

Unit 16: Understanding and Using Fabrication Skills for Blacksmithing and Metalworking

Unit reference number:	T/602/0713
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

This unit aims to introduce learners to fabrication skills for blacksmithing and metalworking, and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or on to further/higher education.

● Unit introduction

A blacksmith's work can consist of producing single, forged items but, invariably, it will involve the connection of two or more pieces of material to realise its final shape. Knowledge and skill in fabrication are therefore an intrinsic part of the metalworker's craft in any situation involving the assembly of multiple components.

This unit gives learners the opportunity to gain and develop the knowledge and skills needed to produce a variety of simple fabrications in sheet metal. It includes the interpretation of a specification, identification of materials, measuring, marking out and cutting to diagrams and/or drawings, forming metal, joining of materials, and the evaluation of the development processes.

Learning outcome 1 addresses the range of materials available and the cross sectional forms they might be supplied in. While most of the experience gained in this unit will be in the use of mild steel, the range of metals and their various forms of supply to suit differing situations will also be covered.

Learning outcome 2 is concerned with marking out and cutting appropriately to produce simple sheet metal components to a specified accuracy.

Learning outcomes 3 and 4 cover the use of bending/forming machines and the common joining methods used in fabrication processes.

● Learning outcomes

On completion of this unit a learner should:

- 1 Know the metals and associated forms of supply commonly used in fabrication processes
- 2 Be able to mark out and cut to a parallel line development specification
- 3 Be able to use fabrication bending/forming equipment to produce a parallel line development sheet fabrication
- 4 Be able to use fabrication joining methods to create a parallel line development sheet fabrication.

Unit content

1 Know the metals and associated forms of supply commonly used in fabrication processes

Metals: ferrous; non-ferrous (brass, copper, aluminium, lead); physical and mechanical properties of commonly used metals; workshop tests to identify metals; advantages and limitations of different commonly used metals; forms of supply (sheet, plate, rolled steel sections); costs; sources of supply

2 Be able to mark out and cut to a parallel line development specification

Marking out and cutting metals: use of diagrams/drawings; parallel line method of surface development; marking out equipment (pencils, scribe, rules, squares, dividers, trammels); cutting out/material removal equipment (snips, chisels, manual and powered guillotines, hand saws, nibblers, hand shears); setting up, use and maintenance of equipment; relevant current legislation and codes of practice eg Health and Safety at Work Act 1974, Provision and Use of Work Equipment Regulations 1998, Control of Substances Hazardous to Health (COSHH) Regulations 2002; personal protective equipment (PPE); risk assessment

3 Be able to use fabrication bending/forming equipment to produce a parallel line development sheet fabrication

Manual bending/forming equipment: manual bending/forming machines; hammers; stakes; folding bars; methods of use; accuracy (joint fit up, assembly sequence, edge treatment); finish (selection, techniques, equipment, tools); setting up, use and maintenance of equipment; relevant current legislation and codes of practice eg Health and Safety at Work Act 1974, Provision and Use of Work Equipment Regulations 1998, Control of Substances Hazardous to Health (COSHH) Regulations 2002; PPE; risk assessment

4 Be able to use fabrication joining methods to create a parallel line development sheet fabrication

Joining methods: self-securing joints; rivets; skin adhesion processes; spot welding; related equipment and materials; advantages and limitations of methods; uses of each method; costs; relevant current legislation and codes of practice eg Health and Safety at Work Act 1974, Provision and Use of Work Equipment Regulations 1998, Control of Substances Hazardous to Health (COSHH) Regulations 2002; PPE; risk assessment

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 describe the physical and mechanical properties of ferrous metals blacksmiths use in fabrication processes [RL, SM]	M1 describe the workshop tests used to identify the most commonly used ferrous and non-ferrous metals in fabrication processes	
P2 describe the physical and mechanical properties of non-ferrous metals blacksmiths use in fabrication processes [RL, SM]		
P3 mark out a component to meet a given parallel line development specification [RL, SM]		
P4 produce a risk assessment for the use of a specified piece of fabrication equipment [RL, SM, EP]		
P5 cut out a component to meet a given parallel line development specification [RL, SM, EP]		
P6 use manual fabrication bending machinery in the production of a sheet metal component to meet a given parallel line development specification [RL, SM, EP]		
P7 use fabrication forming machinery in the production of a sheet metal component to meet a given parallel line development specification [RL, SM, EP]		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<p>P8 apply an appropriate fabrication joining method on a component produced to meet a given parallel line development specification. [RL, SM, EP]</p>	<p>M2 select and apply multiple forming/joining methods to fabricate a sheet metal component to meet a given parallel line development specification.</p>	<p>D1 evaluate the use of selected cutting, forming and joining methods in the production of a sheet metal component to meet a given parallel line development specification, and make recommendations for improvement.</p>

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to work experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, workshops, discussions, practical demonstrations, site visits, case studies, internet and/or library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities are undertaken so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to use fabrication forming machinery and they should ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Whichever delivery methods are used, it is essential that tutors stress the importance of operator welfare, sound environmental management and the need to manage the resource using legal methods.

Health and safety issues relating to working with fabrication materials and machinery must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities. Adequate PPE must be provided and used following the production of suitable risk assessments.

Visiting expert speakers could add to the relevance of the subject for learners. For example, blacksmiths or fabricators could talk about their work, the situations they face and the methods they use.

Tutors should consider integrating the delivery, private study and assessment for this unit with other relevant units and assessment instruments learners are taking as part of their programme of study.

Learning outcome 1 requires learners to know about the metals and associated forms of supply commonly used in fabrication processes. This is likely to be delivered through formal lectures, discussions, demonstrations, workshop practicals, site visits and independent learner research.

Learning outcome 2 deals with the marking and cutting needed to meet parallel line development specifications. This is likely to be delivered through supervised workshop practicals and independent learner research, supported by formal classroom activity. In general, learners will work with mild steel in a range of thicknesses in order for learners' experience to be as broad as possible. Other metals could be considered where possible.

For learning outcome 3 learners must use fabrication bending/forming equipment to produce a parallel line development sheet fabrication. Techniques will be discussed, demonstrated and practised in the fabrication workshop to produce simple, quality fabrications in mild steel to a repeatable standard. Delivery is likely to be in the form of supervised practical workshops supported by formal classroom activity.

Learning outcome 4 deals with the use of fabrication joining methods to create a parallel line development sheet fabrication. This learning outcome could be delivered in a similar way to learning outcomes 2 and 3.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Identifying and Selecting Metals in Fabrication (P1, P2, M1) Tutor introduces the assignment brief.
Theory session and directed research: recognising materials and factors influencing choice in fabrication.
Assignment 2: Risk Assessment for a Fabrication Machine (P4)
Tutor introduces the assignment brief.
Theory session and practice: discuss the factors involved and undertaking the risk assessment.
Assignment 3: Using Fabrication Skills (P3, P5, P6, P7, P8, M2, D1)
Tutor introduces the assignment brief.
Demonstrate marking out and cutting equipment and techniques.
Practical application of marking out and cutting equipment and techniques.
Demonstrate bending and forming equipment and techniques.
Practical application of bending and forming equipment and techniques.
Demonstrate joining equipment and techniques.
Practical application of joining equipment and techniques.
Undertake review of own performance in producing a hollow form using parallel line development.
Unit review.

Assessment

For P1, learners must describe the physical and mechanical properties of ferrous and non-ferrous metals metalworkers commonly use in fabrication processes. P1 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, accompanied by appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

Alternatively, evidence for P1 could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written assignment.

For P2, learners must mark out and cut a component to meet a given parallel line development specification. Tutors should identify the specification or agree it through discussion with learners. The specification should cover the usual factors that would be found in industry, such as design criteria, measurements, materials, finish tolerances and any relevant standards. The specification may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair, the size and complexity of the task should be the same for all learners.

P2 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, accompanied by appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

P3 requires learners to use fabrication bending/forming to produce a sheet metal component to meet a given parallel line development specification. Tutors should identify the specification or agree it through discussion with learners. The specification should cover the usual factors that would be found in industry, such as design criteria, measurements, materials, finish tolerances and any relevant standards. The specification may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair, the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for P2.

For P4, learners must apply an appropriate fabrication joining method on a component produced to meet a given parallel line development specification. Tutors should identify the specification or agree it through discussion with learners. The specification should cover the usual factors that would be found in industry, such as design criteria, measurements, materials, finish tolerances and any relevant standards. The specification may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair, the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for P2.

For M1, learners must describe the workshop tests used to identify the ferrous and non-ferrous metals metalworkers commonly use in fabrication processes. Learners could include in their evidence examples of tests that they have carried out for this learning outcome. Evidence could be in the same form as for P1.

For M2, learners must select and apply multiple joining methods to fabricate a sheet metal component to meet a given parallel line development specification. Tutors should identify the specification or agree it through discussion with learners. The specification may be the same as that used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair, the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for P2.

For D1, learners must evaluate the use of selected cutting, forming and joining methods in the production of a sheet metal component and make recommendations for improvement. Tutors should identify the methods or agree them through discussion with learners. Learners are expected to provide evidence for the use of three different cutting, forming and joining methods. The methods may be the same as those used to provide evidence for other grading criteria. Where possible, to ensure assessment is fair, the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for P2.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1	Identifying and selecting metals in fabrication	You are considering the best material to use to make a specified fabrication. You will describe the workshop tests commonly used to identify metals and consider the optimum physical and mechanical properties of ferrous and non-ferrous metals, and make a recommendation.	Written work.
P4	Risk assessment for a fabrication machine	Your blacksmiths' workshop has just taken delivery of a new fabrication machine. You are to produce a risk assessment for its use.	Written work.

Criteria covered	Assignment title	Scenario	Assessment method
P3, P5, P6, P7, P8, M2, D1	Produce and evaluate a hollow form using parallel line development	<p>You are to produce a hollow form using parallel line development. This will involve marking out, cutting, bending and multiple forming and joining methods to meet a given specification.</p> <p>On completion you will evaluate the use of the skills/techniques and make recommendations for improvement.</p>	<p>Observation and assessment of practical work.</p> <p>Written work.</p>

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Fabrication Techniques and Sheet Metal Work	Undertake Workshop Practice for Blacksmithing and Metalworking
Application of Welding Processes	Undertake Drawing Practice for Blacksmithing and Metalworking
	Undertake Oxy-acetylene Welding for Blacksmithing and Metalworking
	Undertake Manual Metal Arc Welding for Blacksmithing and Metalworking
	Undertake Metal Arc Gas Shielded Welding for Blacksmithing and Metalworking
	Undertake Fabrication Drawing for Blacksmithing and Metalworking
	Understanding and Using Fabrication Techniques for Blacksmithing and Metalworking

This unit also has links with Level 3 National Occupational Standards in Fabrication and Welding, and Farriery.

Essential resources

Learners will need supervised access to sufficiently resourced workshops appropriate to their specialist pathways. Workshops should offer a comprehensive range of sheet metal and fabrication tools, machinery and equipment so that learners can progress through the unit. For example guillotines, saws, pillar drills, bending/folding machines, other ancillary equipment and hand tools.

Learners must also have access to a sufficiently diverse range of stock sizes/sections.

Library and IT facilities should be available to enable research techniques, materials, equipment and examples of work.

Additional health and safety information and support should be provided.

Tutors delivering this unit should have vocationally-specific craft knowledge.

Employer engagement and vocational contexts

This unit focuses on developing the practical skills and underpinning knowledge associated with successful fabrication. Tutors are encouraged to make links with local blacksmiths and fabrication and engineering companies. A visit to a successful fabrication company is particularly advised so that learners can appreciate the conversion process within an industrial context.

Indicative reading for learners

Textbooks

Blandford P – *Practical Blacksmithing and Metalworking 2nd Edition* (TAB Books Inc, 1988)
ISBN 9780830628940

Cooper K and Greenwood T – *Technician Fabrication and Welding* (Cassel, 1979) ISBN 9780304300273

Dickason A – *The Geometry of Sheet Metal Work* (Longman, 1987) ISBN 9780582009615

Flood C – *Fabrication Welding and Metal Joining Processes* (Butterworth-Heinemann, 1981)
ISBN 9780408004480

Pritchard D – *Soldering, Brazing and Welding: A Manual of Techniques* (The Crowood Press, 2001)
ISBN 9781861263919

Ross R – *Metallic Materials Specification Handbook* (Kluwer Academic Publishers, 1991)
ISBN 9780412369407

Rural Development Commission – *Wrought Ironwork Gates* (Countryside Agency, 1992)
ISBN 9781869964221

Smith F – *Basic Fabrication and Welding Engineering* (Longman Higher Education, 1975)
ISBN 9780582424319

Yarwood A – *Sheet Metal Drawing and Development* (Thomson Learning, 1983) ISBN 9780304309559

Journals

Artist Blacksmith

Forge

Welding and Metal Fabrication

The Worshipful Company of Blacksmiths newsletter

Websites

en.wikipedia.org/wiki/Fabrication_metal

Fabrication

en.wikipedia.org/wiki/Sheet_metal_forming

Sheet metal forming

www.baba.org.uk

The British Artist Blacksmiths Association

www.gowelding.com

Gowelding

www.hse.gov.uk

Health and Safety Executive

www.megco.uk

Materials Engineering Group

www.roymech.co.uk/Useful_Tables/Manufacturing/Welding.html

Welding processes

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Creative thinkers	producing a risk assessment
Reflective learners	discussing material properties using fabrication forming and joining equipment
Self-managers	discussing material properties using fabrication forming and joining equipment
Effective participators	using fabrication forming and joining equipment.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	researching the physical and mechanical properties of ferrous and non-ferrous metals used by blacksmiths
Team workers	working with others to produce a risk assessment form for workshop machinery.

● Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	producing a risk assessment form for a specified fabrication machine
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching the physical and mechanical properties of ferrous and non-ferrous metals used by blacksmiths
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching the physical and mechanical properties of ferrous and non-ferrous metals used by blacksmiths
ICT – Develop, present and communicate information	
Bring together information to suit content and purpose	describing the physical and mechanical properties of ferrous and non-ferrous metals used by blacksmiths
Present information in ways that are fit for purpose and audience	describing the physical and mechanical properties of ferrous and non-ferrous metals used by blacksmiths
Mathematics	
Use appropriate checking procedures and evaluate their effectiveness at each stage	marking out and cutting out components
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching the physical and mechanical properties of ferrous and non-ferrous metals used by blacksmiths.