SEG Awards ABC Level 3 Diploma in Fabrication and Welding Techniques and Skills

Qualification Guidance

Level 3 Diploma – 603/5755/1



This is a live document and as such will be updated when required. It is the responsibility of the approved centre to ensure the most up-to-date version of the Qualification Guide is in use. Any amendments will be published on our website and centres are encouraged to check this site regularly.

About us

At the Skills and Education Group Awards (ABC Awards)[1] we continually invest in high quality qualifications, assessments and services for our chosen sectors. As a UK leading sector specialist we continue to support employers and skills providers to enable individuals to achieve the skills and knowledge needed to raise professional standards across our sectors.

Skills and Education Group has an on-line registration system to help customers register learners on its qualifications, units and exams. In addition it provides features to view exam results, invoices, mark sheets and other information about learners already registered.

The system is accessed via a web browser by connecting to our secure website using a username and password: https://ors.skillsandeducationgroupawards.co.uk/

Sources of Additional Information

The Skills and Education Group Awards website https://skillsandeducationgroupawards.co.uk/ provides access to a wide variety of information.

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1	1/4/2020	Original document	n/a
2	8/10/2020	Progression Opportunities updated	Page 8
3	07/07/2025	Review date updated to 31/08/2027	Page 9

[1] ABC Awards is a brand of the Skills and Education Group Awards, a recognised awarding organisation and part of the Skills and Education Group. Any reference to ABC Awards, its registered address, company or charity number should be deemed to mean the Skills and Education Group Awards.

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Introduction

- At Skills and Education Group Awards we have updated our suite of Fabrication and Welding qualifications to include the latest fabrication and welding techniques, materials, processes and practices. They are assessed in line with industry demands, which include updated rigorous practical assessments and online on-demand assessments.

- The qualification structures have been developed with the typical learner in mind, to ensure the units contained within them are relevant and facilitate progression, whether that is onto higher levels of learning, employment or specialist fabrication and welding procedures.

The qualifications have been developed in conjunction with academia and industry experts and informed by the work of professional bodies in the fabrication and welding field. At Level 2 and Level 3, the qualifications have been designed to complement the recently developed Apprenticeship Standards in Welding.

Aims

Raise a learner's skill level and enhance their underpinning knowledge to promote progression from basic welding and fabrication skills to a more highly developed understanding of equipment functions and how materials behave when subjected to fabrication and welding process.

Educate the learner in the observation of the correct and safe procedures that are paramount in the fabrication and welding industry.

Target Group

The target group includes, but is not limited to:

- young people who are following an apprenticeship programme
- young people who are new entrants to the industry
- adults wishing to specialise or upskill by pursuing single units
- the self-employed

Qualification Structure

Rules of Combination:

Learners must achieve a minimum of 46 credits
11 credits must be from Group A.
7 credits must be from Group B
7 credits must be from Group C.
7 credits must come from Group D
7 credits must be from Group E.
An additional 7 credits must come from Group B, C, D, E or F

Units	Unit Number	Level	M/O	Credit Value	GLH
Group A					
1. Health and Safety in a Fabrication and Welding Environment	T/618/0753	2	M	3	20
2. Materials, Science and Calculations for Fabrication and Welding Practice	D/616/1291	3	M	8	80
Group B					
3. Manual Metal-Arc Welding – (Vertical) Low Carbon Steel, Stainless Steel or Aluminium	H/616/1292	3	O	7	60
4. Metal-Arc Gas Shielded Welding – (Vertical) Low Carbon Steel, Stainless Steel or Aluminium	K/616/1293	3	O	7	60
5. Tungsten-Arc Gas Shielded Welding – (Vertical) Low Carbon Steel, Stainless Steel or Aluminium	M/616/1294	3	O	7	60
Group C					
6. Fabrication Processes – Plate (3 mm and Above in Thickness)	T/616/1295	3	O	7	60
7. Fabrication Processes – Sheet Metal (below 3 mm in Thickness)	A/616/1296	3	O	7	60
Group D					
8. Manual Metal-Arc Welding – (Overhead) Low Carbon Steel or Stainless Steel	F/616/1297	3	O	7	60
9. Metal-Arc Gas Welding – (Overhead) Low Carbon Steel, Stainless Steel or Aluminium	J/616/1298	3	O	7	60
10. Tungsten-Arc Gas Shielded Welding – (Overhead) Low Carbon Steel, Stainless Steel or Aluminium	L/616/1299	3	O	7	60
11. Thick Plate Welding using Flux Cored Metal-Arc Gas Shielded Welding	T/616/1300	3	O	7	60

12. Pipe Welding using Manual Metal-Arc Welding, Metal-Arc Gas Shielded Welding or Tungsten-Arc Gas Shielded Welding	A/616/1301	3	O	7	60
Group E					
13. Advanced Fabrication Processes – Plate (3 mm and Above in Thickness)	F/616/1302	3	O	7	60
14. Advanced Fabrication Processes – Sheet Metal (below 3 mm in Thickness)	J/616/1303	3	O	7	60
Group F					
15.Engineering Drawing Using Manual and CAD Techniques	M/503/9511	3	O	7	60
16. Materials for fabrication and welding techniques and Skills	D/618/0794	3	O	7	60

GLH: 400 hours TQT: 460 hours Credit value: 46

Assessment

In order to successfully achieve this qualification a learner must fully meet all of the learning outcomes. This is done by completing the Skills and Education Group Awards' practical and online multiple-choice assessments.

All centres are required to have internal quality assurance processes in place. Assessment workbooks are available on the Skills and Education Group Awards website for learners to complete to form the internal assessment requirements for each unit. The practical tasks in the workbooks are graded at a pass, merit or distinction.

The Science and Calculations unit is assessed via an externally set and externally assessed multiple choice question (MCQ) assessment. The examination provides the grade for this unit at a:

- Pass – 60%
- Merit – 70% or
- Distinction – 80%.

The overall qualification is graded as pass/fail however, unit achievements at pass, merit or distinction are shown on the qualification transcript.

For further information around assessment including reasonable adjustments and special considerations please review the Access to Assessment Policy here: https://skillsandeducationgroupawards.co.uk/policies-and-procedures/

Practice Assessment Material

Skills and Education Group Awards will make paper-based, multiple choice, practice tests available for learners prior to undertaking the online knowledge test. These questions will be of a comparable level and cover the same subject areas as listed above in the 'assessment' section, but they will not be the same questions as those presented during the online knowledge test.

Teaching Strategies and Learning Activities

Centres should adopt a delivery approach which supports the development of all individuals. The aims and aspirations of all the learners, including those with identified special needs or learning difficulties/disabilities, should be considered and appropriate support mechanisms put in place.

Progression Opportunities

Learners who successfully achieve this qualification could progress into employment within a fabrication and welding environment or a manufacturing environment.

Tutor/Assessor Requirements

Skills and Education Group Awards require those involved in the assessment process to be suitably experienced and/or qualified. In general terms, this usually means that the Tutor/Assessor must be knowledgeable in the subject/occupational area to at least the level they are delivering/assessing at.

Those responsible for Internal Quality Assurance (IQA) must be knowledgeable of the subject/occupational area to a suitable level to carry out accurate quality assurance practices and processes.

Resource Requirements

Centres must provide access to sufficient equipment in the centre or workplace to ensure learners have the opportunity to cover all of the practical activities.

For external assessments the examination should be conducted at the Centre where the course delivery has taken place and should be carried out in accordance with the examination requirements of Skills and Education Group Awards.

Language

These specifications and associated assessment materials are in English only.

Qualification Summary

SEG Awards ABC Level 3 Diploma in Fabrication and Welding Techniques and Skills								
Qualification Number	603/5755/1							
Regulated	The qualification identified above is regulated by Ofqual, Qualifications Wales and CCEA Regulation.							
Assessment	• Internally set, internally assessed • Externally set, internally assessed • Externally set, externally assessed • Internal and external moderation							
Grading	Pass							
Operational Start Date	01/09/2020							
Review Date	31/08/2027							
Skills and Education Group Awards Sector	Engineering							
SSA Sector	4.1 Engineering							
Contact	See the Skills and Education Group Awards website for Customer Support Officer responsible for these qualifications.							
Qualification Purpose	C. Prepare for employment C1. Prepare for employment in a broad occupational area							
Entry Requirements	There are no formal pre-requisites for entry onto this qualification. Each centre is required to notify the awarding body of its policies on access and equality of opportunity. Within the parameters of these policies, a centre is expected to recruit with integrity on the basis of a learner's ability to contribute to and successfully complete the qualification.							
Age Range	Pre 16		16 - 18	✓	18+	✓	19+	✓

Recommended GLH	Level 3 Diploma – 400
Recommended TQT	Level 3 Diploma – 460
Credit Value	Level 3 Diploma – 46
Learning Aims Reference	See Learning Aim Reference Service (LARS) website: https://data.gov.uk/dataset/learning-aim-reference-service
Type of Funding Available	See Learning Aim Reference Service (LARS) website
Qualification Fee	See Skills and Education Group Awards website for current fees and charges.
Additional Information	See Skills and Education Group Awards website for resources available for this qualification.

Unit Details

1. Health and Safety in a Fabrication and Welding Environment

Unit Reference	T/618/0753
Level	2
Credit Value	3
Guided Learning Hours	20
Unit Summary	In this unit, learners will find out about health and safety legislation, and the application of safe working practices within a workplace. They will explore hazards and precautions, signs and symbols and basic safety procedures. Health and Safety must be an integral part of every learner's programme. It is expected that the outcomes listed will be integrated as appropriate into each unit of this qualification. Skills and Education Group Awards has produced a workbook which learners can use to provide evidence of achievement against the learning outcomes and assessment criteria. The workbook is available on the ABC website. Skills and Education Group Awards also provides Learner Achievement Checklists to record achievement. These are also available on ABC's website.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about health and safety responsibilities	1.1. Identify the basic responsibilities of employer and employee with regard to Health and Safety at Work Act 1974 (where legislation, regulations do not apply in the jurisdiction, relevant ones should be applied) 1.2 Identify the statutory requirements and legislation of the Health and Safety at Work in a fabrication and welding work environment

2. Know how to avoid risks in a fabrication and welding work environment	2.1. Identify and describe where potential health and safety hazards may occur within a fabrication and welding work environment 2.2 Identify potential hazards and the necessary precautions in a fabrication and welding environment for each of the following • when moving and handling materials • when using hand and power tools • when using thermal processes
3. Undertake a risk assessment of fabrication and welding work environment	3.1 Identify the five steps of a risk assessment 3.2 Conduct a risk assessment of a fabrication and welding work environment 3.3 Report findings to an appropriate person in line with organisational requirements
4. Know how to protect themselves in a work environment	4.1 State reasons why protective clothing and equipment should be worn 4.2 Identify common safety guards, screens and fences within a workshop situation 4.3 Locate fire extinguishers, emergency switches and exits in the work environment 4.4 Describe how waste materials should be dealt with to comply with current laws and regulations
5. Know about accident and emergency procedures	5.1 Describe their organisational accident and emergency procedures in relation to • injury to self or others • fire • malfunctions of equipment • problems with hazardous substances
6. Understand safety signs	6.1 Identify safety signs within the following groups • mandatory • warning • safe condition • prohibited

2. Materials, Science and Calculations for Fabrication and Welding Practice

Unit Reference	D/616/1291
Level	3
Credit Value	8
Guided Learning Hours	80
Unit Summary	This is a mandatory unit which will be assessed by a 40 question on-line multi-choice question (MCQ) assessment. Learners will gain an understanding of various topics associated with the related aspects of welding and fabrication. The main areas or key focus points are materials, science, calculations and quality control of welding and fabrication operations. There is no practical requirement for this unit, however, observation of demonstrations concerning various aspects of the assessment criteria carried out in the workshop or laboratory is to be encouraged.

Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Identify a range of materials used in engineering	1.1. Identify the characteristics of materials used in engineering, to include: • ferrous metals • non–ferrous metals • thermoplastics • thermosetting plastics • ceramics • composites 1.2. Identify an engineering application for each material listed in 1.1 1.3. Identify the approximate carbon percentage of: • low carbon steel • medium carbon steel • high carbon steel 1.4. Identify common alloying elements added to steel 1.5. Describe the changes to the mechanical properties of steels by the addition of alloying elements 1.6. Identify typical compositions of common engineering materials, to include • stainless steel • brass • bronze • duralumin
2. Know about the crystalline structure of weld deposits in steels	2.1. Identify the different types of crystalline structure found in both single pass and multi pass weld deposits found in welded joints in steels, to include: • parent material • weld deposit • heat affected zone (HAZ) 2.2. Identify the stages of recrystallisation and grain growth in steel

3. Know about heat treatments and the effects of heat on materials	3.1. Identify the heat treatment process of materials, to include: • annealing • normalising • hardening • tempering • stress relieving 3.2. Describe how the properties of a material can be changed by the application of a heat treatment process 3.3. Describe the effects of hot and cold working on the mechanical properties of steels 3.4. Identify the purpose of using pre and post heating on welded joints in steels 3.5. Describe the effects of welding and cooling rates on the structure and mechanical properties of welded joints
4. Know about the mechanical testing of materials and the properties of materials	4.1. Identify methods of mechanically testing materials, to include: • tensile testing • hardness testing (Brinell, Vickers and Rockwell) • charpy/izod testing • fatigue testing 4.2. Define the terms associated with the properties of materials, to include: • work hardening • weldability of materials • hardenability • cold working 4.3. Identify the effects when different types of forces are applied to a material, to include: • tensile force • compressive force • shear force • torsion
5. Understand the structure and state of matter	5.1. Recognise the three states of matter 5.2. Identify the basic structure of matter, to include: • atoms • molecules • elements • compounds • mixtures 5.3. Be able to give examples of elements, compounds and mixtures

6. Understand the units used in the SI system	6.1. Recognise the SI units for engineering applications, to include: • force • energy • heat • time • length • area • volume • mass • electrical current • gas pressure
7. Understand the electrical principles and conditions of welding processes	7.1. Define: • open circuit voltage (OCV) • arc voltage • welding current 7.2. Identify the effects of increasing/decreasing the arc length when MMA welding on the: • welding current • arc voltage 7.3. Identify the characteristics of a welding power source, to include flat and drooping types 7.4. Identify welding processes that use flat or drooping characteristic type power sources 7.5. Explain the terms associated with welding power sources, to include: • duty cycles • single and three phase systems • tapped reactor • moving core reactor

Be able to use calculations relating to fabrication and welding activities	8.1. Calculate volume and surface areas applicable to fabricated and welded assemblies 8.2. Calculate the cost of welding, to include: • purchase of equipment • cost of consumables • purchase of materials • cost of labour 8.3. Calculate total length of welding required for a fabricated assembly 8.4. Calculate unknown angles and side lengths in right angled triangles using trigonometry 8.5. Calculate unknown side lengths in right angled triangles using the Pythagoras theory 8.6. Calculate the length of flat section required to produce a cylinder of a given diameter using the mean or neutral line 8.7. Calculate bending allowances when producing bends/folds in material
9. Know about the problems associated with the manufacture of fabricated and welded assemblies	9.1. Identify different types of distortion that can occur in welded assemblies, to include: • longitudinal • transverse • angular 9.2. Identify methods used for the control of distortion in welded assemblies 9.3. Describe the importance of selecting and using the correct joint preparation for a given joint type 9.4. Describe typical welding defects specific to the welding processes listed: • MMA welding • MAGS welding • TAG welding 9.5. Identify the problems associated with the conditions found in a completed welded joint, to include: • residual stress • corrosion • shock loading • distortion

10. Know the importance of quality assurance in fabrication and welding activities	10.1. Describe the application and procedures to be followed when carrying out non-destructive testing (NDT) of welded joints, to include: • dye penetrant testing • magnetic particle testing • ultrasonic flaw detection • radiography 10.2. Identify the limitations of using the NDT methods listed in 10.1 10.3. Identify the importance of carrying out quality control checks on welding consumables 10.4. Identify the application and use of quality control documentation, to include: • welding procedure specification (WPS) • Inspection report for welding • certificates of conformity (consumables)

3. Manual Metal-Arc Welding – (Vertical) Low Carbon Steel, Stainless Steel or Aluminium

Unit References	H/616/1292
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	This unit covering manual metal-arc (MMA) welding is designed to further the skills of the learner who has satisfactorily completed and achieved a level 2 qualification in fabrication and welding practice. Learners will further develop skills in the theory of safe working practice and the theoretical aspects of technology associated with this particular welding process. For this qualification all welding is to be carried out in the vertical welding position (PF/PG) covering a range of welded joints. Both the fillet weld and butt joint will be tested to ensure that they are structurally sound.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Understand health and safety legislation and follow safe working practices	1.1. Identify the responsibilities of both the employer and the employee when complying with the Health and Safety at Work Act 1974 1.2. Identify the use of current legislation, to include: • COSHH (Control of Substances Hazardous to Health) • PUWER (Provision and Use of Work Equipment) • RIDDOR (Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations) 1.3. Identify the use of a risk assessment procedure 1.4. Identify safe working practices when using the MMA welding process, to include working: • in a confined space

2. Be able to identify and use, in a safe manner, equipment used for MMA welding activities	2.1. Describe the function of the equipment used in MMA welding, to include: • transformer • generator • rectifier • invertors • welding lead cable • welding return cable • secondary earth and connector • electrode holder • cable clamp • low voltage safety devices (LVSD) 2.2. Identify suitable maintenance checks that would be required on the items listed in 2.1 2.3. State the procedures to be followed for the safe storage of welding equipment when the welding activity has been completed
3. Be able to identify consumables used when using the MMA welding process	3.1. Identify a range of electrodes that are used for the MMA welding process, to include: • general purpose • low hydrogen (basic) • positional 3.2. State the function of the flux coating on electrodes 3.3. Describe the effects of incorrect storage of electrodes 3.4. State the effect of using damaged electrodes when carrying out welding activities
4. Understand the welding parameters used when carrying out MMA welding in the vertical welding (PF/PG) position	4.1. Identify and select the welding parameters to be used when welding materials in the vertical welding position (PF/PG), to include: • welding current • OCV (open circuit voltage) • electrode slope and tilt angles • arc length • speed of travel • electrode polarity

5. Know about material preparation and the setting up of MMA welding equipment	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded 5.2. Identify terms associated with welding preparations, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.3. Describe the application of distortion control techniques, to include: • pre-setting • restraint • joint geometry 5.4. Be able to follow instructions given on a WPS (Welding Procedure Sheet)
6. Be able to complete welds in the vertical welding position (PF/PG) using the MMA welding process	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the MMA welding process on low carbon steel or stainless steel or aluminium • tee fillet (PF) • butt (PF) • open outside corner (PF or PG) • lap joint (PF or PG)
7. Know how to carry out visual inspection and destructive tests on completed welds	7.1. Carry out visual inspection of completed welds 7.2. Prepare and carry out nick break tests on the completed fillet welds 7.3. Prepare and carry out destructive tests on completed butt welds, to include: • face bend • root bend • fracture test 7.4. Record the results of the weld examination as detailed in 7.1, 7.2 and 7.3
8. Know about defects found in welds produced by the MMA welding process	8.1. Identify and describe typical defects found in MMA welded joints, to include: • cracks • inclusions (slag) • undercut • arc craters • porosity • lack of penetration 8.2. Identify possible causes of the defects listed in 8.1

4. Metal-Arc Gas Shielded Welding – (Vertical) Low Carbon Steel, Stainless Steel or Aluminium

Unit References	K/616/1293
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	This unit covering metal-arc gas shielded (MAGS) welding is designed to further the skills of the learner who has satisfactorily completed and achieved a level 2 qualifications in fabrication and welding practice. Learners will further develop skills in the theory of safe working practice and the theoretical aspects of technology associated with this particular welding process. For this qualification all welding is to be carried out in the vertical welding position (PF/PG) covering a range of welded joints. Both the fillet weld and butt joint will be tested to ensure that they are structurally sound.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Understand health and safety legislation and follow safe working practices	1.1. Identify the responsibilities of both the employer and the employee when complying with the Health and Safety at Work Act 1974 1.2. Identify the use of current legislation, to include: • COSHH (Control of Substances Hazardous to Health) • PUWER (Provision and Use of Work Equipment) • RIDDOR (Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations) 1.3. Identify the use of a risk assessment procedure 1.4. Identify safe working practices when using the MAGS welding process, to include working: • in a confined space • at an height above 2 metres • with containers that have held chemicals or flammable liquids • in damp or wet conditions

2. Be able to identify and use, in a safe manner, equipment used for MAGS welding activities	2.1. Describe the function of the equipment used in the MAGS welding process, to include: • rectifier • welding lead cable and clamp • welding return cable and clamp • secondary earth and connector • torch • contact tip • shroud/nozzle • wire feed mechanism • gas supply, regulator and flow meter 2.2. Identify suitable maintenance checks that would be required on the items listed in 2.1 2.3. State the procedures to be followed for the safe storage of welding equipment when the welding activity has been completed
3. Be able to identify consumables used when using the MAGS welding process	3.1. Identify a range of electrode wires that are used for the MAGS welding process, to include: • non-coated • copper coated 3.2. Describe the effects of incorrect storage of electrode wires 3.3. Recognise the effect of using damaged electrode wires when carrying out welding activities 3.4. Identify the shielding gas/es used in MAGS welding 3.5. Identify the function of the shielding gas used in MAGS welding
4. Understand the welding parameters used when carrying MAGS welding in the vertical welding (PF/PG) position	4.1. Recognise the different modes of metal transfer used in MAGS welding 4.2. Identify and select the welding parameters to be used when welding materials greater than 6 mm in thickness in the vertical welding position (PF/PG). • mode of metal transfer • welding current • arc voltage • torch slope and tilt angles • shielding gas flow rate • wire speed • speed of travel

5. Know about material preparation and the setting up of MAGS welding equipment	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded 5.2. Identify terms associated with welding preparations, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.3. Describe the application of distortion control techniques, to include: • pre-setting • restraint • joint geometry 5.4. Be able to follow instructions given on a WPS (Welding Procedure Sheet)
6. Be able to complete welds in the vertical welding position (PF/PG) using the MAGS welding process	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the MAGS welding process on low carbon steel or stainless steel or aluminium • tee fillet (PF) • butt (PF) • open outside corner (PF or PG) • lap joint (PF or PG)
7. Know how to carry out visual inspection and destructive tests on completed welds	7.1. Carry out visual inspection of completed welds 7.2. Prepare and carry out nick break tests on completed fillet welds 7.3. Prepare and carry out destructive tests on completed butt welds, to include: • face bend • root bend • fracture test 7.4. Record the results of the weld examination as detailed in 7.1, 7.2 and 7.3
8. Know about defects found in welds produced by the MAGS welding process	8.1. Identify and describe typical defects found in the MAGS welding process joints, to include: • cracks • inclusions • undercut • lack of fusion • arc craters • porosity • lack of penetration 8.2. Identify possible causes of the defects listed in 8.1

5. Tungsten-Arc Gas Shielded Welding – (Vertical) Low Carbon Steel, Stainless Steel or Aluminium

Unit References	M/616/1294
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	This unit covering tungsten inert gas shielded (TAG) welding is designed to further the skills of the learner who has satisfactorily completed and achieved a level 2 qualification in fabrication and welding practice. Learners will further develop skills in the theory of safe working practice and the theoretical aspects of technology associated with this particular welding process. For this qualification all welding is to be carried out in the vertical welding position (PF/PG) covering a range of welded joints. Both the fillet weld and butt joint will be tested to ensure that they are structurally sound.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Understand health and safety legislation and follow safe working practices	1.1. Identify the responsibilities of both the employer and the employee when complying with the Health and Safety at Work Act 1974 1.2. Identify the use of current legislation, to include: • COSHH (Control of Substances Hazardous to Health) • PUWER (Provision and Use of Work Equipment) • RIDDOR (Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations) 1.3. Identify the use of a risk assessment procedure 1.4. Identify safe working practices when using the TAG welding process, to include working: • in a confined space • at an height above 2 metres • with containers that have held chemicals or flammable liquids • in damp or wet conditions • with hazards from using high frequency units

2. Be able to identify and use, in a safe manner, equipment used for TAG welding activities	2.1. Describe the function of the equipment used in the TAG welding process, to include: • rectifier • inverter • high frequency units • welding lead cable and clamp • welding return cable and clamp • secondary earth and connector • torch • tungsten • collet • shroud • cooling system • gas supply, regulator and flow meter 2.2. Identify suitable maintenance checks that would be required on the items listed in 2.1 2.3. State the procedures to be followed for the safe storage of welding equipment when the welding activity has been completed
3. Be able to identify consumables used with the TAG welding process	3.1. Identify a range of tungsten electrodes that are used for the TAG welding process, to include: • types used • size (diameter) • alloying additions • preparation of electrode tip (shape/dimensions) 3.2. Identify a range of filler wires that are used for the TAG welding process, to include: • types used • size (diameter) • alloying additions 3.3. Describe the effects of incorrect storage of tungsten electrode and filler wires 3.4. State the effect of using damaged tungsten electrode and filler wires when carrying out welding activities 3.5. Identify the shielding gas/es used in TAG welding 3.6. Identify the function of the shielding gas used in TAG welding

4. Understand the welding parameters used when carrying out TAG welding in the vertical welding (PF/PG) position	4.1. Identify and select the welding parameters to be used when welding in the vertical welding position (PF/PG): • welding current • torch slope and tilt angles • filler wire slope and tilt angles • shielding gas flow rate • arc length • speed of travel 4.2. Identify the use of autogenous techniques when using the TAG welding process
5. Know about material preparation and the setting up of TAG welding equipment	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded 5.2. Identify terms associated with welding preparations, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.3. Describe the application of distortion control techniques, to include: • pre-setting • restraint • joint geometry • chills • weld sequence 5.4. Be able to follow instructions given on a WPS (Welding Procedure Sheet)
6. Be able to complete welds in the vertical welding position (PF/PG) using the TAG welding process	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the TAG welding process on low carbon steel or stainless steel or aluminium • tee fillet (PF) • butt (PF) • open outside corner (PF or PG) • lap joint (PF or PG)

7. Know how to carry out visual inspection and destructive tests on completed welds	7.1. Carry out visual inspection of completed welds 7.2. Prepare and carry out nick break tests on completed fillet welds 7.3. Prepare and carry out destructive tests on completed butt welds, to include: • face bend • root bend • fracture test 7.4. Record the results of the weld examination as detailed in 7.1, 7.2 and 7.3
8. Know about defects found in welds produced by the TAG welding process	8.1. Identify and describe typical defects found in the TAG welding process joints, to include: • cracks • inclusions • undercut • lack of fusion • arc craters • porosity • lack of penetration 8.2. Identify possible causes of the defects listed in 8.1

6. Fabrication Processes – Plate (3 mm and above in thickness)

Unit Reference	T/616/1295
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	The practical content of this unit requires the learner to manufacture a fabricated assembly in material of 3 mm thickness or above to given dimensions and within a specified tolerance. Understanding safe working practices when carrying out fabrication activities is an important criterion in all aspects of this unit. Other areas include working from fabrication drawings, marking out, cutting, forming and assembly.

Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Understand safe working practices when carrying out fabrication activities	1.1. Identify safe lifting methods to be used when lifting and handling materials 3 mm in thickness or above using: • manual lifting methods • mechanical lifting methods 1.2. Identify the use of current legislation covering: LOLER (Lifting Operations and Lifting Equipment Regulations) 1.3. Identify the safe working practices required when using fabrication tools and equipment, to include: • hand tools • thermal cutting equipment • shearing machines • drilling machines • rolling machines (manual and powered) 1.4. Identify and describe the importance of safety features on powered machinery, to include: • guarding of moving parts • electrical isolators • emergency stop buttons
2. Understand how to read and interpret fabrication drawings	2.1. Identify the use of orthographic drawings when manufacturing fabricated assemblies 2.2. Understand the need for tolerances in fabrication assembly activities
3. Know about marking out materials greater than 3 mm in thickness	3.1. Identify the importance of the correct storage of marking out equipment when not in use 3.2. Use a range of marking out equipment to mark out material greater than 3 mm in thickness, to include: • rulers/tapes • dividers/trammels • scribers • squares • protractors 3.3. Describe the importance of working from a fixed datum edge, line or point when marking out 3.4. Describe features of marking out, to include: • progressive marking out • chain measuring • cumulative error • pitch circle diameter (PCD) 3.5. Calculate bending and rolling allowances in materials greater than 3 mm in thickness, to include:

	• bends at 90° in 3 mm thick material and above • length of flat section required to produce a cylinder of a fixed diameter using the neutral /mean line of the material
4. Be able to identify and use thermal cutting equipment	4.1. Identify and describe the equipment used for thermal cutting operations, to include: • oxy/fuel gas methods • plasma arc 4.2. Identify the cutting nozzle arrangements when using the following gas mixtures: • oxy/acetylene • oxy/propane 4.3. Use oxy/fuel gas or plasma arc cutting equipment to produce: • straight lines • circles or radii 4.4. Identify the cutting aids and attachments used with thermal cutting activities
5. Be able to identify and use mechanical cutting equipment	5.1. Identify the parameters when selecting a cutting machine, to include: • type of material to be cut • maximum thickness of material • maximum length of cut • blade clearance 5.2. Identify cutting equipment, to include: • powered guillotine • universal steel worker 5.3. Identify the use of cutting machine attachments, to include: • adjustable back stop • squaring arm • stroke counter 5.4. Identify drilling machines, to include: • bench drilling machine • pillar drilling machine 5.5. State the importance of regular maintenance on powered cutting equipment
6. Be able to identify and use forming equipment	6.1. Identify the parameters when selecting and using a forming machine, to include: • type of material to be formed • maximum thickness of material • maximum length of material to be formed • sectional shape required 6.2. Identify forming equipment, to include: • manual folding machine

	• powered press brake • manual sheet rollers • powered rollers (pyramid and pinch type) • powered section bending rollers
7. Know about methods of joining parts in fabricated assemblies in materials above 3 mm in thickness	7.1. Identify a range of mechanical fasteners to join and assemble fabricated components, to include: • black bolts • HSFG (High strength friction grip bolts) • turned barrel bolts 7.2. Identify a range of welding processes used to join and assemble fabricated components 7.3. Describe methods of distortion control that are used when welding fabricated components
8. Be able to assemble fabricated components to given specifications	8.1. Follow instructions given on a Fabrication Specification Sheet (FSS) 8.2. Identify a range of assembly aids used to locate parts and maintain alignment during assembly, to include: • bridge and wedges • draw bolts • cleats • clamps • drifts • magnets 8.3. Plan the sequence of manufacture and assembly of a fabricated component
9. Be able to produce a fabricated assembly in materials above 3 mm in thickness	9.1. Produce a fabricated component in material 3 mm in thickness or above, to include: • marking out • cutting material • rolling • bending/folding • drilling • assembling 9.2. Carry out the requirements as listed in 9.1 to the required tolerance and dimensional accuracy as detailed on the drawing 9.3. Carry out inspection of the completed assembly using a range of inspection equipment

7. Fabrication Processes – Sheet Metal (Below 3 mm in Thickness)

Unit Reference	A/616/1296
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	The practical content of this unit requires the learner to manufacture a fabricated assembly in sheet metal (below 3 mm in thickness) to given dimensions and within a specified tolerance. Understanding safe working practices when carrying out sheet metal fabrication activities is an important criterion in all aspects of this unit. Other areas include working from fabrication drawings, marking out, cutting, forming and assembly.

Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Understand safe working practices when carrying out sheet metal activities	1.1. Identify safe lifting methods to be used when lifting and handling sheet metal below 3 mm in thickness using: • manual lifting methods • mechanical lifting methods 1.2. Identify the use of current legislation covering: LOLER (Lifting Operations and Lifting Equipment Regulations) 1.3. Identify the safe working practices required when using fabrication tools and equipment, to include: • hand tools • shearing machines • forming machines • drilling machines • rolling machines (manual and powered) 1.4. Identify and describe the importance of safety features on powered machinery, to include: • guarding of moving parts • electrical isolators • emergency stop buttons
2. Understand how to read and interpret fabrication drawings	2.1. Identify the use of orthographic drawings when manufacturing fabricated assemblies

	2.2. Understand the need for tolerances in sheet metal fabrication assembly activities
3. Know about marking out materials less than 3 mm in thickness	3.1. Identify the importance of the correct storing of marking out equipment when not in use 3.2. Use a range of marking out equipment to mark out sheet metal, to include: • rulers/tapes • dividers/trammels • scribers • squares • protractors 3.3. Describe the importance of working from a fixed datum edge, line or point when marking out 3.4. Describe features of marking out, to include: • progressive marking out • chain measuring • cumulative error 3.5. Calculate bending and rolling allowances in sheet metal, to include: • bends at 90° in sheet metal material • length of flat section required to produce a cylinder of a fixed diameter using the neutral/mean line of the material
4. Be able to identify and use cutting equipment	4.1. Identify the parameters when selecting a cutting machine, to include: • type of material to be cut • maximum thickness of material • maximum length of cut • blade clearance 4.2. Identify mechanical/manual cutting equipment, to include: • powered guillotine • nibbling machine • bench shears • tin snips 4.3. Identify the use of mechanical cutting machine attachments, to include: • adjustable back stop • squaring arm • stroke counter 4.4. Identify drilling machines, to include: • bench drilling machine • pillar drilling machine • hand held power drill 4.5. State the importance of regular maintenance on powered cutting equipment

	4.6. Recognise the application and use of plasma arc cutting on materials less than 3 mm in thickness
5. Be able to identify and use forming equipment	5.1. Identify the parameters when selecting and using a forming machine, to include: • type of material to be formed • maximum thickness of material • maximum length of material to be formed • sectional shape required 5.2. Identify forming equipment, to include: • manual folding machine • powered press brake • manual sheet rollers(pyramid and pinch type) • powered rollers (pyramid and pinch type)
6. Know about methods of joining parts in fabricated assemblies in sheet metal	6.1. Identify a range of mechanical fasteners to join and assemble fabricated components, to include: • black bolts • hollow rivets • self-tapping screws 6.2. Identify a range of welding processes used to join and assemble fabricated components, to include: • MAGS welding • TAG welding • resistance spot welding 6.3. Describe methods of distortion control that are used when welding fabricated components 6.4. Identify a range of self-securing joints used to fasten materials less than 3 mm in thickness, to include: • grooved seam • knocked up • paned down 6.5. Recognise methods used to stiffen sheet metal assemblies
7. Be able to assemble fabricated components to given specifications	7.1. Follow instructions given on a Fabrication Specification Sheet(FSS) 7.2. Identify a range of assembly aids used to locate parts and maintain alignment during assembly, to include: • supports • jigs/fixtures • clamps • magnets 7.3. Plan the sequence of manufacture and assembly of a fabricated component
8. Be able to produce a fabricated	8.1. Produce a fabricated component in sheet metal, to include:

assembly in sheet metal	• marking out • cutting material • rolling • bending/folding • drilling • assembling 8.2. Carry out the requirements as listed in 8.1 to the required tolerance and dimensional accuracy as detailed on the drawing 8.3. Carry out inspection of the completed assembly using a range of inspection equipment

8. Manual Metal-Arc Welding – (Overhead) Low Carbon Steel, Stainless Steel or Aluminium

Unit References	F/616/1297
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	Learners will develop a high standard of practical skills to enable them to produce acceptable welded joints in the overhead (PE) welding position. This Diploma level qualification requires the learner to have a good understanding of health and safety, welding equipment, consumables, joint preparation and the quality assurance required to conform to relevant standards applicable to the welding industry. The learner has a choice of materials to weld by the manual metal-arc (MMA) welding process, these being low carbon steel stainless steel or aluminium.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about Health and Safety when carrying out MMA welding activities	1.1. Identify the roles of various organisations involved with safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities

	1.2. Identify the roles of various individuals involved with health and safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose for and typical contents of an organisations' Health and Safety Policy 1.4. Describe the purpose of a risk assessment, to include: • who should carry out risk assessments • when to carry out a risk assessment • identification of the 5 steps of risk assessment 1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment 1.6. Describe the control and safe removal of welding fumes and gases created during the welding process, to include: • natural extraction • local extraction • PPE and specialist breathing equipment
2. Understand power sources and electrical features relating to the MMA welding process	2.1. Identify the different power sources used in MMA welding, to include: • transformer • generator • rectifier • invertor 2.2. Describe features of the power sources as listed in 2.1, to include: • type of current produced (AC/DC) • maintenance requirements • portability • suitable applications 2.3. Identify the advantages and limitations of using both alternating current (AC) and direct current (DC) 2.4. Describe how the electrical features listed affect the MMA welding process: • change of polarity when using direct current (DC)

	• current control (tapped, moving core and moving coil) • duty cycle of the power source • drooping characteristic feature
3. Understand the selection, use and storage of welding consumables used in the MMA welding process	3.1. Describe the importance of correct storage conditions for electrodes, to include: • location • ventilation • contamination • labelling 3.2. Identify the use of different types of electrodes, to include: • cellulosic • rutile • basic (low hydrogen) 3.3. Describe the reasons why basic (low hydrogen) electrodes require special conditions when being stored prior to use 3.4. Describe the effects of using damaged or damp electrodes 3.5. Identify the functions of: • flux coating on the electrode • slag covering on the weld deposit
4. Understand the welding parameters used when carrying out MMA welding in the overhead welding (PE) position to produce butt and fillet welds	4.1. Identify and select the welding parameters to be used when welding low carbon steel in the overhead welding position (PE), to include: • welding current • OCV (open circuit voltage) • electrode slope and tilt angles • arc length • speed of travel • electrode polarity
5. Know about material preparation and distortion control when using MMA welding	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.2. Describe the advantages and limitations of the methods listed that are used to produce suitable welding preparations on materials, to include: • thermal methods • mechanical (chip forming) • shearing • bevelling machines • abrasive methods

	5.3. Identify the main types of distortion found in completed welded joints, to include: • longitudinal • transverse • angular 5.4. Describe the significance of residual stress found in welded joint 5.5. Identify the main causes of distortion in welded joints 5.6. Identify methods used to control distortion in welded joints

6. Be able to complete welds in the overhead welding position (PE) using the MMA welding process	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the MMA welding process on low carbon steel. • tee fillet (PE) • butt weld(PE) • open outside corner (PE) • lap joint (PE) 6.3. Carry out destructive tests on the completed welds and document the results. Tests to include: • face bend • root bend • fracture test
7. Know about defects found in welds produced by the MMA welding process	7.1. Identify defects and imperfections that may be found in welds completed in the overhead position (PE) by the MMA welding process 7.2. Identify the use of aids when carrying out visual inspection of welded joints, to include: • magnifying glass • welding gauge • fillet weld gauge • borescope
8. Know the function of inspection, quality control and quality assurance as applied to welding activities	8.1. Identify the function of: • weld inspection activities • quality control • quality assurance 8.2. Describe the importance of carrying out quality control checks on consumables used in MMA welding activities 8.3. Describe the range and purpose of destructive workshop tests used on welded joints 8.4. Identify the use and application of the four main methods of non-destructive testing (NDT), to include: • dye penetrant flaw detection • magnetic particle flaw detection • ultrasonic flaw detection • radiographic flaw detection using both X ray and gamma ray 8.5. Identify the importance of documenting weld inspection activities

9. Metal-Arc Gas Shielded Welding – (Overhead) Low Carbon Steel, Stainless Steel or Aluminium

Unit References	J/616/1298
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	Learners will develop a high standard of practical skills to enable them to produce acceptable welded joints in the overhead (PE) welding position. This Diploma level qualification requires the learner to have a good understanding of health and safety, welding equipment, consumables, joint preparation and the quality assurance required to conform to relevant standards applicable to the welding industry. The learner has a choice of materials to weld by the metal-arc gas shielded (MAGS) welding process, these being low carbon steel, stainless steel or aluminium.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about Health and Safety when carrying MAGS welding activities	1.1. Identify the roles of various organisations involved with Health and safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities 1.2. Identify the roles of various individuals involved with Health and safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose and typical contents of an organisations Health and Safety Policy 1.4. Describe the purpose of a risk assessment, to include: • who should carry out risk assessments • when to carry out a risk assessment • identification of the 5 steps of risk assessment

	1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment 1.6. Describe the control and safe removal of welding fumes and gases created during the welding process, to include: • natural extraction • local extraction • PPE and specialist breathing equipment
2. Understand power sources and electrical features relating to the MAGS welding process	2.1. Identify the power sources used in MAGS welding 2.2. Describe the principle of the self-adjusting arc mechanism as applied to MAGS welding 2.3. Describe how inductance can regulate the quality of the weld deposit 2.4. Identify the modes of metal transfer used in MAGS welding activities, to include: • dip • spray • pulse
3. Understand the selection, use and storage of welding consumables used in MAGS welding	3.1. Describe the importance of correct storage conditions for electrode wires, to include: • location • ventilation • contamination • labelling 3.2. Identify the use of different types of electrode wire, to include: • non-coated • coated (copper) 3.3. Describe the content and use of deoxidising agents added to electrode wires 3.4. Describe the effects of using damaged or corroded electrode wires 3.5. Identify the range and application of shielding gases and gas mixtures used in MAGS welding
4. Understand the welding parameters used when carrying out MAGS welding in the overhead welding (PE)	4.1. Identify and select the welding parameters to be used when welding low carbon steel in the overhead welding position (PE), to include: • welding voltage • wire feed speed • torch slope and tilt angles • electrode extension

position to produce butt and fillet welds	• speed of travel • inductance • shielding gas flow rate (LPM)
5. Know about material preparation and distortion control when using MAGS welding	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.2. Describe the advantages and limitations of the methods listed that are used to produce suitable welding preparations on materials, to include: • thermal methods • mechanical (chip forming) • shearing • bevelling machines • abrasive methods 5.3. Identify the main types of distortion found in completed welded joints, to include: • longitudinal • transverse • angular 5.4. Identify the causes of distortion in welded joints 5.5. Identify methods used to control distortion in welded joints 5.6. Describe the significance of residual stress found in welded joints
6. Be able to complete welds in the overhead welding position (PE) using the MAGS welding process	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the MAGS welding process on low carbon steel or stainless steel. • tee fillet (PE) • butt (PE) • open outside corner (PE) • lap joint (PE) 6.3. Carry out destructive tests on the completed welds and document the results. Tests to include: • face bend • root bend • fracture test • nick break test

7. Know the function of inspection, quality control and quality assurance as applied to welding activities	7.1. Identify the function of: • weld inspection activities • quality control • quality assurance 7.2. Describe the importance of carrying out quality control checks on consumables used in MAGS welding activities 7.3. Describe the range and purpose of destructive tests used on welded joints 7.4. Identify the use and application of the four main methods of non-destructive testing (NDT), to include: • dye penetrant flaw detection • magnetic particle flaw detection • ultrasonic flaw detection • radiographic flaw detection using both X ray and gamma ray 7.5. Identify the importance of documenting weld inspection activities
8. Know about defects found in welds produced by the MAGS welding process	8.1. Identify defects and imperfections that may be found in welds completed in the overhead position (PE) by the MAGS welding process 8.2. Identify aids used when carrying out visual inspection of welded joints, to include: • magnifying glass • welding gauge • fillet weld gauge • borescope

10. Tungsten-Arc Gas Shielded Welding – (Overhead) Low Carbon Steel, Stainless Steel or Aluminium

Unit References	L/616/1299
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	Learners will develop a high standard of practical skills to enable them to produce acceptable welded joints in the overhead (PE) welding position. This Diploma level qualification requires the learner to have a good understanding of health and safety, welding equipment, consumables, joint preparation and the quality assurance required to conform to relevant standards applicable to the welding industry. The learner has a choice of materials to weld by the tungsten-arc gas shielded (TAG) welding process, these being low carbon steel, stainless steel or aluminium.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about Health and Safety when carrying out TAG welding activities	1.1. Identify the roles of various organisations involved with Health and safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities 1.2. Identify the roles of various individuals involved with Health and Safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose and typical contents of an organisations Health and Safety Policy 1.4. Describe the purpose of a risk assessment, to include: • who should carry out risk assessments • when to carry out a risk assessment • identification of the 5 steps of risk assessment

	1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment 1.6. Describe the control and safe removal of welding fumes and gases created during the welding process, to include: • natural extraction • local extraction • PPE and specialist breathing equipment 1.7. Describe the hazards associated when using the TAG welding process, to include: • arc radiation • using high frequency • production of phosgene gas
2. Understand power sources and electrical features relating to the TAG welding process	2.1. Identify the power sources used in TAG welding 2.2. Identify the type of welding current (AC/DC) and polarity to be used when welding: • low carbon steel • stainless steel • aluminium 2.3. Describe the application and use of equipment used in the TAG welding process, to include: • high frequency unit • current control foot pedal • gas pressure regulator • gas flow meter • gas lens

3. Understand the selection, composition, use and storage of welding consumables used in TAG welding	3.1. Describe the importance of correct storage conditions for tungsten electrodes and filler wires, to include: • location • ventilation • contamination • labelling 3.2. Identify the range of different alloying elements added to tungsten electrodes 3.3. Identify the electrode (tip) preparation required when using an AC or DC welding current 3.4. Identify the content and application of a range of filler wires used in the TAG welding process 3.5. Describe the effects of using damaged tungsten electrodes and filler wires 3.6. Identify the range and application of shielding gases used in the TAG welding process
4. Understand the welding parameters used when carrying out TAG welding in the overhead welding (PE) position to produce butt and fillet welds	4.1. Identify and select the welding parameters to be used when welding low carbon steel, stainless steel or aluminium in the overhead welding position (PE), to include: • welding voltage • slope in/slope out control • torch slope and tilt angles • high frequency • speed of travel • pre/post gas flow • shielding gas flow rate (LPM) 4.2. Describe the application and function of gas backing /purging

5. Know about material preparation and distortion control when using TAG welding	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.2. Describe the advantages and limitations of the methods listed that are used to produce suitable welding preparations on materials, to include: • thermal methods • mechanical (chip forming) • shearing • bevelling machines • abrasive methods 5.3. Identify the main types of distortion found in completed welded joints, to include: • longitudinal • transverse • angular 5.4. Identify the main causes of distortion in welded joints 5.5. Identify methods used to control distortion in welded joints 5.6. Describe the significance of residual stress found in welded joints
6. Be able to complete welds in the overhead welding position (PE) using the TAG welding process	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the TAG welding process on one material type to cover, low carbon steel, stainless steel or aluminium in a thickness range of between 1.6 mm to 3 mm. • tee fillet (PE) • butt (PE) • open outside corner (PE) • lap joint (PE) 6.3. Carry out destructive tests on the completed welds and document the results. Tests to include: • face bend • root bend • fracture test • nick break test

7. Know the function of inspection, quality control and quality assurance as applied to welding activities	7.1. Identify the function of: • weld inspection activities • quality control • quality assurance 7.2. Describe the importance of carrying out quality control checks on consumables used in TAG welding activities 7.3. Describe the range and purpose for destructive tests used on welded joints 7.4. Identify the use and application of the four main methods of non-destructive testing (NDT), to include: • dye penetrant flaw detection • magnetic particle flaw detection • ultrasonic flaw detection • radiographic flaw detection using both X ray and gamma ray 7.5. Identify the importance of documenting weld inspection activities
8. Know about defects found in welds produced by the TAG welding process	8.1. Identify defects and imperfections that may be found in welds completed in the overhead position (PE) by the TAG welding process 8.2. Identify aids used when carrying out visual inspection of welded joints, to include: • magnifying glass • welding gauge • fillet weld gauge • borescope

11. Thick Plate Welding using Flux Cored Metal-Arc Gas Shielded Welding

Unit Reference	T/616/1300
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	Learners will develop a high standard of practical skills to enable them to produce acceptable welded joints in the flat (PA) or horizontal vertical (PB) welding positions. This Diploma level qualification requires the learner to have a good understanding of health and safety, welding equipment, consumables, joint preparation and the quality assurance required to conform to relevant standards applicable to the welding industry. Welds are produced by the metal-arc gas shielded (MAGS) welding process using flux cored wires. The material is low carbon steel in a range of thickness from 6 mm to 12 mm.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about Health and Safety when carrying MAGS welding activities using flux cored wires	1.1. Identify the roles of various organisations involved with health and safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities 1.2. Identify the roles of various individuals involved with health and safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose and typical contents of an organisations Health and Safety Policy 1.4. Describe the purpose of a risk assessment, to include: • who should carry out risk assessments • when to carry out a risk assessment

	• identification of the 5 steps of risk assessment 1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment 1.6. Describe the control and safe removal of welding fumes and gases created during the welding process, to include: • natural extraction • local extraction • PPE and specialist breathing equipment
2. Understand power sources and electrical features relating to the MAGS welding process using flux cored wires	2.1. Identify the power sources used in MAGS welding using flux cored wires 2.2. Describe the principle of the self-adjusting arc mechanism as applied to MAGS welding using flux cored wires 2.3. Describe how inductance can influence the quality of the weld deposit 2.4. Describe the characteristics of the mode of metal transfer, to include: • spray transfer • globular transfer
3. Understand the selection, use and storage of welding consumables	3.1. Describe the importance of correct storage conditions for flux cored electrode wires, to include: • location • ventilation • contamination • labelling 3.2. Identify the use of different types of flux cored wires 3.3. Describe the content and use of fluxes added electrode wires 3.4. Describe the effects of using damaged or corroded flux cored electrode wires 3.5. Identify the range and application of shielding gases and gas mixtures used in flux cored MAGS welding

4. Understand the welding parameters used when carrying out MAGS welding using flux cored wires in the overhead welding (PE)position to produce butt and fillet welds	4.1. Identify and select the welding parameters to be used when welding low carbon steel in the flat (PA) or horizontal vertical (PB) welding positions, to include: • welding voltage range • welding amperage range • wire feed speed • torch slope and tilt angles • electrode extension • speed of travel • inductance • type of shielding gas (if used) • shielding gas flow rate (LPM)
5. Know about material preparation and distortion control when carrying out MAGS welding using flux cored wires	5.1. Identify suitable welding preparations for the type of joint and material thickness being welded, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.2. Describe the advantages and limitations of the methods listed that are used to produce suitable welding preparations on materials, to include: • thermal methods • mechanical (chip forming) • shearing • bevelling machines • abrasive methods 5.3. Identify the main types of distortion found in completed welded joints, to include: • longitudinal • transverse • angular 5.4. Identify the causes of distortion in welded joints 5.5. Identify methods used to control distortion in welded joints 5.6. Describe the significance of residual stress found in welded joints
6. Be able to complete welds in the flat (PA) or horizontal welding position (PB) by the MAGS welding process using flux cored wires	6.1. Identify appropriate safety checks on the welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints to be welded by the MAGS welding process using flux cored wires on low carbon steel in a thickness range of between 6 mm to 12 mm. • tee fillet (PA or PC)) • single vee butt (PA) • double vee butt (PA)

7. Know the function of inspection, quality control and quality assurance as applied to welding activities	7.1. Identify the function of: • weld inspection activities • quality control • quality assurance 7.2. Describe the importance of carrying out quality control checks on consumables used in MAGS welding activities 7.3. Describe the range and purpose for destructive tests used on welded joints 7.4. Identify the use and application of the four main methods of non-destructive testing (NDT), to include: • dye penetrant flaw detection • magnetic particle flaw detection • ultrasonic flaw detection • radiographic flaw detection using both X ray and gamma ray 7.5. Identify the importance of documenting weld inspection activities
8. Know about defects found in welds produced by the MAGS welding process using flux cored wires	8.1. Identify defects and imperfections that may be found in welds completed in the flat (PA) or horizontal vertical position (PC) by the MAGS welding process using flux cored wires 8.2. Identify aids used when carrying out visual inspection of welded joints, to include: • magnifying glass • welding gauge • fillet weld gauge • borescope

12. Pipe Welding using Manual Metal-Arc Welding, Metal-Arc Gas Shielded Welding or Tungsten-Arc Gas Shielded Welding

Unit References	A/618/1301
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	Learners will develop a high standard of practical skills to enable them to produce acceptable welded joints in pipe assemblies covering fixed and rotated welding positions. This Diploma level qualification requires the learner to have a good understanding of health and safety, welding equipment, consumables, joint preparation and the quality assurance required to conform to relevant standards applicable to the welding industry. Welds will be produced in pipes of differing diameters and wall thicknesses. The learner will select one process from manual metal-arc (MMA), metal-arc gas shielded (MAGS) or tungsten-arc gas shielded (TAG) welding to complete the welded joints required.
Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about Health and Safety when carrying out pipe welding activities	1.1. Identify the roles of various organisations involved with health and safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities 1.2. Identify the roles of various individuals involved with health and safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose and typical contents of an Organisations health and safety policy 1.4. Describe the purpose of a risk assessment, to include: • who should carry out risk assessments

	• when to carry out a risk assessment • identification of the 5 steps of risk assessment 1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment 1.6. Describe the control and safe removal of welding fumes and gases created during the welding process, to include: • natural extraction • local extraction • PPE and specialist breathing equipment 1.7. Identify the risk associated with pipe welding on site, to include: • location • environmental (wind, rain etc.) • availability of power supply • working/welding in trenches • welding at heights
2. Understand power sources and electrical features relating to welding processes used for pipe welding activities	2.1. Identify the different power sources used when welding with MMA, MAGS and TAG welding, to include: • transformer • generator • rectifier • invertor 2.2. Describe features of the power sources as listed in 2.1, to include: • type of current produced (AC/DC) • maintenance requirements • portability • suitable applications 2.3. Identify specialist equipment used when carrying out pipe welding activities, to include: • pipe cutting equipment • jigs/fixtures • turntables/rotators/manipulators

3. Understand the selection, use and storage of welding consumables	3.1. Describe the importance of correct storage conditions for electrodes, wires and gas cylinders, to include: • location • ventilation • contamination • labelling 3.2. Identify the use of different types of electrodes, electrode wires and filler wires when carrying out pipe welding activities 3.3. Describe the effects of using damaged or corroded electrodes, electrode wires and filler wires when carrying out pipe welding activities
4. Understand the welding parameters required when using MMA welding to produce welds in low carbon steel pipes	4.1. Identify and select the required welding parameters to be used when welding low carbon steel pipes using MMA welding processes, to include: • welding voltage • welding current • electrode polarity • wire feed speed • torch slope and tilt angles • electrode extension • speed of travel • inductance • gas delay system • shielding gas type • shielding gas flow rate (LPM)

5. Know about material preparation and joint set-up when pipe welding	5.1. Identify suitable welding preparations for the type of joint, diameter and wall thickness of the pipe being welded, to include: • included angle • angle of bevel • root face dimension • root gap dimension 5.2. Identify different types of joints used in pipe work assemblies, to include: • butt welds • branch joints • slip on flange • set on flange 5.3. Describe the advantages and limitations of the methods listed that are used to produce suitable welding preparations on materials, to include: • thermal methods • mechanical (chip forming) • bevelling machines • abrasive methods 5.4. Identify the application of both permanent and temporary backing rings used in pipe welding 5.5. Identify methods used to ensure pipe alignment before and during welding activities 5.6. Identify different types of pipe work fittings, to include: • concentric reducers • eccentric reducers • equal diameter tee pieces • unequal diameter tee pieces • elbows 45° 60° 90° • blank ends (dished ends)
6. Be able to complete welds in pipe work using a selected welding process	6.1. Identify appropriate safety checks on the selected welding equipment prior to use 6.2. Select suitable welding parameters to enable the listed joints (given in 6.3.) to be welded by one process from the following: • MMA welding 6.3. Weld No 1 – single vee pipe butt weld – rotated. Weld No 2 – single vee pipe butt weld – fixed horizontal vertical position. Weld No 3 – pipe to flange weld – rotated. Weld No 4 – set on branch weld in unequal diameter pipes – rotated. 6.4. Identify the practice of using dual process techniques for pipe welding activities

	6.5. Carry out destructive tests on the completed welds and document the results. Tests to include: • face bend • root bend • fracture test • nick break test
7. Know the function of inspection, quality control and quality assurance as applied to pipe welding activities	7.1. Identify the function of: • weld inspection activities • quality control • quality assurance 7.2. Describe the importance of carrying out quality control checks on consumables used for welding pipes 7.3. Describe the range and purpose of destructive tests used on welded joints 7.4. Identify the use and application of the four main methods of non-destructive testing (NDT), to include: • dye penetrant flaw detection • magnetic particle flaw detection • ultrasonic flaw detection • radiographic flaw detection using both X ray and gamma ray • visual inspection of pipe bores/root penetration using endoscope/borescope 7.5. Identify the importance of documenting weld inspection activities
8. Know about defects found in pipe welded joints produced by the MMA welding processes	8.1. Identify defects and imperfections that may be found in pipe welded assemblies using MMA welding processes 8.2. Identify aids used when carrying out visual inspection of welded joints, to include: • magnifying glass • welding gauge • fillet weld gauge • borescope

13. Advanced Fabrication Processes – Plate (3 mm and Above in Thickness)

Unit Reference	F/616/1302
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	The practical content of this unit requires the learner to demonstrate skills in reading complex drawings, marking out, cutting, forming and assembling parts of a fabricated assembly that meet the required dimensional accuracy and tolerance in low carbon steel greater than 3 mm in thickness. The theoretical aspects of this unit covers the features of fabrication work that enable the practical work to be carried out safely and understanding the various processes involved which are required to produce complex assemblies.

Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Know about Health and Safety when carrying out plate work fabrication activities	1.1. Identify the roles of various organisations involved with health and safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities 1.2. Identify the roles of various individuals involved with health and safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose and typical contents of an organisations Health and Safety Policy 1.4. Describe the purpose of a risk assessment to include: • who should carry out risk assessments • when to carry out a risk assessment • identification of the 5 steps of risk assessment

	1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment
2. Know about the safe handling and moving of materials greater than 3 mm in thickness	2.1. Identify current legislation and regulations relating to both manual and mechanical lift operations, to include: • manual handling operations regulations • lifting operations and lifting equipment • regulations (LOLER) 2.2. Describe safe manual lifting operations, to include: • planning the lifting manoeuvre • use of suitable PPE • correct posture when lifting • maximum recommended weight limit • use of lifting aids 2.3. Describe mechanical lifting operations, to include: • planning the lifting manoeuvre • safe working load (SWL) • recommended maximum spread angle of slings • selecting slings appropriate to load being lifted/moved • correct use of slinging techniques • use of hand signals to crane operator 2.4. Identify the use and application of a range of mechanical lifting accessories, to include: • friction grip plate clamp • "D" shackle • lifting beam • eye bolt • nylon, wire and rope slings
3. Know how to mark out fabricated assemblies from complex drawings	3.1. Read complex fabrication assembly drawings that show: • symbols • abbreviations • standard drawing conventions 3.2. Identify a range of instruments/equipment to mark out complex fabricated assemblies 3.3. Use a range of methods to mark out complex fabricated assemblies, to include: • direct marking onto the material • use of templates

	3.4. Identify the importance of safe storage of marking out instruments/equipment 3.5. Mark out on materials greater than 3 mm in thickness fabricated assemblies, to include: • bending allowances • calculating mean/neutral diameters
4. Know about thermal cutting techniques used on materials greater than 3 mm in thickness	4.1. Identify safe working practices when using thermal cutting equipment 4.2. Identify the advantages and limitations of using a range of thermal cutting equipment to cut material greater than 3 m in thickness, to include: • oxy/acetylene cutting equipment • oxy/propane cutting equipment • plasma cutting • laser cutting 4.3. Use thermal cutting equipment to produce a Range of cuts in plate to a given tolerance, to include: • straight cuts • circles and radii 4.4. Describe methods used to control distortion when cutting materials greater than 3 mm in thickness using thermal cutting equipment
5. Know about mechanical cutting techniques used on materials greater than 3 mm in thickness	5.1. Identify safe working practices when using mechanical cutting equipment 5.2. Identify a range of safety features used on mechanical cutting equipment, to include: • emergency stop buttons • fixed guards • movable guards • micro switch locking devices 5.3. Identify chip forming and non-chip forming methods of mechanical cutting applications 5.4. Describe how the capacity of a mechanical guillotine is determined 5.5. Identify the principle of shearing material greater than 3 mm in thickness, to include: • blade clearance • shearing angle • blade rake angle 5.6. Use mechanical cutting equipment to produce cuts in material greater than 3 mm in thickness
6. Know about forming operations	6.1. Identify safe working practices when using forming equipment

used on materials greater than 3 mm in thickness	6.2. Identify a range of safety features used on forming equipment, to include: • emergency stop buttons • fixed guards • movable guards • micro switch locking devices 6.3. Identify the difference in the tooling for a press brake when carrying out: • air bending • coining 6.4. Identify the features and application of both manual and mechanical rolling equipment, to include: • pinch type rolling machines • pyramid type rolling machine • section bending rollers • cone rollers 6.5. Use forming machines to produce fabricated assemblies in material greater than 3 mm in thickness
7. Know about methods of joining parts in fabricated assemblies in materials above 3 mm in thickness	7.1. Identify a range of welding processes used to join and assemble fabricated components, to include: • MMA • MAGS 7.2. Identify the specific application of mechanical fasteners, to include: • high strength friction grip bolts • turned barrel bolts • black bolts 7.3. Describe how high strength friction grip bolts, nuts and washers can be positively identified 7.4. Identify faults that may arise in the joints of a fabricated assembly when using mechanical fasteners 7.5. Describe the advantages and limitations of joining fabricated assemblies by welding compared to using mechanical fasteners
8. Be able to assemble Fabricated components to given specifications	8.1. Identify the use of a fabrication procedure sheet 8.2. Identify a range of assembly aids that can be used to maintain alignment of parts, avoid twisting and control distortion before and during assembly 8.3. Identify a range of tools/equipment that can be used to inspect fabricated assemblies to ensure the accuracy of the finished product, to include:

	• rule/tape measure • squares/protractors • straight edge • vernier gauge • profile gauge
9. Produce a fabricated assembly in materials greater than 3 mm in thickness	9.1. Produce a fabricated component in material greater than 3 mm in thickness, to include: • marking out • cutting material • rolling • bending/folding • drilling • assembling 9.2. Carry out the requirements as listed in 9.1. to the required tolerance and dimensional accuracy as detailed on the drawing 9.3. Carry out inspection of the completed assembly using a range of inspection equipment

14. Advanced Fabrication Processes – Sheet Metal (Below 3 mm in Thickness)

Unit Reference	J/616/1303
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	The practical content of this unit requires the learner to demonstrate skills in reading complex drawings, marking out, cutting, forming and assembling parts of a fabricated assembly that meet the required dimensional accuracy and tolerance in low carbon steel less than 3 mm in thickness. The theoretical aspects of this unit covers the features of fabrication work that enable the practical work to be carried out safely and understanding the various processes involved which are required to produce complex assemblies.

Learning Outcomes The learner will:	Assessment Criteria The learner can:

1. Know about Health and Safety when carrying out sheet metal fabrication activities	1.1. Identify the roles of various organisations involved with health and safety in the workplace, to include: • Health and Safety Executive (HSE) • Environmental Health • Local Authorities 1.2. Identify the roles of various individuals involved with health and safety in the workplace, to include: • Company safety officers • Company safety representatives • Environmental health officers • HSE inspectors 1.3. Identify the purpose and typical contents of an organisations Health and Safety Policy 1.4. Describe the purpose of a risk assessment, to include: • who should carry out risk assessments • when to carry out a risk assessment • identification of the 5 steps of risk assessment 1.5. Identify the precautions to be taken when working in high risk areas, to include: • risk assessments • permits to work • high/low temperature working conditions • lock off systems • isolation of equipment
2. Know about the safe handling and moving of material less than 3 mm in thickness	2.1. Identify current legislation and regulations relating to both manual and mechanical lift operations, to include: • manual handling operations regulations • lifting operations and lifting equipment • regulations (LOLER) 2.2. Describe the safe manual lifting operations, to include: • planning the lifting manoeuvre • use of suitable PPE • correct posture when lifting • maximum recommended weight limit • use of lifting aids 2.3. Describe mechanical lifting operations, to include: • planning the lifting manoeuvre • safe working load (SWL) • recommended maximum spread angle of slings • selecting slings appropriate to load being lifted/moved • correct use of slinging techniques

	• use of hand signals to crane operator
3. Know how to mark out fabricated assemblies from complex drawings	3.1. Read complex fabrication assembly drawings that show: • symbols • abbreviations • standard drawing conventions 3.2. Identify a range of instruments/equipment to mark out complex fabricated assemblies in low carbon steel less than 3 mm in thickness 3.3. Use a range of methods to mark out complex fabricated assemblies, to include: • direct marking onto the material • use of templates 3.4. Identify the importance of safe storage of marking out instruments/equipment 3.5. Mark out on materials less than 3 mm in thickness fabricated assemblies, to include: • bending allowances • calculating mean/neutral diameter s
4. Know about hand tools used in the manufacture of sheet metal assemblies	4.1. Identify a range of hand tools/equipment that are used to manufacture fabricated assemblies in low carbon steel less than 3 mm in thickness, to include the following processes: • cutting material • forming material • assembling parts
5. Know about mechanical cutting techniques used on materials less than 3 mm in thickness	5.1. Identify safe working practices when using mechanical cutting equipment 5.2. Identify a range of safety features used on mechanical cutting equipment, to include: • emergency stop buttons • fixed guards • movable guards • micro switch locking devices 5.3. Identify chip forming and non-chip forming methods of mechanical cutting applications 5.4. Describe how the capacity of a mechanical guillotine is determined 5.5. Identify the principles of shearing material less than 3 mm in thickness, to include: • blade clearance • shearing angle • blade rake angle

	5.6. Use mechanical cutting equipment to produce cuts in material less than 3 mm in thickness
6. Know about forming operations used on sheet metal assemblies	6.1. Identify safe working practices when using forming equipment 6.2. Identify a range of safety features used on forming equipment, to include: • emergency stop buttons • fixed guards • movable guards • micro switch locking devices 6.3. Identify the difference in the tooling for a press brake when carrying out: • air bending • coining 6.4. Identify the features and application of both manual and mechanical rolling equipment, to include: • pinch type rolling machines • pyramid type rolling machine 6.5. Use forming machines to produce fabricated assemblies in material less than 3 mm in thickness
7. Know about methods of joining parts in sheet metal fabricated assemblies	7.1. Identify a range of welding processes used to join and assemble fabricated components in material less than 3 mm in thickness, to include: • MAGS welding • TAG welding • resistance welding (spot and seam) 7.2. Identify a range of self-secured joints used to join and assemble sheet metal components, to include: • grooved seam • paned down joint • knocked up joint 7.3. Identify the specific application of mechanical fasteners, to include: • black bolts • self-tapping screws • hollow rivets (blind/pop) 7.4. Identify the specific application of adhesives used to join sheet metal components
8. Be able to assemble fabricated components to given specifications	8.1. Identify the use of a fabrication procedure sheet 8.2. Identify a range of assembly aids that can be used to maintain alignment of parts, avoid twisting and control distortion before and during assembly

	8.3. Identify a range of tools/equipment that can be used to inspect fabricated assemblies to ensure the accuracy of the finished product, to include: • rule/tape measure • squares/protractors • straight edge • vernier gauge • profile gauge
9. Produce a fabricated assembly in low carbon steel less than 3 mm in thickness	9.1. Produce a fabricated component in low carbon steel less than 3 mm in thickness, to include: • marking out • cutting material • rolling • bending/folding • drilling • assembling 9.2. Carry out the requirements as listed in 9.1. to the required tolerance and dimensional accuracy as detailed on the drawing 9.3. Carry out inspection of the completed assembly using a range of inspection equipment

15. Engineering Drawing Using Manual and CAD Techniques

Unit Reference	M/503/9511
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	By following this unit, learners will use both manual drawing and CAD systems to produce orthographic drawings of fabricated assemblies. Further drawings using both methods will cover the principles and applications of radial line, parallel line, triangulation, cutting planes and the use of the common central sphere to produce pattern developments for various components. There will be a strong emphasis on presentation and accuracy of completed drawings ensuring they conform to current BS. EN and/or ISO standards

Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Be able to produce engineering drawings using manual techniques	1.1 Produce drawings of fabricated assemblies using orthographic projection 1.2 Dimension drawings to current BS, EN and/or ISO Standards 1.3 Apply welding symbols to current BS, EN and/or ISO Standards
2. Be able to develop patterns using manual techniques	2.1 Use the parallel line method to produce pattern developments 2.2 Use the radial line method to produce pattern developments 2.3 Use triangulation to produce pattern developments
3. Be able to determine lines of intersection	3.1 Use cutting planes to determine the line of intersection between two sections 3.2 Use the principle of the common centre sphere (CCS) to determine the lines of intersection
4. Produce engineering drawings using CAD software	4.1 Set up the CAD system to include • Layers • Paper sizes • Co-ordinates X-Y • Grid and snap references 4.2 Identify and use commands to facilitate CAD drawings 4.3 Produce drawings of fabricated assemblies using orthographic projection 4.4 Dimension drawings to current NS, EN and/or ISO Standards 4.5 Add text to drawings
5. Develop simple pattern developments using CAD	5.1 Use the parallel line method of development to produce half and full patterns 5.2 Use the radial line method of development to produce half and full patterns

6. Be able to manage file systems	6.1 Save the completed work in a suitable file system 6.2 Retrieve work from files created 6.3 Print/plot completed drawings/patterns

16. Materials for Fabrication and Welding Techniques and Skills

Unit Reference	D/618/0794
Level	3
Credit Value	7
Guided Learning Hours	60
Unit Summary	This unit explores and develops the learner's understanding of metallurgy, heat treatment and mechanical testing. Common causes of failure are identified and the mechanisms by which they of occur in welded fabrications are also included within this unit. All processes are to conform to current BS, EN and/or ISO standards

Learning Outcomes The learner will:	Assessment Criteria The learner can:
1. Understand aspects of basic metallurgy	1.1 For mixtures of metals, describe the terms • solubility • solid solutions
2. Understand heat treatment	2.1 Describe the effect of gain structure on annealing, normalising and hardening techniques with reference to temperatures and cooling rates. 2.2 Define • hardenability • weldability to British Standards • work hardening 2.3 Define the critical cooling velocity with reference to • changes in microstructure • changes in mechanical properties • influence of mass/section of welded structures • hard zone cracking 2.4 Describe the effects of alloying elements used to produce

	Alloy steels 2.5 Calculate carbon equivalents to current British Standards 2.6 Describe hot and cold cracking in terms of • cooling rate • hydrogen influence of impurities
3. Understand mechanical Testing	3.1 Describe the behaviour of a material subject to a tensile force in terms of • stress, strain and elasticity • yield strength • tensile strength • percentage elongation • percentage reduction in area • stiffness (without proof of Young's modulus) • proof stress 3.2 State Hooke's Law 3.3 Describe in simple terms the effects of compressive force and shear stress on common materials 3.4 Describe the following mechanical testing methods • hardness testing (Brinell, Vickers and Rockwell) • fatigue testing • charpy impact test 3.5 Describe how mechanical properties can affect the testing of metals 3.6 Describe in simple terms the mechanism by which creep occurs 3.7 Describe the mechanism by which the following types of corrosion (stress, galvanic, rusting) occurs 3.8 Give examples of where the methods (mechanical barriers, inhibitors and sacrificial anodes) are used to overcome the effects caused by the types of corrosion described above

Appendices

Recognition of Prior Learning, Exemption and Credit Transfer

Skills and Education Group Awards policy enables learners to avoid duplication of learning and assessment in a number of ways:

- Recognition of Prior Learning (RPL) – a method of assessment that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and do not need to develop through a course of learning.
- Exemption - Exemption applies to any certificated achievement which is deemed to be of equivalent value to a unit within Skills and Education Group Awards qualification but which does not necessarily share the exact learning outcomes and assessment criteria. It is the assessor's responsibility, in conjunction with the Internal Moderator, to map this previous achievement against the assessment requirements of the Skills and Education Group Awards qualification to be achieved in order to determine its equivalence.
  Any queries about the relevance of any certificated evidence, should be referred in the first instance to your centre's internal moderator and then to Skills and Education Group Awards.
  It is important to note that there may be restrictions upon a learner's ability to claim exemption or credit transfer which will be dependent upon the currency of the unit/qualification and a learner's existing levels of skill or knowledge.
  Where past certification only provides evidence that could be considered for exemption of part of a unit, learners must be able to offer additional evidence of previous or recent learning to supplement their evidence of achievement.
- Credit Transfer – Skills and Education Group Awards may attach credit to a qualification, a unit or a component. Credit transfer is the process of using certificated credits achieved in one qualification and transferring that achievement as a valid contribution to the award of another qualification. Units / Components transferred must share the same learning outcomes and assessment criteria along with the same unit number. Assessors must ensure that they review and verify the evidence through sight of:
  - original certificates OR
  - copies of certificates that have been signed and dated by the internal moderator confirming the photocopy is a real copy and make these available for scrutiny be the External Moderator.
- Equivalencies – opportunities to count credits from the unit(s) from other qualifications or from unit(s) submitted by other recognised organisations towards the place of mandatory or optional unit(s) specified in the rule of combination. The unit must have the same credit value or greater than the unit(s) in question and be at the same level or higher.

Skills and Education Group Awards encourages its centres to recognise the previous achievements of learners through RPL, Exemption and Credit Transfer. Prior achievements may have resulted from past or present employment, previous study or voluntary activities.

Centres should provide advice and guidance to the learner on what is appropriate evidence and present that evidence to the external moderator in the usual way.

Further guidance can be found in 'Delivering and Assessing Skills and Education Group Awards Qualifications' which can be downloaded from: https://skillsandeducationgroupawards.co.uk/wp-content/uploads/2017/12/SEG-Awards_Delivering-and-Assessing-Qualifications-19-20.pdf

Certification

Learners will be certificated for all units and qualifications that are achieved and claimed.

Skills and Education Group Awards policies and procedures are available on the Skills and Education Group Awards website.

Glossary of Terms

Guided Learning Hours (GLH)
GLH is where the learner participates in education or training under the immediate guidance or supervision of a tutor (or other appropriate provider of education or training). It may be helpful to think – 'Would I need to plan for a member of staff to be present to give guidance or supervision?'

GLH is calculated at the unit/component level and added up at the qualification level. Examples of guided learning include:

- Face-to-face meeting with a tutor
- Telephone conversation with a tutor
- Instant messaging with a tutor
- Taking part in a live webinar
- Classroom-based instruction
- Supervised work
- Taking part in a supervised or invigilated assessment
- The learner is being observed.

TQT (Total Qualification Time)
The number of notional hours which represents an estimate of the total amount of time that could reasonably be expected to be required, in order for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.' The size of a qualification is determined by the TQT.

TQT is made up of the GLH plus all other time taken in preparation, study or any other form of participation in education or training but not under the direct supervision of a lecturer, supervisor or tutor.

TQT is calculated at qualification level and not unit/component level.

Examples of unsupervised activities that could contribute to TQT include:

- Researching a topic and writing a report
- Watching an instructional online video at home/e-learning
- Watching a recorded webinar
- Compiling a portfolio in preparation for assessment
- Completing an unsupervised practical activity or work
- Rehearsing a presentation away from the classroom
- Practising skills unsupervised
- Requesting guidance via email – will not guarantee an immediate response.