Level 3 Diplomas in Engineering Construction (2660)

Qualification handbook for centres

600/2639/X

www.cityandguilds.com
October 2021
Version 2.0

Qualification at a glance

Qualification title	GLH	TQT	City & Guilds no.	Accreditation no.
Level 3 Diploma in Engineering Construction – Fabrication Steel Erecting	403	440	2660-30	600/2639/X
Level 3 Diploma in Engineering Construction – Fabrication Platework			2660-31	
Level 3 Diploma in Engineering Construction – Moving Loads			2660-32	
Level 3 Diploma in Engineering Construction – FabricationPipefitting			2660-33	
Level 3 Diploma in Engineering Construction – Mechanical Fitting			2660-34	
Level 3 Diploma in Engineering Construction – Welding			2660-35	

Version and date	Change detail	Section
2.0 October 2021	TQT added	**Qualification at a glance**

Contents

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1 Introduction

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

Qualification title and level	City & Guilds qualification number	Registration and certification
Level 3 Diploma in Engineering Construction – Fabrication Steel Erecting	2660-30	Consult the Walled Garden/Online Catalogue for last dates
Level 3 Diploma in Engineering Construction – Fabrication Platework	2660-31	
Level 3 Diploma in Engineering Construction – Moving Loads	2660-32	
Level 3 Diploma in Engineering Construction – Fabrication Pipefitting	2660-33	
Level 3 Diploma in Engineering Construction – Mechanical Fitting	2660-34	
Level 3 Diploma in Engineering Construction – Welding	2660-35	

Area	Description
Who are the qualifications for?	They are for candidates who work or want to work in Engineering Construction including: • Pipefitters • Mechanical Fitters • Steel Erectors • Riggers (Moving Loads) • Platers • Pipe Welders • Plate Welders
What do the qualifications cover?	They allow candidates to learn, develop and practise the skills required for employment and/or career progression in the Engineering Construction sector.
Are the qualifications part of a framework or initiative?	They serve as a technical certificate, in the Engineering Construction Advanced Level Apprenticeship Framework.
Who did we develop the qualification with?	They were developed in association with ECITB.

1.1 Structure

There are **six** qualification pathways (programmes of study):

- Level 3 Diploma in Engineering Construction - Fabrication Steel Erecting
- Level 3 Diploma in Engineering Construction - Fabrication Platework
- Level 3 Diploma in Engineering Construction - Moving Loads
- Level 3 Diploma in Engineering Construction - Fabrication Pipefitting
- Level 3 Diploma in Engineering Construction - Mechanical Fitting
- Level 3 Diploma in Engineering Construction - Welding

To achieve a full **Level 3 Diploma in Engineering Construction**, candidates must achieve the Mandatory and Optional units listed below. They can also achieve one or more additional units if they choose to do so.

Summary of units

Unit	Title	UAN	Credits	GLH
2660-301	Engineering health and safety	Y/503/0334	9	80
2660-302	Interpreting information and marking out fabrication materials for steel erecting	Y/503/3704	8	72
2660-303	Hand cutting and shaping processes	Y/503/3718	16	144
2660-304	Assembly and erection of structural steelwork	D/503/3719	24	219
2660-305	Interpreting information and marking out fabrication materials	R/503/3720	21	179
2660-306	Preparation, joining and assembly of fabrication materials	J/503/3939	15	135
2660-307	Forming of thick plate and sections	D/503/3722	22	196
2660-308	Prepare loads for moving, lifting and positioning	H/503/3723	15	145
2660-309	Move loads in engineering construction	K/503/3724	14	125
2660-310	Lift and position loads in engineering construction	M/503/3725	6	53
2660-311	Interpret information and mark out pipework materials	T/503/3726	16	142
2660-312	Preparation, fabrication and joining of pipework assemblies	J/503/3729	21	181
2660-313	Fabrication, installation and dismantling of pipework systems	F/503/3731	22	186
2660-314	Preparing for and inspecting fitting operations	L/503/3733	16	138
2660-315	Fitting by use of hand tools	Y/503/3735	12	108
2660-316	Fitting by machining and assembling components	H/503/3737	16	144
2660-317	Preparing and quality controlling the welding operation	A/503/3744	9	81
2660-318	Welding with the manual metal-arc (MMA) process	T/503/3757	24	213
2660-319	Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded process	J/503/3763	21	179
2660-320	Welding with the metal inert gas/metal active gas (MIG/MAG) process	H/503/3771	21	185
2660-321	Welding with the flux cored arc welding (FCAW) process	L/503/3781	21	185

Level 3 Diploma in Engineering Construction – Fabrication Steel Erecting

Mandatory units	**Minimum credit value 57**
Unit number	**Unit title**
2660-301	Engineering health and safety
2660-302	Interpreting information and marking out fabrication materials for steel erecting
2660-303	Hand cutting and shaping processes
2660-304	Assembly and erection of structural steelwork
Additional units	
305-321	

Level 3 Diploma in Engineering Construction – Fabrication Platework

Mandatory units	**Minimum credit value 67**
Unit number	**Unit title**
2660-301	Engineering health and safety
2660-305	Interpreting information and marking out fabrication materials
2660-306	Preparation, joining and assembly of fabrication materials
2660-307	Forming of thick plate and sections
Additional units	
302-304	
308-321	

Level 3 Diploma in Engineering Construction – Moving Loads

Mandatory units	**Minimum credit value 44**
Unit number	**Unit title**
2660-301	Engineering health and safety
2660-308	Prepare loads for moving, lifting and positioning
2660-309	Move loads in engineering construction
2660-310	Lift and position loads in engineering construction
Additional units	
302-307	
311- 321	

Level 3 Diploma in Engineering Construction – Fabrication Pipefitting

Mandatory units	**Minimum credit value 68**
Unit number	**Unit title**
2660-301	Engineering health and safety
2660-311	Interpret information and mark out pipework materials
2660-312	Preparation, fabrication and joining of pipework assemblies
2660-313	Fabrication, installation and dismantling of pipework systems
Additional units	
302-310	
314-321	

Level 3 Diploma in Engineering Construction – Mechanical Fitting

Mandatory units	**Minimum credit value 53**
Unit number	**Unit title**
2660-301	Engineering health and safety
2660-314	Preparing for and inspecting fitting operations
2660-315	Fitting by use of hand tools
2660-316	Fitting by machining and assembling components
Additional units	
302-313	
317- 321	

Level 3 Diploma in Engineering Construction – Welding

Mandatory units	**Minimum credit value 60**
Unit number	**Unit title**
2660-301	Engineering health and safety
2660-317	Preparing and quality controlling the welding operation
Optional units	Any **two** units
2660-318	Welding with the manual metal-arc (MMA) process
2660-319	Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded process
2660-320	Welding with the metal inert gas/metal active gas (MIG/MAG) process
2660-321	Welding with the flux cored arc welding (FCAW) process
Additional units	
302-316	

Additional Guidance

Candidates can choose 2 of 4 welding units - the centre should consider the requirements of the learner and the employer. Unit 318 Welding with the Manual Metal Arc (MMA) Process provides skills which may be transferable to other welding units.

1.2 Opportunities for progression

On completion of these qualifications candidates to progress into employment, Higher Education or to the following qualifications:

- ECITB Level 3 Diploma in Installing Engineering Construction Plant and Systems - Pipefitting
- ECITB Level 3 Diploma in Installing Engineering Construction Plant and Systems – Mechanical Fitting
- ECITB Level 3 Diploma in Welding Engineering Construction Pipework
- ECITB Level 3 Diploma in Welding Engineering Construction Plate
- ECITB Level 3 Diploma in Fabricating Engineering Construction Steel Structures – Plating
- ECITB Level 3 Diploma in Erecting Engineering Construction Capital Plant Steel Structures
- ECITB Level 3 Diploma in Moving Engineering Construction Loads

2 Centre requirements

2.1 Approval

If your Centre is approved to offer the qualification Level 3 Certificate in Engineering Construction (2456-21 – 2456 -25) you will receive automatic approval for the equivalent qualification numbers in the Level 3 Diploma in Engineering Construction.

Qualification approval is required for the Moving Loads Qualification Pathway as is this is new.

New centres will need to gain both centre and qualification approval. Please refer to the *Centre Manual - Supporting Customer Excellence* for further information. Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

2.2 Resource requirements

Physical resources and site agreements

Centres can use specially designated areas within a centre to assess.

Centre staffing

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

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

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

Assessors and internal verifiers

Assessor/Verifier (A/V) units are valued as qualifications for centre staff, but they are not currently a requirement for the qualifications.

Continuing professional development (CPD)

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

2.3 Candidate entry requirements

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

Age restrictions

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

3 Delivering the qualification

3.1 Initial assessment and induction

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

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications
- the appropriate type and level of qualification.

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

3.2 Support materials

Description	How to access
Qualification Handbook	**www.cityandguilds.com**
Assignment guide and templates for centres	**www.cityandguilds.com**
Sample assignments	**www.cityandguilds.com**

For further information to assist with the planning and development of the programme, please refer to the following:

The Engineering Construction Industry Training Board (ECITB)
Apprenticeships
Blue Court
Church Lane
Kings Langley
Hertfordshire
WD4 8JP
01923 260000
01923 270969 (fax)

4 Assessment

4.1 Assessment of the qualification

Candidates must successfully complete:

- one multiple choice test for Unit 301 Engineering Health and Safety
- one centre devised assignment for each mandatory, optional and additional unit.

City & Guilds has written the following to use with this qualification:

- online multiple choice test, using the GOLA system for the Mandatory Unit 301 Engineering Health and Safety
- templates which tutors/assessors can use to write their own assignments
- practice or sample assignments, which can be downloaded from the City & Guilds website.

Unit	Title	Assessment method	Where to obtain assessment materials
2660-301	Engineering health and safety	City & Guilds GOLA multiple choice test	N/A
		The test covers the all of the knowledge in the unit.	Examinations provided on GOLA.
2660-302-321	Various	The assignment covers the skills and knowledge in the unit.	**www.cityandguilds.com**
		It is set, delivered and marked by the tutor/assessor, and will be externally verified by City & Guilds to make sure it is properly carried out.	City & Guilds has written guidance for centres to write their own assessments/assignments.

Centre set assignments

Centres must refer to '*Developing assignments – guidance for centres'* and the associated assignment development forms which are available to download from **www.cityandguilds.com**.

Example assignments and specific assessment guidance for each unit is also available for this qualification and can be found on **www.cityandguilds.com**.

Approval process for centre set assignments

Centre set assignments must be approved by the external verifier before use. For each assignment, the *assignment sign off sheet* (AD3) must be completed and be made available to the EV for inspection.

Time allowance for assessments

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

- The centre will assign specific time constraints for each assignment if appropriate, please refer to the sample individual assignments and guidance documentation.

- Centre staff should guide candidates to ensure excessive evidence gathering is avoided. Centres finding that assignments are taking longer than expected, should contact the external verifier for guidance
- All assignments must be completed and assessed within the candidate's period of registration. Centres should advise candidates of any internal timescales for the completion and marking of individual assignments.

Test specifications

The test specification for the unit assessed by an online multiple-choice assessment is listed below.

2660-301: Engineering health and safety
Duration: 1 hour

Outcome		No. of questions	%
1	Understand compliance with statutory health and safety regulations and organisational requirements	13	32.5
2	Understand compliance with statutory environmental regulations and organisational requirements	7	17.5
3	Know how to implement accident and emergency procedures	9	22.5
4	Understand safe working practices and procedures	11	27.5
	Total	**25**	**100**

4.2 Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification. RPL is allowed and is not sector specific.

There are links with the ECITB competency qualifications – see Appendix 1. The practical activities in the Level 3 Diploma in Engineering Construction (2660) will not provide evidence of competence for the competence based qualification. However, the practical activities in the competency based qualification may provide evidence for the Level 3 Diploma in Engineering Construction (2660). There may be recognition of knowledge evidence across the qualifications.

5 Units

Availability of units

These units each have the following:

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

Where there are references to British, European and International standards the current version should be used.

Glossary of words used in the units

Term	Definition
Safe Working Loads (SWL)	Safe Working Load (SWL) may also be known as Working Load Limits (WLL)
Working Loads Limits (WLL)	Working Load Limits (WLL) may also be known as Safe Working Load (SWL)

Unit 301 Engineering health and safety

Level: **3**
Credit value: **9**
UAN: **Y/503/0334**

Unit aim

This unit is concerned with the requirements that are essential to enable engineering activities to be carried out safely and effectively. It includes dealing with statutory and organisational requirements in accordance with approved regulations, codes of practice and procedures. It covers responsibilities relating to accident reporting and the identification of hazards and risks.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. understand compliance with statutory health and safety regulations and organisational requirements
2. understand compliance with statutory environmental regulations and organisational requirements
3. know how to implement accident and emergency procedures
4. understand safe working practices and procedures

Guided learning hours

It is recommended that **80** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the NVQ Level 3 Unit No 1: Complying with Statutory Regulations and Organisational Safety Requirements

Support of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Assessment

This unit will be assessed by an online multiple-choice assessment.

Unit 301 Engineering health and safety

Outcome 1 understand compliance with statutory regulations and organisational requirements

Assessment Criteria

The learner can:

1. describe the health and safety **regulations** applicable to engineering operations
2. explain **employers' responsibilities** to maintain health and safety
3. describe essential **operator and bystander** health and safety requirements
4. explain the Reportable Diseases and Dangerous Occurrences Regulations (**RIDDOR**) relevant to engineering
5. explain the procedures for **reporting accidents**
6. explain how the **management of health and safety** regulations are implemented
7. state the roles, responsibilities and powers of **health and safety personnel**
8. explain the sources of health and safety literature/advice and how to access it
9. describe how to carry out a **risk assessment** identifying potential health hazards
10. state the general rules for the observance of **safe practices**

Range

Regulations: Health and Safety at Work etc. Act, Control of Substances Hazardous to Health Regulations (COSHH), Provision and Use of Work Equipment Regulations (PUWER), Electricity at Work Regulations, Control of Major Accident Hazards Regulations (COMAH), Control of Noise at Work Regulations, Lifting Operations and Lifting Equipment Regulations (LOLER)

Employers' responsibilities: safe: place of work, plant and equipment, system of work, working environment, methods of handling, storing and transporting goods and materials

reporting of accidents (RIDDOR), information, instruction, training and supervision of employees, a health and safety policy

Operator and bystander: Personal Protective Equipment (PPE), Respiratory Protective Equipment (RPE)' secure areas

Reporting accidents: Summary of accident, name of victim(s), summary of events prior to accident, details of witnesses, information on injury or loss sustained, conclusions, recommendations, supporting material (photographs, video), diagrams, date, signature of person(s) responsible for report

Management of Health and Safety: Including the four C's of positive health and safety (Competence, Control, Co-operation, Communication)

Health and safety personnel: Health and Safety Advisors, Health and Safety Representatives, Health and Safety Executive Inspectors, Environmental Health Officers

Risk assessment: Potential hazards, slippery or uneven surfaces, spillages, scrap or waste material, inflammable materials, faulty or missing machine guards, faulty electrical connections or damaged cables, material ejection, pressure and stored energy, unshielded processes, volatile and toxic materials, dust and fumes, contaminants and irritants, materials handling and transportation, working at heights

Safe practices: Be alert, maintain personal hygiene, protect yourself and other people, know emergency procedures, report all hazards

Unit 301 Engineering health and safety

Outcome 2 understand compliance with statutory environmental regulations and organisational requirements

Assessment Criteria

The learner can:

1. describe the differences between the **human and environmental conditions** leading to accidents in the workplace and the means of **controlling** them
2. describe the Environmental Management Systems standard ISO 14001 in terms of the engineering industry
3. describe the implementation of **environmental legislation** as it applies to engineering industries
4. identify health and safety **signs** and explain their purpose

Range

Human and environmental conditions:

Causes of accidents

Human: Lack of management control, carelessness; improper behaviour and dress; lack of training, supervision and experience; fatigue; drug-taking and alcohol intake, **Environmental**: Unguarded or faulty machinery or tools; inadequate ventilation; untidy, dirty, overcrowded workplace; inadequate lighting

Controlling

Eliminate the hazard, replace the hazard with something less dangerous, guard the hazard, personal protection, health and safety education and publicity

Environmental legislation: Environmental Protection Act, Pollution Prevention and Control Act, Clean Air Act, Radioactive Substances Act, Controlled Waste Regulations, Dangerous Substances and Preparations and Chemicals Regulations, Hazardous Waste Regulations

Signs: warning, prohibition, mandatory, information, fire

Unit 301 Engineering health and safety

Outcome 3 know how to implement accident and emergency procedures

Assessment Criteria

The learner can:

1. explain the need for the provision of **first aid** treatment
2. explain the **health and safety procedures** that prevent injury or discomfort to skin, eyes, hands and limbs
3. explain the appropriate **emergency action** to be taken in cases of electric shock
4. explain precautions to be taken to avoid **electric shock**
5. explain the causes of **asphyxiation** and the appropriate emergency action to be taken
6. state what is meant by a dangerous occurrence and hazardous malfunction
7. describe the procedures to be followed in the event of the sounding of an **emergency alarm**
8. describe methods of **fire prevention**

Range

First aid: Location of facilities, location of qualified first aiders

Health and safety procedures: Personal hygiene, skin protection and care, care of eyes, use of eye and face protectors which are to current EN specifications, use of respirators, dangers of hair and loose clothing getting caught in machinery, means of avoiding such dangers, benefits and use of protective clothing, use of safety guards, screens and fences

Emergency action: Isolate electrical supply, removal from electricity supply, basic resuscitation procedures

Electric shock: Hazards arising from the use of electrical equipment, general health and safety rules: checking and inspection of cables, leads and plugs; earthing; problems associated with the use of portable equipment; use of reduced voltage equipment; Health and safety training; Warning signs and notices; isolation procedures

Asphyxiation: Confined working space, inadequate ventilation

Emergency alarm; Evacuation system, escape routes, assembly points (reporting to assembly points, not to return until authorised)

Fire prevention: Risk assessments; Methods of controlling fires, fire procedures, adhering to fire safety legislation

Additional Guidance

Fire prevention: Fire risk assessments, causes of fire, fire prevention, spread of fire, methods of controlling fires, conditions required for combustion and extinction, the fire triangle, fire procedures (fire drills, fire fighting equipment for different types of fires, extinguishers (types classification for types of fire), automatic equipment, adhering to fire safety legislation)

Unit 301 Engineering health and safety

Outcome 4 understand safe working practices and procedures

Assessment Criteria

The learner can:

1. describe the range of Personal Protective Equipment (PPE) available and relate its use to the operations that will be undertaken
2. explain use of Respiratory Protective Equipment (**RPE**) when undertaking tasks involving exposure to hazardous substances and the range available
3. describe how to carry out a risk assessment for using mechanical lifting equipment
4. state the requirements of the Lifting Operations and Lifting Equipment Regulations (LOLER)
5. explain the health and safety rules for the use of mechanical lifting equipment
6. explain the purpose and methods of use of **accessories** to lifting gear
7. describe the Manual Handling Operations Regulations as they apply to engineering industries
8. explain the necessity of a **permit to work** procedure
9. explain the necessity of 'lock-off' procedures
10. state the procedures used to notify/report hazards to **appropriate people**
11. state situations in which it is unadvisable or unsafe to **work in isolation**

Range

RPE: Chemicals and solvents, fumes, dust or harmful particulates, heat

Accessories: Hooks, slings, eyebolts, shackles, chains, rings, special-to-purpose equipment, rules for the use of slings

Appropriate people: Supervisors, health and safety advisors, health and safety representatives, fire marshals, works/site rescue team

Work in isolation: In confined spaces, above ground or in trenches, in close proximity to unguarded machinery, when a fire risk exists, with toxic or corrosive substances, on site

Additional Guidance

Permit to work: Purpose, description, content, types (including: 'hot working', electrical, maintenance operations, pressure testing, etc.), procedure for use

LOLER: As a general rule loads over 20kg need powered lifting gear, never exceed the maximum safe working load (SWL)/ working load limit (WLL) indicated on the equipment and the accessories, avoid shock loading the lifting equipment, swinging and twisting, estimate the centre of gravity, position the lifting hook above the centre of gravity of the load to maintain an even balance, avoid pushing or pulling the load to adjust the balance, do not transport loads over the heads of people or walk under a load, do not leave a load hanging unnecessarily and, in any event, have someone to watch over it, always lower the load gently into position; make sure it will not move once the lifting equipment is removed, check date of equipment tests

Accessories: Hooks (materials, design and certification) slings (materials, design and certification; The importance of the angle at the top, forces in the legs proportional to the angle at the top, design and construction of rope slings [natural and man-made fibres, steel wire slings]); Eyebolts (design and construction to published standards, use when lifting engines, gearboxes, the importance of ensuring that the eyebolt shoulder is screwed flush to face of component) shackles (design and construction to published standards, the importance of SWL/WLL for different sizes) chains (design and construction; the importance of regular checking and testing to avoid failure from damage and metal fatigue) rings (design and construction to published standards; importance of use with slings and chains), special-to-purpose equipment (use for lifting special equipment, regular lifting e.g. oil drums, production components) rules for the use of slings (never bend around sharp corners and edges and avoid overbending, use of protective covers on corners of loads,

never twist or kink the sling never use a worn or damaged sling; Always observe the safe working load (SWL)/working load limit (WLL))

Unit 302 Interpreting information and marking out fabrication materials for steel erecting

Level: 3
Credit value: 8
UAN: Y/503/3704

Unit aim
This unit is part of the occupational award for steel erecting. The unit is concerned with using drawings and specifications to identify materials and prepare for fabrication activities.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. understand how to interpret drawings, specifications, data and procedures
2. be able to interpret drawings, specifications, data and procedures
3. understand how to identify common engineering materials used in fabrication engineering
4. understand and identify the structure and basic working mechanical and thermal properties of the materials

Guided learning hours
It is recommended that **72** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS E1, E6, E7, E8, E11, E12 and E13

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 302 Interpreting information and marking out fabrication materials for steel erecting

Outcome 1 understand how to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. state the importance and **purpose of a drawing or specification**
2. describe how to obtain drawings, specifications and data
3. define the technical language and terminology which applies to engineering specifications and technical drawings
4. state the means of communicating **technical information**
5. state how to interpret **drawings** of plate and structural sections to **appropriate standards**
6. state how to identify components from **drawings, specifications and data**
7. describe the **importance of accurate measurement** and use of measuring equipment

Range

Purpose of a drawing or specification: To determine shape and characteristics of fabricated products; To determine material, tools, equipment and fabrication requirements

Technical information: Engineering drawings; method statements; Data sheets and wall charts; Standard/manufacturers' tables and servicing/repair manuals; ICT (hardware/software – e.g. CAD programmes), electronic storage devices

Drawings: Assembly detail and general arrangement drawings; Basic and additional information to be found on drawings – projection, unit of measurement, scale, material specification, protective treatment, general tolerance, drawing reference number, warning notes e.g. machining allowance; Orthographic: first and third angle projections, pictorial: isometric and oblique views, single plane sectioned and auxiliary views; Standard conventions – types of line, representation of common features

Appropriate standards: BSEN ISO 1660 (1996) and BS/EN22553 (1995)

Drawings, specifications and data: Technical drawings, sections and diagrams; Material or component list; Data sheets and wall charts

Importance of accurate measurement: The danger of accumulated errors in marking out components and the importance of working from centre lines and datum faces/edges; Accurate use of rules and tapes in metric and imperial systems

Unit 302 Interpreting information and marking out fabrication materials for steel erecting

Outcome 2 be able to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. interpret **working drawings**, specifications or procedures to extract necessary information to prepare the work piece and related processes for assembly and erection operations
2. apply safety requirements
3. use metric and imperial systems of measurement
4. select and use suitable measuring equipment for required work, having regard to accuracy requirements
5. measure and mark out components
6. undertake appropriate reporting procedures for non-compliance

Range

Working drawings: General arrangement drawings; component drawings; sub-assembly drawings; sketches; site drawings; CAD drawings

Unit 302 Interpreting information and marking out fabrication materials for steel erecting

Outcome 3 understand how to identify common engineering materials used in fabrication engineering

Assessment Criteria

The learner can:

1. identify and describe a range of commonly used engineering **materials**
2. describe the applications of common engineering **materials**
3. describe the basic **techniques for identifying** different types of material
4. describe the work shop techniques used to classify ferrous metals, non ferrous metals and non metals
5. identify common **forms of materials**

Range

Materials: (2 of the following 4 groups) Metals – ferrous, non ferrous; Polymers – thermoplastics, thermosetting; Ceramics – glass, porcelain, carbides; Composites - fibre reinforced plastics (FRP), reinforced concrete

Techniques for identifying: Visual; Tactile; Magnetic properties

Forms of materials: Pipe and tube; Plate; Sheet; Sections; Castings; Extrusions

Unit 302 Interpreting information and marking out fabrication materials for steel erecting

Outcome 4 understand and identify the structure and basic working mechanical and thermal properties of the materials

Assessment Criteria

The learner can:

1. state variations in **material structures**
2. identify the **procedures for determining the properties of materials**
3. describe the **properties influencing the selection of materials** for given applications
4. describe the influence of hot and cold working during fabrication on the properties of materials
5. explain why selected treatments may be required during fabrication operations
6. identify the **types of heat treatment** and their application
7. describe different **types of corrosion**
8. describe different **types of corrosion protections**
9. state the **types of surface treatment** and their applications
10. identify materials by colour coding and/or **supplied data**
11. report the significance of the properties on material behaviour in both a mechanical and thermal context

Range

Material structures: Crystal nature; Grain size and alignment

Procedures for determining the properties of materials: Specifications; Magnetic; Thermal; Mechanical tests; Micro/macro-examination

Properties influencing the selection of materials: Density; Strength – ductility, toughness, elasticity, hardness, malleability; Appearance; Cost; Conductivity; Resistance to - environmental degradation, corrosion, heat

Types of heat treatment: Annealing; Normalising; Stress relief; Pre/post heating

Types of corrosion: Atmospheric; Stress; Aquatic; Electrolysis

Types of corrosion protection: Cathodic; Sacrificial anode; Impressed current

Types of surface treatment: Galvanising; Surface plating; Anodising/sheradizing; Painting; Cladding/lining; Other coatings; Cleaning methods; Fire proofing

Supplied data: Hard stamp

Unit 303 Hand cutting and shaping processes

Level: **3**
Credit value: **16**
UAN: **Y/503/3718**

Unit aim

This unit is part of the occupational award for steel erecting. The aim of this unit is to provide the skills and knowledge required to produce components and assemblies by using hand cutting and shaping techniques.

Learning outcomes

There are **six** learning outcomes to this unit. The learner will:

1. understand how to apply safe working practices
2. be able to apply safe working practices
3. understand how to prepare equipment and carry out the cutting operation
4. be able to prepare equipment and carry out the cutting operation
5. understand how to specify cutting and shaping processes for given applications
6. be able to specify cutting and shaping processes for given applications

Guided learning hours

It is recommended that **144** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following ECITB NOS E6, E12, E13, FSS1

Support of the unit by a sector or other appropriate body

This unit is endorsed by ECITB.

Assessment

This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 303 Hand cutting and shaping processes

Outcome 1 understand how to apply safe working practices

Assessment Criteria

The learner can:

1. describe how to identify **defects/potential safety hazards** in the use and condition of hand tool
2. state the **portable shaping equipment safety requirements** applicable to work operations
3. describe the **safety precautions specific to cutting by shear**
4. explain the safety precautions to be observed when using angle grinders and cutting discs
5. describe the **measures to protect against safety hazards** associated with guillotines, sawing, nibbling, drilling, and routing operations
6. state the potential safety hazards associated with grinding and sanding

Range

Defects/potential safety hazards: Damaged equipment: repair or replace; Use of non-sparking tools when working in flammable and explosive environment; Ensuring shaping tools are handled carefully. All within the relevant working environment.

Portable shaping equipment safety requirements: Use of low voltage portable electrical equipment; Safety checks on electrical equipment, good insulation, appropriate guarding, PAT testing; Working within the thickness range of the equipment

Safety precautions specific to cutting by shear: Handling of sheet and plate, use of gloves and protective footwear; Importance of following specific instructions and regulations related to cutting equipment, use of guards

Measures to protect against safety hazards: Correct use of work holding devices when shearing, sawing and drilling component parts; The need for personal protective clothing and eye protection required to protect against hot metals and air born particles

Unit 303 Hand cutting and shaping processes

Outcome 2 be able to apply safe working practices

Assessment Criteria

The learner can:

1. plan and undertake cutting and shaping operations safely
2. carry out a documented risk assessment for a fabrication cutting and shaping operation to include work area, tools, equipment and components being shaped

Unit 303 Hand cutting and shaping processes

Outcome 3 understand how to prepare equipment and carry out the cutting operation

Assessment Criteria

The learner can:

1. explain how to **prepare hand tools** for cutting and shaping operations
2. state the differences between the action of chip and non chip forming cutting processes
3. explain how to refer to manufacturers' tables and charts to select hand tools capable of making cuts which conform to **product specification criteria**
4. describe how to select hand and powered tools for **specific applications**
5. explain how to **prepare powered tools for cutting and shaping** operations
6. explain the **process of oxy-fuel gas cutting**
7. describe the **process for setting up of oxy-fuel gas cutting equipment**
8. describe the **factors** which can influence the quality of the thermal cut edge
9. describe the process for cutting materials via compressed air powered cutting devices
10. explain the operation of oxy-fuel gas and arc plasma **cutting techniques**
11. state the purpose of inspection and the **methods for checking accuracy** of dimensions, form and fitness of the shaped component

Range

Prepare hand tools: Tools selected to meet specification requirements and checked for freedom from defects, degree of sharpness, loose parts, chips and cracks; Trial tests on scrap materials to optimise cutting action and allow dimensional checks to confirm degree of accuracy

Product specification criteria: The shape and dimensions of tools to meet dimensional requirements of the specification; Design and dimensions of the tools cutting action e.g. point angle of chisel, scraper, teeth per centimetre (files and saw blades), helix angle of drills selected according to the material to be cut and the accuracy of cut required; Equipment for general and specialist applications e.g. twist drills in imperial and metric sizes for general purpose applications, reamers for accurately finishing holes to an exact size and circular shape

Specific applications: Notching; Straight cuts; External and internal circular shapes; Irregular shapes

Prepare powered tools for cutting and shaping: Power tools checked for correct operation of self centring chucks, position of holding handle and secure positioning of cutting tools; Correct setting of speeds and feeds for the type and thickness of material to be cut; The work piece is securely clamped to - work tables for fixed cutting operations, templates/guides for moveable work pieces

Process of oxy fuel gas cutting: Exothermic chemical action; The influence of oxide combustion temperature; The functions of the pre-heat flame; The action of the cutting flame

Process for setting up of oxy-fuel gas cutting equipment: Control of blowpipe, oxygen and fuel gas pressure and flow rate; Control of cutting oxygen flow rate; Arrangements for mixing of oxygen and fuel gas for pre-heating; The construction and application of typical cutting nozzles; Procedures for lighting, adjusting and extinguishing the cutting flame

Factors: Relationship between cutter nozzle size and thickness of material being cut; Material to be cut and materials susceptible to edge hardening and cracking; Cutting torch oxygen pressure; Material condition: surface scale, internal defects; Speed of cutting torch travel; Distance of nozzle from the surface to be cut; Consistency of angle of nozzle to surface during cutting; Cutting path control for straight line and circles; Methods of distortion control

Cutting techniques: Free hand cutting procedures for starting cut from edge of plate and away from edge, procedures for cutting round bar and typical sections; Guided hand cutting use of: single

and double cutting supports, circle attachments; Cutting equipment used for bevelling pipe and plate; Safety precautions to protect eyes and prevent inhalation of fumes

Methods for checking accuracy: The function of a datum surface and datum line; The function of standard measuring equipment; The methods of checking the accuracy of shaped components in terms of - linear dimensions, alignment, squareness and freedom from twist, circularity

Unit 303 Hand cutting and shaping processes

Outcome 4 be able to prepare equipment and carry out the cutting operation

Assessment Criteria

The learner can:

1. carry out a documented risk assessment for workshop/site based hand cutting operations to include work area, tools, equipment and components being shaped
2. select and set up suitable shaping equipment to meet component specification
3. set up non chip forming and chip forming cutting processes
4. produce components using standard cutting tools
5. use thermal cutting processes to cut material to size and shape

Unit 303 Hand cutting and shaping processes

Outcome 5 Understand how to specify cutting and shaping processes for given applications

Assessment Criteria

The learner can:

1. describe **how to select** hand and powered cutting tools for specific shaping applications
2. describe how to refer to manufacturers' tables and charts to select hand tools capable of making cuts which conform to **product specification criteria**
3. state how to select mechanical and powered tools for **specific shaping applications**
4. explain the benefits, applications and limitations influencing selection of cropping machines and machine saws used for cutting straight edges or curves in sheet/plate and sectional materials
5. describe how to refer to manufacturers' tables and charts to **select drills and drilling equipment** for general and specialist applications
6. state **factors influencing the selection of thermal cutting processing (oxy-gas/arc plasma)**
7. compare the **advantages and limitations** of oxy-gas and arc plasma cutting
8. compare different **types of shaping operations**

Range

How to select: Low cost high portability of hand tools; Potential for higher production efficiency, greater accuracy and ability to cut thicker sections with power tools

Product specification criteria: The shape and dimensions of tools to meet dimensional requirements of the specification; Design and dimensions of the tools cutting action - point angle of chisel, teeth per centimetre (files and saw blades), helix angle of drills, clearance angle/rake angle and face clearance of shear blades selected according to the material to be cut and the accuracy of cut required

Specific shaping operations: Notching straight cuts; External and internal circular shapes; Irregular shapes

Select drills and drilling equipment: Twist drills in imperial and metric size for general purpose applications; Reamers for accurately finishing holes to an exact size and circular shape

Factors influencing the selection of thermal cutting processing (oxy-gas/arc plasma): Material to be cut – low-carbon steel, low-alloy steel, stainless steels, non ferrous metals and alloys; Properties - oxide melting point, thermal conductivity, electrical conductivity; The limit on material thickness and/or size of product which can be cut; Oxy-gas cutting high portability and relatively low cost for workshop/site operations

Advantages and limitations: Equipment requirements; Speed of cutting and ability to cut a range of materials; Quality of the cut edge; Noise and fumes produced

Types of shaping operations: Cropping and shearing; Drilling and punching; Sawing and oxy-fuel cutting; Plasma arc; Grinding

Unit 303 Hand cutting and shaping processes

Outcome 6 be able to specify cutting and shaping processes for given applications

Assessment Criteria

The learner can:

1. select and set up suitable shaping equipment to meet component specification
2. select methods of hand and machine cutting for a range of products to ensure efficient production according to specifications
3. inspect shaped product for freedom from defects

Unit 304 Assembly and erection of structural steelwork

Level: **3**
Credit value: **24**
UAN: **D/503/3719**

Unit aim
This unit is part of the occupational award for steel erecting. It is concerned with the assembly and erection of structural steelwork and includes preparation, assembly and fabrication.

Learning outcomes
There are **six** learning outcomes to this unit. The learner will:
1. understand how to prepare work areas for structural steelwork
2. be able to prepare work areas for structural steelwork
3. understand how to assemble and join fabricated assemblies
4. be able to assemble and join fabricated assemblies
5. understand how to move engineering structures
6. be able to move engineering structures

Guided learning hours
It is recommended that **219** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS E1, E2, E3, E4, E5, E8, E9, E10, E11, E12, E13
ML1, ML2, ML3, ML4, ML6, ML7, ML8, ML9, ML11
CO1, CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 304 Assembly and erection of structural steelwork

Outcome 1 understand how to prepare work areas for structural steelwork

Assessment Criteria

The learner can:

1. explain the **basic technical terminology** used in erecting
2. state **principal duties** of a rigger/erector
3. describe the purpose of **general erecting equipment** and techniques for their use
4. state the techniques for erection and dismantling of **ladders**
5. describe **preparatory requirements** for site assembly
6. describe the different work stages and techniques for erecting **steelwork structures**
7. describe **factors involved in planning** the handling and erection of heavy steel work plate girders, pre-assembled structures and vessels.

Range

Basic technical terminology: Lifting equipment; Lifting appliance; Temporary working platform

Principle duties: Applying safe working practices, recognised hand signals, for self and others and as a member of a team in the erection of major equipment and components; Working as a member of a team during the assembly, erection and alignment of structural steel sections, temporary working platforms, rigging of lifting gear/lifting appliances

General erecting equipment: Tensioning screws; Beam clamps; Chain blocks; Pull lift; Sheave blocks; Hand/power operated winches; Tirfors; Spanners, including podger; Drift and wedges; Lifting accessories; Forklift trucks, Telehandlers, Sideloaders, gantry cranes

Ladders: Single, double and triple extensions; Aluminium and wood

Preparatory requirements: Refer to site assembly drawings to identify suitable areas for positioning steelwork and the areas which need to be cleared of structural materials, obstacles and debris

Steelwork structures: Vertical columns, including adjustment of alignment; Beam braces and intermediate members; Roof trusses (lattice and portal)

Factors involved in planning: Planning operations - use of models when moving structures around obstacles, briefing individuals and teams, preparation prior to erection including, stiffening unstable components prior to lifting, use of corseting and internal bracings, use of crane mats to improve stability by spreading load bearing and pressure; estimation of centre of gravity for components/assemblies

Unit 304 Assembly and erection of structural steelwork

Outcome 2 be able to prepare work areas for structural steelwork

Assessment Criteria

The learner can:

1. prepare work areas for fabricating and assembling structural steelwork
2. use sketches or models to demonstrate procedures for completing **common erecting activities**

Range

Common erecting activities: Alignment of columns; Erecting roof trusses; Erecting Floor plates, mezzanine flooring and splices; Assembling, positioning and securing ladders for specific applications

Unit 304 Assembly and erection of structural steelwork

Outcome 3 understand how to assemble and join fabricated assemblies

Assessment Criteria

The learner can:

1. state how to identify , with the aid of manufacturers' tables, the general characteristics and applications of mechanical fastening devices
2. describe the types of **nuts, bolts and washers** used in structural steelwork, plate and pipe work fabrications
3. describe a range of **assembly aids and hand tools**
4. state the **methods of bolt tensioning and tightening sequences**
5. state the importance completing **preparatory checks**
6. explain why it is important to ensure that the assembly area is clean and free from obstructions
7. explain why component parts that are to be assembled are located in a safe accessible position and are checked for compliance with specification
8. explain the importance of recording component shortages and notifying the appropriate authority
9. state the importance of following the correct sequence of assembly in accordance with the specification
10. explain the reasons for utilising sub-assemblies, trial assemblies and aids to support dimensional accuracy
11. describe the **methods for setting up frames and structures**
12. describe procedures used for the operational shut down of live plant prior to assembly operations
13. state the purpose of, and techniques for completing **in-process and final inspections**
14. state the particular **health and safety hazards** associated with fabrication assembly
15. state the **component parts** of frames and structures
16. explain the reasons for machining **critical components** prior to assembly
17. state the **common thermal joining processes** used in fabrication
18. state the types of **basic welded joints and positions**
19. state the importance of removing protective coatings prior to thermal jointing
20. state the appropriate process technology used to carry out tack welding
21. describe the **common causes of distortion** in steelwork structures
22. describe methods of controlling and acceptable methods of rectifying distortion of welded structures

Range

Nuts, bolts and washers: black; turned barrel; high strength friction grip; TCB bolts; common forms of locking devices

Assembly aids and hand tools: Wedges; Drifts; Podgers; Dogs; Bridges; Tirfors; Spanners; Torque wrenches; Sockets; Key plates; Feeler Gauges

Methods of bolt tensioning and tightening sequences: Tensioning method - torque and impact wrenches, load indicating bolts and washers, part turn methods; tightening sequences for - back to back angle bracing, column splicing, pipe flanges, Read and use information on site bolts lists

Preparatory checks: Cleanliness of surfaces which are in contact; Correct tensioning; Sequence of tightening; Hole diameters to specific tolerances and need for correct alignment of holes

Methods for setting up frames and structures: Logical sequence of assembly to avoid twist and distortion; Use of tack bolts and tack welds; Use of stays to maintain shape; Use of spirit levels, piano wire and bubble level, water level and tilting level, laser level, Total Station software

In-process and final inspections: The function of datum surface or datum line; The function of standard measuring equipment; the tolerance to accuracy and relation to specific tolerance and function; Methods of checking correct sequence of assembly, the accuracy of dimensions, alignment, squareness, and freedom from twist or distortion

Health and Safety hazards: Safe lifting methods and use of lifting aids as relevant to specific working environments e.g. reasons for having a maximum included angle for a two leg sling; Dangers when working at heights - use of staging and roping off to prevent personal falls, use of warning signs and hard hats and other personal protective equipment to reduce risk of injury, securing of ladders and ancillary equipment, recognised hand signals

Component parts: Columns and stanchions; Beams and girders; Portal frames; structural frames, bracing and purlins; Cladding; Staircases, landings and handrails; Hoppers, bunkers and vessels; Pipe work and ducting

Critical components: Stanchions; Columns; Pipe flanges; Joint edge preparation

Common thermal joining processes: Manual metal-arc welding; metal-arc gas-shielded welding - gases, electrodes and filler wires, set up and use; The action of the flux constituents in terms of - protective gaseous shield, stabilise the arc, provide deoxidisers, provide alloying elements

Basic welded joints and positions: Butt, fillet; Flat, vertical, horizontal, vertical, overhead

Common causes of distortion: Weld metal cooling from liquid to solid at room temperature; Expansion of restrained metal when heated above plastic yield and subsequent contraction

Unit 304 Assembly and erection of structural steelwork

Outcome 4 be able to assemble and join fabricated assemblies

Assessment Criteria

The learner can:

1. evaluate and select the most suitable method of assembly and joining for the selected application
2. interpret assembly drawings and record the sequence of operations and processing requirements
3. use assembly procedures, tools and processes for assembling and joining products
4. use appropriate process to make fabricated joints

Unit 304 Assembly and erection of structural steelwork

Outcome 5 understand how to move engineering structures

Assessment Criteria

The learner can:

1. identify and describe the types, applications, and advantages of specific lifting equipment
2. describe the knots, hitches and bends used in ropes and slings and their applications for slinging and lifting
3. describe splices used in wire ropes and their applications for slinging and lifting
4. state how to determine **loadings and forces on lifting equipment**
5. state the techniques required for using **common items of lifting equipment**
6. state the techniques for loading crane hooks with slings
7. describe procedures for lifting unbalanced loads in relation to the positioning of crane hooks with equal slings, positioning of crane with unequal length slings and the use of stretching screw/turn buckles
8. state how to determine by estimating and calculating the centre of gravity of simple and built up complex shapes in order to locate best possible lifting positions
9. state the main uses of a range of **lifting appliances** in common use on engineering construction sites
10. state the **rules for power lifting of loads**
11. state the potential **health and safety hazards and appropriate preventative actions** in respect of construction lifting equipment regulations 1998 (LOLER)

Range

Types, applications, and advantages of specific lifting equipment: Wire rope slings and attachments including thimble, reeving thimble, soft eye, endless and brother types; Flat belt slings including woven nylon/terylene wire mesh plastics covered, plaited, nylon wound; the main types of lifting equipment - chain slings, rope slings, handlines/guidelines/taglines; shackle, swivel hook, plate clamp, ring link/eye bolt; sling attachments including bow and dee shackles lugs, plain and collar eye bolts, pipe and plate clamps, dynamometer; The advantages of belt slings as providing breadth of bearing to a load, reducing risk of load damage; Main types of fibre ropes as manilla, sisal, nylon, terylene, polypropylene

Loadings and forces on lifting equipment: Use of manufacturers' tables to determine diameter of chain links, Safe Working Load (SWL)/Working Load Limit (WLL) and angle of slings for single and double chain slings; estimate and calculate mass of simple plate shapes and section material; calculate mass of more complex plate shapes and built up components; Identify alternative methods of estimating loads - advice/delivery notes, markings on load to be lifted, crane weight load devices, crane attached weighing machines; How to determine weights of plate, pipe, and sections from manufacturers' tables

Common items of lifting equipment: Plate clamps; Choke and basket hitches/slings including soft eye types, with single and double thimbles, endless types, brother wire rope and chain type slings

Lifting appliances: Winches; Mobile derrick; Tower crane; Truck mounted mobile crane; Crawler mounted mobile crane; Skyhorse; Fly jib; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes; The main component parts of each lifting appliance;

Rules for power lifting of loads: Minimum and maximum safe working loads; Stability of lifted loads during and immediately after lifting; Avoidance of pushing/pulling loads; Transporting loads over the heads of workers and others

Health and safety hazards and appropriate preventative actions: The condition, suitability, inspection and identification of lifting chains, rope or lifting equipment; Conditions relating to SWL/WLL of rope slings; Type of faults in wire ropes which render them unserviceable in relation to worn, broken, fraying, kinked, or corroded strands; Edge protectors; Identify chain sling defects by

visual examination - stretched links, wear, distortion; Identify belt sling defects by visual examination – cuts, fraying, blistering; safety precautions to be taken when using flat belts, slings, in relation to - desired curvature, care of hooks and eye bolts, avoiding rough/sharp edges when using ropes and slings, need to avoid contact with heat or chemicals, storage in dry well ventilated areas, observing maximum bite and slinging angles

Additional Guidance

Lifting appliances: The terminology applicable to lifting appliances – hoisting and lowering, slewing, derricking, luffing

Unit 304 Assembly and erection of structural steelwork

Outcome 6 be able to move engineering structures

Assessment Criteria

The learner can:

1. prepare **knots, hitches, and bends** used in ropes and slings for practical applications
2. identify an irregular shaped load and estimate the:
   - mass of the component and the forces in the slings
   - centre of gravity and required positions to attach lifting equipment
3. select lifting appliances, lifting techniques and equipment for a range of site applications, for confirmation with supervisor
4. use sketches or models to identify potential hazards on site prior to erection operations
5. survey a working site to identify actual safety hazards and make recommendations for improvement
6. identify site safety requirements and equipment by reference to legislative documents and brochures provided by suppliers of safety equipment

Range:

Knots, hitches and bends: Reef knot, bowline, running bowline, clove hitch, rolling hitch, round turn and two half hitches

Unit 305 Interpreting information and marking out fabrication materials

Level: 3
Credit value: 21
UAN: R/503/3720

Unit aim
This unit is part of the occupational award for plating. It is concerned with the interpretation of specifications, and measurement and marking out of sheet metal.

Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand how to interpret drawings, specifications, data and procedures
2. be able to interpret drawings, specifications, data and procedures
3. understand how to measure and mark out components, templates and patterns
4. be able to measure and mark out components, templates and patterns
5. understand how to identify common engineering materials used in fabrication
6. be able to identify common engineering materials used in fabrication
7. understand how to identify the structure and basic mechanical and thermal working properties of the materials
8. be able to identify the basic mechanical and thermal working properties of the materials

Guided learning hours
It is recommended that **179** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS FSS1, FSS3, FSS4, FSS6, FSS8

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 305 Interpreting information and marking out fabrication materials

Outcome 1 understand how to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. state the importance and purpose of a drawing or specification
2. describe how to obtain drawings, specifications and data
3. define the technical language and terminology which applies to engineering specifications and technical drawings
4. state the means of communicating **technical information**
5. state how to interpret **drawings** of plate and structural sections to **appropriate standards**
6. state how to identify components from **drawings, specifications and data**
7. describe the **importance of accurate measurement** and use of measuring equipment

Range

Purpose of a drawing or specification: To determine shape positioning and characteristics of fabricated products; To determine material, tools, equipment and fabrication requirements

Technical information: Engineering drawings; method statements; Data sheets and wall charts; Standard/manufacturers' tables and servicing/repair manuals; ICT (hardware/software – e.g. CAD programmes), electronic storage devices

Drawings: Assembly detail and general arrangement drawings; Basic and additional information to be found on drawings – projection, unit of measurement, scale, material specification, protective treatment, general tolerance, drawing reference number, warning notes e.g. machining allowance; Types of view orthographic: first and third angle projections, pictorial: isometric and oblique views, single plane sectioned and auxiliary views; standard conventions – types of line, representation of common features

Appropriate standards: BSEN ISO 1660 (1996) and BS/EN22553 (1995)

Drawings, specifications and data: Technical drawings, sections and diagrams; Material or component list; Data sheets and wall charts

Importance of accurate measurement: The danger of accumulated errors in marking out components and the importance of working from centre lines and datum faces/edges; Accurate use of rules and tapes in metric and imperial systems

Unit 305 Interpreting information and marking out fabrication materials

Outcome 2 be able to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. interpret working drawings, fabrication specifications and/or procedures to extract necessary information to prepare the work piece and related processes for fabrication operations
2. determine component and material requirements through the preparation of parts lists and sketches, taking into consideration working tolerances and material allowances for subsequent fabrication operations
3. prepare for **working constraints**
4. apply safety requirements
5. produce method statements, selecting the most effective and efficient method and sequence of manufacture
6. inspect finished product to assess compliance with specification requirements

Range

Working constraints: Set-out requirements; Nesting arrangements; Sub-assemblies; Mirror images; Quantities required; Type of equipment to be used

Unit 305 Interpreting information and marking out fabrication materials

Outcome 3 understand how to measure and mark out components, templates and patterns

Assessment Criteria

The learner can:

1. state the **importance of accurate measurement** and use of measuring equipment
2. describe the reasons for using templates to avoid repetitive measuring and marking out of similar parts, material optimisation, guiding equipment
3. state the materials used for template making and the factors influencing selection and processing allowances
4. identify methods used to determine the circumferences of pipes
5. explain how to calculate and check blank sizes to ensure compliance with forming allowances and specification requirements
6. describe the **methods of constructing lines and curves of intersection**
7. state how to **determine the lines of intersection**
8. describe how to develop templates and patterns by the parallel line method of pattern development for cylindrical, square, and rectangular sections
9. explain how to develop templates and patterns by the radial line method of pattern development for right and oblique cones and pyramids
10. explain how to develop templates and patterns by the triangulation method of pattern development for common **work pieces**
11. state the **methods of marking out material** for cutting, forming and joining operations

Range

Importance of accurate measurement: The danger of accumulated errors in marking out components, templates, and patterns, and the importance of working from centre lines and datum faces/edges; How to select appropriate measuring equipment for given applications including the use of rules, callipers, dividers, beam trammels, micrometer and vernier callipers, surface plate, vernier height gauges and protractors and standard sheet gauges, in metric and imperial systems

Methods of constructing lines and curves of intersection: Construction of regular geometrical shapes such as ellipse, oval, and polygon; Construction of sectional views through cylinders pyramids and cones; Projection of auxiliary sections and views to clarify drawings and simplify surface developments

Determine the lines of intersection: The use of projection; Common central spheres; Cutting planes

Work pieces: Hoods; Hopper; Kinked plates; Transforming pieces between parallel and non parallel planes and long tapers

Methods of marking out material: function of a template loft and/or similar area; concept of neutral surface to determine cutting dimensions for rolling and forming operations; methods of locating welded, bolted and riveted fitments; methods of marking out plate/chequer plate and the danger of wrong hand image error which may result from this operation; the methods of marking off material with reference to - allowances for thickness of plate and variations of size and shape of sections, dimensional accuracy, quantity required; how to derive connection plate shape for components using standard pitch and edge distances; how to locate hole centres from standard back marks and cross-centres; the function of setting points (S.O.P) for full size layouts; methods applied to batch or one off production; methods of setting out cambers, including calculation method; methods of setting out rectangles - using trammels, 3:4:5 method, checking diagonals, use of chalk line

Unit 305 Interpreting information and marking out fabrication materials

Outcome 4 be able to measure and mark out components, templates and patterns

Assessment Criteria

The learner can:

1. apply metric and imperial systems of measurement
2. select and use suitable measuring equipment for required work, having regard to accuracy requirements
3. measure and mark out components, templates and patterns
4. develop templates and patterns
5. make card or metal models from templates and patterns

Unit 305 Interpreting information and marking out fabrication materials

Outcome 5 understand how to identify common engineering materials used in fabrication

Assessment Criteria

The learner can:

1. state the basic techniques for identifying types of material
2. describe the use of workshop techniques to **classify materials**
3. identify **common forms of supply** for materials

Range

Techniques for identifying types of material: Visual; Assessment of relative weight; Magnetic properties

Classify materials: Metals – ferrous, non ferrous; non metals

Common forms of supply: Pipe and tube; Plate; Sheet; Sections; Castings; Extrusions

Unit 305 Interpreting information and marking out fabrication materials

Outcome 6 be able to identify common engineering materials used in fabrication

Assessment Criteria

The learner can:

1. carry out initial assessment of commonly used engineering **materials**
2. classify **materials** and identify appropriate grouping and category

Range

Materials: Metals – ferrous, non ferrous; Polymers – thermoplastics, thermosetting; Composites - fibre reinforced plastics (FRP)

Unit 305 Interpreting information and marking out fabrication materials

Outcome 7 understand how to identify the structure and basic mechanical and thermal working properties of the materials

Assessment Criteria

The learner can:

1. describe the procedures for determining the properties of materials
2. state the **properties influencing the selection of materials** for given applications
3. state the influence of hot and cold working during fabrication on the mechanical properties of materials, requiring selected treatments during fabrication operations
4. state the different **types of heat treatment** and their applications
5. describe defects that are visible to the eye and those **defects that can be revealed by Non Destructive Testing (NDT) inspection**
6. identify different **types of corrosion**
7. identify different **types of corrosion protection**
8. state the **types of surface treatment** and their application
9. state the function of columns, beams, stanchions and bases as component parts of frames and structures
10. describe the function of tension and compression members

Range

Procedures for determining the properties of materials: Specifications; Magnetic; Thermal; Physical; Mechanical tests including tensile, impact, hardness; Micro/macro-examination

Properties influencing the selection of materials: Density; Strength – ductility, toughness, elasticity, hardness, malleability, appearance, cost; Conductivity; Resistance to - environmental degradation, corrosion, heat

Types of heat treatment: Annealing; Normalising; Stress relief; Pre/post heating

Defects that can be revealed by Non Destructive Testing (NDT) inspection: Radiographic; Ultra-sonic; Magnetic particle; Dye penetrant

Types of corrosion: Atmospheric; Stress; Aquatic

Types of corrosion protection: Cathodic; Sacrificial anode; Impressed current; Electrolysis

Types of surface treatment: Galvanising; Surface plating; Anodising/sheradizing; painting; Cladding/lining; Other coatings; Cleaning methods; Fire proofing

Unit 305 Interpreting information and marking out fabrication materials

Outcome 8 be able to identify the basic mechanical and thermal working properties of the materials

Assessment Criteria

The learner can:

1. identify material structure by applying tests, examining performance or supplied data
2. assess the properties of materials by conducting examinations or applying tests
3. report the specific changes to material behaviour in both a mechanical and thermal context
4. demonstrate how to identify defects found by visual and Non Destructive Testing (NDT) methods

Unit 306 Preparation, joining and assembly of fabrication materials

Level: **3**
Credit value: **15**
UAN: **J/503/3939**

Unit aim
This unit is part of the occupational award for platework. It covers the requirements for cutting, shaping, joining and fabrication of materials.

Learning outcomes
There are **six** learning outcomes to this unit. The learner will:
1. understand how to specify cutting and shaping processes for given applications
2. be able to specify cutting and shaping processes for given applications
3. understand how to prepare equipment and shape the product to the required specification
4. be able to prepare equipment and shape the product to the required specification
5. understand how to assemble and join fabricated assemblies
6. be able to assemble and join fabricated assemblies

Guided learning hours
It is recommended that **135** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS FSS2, FSS3, FSS4, FSS6
CO2, CO3
QSE9

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 306 Preparation, joining and assembly of fabrication materials

Outcome 1 understand how to specify cutting and shaping processes for given applications

Assessment Criteria

The learner can:

1. identify the factors which can influence the selection of cutting and shaping processes for different operations
2. identify the **equipment used in oxy-fuel gas cutting**
3. explain the **process of oxy-fuel gas cutting**
4. state the **factors influencing the quality of the thermal cut edge**
5. explain the plasma arc cutting process
6. state the **equipment for cutting by shear** and their different applications
7. describe the **methods for cutting by shear**
8. describe **special forms of shearing**
9. describe **how to select hand and powered cutting tools** for specific **shaping operations**
10. explain how to refer to manufacturers' tables and charts to **select hand tools capable of making cuts which conform to product specification** requirements
11. describe how to **select mechanical and powered tools for specific applications**
12. explain how guide templates can be used as a production aid when cutting irregular shapes using powered tools
13. explain why powered guillotines with guides, back stop and front stop production aids are suitable for batch production of uniform shaped components
14. describe the factors which influence the selection of cropping machines and machine saws used for cutting straight edges or angles in sheet/plate and sectional materials
15. explain how to refer to manufacturers' tables and charts to **select drills and drilling equipment for general and specialist applications**
16. state **factors influencing the selection of thermal cutting processing (oxy-gas/arc plasma)**
17. compare the **advantages and limitations** of oxy-gas and arc plasma cutting

Range

Equipment used in oxy-fuel gas cutting: Compressed gas cylinders, colour, transport, storage; Regulators; Hose; Blowpipes; Safety equipment - flash back arrestors, non-return valves

Process of oxy-fuel gas cutting: Exothermic chemical action; The influence of oxide combustion temperature; The functions of the pre-heat flame; The action of the cutting flame

Factors influencing the quality of the thermal cut edge: Relationship between cutter nozzle size and thickness of material being cut; Material to be cut and materials susceptible to hardening and cracking; Cutting torch gas pressure; Material condition: surface scale, internal defects; Speed of cutting torch travel; Distance of nozzle from the surface to be cut; Consistency of angle of nozzle to surface during cutting; Cutting path control for straight line and circles; Methods of distortion control

Equipment for cutting by shear: Guillotine; Nibbler; Rotary shears; Universal metal worker section cutting, punching, cropping, notching

Methods for cutting by shear: The compression and shear force exerted during cutting action; The cutting action; Clearance angle; Cutting (wedge) angle; Rake angle; Face clearance between the cutting edges as applied to the upper and lower edges when cutting different material/thickness; The relative movement between the cutting edges; The application of shear force by – lever, direct acting force, rotating bevelled cutting wheels; The effect of the material properties, thickness and

length of cut on, cutting by hand shears, machine capacity for manually and power operated machines;

Special forms of shearing: Section profiling machine; Machinery for profiling sheet and plate, punching, blanking; Combined cutting and forming press tools

How to select hand and powered cutting tools: Low cost high portability of hand tools; Potential for higher production efficiency, greater accuracy and ability to cut thicker sections with power tools

Shaping operations: Cropping and shearing; Drilling and punching; Sawing and oxy-fuel cutting; Planing and oxy-fuel cutting; Milling and ending

Select hand tools capable of making cuts which conform to product specification: The shape and dimensions of tools to meet dimensional requirements of the specification; design and dimensions of the tools cutting action - point angle of chisel, teeth per centimetre (files and saw blades), helix angle of drills, clearance angle/rake angle and face clearance of shear blades selected according to the material to be cut and the accuracy of cut required

Select mechanical and powered tools for specific applications: Notching; Straight cuts; External and internal circular shapes; Irregular shapes

Select drills and drilling equipment for general and specialist applications: Twist drills in imperial and metric size for general purpose applications; reamers for accurately finishing holes to an exact size and circular shape

Equipment used in oxy-fuel gas cutting: Compressed gas cylinders, colour, transport, storage; Regulators; hoses; cutting torches; Safety equipment - flash back arrestors, non-return valves

Factors influencing the selection of thermal cutting processing: Material to be cut – low-carbon steel, low-alloy steel, stainless steels, non ferrous metals and alloys; Properties - oxide melting point, thermal conductivity, electrical conductivity; The limit on material thickness and/or size of product which can be cut; Oxy-gas cutting high portability and relatively low cost for workshop/site operations

Advantages and limitations: Equipment requirements; Speed of cutting and ability to cut a range of materials; Quality of the cut edge; Noise and fumes produced

Unit 306 Preparation, joining and assembly of fabrication materials

Outcome 2 be able to specify cutting and shaping processes for given applications

Assessment Criteria

The learner can:

1. select and set up suitable shaping equipment to meet component specification
2. compare methods of hand and machine cutting used for a range of products, justifying selection on the basis of production efficiency and the ability to meet the product specification
3. inspect shaped product for freedom from defects

Unit 306 Preparation, joining and assembly of fabrication materials

Outcome 3 understand how to prepare equipment and shape the product to the required specification

Assessment Criteria

The learner can:

1. explain how to **identify defects/potential safety hazards** in the use and condition of hand tools
2. state the **safety requirements applicable to portable shaping equipment**
3. state the **safety precautions specific to cutting by shear**
4. describe the **types of tools** applicable to the cutting process
5. explain how the correct use of work holding devices can help to reduce safety hazards when shearing, sawing and drilling component parts
6. describe how to **interpret written and graphical instructions** and plan a logical sequence of operations to produce a finished shape by hand cutting
7. describe **the set up of oxy-fuel gas cutting equipment**
8. describe the operation of **oxy-fuel gas and plasma arc cutting techniques**
9. state how to **prepare hand tools** for cutting and shaping operations
10. state the difference between the actions of chip and non chip forming cutting processes
11. describe how to **prepare powered tools for cutting and shaping operations**
12. describe the **setting up of cutters** in shearing machines
13. describe the **setting up of punches and dies** in cropping and punching machines
14. state the purpose of inspection and the **methods for checking accuracy** of dimensions, form and fitness of the shaped component

Range

Identify defects/potential safety hazards: Carry out visual inspection of equipment prior to use; Use of non-sparking tools when working in flammable and explosive environments; Ensuring shaping tools are handled carefully during use

Safety requirements applicable to portable shaping equipment: Use of low voltage portable electrical equipment; Safety checks on electrical equipment - good insulation, appropriate guarding, PAT testing; working within the thickness range of the equipment

Safety precautions specific to cutting by shear: Handling of sheet and plate, use of correct Personal Protective Equipment (PPE); Importance of following specific instructions and regulations related to cutting equipment, use of guards

Types of tools: could include – grinder; chopsaw; bandsaw; reciprocating saw

Interpret written and graphical instructions: The sequence of operations required to manufacture a product - economic use of materials, simplicity of cutting and shaping (use of stops and guides), quantity required (batch or one of), the full use of production aids and equipment, preservation of coated or polished surfaces, accuracy of dimension and form, standard of finish required, opportunities for stack processing (drilling/sawing), setting of optimum process settings to maximise production efficiency control of torches, oxygen and fuel gas pressure and flow rates

The set up of oxy-fuel gas cutting equipment: Control of cutting oxygen flow rate; Arrangements for mixing of oxygen and fuel gas for pre-heating; The construction and application of typical cutting nozzles; Procedures for lighting, adjusting and extinguishing the cutting flame; Positioning screens to protect against - molten metal emitted from oxy-gas cutting, and arc flashes

Oxy-fuel gas and plasma arc cutting techniques: Free hand cutting procedures for starting cut from edge of plate and away from edge, procedures for cutting round bar and typical sections; Guided hand cutting use of: single and double cutting supports, circle attachments; Cutting equipment used for bevelling pipe and plate

Prepare hand tools: Tools selected to meet specification requirements and checked for freedom from defects, degree of sharpness, loose parts, chips and cracks; trial tests on scrap materials to optimise cutting action and allow dimensional checks to confirm degree of accuracy

Prepare powered tools for cutting and shaping operations: Powered tools checked for correct operation of self centring chucks, position of holding handles, and secure positioning of cutting tools/wheels; correct setting of speeds and feeds for the type and thickness of material to be cut; correct selection of appropriate consumables; the work piece is securely clamped to - work tables for fixed cutting operations, templates/guides for movable work pieces

Setting up of cutters: The correct face clearance between the cutters; No overlap between the cutter points; Correct distance between the cutters; Correct depth of travel of cutters

Setting up of punches and dies: Size punch and die to suit material thickness; length of stroke to suit material thickness; Alignment of punch when cutting edge facing the direction of feed and to give concentricity with the die; Depth of punch insertion into die

Methods for checking accuracy: The function of a datum surface and datum line; The function of standard measuring equipment; The methods of checking the accuracy of shaped components in terms of - linear dimensions, alignment, squareness and freedom from twist, circularity; batch to batch conformity, the condition for which - defects are critical and cannot be re-worked, components can be brought back within specification through re-working

Unit 306 Preparation, joining and assembly of fabrication materials

Outcome 4 be able to prepare equipment and shape the product to the required specification

Assessment Criteria

The learner can:

1. plan and undertake cutting and shaping operations safely
2. carry out a documented risk assessment for a fabrication cutting and shaping operations to include work area, tools, equipment and components being shaped
3. check the function and action of moving parts on equipment and relate to manufacturers' instruction manuals
4. produce components using standard cutting tools
5. show the effect of different equipment settings on the quality of cut edge
6. compare the products dimensional accuracy of different cutting methods, with and without the use of templates/guides/machine stops
7. use standard cutting tools to give special purpose results and compare for accuracy, finish, and freedom from distortion
8. set up non chip forming and chip forming cutting processes

Unit 306 Preparation, joining and assembly of fabrication materials

Outcome 5 understand how to assemble and join fabricated assemblies

Assessment Criteria

The learner can:

1. state how to identify with the aid of manufacturers' tables, the general characteristics and applications of mechanical fastening devices
2. describe the **types and categories of fastening devices** and fittings
3. identify essential tools that are required to secure mechanical fastening devices
4. state the importance of completing **preparatory checks** before assembling and joining fabricated assemblies
5. describe how to ensure that the assembly area is clean and free from obstructions
6. explain methods for ensuring that component parts to be assembled are located in a safe accessible position and are checked for compliance with specification
7. explain how and why component shortages should be recorded and reported to the appropriate authority
8. explain the reasons for and **methods of providing surface protection of materials** to be assembled, prior to, during and after assembly
9. state how to ensure correct sequence of assembly to specification, the need for component tolerance/allowances, reason from sub-assemblies, trial assemblies and aids to support dimensional accuracy
10. describe **methods used to obtain a level surface** for assembly and explain why this is so important
11. state the reasons for machining **critical components** prior to assembly
12. state **methods used to set up frames and structures**
13. explain when to use jigs and other assembly aids to improve standardisation and limit distortion and other assembly defects
14. describe assembly procedures related to **specific fabrication contexts**
15. state the **sequence of operation** to fabricate a steel work structure
16. state the **common thermal joining processes** used in fabrication
17. describe the **action of the flux constituents** in terms of welding processes
18. state the types of basic **welded joints and positions**
19. explain the importance of removing protective coatings prior to thermal joining and the relevant health and safety requirements, including Personal Protective Equipment (PPE) required for thermal joining methods
20. describe the appropriate process technology to carry out tack welding, and butt and fillet welds in a flat position
21. describe **causes of distortion** in fabricated assemblies
22. state the methods of controlling and acceptable methods of rectifying distortion of welded structures
23. explain how and where to obtain specification and/or quality control documentation
24. describe the methods and techniques used for checking fabricated components
25. state the typical fabrication defects and variations which may arise from **fabrication work operations**
26. state how to identify typical fabricated and checking defects
27. state the procedures for dealing with defects and variations
28. explain the factors to be taken into account when assessing the relative costs of re-working an item or deciding to scrap the defective item

29. identify who to approach for assistance in applying inspection methods and techniques

Range

Types and categories of fastening devices: solid rivets; black, fitted and high strength friction grip bolts; TCB bolts; lock, castellated and self locking nuts; flat, taper, spring, tab and load indicating washers; lindapters

Preparatory checks: Cleanliness of surfaces which are in contact; Correct tensioning; Sequence of tightening; Hole diameters to specific tolerances and need for correct alignment of holes

Methods of providing surface protection of materials: Painting; Use of heat resistant materials; Lagging

Methods used to obtain a level surface: Spirit level and straight edge; Water level; Piano wire and bubble level; Tilting level; Laser level; Total Station

Critical components: Stanchions; Columns; Pipe flanges; Joint edge preparation

Methods used to set up frames and structures: Logical sequence of assembly to avoid twist and distortion; Use of tack bolts and tack welds; Use of jigs and fixtures; Use of stays and spiders to maintain shape; Use of spirit levels, piano wire and bubble level, water level and tilting level

Specific fabrication contexts: Pipe fabrication - setting up equal and unequal diameter branch pipes on perpendicular and inclined planes, use of quarter lines; structural and steel plate fabricated assembly - portal leg, raker, valley, knee and apex joints, plate beams, castellated beams and machined bases, roof trusses and lattice girders, stairways and platforms

Sequence of operation: Economy in the use of material; Simplicity of construction; Quantity required; full use of production aids/equipment; Dimensional accuracy; Standard of finish

Common thermal joining processes: Manual metal-arc welding; Metal-arc gas-shielded welding in terms of - gases, electrodes and filler wires, set up and use

Action of the flux constituents: Protective gaseous state; Stabilise the arc; Provide deoxidisers; Provide alloying elements; Protection of weld metal; Slag formation; Addition of alloying elements to weld metal; Stabilising the arc

Welded joints and positions: Butt, fillet; flat, vertical, horizontal/vertical, overhead

Causes of distortion : Weld metal cooling from liquid to solid at room temperature; Expansion of restrained metal when heated above plastic yield and subsequent contraction

Fabrication work operations: Mechanical cutting; Thermal cutting; Forming; Joining

Unit 306 Preparation, joining and assembly of fabrication materials

Outcome 6 be able to assemble and join fabricated assemblies

Assessment Criteria

The learner can:

1. select assembly methods for specific applications
2. obtain specification
3. evaluate the suitability of assembly and joining methods for the selected application
4. use assembly procedures, tools and processes for assembling and joining products
5. interpret assembly drawings and follow the sequence of operations and processing requirements
6. use appropriate techniques to make fabricated joints
7. select method and equipment required to check conformance
8. ensure equipment and methods are approved for checking
9. ensure that all **aspects of the assembly are checked for compliance**
10. assess compliance, defects and variations identified and dealt with
11. record all checks made

Range

Aspects of the assembly are checked for compliance: Linear dimensions; Angles; profiles; Surface finish; Distortion

Unit 307 Forming of thick plate and sections

Level: 3
Credit value: 22
UAN: D/503/3722

Unit aim
This unit is part of the occupational award for platework. It covers the processes of forming using hand and mechanised equipment.

Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand how to specify forming processes for thick plate and sections
2. be able to specify forming processes for thick plate and sections
3. understand how to apply safe working practices
4. be able to apply safe working practices
5. understand how to produce components using a range of forming and shaping techniques
6. be able to produce components using a range of forming and shaping techniques
7. understand how to form the product to the required specification
8. be able to form the product to the required specification

Guided learning hours
It is recommended that **196** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS FSS3, FSS4, FSS8
CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 307 Forming of thick plate and sections

Outcome 1 understand how to specify forming processes for thick plate and sections

Assessment Criteria

The learner can:

1. identify the factors which can influence the selection of forming processes for different operations
2. state how to distinguish between hand forming and mechanised processes in terms of equipment and typical applications
3. describe **hand forming processes** used for hot and cold forming of **platework**
4. describe **hand forming processes** used for hot and cold forming of **structural steel** sections
5. explain the **factors** which can impact upon the selection of mechanised equipment for mechanised powered forming of platework and structural steel
6. state the **factors influencing the selection of rolling machines**

Range

Hand forming processes (platework): Use of hammers and flattening devices for levelling plate and stretch forming flat strip; spot heating to correct distortion using the principles of expansion/contraction; hot bending of flat bar (X and Y planes) using hand tools and selected radius formers

Hand forming processes (structural steel): Use of hammers to stretch form rolled steel angles, important applications include straightening or cambering; localised vee shaped heating of beams and columns to straighten or camber

Factors: Mechanical properties of material to be formed; Plate thickness and plate dimensions; Finished shape of product (single or double curvature); Design specification of forming equipment; Plate handling equipment

Factors influencing the selection of rolling machines: Thickness of material; Radius of formed product; Batch production requirements related to forming leading and trailing edges; Shape of form and type of product – cylindrical, conical, sectional components, work which requires straightening, pipe over 20 mm diameter; surface finish

Unit 307 Forming of thick plate and sections

Outcome 2 be able to specify forming processes for thick plate and sections

Assessment Criteria

The learner can:

1. show the effect of different equipment settings and formers on the form and accuracy of the product
2. compare different forming processes to form a given product
3. evaluate dimensional accuracy, freedom from surface defects and production efficiency of each method
4. use standard and non-standard forming tools to give special purpose results and compare the product form, strength and rigidity

Unit 307 Forming of thick plate and sections

Outcome 3 understand how to apply safe working practices

Assessment Criteria

The learner can:

1. explain how to refer to current regulations and codes of practice regarding the use and guarding of **forming equipment**
2. identify the required personal protective clothing and equipment (PPE) to guard against dangers to the body, hands and feet when handling hot and cold materials
3. explain the reasons for ensuring the electrical isolation of powered equipment during set-up and that emergency stops and guards are in place and working efficiently
4. describe how to check the condition of hand forming tools for safe and efficient operation
5. describe how to apply good housekeeping practices to ensure that the immediate work area is kept clean and tidy
6. state how to record work related accidents

Range

Forming equipment: Power bending rolls; Presses (Brake press, portal press, side press); Folding machines; Pipe bending equipment

Unit 307 Forming of thick plate and sections

Outcome 4 be able to apply safe working practices

Assessment Criteria

The learner can:

1. promote safe and efficient operation
2. follow safe working practices when using forming equipment
3. identify and apply work practices which will improve the immediate working environment of where forming operations are completed

Unit 307 Forming of thick plate and sections

Outcome 5 understand how to produce components using a range of forming and shaping techniques

Assessment Criteria

The learner can:

1. explain how to select machines and equipment to carry out **forming operations**
2. explain how to check blank sizes to ensure compliance with forming allowances and specification requirements
3. describe the importance of checking the linear dimensions and relevant plate surface of forming/bend lines to confirm **compliance**
4. state the work instructions which should be incorporated with forming operations, such as pre-forming leading and trailing edges of cylinder blanks prior to rolling
5. describe the **set up procedures for hand forming equipment**
6. describe the **set up procedures for folding and bending equipment**
7. describe the **set up procedures for bending rolls**
8. explain the factors affecting spring-back allowance and minimum bend radius
9. calculate the difference between mean and neutral surface
10. calculate the neutral surface and bending allowance for plate, pipe and sectional material
11. describe the location of bend lines for different metals and thickness

Range

Compliance: Meet specification requirements; Ensure correct numbered sequence of forming operations; Determine size and shape of any notching; Prevent the dangers of wrong hand or mirror image caused by the forming operation

Set up procedures for hand forming equipment: The required selection of hand tools free from defects, laid out in correct sequence for forming operations; Securing of formers in vices and locating holes; Prepared access to any ancillary facilities such as heating and quenching equipment; Access to forming templates to check each stage of forming

Set up procedures for folding and bending equipment: Top and bottom forming tools of the correct dimensions and forming radius; The correct position of top forming tool relative to the bottom tool; Correct positioning of material to be formed or stops and guides to improve production efficiency on batch production; machine adjustments to accommodate metal thickness and material spring back; access to appropriate lifting facilities

Set up procedures for bending rolls: Correct radius of form for successive operations; Addition of ancillary devices to assist rolling of special shapes such as cone guide roller; Access to forming templates to check radius of form; Clear access on either side of machine to allow for freedom of plate movement

Additional Guidance

Forming operations: This should include machine guarding

Unit 307 Forming of thick plate and sections

Outcome 6 be able to produce components using a range of forming and shaping techniques

Assessment Criteria

The learner can:

1. check the function and action of moving parts of equipment and relate to manufacturer's instruction manuals
2. promote safe and efficient operation of equipment
3. carry out trial forming tests on material to establish accuracy of blank sizes, correct position of bending line and correct bending sequence

Unit 307 Forming of thick plate and sections

Outcome 7 understand how to form the product to the required specification

Assessment Criteria

The learner can:

1. state how to interpret written and graphical instructions and plan a **logical sequence of operations** to form plate or structural products
2. explain how to **carry out forming operations**
3. state the purpose of inspections and the **methods for checking the accuracy of dimensions, form and finish** of the formed component

Range

Logical sequence of operations: Sequence of forming operations; quantity required (batch/one of); the full use of production aids and equipment; use of bracings; preservation of surface finish/coating; accuracy of form

Carry out forming operations: The sequence of forming operations required - centre outwards for stretch forming using hand tools - working away from one or more datum edges for bending/folding, turning the plate over for bends on opposite sides according to the numbered sequence - in progressive stages from one plate edge to the other when using rolling equipment - requirements increments of pressure for every pass through the rolls - edges of the plate or section require pre setting to the correct radius prior to rolling

Methods for checking the accuracy of dimensions, form and finish:

The function of datum surface, datum lines; The function of standard measuring equipment; Accuracy with regard to specified tolerance; Standard tolerance for specific purposes; Relate function to specific purposes; The method of checking the accuracy of - linear dimensions, alignment, squareness, freedom from twist, circularity, batch to batch conformity; The conditions for which - defects are critical and cannot be re-worked, components can be brought back within specification through re-working

Unit 307 Forming of thick plate and sections

Outcome 8 be able to form the product to the required specification

Assessment Criteria

The learner can:

1. demonstrate the effect of different equipment settings and formers on the shape and accuracy of the product
2. compare different forming processes to form a given product
3. evaluate dimensional accuracy, freedom from surface defects and production efficiency of each method
4. use standard and none standard forming tools
5. test sequence of forming activities on material
6. produce components using a range of forming and shaping techniques

Unit 308 Prepare loads for moving, lifting and positioning

Level: 3
Credit value: 15
UAN: H/503/3723

Unit aim
This unit is part of the occupational award for moving loads. The unit is concerned with using drawings and specifications to identify requirements for moving, lifting and positioning engineering construction loads.

Learning outcomes
There are **seven** learning outcomes to this unit. The learner will:
1. understand how to interpret drawings, specifications, data and procedures
2. be able to interpret drawings, specifications, data and procedures
3. understand how to identify common engineering materials used in fabrication engineering
4. understand how to identify the structure and basic mechanical and thermal working properties of the materials
5. be able to identify the structure and basic mechanical and thermal working properties of the materials
6. understand how to prepare loads for moving, lifting and positioning
7. be able to prepare loads for moving, lifting and positioning

Guided learning hours
It is recommended that **145** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS ML1, ML3, ML6, ML8

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 1 understand how to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. state the importance and purpose of a drawing or specification
2. describe how to obtain drawings, specifications and data
3. define the technical language and terminology which applies to engineering specifications and technical drawings
4. state the means of communicating **technical information**
5. state how to interpret **drawings** of plate and structural sections to **appropriate standards**
6. state how to identify components from **drawings, specifications and data**
7. describe the **importance of accurate measurement** and use of measuring equipment

Range

Purpose of a drawing or specification: To determine shape and characteristics of fabricated products; To determine material, tools, equipment and fabrication requirements

Technical information: Engineering drawings; method statements; Data sheets and wall charts; Standard/manufacturers' tables and servicing/repair manuals; ICT (hardware/software – e.g. CAD programmes), electronic storage devices

Drawings: Assembly detail and general arrangement drawings; Basic and additional information to be found on drawings – projection, unit of measurement, scale, material specification, protective treatment, general tolerance, drawing reference number, warning notes e.g. machining allowance; Orthographic: first and third angle projections, pictorial: isometric and oblique views, single plane sectioned and auxiliary views; Standard conventions – types of line, representation of common features

Appropriate standards: BSEN ISO 1660 (1996) and BS EN22553 (1995)

Drawings, specifications and data: Technical drawings, sections and diagrams; Material or component list; Data sheets and wall charts

Importance of accurate measurement: The danger of accumulated errors in marking out components and the importance of working from centre lines and datum faces/edges; Accurate use of rules and tapes in metric and imperial systems

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 2 be able to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. interpret **working drawings**, specifications or procedures to extract necessary information to prepare the work piece and related processes for assembly and erection operations
2. apply safety requirements
3. use metric and imperial systems of measurement
4. select and use suitable measuring equipment for required work, having regard to accuracy requirements
5. undertake appropriate reporting procedures for non-compliance

Range:

Working drawings: General arrangement drawings; component drawings; sub assembly drawings; sketches; site drawings; CAD drawings

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 3 understand how to identify common engineering materials used in fabrication engineering

Assessment Criteria

The learner can:

1. identify and describe a range of commonly used engineering **materials**
2. describe the applications of common engineering **materials**
3. identify common **forms of materials**

Range

Materials: Could include: Metals – ferrous, non ferrous; Polymers – thermoplastics, thermosetting; Ceramics – glass, porcelain, carbides; Composites - fibre reinforced plastics (FRP), reinforced concrete

Forms of materials: Pipe and tube; Plate; Sheet; Sections; Castings; Extrusions

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 4 understand how to identify the structure and basic mechanical and thermal working properties of the materials

Assessment Criteria

The learner can:

1. state variations in **material structures**
2. identify the **procedures for determining the properties of materials**
3. describe the **properties influencing the selection of materials** for given applications
4. describe the influence of hot and cold working during fabrication on the properties of material
5. explain why selected treatments may be required during fabrication operations
6. identify the **types of heat treatment** and their application
7. describe different **types of corrosion**
8. describe different **types of corrosion protection**s
9. state the **types of surface treatment** and their applications

Range

Material structures: Crystal nature; Grain size and alignment

Procedures for determining the properties of materials: Specifications; Magnetic; Thermal; Mechanical tests; Micro/macro-examination

Properties influencing the selection of materials: Density; Strength – ductility, toughness, elasticity, hardness, malleability; Appearance; Cost; Conductivity; Resistance to - environmental degradation, corrosion, heat

Types of heat treatment: Annealing; Normalising; Stress relief; Pre/post heating

Types of corrosion: Atmospheric; Stress; Aquatic; Electrolysis

Types of corrosion protection: Cathodic; Sacrificial anode; Impressed current

Types of surface treatment: Galvanising; Surface plating; Anodising/sheradizing; Painting; Cladding/lining; Other coatings; Cleaning methods; Fire proofing

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 5 be able to identify the structure and basic mechanical and thermal working properties of the materials

Assessment Criteria

The learner can:

1. identify materials by colour coding and/or hard stamp
2. report the significance of the properties on material behaviour in both a mechanical and thermal context

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 6 understand how to prepare loads for moving, lifting and positioning

Assessment Criteria

The learner can:

1. describe the work area and equipment preparation requirements for load moving, lifting and positioning
2. describe how to **establish the weight** of loads
3. describe **the factors which must be considered** when planning load moving routes
4. describe the different types of lifting, moving and handling **equipment**
5. identify procedures for the ensuring the **care and security of lifting equipment**, accessories and tools
6. describe **slinging and lifting methods and techniques**
7. explain lifting, moving and handling **methods and techniques**
8. explain reporting documentation and control procedures

Range

Establish the weight: could include: Load cells – use and calculation; Calculation; Data Sheets; Weighbridge

The factors which must be considered: Method statements; Client requirements; Task analysis

Equipment: Could include: Trolleys; Rollers; Slings; Winches and hoists; Skids/skates; Ropes; Jacks; Cranes; Wire ropes; Mobile access for de-rigging; Mobile elevating platforms; Tirfors; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes

Care and security of lifting equipment: Colour codes, visual inspection, test certification

Slinging and lifting methods and techniques: How to determine sling angles; How to apply slings and chains

Methods and techniques: Manually controlled equipment; Automatically controlled equipment; With vertical lifts; Without vertical lifts; Using mobile elevating platforms; forklift trucks ; cranes; cherry pickers.

Unit 308 Prepare loads for moving, lifting and positioning

Outcome 7 be able to prepare loads for moving, lifting and positioning

Assessment Criteria

The learner can:

1. carry out a risk assessment
2. **prepare the work area** for load moving, lifting and positioning
3. interpret appropriate documentation to identify the **method** to move the load and select the appropriate **equipment**
4. establish the weight of the load to be moved
5. check that the **equipment** to be used is capable of moving the load safely
6. identify and select appropriate lifting points taking into account the centre of gravity
7. confirm the route for moving the load minimising risk to people and property
8. secure and protect loads and equipment before moving operation start

Range

Prepare the work area: Obtain lifting plan and appropriate associated documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, safety equipment (e.g. lighting, barriers, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Method: Manually controlled equipment; Automatically controlled equipment; With vertical lifts; Without vertical lifts

Equipment: Trolleys; Rollers; Slings; Winches and hoists; Skids/skates; Ropes; Jacks; Cranes; Wire ropes; Mobile access for de-rigging; Tirfors; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes

Unit 309 Move loads in engineering construction

Level: 3
Credit value: 14
UAN: K/503/3724

Unit aim
This unit is part of the occupational award for moving loads. The unit is concerned with the methods and techniques for safely lifting and moving engineering construction loads.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. understand how to move engineering construction loads
2. be able to move loads in engineering construction
3. understand the techniques and practices for moving and positioning loads
4. be able to move and position loads in engineering construction

Guided learning hours
It is recommended that **125** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS ML1, ML2, ML3, ML4, ML6, ML8, ML9

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 309 Move loads in engineering construction

Outcome 1 understand how to move engineering construction loads

Assessment Criteria

The learner can:

1. identify and describe the types, applications, and advantages of specific lifting equipment
2. describe the knots, hitches and bends used in ropes and slings and their applications for slinging and lifting
3. describe splices used in wire ropes and their applications for slinging and lifting
4. state how to determine **loadings and forces on lifting equipment**
5. state the techniques required for using **common items of lifting equipment**
6. state the techniques for loading crane hooks with slings
7. describe procedures for lifting unbalanced loads in relation to the positioning of crane hooks with equal slings, positioning of crane with unequal length slings and the use of stretching screw/turn buckles
8. state how to determine by estimating and calculating the centre of gravity of simple and built up complex shapes in order to locate best possible lifting positions
9. state the main uses of a range of **lifting appliances** in common use on engineering construction sites
10. state the **rules for power lifting of loads**
11. state the potential **health and safety hazards and appropriate preventative actions** in respect of construction lifting equipment regulations 1998 (LOLER)

Range

Types, applications, and advantages of specific lifting equipment: Wire rope slings and attachments including thimble, reeving thimble, soft eye, endless and brother types; Flat belt slings including woven nylon/terylene wire mesh plastics covered, plaited, nylon wound; the main types of lifting equipment - chain slings, rope slings, shackle, swivel hook, plate clamp, ring link/eye bolt; sling attachments including bow and dee shackles lugs, plain and collar eye bolts, pipe and plate clamps, dynamometer; The advantages of belt slings as providing breadth of bearing to a load, reducing risk of load damage; Main types of fibre ropes as manilla, sisal, nylon, terylene, polypropylene

Loadings and forces on lifting equipment: Use of manufacturers' tables to determine diameter of chain links, Safe Working Load (SWL)/Working Load Limit (WLL) and angle of slings for single and double chain slings; estimate and calculate mass of simple plate shapes and section material; calculate mass of more complex plate shapes and built up components; Identify alternative methods of estimating loads - advice/delivery notes, markings on load to be lifted, crane weight load devices, crane attached weighing machines; How to determine weights of plate, pipe, and sections from manufacturers' tables

Common items of lifting equipment: Plate clamps; Choke and basket hitches/slings including soft eye types, with single and double thimbles, endless types, brother wire rope and chain type slings

Lifting appliances: Winches; Mobile derrick; Tower crane; Truck mounted light duty mobile crane; Crawler mounted heavy duty mobile crane; Skyhorse; Fly jib; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes; The main component parts of each lifting appliance

Rules for power lifting of loads: Minimum and maximum safe working loads; Stability of lifted loads during and immediately after lifting; Avoidance of pushing/pulling loads; Transporting loads over the heads of workers and others

Health and safety hazards and appropriate preventative actions: The condition, suitability, inspection and identification of lifting chains, rope or lifting equipment; Conditions relating to SWL/WLL of rope slings; Type of faults in wire ropes which render them unserviceable in relation to

worn, broken, fraying, kinked, or corroded strands; Edge protectors - when using belt slings to prevent sharp edges cutting into the slings; Identify chain sling defects by visual examination - stretched links, wear, distortion; Identify belt sling defects by visual examination – cuts, fraying, blistering; safety precautions to be taken when using flat belts, slings, in relation to - desired curvature, care of hooks and eye bolts, avoiding rough/sharp edges when using ropes and slings, need to avoid contact with heat or chemicals, storage in dry well ventilated areas, observing maximum bite and slinging angles

Additional Guidance

Lifting appliances: The terminology applicable to lifting appliances – hoisting and lowering, slewing, derricking, luffing

Unit 309 Move loads in engineering construction

Outcome 2 be able to move loads in engineering construction

Assessment Criteria

The learner can:

1. prepare **knots, hitches, and bends** used in ropes and slings for practical applications
2. identify an irregular shaped load and estimate the:
    - mass of the component and the forces in the slings
    - centre of gravity and required positions to attach lifting equipment
3. select lifting appliances, lifting techniques and equipment for a range of site applications, for confirmation with supervisor
4. use sketches or models to identify potential hazards on site prior to load moving operations
5. survey a working site to identify actual safety hazards and make recommendations for improvement
6. identify site safety requirements and equipment by reference to legislative documents and brochures provided by suppliers of safety equipment

Range

Knots, hitches and bends: Reef knot, bowline, running bowline, clove hitch, rolling hitch, round turn and two half hitches

Unit 309 Move loads in engineering construction

Outcome 3 understand the techniques and practices for moving and positioning loads

Assessment Criteria

The learner can:

1. describe the **methods and techniques** used to move **loads**
2. explain load assessment methods and techniques
3. explain route planning methods and techniques
4. describe the different **communication methods** which may be used for load moving activity
5. describe load moving **equipment**, their uses and operating procedures
6. explain reporting documentation and control procedures

Range

Methods and techniques: Manually controlled equipment; Automatically controlled equipment; With vertical lifts; Without vertical lifts; Using mobile elevating platforms; forklift trucks ; cranes; cherry pickers.

Communication method: Radio; Written message; Telephone; Hand signals; Verbal

Equipment: Trolleys; Rollers; Slings; Winches and hoists; Skids/skates; Ropes; Jacks; Cranes; Wire ropes; Mobile access for de-rigging; Mobile elevating platforms; Tirfors; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes

Additional guidance

Loads: e.g. Pipe spools; steelwork; motors; pumps; turbines; boilers; bundles of tubing; irregular shaped loads

Unit 309 Move loads in engineering construction

Outcome 4 be able to move and position loads in engineering construction

Assessment Criteria

The learner can:

1. position the moving **equipment** so that the weight of the load is evenly distributed
2. attach the appropriate handling equipment securely to the load, using approved methods to eliminate slippage
3. confirm that the load is secure before moving
4. use the confirmed **communication method** during load moving activity
5. move the **load** over the selected approved route
6. position and release the load safely in its final destination
7. deal promptly and effectively with problems and report those that cannot be solved

Range

Equipment: Trolleys; Rollers; Slings; Winches and hoists; Skids/skates; Ropes; Jacks; Cranes; Wire ropes; Mobile access for de-rigging; Mobile elevating platforms; Tirfors; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes

Communication method: Radio; Written message; Telephone; Hand signals; Verbal

Additional guidance

Loads: e.g**.** Pipe spools; steelwork; motors; pumps; turbines; boilers; bundles of tubing; irregular shaped loads

Unit 310 Lift and position loads in engineering construction

Level: **3**
Credit value: **6**
UAN: **M/503/3725**

Unit aim
This unit is part of the occupational award for moving loads. The unit is concerned with the methods and techniques for safely lifting and positioning engineering construction loads.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. understand how to move and position fabricated assemblies
2. be able to move and position fabricated assemblies
3. understand the work area and equipment reinstatement requirements
4. be able to reinstate the work area upon completion of lifting and positioning activity

Guided learning hours
It is recommended that **53** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS ML1, ML2, ML4, ML5, ML6, ML8, ML10

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 310 Lift and position loads in engineering construction

Outcome 1 understand how to move and position fabricated assemblies

Assessment Criteria

The learner can:

1. state the potential **health and safety hazards and appropriate preventative actions** in respect of construction lifting equipment regulations 1998 (LOLER)
2. state the **rules for power lifting of loads**
3. identify and describe the **types, applications, and advantages of specific lifting equipment**
4. explain how to determine **loadings and forces on lifting equipment**
5. state the purpose of and techniques for using **general lifting equipment**
6. describe the **preparatory requirements for site assembly**
7. describe **techniques used for moving and positioning steelwork structures** in terms of the main stages in erecting
8. state procedures used for operational shut down of live plant prior to assembly operations
9. state the purpose of, and **techniques for in-process and final inspection**
10. identify particular **health and safety hazards associated with fabrication assembly**
11. state the techniques used for loading crane hooks with slings
12. explain the procedures used for lifting unbalanced loads in relation to positioning of crane hook with equal slings, positioning of crane with unequal length slings
13. state how to determine by estimating and calculating the centre of gravity of simple and built up complex shapes in order to locate best possible lifting positions
14. state the main uses of a range of **lifting appliances** in common use on engineering construction sites
15. explain reporting documentation and control procedures

Range

Health and safety hazards and appropriate preventative actions: The condition, suitability, inspection and identification of lifting chains, rope or lifting equipment; Load cell; Conditions relating to Safe Working Load (SWL)/Working Load Limit (WLL) of rope slings; Type of faults in wire ropes which render them unserviceable in relation to worn, broken, fraying, kinked, or corroded strands; Identify chain sling defects by visual examination - stretched links, wear, distortion; Identify belt sling defects by visual examination – cuts, fraying, blistering; safety precautions to be taken when using flat belts, slings, in relation to - desired curvature, care of hooks and eye bolts, avoiding rough/sharp edges when using ropes and slings, need to avoid contact with heat or chemicals, storage in dry well ventilated areas, observing maximum bite and slinging angles

Rules for power lifting of loads: Minimum and maximum safe working loads; Stability of lifted loads during and immediately after lifting; Avoidance of pushing/pulling loads; Transporting loads over the heads of workers and others

Types, applications, and advantages of specific lifting equipment: Wire rope slings and attachments including thimble, reeving thimble, soft eye, endless and brother types; Flat belt slings including woven nylon/terylene wire mesh plastics covered, plaited, nylon wound; the main types of lifting equipment - chain slings, rope slings, shackle, swivel hook, plate clamp, ring link/eye bolt; sling attachments including bow and dee shackles lugs, plain and collar eye bolts, pipe and plate clamps, dynamometer; The advantages of belt slings as providing breadth of bearing to a load, reducing risk of load damage; Main types of fibre ropes as manilla, sisal, nylon, terylene, polypropylene

Loadings and forces on lifting equipment: Use of manufacturers' tables to determine diameter of chain links, Safe Working Load (SWL)/Working Load Limit (WLL) and angle of slings for single and double chain slings; estimate and calculate mass of simple plate shapes and section material; calculate mass of more complex plate shapes and built up components; Identify alternative methods of estimating loads - advice/delivery notes, markings on load to be lifted, crane weight load devices, crane attached weighing machines; How to determine weights of plate, pipe, and sections from manufacturers' tables

General lifting equipment: Tensioning screws; Beam clamps; Chain blocks; Pull lift; Sheave blocks; Hand/power operated winches; Tirfors; jacks

Techniques used for moving and positioning steelwork structures: Vertical columns, including adjustment of alignment and levelling base; Ties and intermediate members; Roof trusses

Techniques for in-process and final inspection: The function of datum surface or datum line; The function of standard measuring equipment; The tolerance to accuracy and relation to specific tolerance and function; Methods of checking correct sequence of assembly, the accuracy of dimensions, alignment, squareness, and freedom from twist or distortion

Health and safety hazards associated with fabrication assembly: Safe lifting methods and use of lifting aids e.g. reasons for having a maximum included angle for a two leg sling; dangers when working at heights - use of staging and roping off to prevent personal falls, use of warning signs and hard hats and other personal protective equipment to reduce risk of injury, securing of ladders and ancillary equipment; Use of harnesses and lanyards to prevent falls

Lifting appliances: Winches; Mobile derrick; Tower crane; Truck mounted light duty mobile crane truck; Crawler mounted heavy duty mobile crane; Skyhorse; Fly jib; Mobile access for de-rigging; Mobile elevating platforms; Tirfors; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; side loaders; gantry cranes; The main component parts of each lifting appliance

Additional guidance

Preparatory requirements for site assembly: Reference to site assembly drawings to identify suitable site for positioning steelwork, area to be cleared of structural materials, obstacles and debris

Lifting appliances: The terminology applicable to lifting appliances – hoisting and lowering, slewing, derricking, luffing

Unit 310 Lift and position loads in engineering construction

Outcome 2 be able to move and position fabricated assemblies

Assessment Criteria

The learner can:

1. identify an irregular shaped load and estimate the
    - mass of the component and the force on the slings
    - centre of gravity and required positions for lifting lugs
2. select lifting appliances, lifting techniques and equipment for a range of site applications, for confirmation with supervisor
3. use sketches or models to identify potential hazards on site prior to load moving and positioning operations
4. survey a work site to identify actual safety hazards and make recommendations for improvement
5. apply site safety requirements and equipment by reference to legislative documents and brochures provided by suppliers of safety equipment

Unit 310 Lift and position loads in engineering construction

Outcome 3 understand the work area and equipment reinstatement requirements

Assessment Criteria

The learner can:

1. describe the methods and requirements for reinstating the work area, **manual equipment** and **powered equipment**
2. explain the consequences of incorrectly reinstating the work area, **manual equipment** and **powered equipment**

Range

Manual equipment: To include 2 of Trolleys; Rollers; Slings; Winches and hoists; Skids/skates; Ropes; Jacks; Wire ropes; Tirfors; Manually operating lifting aids, e.g. block and tackle

Powered equipment: To include 2 of: Mobile access for de-rigging; Mobile elevating platforms; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; Side loaders; Gantry cranes

Unit 310 Lift and position loads in engineering construction

Outcome 4 be able to reinstate the work area upon completion of lifting and positioning activity

Assessment Criteria

The learner can:

1. shut down the **powered equipment** to a safe condition on completion of moving load activities
2. reinstate the work area to a safe condition and correctly dispose of waste materials
3. store re-usable consumables and **equipment** in accordance with appropriate procedures
4. clearly identify the stored resources
5. complete all necessary documentation

Range

Powered equipment: To include 2 of Mobile access for de-rigging; Mobile elevating platforms; Manually operating lifting aids, e.g. block and tackle; Forklift trucks and Telehandlers; Trailers; Side loaders; Gantry cranes

Equipment: To include 2 of Trolleys; Rollers; Slings; Winches and hoists; Skids/skates; Ropes; Jacks; Wire ropes; Tirfors; Manually operating lifting aids, e.g. block and tackle

Unit 311 Interpret information and mark out pipework materials

Level: 3
Credit value: 16
UAN: T/503/3726

Unit aim
This unit is part of the occupational award for pipefitting. It is concerned with the use of drawings and specifications to identify and mark out materials and prepare for pipefitting operations.

Learning outcomes
There are **seven** learning outcomes to this unit. The learner will:
1. understand how to interpret drawings, specifications, data and procedures
2. be able to interpret drawings, specifications, data and procedures
3. understand how to measure and mark out components, templates and patterns
4. be able to measure and mark out components, templates and patterns
5. understand how to identify common engineering materials used in fabrication
6. be able to identify common engineering materials used in fabrication
7. understand how material properties, common protection and pipework treatment methods can affect marking out

Guided learning hours
It is recommended that **142** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS IPS Pipe 1, IPS Pipe 2, IPS Pipe 4, IPS Pipe 7, IPS Pipe 8

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 311 Interpret information and mark out pipework materials

Outcome 1 understand how to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. state the importance and purpose of a drawing or specification
2. state how to obtain drawings, specifications and data
3. define the technical language and terminology which applies to pipefitting specifications and technical drawings
4. state the means of communicating **technical information**
5. describe how to interpret **drawings** of pipe, plate and structural sections in accordance with **current relevant standards**
6. identify and interpret a range of basic and additional **information found on drawings**
7. explain the characteristics of different **types of technical drawing**
8. identify techniques for cutting, drilling and bending
9. describe how to identify components from **drawings, specifications and data**
10. describe how to interpret **technical drawings of pipe systems** in accordance with **current relevant standards**

Range

Technical information: Technical drawings; Operation sheets; Data sheets and wall charts; Standard/manufacturers' tables and servicing/repair manuals; ICT (hardware/software – e.g. CAD programmes), electronic storage devices

Drawings: Assembly, detail isometrics and general arrangement drawings

Current relevant standards: BSEN ISO 1660(1996), BS/EN22553 (1995) and BS 1553

Information found on drawings: Projection; Unit of measurement; Scale; Material and specification; Heat and protective treatment; General tolerance; Issue reference; Warning notes e.g. jointing tolerances; types of line; representation of common features

Types of technical drawing: Orthographic: first and third angle projections; Pictorial: isometric and oblique views; Single plane sectioned and auxiliary views; Isometric pipe work drawings

Drawings, specifications and data: Technical drawings, sections, exploded views and diagrams; Manufacturers' installation, maintenance, repair and parts data; Data sheets and wall charts

Technical drawings of pipe systems: Block plans/plant layout drawings to determine - the pipeline function; basic equipment; schematic detail; constraints/safety hazards arising from the site/location.

Pipe assembly drawings to - determine pipe system specifications; determine bend, joint and fitting requirements; orientate branches and turns; discriminate between assembly, sub-assembly and components; pipe support arrangements.

Fabrication component drawings to determine - welding requirements in accordance with current BS, EN, ISO standards; the development of pipe reinforcements; set on and set in branches in the perpendicular and inclined planes; pipe support details.

Additional Guidance

Purpose of a drawing or specification: Determine shape and characteristics of fabricated products; material, tools, equipment and fabrication requirements

Unit 311 Interpret information and mark out pipework materials

Outcome 2 be able to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. interpret working drawings, fabrication specifications and procedures to extract necessary information to prepare the work piece and related processes for fabrication operations
2. identify component and material requirements through the preparation of parts lists and sketches, taking into consideration working tolerances, and material allowances for subsequent fabrication operations
3. identify **working constraints**
4. identify safety requirements
5. interpret a method statement to select the most effective and efficient method and sequence of fabrication
6. inspect finished product to assess compliance with specification requirements

Range

Working constraints: Set-out requirements; Nesting arrangements; Sub-assemblies; Mirror images; Quantities required.

Unit 311 Interpret information and mark out pipework materials

Outcome 3 understand how to measure and mark out components, templates and patterns

Assessment Criteria

The learner can:

1. explain why accurate measurement and use of measuring equipment is so important
2. describe how accumulated errors can affect the marking out of components, templates and patterns
3. describe the principles and importance of working from centre lines and datum faces/edges
4. describe the different types of **measuring equipment** that is available
5. explain how to select equipment for given measuring and marking out applications
6. state the reasons for and advantages of using templates
7. describe the materials used for template making and the factors influencing selection and processing allowances
8. describe the methods used to determine the circumferences of pipes
9. explain how to calculate pipework centres taking into account forming allowances and specification requirements
10. describe the **methods of constructing lines and curves of intersection**
11. state how to determine the lines of intersection by means of projection using full layouts and projection using short cut methods
12. describe how to develop **standard templates and patterns** by parallel line methods of surface development
13. explain how to mark out pipe fabrications in terms of bend lines (centre and outside lines) and off sets (centre and outside lines)
14. explain why it may be beneficial to produce sketches of weld preparations and system components
15. explain the purpose of **piping arrangement drawings** and what they are designed to indicate
16. describe the methods for using drawings to produce material lists and cutting lists

Range

Measuring equipment: Callipers; Dividers; Beam; Trammels, Micrometer and Vernier callipers; Surface plate; Vernier height gauges and protractors; Standard sheet gauges, in metric and imperial systems; Theodolite; Laser; Rule; Square

Methods of constructing lines and curves of intersection: Construction of regular geometrical shapes such as circles, ellipses and ovals; Construction of sectional views through cylinders; Projection of auxiliary sections and views to clarify drawings and simplify surface developments

Standard templates and patterns: Mitred turns; Segmental bends; Set on branches (square, lateral (inclined), equal, unequal, off centre); Set in branches (square, lateral (inclined), equal, unequal, off centre)

Piping arrangement drawings: Pipe systems and their function; Basic equipment and collection of equipment for specific arrangements (valves, control, trapping, pumping); Schematic to arrangement drawings

Unit 311 Interpret information and mark out pipework materials

Outcome 4 be able to measure and mark out components, templates and patterns

Assessment Criteria

The learner can:

1. identify metric and imperial systems of measurement
2. select and use suitable measuring equipment for required work, having regard to accuracy requirements
3. measure and mark out **components**, templates and patterns
4. develop templates and patterns
5. mark pipework or components from templates and patterns.

Range

Components: Branches; Reducers; 'Y' pieces

Unit 311 Interpret information and mark out pipework materials

Outcome 5 understand how to identify common engineering materials used in fabrication

Assessment Criteria

The learner can:

1. state the basic techniques for identifying types of material
2. describe the workshop techniques used to classify **materials**
3. identify **reasons why different materials are selected** for given applications
4. identify common engineering materials
5. state the materials used for the external and internal protection of pipe systems and other methods used for conveying **matter**

Range

Techniques for identifying types of material: Visual; Tactile; Material data sheet; Magnetic properties

Materials: Metals (ferrous, non ferrous); Polymers (thermoplastics, thermosetting); Ceramics (glass, porcelain, carbides); Composites (fibre reinforced plastics (FRP), reinforced concrete)

Reasons why materials are selected: Strength; Ductility; Malleability; Density; Appearance; Resistant properties; Cost

Matter: Solids; Common liquids; Gases; Process liquids and vapours

Unit 311 Interpret information and mark out pipework materials

Outcome 6 be able to identify common engineering materials used in fabrication

Assessment Criteria

The learner can:

1. identify and carry out initial assessment of commonly used engineering **materials**
2. classify **materials** and identify appropriate grouping and category
3. explain the significance of the **properties** on material behaviour in both a mechanical and thermal context

Range

Materials: Metals (ferrous, non ferrous); Polymers (thermoplastics, thermosetting); Ceramics (glass, porcelain, carbides); Composites (fibre reinforced plastics (FRP), reinforced concrete)

Properties: Density; Strength – ductility, toughness, elasticity, hardness; Conductivity; Resistance to - environmental degradation, corrosion, heat/low temperature

Unit 311 Interpret information and mark out pipework materials

Outcome 7 understand how material properties, common protection and pipework treatment methods can affect marking out

Assessment Criteria

The learner can:

1. state the **procedures for determining the magnetic, thermal and physical properties of materials**
2. describe the influence of hot and cold working during fabrication on the mechanical properties of materials
3. explain why selected treatments may be required during fabrication operations
4. identify **types of heat treatment** and their applications
5. describe the characteristics of different **types of corrosion**
6. identify different types of **corrosion protection**
7. describe the **conditions in which pipe work requires protection**
8. describe the different **types of surface treatment** and their applications
9. state the purpose of insulation and the types of insulation material
10. state the forms of external covering used to protect insulation
11. describe the methods of applying insulation to equipment which may require frequent access

Range

Procedures for determining the magnetic, thermal and physical properties of materials: Specifications; Mechanical tests; Micro/macro-examination

Properties: Density; Strength – ductility, toughness, elasticity, hardness; Conductivity; Resistance to - environmental degradation, corrosion, heat/low temperature

Types of heat treatment: Annealing; Normalising; Stress relief; Pre/post heating

Types of corrosion: Atmospheric (oxidation, rust, acid erosion); Stress (bending, evaporating/contracting); Liquid (salt water and other fluid solutions, electrolytic action); Solid (potash, concretes); Contaminants (e.g. action of stainless steel on mild steel)

Corrosion protection: Coating; Cathodic; Sacrificial anode; Impressed current

Conditions in which pipe work requires protection: Corrosion inside of the pipe; Corrosion outside of the pipe; Erosion inside of the pipe; Erosion outside of the pipe; Prevention of contamination of the product

Types of surface protection: Galvanising; Surface plating; Anodising/sheradizing (zinc coatings); Painting; Cladding/lining; Other coatings; Cleaning methods

Unit 312 Preparation, fabrication and joining of pipework assemblies

Level: 3
Credit value: 21
UAN: J/503/3729

Unit aim
This unit is part of the occupational award for pipefitting. It is concerned with the skills and knowledge in respect of assembly methods, and joining of pipe work.

Learning outcomes
There are **nine** learning outcomes to this unit. The learner will:
1. understand how to prepare for the assembly of fabricated pipework sections
2. be able to identify assembly methods for fabricated pipework
3. understand how to fabricate components for pipework assemblies
4. be able to fabricate products to specification
5. understand how to fabricate products to a specification
6. understand how to assemble pipework components
7. understand how to prepare for the thermal joining of pipework
8. understand how to complete the thermal jointing of pipework sections
9. understand how to inspect pipework assemblies

Guided learning hours
It is recommended that **181** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS IPS Pipe 1, IPS Pipe 2, IPS Pipe 5, IPS Pipe 6, IPS Pipe 7, IPS Pipe 8
CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 1 understand how to prepare for the assembly of fabricated pipework sections

Assessment Criteria

The learner can:

1. describe how to ensure general assembly area is clean and free from obstructions
2. explain why component parts to be assembled must be located in a safe, accessible position and checked for compliance with specification
3. identify, with the aid of tables and data sheets; the types, general characteristics and applications of mechanical **jointing devices**
4. identify the **essential tools** required to secure mechanical jointing devices
5. describe the **variable factors** which apply to the assembly of pipework components
6. state the correct sequence for tightening flange bolts and methods of tensioning to the required tolerance/specification
7. state the reasons for and **methods of surface protection** of materials to be assembled, prior to, during and after assembly
8. explain the actions to take if any components shortages are identified

Range

Jointing devices: Nuts, bolts, washers, studs; Flanges; Mechanical fittings; Threaded fittings

Essential tools: Socket sets, torque wrenches, stilsons, spanners, chains

Variable factors: Cleanliness of surfaces in contact; correct tensioning; sequence of tightening; diameters to specific tolerances; need for correct alignment of holes; thread qualities; square ends; undamaged ends; fittings in tolerance; correct gaps; correct assembly sequences; parallel faces

Methods of surface protection: Painting; Lagging; Galvanising; Coating

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 2 be able to identify assembly methods for fabricated pipework

Assessment Criteria

The learner can:

1. select assembly methods for specific applications
2. evaluate the suitability of assembly and joining methods for the selected application
3. interpret assembly drawings, record and follow the sequence of operations and processing requirements
4. use assembly procedures, tools and processes for assembling and joining **products**
5. use appropriate processes to make fabricated joints.

Range

Products: Plastic, Copper, Carbon Steel, Stainless Steel, Composites

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 3 understand how to fabricate components for pipework assemblies

Assessment Criteria

The learner can:

1. state the method of producing a working sequence for the fabrication and installation of pipe work
2. state the reasons for **machining critical components** prior to assembly
3. identify when to use jigs and other assembly aids to improve standardisation and limit distortion and other assembly defects
4. describe assembly procedures related to the setting up of equal and unequal diameter branch pipes on perpendicular and inclined planes
5. state the importance of working to a method statement
6. describe how to fabricate jacketed pipe and pipe work reinforcements
7. state how to **calculate pipe lengths**
8. describe the methods for **cutting pipes** to length

Range

Machining critical components: Pipe flange faces; joint edge preparation

Calculate pipe lengths: End-to-end; End to centre; Centre to centre; Face to face; Face to centre

Cutting pipes: Wheel cutters; Saws; Cutting discs; Shears for plastic pipe

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 4 be able to fabricate products to specification

Assessment Criteria

The learner can:

1. produce a point of work risk assessment for hand cutting operations to include work area, tools, equipment and components being shaped
2. plan and undertake cutting operations safely
3. prepare tools for cutting and shaping operations
4. select and set up suitable shaping equipment to meet component specification
5. measure the **accuracy of different cutting methods**
6. use standard cutting tools and check for accuracy, finish and freedom from distortion
7. bend **pipe** using a range of techniques for a given task.

Range

Accuracy of different cutting methods: Differences between thermal and mechanical cutting methods.

Pipe: Plastic, Copper, Carbon Steel, Stainless Steel, Composites

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 5 understand how to fabricate products to a specification

Assessment Criteria

The learner can:

1. describe the **selection criteria** for choosing hand and powered cutting tools for specific shaping applications
2. explain how to use tables and charts to help select hand tools capable of making cuts which conform to product specification requirements
3. identify **factors** which will help decide which hand tools are used to meet product specification requirements
4. state **how to select mechanical and powered tools** for specific applications
5. explain why guide templates can be used as a production aid when cutting irregular shapes using powered tools
6. describe how to **prepare hand tools** for cutting threads and shaping operations
7. explain the **processes for hot and cold forming** of pipe work
8. state the **factors for selecting hot or cold pipe bending methods**
9. state how to **prepare powered tools** for thread cutting and shaping operations
10. state the purpose of inspection and **methods for checking accuracy** of dimensions, form and fitness of the shaped component

Range

Selection criteria: Low cost high portability of hand tools; Potential for higher production efficiency, greater accuracy and ability to cut thicker sections with power tools

Factors: The shape and dimensions of tools to meet dimensional requirements of the specification; Design and dimensions of the tools cutting action - point angle of chisel/scraper, teeth per centimetre (files and saw blades), clearance angle/rake angle; Equipment for general and specialist applications - twist drills in imperial and metric sizes for general purpose applications - reamers for de-burring, accurately finishing holes to an exact size and circular shape

How to select mechanical and powered tools: Angles; Straight cuts, external and internal circular shapes, irregular shapes

Prepare hand tools: Tools selected to meet specification requirements and checked for freedom from defects, degree of sharpness, loose parts; Trial tests on scrap materials to optimise cutting action and allow dimensional checks to confirm degree of accuracy

Processes for hot and cold forming: Use of springs for forming 90° bends in copper up to 22 mm bore; Cold bending steel pipe up to 2”NB; Hot bending steel pipe using suitable bending blocks

Factors for selecting hot or cold pipe bending methods: Pipe dimensions; Pipe material; Mode of pipe manufacture; Degree of accuracy required; Type of equipment available

Prepare powered tools: Powered tools checked for correct operation of self centring chucks, position of holding handle and secure positioning of cutting tools, presence of guard; Correct setting of speeds and feeds for the type and thickness of material to be cut; The work piece is securely clamped to - work tables for fixed cutting operations - templates/guides for movable work pieces

Methods for checking accuracy: The function of a datum surface and datum line; The function of standard measuring equipment; Tolerances with regard to accuracy; Standard tolerances for specific purposes; Relate function to specific tolerances the methods of checking the accuracy of shaped components in terms of - linear dimensions, alignment, squareness and freedom from twist, circularity.

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 6 understand how to assemble pipework components

Assessment Criteria

The learner can:

1. identify **factors** that can help to ensure the correct assembly of pipework configurations
2. state the reasons for and **methods used to obtain a level plane** for assembly
3. explain how to use plumb bobs, squares and levels to determine pipe levels and slope when installing pipe work
4. explain why pipework must be **correctly routed**
5. explain why joint access and the need to keep the number of positional welds to a minimum are important factors when considering the positioning of joints
6. describe the types of **metallic pipe joint** in terms of their nature as permanent /demountable joints
7. state the benefits and limitations of pipe bending over the use of pipe fittings
8. state the equipment, **materials**, procedures and their use for making **metallic pipe joints**
9. state the range of fittings used in joining non-metallic pipework
10. describe the types of **non-metallic pipe joints**
11. state the equipment, materials and procedures for making **non-metallic pipe joints**
12. describe the different types of **pipe support**
13. state how the size and type of pipe relates to the span between supports

Range

Factors: Correct sequence of assembly to specification; The need for component tolerance/allowances; Reason for using subassemblies, trial assemblies and aids to support dimensional accuracy

Methods used to obtain a level plane: Spirit level and straight edge; water level; tilting level; laser level; theodolite

Metallic pipe joint: Thread; flange; weld; mechanical; solder; braze

Materials: Gaskets; O-rings; Jointing compounds/sealants; tapes

Non-metallic pipe joints: Thread; flanged; weld, socket fusion, butt fusion; solvent weld; solvent cement; mechanical

Pipe support: Hangers; pipe bridges; pipe saddles; anchors; guides; variable and constant loading

Additional Guidance

Correctly routed: Fittings; insulation; access and routings of pipe work, which avoids walkways, other barriers and allows access to equipment

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 7 understand how to prepare for the thermal joining of pipework

Assessment Criteria

The learner can:

1. identify the equipment used in oxy-fuel cutting
2. state the **factors influencing the selection of thermal cutting processes (oxy-gas/arc plasma)**
3. describe the **characteristics of oxy-fuel cutting** in relation to the cutting and shaping of pipework sections
4. state **process for setting up and shutting down** oxy-fuel cutting equipment
5. describe the **arc plasma cutting process** in relation to the cutting and shaping of pipework sections
6. describe the effects of noise and fumes produced by plasma cutting
7. state the **factors which can influence the quality of the thermal cut edge**
8. state how to **prepare power tools** for cutting and shaping of edge preparations
9. state the safety precautions to be observed when using angle grinders and cutting discs

Range

Equipment used in oxy-fuel cutting: compressed gas cylinders colour, transport, storage; regulators; hose; blowpipes; safety equipment (flash back arrestors, non-return valves)

Characteristics of oxy-fuel cutting: The functions of the pre-heat flame; the action of the cutting flame

Process for setting up and shutting down: Leak detection; Gas pressures; Control of cutting process; typical cutting nozzles; Lighting and shut down procedures

Prepare power tools: Confirm current test (PAT tested and PUWER compliant); Check for defects; Correct speeds; the correct disc selection for materials

Additional Guidance:

Factors influencing the selection of thermal cutting processes (oxy-gas/arc plasma): material to be cut - process applications for low-carbon steel, high carbon steel, alloy steels, non ferrous metals and alloys (in terms of the material's: oxide melting point, thermal conductivity, electrical conductivity); limits on material thickness and/or size of product which can be cut; selection of cylinders for appropriate working conditions; impact of cost

Factors which can influence the quality of the thermal cut edge: relationship between cutter nozzle size and thickness of material being cut; material to be cut and materials susceptible to hardening and cracking; cutting torch oxygen pressure; material condition: surface scale, internal defects; speed of cutting torch travel; distance of nozzle from the surface to be cut; consistency of angle of nozzle to surface during cutting; cutting path control for straight line and circles; methods of distortion control

Arc plasma cutting process: make sure that all cables and hoses are - free from damage, leak free, correctly maintained; the use of pressurised high temperature plasma stream as the cutting medium - the generation of ionised plasma by an electric arc struck between a tungsten electrode and a copper torch nozzle/focusing plasma gas at the cutting zone by arc transfer: distinction between main and pilot arc: arc transfer technique, devices for/ avoiding double arcing, action to be taken in the event of double arcing; gases used for plasma cutting and outline reasons for their

selection - need for inert, non combustible gas, gases used: argon/hydrogen/ nitrogen combinations, reasons for selection in terms of materials to be cut, material thickness gas cost

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 8 understand how to complete the thermal jointing of pipework sections

Assessment Criteria

The learner can:

1. state the characteristics and applications of Manual metal –arc (MMA), Metal inert gas (MIG) and Tungsten inert gas (TIG) welding
2. describe the **welding processes**
3. describe the action and purpose of the **flux constituents**
4. state the types of **basic joints and positions**
5. state the **procedure for tack welding** pipe work
6. state the importance of identifying protective coatings prior to thermal jointing
7. state the potential hazards associated with the removal of protective coatings
8. state the relevant health and safety requirements and Personal Protective Equipment (PPE) required for different joining methods
9. state the **causes of distortion**
10. describe the methods of controlling and acceptable methods of rectifying distortion of welded structures
11. state the appropriate process technology to carry out tack welding and butt and fillet welds in a flat position

Range

Welding processes: Gases, electrodes and filler wires; Set up and use

Flux constituents: Protective gaseous shield; Stabilise the arc

Basic joints and positions: Butt, fillet; Flat, Vertical, Horizontal-vertical, Overhead

Procedure for tack welding: Number, size and position of tacks; methods and reasons for maintaining root gap; methods of setting up, squaring and orientation of bolted flanges; setting weld neck, slip on, socket and stub flanges

Causes of distortion: Unrestrained parent metals; Insufficient tacking; Incorrect set ups; Incorrect welding parameters

Unit 312 Preparation, fabrication and joining of pipework assemblies

Outcome 9 understand how to inspect pipework assemblies

Assessment Criteria

The learner can:

1. state the inspection process and the **items to be checked** for prefabricated pipework
2. state the purpose of inspection and **methods of checking the accuracy of dimensions, form and the fitness** of the shaped components
3. describe the **methods for checking the accuracy of the joint**
4. state the actions to take when defects are critical and cannot be re-worked and where components can be brought back within specification through re-working
5. describe the **methods of non-destructive testing** of joints and explain the suitability of such tests for particular purposes

Range

Items to be checked: Material and general condition of pipe/pipe work; NB alignment of pipe; position of fittings and equipment; orientation of branches, tees, elbows and flanges; dimensions; quality and accuracy of bends; quality of pipe joints

Methods of checking the accuracy of dimensions, form and the fitness: The function of a datum surface and datum line; The function of standard measuring equipment; Tolerances with regard to accuracy; Standard tolerances for specific purposes; Relate function to specific tolerances

Methods for checking the accuracy of shaped components: Linear dimensions; Alignment; Squareness and freedom from twist; Circularity

Methods of non-destructive testing: Visual; Dye penetrant; Magnetic particle; X-ray; Ultrasonic

Unit 313 Fabrication, installation and dismantling of pipework systems

Level: 3
Credit value: 22
UAN: F/503/3731

Unit aim
This unit is part of the occupational award for pipefitting. It is concerned with the skills and knowledge in respect of the methods for fabricating, installing and dismantling pipework systems.

Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand how to apply safe working practices
2. be able to apply safe working practices
3. understand how to install pipework systems
4. be able to install pipework systems
5. understand how to commission and test pipework systems
6. be able to commission and test pipework systems
7. understand how to prepare for the dismantling of pipework
8. be able to dismantle pipework

Guided learning hours
It is recommended that **186** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS IPS Pipe 1, IPS Pipe 2, IPS Pipe 3, IPS Pipe 4, IPS Pipe 9, IPS Pipe 11, IPS Pipe 12
CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 1 understand how to apply safe working practices

Assessment Criteria

The learner can:

1. state the regulations which apply to the hazards presented by piped services
2. state procedures for safely **shutting down an in-service pipeline**
3. state the safety precautions for **dismantling a pipeline** which has been isolated but is still under pressure
4. describe how to identify **defects/potential safety hazards** in the use and condition of hand tools
5. state the **safety requirements** applicable to portable shaping equipment
6. explain the **potential safety hazards associated with sawing, drilling**, and associated operations
7. state the dangers of fire and explosion and other potential safety hazards associated with the completion of grinding operations
8. state the importance of identifying any insulation materials before disturbing
9. explain the potential safety hazards associated with handling insulation in old and new situations

Range

Shutting down an in-service pipeline: Permit to work procedure; Certificate of clearance for work on hazardous chemical and flammable fluid and vapour pipelines; Arrangements for stand-by operation during maintenance

Dismantling a pipeline: Safe shut-off isolating valves; Controlled release of pressure; Cooling down allowance; Pressure checking before dismantling; Blanking off as appropriate

Defects/potential safety hazards: Damaged equipment, repair or replace; Use of non sparking tools when working in flammable and explosive environments; Ensuring shaping tools are handled carefully

Safety requirements: Use of low voltage portable electrical equipment; Safety checks on electrical equipment: good insulation, appropriate guarding; PAT testing; Working within the thickness range of the equipment

Potential safety hazards associated with sawing, drilling: Correct use of work holding devices when drilling component parts; setting correct drill speed

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 2 be able to apply safe working practices

Assessment Criteria

The learner can:

1. identify potential hazards on site prior to installation operations
2. survey a work site to identify actual safety hazards and make recommendations for improvement.
3. identify from site drawings and company documentation, **safe shut down procedures for pipe systems**

Range

Safe shut down procedures for pipe systems: Permit to work procedure; Certificate of clearance for work on hazardous chemical and flammable fluid and vapour pipelines; Arrangements for stand-by operation during maintenance

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 3 understand how to install pipework systems

Assessment Criteria

The learner can:

1. state the main **uses of piped fluid systems**
2. describe how to identify pipe contents from **technical data**
3. state that flow is proportional to the product of velocity and cross sectional area of the carrier system
4. state the application of, and pipe connections to, the **main components used in pipe systems**
5. describe the **factors that determine the rate of heat transfer** in heat exchangers
6. describe the applications and characteristics of **filtration and filter systems**
7. describe the types and applications of **pipeline protection systems**
8. state general **considerations when installing pipe supports** given in BS1552 (part 1)
9. identify different types of pipe supports in common use and their applications
10. state the factors to be considered when erecting and installing pipe work systems
11. describe benefits and limitations of different **methods of preparing pipework for fabrication**
12. state the **methods used for joint alignment**
13. describe the types of gaskets and sealing compounds in common use and their applications
14. state sequence of tightening bolts and **methods of tensioning** to the required specification

Range

Uses of piped fluid systems: National services: water, natural gas; factory services: steam, compressed air, vacuum; process installations: chemical, petrochemical, food; domestic: hot and cold water

Technical data: BS 1710 Colour coding, and the limit to basic colours for water, steam, oils and combustible liquids, gases, acids, alkalis, air; Other liquids and electrical services; Identifying other details such as temperature, direction of flow

Main components used in pipe systems: Pumps, compressors; Boilers; Isolating valves, control valves, safety valves, drain valves, exchangers, non-return/check valves, filters and strainers, steam traps, bleeding and vent valves

Factors that determine the rate of heat transfer: Surface area; Type of materials used; Temperature difference; Insulation; Method of construction

Filtration and filter systems: The purpose of filtration; Filtration requirements of gas and liquid pipe systems; Precautions necessary when assembling/dismantling filters

Pipeline protection systems: Prevention of internal overloading; Solidification, electrical/fire hazards and the main methods of achieving protection

Considerations when installing pipe supports: Methods of accommodating movement due to expansion/gross weight; Thermal/pressure cycling; Hydrostatic testing; Ability of building structure to withstand applied load; Position of supports relative to plant equipment; Vibration

Methods of preparing pipework for fabrication: Cutting pipes to length by - hand and mechanical saws, abrasive wheels, tube cutters, thermal cutters; Preparing pipe ends for welding by - hand grinding machines, tube cutters, thermal cutting, mechanical machining; Preparing pipes for branch attachment by - hand grinding machines, thermal cutting

Methods used for joint alignment: Types of faces for flanged joints; spigots and butt weld clamping systems

Methods of tensioning: Use of mechanical, hydraulic and pneumatic torquing devices to achieve specific tolerances

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 4 be able to install pipework systems

Assessment Criteria

The learner can:

1. p**repare the work area** for pipework installation operations
2. identify an operational pipe system conforming to BS1710 colour coding pipe contents/services including operating temperature, pressures and direction of flow
3. draw a system detailing operational features
4. identify from detail, general arrangement and site drawings, the main components used in a pipe installation, operating principles and constructional features
5. produce a pipe system using a variety of components to be joined using lengths of tube, fittings and pipe bracket supports
6. carry out suitable checks and commission the installation
7. **restore the work area** upon completion of installation activities

Additional Guidance:

Prepare the work area: Obtain fabrication instructions, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled; Reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 5 understand how to commission and test pipework systems

Assessment Criteria

The learner can:

1. identify different specified **methods of cleaning pipe systems**
2. describe the **pre-test inspection** and correction/final inspection procedures
3. describe **hydrostatic, pneumatic and vacuum testing methods**
4. explain the reasons for completing purge, slow warm-up and slow pressurisation procedures for bringing pipe systems back on line
5. state the **methods of decommissioning** pipe systems prior to maintenance/repair
6. identify the **checks required to bring piped systems on line** following installation/ maintenance work
7. describe how and where to obtain specification and/or quality control documentation
8. identify typical fabrication defects and variations which may arise
9. describe how to identify typical fabricated defects
10. describe how to check for typical defects
11. describe the procedures for dealing with defects and variations
12. state the **factors** taken into account to determine what action should be taken
13. identify who to approach for assistance in applying inspection methods and techniques

Range

Methods of cleaning pipe systems: Mechanical and chemical descaling; Detergents; Pickling; Specific site requirements (e.g. nuclear/medical)

Pre-test inspection: Compliance with drawings and specifications; Adequate venting and drainage points in pipe work; Piping component orientation; Missing components; Valves and other equipment which may be damaged as a result of test pressure conditions which may render the test invalid

Hydrostatic, pneumatic and vacuum testing methods: Equipment used; Procedure for applying the test and safety precautions to be observed; The limitations - upper pressure limit, problems identifying faults; Procedures for corrective action in the event of test failure

Methods of decommissioning: Safe shutdown; Safe isolation; Controlled pressure release; Safe cool down; Checks before dismantling; Isolation by freezing

Checks required to bring piped systems on line: Alignment and slope; Electrical power supplies/insulation; Safety switches/devices and interlocks; Testing of pipes and pipelines; Blowing through, purged warm up, avoidance of thermal and hydraulic shock loading; Operate the system and compare performance with production/ service requirements; Complete reports and job sheets of - work carried out to restore system to operational condition, complete maintenance schedule as appropriate, report and recommendations on systems condition; Report to appropriate authority

Factors: Relative costs of re-working; Scrapping the defective item

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 6 be able to commission and test pipework systems

Assessment Criteria

The learner can:

1. obtain method statements and specifications
2. select method and equipment required to check conformance
3. ensure equipment and methods are approved for checking
4. ensure **checks for compliance** are completed on fabricated components
5. Assess compliance, ensuring that defects and variations are identified and dealt with
6. complete a record of all checks made
7. observe appropriate safety precautions and carry out a pressure test at the recommended pressure and inspect for leaks
8. produce a check list of the tasks and tests to be undertaken to bring a pipe system on line following installation
9. commission a pipe system

Range

Checks for compliance: Linear dimensions; angles; profiles; Surface finish; Flow direction; Missing components.

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 7 understand how to prepare for the dismantling of pipework

Assessment Criteria

The learner can:

1. describe the **procedures for the operational shut down** of live plant including use of risk assessment, method statements and permits to work
2. describe the safe **method** of dismantling pipework systems
3. explain the procedures for marking pipework materials to ensure that correct re- assembly can be achieved
4. explain how to use temporary supports
5. explain how to safely move pipe from installed position
6. state the procedures to be adopted when working in confined spaces and the requirements for safe exit routes

Range

Procedures for the operational shut down: purging; cleaning; draining; de-pressurising

Method: Use of flammable equipment/work methods; potential vacuums; stored energy; methods of removing hangers, supports; methods for safely splitting flanges and joints; methods for controlling static electricity; non spark tools; Need for cool down or heating periods

Unit 313 Fabrication, installation and dismantling of pipework systems

Outcome 8 be able to dismantle pipework

Assessment Criteria

The learner can:

1. **prepare the work area** for pipework dismantling operations
2. produce a point of work risk assessment for pipework dismantling operations
3. obtain a permit to work if required
4. comply with all appropriate safety and procedural documentation
5. confirm that stored energy (or vacuum) is released
6. select and use suitable tools for dismantling joints
7. confirm tools for cutting are suitable for work operation
8. apply appropriate methods to temporarily support, lift and position pipework after dismantling
9. **restore the work area** upon completion of pipework dismantling operations

Additional Guidance:

Prepare the work area: Obtain dismantling instructions, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 314 Preparing for and inspecting fitting operations

Level: **3**
Credit value: **16**
UAN: **L/503/3733**

Unit aim

This unit is part of the occupational award for mechanical fitting. It covers the skills and knowledge associated with interpreting specifications and selecting materials prior to undertaking fitting operations.

Learning outcomes

There are **six** learning outcomes to this unit. The learner will:

1. understand how to interpret drawings, specifications, data and procedures
2. be able to interpret drawings, specifications, data and procedures
3. understand how to prepare materials for fitting operations
4. be able to prepare materials for fitting operations
5. understand how to carry out measurement, marking out and inspection operations
6. be able to carry out measurement, marking out and inspection operations

Guided learning hours

It is recommended that **138** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following ECITB NOS IPS Mech 1, IPS Mech 6, IPS Mech 9, IPS Mech 10, IPS Mech 11

Support of the unit by a sector or other appropriate body

This unit is endorsed by ECITB.

Assessment

This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 314 Preparing for and inspecting fitting operations

Outcome 1 understand how to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. state the means for communicating technical information
2. state **who can provide assistance** in interpreting specifications
3. describe how to interpret **drawings** to **current standards**
4. describe how to interpret standard/manufacturer's tables or graphs to select materials for a particular application and obtain specific information from graphs
5. state the reasons for using colour coding to ensure safety in an engineering workshop
6. interpret **current standards** relating to limits and fits

Range

Communicating technical information: Engineering drawings; Datasheets and wall charts; Manufacturers tables and servicing manuals; Technical drawings, diagrams and exploded views; Setting out plans and site layouts

Who can provide assistance: Supervisor; Team leader; Site manager; Mentor; Foreman

Drawings: Imperial and metric; Assembly, detail, general assembly; Features of drawings - projection, units of measurement and size, scale, material and specification, heat and protective treatment, general tolerance, tool references, warning notes; Distinguish between, orthographic: first and third angle projections, pictorial: isometric and oblique views, single plane sectioned views; Standard conventions - types of line, representation of common features; Dimensioning techniques

Current standards: BS EN ISO 1660 (drawings); BS EN ISO 286-2:2010 (limits and fits)

Unit 314 Preparing for and inspecting fitting operations

Outcome 2 be able to interpret drawings, specifications, data and procedures

Assessment Criteria

The learner can:

1. identify **current standards** for fitting activities
2. identify limits, tolerances and finishes
3. interpret information from engineering **drawings**
4. select the most effective method of carrying out fitting operations
5. sketch isometric and oblique views from orthographic drawings of components

Range

Current standards: BS EN ISO 1660 (drawings); BS EN ISO 286-2:2010 (limits and fits)

Drawings: Imperial and metric; Assembly, detail, general assembly; Features of drawings - projection, units of measurement and size, scale, material and specification, heat and protective treatment, general tolerance, tool references, warning notes; Orthographic: first and third angle projections, pictorial: isometric and oblique views, single plane sectioned views; Standard conventions - types of line, representation of common features

Unit 314 Preparing for and inspecting fitting operations

Outcome 3 understand how to prepare materials for fitting operations

Assessment Criteria

The learner can:

1. state **materials** used in fitting operations
2. state the types of **materials** used in fitting operations
3. state material **specifications, codes and conventions**
4. state workshop **tests** to identify engineering materials
5. describe the **characteristics of engineering materials**
6. state how to handle material and equipment during completion of a fitting activity
7. describe the range of **heat treatment processes**
8. state the reasons for applying **heat treatment processes**
9. state which procedures exist for the pre-treatment of materials
10. identify **forms of supply** for engineering construction materials

Range

Materials: Ferrous metals; Non-ferrous metals; Non metallic e.g. plastics, carbon

Specifications, codes and conventions: Company; Manufacturer**;** National/international standards

Characteristics of engineering materials: Temperature stability; Heat resistance; Corrosion and wear resistance; Acoustic and shock absorption

Tests: Visual; Surface hardness**;** Reaction to a magnet**;** By spark test

Properties: Ductility**;** Hardness**;** Strength (compressive, shear, tensile, torsional; Elasticity**;** Toughness**;** Brittleness**;** Malleability**;** Plasticity**;** Thermal conductivity**;** Electrical conductivity

Heat treatment processes: Annealing**;** Normalising**;** Pre and post heat treatments**;** Surface heat treatment including case hardening

Forms of supply: Pipe and tube; Plate; Sheet; Sections; Castings; Extrusions; Types of bar

Unit 314 Preparing for and inspecting fitting operations

Outcome 4 be able to prepare materials for fitting operations

Assessment Criteria

The learner can:

1. identify the uses and characteristics of **materials** typically used in fitting operations
2. select material of the required type, quality and quantity to meet the requirements
3. make **materials** ready for use
4. carry out pre-treatment
5. set out **materials** in required locations

Range

Materials: Ferrous metals; Non-ferrous metals; Non metallic e.g. plastics

Unit 314 Preparing for and inspecting fitting operations

Outcome 5 understand how to carry out measurement, marking out and inspection operations

Assessment Criteria

The learner can:

1. state the dimensional properties of the fitting operations materials to be measures/checked
2. state the purpose of the ISO 9001 series of standards in terms of measuring, marking out and inspections
3. state the applications of **tools and equipment used in fitting operations**
4. illustrate how to mark out from a **reference position**
5. state the types of **accuracy** in terms of limits and fits
6. describe the **effects of geometric tolerance** in terms of fitting operations
7. describe the methods of producing **geometric shapes** being used on components
8. explain how to **use slip gauges as a reference standard** for measuring length
9. state the significance of surface roughness and the importance of checking surface finish with standard blocks
10. describe the process for the **selection of inspection gauges**
11. describe the methods for **inspecting mechanical components**
12. describe the importance of recording in order to be able to trace information

Range

Tools and equipment used in fitting operations: Rules; Scribes; Callipers; Squares; Protractors; Micrometers - outside (imperial and metric), inside (imperial and metric), depth (imperial and metric); Verniers - callipers (imperial and metric), height gauge (imperial and metric), protractor; Surface plates, tables and straight edges**;** Vee-blocks**;** Spirit levels (planes and graduated phials)

Reference position: Use of XYZ axis; From types of datum

Accuracy: In accordance with BS1916 and BS4500 ; Limits and fits – clearance, transition, interference; Accumulative errors; Geometric tolerance

Geometric shapes: Datums, centre lines, cutting lines; Hole, positions; Circles; Angles; Radii; Profiles

Additional Guidance

Effects of geometric tolerance: Overall variation in form and or position of feature; geometrical tolerancing, the symbols used on drawings, their indication and interpretation; the definition of maximum material condition eg application to geometrical and dimensional tolerancing; the significance of the letter 'M' when added to either a toleranced dimension or a datum letter, or both

Use of slip gauges as reference standard: Classification of slip gauges in terms of accuracy; Building up of slip gauges combinations; The use of ancillary equipment e.g. adjustable clamps, dovetail measuring accessories; Use of similar equipment for measuring length; Care and maintenance of slip gauges; Use of sine bars, angle blocks, rollers for use in angular measurement

Selection of inspection gauges: The use of gap, plug and ring gauges**;** The difference between non-adjustable and adjustable gauges - checking gauges used for checking during production, gap gauges used for checking external dimensions, plug gauges used for checking internal dimensions; GO and NOT-GO features of gauges; Relate the accuracy of the gauges listed to the nominal dimension to be measured; Gauges used for checking internal and external threads; Application in the use of the following gauges – dial, radius, pitch, profile, feeler

Inspecting mechanical products

In the compliance checking methods and techniques used; What equipment is used during the compliance checking process; The reasons for applying some methods and not others; Which defects can be rectified by levelling or re-shaping; How burrs can be removed on cut edges and trim excess material; When a poor surface finish is suitable for further treatment; The acceptable limits of dimensional tolerance; The acceptable limits of surface finishes; What defects are critical and non-critical; To visually inspect for surface and edge defects; To use rules for tape measures to check linear dimensions; To check shape and dimensions with straight edges, squares and gauges; To use surface plates to check flat surfaces; The importance of recording being able to trace information; The accuracy required by production and quality functions

Unit 314 Preparing for and inspecting fitting operations

Outcome 6 be able to carry out measurement, marking out and inspection operations

Assessment Criteria

The learner can:

1. select **tools** for measuring, marking out, calibration and inspection tasks
2. measure and mark out to prescribed tolerances
3. check to confirm that calibration of measuring, inspection and marking out equipment is to current standards

Range

Tools: Micrometers - outside (imperial and metric), inside (imperial and metric), depth (imperial and metric); Verniers - callipers (imperial and metric), height gauge (imperial and metric); Scribe and rule/straight edge

Unit 315 Fitting by use of hand tools

Level: **3**
Credit value: **12**
UAN: **Y/503/3735**

Unit aim
This unit is part of the occupational award for mechanical fitting. It covers the skills and knowledge associated with the techniques for completing mechanical fitting operations by the use of hand tools.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. understand how to identify methods and techniques for hand fitting operations
2. be able to identify methods and techniques for hand fitting operations
3. understand how to carry out hand fitting operations
4. be able to carry out hand fitting operations

Guided learning hours
It is recommended that **108** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS IPS Mech 1, IPS Mech 6, IPS Mech 7, IPS Mech 9, IPS Mech 10

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 315 Fitting by use of hand tools

Outcome 1 understand how to identify methods and techniques for hand fitting operations

Assessment Criteria

The learner can:

1. explain the criteria for classifying types of file
2. describe the use of sectional **forms of file**
3. explain the effect that different **types of hacksaw blade** has on cutting operations
4. state the **terms** used in drilling and reaming
5. describe the **reasons for** choosing types of drilling operations
6. describe the range of screw threads for different applications within fitting operations
7. define the **characteristics** of different screw threads
8. identify the **applications** of different screw threads
9. identify appropriate **drilling equipment** for work operations
10. describe the processes for using **hand reaming equipment**
11. describe different **manual threading methods**
12. describe how **drill features** can effect cutting operations
13. describe how **reamer features** can effect reaming operations
14. describe how the taper and die features can effect a threading operation

Range

Criteria for classifying types of file: Length; Sectional form; Cut of teeth; Rough; Middle; Bastard; Second; Smooth; Dead smooth

Forms of file: Flat; Needle; Square; Triangular (three square); Round; Half round; Knife edge

Types of hacksaw blade: Teeth per inch (TPI); Angles of teeth; Types of material to be cut

Terms: Through holes; Blind holes; Countersinking; Counter boring; Centring; Accurate hole dimensions; Surface finish

Reasons for: Through holes for screws, bolts and rivets; Countersinking for screws and rivets; Counter boring for cap head screws; As a preparatory operation for – tapping, reaming, countersinking, counter boring and trepanning

Characteristics: Major, minor and effective diameter; Pitch; Left/right hand thread; Single or multi-start

Applications: As a fastening device – bolts, screws, studs and nuts; To transmit motion – vices, jacks and machine tool mechanisms

Drilling equipment: Hand drills; Electric and pneumatic portable drills; magnetic based drills; Pedestal; Upright; Pillar drill

Hand reaming equipment: Hand reamers; hand taper-pin reamers; hand socket reamers

Manual threading methods: Internal screw threads by taps; Internal screw threads by special taps and thread inserts; External screw threads by dies; Cleaning external screw threads by die nuts

Drill features: Rake angle; Wedge angle; Clearance

Reamer features: Types of flute; Taper lead; Rotation of cutting; Rake angle

Taper and dies features: Application of rake; clearance; cutting angle

Unit 315 Fitting by use of hand tools

Outcome 2 be able to identify methods and techniques for hand fitting operations

Assessment Criteria

The learner can:

1. select the appropriate engineering **operation** from given specifications
2. select the appropriate tools and equipment for operations

Range

Operation: To include a minimum of - Filing; Sawing; Drilling; Reaming; Threading

Unit 315 Fitting by use of hand tools

Outcome 3 understand how to carry out hand fitting operations

Assessment Criteria

The learner can:

1. describe the main **features of drills**
2. identify different **types of drill**
3. describe the function of different **types of drill**
4. explain why drills are made from different **materials**
5. describe the **characteristics of taps**
6. explain why taps are made from **different materials**
7. describe the different **types of die**
8. describe the different **work holding devices** for drilling and threading
9. state the reasons for using a pilot drill
10. describe when to use aligning devices
11. define the terms 'advance turn' and 'back off'
12. describe how to choose the thread through the use of a thread gauge or mating nut/bolt
13. describe how to clean the tap/die after use and the storage conditions that should be observed
14. explain how to ensure that the initial diameter is correct prior to threading
15. identify the appropriate tool holding device for each discipline

Range

Features of drills: Flute length; Drilling length; Point; Body and recess; Shank; Size (diameter)

Types of drill: Parallel shank – jobber, long series, stump; Morse taper shank

Materials: Carbon; High speed steel; Stainless steel; Tipped drills

Characteristics of taps: Grouping into sets (taper, second, bottoming); Serial taps for heavy duty work; Flutes (type, number and application for different materials)

Different materials: Tool steel for plain carbon steel, non ferrous metals and cast iron; High speed steel for high tensile steel

Types of die: Circular split dies; Rectangular loose dies; Solid die nuts; Pipe thread dies (parallel and taper), thread chases

Work holding devices: Vices; Clamps and blocks; Chucks; Tap wrenches and die stocks

Unit 315 Fitting by use of hand tools

Outcome 4 be able to carry out hand fitting operations

Assessment Criteria

The learner can:

1. select the appropriate Personal Protective Equipment (PPE) for hand fitting **operations**
2. **prepare the work area** for hand fitting operations
3. carry out a **risk assessment**
4. obtain a permit to work if required
5. carry out filing and sawing operations
6. drill, thread and ream holes to specifications and method statements
7. restore work areas to a clear and safe condition on completion of the operation

Range

Operations: Drilling; Reaming; Threading; Filing; Sawing

Risk assessment: Point of work; Whole job

Additional Guidance

Prepare the work area: Obtain fabrication instructions, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 316 Fitting by machining and assembling components

Level: 3
Credit value: 16
UAN: H/503/3737

Unit aim
This unit is part of the occupational award for mechanical fitting. It covers the skills and knowledge related to machine tool operations and assembly techniques.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. understand how to carry out machine tool and grinding and scraping operations
2. be able to carry out machine tool and grinding and scraping operations
3. understand how to assemble components
4. be able to assemble components

Guided learning hours
It is recommended that **144** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS IPS Mech 2, IPS Mech 3, IPS Mech 4, IPS Mech 5, IPS Mech 7, IPS Mech 8

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 316 Fitting by machining and assembling components

Outcome 1 understand how to carry out machine tool and grinding and scraping operations

Assessment Criteria

The learner can:

1. identify **common machine tools** and their component parts
2. describe the methods of **work holding for machine tools**
3. apply the formula for calculating speeds and feeds for common machine tools
4. define the purpose of turning and milling operations
5. identify **lathe tools** for centre lathe turning
6. describe the methods for producing **common lathed features**
7. identify the **types of cuts** and **cutters** used for milling operations
8. describe the correct **methods and purpose of grinding**
9. state why grinding wheel selection is important when using different bonding and abrasive materials
10. state the **factors affecting wheel** selection
11. identify the **parts of a pedestal grinder**
12. state the purpose of the parts of a pedestal grinder
13. explain why work pieces must be clamped when using portable power tools for hand grinding
14. describe the **techniques used for scraping**
15. describe **scraping applications**

Range

Common machine tools: Centre lathe; Horizontal Milling machine; Vertical milling machine; Drilling machine

Work holding for machine tools: Centre lathe: 3 and 4 jaw chucks, collet chuck; Horizontal and vertical milling: vices, clamps and rotary tables; Grinding machines: 3 and 4 jaw chuck; Drilling machine: vices and clamps

Lathe tools: Turning and facing; Straight nose roughing; Knife/side cutting; Round nose; Parting off; Screw cutting; Knurling

Common lathed features: External diameters; Shoulders; Faces; Chamfers; Radii

Types of cuts: Flat, horizontal, vertical and angled surfaces; Slots; Grooves; Holes

Cutters: Slot drills; End mills; Face mills; Cylindrical; Tee slot; Wood ruff

Methods and purpose of grinding: The production of a flat, cylindrical surface; The removal of material from surfaces

Factors affecting wheel: Material to be ground; Amount of material to be removed; Finish required; Arc/area of contact

Parts of a pedestal grinder: Wheel guards; Rotating wheels; Work rest; Safety glass visor

Techniques used for scraping: Vices, clamps and blocks are used for work holding when scraping; Scrapers to remove small amounts of metal

Scraping applications: Bearings can be scraped with a half-round scraper; Holes can be de-burred with a three-square scraper.

Unit 316 Fitting by machining and assembling components

Outcome 2 be able to carry out machine tool and grinding and scraping operations

Assessment Criteria

The learner can:

1. **prepare the work area** for machine tool and grinding and scraping operations
2. carry out a **risk assessment**
3. obtain a permit to work if required
4. interpret the machining **documents** to extract necessary information to prepare the work piece and machining process for the shaping operation
5. produce an operation sheet selecting the most effective and efficient process of manufacture
6. check speed, feed and coolant systems operate correctly
7. carry out **machining operations**
8. use a range of machining methods, single and multiple tool set ups
9. monitor **machine processes**
10. resolve problems relating to machining, grinding and scraping
11. **restore the work area** to a clean and safe condition on completion of the operation

Range

Risk assessments: Whole job; point of work

Documents: Specification; drawings; procedures

Machining operations: Shape has a limited number of surfaces, angles and dimensions to be achieved and not more than two different stages; Centre lathe: Horizontal milling machine; Vertical milling machine; Drilling machine

Machine processes: Cutting process; surface appearance; measurement

Additional Guidance:

Prepare the work area: Obtain fabrication instructions, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 316 Fitting by machining and assembling components

Outcome 3 understand how to assemble components

Assessment Criteria

The learner can:

1. state the mechanical **joining and locking systems** for fitting operations
2. describe **mechanical joining systems** for fabrication operations
3. describe **simple fabrication applications**
4. explain why drills are made from different materials
5. describe thermal jointing using Manual Metal Arc (MMA) welding
6. describe process operations for the set up and use of Alternating Current/Direct Current (AC/DC) MMA equipment
7. explain the **safety aspects** that must be considered when MMA welding
8. identify different **welding positions**
9. identify types of **basic welded joints**
10. describe process operations for **hard and soft soldering**

Range

Joining and locking systems: Fasteners and locking systems (threaded fasteners, bolts, nuts, screws washers, thread inserts, studs, internal and external circlips, spring washers, tab washers); Pins and keys (parallel key and pins, taper key and pins, split pin); Rivets (round, flat, counter sunk, hollow)

Mechanical joining systems: Bolts - black and turned, high strength friction grip; Washers – taper, plane; Nuts and locking devices – locknuts, castellated nuts, spring, washers, tab washers

Simple fabrication applications: Joining structural sections and columns to base plates

Safety aspects: Routing of cables; Personal Protective Equipment (PPE); Fume extraction; Barrier screening to protect from the arc; Earthing of work

Welding positions: Flat; Vertical; Horizontal vertical; Over head

Basic welded joints: Butt; fillet

Hard and soft soldering: Set up of the equipment and cleaning the joint; Selection of filler wires and fluxes; techniques for applying filler wires and fluxes; removal of flux residue

Additional Guidance

Mechanical joining systems: Bolts and fastenings on mechanical devices / flanges must be correctly tensioned in the correct sequence and to the correct pressure, using either hand held torque wrenches, or hydraulic torque tensioning equipment.

Unit 316 Fitting by machining and assembling components

Outcome 4 be able to assemble components

Assessment Criteria

The learner can:

1. **prepare the work area** for the assembly of components
2. carry out a **risk assessment**
3. obtain a permit to work if required
4. assemble mechanical components by mechanical and thermal methods
5. inspect the assembled product for compliance to specification
6. **restore the work area** to a clean and safe condition on completion of the operation

Range

Risk assessments: Whole job; point of work

Additional Guidance:

Prepare the work area: Obtain fabrication instructions, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 317 Preparing and quality controlling the welding operation

Level: 3
Credit value: 9
UAN: A/503/3744

Unit aim
This unit covers the preparations needed to carry out effectively any welding operation. It includes the interpretation of specifications, selection of the process, ancillary equipment and consumables and related quality assurance systems.

Learning outcomes
There are **four** learning outcomes to this unit. The learner will:
1. understand how to interpret welding specifications to relevant standards
2. be able to interpret welding specifications to relevant standards
3. understand how to inspect and control welding operations
4. be able to inspect and control welding operations

Guided learning hours
It is recommended that **81** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS W1, W2, W3, W4, W6,
CO3
Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 317 Preparing and quality controlling the welding operation

Outcome 1 understand how to interpret welding specifications to relevant standards

Assessment Criteria

The learner can:

1. describe the terminology and procedures used in appropriate **quality documents** which apply to welding operations
2. explain what is meant by 'quality assurance' and 'quality control'
3. identify appropriate **quality requirements** which apply to welding
4. state how to **interpret fabrication engineering drawings** in accordance with **appropriate standards**
5. state how to interpret **weld symbols**
6. identify the **factors which will influence the type of edge preparation** required
7. describe **methods** for producing edge preparations
8. state how to differentiate between **common engineering materials**
9. describe factors which influence the weldability of different materials
10. describe requirements for pre-heating and slow cooling thick sections, alloy steels, and non-ferrous alloys
11. identify the criteria used to determine welding procedures

Range

Quality documents: BS EN ISO 9001 - quality assurance and quality control systems

Quality requirements: Reasons for using weld procedures; Purpose of qualifying a weld procedure; Reasons for qualifying welding personnel; Welder qualifications, responsibilities and limitations; Reasons for carrying out Non Destructive Testing (NDT) on welds; Monitoring and measuring welding repair rate to determine – quality and productivity

Interpret fabrication engineering drawings: Weld location; Sectional views showing joint preparations designed for partial or full fusion with access from one or both sides e.g. lap and 'T' fillet, square edge 'V', 'J', and 'U' profiles; Weld dimensions; Significance of notes on drawings e.g. relating to sequence of welding

Appropriate standards: BS EN ISO 1660 (1996)

Weld symbols: Identified in BS EN 22553

Factors which will influence the type of edge preparation: Metal thickness; Type of metal; Partial and full fusion joints; Welding process used; Single or double sided access; Efficiency of welding operations - optimum geometry for application and process, edge symmetry, dimensional accuracy and tolerance of profile and edge alignment, uniformity of edge preparation; the effects of incorrect edge preparation (increased volume of weld metal and welding time, greater risk of distortion and residual stress)

Methods: Oxy-fuel gas cutting; Arc/air cutting; Grinding; Nibbling; Plasma; Machining

Common engineering materials: Ferrous metals - low carbon steel, high carbon steel and 18/8 stainless steel, cast iron; Non-ferrous - aluminium alloys, copper alloys, nickel alloys, titanium alloys

Unit 317 Preparing and quality controlling the welding operation

Outcome 2 be able to interpret welding specifications to relevant standards

Assessment Criteria

The learner can:

1. interpret terminology in appropriate **quality documents** which apply to welding operations
2. interpret test certificates to identify base materials
3. interpret fabrication engineering drawings in **relation to welding requirements**
4. use temperature indicating equipment to identify pre-heat temperature.

Range

Quality documents: BS EN ISO 9001; quality manuals, procedures, work instructions, Weld Procedure Sheets (WPS)

Relation to welding requirements: Edge preparations; Position of welds; Symbols, Specific treatments

Unit 317 Preparing and quality controlling the welding operation

Outcome 3 understand how to inspect and control welding operations

Assessment Criteria

The learner can:

1. state the **relevant British and international standards** relating to weld quality assurance
2. state the **range of welding tests** required
3. describe common types of weld **defects** and the types of weld failure associated with each
4. describe how to prepare for post weld inspection and testing
5. describe how to use **welding gauges** to inspect profile of edge preparations and weld dimensions
6. explain the difference between destructive (DT) and non-destructive (NDT) methods of testing

Range

Relevant British and international standards: European Standards (EN), American Society of Mechanical Engineers (ASME)

Range of welding tests: Welder approval qualification to EN 287, ASME IX and BS 4872; Weld procedure qualification to BS EN ISO 15607:2003

Defects: Porosity; Undercut; Slag inclusion; Lack of fusion; lack of penetration; excessive penetration

Welding gauges: Fillet gauges; mis-match gauges; profile gauge; bevel gauge

Unit 317 Preparing and quality controlling the welding operation

Outcome 4 be able to inspect and control welding operations

Assessment Criteria

The learner can:

1. identify welding **defects**
2. set up edge cutting equipment
3. use **welding gauges**
4. carry out preparation for post weld inspections

Range

Defects: Porosity; Undercut; Slag inclusion; Lack of fusion; lack of penetration; excessive penetration

Welding gauges: Fillet gauges; mis-match gauges; profile gauge; bevel gauge

Unit 318 Welding with the manual metal arc (MMA) process

Level: 3
Credit value: 24
UAN: T/503/3757

Unit aim
This unit covers the skills and knowledge related to joining materials using the manual metal arc welding (MMA) process. It includes preparation of equipment and materials, welding techniques and safe working practices.

Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand how to assemble and prepare manual metal arc welding equipment
2. be able to assemble and prepare manual metal arc welding equipment
3. understand how to identify and prepare materials and consumables
4. be able to identify and prepare materials and consumables
5. understand how to identify and apply different welding techniques
6. be able to identify and apply different welding techniques
7. understand how to follow correct procedures and take precautions during welding operations
8. be able to follow correct procedures and take precautions during welding operations

Guided learning hours
It is recommended that **213** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS W1, W3, W5, W6, W16, W23, W25, W33, W40, W42, CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 1 understand how to assemble and prepare manual metal arc welding equipment

Assessment Criteria

The learner can:

1. state the range and types of **welding equipment** and the operating features of the equipment
2. describe procedures for **safe handling** and care of welding equipment
3. describe essential **operator and bystander safety requirements**
4. describe the procedures for setting up and **commissioning** MMA welding equipment
5. state the factors influencing the selection of power source and **ancillary equipment**

Range

Welding equipment: Transformers; Generators; Welding leads; Returns; Earths; Remote control devices

Safe handling: Storage; Portability (safe handling); Correct operation

Operator and bystander safety requirements: Protective clothing and equipment; Anti flash screens

Commissioning: Type and range of current required; Operating parameters; Location - workshop, site, at height; confined space

Ancillary equipment: Electrode holders; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 2 be able to assemble and prepare manual metal arc welding equipment

Assessment Criteria

The learner can:

1. select and set up manual metal-arc **welding equipment**
2. check and **commission the equipment**
3. select **ancillary equipment** appropriate to the application

Range

Welding equipment: Transformers; Generators; Welding leads; Returns; Earths; Remote control devices

Commission the equipment: Type and range of current required; Operating parameters; Location - workshop, site, at height; confined space

Ancillary equipment: Electrode holders; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 3 understand how to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. state the procedures for identifying and preparing types of material from drawing specifications and completion of a magnetic test
2. describe the **range and characteristics of electrodes** used with the manual metal-arc process
3. describe the **factors** that affect the selection of consumables
4. state the electrode classification system in accordance with appropriate **industry standards**
5. state the **function of flux coatings**
6. explain how welding electrodes should be **stored and handled**
7. state the range of **joint configurations** used for manual metal-arc welding applications
8. identify appropriate manual and powered cleaning methods used for different materials

Range

Range and characteristics of electrodes: Electrodes composition and flux coating; Deposition rate and quality; Penetration; Positional capabilities

Factors: Electrode sizes; Correct diameter for material thickness; Positional requirements; Welding joint configuration

Industry standards: BS EN ISO 2560 (2009)

Function of flux coatings: Protection of weld metal; Slag formation; Controls weld surface profile; Addition of alloying elements to weld metal; Stabilising the arc

Stored and handled: Drying ovens; Portable heating quivers; Maintaining flux integrity – vacuum packing systems and procedures, electrode storage

Joint configurations: 'Open square butt'; lap and 'T' fillets; 'V' 'J', 'U' and bevel butt joints

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 4 be able to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. **prepare the work** area to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. select appropriate Personal Protective Equipment (PPE)
5. identify and prepare materials from job specification or Weld Procedure Sheet (**WPS**)
6. select and prepare welding consumables appropriate to the material and application
7. prepare consumables and **joints** to be welded in accordance with weld procedure sheets (**WPS**) or manufacturer's recommendations.
8. prepare and **set up material/component** for welding
9. clean joint area and position/secure work accordingly
10. **restore the work area**

Range

Joints: 'T' fillets; Lap joints; Butt joints

Set up material/component: Jigs; Positioners; Tack welding; pre-setting and strong backs

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

WPS: Recommend emphasis on requirements for pre- and post heating

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 5 understand how to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. describe appropriate **current settings and conditions**
2. identify electrode types, sizes and **characteristics**
3. explain electrode manipulation and angles, positional considerations and deposition rates
4. describe different **welding techniques**
5. describe the characteristics of **joint design and welding sequence**
6. state requirements for positional welding in terms of consumables and welding techniques
7. describe the **characteristics of jigs, positioners and manipulators**

Range

Current settings and conditions Alternating Current (AC); Direct Current (DC); Amperage range; Electrode polarity

Characteristics: Diameter; Basic, cellulosic and rutile coatings; low hydrogen

Welding techniques: Stop and start procedures; Number and sequence of runs; Weaving; Key holing; Positioning; Speed

Joint design and welding sequence: Weld strength; Distortion control; Weld economics; Weld procedures; Pre-heat techniques

Characteristics of jigs, positioners and manipulators: Rigidity; Distortion control and gravity assisted deposits; Productivity

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 6 be able to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. prepare the work area to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. select appropriate Personal Protective Equipment (PPE)
5. use a range of different **welding parameters**
6. use different **welding techniques**
7. make **joints** in **different materials** in accordance with the WPS
8. manipulate work piece as required
9. **restore the work area**

Range

Welding parameters: Amperage range; Electrode polarity; Direct Current (DC)

Welding techniques: Stop and start procedures; Number and sequence of runs; Weaving; Key holing; Positioning

Joints: 'T' fillets; Lap joints; Butt joints

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Welding parameters: Alternating Current (AC)

Different materials: Ferrous and non-ferrous metals

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 7 understand how to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. describe safe working practices and the range of personal protective equipment (PPE) applicable to the process
2. describe the process for setting up and securing **welding components**
3. describe the design and operation of fixing and manipulating devices in terms of safety, positions and speed
4. state the principles and **purpose of a weld procedure**
5. describe the **factors influencing distortion** and methods of control
6. describe the correct **start and finish procedures**
7. describe the **factors affecting weld quality**
8. describe the post weld **inspection process**
9. describe the implications for personal safety and co-workers when working in different **situations**
10. describe different **methods of testing**

Range

Welding components: Joints; tack welding; jigs; manipulators

Purpose of a weld procedure: Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Factors influencing distortion: Material conductivity; Joint design; Heat input and distribution (process and speed); Number and sequence of runs

Start and finish procedures: Strike up technique; 'run on; 'run off'; taper dressing to assist re-starts; Advantages of using hot starting on power sources

Factors affecting weld quality: Use of correct welding parameters; Follow correct procedure; Cleanliness of joint and consumables; Correct selection of consumables; pre-heating and post-heating; environmental and weather conditions

Inspection process: Cleaning procedures; Inspect completed weld; Confirm weld conforms to relevant standards; Check for visual defects (oxidation, cracks, surface porosity, undercut); spatter; profile

Situations: At height; On site; In inclement weather; Confined space; Specific site requirements

Methods of testing: Destructive - bend testing, macro examination, nick and break; Non destructive - visual, ultrasonic, Magnetic Particle Inspection (MPI), Dye Penetrant Inspection (DPI), Radiography

Unit 318 Welding with the manual metal arc (MMA) process

Outcome 8 be able to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. position and secure work piece correctly
5. interpret and apply correct **weld procedure**
6. use correct welding sequence for a given application
7. clean and dress the joint as required
8. **restore the work area**

Range

Weld procedure: Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Level: 3
Credit value: 21
UAN: J/503/3763

Unit aim

This unit covers the skills and knowledge related to joining materials using the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process. It includes preparation of equipment and materials, welding techniques and safe working practices.

Learning outcomes

There are **eight** learning outcomes to this unit. The learner will:

1. understand how to assemble and prepare tungsten inert gas/tungsten arc gas shielded equipment
2. be able to assemble and prepare tungsten inert gas/tungsten arc gas shielded equipment
3. understand how to identify and prepare materials and consumables
4. be able to identify and prepare materials and consumables
5. understand how to identify and apply different welding techniques
6. be able to identify and apply different welding techniques
7. understand how to follow correct procedures and take precautions during welding operations
8. be able to follow correct procedures and take precautions during welding operations

Guided learning hours

It is recommended that **179** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit is linked to the following ECITB NOS W1, W3, W5, W6, W10, W11, W12, W13, W31, W32, W34
CO2, CO3

Support of the unit by a sector or other appropriate body

This unit is endorsed by ECITB.

Assessment

This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 1 understand how to assemble and prepare tungsten inert gas/tungsten arc gas shielded equipment

Assessment Criteria

The learner can:

1. state the range and **types of welding set** and the operating features of the equipment
2. state essential welding connections and services
3. describe procedures for **safe handling** and care of gas cylinders
4. describe essential operator and bystander safety requirements
5. state the **factors** influencing the selection of power source and **ancillary equipment**

Range

Types of welding set: Transformer/rectifier; Wave forms; HF scratch start devices (high frequency); Remote control switches

Essential welding connections: Welding return and earth; Harnesses/looms for hoses and cables - welding torch (light and heavy duty), selection of torch design including collets, ceramics, bodies and gas lenses; Gas supply and flow control - appropriate gas selection, check for leaks of gas supply using approved leak detection methods; Coolants – water, air; Remote control devices

Safe handling: Storage; Portability (safe handling); Correct operation

Operator and bystander safety requirements: Protective clothing and equipment; Anti flash screens

Factors: Material type and thickness; joint location; single or dual process e.g. suitability for TIG root and MMA fill and cap.

Ancillary equipment: Electrode holders; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 2 be able to assemble and prepare tungsten inert gas/tungsten arc gas shielded equipment

Assessment Criteria

The learner can:

1. select appropriate Personal Protective Equipment (PPE)
2. obtain and interpret the Weld Procedure Sheet (WPS)
3. select the appropriate Tungsten electrode
4. select and set up tungsten inert gas/tungsten-arc gas-shielded **welding equipment**.
5. check and commission the equipment.
6. select **ancillary equipment** appropriate to the application

Range

Welding equipment: Transformer/rectifier; Wave forms; HF high frequency /scratch start devices (); Remote control switches; Welding return and earth; Harnesses/looms for hoses and cables - welding torch (light and heavy duty), selection of torch design including collets, ceramics, bodies and gas lenses; Gas supply and flow control - appropriate gas selection, check for leaks of gas supply using approved leak detection methods; Coolants – water, air; Remote control devices

Ancillary equipment: Electrode holders; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 3 understand how to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. state the **methods used for identifying** and preparing types of material
2. describe the **range of electrodes** used with the tungsten-arc gas shielded process
3. state the typical applications for different **electrode sizes**
4. describe the care and correct preparation procedures for Tungsten electrodes
5. describe the different Tungsten electrode **end profiles** as appropriate to Alternating Current (AC) and Direct Current (DC) welding applications
6. describe the **range and characteristics of filler materials** used with the tungsten- arc gas shielded process
7. state the range of **joint configurations** used for tungsten arc gas shielded welding applications
8. state set up procedures for machine profile bevel configurations
9. state the back purging methods and the use of parts for root protection when welding alloys which are prone to oxidation
10. state the **cleaning methods** used for different materials and consumables

Range

Methods used for identifying: cast number and material test certificate; Drawing specification and magnetic test; Weld Procedure Sheets

Range of electrodes: Colour coding; Pure Tungsten; Alloyed (thoriated, ceriated, lanthanated, zirconiated)

Electrode sizes: 1.6 mm; 2.4 mm; 3.2 mm

End profiles: Conical; Frustum (part of cone); Tapered

Range and characteristics of filler materials: Size and chemical composition to fulfil the requirements of the material and weld procedure; Classification of filler wires to BSEN 14640

Joint configurations: Outside corners; Lap and 'T' fillet; Square edge; 'V', 'U' and 'J' butt; Inserts.

Cleaning methods: Chemical; Mechanical; Abrasives

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 4 be able to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. identify and prepare materials from job specification or Weld Procedure Sheets (**WPS**)
2. select welding consumables
3. prepare consumables in accordance with WPS or manufacturer's recommendations
4. prepare and set up materials and components for welding in accordance with WPS
5. clean joint area and position and secure work accordingly.

Range

WPS: Emphasis on pre- and post heating requirements

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 5 understand how to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. state electrode types, current range, polarity, sizes and applications
2. describe the suitability of electrode types in relation to different **welding factors**
3. describe the reasons for selecting the **gas** and related equipment
4. state appropriate **current settings** and operating conditions
5. state appropriate **electrode and filler rod manipulation and angles**
6. describe joint, design fit-up and securing requirements
7. explain different **welding techniques**
8. describe common **joint design considerations**
9. state requirements for **positional welding equipment**
10. describe techniques for welding **butt welded pipe joints** in a range of materials

Range

Welding factors: Profile considerations; Type of material; Joint design; Penetration requirements

Gas: Inert nature of shielding gas used to protect the weld; Types and applications of gases; Types of ceramic nozzles; Flow meters in litres/min in accordance with weld specification sheet; Types and application of gas lenses; Gas purging purpose and techniques

Current settings: Reasons for selecting AC current for aluminium alloys; Reasons for selecting DC electrode

Electrode and filler rod manipulation and angles: Appropriate welding technique; Included angle variations

Welding techniques: Multi run; Dual process; Manual; Automated; Spot; Continuous hot wire

Joint design considerations: Welding sequence, material type and thickness; Distortion control; Accessibility; Weld quality

Positional welding equipment: Jigs; Positioners; Rotators

Butt welded pipe joints: Rotated with and without backing rings or inserts; Fixed position with and without backing rings or inserts

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 6 be able to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point or Work Risk Assessment (PoWRA)
3. obtain a Permit to Work or Hot Work Permit if required
4. clean and dress joints as required
5. use a range of different **welding equipment**
6. apply a range of different **welding parameters**
7. use different **welding techniques**
8. make **joints** in **different materials** in accordance with the WPS
9. **restore the work area**

Range

Welding equipment: Transformer; Rectifier, High Frequency (HF); Shielding gas

Welding parameters: Amperage range; Electrode polarity; DC

Welding techniques: Stop and start procedures; number and sequence of runs; weaving; keyholing; positioning

Joints: 'T' fillets; Lap joints; Butt joints

Different materials: Ferrous and non ferrous materials

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 7 understand how to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. describe safe working practices and the range of personal protective clothing and equipment applicable to the process
2. describe the **setting up and securing of joints**
3. describe **purging techniques**
4. describe the design and operation of fixing and manipulating devices in terms of safety, positions and speed
5. state the principles and **purpose of a weld procedure**
6. describe the **factors influencing distortion** and methods of control
7. state the **correct start and finish procedures**
8. state the **factors affecting weld quality**
9. describe the post weld **inspection process**
10. describe the implications for personal safety and co-workers when working in different **situations**

Range

Setting up and securing of joints: Jigs, tacking; Pre-setting

Purging techniques: Local purging (use of dams and bungs); whole systems purging

Purpose of a weld procedure: Joint design; Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Factors influencing distortion; Type of material; Joint design; Heat input and distribution (process and speed); Number and sequence of runs

Correct start and finish procedures: Variable current (slope-up and slope-down); Taper dressing to assist re-starts; Post gas flow/pre flow gas

Factors affecting weld quality: Use of correct welding parameters; Follow correct procedure; Cleanliness of joint and consumables; Correct selection of consumables; Environment and weather; Correct gas flow rates

Inspection process: Heat treatment; Grinding and polishing; Cleaning procedures; Inspect completed weld; Confirm weld conforms to relevant standards; Check for visual defects (oxidation, cracks, surface porosity, undercut, profile)

Situations: At height; On site; In inclement weather; Confined space and applicable to relevant site conditions

Unit 319 Welding with the tungsten inert gas/tungsten arc gas (TIG/TAG) shielded welding process

Outcome 8 be able to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. position and secure work piece correctly
5. interpret and apply correct **weld procedure**
6. use correct welding sequence for a given application
7. clean and dress the joint as required
8. **restore the work area**

Range

Weld procedure: Joint design; Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Level: 3
Credit value: 21
UAN: H/503/3771

Unit aim
This unit covers the skills and knowledge related to joining materials using the metal inert gas /metal active gas (MIG/MAG) process. It includes preparation of equipment and materials, welding techniques and safe working practices.

Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand how to assemble and prepare metal inert/active gas shielded welding equipment
2. be able to assemble and prepare metal inert/active gas shielded welding equipment
3. understand how to identify and prepare materials and consumables
4. be able to identify and prepare materials and consumables
5. understand how to identify and apply different welding techniques
6. be able to identify and apply different welding techniques
7. understand how to apply materials, consumables, techniques and precautions
8. be able to follow correct procedures and take precautions during welding operations

Guided learning hours
It is recommended that **185** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS W1, W3, W5, W6, W19, W20, W21, W22, W36, W37, W38, W39
CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 1 understand how to assemble and prepare metal inert/active gas shielded welding equipment

Assessment Criteria

The learner can:

1. state the range, types and features of **welding equipment** and the operating features of the equipment
2. state **essential welding connections** and services
3. describe procedures for **safe handling** and care of gas cylinders
4. describe essential **operator and bystander safety requirements**
5. state the **factors** influencing the selection of power source and **ancillary equipment**

Range

Welding equipment: Power sources, inverter , generator, rated output, measurement of electrical output and continuity, power source characteristics, function of induction, return, earth, construction, rated output, welding guns, contact tip, return clamps, wire feed systems and control, ancillary equipment

Essential welding connections: Welding return and earth; Harnesses/looms for hoses and cables - welding gun, selection of gun design including collets, shrouds, bodies and gas lenses; Gas supply and flow control - appropriate gas selection, check for leaks of gas supply using approved leak detection methods; Coolants – water, air; Remote control devices, electrode wire feed systems

Safe handling: Storage; Portability (safe handling); Correct operation

Operator and bystander safety requirements: Protective clothing and equipment; Anti flash screens

Factors: Material type and thickness; joint location; single or dual process; stick-out; shielded and self-shielded processes; transfer methods (dip, globular, spray, pulsed)

Ancillary equipment: MIG/MAG gun; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Additional Guidance

Welding equipment: Power sources (output direct current [d.c.], Constant Current (CC-DC) or Constant Voltage (CV) Welding Power Source, transformer/rectifier [function, operation, construction, function of smoothing capacitors], inverter [function, operation, construction], generator [fuel driven, function, operation, construction], rated output [duty cycle]), leads used (welding [water cooled, air cooled, harness construction], return, earth, construction, rated output [duty cycle]), welding guns/torches (water cooled, air cooled, construction, types [push, pull, reel-on-gun] swan neck design, pistol design, nozzles [dip, spray], contact tip [functions, material, sizes, clearing a burn-back), return clamps (types, clamping mechanisms), wire feed control (variable speed motor, direct control of wire feed rate, indirect control of welding current, solenoid valves [shielding gas, water], jog-feed control, gas purge control) ancillary equipment (angle grinders, wire brushes, linishers, flap-wheels, hammer and chisel, extraction)

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 2 be able to assemble and prepare metal inert/active gas shielded welding equipment

Assessment Criteria

The learner can:

1. select appropriate Personal Protective Equipment (PPE)
2. obtain and interpret the weld procedure sheet (WPS)
3. select the appropriate **electrode wire**
4. select and set up metal inert gas shielded **welding equipment**
5. check and commission the equipment.
6. select **ancillary equipment** appropriate to the application

Range

Electrode wire: Welding consumables in line with the appropriate current standards: electrode wires and deposits for gas shielded metal arc welding of non alloy and fine grain steels, classification: (sizes [diameters, reel sizes available], chemical composition of the weld metal, deoxidisers, function of copper coating, protection of bare wires); Non-ferrous metals (types, availability, typical sizes), storage (storage, identification, segregation (classification, size)

Welding equipment: Power sources, inverter , generator, rated output, measurement of electrical output and continuity, relationship between wire feed speed control and welding current, power source characteristics, function of induction, return, earth, construction, rated output, welding guns, contact tip, shielding gas nozzle, return clamps, wire feed control, ancillary equipment

Ancillary equipment: MIG/MAG gun; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 3 understand how to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. state the **methods used for identifying** and preparing types of material
2. describe the **range of electrode wires** used with the metal inert gas shielded process
3. state the typical applications for different **electrode wire sizes**
4. describe the range and characteristics of **shielding gases** used with the metal inert gas shielded process
5. state the range of **joint configurations** used for metal inert gas shielded applications
6. state set up procedures for machine profile bevel configurations
7. state the back purging methods and the use of parts for root protection when welding metals which are prone to oxidation
8. state the **cleaning methods** used for different materials and consumables

Range

Methods used for identifying: Cast number and material test certificate; Drawing specification and magnetic test; Weld Procedure Sheets

Range of electrode wires: Welding consumables in line with the appropriate current standards: electrode wires and deposits for gas shielded metal arc welding of non alloy and fine grain steels, classification: (sizes [diameters, reel sizes available], chemical composition of the weld metal, deoxidisers, function of copper coating, protection of bare wires), non-ferrous metals (types, availability, typical sizes), storage (storage, identification, segregation (classification, size)

Electrode wire sizes: 0.6 mm; 0.8 mm; 1.0 mm; 1.2mm

Shielding gases: BS EN 439: Welding consumables: shielding gases for MIG/MAG welding and cutting, effects of shielding gases/gas mixtures (weld pool/arc area protection, heat input, weld geometry, penetration profile, travel speed, mode of metal transfer), applications for shielding gases/gas mixtures (argon, helium, carbon dioxide, argon/carbon dioxide mixtures, argon/oxygen/carbon dioxide mixtures, argon/oxygen mixtures, helium/argon/oxygen/carbon dioxide mixtures), gas pressure requirements, flow rates for applications

Joint configurations: Outside corners; Lap and 'T' fillet; Square edge; 'V', 'U' and 'J' butt; Inserts.

Cleaning methods: Chemical; Mechanical; Abrasives

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 4 be able to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. identify and prepare materials from job specification or Weld Procedure Sheets (**WPS**)
2. select welding consumables
3. prepare consumables in accordance with **WPS** or manufacturer's recommendations.
4. prepare and set up materials and components for welding in accordance with **WPS**
5. clean joint area and position and secure work accordingly.

Range

WPS: Recommend emphasis on requirements for pre- and post heating

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 5 understand how to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. state electrode wire types, current range, polarity, sizes and applications
2. describe the suitability of electrode wire types in relation to different **welding factors**
3. describe the reasons for selecting the **gas** and related equipment
4. state appropriate **current settings** and operating conditions
5. state appropriate **electrode wire and MIG gun manipulation and angles**
6. describe joint, design fit-up and securing requirements
7. explain different **welding techniques**
8. describe common **joint design considerations**
9. state requirements for **positional welding equipment**
10. describe techniques for welding **butt welded pipe joints** in a range of materials

Range

Welding factors: Profile considerations; Type of material; Joint design; Penetration requirements

Gas: cylinders, manifold systems, regulators (fixed, single-stage, two-stage), gas flow meters in litres/min in accordance with weld specification sheet, gas tubes and connectors, use of solenoid valves, heaters for CO_2

Current settings: Reasons for selecting DC electrode

Electrode wire and MIG gun manipulation and angles: Appropriate welding technique; transfer method (transfer methods (dip, globular, spray, pulsed), Included angle variations, Electrode wire extension (stick-out), wire feed speed

Welding techniques: Multi run; Manual; Semi-automatic; Automated

Joint design considerations: Welding sequence, material type and thickness; Distortion control; Accessibility; Weld quality

Positional welding equipment: Jigs; Positioners; Rotators

Butt welded pipe joints: Rotated with and without backing rings or inserts; Fixed position with and without backing rings or inserts

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 6 be able to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a Permit to Work or Hot Work Permit if required
4. clean and dress joints as required
5. use a range of different **welding equipment**
6. apply a range of different **welding parameters**
7. use different **welding techniques**
8. make **joints** in **different materials** in accordance with the WPS
9. **restore the work area**

Range

Welding equipment: Power sources, inverter , generator, rated output, measurement of electrical output and continuity, relationship between wire feed speed control and welding current, power source characteristics, function of induction, return, earth, construction, rated output, welding guns, contact tip, shielding gas nozzle, return clamps, wire feed control, ancillary equipment

Welding parameters: Amperage range; Electrode polarity; DC

Welding techniques: Stop and start procedures; contact tip to workpiece distance; Electrode wire extension (stick-out); wire feed speed; arc length; number and sequence of runs; weaving; key holing; positioning

Joints: 'T' fillets; Lap joints; Butt joints

Different materials: Ferrous and non ferrous materials

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 320 Welding with the metal inert gas/metal active gas (MIG/MAG) process

Outcome 7 understand how to apply materials, consumables, techniques and precautions

Assessment Criteria

The learner can:

1. describe safe working practices and the range of personal protective clothing and equipment applicable to the process
2. describe the **setting up and securing of joints**
3. describe the design and operation of fixing and manipulating devices in terms of safety, positions and speed
4. state the principles and **purpose of a weld procedure**
5. describe the **factors influencing distortion** and methods of control
6. state the **correct start and finish procedures**
7. state the **factors affecting weld quality**
8. describe the post weld **inspection process**
9. describe the implications for personal safety and co-workers when working in different **situations**

Range

Setting up and securing of joints: Jigs, tacking; Pre-setting

Purpose of a weld procedure: Joint design; Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Factors influencing distortion; Type of material; Joint design; Heat input and distribution (process and speed); Number and sequence of runs

Correct start and finish procedures: Variable current; Taper dressing to assist re-starts; Post gas flow/pre flow gas

Factors affecting weld quality: Use of correct welding parameters; Follow correct procedure; Cleanliness of joint and consumables; Correct selection of consumables; Environment and weather; Correct gas flow rates; wire feed speed

Inspection process: Heat treatment; Grinding and polishing; Cleaning procedures; Inspect completed weld; Confirm weld conforms to relevant standards; Check for visual defects (oxidation, cracks, surface porosity, undercut, profile)

Situations: At height; On site; In inclement weather; Confined space and applicable to relevant site conditions

Unit 321 Welding with the flux cored arc welding (FCAW) process

Level: 3
Credit value: 21
UAN: L/503/3781

Unit aim
This unit covers the skills and knowledge related to joining materials using the flux cored arc welding (FCAW) process. It includes preparation of equipment and materials, welding techniques and safe working practices.

Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand how to assemble and prepare flux cored arc welding equipment
2. be able to assemble and prepare flux cored arc welding equipment
3. understand how to identify and prepare materials and consumables
4. be able to identify and prepare materials and consumables
5. understand how to identify and apply different welding techniques
6. be able to identify and apply different welding techniques
7. understand how to follow correct procedures and take precautions during welding operations
8. be able to follow correct procedures and take precautions during welding operations

Guided learning hours
It is recommended that **185** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards
This unit is linked to the following ECITB NOS W1, W3, W5, W6, W9, W18, W24, W26, W35, W41 CO2, CO3

Support of the unit by a sector or other appropriate body
This unit is endorsed by ECITB.

Assessment
This unit will be assessed by an assignment which is centre set and marked and externally verified.

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 1 understand how to assemble and prepare flux cored arc welding equipment

Assessment Criteria

The learner can:

1. state the range and types of **welding equipment** and the operating features of the equipment
2. describe procedures for **safe handling** and care of welding equipment
3. describe essential **operator and bystander safety requirements**
4. describe the procedure for setting up and commissioning flux core arc welding (FCAW) equipment
5. state the factors influencing the selection of power source and **ancillary equipment**

Range

Welding equipment: Transformers; Generators; Welding leads; Returns; Earths; Remote control devices

Safe handling: Storage; Portability (safe handling); Correct operation

Operator and bystander safety requirements: Protective clothing and equipment; Anti flash screens

Commissioning: Type and range of current required; Operating parameters; Location - workshop, site, at height; confined space

Ancillary equipment: FCAW gun; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 2 be able to assemble and prepare flux cored arc welding equipment

Assessment Criteria

The learner can:

1. select appropriate Personal Protective Equipment (PPE)
2. obtain and interpret the weld procedure sheet (WPS)
3. select the appropriate **electrode wire**
4. select and set up flux cored arc welding (FCAW) **equipment**
5. select appropriate shielding gas if required
6. check and commission the **equipment**
7. select **ancillary equipment** appropriate to the application

Range

Electrode wire: Types of electrode wire structures, wire sizes (1.0mm, 1.2mm, 2.4mm), types and purpose of flux

Equipment: Transformers; Generators; Welding leads; Returns; Earths; Remote control devices

Equipment: Power sources, inverter , generator, rated output, measurement of electrical output and continuity, relationship between wire feed speed control and welding current, power source characteristics, function of induction, return, earth, construction, rated output, welding guns, contact tip, return clamps, wire feed control, ancillary equipment

Ancillary equipment: FCAW gun; Welding leads; Return clamp; Protective clothing and equipment; Anti flash screens; Isolators; Extraction (protection from welding fume)

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 3 understand how to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. state the procedures for identifying and preparing types of material from drawing specifications and completion of a magnetic test
2. describe the **range and characteristics of electrodes** used with the flux cored arc process
3. describe the **factors** that affect the selection of consumables
4. state the electrode classification system in accordance with appropriate **industry standards**
5. state the **function of flux core**
6. explain how welding electrode wire should be stored and handled
7. state the range of **joint configurations** used for flux cored arc welding applications
8. identify appropriate manual and powered cleaning methods used for different materials

Range

Range and characteristics of electrodes: Electrode wire composition and flux core; Deposition rate and quality; Penetration; Positional capabilities

Factors: Electrode sizes; Correct diameter for material thickness; Positional requirements; Welding joint configuration

Industry standards: BS EN ISO 2560 (2009)

Function of flux core: Protection of weld metal; Slag formation; Addition of alloying elements to weld metal; Stabilising the arc

Joint configurations: 'open square butt'; lap and 'T' fillets; 'V' 'J', 'U' and bevel butt joints

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 4 be able to identify and prepare materials and consumables

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. select appropriate Personal Protective Equipment (PPE)
5. identify and prepare materials from job specification or Weld Procedures Sheet (**WPS**)
6. select and prepare welding consumables appropriate to the material and application
7. prepare consumables and **joints** to be welded in accordance with weld procedure sheets (**WPS**) or manufacturer's recommendations
8. prepare and **set up material/component** for welding
9. clean joint area and position/secure work accordingly
10. **restore the work area**

Range

Joints: 'T' fillets; Lap joints; Butt joints

Set up material/component: Jigs; Positioners; Tack welding; pre-setting and strong backs

WPS: Recommend emphasis on requirements for pre- and post heating

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 5 understand how to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. state electrode wire types, current range, polarity, sizes and applications
2. describe the suitability of electrode wire types in relation to different **welding factors**
3. describe the reasons for selecting the **gas** and related equipment
4. state appropriate **current settings** and operating conditions
5. state appropriate **electrode wire and FCAW gun manipulation and angles**
6. describe joint, design fit-up and securing requirements
7. explain different **welding techniques**
8. describe common **joint design considerations**
9. state requirements for **positional welding equipment**
10. describe techniques for welding **butt welded pipe joints** in a range of materials

Range

Welding factors: Profile considerations; Type of material; Joint design; Penetration requirements

Gas (where required): cylinders, manifold systems, regulators (fixed, single-stage, two-stage), gas flow meters in litres/min in accordance with weld specification sheet, gas tubes and connectors, use of solenoid valves, heaters for CO_2

Current settings: reasons for choosing appropriate current for materials

Electrode wire and FCAW gun manipulation and angles: Appropriate welding technique; transfer method (transfer methods (dip, globular, spray, pulsed), Included angle variations, Electrode wire extension (stick-out), wire feed speed

Welding techniques: Multi run; Dual process – (setting up a welded joint for multi process); Semi-automatic; Fully automatic

Joint design considerations: Welding sequence, material type and thickness; Distortion control; Accessibility; Weld quality

Positional welding equipment: Jigs; Positioners; Rotators

Butt welded pipe joints: Rotated with and without backing rings or inserts; Fixed position with and without backing rings or inserts

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 6 be able to identify and apply different welding techniques

Assessment Criteria

The learner can:

1. prepare the work area to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. select appropriate Personal Protective Equipment (PPE)
5. use a range of different **welding parameters**
6. use different **welding techniques**
7. make **joints** in **different materials** in accordance with the WPS
8. manipulate work piece as required
9. **restore the work area**

Range

Welding parameters: Amperage range; Electrode polarity; Direct Current (DC)

Welding techniques: Stop and start procedures; Number and sequence of runs; Weaving; Key holing; Positioning

Joints: 'T' fillets; Lap joints; Butt joints

Additional Guidance

Welding parameters: Direct current

Different materials: Ferrous and non-ferrous metals

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 7 understand how to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. describe safe working practices and the range of personal protective equipment (PPE) applicable to the process
2. describe the process for setting up and securing **welding components**
3. describe the design and operation of fixing and manipulating devices in terms of safety, positions and speed
4. state the principles and **purpose of a weld procedure**
5. describe the **factors influencing distortion** and methods of control
6. describe the correct **start and finish procedures**
7. describe the **factors affecting weld quality**
8. describe the post weld **inspection process**
9. describe the implications for personal safety and co-workers when working in different **situations**
10. describe different **methods of testing**

Range

Welding components: Joints; tack welding; jigs; manipulators

Purpose of a weld procedure: Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Factors influencing distortion: Material conductivity; Joint design; Heat input and distribution (process and speed); Number and sequence of runs

Start and finish procedures: Strike up technique; 'run on; 'run off'; taper dressing to assist re-starts; Advantages of using hot starting on power sources

Factors affecting weld quality: Use of correct welding parameters; Follow correct procedure; Cleanliness of joint and consumables; Correct selection of consumables; pre-heating and post-heating

Inspection process: Cleaning procedures; Inspect completed weld; Confirm weld conforms to relevant standards; Check for visual defects (oxidation, cracks, surface porosity, undercut, profile)

Situations: At height; On site; In inclement weather; Confined space; Specific site requirements

Methods of testing: Destructive - bend testing, macro examination, nick and break; Non destructive - visual, ultrasonic, Magnetic Particle Inspection (MPI), Dye Penetrant Inspection (DPI), Radiography

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 8 be able to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. position and secure work piece correctly
5. interpret and apply correct **weld procedure**
6. use correct welding sequence for a given application
7. clean and dress the joint as required
8. **restore the work area**

Range

Weld procedure: Joint design; Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Unit 321 Welding with the flux cored arc welding (FCAW) process

Outcome 8 be able to follow correct procedures and take precautions during welding operations

Assessment Criteria

The learner can:

1. **prepare the work area** to carry out welding
2. carry out a Point of Work Risk Assessment (PoWRA)
3. obtain a permit to work or hot work permit if required
4. position and secure work piece correctly
5. interpret and apply correct **weld procedure**
6. use correct welding sequence for a given application
7. clean and dress the joint as required
8. **restore the work area**

Range

Weld procedure: Joint design; Welding parameters; Consumables specification; Welding technique; Pre and post weld care

Additional Guidance

Prepare the work area: Obtain welding instructions/WPS, documentation (risk assessments, method statements, permits to work), tools, equipment and other consumables, service supplies, safety equipment (e.g. lighting, barriers, screens, signs, waste disposal facilities); Carry out pre operation briefings as required; Check work area is clean and fit for purpose

Restore the work area: Leave the work area free of unused consumables; Cleaning the work area, putting tools and equipment into safe storage, identify any materials used that are classified as hazardous and those that can be recycled, reporting any damage caused by the maintenance or installation activity where additional restoration work may be needed, informing all interested parties who need to know of any changes that may affect the operation of the system, or of any new conditions that could exist in the work area; Work termination documents or reports that may be required are completed and passed on to an authorised person (e.g. terminating permits to work)

Appendix 1 Relationships to other qualifications

Links to other qualifications

These qualifications have connections to the:

- City & Guilds Level 3 Diploma in Engineering(2850)
- ECITB Level 3 Diploma in Installing Engineering Construction Plant and Systems - Pipefitting
- ECITB Level 3 Diploma in Installing Engineering Construction Plant and Systems – Mechanical Fitting
- ECITB Level 3 Diploma in Welding Engineering Construction Pipework
- ECITB Level 3 Diploma in Welding Engineering Construction Plate
- ECITB Level 3 Diploma in Fabricating Engineering Construction Steel Structures – Plating
- ECITB Level 3 Diploma in Erecting Engineering Construction Capital Plant Steel Structures
- ECITB Level 3 Diploma in Moving Engineering Construction Loads

Literacy, language, numeracy and ICT skills development

These qualifications can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see **www.cityandguilds.com/functionalskills**
- Essential Skills (Northern Ireland) – see **www.cityandguilds.com/essentialskillsni**
- Essential Skills Wales – see **www.cityandguilds.com/esw**

Appendix 2 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on **www.cityandguilds.com**.

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information such on such things as:

- **Walled Garden:** how to register and certificate candidates on line
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

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www.cityandguilds.com

Useful contacts

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

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: **feedbackandcomplaints@cityandguilds.com**

Published by City & Guilds
1 Giltspur Street
London
EC1A 9DD
T +44 (0)844 543 0000
F +44 (0)20 7294 2413
www.cityandguilds.com

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