - 1.8 set up the work piece to achieve correct joint fit-up and alignment to include setting and checking all of the following as is applicable to the type of installation:
    - a. handling and loading equipment
    - b. traversing mechanisms
    - c. safety mechanisms
    - d. preparation of materials and joint faces is to specification
    - e. work holding arrangements
    - f. transfer mechanisms
  - 1.9 select and prepare the appropriate consumables in line with the joining procedure specification
  - 1.10 set and adjust the machine operating conditions to achieve joints of the required quality and within specified dimensional accuracy
  - 1.11 set up the welding installation and parameters in accordance with the welding procedure specification to include setting up all of the following as is applicable to the type of installation:
    - a. welding current
    - b. welding and squeeze times
    - c. electrode pressure cycle
    - d. welding speed (seam)
    - e. weld pitch (spot)
  - 1.12 set up the equipment to produce welded components in the specified materials and forms that cover both of the following:
    - a. two different material thicknesses
    - b. two different joint configurations
  - 1.13 check that all safety mechanisms are in place and that the equipment is operating satisfactorily
  - 1.14 prove the installation is operating correctly and is ready for production by producing specified trial welds and checking all of the following as is applicable to the application:
    - a. visual appearance of weld area
    - b. dimensional accuracy
    - c. weld quality
    - d. machine settings are as specified
  - 1.15 deal promptly and effectively with problems within their control and report those that cannot be solved
  - 1.16 solve problems in production relating to two of the following:
    - a. machine performance
    - b. condition of electrode
    - c. joint set-up
    - d. condition of materials being joined

<b>Learning outcome</b>
The learner will: 2. know how to prepare resistance spot, seam and projection welding machines for production
<b>Assessment criteria</b>
The learner can:

- 2.1 explain the specific safety precautions to be taken when setting and operating resistance welding installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; operation of machine safety devices; stopping the machine in an emergency; closing down the machine on completion of the welding activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials)
- 2.2 describe the hazards associated with resistance welding machines and explain how they can be minimised (dangers from live internal electrical components, fumes, hot metal, expulsion of hot particles, moving parts of machines)
- 2.3 explain the basic principles of resistance welding (heat and pressure to join metals; heating effect of welding current; principle features of the welded joint; heat input; welding and pressure cycles; how variations in the parameters influences the weld features; terminology used in welding)
- 2.4 describe the key components and features of the resistance welding equipment used (power source; welding head; power range; electrical parameters such as voltage, current, electrode pressure and welding time; systems for parameter control)
- 2.5 explain the basic principles of mechanised and automated resistance welding (types of installation; machine functions; control systems; safety features; loading, handling, clamping and transfer of components)
- 2.6 explain how to extract the information required from the drawing and welding procedure specifications to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken
- 2.7 describe the types of electrodes used in resistance welding, contact profiles and maintenance requirements of the electrodes
- 2.8 describe the types of joints applicable to resistance welding and the surface preparation required
- 2.9 explain the methods used to set up and restrain the joints to achieve correct location of components (work holding arrangements; component location and contact)
- 2.10 explain how to setup the welding equipment to the welding procedure specification (setting welding conditions, time and pressure cycles; welding speed)
- 2.11 explain how to check that the equipment functions to the required specification (running pre-production trials to prove that the installation is working satisfactorily)
- 2.12 describe the problems that can occur with the welding activities and explain how these can be overcome (welding characteristics of relevant materials and sources of weld defects; methods of prevention)
- 2.13 describe the organisational quality systems (standards to be achieved; production records to be kept)
- 2.14 explain the personal approval tests and their applicability to their work
- 2.15 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

## Unit 312

## Preparing laser welding machines for production

<b>UAN:</b>	<b>T/504/9179</b>
<b>Level:</b>	3
<b>Credit value:</b>	70
<b>GLH:</b>	245
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 12: Preparing Laser Welding Machines for Production (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare laser welding machines for production in accordance with approved procedures. The learner will be required to set up and check both the welding installation and all associated mechanical and electrical apparatus forming part of the mechanised or automated installation. This will include setting up of handling and loading equipment, workholding arrangements, transfer mechanisms and safety equipment as is applicable to the machine type. In setting up the welding conditions the learner will be expected to set the optical system, beam characteristics, beam alignment, electrical parameters, welding speed and, where applicable, the shielding gas system. The learner must produce trial welds and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification and solving machine related problems during production will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for setting up the welding equipment and to report any problems with the welding equipment or welding activities that they cannot resolve, or are outside their</p>

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permitted authority, to the relevant people. The learner 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.

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying laser welding procedures. The learner will understand the welding process carried out, and its application, and will know about the equipment, relevant materials and consumables in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. prepare laser welding machines for production
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure specification and job instructions for the work to be produced 1.3 check that the equipment is as specified and in usable condition 1.4 confirm the laser welding equipment is suitable for production by carrying out all of the following checks: a. the equipment is correctly maintained and in a safe and usable condition b. the condition of the optical system meets safe operational requirements c. the equipment is correctly calibrated (where applicable) d. all electrical and mechanical systems function smoothly e. equipment shut down systems function correctly 1.5 obtain the required components and check that the joint preparation complies with the specification 1.6 set up the handling, work-holding and associated equipment to achieve correct joint positioning 1.7 set up the components to achieve correct joint fit-up and alignment

to include setting and checking all of the following as is applicable to the type of installation:

- a. surface preparation and condition of joint faces is according to specification
  - b. handling and loading equipment
  - c. workholding arrangements
  - d. traversing or manipulating devices
  - e. transfer mechanisms
  - f. safety mechanisms
- 1.8 select and prepare the appropriate consumables in line with the joining procedure specification
- 1.9 set and adjust the machine operating conditions to achieve joints of the required quality and within specified dimensional accuracy
- 1.10 set up the welding equipment and parameters in accordance with instructions and the welding procedure specification to include setting all of the following as is applicable to the type of installation:
- a. optical system
  - b. beam characteristics
  - c. beam alignment
  - d. electrical parameters
  - e. welding speed
  - f. shielding gas system (where applicable)
- 1.11 set up the equipment to produce welded components which covers both of the following:
- a. two different components
  - b. two different material groups
- 1.12 check that all safety mechanisms are in place and that the equipment is operating satisfactorily
- 1.13 prove the installation is operating correctly and is ready for production by producing specified trial welds and checking all of the following as is applicable to the application:
- a. visual appearance of weld
  - b. dimensional accuracy
  - c. quality of weld
  - d. machine settings are as specified
- 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.15 solve problems in production relating to two of the following:
- a. machine performance
  - b. joint set-up
  - c. condition of materials being joined
  - d. consumables

<b>Learning outcome</b>
The learner will: 2. know how to prepare laser welding machines for production
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when setting and operating laser welding installations (working with machinery; care when working with laser beams; protecting

- other workers; the use of appropriate personal protective equipment (PPE); machine guards; ventilation and fume extraction; machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials)
- 2.2 describe the hazards associated with laser welding machines and explain how they can be minimised (dangers from laser beams; live electrical components; fumes and gases; hot metal; moving parts of machinery)
  - 2.3 explain the basic principles of laser welding (using a laser beam to join metals by fusion; forming a weld; use of filler metal; principal features of a welded joint; process principles, nature of the laser beam; methods of generating a laser beam; guiding and optical focussing, laser optics, parameters, heat input; use of shielding gases, how variation in the parameters influences the weld features and penetration, quality and output; terminology used in welding)
  - 2.4 describe the key components and features of the equipment (types of laser beam generator, beam characteristics, power ranges; beam guiding and focusing arrangements; power sources; materials and thickness capabilities; facilities for manipulating the components for welding; safety features; shielding gas supply and control)
  - 2.5 explain the basic principles of mechanised and automated welding (types of installations; machine functions; loading, handling, clamping and transfer of components; traversing components for welding; control of machine functions; safety features)
  - 2.6 explain how to extract the information required from the drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
  - 2.7 describe the types of joints applicable and the edge preparation required
  - 2.8 describe the problems that can occur with the welding activities and explain how these can be overcome (causes of distortion and methods of control, welding characteristics of parent materials and sources of weld defects; methods of prevention; effect of metal vapour on beam characteristics, penetration and weld shape)
  - 2.9 explain the methods used to set up and restrain the components to achieve correct beam alignment, penetration and control of distortion; manipulation and work holding equipment to present the joint correctly relative to the beam)
  - 2.10 explain how to setup the welding equipment to the welding procedure specification (electrical and optical conditions; focal distance; welding speed)
  - 2.11 explain how to check that the machine functions to the required specification (running pre-production trials to prove that the installation is working satisfactorily)
  - 2.12 describe the organisational quality systems (standards to be achieved; production records to be kept)
  - 2.13 explain the personal approval tests and their applicability to their work
  - 2.14 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

## Unit 313

# Preparing electron beam welding machines for production

<b>UAN:</b>	<b>K/504/9180</b>
<b>Level:</b>	3
<b>Credit value:</b>	70
<b>GLH:</b>	245
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 13: Preparing Electron Beam Welding Machines for Production (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare electron beam welding machines for production in accordance with approved procedures. The learner will be required to set up and check both the welding installation and all associated mechanical and electrical apparatus forming part of the mechanised or automated installation. This will include setting up of handling and loading equipment, workholding arrangements, transfer mechanisms and safety equipment as is applicable to the machine type.</p> <p>In setting up the welding conditions the learner will be expected to set the electrical parameters, beam characteristics, beam alignment, welding speed, vacuum pressure and chamber safety devices. The learner must produce trial welds and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification and solving machine related problems during production will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for setting up the welding</p>



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

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying electron beam welding procedures. The learner will understand the welding process carried out, and its application, and will know about the equipment, relevant materials and consumables in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. prepare electron beam welding machines for production
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure specification and job instructions for the work to be produced 1.3 check that the equipment is as specified and in usable condition 1.4 confirm the electron beam equipment is suitable for production by carrying out all of the following checks: a. the equipment is correctly maintained and in a safe and usable condition b. the equipment is correctly calibrated c. the chamber interior is in a clean condition d. the electron gun is clean e. door faces and seals are sound f. the chamber vacuum system operates correctly g. the accuracy of optical or other beam positioning devices h. the smooth operation of in chamber mechanical equipment i. equipment shut down systems function correctly

- j. the X-ray check list is complied with
- 1.5 obtain the required components and check that the joint preparation complies with the specification
- 1.6 set up the handling, work-holding and associated equipment to achieve correct joint positioning
- 1.7 set up the components to achieve correct joint fit-up and alignment to include setting and checking all of the following as is applicable to the type of installation:
  - a. handling and loading equipment
  - b. workholding arrangements
  - c. traversing or manipulating devices
  - d. transfer mechanisms
  - e. surface preparation and condition of joint faces is according to specification
  - f. safety mechanisms
- 1.8 select and prepare the appropriate consumables in line with the joining procedure specification
- 1.9 set and adjust the machine operating conditions to achieve joints of the required quality and within specified dimensional accuracy
- 1.10 set up the welding equipment and parameters in accordance with instructions and the welding procedure specification to include setting all of the following as is applicable to the type of installation:
  - a. beam alignment
  - b. electrical parameters
  - c. beam characteristics
  - d. welding speed
  - e. chamber pressure
  - f. chamber safety devices
- 1.11 check that all safety mechanisms are in place and that the equipment is operating satisfactorily
- 1.12 prove the installation is operating correctly and is ready for production by producing specified trial welds and checking all of the following as is applicable to the application:
  - a. visual appearance of weld
  - b. dimensional accuracy
  - c. quality of weld
  - d. machine settings are as specified
- 1.13 set up the equipment to produce welded components which covers both of the following:
  - a. two different components
  - b. two different material groups
- 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.15 solve problems in production relating to two of the following:
  - a. machine performance
  - b. joint set-up
  - c. condition of materials being joined
  - d. consumables

<b>Learning outcome</b>
The learner will: 2. know how to prepare electron beam welding machines for production
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when setting and operating electron beam welding installations (working with machinery; care in presence of high voltages; the use of appropriate personal protective equipment (PPE); machine guards; ventilation and fume extraction; machine safety devices; x-ray dosimeters; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with electron-beam welding machines and explain how they can be minimised (dangers from the mains and high voltage supplies; live electrical components; emission of x-rays, fumes and gases; hot metal; moving parts of machinery) 2.3 explain the basic principles of electron beam welding (using an electron beam in vacuum to join metals by fusion; forming a weld; principal features of a welded joint; and penetration process principles, nature of the electron beam; generation and control of an electron beam; parameters, heat input; how variation in the parameters influences the weld features and penetration, quality and output; terminology used in welding) 2.4 describe the key components and features of the equipment (electron gun and control of beam power and characteristics, vacuum chamber and its construction, vacuum system and controls, in-chamber manipulating equipment; power sources and power range, materials and thickness capabilities, safety features; facilities for locating chamber and work handling) 2.5 explain how to extract the information required from the drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.6 describe the types of joints applicable and the edge preparation required 2.7 describe problems that can occur with the welding activities and explain how these can be overcome (magnetic effect of component on beam/joint alignment; effect of metal vapour on beam characteristics and penetration; effects of increase in chamber pressure, welding characteristics of parent materials and sources of weld defects; methods of prevention) 2.8 explain the methods used to set up and restrain the components to achieve correct location and beam alignment; types of in-chamber manipulating equipment 2.9 explain how to setup the welding equipment to the welding procedure specification (setting electrical conditions; beam characteristics, welding speed) 2.10 explain how to check that the machine functions to the required specification (running pre-production trials to prove that the installation is working satisfactorily)

- 2.11 describe the organisational quality systems (standards to be achieved; production records to be kept)
- 2.12 explain the personal approval tests and their applicability to their work
- 2.13 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

## Unit 314

## Preparing friction welding machines for production

<b>UAN:</b>	<b>M/504/9181</b>
<b>Level:</b>	3
<b>Credit value:</b>	65
<b>GLH:</b>	238
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 14: Preparing Friction Welding Machines for Production (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare friction welding machines for production in accordance with approved procedures. The learner will be required to set up and check both the welding installation and all associated mechanical and electrical apparatus forming part of the mechanised or automated installation. This will include setting up of handling and loading equipment, workholding arrangements, in-process monitoring features, transfer mechanisms and safety equipment as is applicable to the machine type.</p> <p>In setting up the welding conditions the learner will be expected to set the electrical conditions, process cycle times, rotational/orbiting speed and weld and forge travel. The learner must produce trial welds and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification and solving machine related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for setting up the welding equipment and to report any problems with the welding equipment or welding activities</p>

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that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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.

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying friction welding procedures. The learner will understand the welding process carried out, and its application, and will know about the equipment, relevant materials and consumables in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. prepare friction welding machines for production
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure specification and job instructions for the work to be produced 1.3 check that the equipment is as specified and in usable condition 1.4 confirm the friction welding equipment is suitable for production by carrying out all of the following checks: a. the equipment is correctly maintained and in a safe and usable condition b. the equipment is correctly calibrated c. all electrical and mechanical systems function smoothly d. equipment shut down systems function correctly 1.5 obtain the required components and check that the joint preparation complies with the specification 1.6 set up the handling, work-holding and associated equipment to achieve correct joint positioning 1.7 set up the components to achieve correct joint fit-up and alignment to include setting and checking all of the following as is applicable to the type of installation:

- a. surface preparation and condition of joint faces is according to specification
  - b. handling and loading equipment
  - c. workholding devices
  - d. transfer mechanisms
  - e. safety devices
- 1.8 select and prepare the appropriate consumables in line with the joining procedure specification
- 1.9 set and adjust the machine operating conditions to achieve joints of the required quality and within specified dimensional accuracy
- 1.10 set up the welding equipment and parameters in accordance with the welding procedure specification to include setting all of the following as is applicable to the type of installation:
- a. friction and forge cycle times
  - b. friction and forge loads (forces)
  - c. frictional burn-off characteristics and forge displacement
  - d. rotational speed or other appropriate friction conditions
  - e. braking effort
- 1.11 set up the equipment to produce welded components which covers both of the following:
- a. two different components
  - b. two different material groups
- 1.12 check that all safety mechanisms are in place and that the equipment is operating satisfactorily
- 1.13 prove the installation is operating correctly and is ready for production by producing specified trial welds and checking all of the following as is applicable to the application:
- a. visual appearance of weld
  - b. dimensional accuracy
  - c. quality of weld
  - d. machine settings are as specified
  - e. in-process monitoring and data acquisition
- 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.15 solve problems in production relating to two of the following:
- a. machine performance
  - b. joint set-up
  - c. condition of prepared materials being joined
  - d. consumables

<b>Learning outcome</b>
The learner will: 2. know how to prepare friction welding machines for production
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when setting and operating friction welding installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; ventilation and fume extraction; machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory

- requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials)
- 2.2 describe the hazards associated with friction welding machines and how they can be minimised (dangers from live electrical components; fumes; hot metal; moving parts of machinery and components)
  - 2.3 explain the basic principles of friction welding (using heat generated by friction to join metals by welding; rotational and orbital methods of heat generation, forming a weld; use of filler metal; principal features of a welded joint; welding cycle, parameters, heat input; how variation in the settings influences the weld features, quality and output; terminology used in welding)
  - 2.4 describe the key components and features of the equipment (types of machines; constructional features; mechanical features, drive train, driven and stationary component holding devices, force generation, and control systems, in-process monitoring features, data acquisition and sensors; braking systems; welding cycle control; feedback and recording)
  - 2.5 explain the basic principles of mechanised and automated welding (types of installations; machine functions: loading, handling, clamping and transfer of components; control of machine functions; safety features)
  - 2.6 explain how to extract the information required from the drawings and welding procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
  - 2.7 describe the preparation of the joint faces; finish, tolerances
  - 2.8 describe the problems that can occur with the welding activities and explain how these can be overcome (welding characteristics of parent materials and sources of weld defects; methods of prevention)
  - 2.9 explain how to setup the welding equipment to the welding procedure specification (setting welding cycle; heating and forging forces, rotational speed)
  - 2.10 explain how to check that the machine functions to the required specification (running pre-production trials to prove that the installation is working satisfactorily)
  - 2.11 describe the organisational quality systems (standards to be achieved; production records to be kept, methods of testing friction welds and principles of quality control in production)
  - 2.12 explain the personal approval tests and their applicability to their work
  - 2.13 describe the extent of their responsibility and explain whom they should report to if they have problems that they cannot resolve



## Unit 315

## Preparing brazing machines for production

<b>UAN:</b>	<b>T/504/9182</b>
<b>Level:</b>	3
<b>Credit value:</b>	45
<b>GLH:</b>	147
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 15: Preparing Brazing Machines for Production (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare torch, inductance, resistance or furnace brazing installations for production in accordance with approved procedures. The learner will be required to set up and check both the brazing installation and all associated mechanical and electrical apparatus forming part of the mechanised or automated installation. This will include setting up of handling and loading equipment, workholding arrangements, traversing mechanisms, transfer mechanisms and safety equipment as is applicable to the machine type.</p> <p>In setting up the brazing conditions the learner will be expected to set the brazing temperature controls, brazing time, flame conditions, flux dispensing arrangements, filler metal placement controls and brazing atmosphere controls as is applicable to the machine type. The learner must produce trial joints and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification and solving machine related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for setting up the brazing equipment and to report any problems with</p>

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the brazing equipment or brazing activities that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with minimum supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying mechanised brazing procedures. The learner will understand the brazing process carried out, and its application, and will know about the equipment, relevant materials and consumables in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output is produced to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. prepare brazing machines for production
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure specification and job instructions for the work to be produced 1.3 check that the equipment is as specified and in usable condition 1.4 prepare and set-up one of the following brazing installations for two different joint configurations in the specified materials, forms and positions, according to work instructions and the welding procedure specification: a. Torch b. Induction c. Resistance d. Furnace 1.5 confirm the brazing machine is suitable for production by carrying out all of the following checks: a. the equipment is correctly maintained and in a safe and usable condition b. the equipment is correctly calibrated

- c. all electrical and mechanical systems function smoothly
- d. equipment shut down systems function correctly
- 1.6 obtain the required components and check that the joint preparation complies with the specification
- 1.7 set up the handling, work-holding and associated equipment to achieve correct joint positioning
- 1.8 set up the work piece to achieve correct joint fit-up and alignment to include setting and checking all of the following as is applicable to the machine type:
  - a. handling and loading equipment
  - b. workholding arrangements
  - c. transfer mechanisms
  - d. preparation of materials and joint faces is to specification
  - e. traversing and indexing mechanisms
  - f. safety mechanisms
- 1.9 select and prepare the appropriate consumables in line with the joining procedure specification
- 1.10 set and adjust the machine operating conditions to achieve joints of the required quality and within specified dimensional accuracy
- 1.11 set up the welding equipment and parameters in accordance with the welding procedure specification to include setting all of the following as is applicable to the machine type:
  - a. brazing temperature control
  - b. brazing time
  - c. flame condition
  - d. flux dispensing arrangements
  - e. filler metal placement
  - f. brazing atmosphere control
  - g. safety devices
- 1.12 check that all safety mechanisms are in place and that the equipment is operating satisfactorily
- 1.13 prove the installation is operating correctly and is ready for production by producing specified trial joints and checking all of the following:
  - a. visual appearance of braze
  - b. dimensional accuracy
  - c. quality of braze
  - d. machine settings are as specified
- 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.15 solve problems in production relating to two of the following:
  - a. machine performance
  - b. joint set-up
  - c. condition of materials being joined
  - d. consumables

<b>Learning outcome</b>
The learner will: 2. know how to prepare brazing machines for production
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when setting and operating brazing installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; ventilation and fume extraction; machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with brazing machines and explain how they can be minimised (dangers from relevant equipment sources; fumes and gases; hot metal; moving parts of machinery) 2.3 explain the basic principles of the relevant brazing process (principal features of brazed joints; wetting and capillary flow, role of fluxes/atmospheres; parameters, heat input; how variation in the parameters influences the quality and output; terminology used in brazing) 2.4 describe the key components and features of the relevant brazing equipment 2.5 explain the basic principles of mechanised and automated brazing (types of installations; machine functions: loading, handling, clamping, manipulating and transfer of components) 2.6 explain how to extract the information required from the drawings and procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.7 explain the types and forms of filler metal; specification; control and storage of consumables 2.8 describe the types of joints applicable and the surface preparation required; methods of applying filler metal 2.9 describe problems that can occur with the brazing activities and explain how these can be overcome, sources of brazing defects and methods of prevention 2.10 explain the methods used to set up and restrain the joint to achieve correct location of components (work holding methods for component location) 2.11 explain how to setup the equipment to the brazing procedure specification 2.12 explain how to check that the machine functions to the required specification (running pre-production trials to prove that the installation is working satisfactorily and producing joints of the specified quality) such as BS EN 18279, 13134 or BS EN 14276 2.13 describe the methods of flux removal and cleaning 2.14 describe the organisational quality systems (standards to be achieved; production records to be kept; testing of brazed joints) 2.15 explain the personal approval tests and their applicability to their work 2.16 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

## Unit 321

## Joining materials using brazing machines

<b>UAN:</b>	<b>A/504/9183</b>
<b>Level:</b>	3
<b>Credit value:</b>	20
<b>GLH:</b>	84
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 21: Joining Materials using Brazing Machines (Suite 3)
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to operate torch, inductance, resistance or furnace brazing installations that have already been prepared for production in accordance with approved instructions or procedures. The learner will be expected to check that the equipment has been approved for production and that sufficient supplies of all the required materials and consumables are present and correct, and ready for production operations to be performed.</p> <p>The learner must operate the installation safely and correctly in accordance with instructions and approved procedures and achieve a joint quality and tolerances that meet the product specification. The learner must continuously monitor the operation of the installation, and make any necessary adjustments to equipment settings in line with their permitted authority in order to produce the brazed joints to the required specification. Meeting production requirements will be an important issue and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for operating the brazing installation and to report any problems or adjustments to the installation that they</p>

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cannot resolve, or are outside their permitted authority, to the relevant people. The learner 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.

The learner's knowledge will provide a sound basis for their work, enabling them to adopt an informed approach to applying brazing procedures and instructions. The learner will have an understanding of how the brazing process works and is applied in mechanised form, and will know about the equipment, materials and consumables in adequate depth to provide a sound background to the process operation and for carrying out the brazing activities to the required specification.

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

<b>Learning outcome</b>
The learner will: 1. join materials using brazing machines
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant joining procedure and work instructions 1.3 operate one of the following mechanised brazing processes in the specified materials, forms and positions: a. torch b. induction c. furnace d. resistance 1.4 confirm that the machine is set up and operating correctly, ready for the joining operations to be carried out by checking all of the following: a. the installation has been approved for production b. supplies of components and consumables are adequate and correctly prepared c. machine settings comply with instructions and the brazing procedure specification d. all machine functions operate correctly e. all safety equipment is in place and functioning correctly

- 1.5 check that the parent material, components, consumables and joint preparation comply with specifications
- 1.6 produced brazed assemblies covering both of the following:
  - a. two different joint configurations
  - b. two different material groups
- 1.7 carry out and monitor the machine operations in accordance with specifications and job instructions
- 1.8 monitor the process operation and machine functions, and make adjustments as required to parameters and mechanisms within their permitted authority and tolerances to include adjusting all of the following as applicable to the machine type:
  - a. brazing temperature
  - b. brazing time
  - c. flux and filler metal dispensing
  - d. brazing atmosphere
  - e. flame condition
  - f. mechanical functions (handling, loading, workholding, transfer)
  - g. safety devices
- 1.9 achieve joints of the required quality and specified dimensional accuracy which:
  - a. achieve the specified joint quality equivalent to the level given in the relevant European/International standard (such as BS EN ISO 18279, 13134 or BS EN 14276) required by the application standard or specification
  - b. meet the required dimensional accuracy within specified tolerances
- 1.10 achieve the rate of output as specified
- 1.11 deal promptly and effectively with problems within their control and report those that they cannot solve
- 1.12 shut down the equipment to a safe condition on conclusion of the joining activities

<b>Learning outcome</b>
The learner will: 2. know how to join materials using brazing machines
<b>Assessment criteria</b>
The learner can: 2.1 explain the safe working practices and procedures to be observed when operating brazing installations (working with machinery; the use of appropriate personal protective equipment (PPE); machine guards; operation of machine safety devices; stopping the machine in an emergency; closing the machine down on completion of activities; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the hazards associated with brazing machines, and explain how they can be minimised (dangers from relevant equipment sources; fumes and gases; hot metal; moving parts of machinery) 2.3 explain the basic principles of the relevant brazing process; terminology used in brazing 2.4 describe the key components and features of the equipment 2.5 explain the basic principles of mechanised and automated brazing (types of installations; machine functions; safety features) 2.6 explain how to extract the information required from drawings and brazing procedure specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.7 explain the operation of the machine controls and their function; care of equipment; control and storage of consumables 2.8 explain how to setup and align the work pieces 2.9 explain how to monitor the brazing process; how to recognise problems and action to be taken 2.10 describe the problems that can occur with the brazing activities (materials, filler metals and joint defects) 2.11 explain the self inspection of the completed work 2.12 describe the organisational quality systems (standards to be achieved; production records to be kept) 2.13 explain the personal approval tests and their applicability to their work 2.14 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve



## Unit 367

## Resolving engineering problems

<b>UAN:</b>	<b>K/600/5755</b>
<b>Level:</b>	3
<b>Credit value:</b>	40
<b>GLH:</b>	96
<b>Relationship to NOS:</b>	This unit has been derived from National Occupational Standard engineering technical support Unit No 43: Resolving engineering problems (Suite 3).
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to resolve engineering problems, in accordance with approved procedures. The learner will be required to investigate the problems, obtaining all the necessary information from the relevant sources to enable them to establish a clear picture of the situation, to identify and evaluate potential corrective actions, and to select the most appropriate and effective solution. The learner's proposed solution will take into account the effects on both the engineering process and on the people involved.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures during the rectification of the engineering problem, and to report any problems that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying problem solving techniques and procedures to engineering situations. The learner will understand the relevant engineering process, and will know about the company</p>

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procedures and systems of operation, in adequate depth to provide a sound basis for carrying out the activities to the required standard.

The learner will be aware of any company/customer, legislative or regulatory health, safety and environmental requirements applicable to the engineering activities being investigated. The learner will understand the specific safety precautions required when carrying out the investigation, especially those for isolating equipment and for taking the necessary safeguards to protect themselves and others in the work area. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. resolve engineering problems
<b>Assessment criteria</b>
The learner can: 1.1 take prompt action to diagnose and rectify the operational problems and keep all relevant people informed of progress 1.2 communicate the solution to appropriate people, using the following methods: a. specific company documentation plus one more from the following: b. written or typed report c. verbal report d. electronic mail e. computer based presentation 1.3 obtain all relevant information relating to the problems 1.4 use information obtained from three of the following sources to help evaluate the problem: a. statistical data b. historical records c. quality audits d. external sources e. feedback from user/customer f. condition monitoring g. fault diagnostics h. operational procedures/manufacturing manuals i. health and safety information j. environmental documents k. development tests l. manufacturer's data 1.5 identify correctly the nature and extent of the problems 1.6 carry out all of the following during the problem solving activity:

- a. discuss/consult with the relevant people about the extent of the problem and its impact on the engineering activity
  - b. gather all appropriate information to help identify or clarify the problem
  - c. evaluate possible solutions, considering temporary, short term and long term solutions
  - d. consider cost implications for each solution
  - e. select the most appropriate solution to rectify the problem
  - f. communicate the proposed solution to the relevant people, obtaining feedback where appropriate
  - g. prepare a plan of action for implementation of the agreed solution
  - h. ensure that the agreed solution is implemented correctly and promptly
  - i. monitor outcomes of the rectification activity, and make any necessary revisions to the plan of action
  - j. ensure that the problem is rectified to the agreed level of acceptability
  - k. ensure that all information is documented to provide an audit trail
  - l. identify the root cause of the problem, using a standard technique
  - m. implement preventive measures, where applicable, to ensure that there is no recurrence of the problem
- 1.7 evaluate all realistic engineering solutions to rectify the problems
- 1.8 identify the most effective engineering solution for rectifying the problems
- 1.9 resolve engineering problems associated with one of the following engineering disciplines:
- a. drawing/design activities (such as mechanical, electrical/electronic, motor vehicle, aerospace, marine)
  - b. manufacturing activities (such as machining, detail fitting, fabrication of components, pressing)
  - c. material processing activities (such as heat treatment, casting, injection moulding, purification)
  - d. composite manufacture (such as wet lay-up, pre-preg laminating, resin infusion, blow moulding)
  - e. finishing activities (such as stripping finishes, painting, plating, anodising, veneering, lacquering)
  - f. assembly activities (such as mechanical, structural, fluid power, electrical/electronic, woodworking)
  - g. installation activities (such as mechanical, electrical/electronic, avionic, structural, environmental equipment)
  - h. plant and equipment (such as site preparation, plant layout, equipment changeover, equipment replacement)
  - i. equipment capability studies/performance measurement
  - j. movement of materials, components or finished goods
  - k. business improvement activities
  - l. engineering safety audits or risk assessments
  - m. quality control/quality assurance
  - n. maintenance activities
  - o. testing and trialling
  - p. modification and repair activities
  - q. research and development

- r. commissioning/decommissioning
  - s. engineering support services
- 1.10 rectify engineering problems arising from two of the following:
- a. component/assembly failure
  - b. equipment malfunction
  - c. design related
  - d. quality related
  - e. scheduling/planning
  - f. product over budget
  - g. project slippage
  - h. ergonomically related
  - i. production control
  - j. contractor related
  - k. safety related
  - l. customer request
  - m. deviation from component/product specification
  - n. material handling devices
  - o. utilities supply (gas, electricity, water, air, etc)
  - p. product/service over lead time
  - q. lack of resources/materials
  - r. environmental/compatibility
  - s. deviation from departmental procedure(s)
  - t. other specific situations
- 1.11 ensure that engineering solutions are implemented correctly and promptly
- 1.12 determine and implement the solution for two of the following:
- a. temporary (interim solution)
  - b. short term (will require further action)
  - c. long term (permanent solution)
- taking into account both of the following:
- d. safety/environmental considerations
  - e. associated costs
- 1.13 ensure that the rectification complies with all relevant regulations and guidelines from all of the following, as appropriate:
- a. organisational guidelines and codes of practice
  - b. equipment manufacturer's operation specification/range
  - c. recognised compliance agency/body's standards
  - d. customer standards and requirements
  - e. BS and/or ISO standards
  - f. health, safety and environmental requirements

<b>Learning outcome</b>
The learner will: 2. know how to resolve engineering problems
<b>Assessment criteria</b>
The learner can: 2.1 explain how to access information on health and safety regulations and guidelines relating to the engineering activities or work area in which the problem exists 2.2 describe the implications of not taking account of legislation, regulations, standards and guidelines when determining solutions to the engineering problems 2.3 explain how to obtain information on the engineering requirements, and the type of information that is available (such as customer requirements and instructions, quality control requirements, product specification, manufacturing methods) 2.4 explain how to access and use the appropriate information and documentation systems 2.5 explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the problem solving process 2.6 describe the company engineering operation procedures where the problem exists 2.7 describe the business need for problem identification and removal 2.8 describe the effects of engineering problems on associated activities 2.9 describe the communication techniques used to obtain information 2.10 describe the principles of effective problem solving, the main problem solving methods and techniques in use, and how to apply them 2.11 describe the benefits of adopting a formalised problem solving process 2.12 explain how to involve the user/customer in the problem solving process 2.13 describe the importance of collecting as much relevant information as possible, and of collating such information in a way which facilitates decision making, and the methods to achieve this 2.14 describe the action planning (to include risk analysis, testing decisions, determining time-scales and protecting the user/customer) 2.15 describe the importance of analysing problems from a variety of perspectives 2.16 explain how to define and verify root cause of a problem 2.17 describe the importance of involving a range of relevant people in generating possible solutions 2.18 describe the importance of developing a range of possible options in solving problems 2.19 describe the factors to be taken into account when resolving problems and determining suitable solutions (especially those covering working conditions and safety) 2.20 describe the methods and techniques for evaluating information 2.21 explain how to present possible solutions in a way which helps relevant people to reach an informed and realistic judgement

- 2.22 explain how to determine and select permanent corrective actions (to include decision making, assessing the criteria and determining the risks, costs and generating alternatives)
- 2.23 describe the process used in the organisation to validate the solution to the engineering problem
- 2.24 explain how to prevent recurrence of the problems (to include proposed changes to management systems, operating systems and procedures, and identification of opportunities for improvements)
- 2.25 describe the importance of customer care and satisfaction
- 2.26 describe the importance of maintaining records of the problem solving activities; what needs to be recorded, and where records are kept
- 2.27 describe the company procedures that apply to the rectification of problems
- 2.28 describe the company reporting procedures, documentation and their application
- 2.29 describe the different ways in which the solutions can be reported back
- 2.30 identify whom to inform of actions taken, and by what means
- 2.31 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve
- 2.32 describe the sources of technical expertise if they have problems that they cannot resolve

## Unit 368

## Implementing engineering activities

<b>UAN:</b>	<b>J/600/5763</b>
<b>Level:</b>	3
<b>Credit value:</b>	40
<b>GLH:</b>	106
<b>Relationship to NOS:</b>	This unit has been derived from National Occupational Standard engineering technical support Unit No 45: implementing engineering activities (Suite 3).
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to implement engineering activities, in accordance with approved procedures. The learner will be required to apply appropriate methods and procedures to ensure that the resources and systems available to them are used effectively and efficiently. The learner will also be required to identify any opportunities to improve the engineering activity during the implementation, and to convey this information to the appropriate people and department (such as with a new or changed assembly or manufacturing activity which may involve planning, design or other departments).</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the implementation of the engineering activities, and to report any problems that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to implementing engineering activities. The learner will be expected to have knowledge that will include</p>

resource management principles. The learner will understand their organisation's methods of operation and quality assurance systems, in sufficient detail to enable them to make informed decisions, and to carry out the implementation activities to the required standard.

The learner will be aware of any company, legislative or regulatory health, safety and environmental requirements applicable to the engineering activity being implemented. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. implement engineering activities
<b>Assessment criteria</b>
The learner can: 1.1 confirm that conditions are suitable to implement operational methods and procedures 1.2 confirm all of the following during the implementation: a. appropriate plant and equipment is available b. materials and components are ready for use c. required resources are available d. timescales for undertaking the activities are as planned e. quality control systems and procedures are in place f. health and safety requirements can be met g. environmental conditions are suitable h. work area/site is suitably prepared i. relevant people are informed 1.3 carry out all of the following when implementing the engineering activities: a. use the correct issue of company information b. check that all essential information and data needed to implement the engineering activity is available c. collect relevant information on the engineering and customer requirements, operations and methods d. use the information collected to determine an implementation plan e. identify potential problems which may influence the implementation of the engineering activity f. check that the appropriate resources will be available at the time they are required g. ensure that health and safety regulations and safe working practices are taken into account h. ensure that the influence of working conditions is recognised and included in the implementation plans 1.4 carry out the implementation of one of the following engineering activities:



- a. drawing/design activities (such as mechanical, electrical/electronic, motor vehicle, aerospace, marine)
  - b. manufacturing activities (such as machining, detail fitting, fabrication of components, pressing)
  - c. material processing activities (such as heat treatment, casting, injection moulding, purification)
  - d. composite manufacture (such as wet lay-up, pre-preg laminating, resin infusion, blow moulding)
  - e. finishing activities (such as stripping finishes, painting, plating, anodising, veneering, lacquering)
  - f. assembly activities (such as mechanical, structural, fluid power, electrical/electronic, woodworking)
  - g. installation activities (such as mechanical, electrical/electronic, avionic, structural, environmental equipment)
  - h. plant and equipment (such as site preparation, plant layout, equipment changeover, equipment replacement)
  - i. equipment capability studies/performance measurement
  - j. movement of materials, components or finished goods
  - k. business improvement activities
  - l. engineering safety audits or risk assessments
  - m. quality control/quality assurance
  - n. maintenance activities
  - o. testing and trialling
  - p. modification and repair activities
  - q. research and development
  - r. commissioning/decommissioning
  - s. engineering support services
- 1.5 provide clear and accurate instructions to all the relevant people
- 1.6 use the following methods to provide the information/instructions:
- a. specific company documentation
- plus one more method from the following:
- b. written or typed report
  - c. verbal report
  - d. electronic mail
- 1.7 obtain accurate information on the operational activities being undertaken
- 1.8 obtain information on the activities and resources required, from three of the following sources:
- a. design office
  - b. quality engineering
  - c. plant engineering
  - d. production engineering
  - e. contractor
  - f. customer
  - g. process engineering
  - h. planning department
  - i. management/directors
  - j. sales department
  - k. health and safety/environmental engineering
  - l. other specific
- 1.9 ensure that quality assurance systems are correctly implemented
- 1.10 ensure that engineering support systems are operating correctly

- 1.11 confirm that one of the following support systems are operating effectively:
  - a. resource supply (such as materials, equipment and people)
  - b. transport
  - c. logistics
  - d. procurement
  - e. utilities
- 1.12 control the use of resources to achieve the most effective results
- 1.13 identify opportunities to improve the operational methods and procedures
- 1.14 carry out all of the following on completion of the implementation activities:
  - a. validation and evaluation of the implementation systems and procedures used
  - b. suggested improvements to their process of implementation
  - c. recommendations for improvements or changes to the engineering activities that were implemented
- 1.15 ensure that the implementation of operational methods and procedures complies with all relevant regulations and guidelines
- 1.16 ensure that implementation methods and procedures used comply with relevant regulations and guidelines, from all of the following, as appropriate:
  - a. organisational guidelines and codes of practice
  - b. equipment manufacturer's operation specification/range
  - c. health, safety and environmental requirements
  - d. recognised compliance agency/body's standards
  - e. customer standards and requirements
  - f. BS and/or ISO standards

<b>Learning outcome</b>
The learner will:
2. know how to implement engineering activities
<b>Assessment criteria</b>
The learner can:
2.1 explain how to access information on health and safety regulations and guidelines relating to the engineering activities to be implemented
2.2 describe the implications of not taking account of legislation, regulations, standards and guidelines when implementing the engineering processes
2.3 describe the personal protective equipment that is required for the work area and process being implemented
2.4 explain how to obtain information on the engineering requirements, and the type of information that is available (such as customer requirements and instructions, quality control requirements, product specification, manufacturing methods)
2.5 explain how to access and use the appropriate information and documentation systems
2.6 describe the engineering methods and procedures that could be used for different types of engineering activity
2.7 explain how to identify conditions that are suitable, and those not

- suitable, for different types of engineering activities
- 2.8 explain how and where to obtain details of the engineering activities being undertaken
  - 2.9 describe the types of data that they will require to implement the engineering activity (such as the activities to be carried out, the sequence in which they must be carried out, timescales, resource requirements, health and safety issues)
  - 2.10 explain how to extract information from drawings, documents and related specifications (to include symbols and conventions to appropriate BS or ISO standards and, where appropriate BS 7671/IEE wiring regulations), in relation to work being planned
  - 2.11 describe the materials, formats, codes and conventions that are used in the drawings and plans
  - 2.12 describe the factors to be taken into account when implementing the engineering activity, especially those covering working conditions and safety
  - 2.13 describe the main types of resource involved with different types of engineering activity, and the typical timescales for providing them
  - 2.14 explain how to verify that resources are suitable
  - 2.15 describe the timescales for carrying out specific engineering activities
  - 2.16 describe the use of the engineering plans and instruction (to include working instructions, along with their purpose and content)
  - 2.17 describe the procedures for changing the plans, to take account of changed circumstances or improvements in the process
  - 2.18 explain how to present observations and recommendations, in the appropriate formats
  - 2.19 describe the importance of maintaining records; what needs to be recorded and where records are kept
  - 2.20 describe the quality assurance systems that are being used
  - 2.21 describe the engineering support systems that are available
  - 2.22 explain why contingency plans need to be drawn up
  - 2.23 identify whom to inform about changes to the plans
  - 2.24 describe the different ways of presenting information to different people
  - 2.25 describe the importance of providing right information at the right time
  - 2.26 describe the roles and responsibilities of key personnel associated with the engineering activity
  - 2.27 describe the problems that can occur during the implementation of the engineering activity, and how these problems can be rectified
  - 2.28 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve
  - 2.29 describe the sources of technical expertise if they have problems they cannot resolve

## Unit 369

## Monitoring engineering activities

<b>UAN:</b>	<b>J/600/5763</b>
<b>Level:</b>	3
<b>Credit value:</b>	40
<b>GLH:</b>	106
<b>Relationship to NOS:</b>	This unit has been derived from National Occupational Standard engineering technical support Unit No 46: monitoring engineering activities (Suite 3).
<b>Assessment requirements specified by a sector or regulatory body:</b>	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to monitor engineering activities, in accordance with approved procedures. The learner will be required to monitor the engineering activity, and the supply and use of resources, both within the company and/or at customer premises, at suitable intervals. In addition, the learner may be required to monitor suppliers and contractors associated with the activity. During the monitoring process, the learner will be required to confirm that the engineering methods used are appropriate, and that the outputs and materials used are within the required specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the engineering activities being monitored, and to report any problems that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will include knowledge of both organisational procedures and discipline-specific engineering principles and processes, within their area of responsibility. This will provide a</p>

good understanding of their work, and will provide an informed approach to applying monitoring procedures to engineering activities. The learner will be conversant with the relevant organisational and quality assurance procedures within their area of responsibility. The learner will also have a knowledge of resource management principles, quality assurance principles and problem solving techniques, in adequate depth to provide a sound basis for carrying out the monitoring activities to the required standards.

The learner will be aware of any company/customer, legislative or regulatory health, safety and environmental requirements applicable to the engineering activities being monitored. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. monitor engineering activities
<b>Assessment criteria</b>
The learner can: 1.1 monitor the operational processes at suitable opportunities 1.2 carry out all of the following during the monitoring activities: a. obtain the necessary specifications and documents required for the monitoring process b. obtain approval to carry out the monitoring activities c. ensure that all appropriate personnel are fully informed of their intended activities d. use appropriate personal protective equipment for the area in which they are carrying out the monitoring activities e. apply safe working practices and procedures at all times f. ensure that by-products and waste are disposed of correctly g. follow the defined monitoring procedures at all times 1.3 carry out the monitoring activities on one of the following engineering activities: a. drawing/design activities (such as mechanical, electrical/electronic, motor vehicle, aerospace, marine) b. manufacturing activities (such as machining, detail fitting, fabrication of components, pressing) c. material processing activities (such as heat treatment, casting, injection moulding, purification) d. composite manufacture (such as wet lay-up, pre-preg laminating, resin infusion, blow moulding) e. finishing activities (such as stripping finishes, painting, plating, anodising, veneering, lacquering) f. assembly activities (such as mechanical, structural, fluid

- power, electrical/electronic, woodworking)
- g. installation activities (such as mechanical, electrical/electronic, avionic, structural, environmental equipment)
- h. plant and equipment (such as site preparation, plant layout, equipment changeover, equipment replacement)
- i. equipment capability studies/performance measurement
- j. movement of materials, components or finished goods
- k. business improvement activities
- l. engineering safety audits or risk assessments
- m. quality control/quality assurance
- n. maintenance activities
- o. testing and trialling
- p. modification and repair activities
- q. research and development
- r. commissioning/decommissioning
- s. engineering support services
- 1.4 during the monitoring activity, carry out all of the following:
  - a. ensure there is an effective supply and use of resources (such as people, materials, equipment)
  - b. verify that materials or equipment used are within specification
  - c. evaluate the outputs of the engineering process, and compare these with specifications
  - d. record any deviations from agreed plans and schedules
  - e. confirm that all relevant regulations and guidelines are complied with
  - f. ensure that relevant people are kept informed
- 1.5 monitor the engineering activity, using two of the following techniques:
  - a. scheduled
  - b. random
  - c. reactive
- 1.6 use two of the following during the monitoring activity:
  - a. observation
  - b. sampling
  - c. data collection
  - d. consultations with relevant people
- 1.7 monitor the supply and use of resources to ensure that they are effectively used
- 1.8 confirm that the materials used during the operational processes comply with specifications
- 1.9 confirm that suitable operational methods and procedures have been used
- 1.10 identify any variations from agreed plans and schedules
- 1.11 ensure that any problems with the operational processes are identified and solved promptly
- 1.12 obtain relevant information from the appropriate sources, to include two of the following:
  - a. work orders
  - b. contracts
  - c. plans/designs
  - d. purchase orders

- e. standard operating procedures
  - f. planning documentation
  - g. quality standards
  - h. equipment or materials supplier information
  - i. schedules
  - j. production control documentation
- 1.13 ensure that the outputs of the operational processes comply with specifications
- 1.14 carry out all of the following on completion of the monitoring activities:
- a. validation and evaluation of the monitoring systems and procedures used
  - b. suggested improvements to their process of monitoring the engineering activity
  - c. recommendations for improvements or changes to the engineering activities that were monitored
- 1.15 communicate the outcomes of the monitoring activity to the relevant people, using the following methods:
- a. specific company documentation
- plus one more method from the following:
- b. written or typed report
  - c. verbal report
  - d. electronic mail
  - e. computer-based presentation
- 1.16 ensure that the operational processes comply with all relevant regulations and guidelines
- 1.17 the process being monitored must comply with relevant regulations, standards and guidelines from all of the following, as appropriate:
- a. organisational guidelines and codes of practice
  - b. equipment manufacturer's operation specification/range
  - c. health, safety and environmental requirements
  - d. recognised compliance agency/body's standards
  - e. customer standards and requirements
  - f. BS and/or ISO standards

<b>Learning outcome</b>
The learner will:
2. know how to monitor engineering activities
<b>Assessment criteria</b>
The learner can:
2.1 explain how to access information on health and safety regulations and guidelines relating to the engineering activities to be monitored
2.2 describe the specific regulations and guidelines that are relevant to the activities being monitored
2.3 describe the specific safety precautions to be taken when carrying out the monitoring and associated activities
2.4 describe the personal protective equipment to be worn in the specific work area, and where this can be obtained
2.5 describe the implications of not taking account of legislation, regulations, standards and guidelines when carrying out the

- monitoring activities
- 2.6 describe the organisational procedures for determining when monitoring should occur, and how it should be undertaken
  - 2.7 describe the monitoring methods and procedures that should be used for the types of engineering activity within their area of responsibility
  - 2.8 describe the potential variations from plans and schedules that might occur during monitoring
  - 2.9 describe the good working knowledge of the processes and specifications of the activity being monitored
  - 2.10 describe the quality assurance systems that are being used
  - 2.11 describe the types of problem that could occur with the monitoring process, and the organisational methods and procedures for resolving them
  - 2.12 describe the importance of solving problems quickly
  - 2.13 explain how to check the outputs of the monitoring process against the specified inputs
  - 2.14 describe the procedures for obtaining information on resources
  - 2.15 explain how to assess the need for resources
  - 2.16 explain how to verify that resources are suitable, and are available within or to the organisation
  - 2.17 describe the importance of maintaining records of the monitoring activities
  - 2.18 describe the type of information to be recorded, and the amount of detail that is required
  - 2.19 explain where records are kept, and the procedure for obtaining them
  - 2.20 describe the importance of ensuring that any records that they use are correctly updated and returned to the appropriate location
  - 2.21 describe the importance of customer care and satisfaction
  - 2.22 describe the different ways of presenting information to different people
  - 2.23 describe the organisational reporting processes and lines of communication
  - 2.24 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve
  - 2.25 describe the sources of technical expertise if they have problems they cannot resolve





## Appendix 1 Relationships to other qualifications

### Links to other qualifications

Mapping is provided as guidance and suggests areas of commonality between the qualifications. It does not imply that candidates completing units in one qualification have automatically covered all of the content of another.

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications.

This qualification has connections to the:

- Level 3 NVQ Diploma in Fabrication and Welding (1781-30-36)
- Level 2 NVQ Diploma in Fabrication and Welding (1782-20)
- Level 3 NVQ Extended Diploma in Fabrication and Welding (1782-60)

### Literacy, language, numeracy and ICT skills development

This qualification can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see [www.cityandguilds.com/functionalskills](http://www.cityandguilds.com/functionalskills)
- Essential Skills (Northern Ireland) – see [www.cityandguilds.com/essentialskillsni](http://www.cityandguilds.com/essentialskillsni)
- Essential Skills Wales (from September 2010).



## Appendix 2 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](http://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.

**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 such 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 GOL/e-volve assessments.

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[www.cityandguilds.com](http://www.cityandguilds.com)

## Useful contacts

<b>UK learners</b> <b>General qualification information</b>	<b>T: +44 (0)844 543 0033</b> <b>E: learnersupport@cityandguilds.com</b>
<b>International learners</b> General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: <b>intcg@cityandguilds.com</b>
<b>Centres</b> Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: <b>centresupport@cityandguilds.com</b>
<b>Single subject qualifications</b> Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: <b>singlesubjects@cityandguilds.com</b>
<b>International awards</b> Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: <b>intops@cityandguilds.com</b>
<b>Walled Garden</b> Re-issue of password or username, Technical problems, Entries, Results, GOLA/e-volve, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: <b>walledgarden@cityandguilds.com</b>
<b>Employer</b> Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: <b>business@cityandguilds.com</b>
<b>Publications</b> Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

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As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

### **City & Guilds Group**

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Land Based Services (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

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