

SQA Advanced Unit Specification

General information for centres

Unit title: Welding Principles and Applications 2

Unit code: HV3N 47

Unit purpose: This Unit is designed to introduce the candidate to the selection of specialised welding processes (laser; electron beam; explosive; ultrasonic; stud; plasma arc; electro-gas; thermit; cold pressure) for specific applications, using knowledge of welding process principles, process parameters and selection criteria.

On completion of the Unit the candidate should be able to:

- 1 Demonstrate an understanding of welding processes.
- 2 Explain the importance of process variables/parameters in welding and weld quality.
- 3 Select a welding process or processes for a specified application.

Credit points and level: 1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: It would be an advantage for candidates to have completed a National Certificate in Fabrication and Welding, National Certificate in Engineering Practice or a Higher in Fabrication Engineering. It would be beneficial if the candidate had successfully completed the SQA Advanced Unit Welding Principles and Applications 1 (HV2T 47) before attempting this Unit.

Core skills: There may be opportunities to gather evidence towards the Core Skills of Numeracy and Problem Solving in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

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Assessment: The assessment of this Unit should take the form of one assessment paper in which all Outcomes are combined and the assessment event should last no longer than two hours. The assessment paper should be composed of a series of structured questions related to a case study.

In the case study the following welding processes may be considered:

laser; electron beam; explosive; ultrasonic; stud; plasma arc; electro-gas; thermit; cold pressure.

The candidate will select a welding process or processes from those listed for a specific application, demonstrating a knowledge of the principles and requirements of welding processes.

The assessment should be conducted under controlled and supervised conditions.

An assessment exemplar will be available for this Unit.

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SQA Advanced Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Demonstrate an understanding of welding processes

Knowledge and/or skills

- ◆ methods of obtaining energy for welding
- ◆ welding plant and equipment
- ◆ mechanisms for protecting the weld pool area from atmospheric contamination
- ◆ consumables required for specific welding processes

Evidence requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of this Outcome at least 60% of the knowledge and/or skills items should be sampled.

A different sample question should be asked each time the Outcome is assessed. Candidates must provide a satisfactory response to assessed questions.

Outcome 2

Explain the importance of process variables/parameters in welding and weld quality.

Knowledge and/or skills

- ◆ the control of variables in welding processes
- ◆ effects of process variables
- ◆ essential and non essential variables
- ◆ variables associated with welding operator: manual or mechanised
- ◆ joint preparations

Evidence requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of this Outcome at least 60% of the knowledge and/or skills items should be sampled.

A different sample question should be asked each time the Outcome is assessed. Candidates must provide a satisfactory response to assessed questions.

Outcome 3

Select a welding process or processes for a specified application

Knowledge and/or skills

- ◆ criteria for selection of a welding process
- ◆ criteria for selection for a specified application

Evidence requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of this Outcome at least 60% of the knowledge and/or skills items should be sampled.

A different sample question should be asked each time the Outcome is assessed. Candidates must provide a satisfactory response to assessed questions.

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Administrative Information

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Unit title:	Welding Principles and Applications 2
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SQA Advanced Unit specification: support notes

Unit title: Welding Principles and Applications 2

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

Outcome 1

This Outcome concentrates on the principles of welding processes.

It looks at how energy for welding is obtained. Assistance for this can be gained from Houlcroft's booklet 'Welding Processes' where welding processes are classified according to how energy for welding is classified (eg thermo-chemical and gas shielded arcs etc). This booklet, although not a new publication, provides good guidance on the range of welding processes available at the time of publication. Attention should also be paid to the developments in welding process since the publication of 'Welding Processes'.

Part of the same publication also refers to the methods by which weldpools and weld areas are, or need to be, protected from atmospheric contamination (eg mechanical exclusion gas shields etc). It is also a requirement that aids to shielding are also considered (eg back purging, backing foams, tiles etc.)

An important consideration in the operation of a welding process is the plant/equipment required to operate and carry out the joining process. The importance of particular equipment and components for the process to operate should be emphasised.

The requirements of a welding process that would be classified as welding consumables. such as fillers, shield gas, electrodes etc. In some cases where consumables such as fillers are not required.

Outcome 2

The control of welding process variables or parameters of each welding process to control energy/heat input and the quality of the weld/ deposited weldmetal.

Importance should be placed on the effects of changes to process variables/parameters on the quality of the weld (eg the effect that increasing or decreasing the welding current when welding using the plasma arc/arc plasma process will have on the size or shape of the weld pool).

Candidates should be familiar with what are considered as essential and non-essential process variables. The changes to process variables that will affect the size, shape and quality of the weld or weld deposit. ASME IX provides good guidance on essential and non-essential variables for welding processes.

Consideration must also be given to the variables associated with progression along the joint. The movement of the torch/gun/welding head (eg speed of travel angle of electrode) whether associated with a mechanised or manual process.

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Welding processes may or may not require the edges' joint faces to have some form of re- shaping to provide a joint preparation to allow the welding through the full thickness of the materials being joined. It would be useful for the candidates to be familiar with the joint preparations in use and those associated with specific welding processes or in general use. The costs associated with removal of material before welding and the need to replace removed material in the form of added filler.

Outcome 3

The criteria used to select a welding process are an important factor in the application or in its use. It may be that oxides need to be removed before or during welding or that fillers need to be added to provide deoxidants to the weldpool during welding as is required in some cases when welding carbon steels.

Other considerations would normally be type of material; thickness/section of material; heat input(output of the process); width of weld/heat affected zone; joint access/joint geometry welding position; workshop or on site requirement; need for highly skilled labour and the economics of the welding/joining process.

Guidance on the delivery and assessment of this Unit

In delivering this Unit centres should be aware of the developments in welding and are expected to review teaching and learning materials from time to time.

There is an obligation on centres to make candidates aware of safety requirements associated with individual welding processes.

It would be of advantage to the candidate to receive regular feedback on progress through this Unit by formative tutorials.

Final assessment for this Unit will be an end test as detailed in the section on assessment.

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards the Core Skills of Numeracy and Problem Solving in this Unit.

Open learning

This Unit is essentially a technology based Unit. Opportunities could be made available for open/ flexible learning and the opportunity should be available for assessment on demand.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Welding Principles and Applications 2

This Unit will give you the opportunity to understand the principles of welding processes and how they are selected for a particular application.

You will gain an understanding of the equipment/plant consumable requirements for welding processes, the importance of the variables/parameters associated with welding processes and the need for their strict control in achieving reliable and quality welds.

You will also learn about the criteria used in the selection of a welding process for a specific application.

Throughout the course of the Unit you will undertake formative assessment tutorials that will not affect the result of final assessment.

Assessment of this Unit will be in a closed-book end test lasting no longer than two hours. The test will be in the form of structured questions related to a case study where a pass mark is set at 50% of the available marks.