Unit 9: Understanding and Using Blacksmithing and Construction Skills

Unit reference number: D/602/0673

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to blacksmithing and construction skills 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 or higher education.

Unit introduction

Blacksmiths are often required to produce complex, utilitarian or decorative work.

This unit expands learners' skills and understanding of the work of the blacksmith by developing a greater breadth and depth of understanding and expertise when producing complex forged artefacts to meet professional expectations and industrial specifications in the workshop.

Learning outcome 1 looks at blacksmithing construction methods. This focuses on developing learners' experience of the range of materials, motifs and construction techniques used by blacksmiths, for example when producing work for typical commission-based gates or railings. This demands a rigorous and professional approach when producing workshop drawings and specifications.

Learning outcome 2 covers the principles and practice of working with dissimilar metals. Learners will produce forged artefacts that demand a broad range of forged elements linked together using a predominance of traditional blacksmith's jointing techniques.

In learning outcome 3, learners will produce a finished, forged complex element/motif. The finishing requirements for completed work for interior and exterior environments will be addressed. Learners should produce specifications covering corrosion control and aesthetic considerations of a variety of finishing processes and coatings.

Learning outcome 4 looks at the production of workshop drawings for complex elements/motifs. Learners should be given the opportunity to research and design their own artefact based on traditional or contemporary form while still satisfying established blacksmithing-based construction methods.

Learning outcomes

On completion of this unit a learner should:

1 Be able to use blacksmithing construction methods

2 Be able to demonstrate principles and practice of working with dissimilar metals

3 Be able to produce a finished, forged, complex element/motif

4 Be able to produce accurate workshop drawings for complex elements/motifs.

Unit content

1 Be able to use blacksmithing construction methods

Construction joint types and methods: tenons eg cut, forged, upsett, offset; pierced pass through; collars; wraps; rivets; halving joints; forge welds eg box, corner, branch, 'T', cage; mechanical fixings eg bolts, wedges, screws, pins; advantages and disadvantages of each method; health and safety; risk assessment

Production: specialised tooling eg punches and chisels, top and bottom tools, drifts and mandrels; historical and contemporary methods eg drilling, punching, use of pre-cut profiles; accuracy eg bend and stretch allowances; marking out eg use of datums, measuring tools; stock estimation; health and safety; cold fitting eg filing, cold chiseling, use of abrasive systems; risk assessment

2 Be able to demonstrate principles and practice of working with dissimilar metals

Materials: metals used within the forge eg steel, stainless steel, copper, bronze, brass, aluminium; stock sections eg bar, plate, sheet, profiles (rolled or cut); physical properties eg effects of hot and cold working; advantages and disadvantages of using different metals in forged constructions eg electro-chemical and dry gas corrosion, cross contamination, aesthetics, patinations; historical and contemporary use

Forging techniques: methods used to forge and join dissimilar metals in the forge; effects of these methods on metals; effects of hot and cold working on dissimilar metals; health and safety; risk assessment

3 Be able to produce a finished, forged, complex element/motif

Processes: complex decorative forged elements eg penny, snub, bolt, bevel, blown back and branch welded scrolls, twists, waterleaves; decorative chiselling/chasing; specialised tooling; health and safety; risk assessment

Finishing: reasons for using finishes; techniques commonly used to finish forged metalwork eg brushing, grinding, filing, etching, waxing, oiling, patination, metal coating, painting; corrosion control methods eg electrolytic, hot metal, paints, powders, dips, sacrificial anodes; historical and contemporary development; health and safety; risk assessment

4 Be able to produce accurate workshop drawings for complex elements/motifs

Drawings: production plan eg method/process plan, gantt chart; setting out; transfer to metal plate; industrial conventions; material estimations; specifications and tolerances; resource and tooling requirements; scaling; health and safety; 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 use forged joining techniques to meet given objectives	**M1** use specified blacksmithing construction and finishing methods to produce a complex artefact to meet given objectives	**D1** evaluate the construction and finishing techniques used making recommendations for improvement.
P2 use mechanical joining techniques to meet given objectives		
P3 use forge welded joining techniques to meet given objectives [EP]		
P4 forge dissimilar metals to meet given objectives		
P5 form dissimilar metals to meet given objectives		
P6 produce a forged complex element/motif to meet a given specification	**M2** describe specified historical and contemporary blacksmithing finishes; give reasons for their uses.	
P7 use finishing techniques on a complex element/motif to meet a given specification [TW]		
P8 produce accurate workshop drawings to meet a given specification for a complex element/motif		
P9 use workshop drawings to meet a given specification for a complex element/ motif [CT, SM]		

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

Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will have links to industrial experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised workshop practicals, research using the internet and/or library resources 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 prior to any work-related activities so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to produce a complex element/motif and they should be encouraged to 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 Pearson website.

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

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

Health and safety issues relating to working in the forge environment must be stressed and regularly reinforced, and risk assessments must be undertaken prior to practical activities. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments.

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 looks at blacksmithing construction methods. Delivery is likely to be through formal lecture, discussion, workshop practicals, site visits and independent learner research.

Learning outcome 2 covers the principles and practice of working with dissimilar metals. This is likely to be delivered through formal lecture, discussion, workshop practicals, site visits and independent research. Learners should be encouraged to develop a consistent approach to the manufacturing process across all of the learning outcomes by producing more complex artefacts covering a broadening range of skills.

Learning outcome 3 covers the production of finished, forged complex elements/motifs. This is likely to be delivered through formal lecture, discussion, workshop practicals, site visits and independent learner research. Using industrially relevant forge equipment, learners need to research the properties of a range of materials and finishing processes to gain knowledge of managing different working environments. Differing sections and sizes of mild steel should be used to produce the samples for learners to have as broad as possible experience of the elements.

Learning outcome 4 looks at the interpretation, production and use of workshop drawings. This is likely to be delivered through formal lecture, discussion, drawing studio/office and workshop practicals, site visits and independent learner research. As learners become more competent in individual techniques they should be encouraged to design artefacts requiring the use of several techniques based on traditional or contemporary form.

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 learners** 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: Workshop Drawings (P8) Tutor introduces the assignment brief. Following the introduction of tutor-set components/artefacts including tolerances, the learner produces drawings and estimations incorporating the required construction and finishing specifications.
Tutor introduction and demonstration of drawing methods as appropriate during the project.
Learner practice and production of drawings.
Learner assessment/feedback.
Assignment 2: Historical and Contemporary Blacksmithing Finishes (M2) Tutor introduces the assignment brief. Learners are asked to produce a presentation covering issues such as the aesthetics, economics, corrosion control and safety involved with selecting, sourcing and applying historical and contemporary blacksmithing finishes.
Learners provides evidence (orally, written or presentation) for at least 5 finishes. Evidence could be in the form of written or verbal feedback using workshop maintenance systems.
Learner research and assignment preparation/writing.
Student assessment/feedback.
Assignment 3: Using Construction Techniques To Produce a Complex Artefact (P1, P2, P3, P4, P5, P6, P7, P8, P9, M1, D1) Tutor introduces the assignment brief. Following the introduction of tutor-set components/artefacts including specifications, the learner produces component(s)/artefacts(s) using the required construction and finishing processes within the set tolerances. Learners evaluate process and product as set against specification and make recommendations for improvement. When finishing, external services such as galvanisers could be introduced and used where appropriate.
Tutor introduction and demonstration of construction and finishing processes as appropriate during the project.
Learner practice and production of components/artefacts.
Learner research, production of workshop records and final evaluation.
Student assessment/feedback.
Visiting lecturer, workshop/site visit to metal finishers.
Unit review.

Assessment

For P1, P2 and P3 learners must use selected blacksmithing construction methods to meet given objectives. Tutors should identify the construction methods and objectives or agree them through discussion with learners. The construction methods and objectives may be the same as those used to provide evidence for other grading criteria. Where possible, to ensure fairness of assessment, the size and complexity of the tasks should be the same for all learners.

Learners are expected to provide evidence covering all of the construction methods listed in the unit content. P1, P2 and P3 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.

For P4 and P5, learners must work with dissimilar metals to meet given objectives. Tutors should identify the metals and objectives or agree them through discussion with learners. The metals and objectives may be the same as those used to provide evidence for other grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least two dissimilar metals. Evidence could be in the same form as for P1, P2 and P3.

P6 and P7 require learners to produce a finished, forged complex element/motif to meet a given 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 fairness of assessment the size and complexity of the task should be the same for all learners. The specification should cover normal factors that can be found in industry, for example, design criteria, measurements, materials, finish tolerances and any relevant standards. Evidence could be in the same form as for P1, P2, P3, P4 and P5.

For P8 and P9, learners must interpret, produce and use accurate workshop drawings to meet a given specification for a complex element/motif. 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 fairness of assessment, the size and complexity of the task should be the same for all learners. The specification should cover normal factors that can be found in industry, for example design criteria, measurements, materials, finish tolerances and any relevant standards. Evidence could be in the same form as for P1, P2, P3, P4 and P5.

For M1, learners use specified blacksmithing construction methods to produce an artefact to meet given objectives. 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 fairness of assessment, the size and complexity of the task should be the same for all learners. The specification should cover normal factors that can be found in industry, for example design criteria, measurements, materials, finish tolerances and any relevant standards. Evidence could be in the same form as for P1, P2, P3, P4, P5, P6, P7, P8 and P9.

M2 requires learners to discuss the use of both historical and contemporary finishes and corrosion control methods in the production of complex elements/motifs. Learners are expected to produce evidence that is wide ranging. They could include examples of finishes that they have used or seen during the delivery of this unit. Evidence could take the form of a pictorial presentation with notes (possibly using software or an overhead projector) or a written assignment.

For D1, learners must evaluate the construction and finishing techniques used on a completed artefact to meet a given specification and make recommendations for improvement. Tutors should identify the artefact and specification or agree them through discussion with learners. Recommendations for improvement must be appropriate and viable—these could be identified during the making process. Where appropriate,

improvements to making quality should be demonstrated within the components/artefacts produced. The artefact and specification may be the same as those used to provide evidence for other grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for M1 and M2.

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 Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P8	Workshop Drawings	You are working as a self-employed Blacksmith and have asked another smith to make some components for a job you are doing. You need to prepare working drawings and specifications for the components.	Drawings and specifications. Forging estimations.
M2	Historical and Contemporary Blacksmithing Finishes	As part of a consultancy contract with English Heritage you have been asked to inspect a potential restoration/reproduction project and discuss potential metal finishes that may have been or could be applied.	Oral questioning. Written assignment or presentation. Finish samples. Visual records. Work logs or other relevant learner notes and drawings. Research.
P1, P2, P3, P4, P5, P6, P7, P8, P9, M1, D1	Using Construction Techniques To Produce a Complex Artefact	As a blacksmith working within the fields of restoration or reproduction you have been asked by English Heritage to produce accurate samples of forged components/ artefacts by working to drawings and specifications using a range of construction techniques.	Practical production of elements and motifs. Observation records completed by learners and the tutor. Work logs or other relevant learner notes and drawings. Witness statements.

Links to other BTEC units

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

Level 2	Level 3
	Understanding and Using Forging Techniques for Blacksmithing and Metalworking
	Undertake Drawing Practice for Blacksmithing and Metalworking
	Undertake Forge Practice for Blacksmithing and Metalworking
	Undertake Blacksmithing Processes
	Understanding and Using Blacksmithing Installation Skills
	Undertake Fabrication Drawing for Blacksmithing and Metalworking

Essential resources

Learners will need supervised access to sufficiently resourced forge workshops appropriate to their specialist pathways. They should contain a comprehensive range of blacksmithing and forge tools, including solid fuel forge hearths, anvils, leg vices, power hammers supported by a range of tongs, hammers, swages, fullers and other ancillary equipment. A sufficiently diverse range of materials and stock sizes/sections, eg mild steel, tool steels, alloys, both ferrous and non-ferrous copper, bronze, brass, stainless steel, aluminium, will also be required.

Areas for fitting and finishing should be available, with access to suitable application and coating facilities.

Learners will also need access to a drawing office/studio space suitable for the observational and technical drawing activities. The principal features and items of equipment should include technical drawing equipment and art materials, for example drawing boards, compasses, set squares, measuring equipment and consumables. Library and IT facilities should be available, with access to unit-specific examples of drawing practice and internet facilities to enable research into techniques, materials, equipment and work examples.

Health and safety considerations require sufficient facilities to be provided to allow for one forging station per learner. 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 introducing and developing the practical skills and underpinning knowledge associated with forged constructions and metal finishing. Tutors are encouraged to promote learner/employer links by arranging industrial visits, specifically to metal finishers, eg galvanisers.

Delivery of personal, learning and thinking skills (PLTS)

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Creative thinkers	producing accurate workshop drawings to meet a given specification for a complex element/motif
Team workers	producing a forged complex element/motif to meet a given specification
Self-managers	using workshop drawings to meet a given specification for a complex element/motif
Effective participators	using specified blacksmithing welding and forging methods.

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	describing specified historical and contemporary blacksmithing finishes; give reasons for their uses
Reflective learners	evaluating the construction and finishing techniques used to produce a complex artefact to meet a given specification and making recommendations for improvement to meet craft standard, using craft samples to demonstrate understanding where appropriate.