

SQA Advanced Unit Specification

General information for centres

Unit title: Fabrication and Welding Materials

Unit code: HV41 47

Unit purpose: This Unit is designed to enable candidates to develop knowledge and understanding of a range of commonly used metals and alloys and the factors affecting their properties and use. The candidates will also develop their knowledge of factors affecting weldability and how to prevent or retard failure states.

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

- 1 Explain the factors affecting the structure of metals and alloys.
- 2 Explain the factors affecting weldability.
- 3 Explain the basic principles of failure in materials.

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, a National Certificate in Engineering Practice or a Higher in Fabrication and Welding Engineering.

Core skills: There may be opportunities to gather evidence towards the Core Skills of Communication, 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.

Assessment: The assessment for all Outcomes of this Unit should be combined together in one assessment paper. The assessment paper should be undertaken by the candidate at one single assessment event in controlled, supervised conditions and should last no longer than two hours. The assessment paper should be composed of structured questions that may relate to a case study.

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

Explain the factors affecting the structure of metals and alloys

Knowledge and/or skills

- ◆ atomic structure
- ◆ solidification
- ◆ alloy types
- ◆ structure modification
- ◆ effects on mechanical properties
- ◆ weld structures

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 factors affecting weldability

Knowledge and/or skills

- ◆ material composition
- ◆ heating and cooling cycle
- ◆ residual stress
- ◆ weldability
- ◆ dilution

SQA Advanced Unit Specification

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

Explain the basic principles of failure in materials.

Knowledge and/or skills

- ◆ hot and cold cracking
- ◆ lamellar tearing
- ◆ fatigue
- ◆ brittle failure
- ◆ corrosion

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.

SQA Advanced Unit Specification

Administrative Information

Unit code:	HV41 47
Unit title:	Fabrication and Welding Materials
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SQA Advanced Unit specification: support notes

Unit title: Fabrication and Welding Materials

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

Atomic structures formations, lattice structures face centred, body centred etc. Interstitial and substitutional alloys. Solid solubility, saturation, precipitation and eutectic. Equilibrium diagrams ferrite, austenite, martensite and pearlite.

Solidification nuclei dendrite growth, grain formation in an ingot, in a weld. Types of grain and grain size, changes to grain size and shape by forming, joining or heat treatment. Heat treatment processes common to fabrication and welding. Effects on mechanical properties by forming, joining and heat treatments. Grain directionality caused by rolling/forming.

Grain structures found in single run and multi run welds. Reasons for grain shape and size in welds.

Outcome 2

The effects of material composition on weldability of metals and alloys in carbon steels low alloy steels, stainless steels, austenitic, duplex and super duplex. Assessment of weldability of non ferrous metals and alloys and commonly fabricated metals and alloys. Assessing the weldability of steels using EN 1011. The welding cooling cycle, pre and post welding heat treatments in reducing residual stress, residual stress patterns showing tensile and compressive stresses, fast and slow patterns. The relationship between residual stress and distortion. Use T.T.T. and C.C.T. diagrams.

The control of weld composition by controlling dilution of the deposited weldmetal weld. In stainless steels the use of Schaffer and Delong diagrams, chromium and nickel equivalents and ferrite number. The formation of sigma phases effects on toughness.

Outcome 3

The mechanisms that cause cold cracking or cracking that are considered to have taken place during the cooling cycle. Hot cracking where cracking takes place during solidification. Methods of preventing cracking by controlling the heating cooling cycle, the hydrogen content of welds and the use of EN 1011.

The causes of lamellar tearing and the use of EN 1011 recommendations on its prevention. Explanation of fatigue and its causes. The relationship between stress and stress cycles (S-N curves), the effects of notches and weld shape on fatigue life.

SQA Advanced Unit Specification

An explanation of fracture taking place in a manner where no deformation or necking takes place. Conditions where brittle fracture may occur and how it can be prevented.

The conditions where corrosion can take place. Materials that are susceptible to corrosion and materials considered to have resistance to corrosion. Types of corrosion, chemical and electrolytic. Prevention of corrosion by protection and sacrificial protection

Guidance on the delivery and assessment of this Unit

The Unit was developed as one of the core parts of the SQA Advanced Certificate in Fabrication, Welding and Inspection Award. It should be delivered early as this enables candidates to utilise the materials skills, knowledge and understanding gained in their consideration when progressing through the fabrication and welding subjects.

Opportunities for developing Core Skills

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

Open learning

If this Unit is delivered by open or distance learning methods, additional resources will be required for candidate support, assessment and quality assurance.

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.

SQA Advanced Unit Specification

General information for candidates

Unit title: Fabrication and Welding Materials

This Unit is designed to provide you with an understanding of the use of materials in the fabrication and welding industry.

You will learn metallurgical structures and the effect of alloys on the materials used in fabrication and welding. The weldability of certain materials can produce problems and these usually require to be addressed prior to joining and fabrication.

The Unit also enables you to understand the principle of failures in material in a variety of situations and produce solutions to these problems.

The Unit is assessed using one written assessment paper. The assessment should be conducted under controlled supervised conditions and should last no longer than two hours.