

Level 3 NVQ Diploma in Fabrication and Welding – Sheet Metalworking (3 mm or less) (1782-30)

September 2018 version 1.2



Qualification at a glance

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

Title and level	GLH	TQT	City & Guilds number	Accreditation number
Level 3 NVQ Diploma in Fabrication and Welding Engineering – Sheet Metalwork (3mm or less)	393	1240	1782-30	601/0078/3

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



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1 Introduction

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

Area	Description
Who is the qualification for?	It is 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">• Level 3 NVQ Extended Diploma in Fabrication and Welding Engineering

Structures

The minimum credit required to achieve this qualification is **158 credits**.

To achieve the **Level 3 NVQ Diploma in Fabrication and Welding Engineering (Sheet Metalworking (3mm or less))**, learners **must** achieve **15** credits from the mandatory units (201-202, 303) and learners **must** also achieve a minimum of **96** credits from the mandatory group (units 322-324), plus a minimum of **40** credits and any **two** units from optional group A (units 325-327), plus a minimum of **7** credits and **one** more unit from optional group B, units (229-230, 328, 331, 366).

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory			
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
Mandatory Pathway group			
F/504/9184	322	Marking Out Components for Metalwork	21
J/504/9185	323	Cutting Sheetmetal to Shape using Hand and Machine Tools	35
L/504/9186	324	Forming Sheetmetal using Hand and Machine Tools	40
Optional group A			
R/504/9187	325	Producing Sheetmetal Assemblies	43
Y/504/9188	326	Heat Treating Materials for Fabrication Activities	12
D/504/9189	327	Developing and Marking Out Templates for Metalwork	28
Optional group B			
F/504/9217	229	Bonding Engineering Materials using Adhesives	14
J/504/9218	230	Joining Materials by Resistance Spot Welding	7
R/504/9190	328	Joining Fabricated Components using Mechanical Fasteners	21
Y/504/9191	331	Producing Fillet Welded Joints using a Manual Welding Process	76
D/504/9211	366	Operating CNC Fabrication Equipment	40

- 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 – Sheet Metalworking (3 mm or less)	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.

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

UAN:	A/601/5013
Level:	2
Credit value:	5
GLH:	35
Relationship to NOS:	This unit has been derived from SEMTA national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<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.

Learning outcome	The learner will:
1. comply with statutory regulations and organisational safety requirements	
Assessment criteria	
<p>The learner can:</p> <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> a. lifting alone b. with assistance of others c. with mechanical assistance
1.10 apply safe working practices and procedures to include: <ul style="list-style-type: none"> 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.

Learning outcome	The learner will:
2.	know how to comply with statutory regulations and organisational safety requirements
Assessment criteria	
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

UAN:	Y/601/5102
Level:	2
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from SEMTA national occupational standard: Using and interpreting engineering data and documentation (Suite 2).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<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.

Learning outcome	The learner will:
1.	use and interpret engineering data and documentation
Assessment criteria	
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"> a. check the currency and validity of the data and documentation used b. exercise care and control over the documents at all times c. correctly extract all necessary data in order to carry out the required tasks d. seek out additional information where there are gaps or deficiencies in the information obtained e. deal with or report any problems found with the data and documentation f. make valid decisions based on the evaluation of the engineering information extracted from the documents g. return all documents to the approved location on completion of the work h. complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation
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"> a. materials or components required b. dimensions c. tolerances d. build quality e. installation requirements f. customer requirements g. time scales h. financial information i. operating parameters j. surface texture requirements k. location/orientation of parts l. process or treatments required m. dismantling/assembly sequence n. inspection/testing requirements 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
 - i. company specific technical instructions
 - j. national, international and organisational standards

<ul style="list-style-type: none"> k. health and safety standards relating to the activity (such as COSHH) l. other specific related documentation <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>

Learning outcome	The learner will:
2.	know how to use and interpret engineering data and documentation
Assessment criteria	
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 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

UAN:	K/601/5055
Level:	3
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from SEMTA national occupational standard: Working efficiently and effectively in engineering (Suite 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<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>

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

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

Unit 229

Bonding engineering materials using adhesives

UAN:	F/504/9217
Level:	2
Credit value:	14
GLH:	56
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 29: Bonding Engineering Materials using Adhesives (Suite 2)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to undertake the joining of engineering materials using adhesive bonding processes, in accordance with approved procedures. The learner will be required to work to instructions, using appropriate or specified bonding agents for the materials to be joined, that meet the specified conditions and subsequent operating conditions to be demanded of the joint. Particular attention will be needed in the preparation of the materials and the application of the bonding agent, as well as the means of securing the joint until the setting or curing process has been completed, so that the finished component meets the level of accuracy required. The adhesive bonding agents used will include impact adhesives, cold curing adhesives, rubber mastic, solvent adhesives, epoxy resins and thermally cured adhesives. The joint will be of two or more materials and may include metallic and/or non-metallic materials and joints of dissimilar materials.</p> <p>The learner's responsibilities will require them to comply with organisational policies and procedures, and/or those of the bonding agent manufacturers. The learner will be expected to report any problems with the bonding agents, materials or bonding activities that they cannot resolve them self,</p>

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 good understanding of their work, and will provide an informed approach to the adhesive bonding activities carried out. The learner will have an understanding of the basic characteristics of the materials to be joined, the bonding agents used and the procedures that go with them, in adequate depth to provide a sound basis for carrying out the activities safely and correctly and for achieving a sound and cohesive joint that is fit for purpose.

The learner will understand the precautions required when working with the various bonding agents, and the safeguards necessary for undertaking the process. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibilities they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. bond engineering materials using adhesives
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the adhesive bonding process: a. correctly prepare the materials for bonding b. select the right constituents and bonding methods c. check the surfaces to be bonded mate properly to make a sound joint possible d. ensure the joint is rigidly secure during the curing period e. remove surplus material and clean up at the appropriate time 1.3 follow the relevant bonding procedure specification and job instructions 1.4 check that the materials to be bonded and bonding agents comply with the specification 1.5 carry out adhesive bonding activities using two of the following types of material: a. metallic b. non-metallic c. combinations of materials 1.6 use two of the following types of adhesives:

- a. impact adhesives
 - b. cold curing adhesives
 - c. rubber mastic
 - d. solvent adhesives
 - e. epoxy resins
 - f. thermally cured adhesives
- 1.7 correctly prepare the parent materials and bonding agents in line with the bonding specification
- 1.8 carry out the bonding operations using the specified processes and techniques to position and bond the materials in their correct locations
- 1.9 produce bonded joints in three of the following types of component:
- a. flat and flanged joints on flat surfaces
 - b. flat and flanged joints on curved surfaces
 - c. vertical components
 - d. horizontal components
 - e. rectangular trunking
 - f. circular trunking
 - g. access flanges, panels and cover plates
 - h. tanks and tank covers
 - i. pipework
- 1.10 use a range of bonding equipment and devices, to include four of the following:
- a. mixing vessels
 - b. spatulas, brushes, knives
 - c. spray equipment
 - d. jigs
 - e. formers
 - f. clamps
 - g. presses
 - h. weights
 - i. temporary fixtures (clips, wiring)
- 1.11 use a range of preparation and cleaning agents, to include two of the following:
- a. detergents
 - b. solvents
 - c. petroleum products
 - d. acids
- 1.12 ensure that any equipment used to maintain surface contact during the bonding activities is set up and used correctly
- 1.13 achieve bonds of the required quality and within the specified dimensional accuracy which comply with all of the following:
- a. components are dimensionally accurate and of the correct orientation
 - b. joints meet the required application standard
 - c. completed joints are clean and free from surplus adhesive
 - d. the completed joint has the required appearance
- 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome
The learner will: 2. know how to bond engineering materials using adhesives
Assessment criteria
The learner can: 2.1 explain the specific safety precautions to be taken when bonding engineering materials using adhesives in a fabrication environment (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations) 2.2 explain the personal protective clothing and equipment to be worn when carrying out bonding as part of the fabrication activities (such as gloves, eye protection, safety helmets, respiratory protection) 2.3 describe the importance of good workshop practice and house keeping, ventilation and fume control equipment, first aid procedures and actions, hazardous substances and relevant sections of COSHH 2.4 describe the correct methods of moving or lifting sheet or plate materials 2.5 describe the hazards associated with bonding fabricated components, and explain how they can be minimised 2.6 describe how to obtain the necessary drawings and joining specifications 2.7 explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken 2.8 describe the material preparations that are required, and the equipment and consumables that are used 2.9 describe the importance of working to organisational and bonding agent manufacturers' instructions whilst carrying out the bonding activities 2.10 describe the methods and techniques used for bonding the materials (such as gluing, impact, chemical and thermal reaction techniques) 2.11 describe the basic characteristics of the adhesives that are to be used 2.12 explain the application of, and precautions to be taken when using, adhesives and solvents 2.13 describe the maintenance and care of tools and equipment 2.14 describe the methods of degreasing components and producing a keying surface 2.15 describe the type and suitability of the adhesives; setting or curing requirements and time, strength and appearance and shelf life 2.16 describe the common causes of defects associated with the bonding processes, and how to avoid them 2.17 describe the effects of the environment on the bonding process (such as temperature, humidity, cleanliness) 2.18 describe how to identify, select, use, and clean, the appropriate bonding agent holding vessels, brushes, stirrers and spatulas, scrapers, knives, clamps and weights 2.19 explain the importance of cleaning up after use, to ensure everything can be used again and to minimise the need for replacement of equipment

- 2.20 describe the reasons for checking that components are assembled in the correct sequence, are positioned dimensionally accurately and to the correct orientation, in accordance with the specifications, prior to bonding
- 2.21 describe how to check that completed joints are firm, sound and fit for purpose
- 2.22 describe the procedures for cleaning off surplus adhesive and tidying up the appearance of joints
- 2.23 describe the problems that can occur with the bonding operations, and how these can be avoided
- 2.24 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve
- 2.25 explain the reporting lines and procedures, line supervision and technical experts

Unit 230

Joining materials by resistance spot welding

UAN:	J/504/9218
Level:	2
Credit value:	7
GLH:	35
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 30: Joining Materials by Resistance Spot Welding (Suite 2)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to set up and use portable, and simple fixed spot welding machines, in accordance with approved instructions or welding procedures. The learner will be expected to check that the equipment is fit for purpose, that electrodes are correctly profiled, and that the component parts are in the correct condition for spot welding. In preparing the equipment, the learner will need to set the welding current, welding and squeeze times and electrode pressure. The learner must operate the equipment safely and correctly, and make any necessary adjustments to the equipment settings and parameters within permitted tolerances, in order to achieve a weld quality and tolerances that meet the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the welding activities undertaken, and to report any problems or adjustments to the equipment 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.</p>

The learner's knowledge will be sufficient to provide a sound basis of their work, and will enable them to adopt an informed approach to applying spot welding procedures and instructions. The learner will understand how the resistance spot welding process works, 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 resistance spot welding equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. join materials by resistance spot welding
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 confirm that the resistance spot welding equipment is fit for purpose, by carrying out all of the following checks: a. equipment range is suitable for the operations to be performed b. portable equipment power leads are undamaged and securely connected c. electrodes are of the correct type, size and profile d. all equipment mechanical and electrical systems operate correctly e. supplies of components are adequate and suitably prepared f. appropriate safety screens are available 1.3 follow the relevant joining procedure and work instructions 1.4 confirm that the machine is set up and operating correctly, ready for the joining operations to be carried out 1.5 set up, check, adjust and operate one of the following resistance spot welding machines: a. portable spot welding machines b. fixed simple spot welding machines 1.6 set up the equipment parameters in accordance with instructions and the welding procedure specification, to include setting all of the following: a. electrode tip diameter/profile b. welding current c. welding and squeeze times d. electrode pressure e. water cooling flow rate (as applicable)

- 1.7 check that the parent material, components, consumables and joint preparation comply with specifications
- 1.8 carry out and monitor the machine operations in accordance with specifications and job instructions
- 1.9 monitor the process operation and make adjustments to parameters, in order to produce welded components covering both of the following:
 - a. two different components
 - b. two different material thicknesses
- 1.10 achieve joints of the required quality and specified dimensional accuracy
- 1.11 produce welded components which meet all the following requirements:
 - a. achieve a weld quality as specified in the application standard
 - b. spot welds are correctly pitched out
 - c. welded components meet the required dimensional accuracy within specified tolerance
- 1.12 make sure that the rate of output is as specified
- 1.13 deal promptly and effectively with problems within their control and report those that they cannot solve
- 1.14 shut down the equipment to a safe condition on conclusion of the joining activities

Learning outcome
The learner will: 2. know how to join materials by resistance spot welding
Assessment criteria
The learner can: 2.1 explain the specific safety precautions to be taken when operating resistance welding equipment (working with machinery, the use of appropriate personal protective equipment (PPE); the use of safety screens; operation of machine safety devices; 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 equipment (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; heat and pressure to form a weld; heating effect of welding current; principal features of the welded joint; heat input; welding and pressure cycles; terminology used in welding 2.4 describe the key components and features of the equipment used (power source; welding head; power range; 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) 2.5 explain how to extract the information required from the drawings and welding procedure specifications (to include symbols and conventions to appropriate BSEN or ISO standards in relation to the work undertaken)

- 2.6 describe the operation of the machine controls and their function; equipment care procedures
- 2.7 describe how to monitor the equipment during the welding process; fine tuning parameters to maintain quality; recognition of problems and action to be taken
- 2.8 describe problems that can occur with the welding activities; materials and weld defects
- 2.9 describe self inspection of completed work
- 2.10 describe the organisational quality systems (standards to be achieved; production records to be kept)
- 2.11 describe the personal approval tests and their applicability to their work
- 2.12 describe the extent of their own authority and explain whom they should report to if they have problems that they cannot resolve
- 2.13 explain the reporting lines and procedures, line supervision and technical experts

Unit 322

Marking out components for metalwork

UAN:	F/504/9184
Level:	3
Credit value:	21
GLH:	77
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 22: Marking Out Components for Metalwork (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to mark out sheet and plate work (including simple templates), and rolled sections in accordance with approved procedures. The learner will be required to select the required materials to use and the appropriate marking out tools and equipment based on the information presented to them and the accuracy to be achieved. Marking out will be the preparation required for cutting, shaping and forming sheet materials, plate and sections as is appropriate to the application and will include marking out workpiece datum's, centre lines, angles and curved details, cutting and bending details including bending allowances and hole centring and outlining details.</p> <p>Materials to be marked out may include ferrous and non-ferrous. Certain materials will require the learner to take the grain flow or rolling direction into account to avoid later production process problems.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the marking out activities undertaken and to report any problems with the materials, equipment or marking out activities that they cannot resolve themselves, or are outside their permitted authority, to the relevant people. The learner</p>

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 good understanding of their work, and provide an informed approach to applying marking out procedures. The learner will understand the marking out process, and its application, and will know about the materials as well as the care and use of tools in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety procedures required when using marking mediums, and when carrying out the marking out activities. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibilities they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. mark out components for metalwork
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 obtain and use the correct information for marking out 1.3 obtain the appropriate marking out equipment and check that it is in a usable condition 1.4 mark out directly onto sheet or plate from drawings using six of the following tools and instruments: a. scribe b. centre punch c. rule and tape d. straight edge e. square f. protractor g. dividers or trammels h. chalk, bluing or paint i. laser j. etching 1.5 prepare suitable datum's and marking out surfaces 1.6 mark out using appropriate methods 1.7 mark out sheet, plate or section materials on two appropriate materials from the following: a. hot rolled mild steel b. cold rolled mild steel c. coated mild steel (such as primed, tinned or galvanised)

	<ul style="list-style-type: none"> d. stainless steel e. aluminium f. brass g. copper h. lead i. titanium j. non-metallic materials
1.8	<p>mark out sheet or plate for three of the following forms/shapes of component:</p> <ul style="list-style-type: none"> a. flat covers and plates b. square and radial bends c. square/rectangular/box sections d. cylindrical sections (such as trunking, pipes, tanks) e. frames or structures f. fish plates, gussets g. brackets h. structural support pads, bed plates i. columns, beams or struts j. simple seatings (such as boiler saddles, tank cradles)
1.9	<p>mark out material to include five of the following features:</p> <ul style="list-style-type: none"> a. datum and centre lines b. square/rectangular profiles c. angles d. circles e. curved profiles f. cutting and bending detail (including allowances) g. hole centring and outlining (circular and linear)
1.10	check that the marking out complies with the specification
1.11	<p>produce marked out component which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> a. company/customer standards and codes of practice b. dimensionally accurate (to drawing or specification) c. clearly defined for required processes d. uses recognised marking out conventions
1.12	deal promptly and effectively with problems within their control and report those that cannot be resolved

Learning outcome	
The learner will:	
2. know how to mark out components for metalwork	
Assessment criteria	
The learner can:	
2.1	explain the specific safety precautions to be taken when working in a fabrication environment with sheet, plate or rolled section materials (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
2.2	describe the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye/ear protection, safety helmets)
2.3	explain the correct methods of moving or lifting sheet, plate and

- rolled section materials
- 2.4 describe the hazards associated with marking out fabricated components and explain how they can be minimised (such as working in a fabrication environment, lifting and handling sheet/fabricated components, slivers/burrs on sheet materials, using marking out mediums, using laser marking out equipment)
 - 2.5 explain the procedures to be adopted to obtain the necessary drawings and job instructions
 - 2.6 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
 - 2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.8 explain how you can produce a three dimensional shape from the two dimensional material
 - 2.9 describe the preparations that need to be carried out on the material prior to marking out to enhance clarity and accuracy, and safety
 - 2.10 explain the principles of marking out, developing basic shapes (flat, rectangular and cylindrical) from flat sheet, plate or rolled section materials
 - 2.11 describe the effective use and care of tools/instruments
 - 2.12 explain the use of marking out conventions (such as datum edges/lines, centre lines)
 - 2.13 explain the material characteristics and process considerations that need to be taken into account when marking out sheet, plate or rolled section materials
 - 2.14 explain how to calculate and mark out true lengths, bend allowances and circumferences
 - 2.15 explain the geometrical construction methods used for straight and radius bends, curved or circumference sections, pyramid or cone sections
 - 2.16 explain ways of laying out the shapes/patterns to maximise the use of plate or sheet material
 - 2.17 explain how to set and adjust the tools, such as squares and protractors
 - 2.18 describe the methods of marking out large or long shapes
 - 2.19 explain how to mark out and transfer information from templates
 - 2.20 explain how to transfer information to the underside of the sheet or plate
 - 2.21 explain the importance of using tools only for the purpose intended, the care that is required when using the equipment and tools, the proper way of preserving and storing tools and equipment between operations
 - 2.22 explain the need for clear and dimensional accuracy in marking out to specifications/drawings
 - 2.23 describe the sort of problems that can occur in marking out fabrication components, and explain how these can be avoided
 - 2.24 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve
 - 2.25 explain the reporting lines and procedures, line supervision and technical experts

Unit 323

Cutting sheetmetal to shape using hand and machine tools

UAN:	J/504/9185
Level:	3
Credit value:	35
GLH:	133
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 23: Cutting Sheetmetal to Shape using Hand and Machine Tools (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to cut and shape sheetmetal (up to and including 3 mm) in order to fabricate clips, brackets, covers, trunking and similar components (including templates) in accordance with approved procedures. The learner will be required to select the appropriate equipment to use for the material and thickness and the accuracy required to be achieved and will use hand tools, hand power tools and machinery as is applicable. The cutting and shaping will involve producing straight cuts, external curved contours, cut-ins, notches and round and square holes.</p> <p>Materials to be cut and shaped may include ferrous and non-ferrous. This will call for care in selecting the right tools so as to avoid damage or contamination to the tools and danger to oneself.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures, seeking out relevant information and to report any problems with the cutting equipment, materials or cutting activities that they cannot personal resolve, or are outside their permitted authority, to the relevant person. The learner will be expected to work with minimum supervision, taking personal responsibility for their own</p>

actions and the quality and accuracy of the work that they produce.

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying sheetmetal cutting and shaping procedures. The learner will understand the processes, the equipment and their application, and will know about the materials in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with fabrication tools and machinery. 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. cut sheetmetal to shape using hand and machine tools
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow relevant specifications for the component to be produced 1.3 obtain the appropriate tools and equipment for the shaping operations and check they are in a safe and usable condition 1.4 shape the materials using appropriate methods and techniques 1.5 cut and finish material to the marked out shape using six of the following tools: a. tin snips b. bench shears c. guillotine d. hacksaw e. band saw f. hand power tools (drill, nibbling) g. pillar drill h. files i. punch/cropping machine j. trepanning k. nibbling machine l. thermal devices 1.6 perform operations to produce all of the following shapes: a. straight cuts b. cut-ins (straight and curved) c. notches d. external and internal curved contours e. round holes

<ul style="list-style-type: none"> f. square holes
<p>1.7 use sheetmetal of various thickness up to and including 3 mm for two appropriate materials and two thicknesses from the following:</p> <ul style="list-style-type: none"> a. hot rolled mild-steel b. cold rolled mild steel c. coated mild steel (such as primed, tinned, galvanised) d. stainless steel e. aluminium f. brass g. copper h. lead i. titanium
<p>1.8 check that all the required shaping operations have been completed to the required specification</p>
<p>1.9 produce cut and shaped components which meet all the following quality and accuracy standards:</p> <ul style="list-style-type: none"> a. company/customer standards requirements b. dimensionally accurate (to drawing or specifications) c. free from distortion d. free from sharp edges, slivers or burrs
<p>1.10 deal promptly and effectively with problems within their control and report those that cannot be solved</p>

<p>Learning outcome</p>
<p>The learner will:</p> <ul style="list-style-type: none"> 2. know how to cut sheetmetal to shape using hand and machine tools
<p>Assessment criteria</p>
<p>The learner can:</p> <ul style="list-style-type: none"> 2.1 explain the specific safety precautions to be taken when working with sheetmetal equipment and materials in a fabrication environment (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations) 2.2 describe the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye/ear protection, safety helmets) 2.3 explain the correct methods of moving or lifting sheetmetal 2.4 explain the safe working practices and procedures that need to be observed when using manual and power operated tools 2.5 describe the hazards associated with fabrication work and explain how they can be minimised, such as using dangerous or badly maintained tools and equipment, operating guillotines and when using hand and bench shears 2.6 explain the procedures for obtaining the necessary drawings and specifications and explain how to check that they are the latest issue 2.7 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and

system of tolerancing

- 2.9 explain how to interpret the marking out conventions on the materials to be cut and shaped (such as cutting lines, centre lines)
- 2.10 describe the tools and techniques available for cutting and shaping sheetmetal (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)
- 2.11 explain what preparations they may have to carry out on the material prior to cutting it
- 2.12 explain the material characteristics and process considerations that need to be taken into account when cutting and shaping sheetmetal
- 2.13 explain the use and care of tools and equipment including checks that need to be made to ensure that the tools are fit for purpose (sharp, undamaged, plugs and cables secure and free from damage, machine guards or safety devices operating correctly)
- 2.14 explain the tool cutting characteristics
- 2.15 explain how to set and adjust the tools and equipment, the use of back stops on guillotines etc
- 2.16 explain the importance of using tools or equipment only for the purpose intended, the care that is required when using the tools or equipment, the proper way of preserving tools or equipment between operations
- 2.17 describe the problems that can occur with cutting and shaping sheetmetal and explain how these can be avoided
- 2.18 explain the importance of using the machine guards and safety protection equipment at all times
- 2.19 describe the inspection techniques that can be applied to check shape and dimensional accuracy are to specification and within acceptable limits
- 2.20 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve
- 2.21 explain reporting lines and procedures, line supervision and technical experts

Unit 324

Forming sheetmetal using hand and machine tools

UAN:	L/504/9186
Level:	3
Credit value:	40
GLH:	140
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 23: Cutting Sheetmetal to Shape using Hand and Machine Tools (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to form sheetmetal (up to and including 3mm) using hand tools and machine tools in accordance with approved procedures. The learner will be required to select the appropriate equipment to use based on the operations required, material to be formed and accuracy to be achieved and this will include such things as hammers and stakes, formers, bending machines, rolling machines, wiring and swaging machines. The components/shapes to be produced will include bends/upstands, folds, box sections, wired edges, cylinders and curved sections, square to round trunking, lobsterback trunking, and stretching and shrinking of materials to form cowlings and rounded covers, curved panels with balled corners, concertina ducting or trunking.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the forming activities undertaken and to report any problems with the tools and equipment, materials or activities that they cannot personally 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.</p>

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying sheet metalwork forming procedures. The learner will understand the forming processes, the equipment used and its application, and will know about the materials and forming techniques in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the components to the required specification.

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

Learning outcome
The learner will: 1. form sheetmetal using hand and machine tools
Assessment criteria
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 correct component drawing and any other related specifications for the component to be produced 1.3 determine what has to be done and how this will be achieved 1.4 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition by carrying out all of the following checks: a. hand tools are in a usable condition (hammer shafts secure; stakes, formers and striking faces free from defects and damage) b. the appropriate machine is selected for the operation being performed c. the machine guards and safety devices are in position and function correctly d. forming tools are appropriate and in a serviceable condition (secure, correct shape, free from damage) e. machine settings are suitable for the material thickness and operations to be performed 1.5 shape the materials to the required specification using appropriate methods and techniques 1.6 use three of the following types of forming equipment/techniques: a. hammers/panel beating equipment b. stakes and formers c. bending machine (hand or powered) d. rolling machine (hand or powered) e. wheeling machine

- f. jenny/wiring machine
 - g. swaging machine
 - h. spot heating techniques
- 1.7 perform forming operations which produces seven of the following shapes:
- a. bends/upstands
 - b. folds
 - c. box sections
 - d. wired edges
 - e. swages
 - f. curved panels
 - g. cylindrical sections
 - h. cowlings and rounded covers
 - i. square to round trunking
 - j. lobsterback trunking
 - k. domed corners
 - l. concertina ducting or trunking
 - m. ribbed components
 - n. boxed edges
 - o. concentric cones
 - p. offset cones
- 1.8 produce components made from two different materials from the following:
- a. mild-steel
 - b. tinned steel
 - c. galvanised plate
 - d. stainless steel
 - e. titanium/special steels
 - f. aluminium
 - g. brass
 - h. copper
 - i. lead
- 1.9 check that all the required shaping operations have been completed to the required standard
- 1.10 produce components which meet all of the following quality and accuracy standards:
- a. dimensional accuracy is within specification tolerances
 - b. finished components meet the required shape/geometry (to the template profile)
 - c. completed components are free from excessive tooling marks, deformation or cracking
- 1.11 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome
The learner will: 2. know how to form sheetmetal using hand and machine tools
Assessment criteria
The learner can: 2.1 explain the specific safety precautions to be taken when working with sheetmetal equipment and materials in a fabrication

- environment (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
- 2.2 describe the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather apron and gloves, eye/ear protection, safety helmets)
 - 2.3 explain the correct methods of moving or lifting sheet or plate materials
 - 2.4 describe the hazards associated with sheetmetal work and explain how they can be minimised, such as handling sheet/fabricated components, using machinery, using dangerous or badly maintained tools and equipment
 - 2.5 explain how to obtain the necessary drawings, specifications and work instructions
 - 2.6 explain how to extract the information from the engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
 - 2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.8 explain the marking out conventions used in sheetmetal work and how to recognise cutting detail and bending and folding lines
 - 2.9 describe the hand tools used in sheetmetal forming activities and typical operations that they are used for (hammers, stakes, formers, sand bags)
 - 2.10 describe the various machine tool forming equipment that can be used to produce a range of shapes (such as bends, box sections, cylinders and curved sections, wired edges and swages)
 - 2.11 describe the methods of stretching and shrinking materials and the tools, equipment and techniques used
 - 2.12 explain how to set up the various machine to produce the required forms (setting up of rolls; setting fingers on bending machines; setting forming tools for swaging)
 - 2.13 explain the ways of limiting distortion, marking, creases, flats (in curved sections)
 - 2.14 describe how the materials are to be prepared for the forming operations and explain why some materials may require a heating process prior to forming
 - 2.15 explain the characteristics of the various materials used with regard to the bending and forming process
 - 2.16 describe the tool and equipment care and maintenance procedures
 - 2.17 describe the problems that can occur with forming sheetmetal and how these can be avoided
 - 2.18 describe the organisational quality control procedures and recognition of pressure forming defects
 - 2.19 describe the dimensional and forming inspection checks that need to be carried out and the tools and equipment to be used
 - 2.20 explain the limitations of the various forming processes and accuracy that may realistically be achieved
 - 2.21 explain ways of avoiding and correcting inaccuracies in forming activities
 - 2.22 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

Unit 325

Producing sheetmetal assemblies

UAN:	R/504/9187
Level:	3
Credit value:	43
GLH:	140
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 25: Producing Sheetmetal Assemblies (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to produce sheetmetal (up to and including 3mm) assemblies in accordance with approved procedures. The learner will be required to correctly interpret specifications and drawings, bring together and assemble and join, in the right order, sheetmetal components and/or light sections in order to construct completed fabricated assemblies or sub-assemblies such as ducting, tanks, cylindrical sections, conical sections, reduction pieces. The learner will be required to lay out and secure the various component parts of the structure using mechanical fastenings, resistance welding or self securing methods in the correct order and ensure they are assembled in a manner that is fit for purpose.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the sheetmetal fabrication activities to be undertaken and to report any problems with the activities, tools and equipment or materials that they cannot personally resolve, or are outside their permitted authority, to the relevant people. 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.</p>

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying sheetmetal fabrication techniques and their assembly and fixing procedures. The learner will understand the techniques used and the requirements of the manufacturing and assembling procedures and their application. The learner will know about the methods of assembling the components of the required strength, that are fit for purpose in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is produced to the required specification.

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

Learning outcome
The learner will: 1. produce sheetmetal assemblies
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the sheetmetal assembly operations: a. correctly prepare and set-up the components and faces to be joined b. use the correct datum faces c. use the specified or appropriate fixing method d. correctly align the components and faces to be joined e. assemble/fabricate the sheetmetal components in the correct order or manner f. produce an assembly which meets the required specification 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 confirm that the specified components are available and that they are in a usable condition 1.5 use four of the following types of components in the assemblies produced: a. sheetmetal covers b. pre-fabricated square/rectangular components c. pre-fabricated cylindrical/conical components d. brackets e. flanges

- f. pipes
 - g. light rolled section (angle, channel or tee section) stiffeners and frame components
- 1.6 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.7 assemble sheetmetal components using two of the following methods:
- a. temporary tack welding
 - b. soldering or brazing
 - c. resistance spot welding
 - d. riveting (hollow or solid)
 - e. adhesive bonding
 - f. flanged and mechanically fastened (bolts, screws)
 - g. self securing joints (knocked up, paned down, swaged, joggled)
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 produce five of the following sheetmetal assemblies:
- a. frames
 - b. tanks
 - c. ducting
 - d. guards
 - e. hoods
 - f. panels
 - g. sectional trunking
 - h. square, rectangular and box sections
 - i. cylindrical sections
 - j. conical sections
 - k. reduction pieces
 - l. transformers
 - m. segmented bends
 - n. steel and composite material assemblies
- 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification to include all of the following:
- a. all components are correctly assembled and aligned in accordance with the specification
 - b. overall dimensions are within specification tolerances
 - c. assemblies meet appropriate geometric tolerances (square, straight, angles free from twists)
 - d. where appropriate pitch of erection holes meet specification requirements
 - e. completed assemblies have secure and firm joints, are clean and free from burrs or flash
- 1.11 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome
The learner will: 2. know how to produce sheetmetal assemblies
Assessment criteria

The learner can:

- 2.1 explain the specific safety precautions to be taken when working in a fabrication environment and when producing sheetmetal assemblies (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
- 2.2 describe the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye protection, safety helmets, ear protection)
- 2.3 explain the safe working practices and procedures needed for producing sheetmetal assemblies
- 2.4 explain the correct methods of moving or lifting bulky fabrications
- 2.5 describe the hazards associated with sheetmetal fabrication and assembly work and explain how they can be minimised (such using dangerous or badly maintained tools and equipment, lifting and handling long and heavy components, cuts, slips trips and falls)
- 2.6 explain how to obtain the necessary drawings and joining specifications
- 2.7 explain how to extract the information from the engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
- 2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.9 explain how to interpret marking out conventions (such as cutting lines, centre lines)
- 2.10 describe the preparations that need to be carried out on the components prior to assembling them
- 2.11 explain the various methods of securing the assembled components the range of mechanical fastening devices that are used (such as nuts and bolts, screws, special fasteners, resistance and tack welding methods and techniques, adhesive bonding of components and self secured joints such as knocked up, paned down, swaged and joggled)
- 2.12 explain how to set up and align the various components and the tools and equipment that is used
- 2.13 describe the methods of temporarily holding the joints together to aid the assembly activities (clamps, rivet clamps)
- 2.14 describe the correct use and care of tools and equipment, and control procedures
- 2.15 explain the importance of using tools or equipment only for the purpose intended, the care that is required when using the tools or equipment, the proper way of preserving tools or equipment between operations
- 2.16 describe the problems that can occur when producing sheetmetal assemblies, and explain how these can be avoided
- 2.17 describe the inspection techniques that can be applied to check shape (including straightness) and dimensional accuracy are to specification and within acceptable limits
- 2.18 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve
- 2.19 explain the reporting lines and procedures, line supervision and technical experts

Unit 326

Heat treating materials for fabrication activities

UAN:	Y/504/9188
Level:	3
Credit value:	12
GLH:	42
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 25: Producing Sheetmetal Assemblies (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to heat treat ferrous and non-ferrous materials in order to assist with the fabrication activities in accordance with approved procedures. The learner will be required to identify and use the appropriate materials, apply the appropriate processes and use tools and equipment based on the information presented to them to achieve the required condition. The heat treatment processes will include hardening, tempering, annealing, normalising/stress relieving and can be applied to the fabricator's tools such as punches, chisels and scribes or the component/materials to be worked on.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the heat treatment activities undertaken and to report any problems with the heat treatment equipment, materials used or heat treatment activities that they cannot personally 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.</p> <p>The learner's knowledge will provide a good understanding of their work, and provide a sound approach to applying the heat</p>

treatment procedures. The learner will understand the principles of heat treatment, and their application, and will know about the effects on the structure of the materials and their characteristics in sufficient depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the process is carried out to the required specification.

The learner will be required to demonstrate safe working practices throughout, and will understand the responsibilities they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. heat treat materials for fabrication activities
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all the following during the heat treatment activities: a. use the correct heat treatment procedure and quality documentation b. follow relevant COSHH and risk assessment procedures c. apply the required heat treatment processes safely and correctly d. ensure the safety of self and others while carrying out the processes e. leave the work area in a safe condition on completion of the activities 1.3 ensure the materials to be processed are suitably prepared for the processing operations to be carried out 1.4 carry out heat treatment processes using two of the following types of equipment a. furnace b. induction heating c. blacksmiths forge d. gas torch e. electrical resistance heating 1.5 carry out the heat treatment process using two of the following cooling/quenching techniques: a. water b. oil c. sand d. air e. brine 1.6 apply the appropriate heat treatment process to two of the following: a. ferrous components/sections b. ferrous high carbon tools (punches, chisels, scribes) c. hot steel rivets

<ul style="list-style-type: none"> d. non-ferrous sheet or plate e. titanium
1.7 check and monitor that the processing equipment is set up and maintained at satisfactory operating conditions throughout the processing operations
1.8 carry out the process in accordance with operating procedures and the workpiece specification requirements
1.9 carry out two of the following heat treatment processes/techniques: <ul style="list-style-type: none"> a. hardening b. tempering c. annealing d. pre-heating e. normalising f. stress relieving
1.10 ensure that the processed workpiece achieves the required characteristics and meets the processing specification
1.11 carry out heat treatment processes to the following quality and accuracy standards: <ul style="list-style-type: none"> a. tools are of the correct hardness for the application and, where appropriate, suitably tempered b. hardened materials are free from cracks c. materials/components are suitably treated to permit working d. distortion is limited and controlled
1.12 deal promptly and effectively with problems within their control and report those that they cannot solve
1.13 dispose of waste and excess materials in line with agreed organisational procedures
1.14 shut down the processing equipment to a safe condition on completion of the processing activities

Learning outcome
The learner will:
2. know how to heat treat materials for fabrication activities
Assessment criteria
The learner can:
2.1 explain the specific safety precautions to be taken and safe working practices to be employed when carrying out the heat treatment of materials in a fabrication environment (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
2.2 describe the personal protective clothing and equipment that needs to be worn when working on heat treatment processes (such as gloves, eye/ear protection)
2.3 explain the handling precautions and correct methods of moving materials, particularly when hot
2.4 describe the hazards associated with heat treatment processes and fabrication and explain how they can be minimised (such as handling sheet/fabricated components, handling hot materials, overheating quenching oils)
2.5 explain the reasons for heat treating materials

- 2.6 describe the various heat treatment processes, methods and procedures that may be applied
- 2.7 describe the type of equipment that can be used to carry out the various heat treatment processes (such as furnaces, blacksmiths forge, gas torches)
- 2.8 explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
- 2.9 explain the handling techniques for hot metal components
- 2.10 explain how the materials need to be prepared in readiness for the heat treatment operations
- 2.11 explain which type of materials can be heat treated and the processes that may be applied
- 2.12 explain the materials and their characteristics and how their structure can be modified
- 2.13 describe the various cooling and quenching techniques that are applied to the processes and why it is important to use the correct process (such as water, oil, sand, air)
- 2.14 explain the use of quenching oils and the need to maintain the oil temperature below the oil flash point
- 2.15 explain the information sources on heat treatment temperatures, tempering colours, soak times required and quenching/cooling mediums to be used
- 2.16 describe the various testing techniques that can be used to check the correct condition has been achieved (simple file tests to check hardening or annealing has been achieved)
- 2.17 explain ways of limiting distortion during the heat treatment process
- 2.18 describe the quality control procedures and recognition of defects
- 2.19 explain the limitations of the various processes
- 2.20 explain the problems that can occur when heat treating materials, and how these can be avoided
- 2.21 describe the organisational procedures for disposing of and recycling of waste
- 2.22 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

Unit 327

Developing and marking out templates for metalwork

UAN:	D/504/9189
Level:	3
Credit value:	28
GLH:	91
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 27: Developing and Marking Out Templates for Metalwork (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required for developing and marking out templates prior to cutting and/or shaping the material in accordance with approved procedures. The learner will be required to select the appropriate materials and equipment to use based on the information presented to them and the accuracy required to be achieved. The templates produced may be used for marking out, setting of fabrications or pipe arrangements or preparing (setting) heavy plate for rolling.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the marking out and template making activities, seeking out relevant information and reporting any problems with the equipment, materials or template making activities that they cannot personally 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.</p> <p>The learner's knowledge will provide a good understanding of their work, and provide an informed approach to template making. The learner will understand the marking out and</p>

template making process and its application, and will know about the equipment, materials and processes to be carried out in sufficient depth to provide a sound basis for carrying out the activities, correcting faults and producing the templates to the required specification.

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

Learning outcome
The learner will: 1. develop and mark out templates for metalwork
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 obtain and use the correct information for marking out 1.3 obtain the appropriate marking out equipment and check that it is in a usable condition 1.4 use all of the following tools and instruments to mark out directly from drawings onto sheetmetal: a. scribe b. centre punch c. rule or tape d. straight edge e. square f. protractor g. dividers or trammels h. chalk, bluing or paint i. laser (where applicable) 1.5 prepare suitable datum's and marking out surfaces 1.6 mark out using appropriate methods 1.7 mark out plate or pipe setting for two of the following: a. angular setting b. large radius section c. plate setting d. burner template 1.8 mark out templates for six of the following: a. radiused and mitred corners b. concentric cones c. offset cones d. truncated cones e. square/rectangular to round f. fishtail

<ul style="list-style-type: none"> g. segmented bends (lobsterback) h. ball corner or spherical section i. fish plates j. bed plates k. gusset plates l. structural components m. simple seating (tank cradles) n. box edges <p>1.9 mark out material to include all of the following features:</p> <ul style="list-style-type: none"> a. datums and centre-lines b. square and rectangular profiles c. angles d. circles and curved profiles e. cutting detail and allowances f. bend/fold allowances g. hole centres and outlining (linear) h. hole centres and outlining (on pitch circles) <p>1.10 check that the marking out complies with the specification</p> <p>1.11 develop templates which meet all the following quality and accuracy standards:</p> <ul style="list-style-type: none"> a. template profile complies with drawing or job requirements b. dimensional accuracy meets drawing/specification c. suitably marked or labelled to identify purpose d. marking out uses recognised conventions <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be resolved</p>

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to develop and mark out templates for metalwork</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 explain the specific safety precautions to be taken when working in a fabrication environment with sheet or plate materials (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)</p> <p>2.2 describe the personal protective clothing and equipment that needs to be worn when carrying out the fabrication activities (such as leather gloves, eye protection, safety helmets)</p> <p>2.3 explain the correct methods of moving or lifting sheet or plate materials</p> <p>2.4 describe the hazards associated with fabrication work and explain how they can be minimised (such as handling sheet/fabricated components; using dangerous or badly maintained tools and equipment)</p> <p>2.5 explain how to obtain the necessary drawings, template specifications and job instructions</p> <p>2.6 explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)</p>

- 2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.8 explain the principles and techniques for marking out templates
- 2.9 explain the geometrical methods used for developing of complex shapes (such as square to round, lobsterback sections) from sheet metal
- 2.10 explain how to produce a three dimensional shape from the two dimensional material
- 2.11 explain the use of marking out conventions (such as datum edges/lines, centre lines)
- 2.12 describe the preparations that need to be carried out on the material prior to marking out to enhance clarity and accuracy, and safety
- 2.13 explain the component material characteristics and process considerations that need to be taken into account when marking out templates
- 2.14 explain why you need allowances for joint and weld preparations for different materials and thicknesses
- 2.15 explain how to calculate true lengths, bend allowances and circumferences
- 2.16 describe the effective use and care of tools/instruments
- 2.17 explain how to mark out and preserve the template for maximum clarity, accuracy and ease of transfer
- 2.18 describe ways of laying out the shapes/patterns to maximise the use of plate or sheet material
- 2.19 explain how to setup and adjust the tools, such as squares and protractors
- 2.20 explain how to transfer information to the underside of the sheet or plate
- 2.21 explain the importance of using tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of preserving and storing tools and equipment between operations
- 2.22 explain the need for clear and dimensional accuracy in marking out to specifications/drawings
- 2.23 describe the problems that can occur in marking out templates and explain how these can be avoided
- 2.24 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve

Unit 328

Joining fabricated components using mechanical fasteners

UAN:	R/504/9190
Level:	3
Credit value:	21
GLH:	77
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 28: Joining Fabricated Components using Mechanical Fasteners (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to undertake the preparation and making of joints between fabricated components using mechanical means in accordance with approved procedures. The learner will be required to produce suitable and appropriate joints using appropriate methods for the materials to be joined that meet the specified conditions and subsequent operating conditions to be demanded of the joint. Particular attention will be needed in the preparation and finishing of the materials so that the finished component is fit for purpose and meets the level of accuracy required. The mechanical fastenings used will include rivets, self-tapping screws, bolts and screwed fittings, anchor nuts and proprietary fasteners as is appropriate to the application and/or specification. The joint will be of two or more materials and may include non-metallic materials and joints of dissimilar metals.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures, or those of the fastener manufacturers. The learner will be expected to seek out the relevant information and to report any problems with the mechanical fasteners or the joining activities that they cannot resolve, or are outside their</p>

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 produce.

The learner's knowledge will provide a good understanding of their work, and provide an informed approach to the joining activities carried out. The learner will understand the basic characteristics of the materials to be joined, the various processes used and the appropriate procedures that go with them in adequate depth to provide a sound basis for achieving a sound and cohesive joint that is fit for purpose.

The learner will understand the safety precautions required when working with the tools and equipment, especially those for use in hot metal processes and the safeguards necessary for undertaking the using processes. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibilities they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. join fabricated components using mechanical fasteners
Assessment criteria
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 instructions, assembly drawings and any other specifications 1.3 check that the specified components are available and that they are in a usable condition 1.4 carry out all of the following during the joining process: a. correctly prepare the faces of the materials to be joined b. select the appropriate/specified fixings c. correctly align the materials and faces to be joined d. assemble the components in the correct order or manner e. produce a joint that meets the requirements of the specification 1.5 use the appropriate methods and techniques to assemble the components in their correct positions 1.6 use four of the following assembly methods and techniques: a. riveting using solid rivets b. riveting using pop/blind rivets c. self-tapping screws d. use of proprietary fasteners

- e. crimping
 - f. assembling using bolt fittings
 - g. using screw fittings to tapped components
 - h. nuts and (spot welded) screw studs
 - i. locking methods and devices
 - j. clinching
- 1.7 produce assemblies which include six of the following:
- a. flat and flanged joints on flat or curved surfaces
 - b. square/rectangular trunking
 - c. circular trunking
 - d. access flanges and cover plates
 - e. tanks and tank covers
 - f. joints with gasket or sealant
 - g. pipes
 - h. structural components
 - i. long or critical alignments
 - j. permanent and temporary assemblies
- 1.8 join the components in three of the following joining positions, access and environmental conditions:
- a. horizontal
 - b. vertical
 - c. overhead
 - d. in workshop conditions
 - e. internal and confined spaces
- 1.9 secure the components using the specified connectors and securing devices
- 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.11 produce joints to all of the following quality and accuracy standards as is applicable to the application:
- a. joints are accurately assembled and aligned in accordance with the specifications
 - b. joints are secure and firm
 - c. bolted and screwed joints are tightened to the correct torque
 - d. riveted joints are free from excessive material deformation and hammer marks
 - e. pitch of holes meet the specification
 - f. completed joints are clean and free from burrs
- 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome
The learner will: 2. know how to join fabricated components using mechanical fasteners
Assessment criteria
The learner can: 2.1 explain the specific safety precautions to be followed when working in a fabrication environment and when carrying out joining activities using fabricated components (general workshop and site safety, appropriate personal protective equipment (PPE), accident procedure; statutory regulations, risk assessment procedures and COSHH regulations) 2.2 describe the personal protective clothing and equipment that needs to be worn when carrying out the joining activities (such as leather gloves, eye protection, safety helmets) 2.3 describe the hazards associated with the joining operations and explain how they can be minimised (such as handling sheet/fabricated components, using hot metal riveting techniques, handling and using sealants and cleaning agents, dangerous or badly maintained tools and equipment) 2.4 explain how to obtain the necessary drawings and joining procedure specifications 2.5 explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken) 2.6 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.7 explain the use of manufacturers' specifications for the types of fasteners used 2.8 explain the advantages and disadvantages of the different forms and methods of mechanical join 2.9 describe the various joining processes that are used and the tools and equipment that is required 2.10 describe the preparations that need to be carried out on the materials/components prior to joining them (such as, materials to be degreased, dry and clean, with hole and flanges de-burred) 2.11 explain how to set up and align the joints prior to fixing and the tools and methods that can be used (such as clamps, rivet gripping tools, temporary fixings, jacking and supporting devices) 2.12 explain how to produce a secure joint using blind rivets and the type of riveting tools that are available 2.13 explain how to produce a good solid riveted joint and the use of the various riveting tools 2.14 explain how to determine the length of the rivets required to give a properly formed rivet head 2.15 describe the range of bolts and screwed fasteners that are to be used; explain why it is important to use the correct type of washer; sequence of tightening bolts on flanged joints; and the tools and equipment used to ensure they are tightened to the required torque 2.16 describe the various types of proprietary fasteners that are used on fabricated assemblies (such as anchor nuts, clinch nuts, welded studs)

- 2.17 explain the materials used and their joining characteristics, electrochemical reaction between dissimilar metals and means of reducing the effects, use of gasket material
- 2.18 describe the checks that need to be carried out on the tools and equipment prior to use to ensure that they are in a safe and usable condition (such as condition of plugs and leads on power tools, condition of striking faces on hammers, condition of riveting tools and rivet snaps)
- 2.19 describe the equipment setting, operating and care procedures; explain why equipment and tools need to be correctly set up and in good condition
- 2.20 explain the importance of using the tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of preserving and storing tools and equipment between operations
- 2.21 describe the quality control and test procedures for detection of defects in joints, visual, feel and measurement checks
- 2.22 describe the problems that can occur with the joining operations and how these can be avoided
- 2.23 describe the extent of their own responsibility and explain whom they should report to if they have problems that they cannot resolve
- 2.24 explain the reporting lines and procedures, line supervision and technical experts

Unit 331

Producing fillet welded joints using a manual welding process

UAN:	Y/504/9191
Level:	3
Credit value:	76
GLH:	252
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 31: Producing Fillet Welded Joints using a Manual Welding Process (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to produce fillet welds in plate, sheet or sections and/or fillet welded joints in pipe/tube using a manual welding process such as manual metal arc, MIG, MAG, TIG, flux cored wire, inert shield or oxy/fuel gas welding equipment in accordance with instructions and/or approved welding procedures. The learner will be required to check that all the workholding equipment and manipulating devices required are available and in a usable condition. The learner will be expected to check the welding equipment to ensure that all the leads/cables, hoses and wire feed mechanisms are securely connected and free from damage.</p> <p>In preparing to weld the learner will need to set and adjust the welding conditions in line with the instructions or welding procedure specification. The learner must operate the equipment safely and correctly and make any necessary adjustments to settings in line with their permitted authority in order to produce the welded joints to the required specification. The learner will be required to demonstrate their capability to produce the fillet welds of the required quality and this could be through tests according to BS 4872 or EN 287 Part 1 and EN 9696 Part 1 (for</p>

aluminium).

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

The learner's knowledge will provide a sound basis for their work, and will provide an understanding of how the particular welding process works. The learner will know about the equipment, materials and consumables in adequate depth to provide a sound background for the welding operations to be performed, and for ensuring the work output is produced to the required specification.

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

Learning outcome
The learner will: 1. produce fillet welded joints using a manual welding process
Assessment criteria
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 job instructions 1.3 check that the joint preparation complies with the specification 1.4 check that joining and related equipment and consumables are as specified and fit for purpose 1.5 make the joints as specified using the appropriate thermal joining technique 1.6 set up, check, adjust and use welding and related equipment for one of the following welding processes: a. Manual Metal Arc b. MIG/MAG c. TIG d. Plasma Arc e. Cored wire f. Oxy/fuel Gas welding 1.7 weld joints according to approved welding procedures in good

access situations in two of the following BS EN ISO 6947 positions:

- a. flat (PA)
- b. horizontal (PC)
- c. horizontal vertical (PB)
- d. vertical upwards (PF)
- e. vertical downwards (PG)
- f. overhead (PE or PD)

1.8 produce fillet welded joints in two of the following forms of material:

- a. plate
- b. sections
- c. pipe/tube
- d. sheet
- e. other specific form

1.9 use consumables as specified in the welding procedure specification covering either:

two types of electrode from:

- a. rutile
- b. basic
- c. cellulosic
- d. nickel alloy
- e. stainless steel
- f. other electrode type

or

two types of filler wire from different material groups

1.10 produce joints of the required quality and of specified dimensional accuracy which:

- a. achieve a minimum weld quality requirements applicable to fillet welds equivalent to those given in the relevant European/International Standards (such as BS EN ISO 5187 and EN30042/ISO 10042) as required by the application standard or specification
- b. meet the required dimensional accuracy within specified tolerance

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

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

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

Learning outcome
The learner will: 2. know how to produce fillet welded joints using a manual welding process
Assessment criteria
The learner can: 2.1 explain the safe working practices and procedures to be observed when working with the selected welding equipment (general workshop and site safety, appropriate personal protective equipment (PPE), fire prevention, protecting other workers from arc eye, safety in enclosed/confined spaces; fume control; accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations; safe disposal of waste materials) 2.2 describe the correct handling and storage of gas cylinders (manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features, emergency shutdown procedures) 2.3 describe the hazards associated with the selected welding process and explain how they can be minimised (live electrical components, poor earthing, arc radiation, fumes and gases, gas supply leaks, spatter, hot slag and metal, grinding and mechanical metal/slag removal; elevated working, enclosed spaces, slips, trips and falls) 2.4 explain the manual welding process selected and the different types of welding equipment (basic principles of fusion welding, ac and dc power sources, ancillary equipment, power ranges, care of equipment, terminology used in welding, flame setting) 2.5 explain how to extract the information required from the drawings and welding procedure specifications (interpretation of welding symbols, scope, content and application of the welding procedure specification) to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken 2.6 describe the consumables associated with the chosen welding process (types of electrodes and or filler metal and their application, types of shielding gas and their application, gas supply and control; correct control, storage and drying of electrodes and filler wire) 2.7 describe the types and features of welded joints in pipe (fillet and butt welds, single and multi-run welds, welding positions, weld quality) 2.8 explain the methods used to set up and restrain the joint to achieve correct location of components and control of distortion (edge preparation, use of jigs and fixtures, manipulators and positioners, tack welding size and spacing in relationship to material thickness and component size, use of temporary attachments, pre-setting) 2.9 explain how to prepare the welding equipment and checks that need to be made to ensure that it is safe and ready to use (electrical connections, power return and earthing arrangements; equipment calibration before use, setting welding parameters, care and maintenance of the equipment) 2.10 describe the techniques of operating the welding equipment to

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

- 2.11 explain the importance of complying with job instructions and the welding procedure specification
- 2.12 describe the problems that can occur with the welding activities and explain how these can be overcome (causes of distortion and methods of control, effects of welding on materials and sources of weld defects; methods of prevention)
- 2.13 describe the organisational quality systems used and weld standards to be achieved; weld inspection and test procedures used including visual and non-destructive tests
- 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 366

Operating CNC fabrication equipment

UAN:	D/504/9211
Level:	3
Credit value:	40
GLH:	133
Relationship to NOS:	This unit has been derived from national occupational standard Fabrication and Welding Engineering Unit 66: Operating CNC Fabrication Equipment (Suite 3)
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to operate computer numerically controlled (CNC) fabrication machines, such as shearing machines, gas, laser, plasma or water jet cutting, punching, bending and forming machines, in accordance with approved procedures. The learner will be expected to take charge of the prepared machine and to check that it is ready for the machining operations to be performed. This will involve checking that all the required materials and consumables are present, and that the machine has been approved for production. In operating the machine, the learner will be expected to follow the correct procedures for calling up the operating program, dealing with any error messages, and executing the program activities safely and correctly.</p> <p>The learner will be required to monitor the cutting or forming operations continuously, making any necessary adjustments to machine parameters in line with the learner's permitted authority. Meeting production targets will be an important issue, and the learner's 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 the CNC activities undertaken, and to report any problems with the equipment, tooling, program, materials</p>

or activities that they cannot personally resolve, or 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 produce.

The learner's underpinning knowledge will be sufficient to provide a good understanding of their work, and will enable them to adopt an informed approach to applying CNC fabrication procedures. They will have an understanding of the CNC machining process used, and its application, and will know about the machine, tooling, materials, machining activities and consumables, in adequate depth to provide a sound background to machine operation and for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. operate CNC fabrication equipment
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 ensure that the machine is ready for operation, by carrying out all of the following: a. checking that the correct operating program is loaded and is at the correct start point b. ensuring that machine guards are in place and correctly adjusted c. positioning and securing material/components without damage and distortion d. checking that cutting tools/tooling are in a suitable condition e. setting plate/section datum's and positioning the machine f. update the program tool data, as applicable g. ensuring that start-up procedures are observed h. adjusting machine settings as required to maintain accuracy 1.3 confirm that the equipment is set up and ready for operation

- 1.4 follow the defined procedures for starting and running the operating system
- 1.5 operate one of the following CNC fabrication machines:
 - a. shearing machine
 - b. punching machine
 - c. forming machine
 - d. bending machine
 - e. plasma cutting
 - f. laser cutting
 - g. gas cutting
 - h. water jet cutting
- 1.6 position and secure the workpiece, using two of the following holding methods/device:
 - a. jigs and fixtures
 - b. clamps and stops
 - c. pneumatic clamps
 - d. other workholding devices
- 1.7 produce components which combine several different operations, which cover five of the following:
 - a. straight cuts
 - b. square/rectangular profiles
 - c. curved profiles
 - d. internal profiles
 - e. angular profiles
 - f. holes linearly pitched
 - g. holes radially pitched
 - h. louvers
 - i. swages
 - j. bends at 90 degrees
 - k. bends of various angles
 - l. multi-bend platework
 - m. curved plates
 - n. slots and apertures
 - o. circles/ellipses
 - p. other specific features
- 1.8 produce components using one of the following types of material:
 - a. ferrous
 - b. non-ferrous
 - c. stainless steel
 - d. special alloys
 - e. other appropriate material
- 1.9 carry out the necessary checks during production for accuracy of four of the following:
 - a. linear dimensions
 - b. vertical dimensions
 - c. position of features
 - d. accuracy of hole/slot dimensions
 - e. accuracy of profiles
 - f. flatness/freedom from excessive distortion
 - g. accuracy of louvers and swages
- 1.10 produce components which meet all of the following standards:

<ul style="list-style-type: none"> a. dimensional accuracy is within the tolerances b. components conforms to the required shape/geometry or profile c. components are free from deformity, burrs and sharp edges <p>1.11 deal promptly and effectively with error messages or equipment faults that are within your control and report those that cannot be solved</p> <p>1.12 monitor the computer process and ensure that the production output is to the required specification</p> <p>1.13 shut down the equipment to a safe condition on conclusion of the activities</p>
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Learning outcome
The learner will:
2. know how to operate CNC fabrication equipment
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when operating CNC fabrication machines and equipment
2.2 describe the safety mechanisms on the machine, and the procedures for checking that they are operating correctly
2.3 describe the hazards associated with working on CNC cutting and forming machines (such as moving machinery, automatic machine operation, handling of tooling/cutting media, lifting and handling workholding devices, handling materials) and how they can be minimised
2.4 explain how to start and stop the machine in both normal and emergency situations
2.5 describe the importance of wearing the appropriate protective clothing and equipment (PPE), and of keeping the work area clean and tidy
2.6 describe the application of the CNC machine, and the range of operations it can perform
2.7 explain where to obtain component drawings, specifications and/or job instructions required for the components being machined
2.8 explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate British, European or relevant international standards in relation to work undertaken)
2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
2.10 explain how to interpret the visual display and the various messages displayed
2.11 describe the function of error messages, and what to do when an error message is displayed
2.12 explain how to find the correct restart point in the program when the machine has been stopped before completion of the program
2.13 explain the operation of the various hand and automatic modes of machine control (such as program operating and control buttons)
2.14 explain how to operate the machine using manual operation, single block run, full program run and feed/speed override controls

- 2.15 explain how to make adjustments to the program operating parameters
- 2.16 explain how to set and secure the workpiece to the machine; the effects of clamping the workpiece; and how material shaping/removal can cause warping/distortion of the finished workpiece
- 2.17 describe the problems that can occur with the cutting/forming activities, and how to prevent them
- 2.18 describe the quality control procedures used, inspection checks that need to be carried out and the equipment to be used
- 2.19 describe the extent of your own responsibility and whom you should report to if you have problems you 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
- Essential Skills (Northern Ireland) – see 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.

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/A/e-volve assessments.

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Useful contacts

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

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