

SQA Advanced Unit Specification

General information

Unit title: Computer Aided Engineering (CAE) and Prototyping (SCQF level 8)

Unit code: HV54 48

Superclass: XA

Publication date: November 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit has been designed to enable learners to develop the knowledge and skills to use standard commercially available software to produce engineering designed products. In addition the learner will be able to review a variety of rapid prototyping (RP) techniques.

Outcomes

On successful completion of the unit the learner will be able to:

- 1 apply general purpose software for an integrated engineering application
- 2 export CAD data to an engineering software application
- 3 use 3D modelling software to generate 3D models and export data for further engineering applications
- 4 describe current RP techniques.

Credit points and level

2 SQA Credits at SCQF level 8: (16 SCQF credit points at SCQF level 8)

SQA Advanced Unit Specification

Recommended entry to the unit

Learners should have knowledge and skills in basic information technology and 2D CAD skills. This may be evidenced by possession of the following SQA Advanced Units: *Information Technology: Applications Software 1, Computer Aided Draughting for Engineers and CNC.*

Core skills

Opportunities to develop aspects of core skills are highlighted in the support notes for this unit specification.

There is no automatic certification of core skills or core skill components in this unit.

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.

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

SQA Advanced Unit: statement of standards

Unit title: Computer Aided Engineering (CAE) and Prototyping
(SCQF level 8)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

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. Learners 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

Apply general purpose software for an integrated engineering application.

Knowledge and/or skills

- ◆ Word processing
- ◆ Spreadsheet
- ◆ Database
- ◆ Presentation software

Outcome 2

Export CAD data to an engineering software application.

Knowledge and/or skills

- ◆ File types
- ◆ Attribute data
- ◆ Geometry format
- ◆ Application of exported CAD data

Outcome 3

Use 3D modelling software to generate 3D models and export data for further engineering applications.

Knowledge and/or skills

- ◆ 3D model creation
- ◆ 2D engineering drawing from 3D model
- ◆ CNC code (from 3D)
- ◆ Flow analysis
- ◆ Stress analysis
- ◆ Mechanical properties
- ◆ Assembly simulation

SQA Advanced Unit Specification

Outcome 4

Describe current rapid prototyping (RP) techniques.

Knowledge and/or skills

- ◆ RP file types
- ◆ Advanced applications for RP
- ◆ RP technologies, eg:
 - Selective laser sintering (SLS)
 - Laminated object manufacturing (LOM)
 - Fused deposition modelling (FDM)
 - Solid ground curing (CSG)
 - 3D printing
 - Any other modern RP methods

Evidence requirements for this unit

Outcome 1

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 tasks. Each learner must demonstrate that they can perform tasks based on a sample of the items shown above. In any assessment of the outcome **three out of four** knowledge and/or skills items should be sampled. Learners must provide a satisfactory response to all three items.

In order to ensure that learners will not be able to foresee which items they will be assessed on, a different sample of three out of four knowledge and/or skills items is required each time the outcome is assessed. Learners must provide a satisfactory response to all three items.

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

- ◆ produce formatted word processed documents
- ◆ produce engineering analysis using spreadsheet software
- ◆ produce an engineering application using database software
- ◆ use presentation software for presenting an engineering application

Assessment of this outcome must involve the application of three of the above general purpose software applications to the engineering tasks in Outcomes 2, 3 and 4. Learner evidence must be in the form of demonstration or submission of the appropriate computer files. Centres must develop an appropriate checklist to confirm the application of the general purpose software within the engineering contexts in Outcomes 2, 3 and 4.

SQA Advanced Unit Specification

Outcome 2

All of the knowledge and/or skills items must be assessed in this outcome.

Learners will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ recognise the various file types for export and import of geometry and attribute data
- ◆ export CAD graphical and non-graphical data (attribute) into an engineering application
- ◆ use exported data in an engineering application

Centres must provide learners with a CAD drawing, consisting of a minimum of four parts, with no attribute data attached. Each of the parts should have a requirement for five elements of attribute data with varying data types (text, numeric, date). The attribute data should be inserted into the CAD drawing and thereafter exported to the appropriate software. Centres must develop an appropriate checklist to confirm learners have satisfied the bullet points above. Evidence for this outcome should be combined with Outcome 3.

Outcome 3

Evidence for the knowledge and/or skills items in this outcome will be provided on a sample basis. Each learner will need to demonstrate that they can produce correct responses based on a sample of the items shown under the knowledge and/or skills items. In any assessment of the outcome, the **first two** knowledge and/or skills items must always be assessed plus any **two out of the last five** knowledge and/or skills items.

In order to ensure that learners will not be able to foresee which items they will be assessed on, a different sample of two knowledge and/or skills items from knowledge and/or skills bullet points three to seven is required each time the outcome is assessed. Learners must provide a satisfactory response to the first two knowledge and/or skills items plus the sampled two items.

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

- ◆ create a 3D solid model using at least six modelling creation tools
- ◆ produce an engineering drawing from a generated 3D model
- ◆ generate CNC code from exported data
- ◆ apply flow or heat analysis of the exported data
- ◆ apply stress analysis software of exported data
- ◆ apply mechanical analysis software of exported data
- ◆ apply assembly analysis software of exported data

Centres must develop an appropriate checklist to confirm learners have satisfied the sampled knowledge and/or skills items above.

SQA Advanced Unit Specification

Outcome 4

Evidence for the knowledge and/or skills items in this outcome will be provided on a sample basis and in any assessment all three of the knowledge and/or skills is necessary, however for the RP Technologies a minimum of TWO are required.

In order to ensure that learners will not be able to foresee which items they will be assessed on, a different sample of RP technologies should be sampled each time the outcome is assessed.

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

- ◆ describe at least two RP file types
- ◆ describe selective laser sintering
- ◆ describe laminated object manufacturing
- ◆ describe fused deposition modelling
- ◆ describe advanced applications for RP

Learner evidence must be submitted in the form of a report, or a presentation using presentation software, to cover the evidence requirements. The report, or presentation, should be prepared in the learner's own time. Any presentation should last 10 to 15 minutes, be delivered to a minimum of four people and the learner should expect to take questions from the audience. Where the learner uses a presentation, she/he should only be assessed on the technical content of the presentation. Centres should make every reasonable effort to ensure that the report, or presentation, is the learner's own work.

Where copying or plagiarism is suspected learners may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the learner's knowledge and understanding.

SQA Advanced Unit: support notes

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Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this unit

This unit has been designed to provide learners with the knowledge and skills to use 3D solid modelling software to produce 3D solid models and 2D engineering drawings for design, analysis and manufacturing.

Learners will also gain experience in integrating CAE for a number of engineering applications.

The learner will acquire skills in order to use 3D solid modelling software to produce solid models. These models will then be used as the source data for further engineering analysis.

Guidance on approaches to delivery of this unit

This unit has been written to allow learners to develop knowledge, understanding and skills in the following areas of CAE. It is recommended that each outcome is delivered in the times shown below:

- 1 Apply general purpose software for an integrated engineering application **(10 hours)**
- 2 Export CAD data to an engineering software application **(4 hours)**
- 3 Use 3D modelling software to generate 3D models and export data for further engineering applications **(60 hours)**
- 4 Describe rapid prototyping (RP) techniques **(6 hours)**

This unit should be delivered using hands on approach using the application software available, which will allow learners to further develop skills in integration and exchanging information /data of various software.

For Outcomes 1, 2 and 3 learning should be through practical application and model generation.

Outcome 4 should be delivered through lectures and demonstrations with visits to organisations with RP facilities.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Outcome 1 should be assessed as an integral part of Outcomes 2, 3 and 4 by using general purpose software (word-processing, spreadsheets, database and presentation software) in the engineering tasks in Outcomes 2, 3 and 4.

In Outcome 2 learners must export CAD data to an appropriate engineering software application and the assessment should be combined with Outcome 3. Suitable examples to cover the assessment requirements of this outcome could be a health and safety equipment register, a parts list, requisitions for purchase or a Bill of Material.

In Outcome 3 learners must generate 3D models using a variety of modelling creation tools. These models will then be used to generate analysis data for other engineering software applications.

The same components could be used throughout the assessment. It is recommended that a 3D solid model is produced, post-processed for analysis and exported to selected engineering application software. Demonstrations of more advanced analysis would be effective at this stage.

In Outcome 4 learners should produce a report, or presentation, outlining rapid prototyping techniques including advanced applications.

It is recommended that reports should be 400–600 words. Report content could include diagrams, pictures and relevant engineering knowledge applicable to an industrial context. It is at the centre's discretion whether the format of the report/presentation is prescribed, or left to the learner to determine.

Centres should encourage site visits to engineering companies or educational establishments to witness RP in practice.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by information and communication technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing core and other essential skills

There may be opportunities to gather evidence towards the following listed core skills components in this unit, although there is no automatic certification of core skills or core skills components.

<i>Information and Communication Technology (ICT)</i>	SCQF level 6
Critical Thinking	SCQF level 6
Review and Evaluation	SCQF level 6

History of changes to unit

Version	Description of change	Date

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

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SQA Advanced Unit: general information for candidates

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(SCQF level 8)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

This unit has been designed to provide you with the knowledge and skills to use 3D solid modelling software to produce 3D solid models and 2D engineering drawings. 3D modelling is seen as the way forward for the communication of engineering graphical and other specification data. Manufacturing engineers, while not the originators of 3D models, will have to interpret and edit these models in order to plan, create, measure and test the resulting product.

You will also gain experience in integrating CAE data for further engineering applications such as CNC code generation, stress analysis, flow analysis and assembly simulation analysis. The analysis will be at introductory level only to verify the exported data. You will be introduced to rapid prototyping techniques in lectures and industrial visits.

Assessment will be by a series of engineering-related software exercises and reports.