

SQA Advanced Unit Specification

General information for centres

Unit title: Alternative Machining Operations

Unit code: HV31 47

Unit purpose: This Unit has been designed to allow candidates to gain an insight into the operational principles and applications of a range of specialist machining operations which do not depend on the use of conventional cutting tools. It is aimed at those candidates who intend to work as advanced engineering crafts persons and are seeking to achieve an SQA Advanced Certificate in Engineering Practice.

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

- 1 Describe specialist machining operations and applications.
- 2 Select specialist machining operations for given manufacturing applications.

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: Access to this Unit is at the discretion of the Centre. However, it would be beneficial if the candidate has some experience in conventional machining techniques particularly workholding, datum location and general health and safety considerations as they apply to machine shops and machinery.

Core Skills: There are opportunities to develop the Core Skills of Written Communication at SCQF level 6, Critical Thinking at SCQF level 5 and Review and Evaluation at SCQF level 5 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 for Outcome 1 should be in the form of a single assessment paper taken at a single assessment event lasting one hour and carried out under supervised, controlled conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Outcome 2 should be assessed by candidates producing a report of between 750 and 1,000 words plus diagrams, appendices etc based on a Case Study in which the candidate has to identify and evaluate specialist machining operations for given applications and decide which is the most appropriate operation for each application. Reports should be developed in the candidate's own time.

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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

Describe specialist machining operations and applications

Knowledge and/or skills

- ◆ Wire-cutting Electro-discharge machining
- ◆ Die-sinking Electro-discharge machining
- ◆ Electro-chemical etching
- ◆ Ultrasonic machining
- ◆ Laser machining
- ◆ High-pressure water-cutting
- ◆ Rapid Prototyping

Evidence Requirements

Evidence for the knowledge and/or skills items in Outcome 1 should be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown under the knowledge and/or skills items in Outcome 1. In any assessment of the Outcome **five out of seven** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to for see what items they will be questioned on, a different sample of five out of seven knowledge and/or skills items are required each time the Outcome is assessed. Candidates must provide a satisfactory response to all items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to:

For Wire-cutting Electro-discharge machining describe

- ◆ process Characteristics: spark generator, dielectric fluid – de-ionised water, work piece material, wire material, wire diameter, work holding device, accuracy, removal rates, surface finish
- ◆ specific applications: progression press tools, injection mould tools, blanking dies, die-sinking electrodes, micro-machining

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For Die-sinking Electro-discharge machining describe

- ◆ process Characteristics: spark generator, dielectric fluid – mineral oil, work piece material, electrode material, electrode shape, accuracy, removal rates, surface finish
- ◆ specific applications: injection mould tools, high speed turbines, micro-machining

For Electro-chemical etching describe

- ◆ processes: electrolysis, machining, grinding
- ◆ process characteristics: power supply, tool-to-workpiece relationship, extraction system, electrolyte, accuracy, removal rates, surface finish
- ◆ specific applications: batch production, 3D features, deburring, grinding

For Ultrasonic machining describe

- ◆ process Characteristics: oscillation generation, tooling, abrasive circulation
- ◆ specific applications: non-metallic materials machining, welding, semi-conductor slicing, deep hole drilling

For laser machining describe

- ◆ process characteristics: laser beam generation, pulsing, carbon dioxide laser
- ◆ specific applications: laser cutting, welding

For high-pressure water-cutting describe

- ◆ processes: pure water and abrasive water-jet cutting
- ◆ process Characteristics: orifice, pump, minimal heat, simple fixturing and no tool change
- ◆ specific applications: prototypes, batch production, 2D or 3D, soft or hard materials

For rapid prototyping

- ◆ processes: stereolithography, 3D printing, selective laser sintering, fused deposition modelling
- ◆ process benefits: reduced lead time on prototype, decreased product development time, increased product complexity

The assessment for Outcome 1 should be in the form of a single assessment paper. This assessment paper should be taken at a single assessment event lasting one hour and carried out under supervised, controlled conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Assessment guidelines

Such a paper should be composed of an appropriate balance of short answer and restricted response questions on four of the seven processes and a more detailed explanation of one of the remaining three processes.

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Outcome 2

Select specialist machining operations for given manufacturing applications

Knowledge and/or skills

- ◆ Key factors in manufacturing applications
- ◆ Matching factors to specialists operations
- ◆ 'Best fit' specialist machining operation

Evidence Requirements

All knowledge and/or skills items should be assessed.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing the candidate is able to:

- ◆ identify and evaluate the key factors (eg surface finish, efficiency, cost of equipment, maintenance costs etc) associated with the given application
- ◆ compare specialist machining operations in terms of meeting the key factors
- ◆ identify 'best fit' specialist operation to meet key factors

Candidate evidence should be presented in the form of a report of between 750 and 1,000 words plus diagrams, appendices etc based on a Case Study in which the candidate has to identify and evaluate specialist machining processes for a minimum of three given applications. Reports should be developed in the candidates own time.

Centres should make every reasonable effort to ensure the assignment is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Centres may wish to issue candidates with suitable guidance notes on the best way to structure their reports.

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Administrative Information

Unit code:	HV31 47
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SQA Advanced Unit Specification: support notes

Unit title: Alternative Machining Operations

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

This Unit has been written in order to allow candidates to develop their knowledge and understanding of the principles of operation and applications of the following specialist machining operations which do not rely on conventional cutting tools:

- 1 Wire-cutting Electro-discharge machining.
- 2 Die-sinking Electro-discharge machining.
- 3 Electro-chemical etching.
- 4 Ultrasonic machining.
- 5 Laser machining.
- 6 High-pressure water-cutting.
- 7 Rapid Prototyping.

This Unit has been developed as an optional unit within the SQA Advanced Certificate in Engineering Practice awards. The Unit is a 1-credit SQA Advanced Unit at SCQF level 7.

It is suggested that Outcome 1 covering the description of the various specialist Machining operations should be delivered and assessed in 32 hours and Outcome 2 involving the selection of an appropriate specialist machining operation for a given application should be covered in 8 hours.

Guidance on the delivery and assessment of this Unit

This Unit should be delivered by a combination of lectures, group discussions and practical demonstrations of the specialist machine processes. Visual aids such as charts, drawings, video etc. will also assist learning. Formative assessment in the form of tutorial questions will assist candidates to consolidation learning. Industrial visits to see the specialist machining operation being used in practice is highly recommended.

Candidates will have opportunities to develop Written Communication skills through undertaking tutorial exercises in Outcome 1, in writing responses to the questions in the assessment paper to Outcome 1 and in preparing the report in Outcome 2. Opportunities will also exist for candidates to develop both Critical Thinking and Review and Evaluation skills while undertaking formative and summative assessment for Outcome 2.

Information on Evidence requirements and Assessment guidelines is given after Outcomes 1 and 2 in the SQA Advanced Unit specification: statement of standards section.

The assessment paper should take place after Outcomes 1 has been delivered and the report should be completed after Outcomes 2 has been finished. Candidates will normally require guidance on the best way to structure and present their report for Outcome 2.

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Opportunities for developing Core Skills

There are opportunities to develop the Core Skills of Written Communication at SCQF level 6, Critical Thinking at SCQF level 5 and Review and Evaluation at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Open learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regards to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessment, whether done at a single or multiple events, was conducted under controlled, supervised conditions.

To keep administrative arrangements to a minimum, it is recommended that for distance learning candidates the assessment paper for Outcome 1 is done at a single assessment event following the guidance given in the Evidence requirement section of Outcome 1 in the SQA Advanced Unit specification: statement of standards section.

For further information and advice, please see *Assessment and Quality Assurance of Open and Distance Learning* (SQA, February 2001 – publication code A1030).

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: Alternative Machining Operations

The specialist machining operations covered in this Unit are to be found in a number of manufacturing industries. Electro-discharge machining and electro-chemical etching are very widely used whilst ultrasonic machining and laser machining are less so. Water jet cutting is, however, the fastest growing technique due to its great versatility and advantages such as elimination of tool changes, etc. Rapid prototyping is also a fast growing technique and is used in the early stages of product design.

The centre where you study this Unit will probably deliver this Unit by a combination of lectures, group discussion and videos demonstrating the various operations. The centre may also arrange one or more industrial visits for on-site demonstrations of the specialist machining operations.

The assessment for Outcome 1 will be in the form of a single assessment paper taken at a single assessment event lasting one hour and carried out under supervised, controlled conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Outcome 2 will be assessed by a written report of between 750 and 1,000 words plus diagrams, appendices etc. based on a Case Study in which you will have to identify and evaluate specialist machining processes for given applications and select the most appropriate process for each application. You will write up the report in your own time.