National Unit Specification: general information

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

CODE F39E 11

COURSE Engineering Skills (Intermediate 2)

SUMMARY

This Unit is a mandatory Unit of the *Engineering Skills (Intermediate 2)* Course and has been designed to be taken as part of that Course but can also be taken as a free-standing Unit. It is suitable for candidates with no previous engineering or employment experience.

In this Unit candidates will develop Computer Aided Draughting (CAD) skills and then integrate the skills of mechanical, fabrication, electrical, and electronic developed in the other Units of this Course. Candidates will select and use the correct tools and materials required to design, manufacture/construct, test, evaluate and report their findings on the manufacture/construction of a project selected from a given brief.

Candidates will have the opportunity to develop employability skills across the range of practical activities.

OUTCOMES

1 Design a product from a given project brief.
2 Identify, select, and use tools, materials, and equipment to manufacture/construct the product.
3 Evaluate the results of practical tests on the product.
4 Review and evaluate own employability skills in practical engineering contexts.

Administrative Information

Superclass: VF

Publication date: April 2008

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

RECOMMENDED ENTRY

Entry is at the discretion of the centre but it is recommended that candidates have successfully completed the following Units or equivalent:

F39B 11 *Engineering Skills: Mechanical and Fabrication (Intermediate 2)*
F39C 11 *Engineering Skills: Electrical and Electronic (Intermediate 2)*
F39D 11 *Engineering Skills: Maintenance (Intermediate 2)*

CREDIT VALUE

1 credit at Intermediate 2 (6 SCQF credit points at SCQF level 5*).

**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 Access 1 to Doctorates.*

CORE SKILLS

Achievement of this Unit gives automatic certification of the following:

Complete Core Skill	None
Core Skill component	Critical Thinking at SCQF level 4

Opportunities for developing aspects of Core Skills are highlighted in *Guidance on Learning and Teaching Approaches for this Unit*.

National Unit Specification: statement of standards

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

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.

OUTCOME 1

Design a product from a given project brief.

Performance Criteria

(a) Produce a design specification for the product in accordance with the given brief.
(b) Correctly add dimensions and manufacturing instructions to the design specification.
(c) Produce a CAD drawing of a product part of the design specification to relevant standards.
(d) Produce a hard copy of the CAD drawing.

OUTCOME 2

Identify, select, and use tools, materials, and equipment to manufacture/construct the product.

Performance Criteria

(a) Identify, select, and safely use a range of relevant tools, materials and equipment.
(b) Safely and correctly manufacture/construct the product from the design specification.
(c) Correctly observe safe working practices in all practical activities.

OUTCOME 3

Evaluate the results of practical tests on the product.

Performance Criteria

(a) Identify and use dimensional checks on the completed product correctly.
(b) Test that the functional use of the completed product conforms to the given brief.
(c) Produce a report which includes a valid conclusion on the functionality of the product.
(d) Communicate the findings of the report to a specified audience.

OUTCOME 4

Review and evaluate own employability skills in practical engineering contexts.

Performance Criteria

(a) Review and evaluate own employability skills.
(b) Seek and record feedback on own performance in employability skills.
(c) Make a judgement on own strengths, weaknesses, and learning points in relation to employability skills.
(d) Identify action points for improvement in relation to employability skills.

National Unit Specification: statement of standards (cont)

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

EVIDENCE REQUIREMENTS FOR THIS UNIT

Performance, product, and written/oral evidence is required to show that all Outcomes and Performance Criteria have been achieved.

Performance and product evidence will be supported by assessor checklists. This evidence will be generated from a project consisting of practical activities carried out under supervised conditions.

The evidence may be gathered at different points throughout the Unit.

Candidates will be assessed on the practical activities in the manufacture/construction of a product in a safe manner. The product will be selected from **ONE** of the following project briefs:

1 Design a project which incorporates at least THREE component parts that will LIFT a 1kg weight to a height of 500mm and LOCK the weight at that height.

or

2 Design a circuit diagram and component layout of an electrical/electronic project that will move an object from a horizontal to vertical position and give an audible and visual indication.

or

3 Design a control system that will measure a physical parameter, give an audible and visual warning when the physical parameter changes and activate an output transducer.

or

4 Design a project that will incorporate a minimum of any TWO from the following: Mechanical; Fabrication; Electrical; Electronic; Control.

Whichever project brief is selected, candidates are required to:

- produce a design specification suitable for manufacture
- produce a hard copy of a CAD drawing of a product part to include:
  - two views
  - three line types
  - dimensions
  - orthographic symbol
  - title block
- select and use the correct tools, materials, and equipment, as required, to safely manufacture and assemble the product
- complete dimensional checks on the completed product
- complete functionality tests on the completed product to check for quality, robustness, fitness for purpose before submitting their work for final assessment

National Unit Specification: statement of standards (cont)

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

Where candidates choose to complete option 4 (the integrated project) they can, if appropriate, work in teams. It is essential that the project produced by such a team will be of sufficient complexity and scope to allow all members of the team to make a contribution equal to the manufacture and assembly of a project by an individual candidate.

Where this occurs the assessor must be satisfied that each individual candidate has produced evidence to demonstrate achievement of all Outcomes and Performance Criteria.

Dimensions must be within the stated tolerance of ± 1mm, as expressed in the National Assessment Bank (NAB) material.

Written/Oral Evidence

Candidates are required to:

- complete an evaluation on the functionality of the project using a given pro forma checklist
- complete a short report of between 250 and 400 words, that includes a valid conclusion on the functionality of the project
- communicate the findings of the report to a peer group
- complete a self evaluation review of their own performance against the following employability skills:
  - showing health and safety awareness — to include wearing PPE, safe working practices and understanding a basic risk assessment
  - interpreting engineering drawings and specifications
  - working cooperatively with others — to include seeking advice, following instructions and working in a team
  - planning and preparing for work — to include selection of correct tools and equipment
  - applying time management — to include working to schedule and undertaking a correct sequence of work
  - quality checking own work
  - self review and evaluation — to include identifying strengths and weaknesses, identifying learning points from practical experiences, and having a positive attitude to learning

A signed record of the review must be retained by the assessor as assessment evidence.

The National Assessment Bank (NAB) item for this Unit provides an appropriate candidate review sheet, assessor checklists and functionality pro forma. These exemplify the national standard. Centres wishing to develop their own assessments should refer to the NAB to ensure a comparable standard.

National Unit Specification: support notes

UNIT Engineering Skills: Design and Manufacture (Intermediate 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

This Unit covers the design, manufacture, test, evaluation, report, and presentation of a project at a basic level. The candidate is required to select materials, tools and equipment correctly and safely in the manufacture/construction and assembly of the product.

It is likely that this Unit will be delivered as part of the Intermediate 2 Engineering Skills Course. In this context, candidate will build on the content covered in the other mandatory Units:

F39B 11 *Engineering Skills: Mechanical and Fabrication (Intermediate 2)*
F39C 11 *Engineering Skills: Electrical and Electronic (Intermediate 2)*
F39D 11 *Engineering Skills: Maintenance (Intermediate 2)*

This Unit provides candidates with the opportunity to integrate some of the skills developed in those Units and be introduced to some applications of the design cycle. These should concentrate on functional aspects such as: fit for purpose, dimensional, material, and the manufacture/construction method.

It is important that the learning takes place in a supervised workshop environment for both CAD and practical activities. Basic safe working practices will be included in the content as it is important that candidates adhere to these at all times.

Candidates will work on a range of activities which will enable them to become familiar with a variety of dimensional and functionality tests. During the process of the project design and manufacture the candidate will use engineering terminology and will be able to demonstrate a basic knowledge and understanding of the terminology in everyday practice.

It would be beneficial if candidates were introduced to basic presentation and reporting techniques in order to plan, prepare, and deliver a short report and presentation to their peers on the use and functionality of the project.

This Unit provides opportunities to develop engineering employability skills such as:

- maintaining good timekeeping and attendance
- showing health and safety awareness
- selecting and using engineering tools and materials
- interpreting engineering drawings and specifications
- working cooperatively with others
- planning and preparing for work
- applying time management
- awareness of environmental considerations
- quality checking own work
- self review and evaluation

The context for learning should include the requirement to be clean, presentable, and appropriately dressed for the practical workshop, wearing PPE including protective clothing when required.

Relevant aspects of current health and safety legislation, current COSHH (Control of Substances Hazardous to Health) Regulations and any systems of work relevant to the candidates' workshop/workplace should be explained and adhered to as part of the work of this Unit.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is important there is an induction to the Unit which will include employability skills and health and safety awareness. This Unit involves experiential learning through the various practical experiences and presentation activities in the manufacture, assembly, and testing of a project. Candidates should experience workshop conditions and should be encouraged to perform tasks and conduct themselves in a manner appropriate to the workplace.

General vocational skills, such as selecting and maintaining manufacturing and test tools and equipment, are integrated within the Unit. As well as carrying out practical tasks, candidates will also learn from brief lessons on health and safety and workshop protocol. Teaching and learning approaches will also include demonstrations of functionality and usage tests by tutors. Short lessons on specific aspects of industrial practice and the correct use of tools and equipment will prove invaluable at intervals throughout the learning experience. These may be followed by brief practical sessions in which the candidates practice the testing skills emphasised by demonstrations.

The design incorporates a CAD drawing of a part of the product and it is important that only a reasonable length of time is apportioned to this activity. The recommended time allocated should be no more than 14 hours and the CAD package can be either 2D, 3D or equivalent, depending on centre resources.

Where centres authorise the use of power tools for candidates, this should only be allowed after suitable training and the completion of a risk assessment, and in accordance with current legislation for that candidate age group. Particular attention should be made to specific legislative requirements where school age candidates are involved.

Where centres opt to use power tools it is essential that the safe and correct use of power tools is demonstrated before candidate use. In addition candidates must be made aware of the dangers of misuse or usage without proper training or associated PPE.

Some centres may be able to arrange demonstrations by local firms or power tool manufacturers to emphasise correct and safe usage of power tools.

Teaching and learning on reporting and presentation skills such as recording of relevant test data, valid conclusions derived from test data, selection and use of the appropriate presentation techniques, planning and preparation of a simple presentation, and use of basic presentation equipment, if appropriate, should also be covered.

Integrated into the Unit are the employability skills that employers value. It should be stressed that all the employability skills are developed in this Unit but only specified employability skills will be assessed. Employability skills are a focus of this Unit and should be promoted from Unit induction to Unit completion.

National Unit Specification: support notes (cont)

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

In order to raise the candidates' awareness of local industries and the realities of the workplace, visits to local engineering firms could be arranged, if appropriate. Equally, visiting speakers from local engineering firms should be encouraged. Additional useful material and employment opportunities can be resourced from the research of local engineering firms or from the internet.

This Unit should be delivered by a combination of teaching and learning approaches which could include:

- Lecturing
- Demonstrations
- Practical activities
- Group discussions
- Tutorials
- Site visits
- Audio visual
- Guest speakers

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

In this Unit candidates will perform simple calculations and take measurements. These activities provide good opportunities to develop the Core Skill of *Numeracy*. Candidates will also share workspace, tools, and equipment. This will provide them with a good context in which to learn to work cooperatively with others. Candidates will develop written and/or oral communications skills when reporting on the functionality. Candidates will use IT equipment and skills when operating a CAD package. Candidates will also have the opportunity to develop practical *Problem Solving* skills when working on the design, manufacture and assembly of a project.

Achievement of this Unit gives automatic certification of the Core Skill component of *Critical Thinking* at SCQF level 4.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

The Unit assessment will include the design, manufacture, and assembly of a product, test evaluation of the product, a report and presentation on the functionality of the product, and a candidate review of employability skills. The design, manufacture, assembly, test, report and presentation of a product and the employability skills are assessed throughout the Unit.

The practical skills assessed in this Unit may be:

♦ Design	♦ CAD
♦ Manufacture	♦ Assembly
♦ Mechanical	♦ Fabrication
♦ Electrical	♦ Electronic
♦ Control	♦ Reporting

National Unit Specification: support notes (cont)

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

The design of the project will be assessed by candidates producing a copy of their design specification. In addition, candidates will produce a CAD drawing of a part of the product. Candidates can produce the whole project specification on the CAD package, if they choose to do so.

The assessment of the manufacture and assembly of the product will be evidenced by assessor observation checklists on the practical activities.

It is anticipated that candidates will be given practice in design, manufacture, and assembly techniques prior to assessment. The assessment activities should also make an important contribution to the learning process.

The test evaluation skills assessed in this Unit are:

- dimensional
- functional

The assessment of the test evaluation will be evidenced by a practical exercise supported by assessor observation checklists.

It is recommended that a pro forma is used for the evaluation of test results. Candidates should use the data to prepare and present a short report to a peer group. The report should be between 250–400 words.

The employability skills assessed in this Unit are:

- showing health and safety awareness
- interpreting engineering drawings and specifications
- working cooperatively with others
- planning and preparing for work
- applying time management
- quality checking own work
- self review and evaluation

The assessment of employability skills will be evidenced by a candidate review sheet supported with assessor observation checklists of the practical activities. It is recommended that the candidate review sheet should be completed towards the end of the Unit when the candidate and assessor will have had a reasonable time to make judgement.

If candidates are working as a team on the practical activities, assessors must satisfy themselves that candidates are competent in each aspect of the given task.

National Unit Specification: support notes (cont)

UNIT Engineering Skills: Design and Manufacture (Intermediate 2)

Opportunities for the use of 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 communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003) and SQA Guidelines on e-assessment for Schools (BD2625, June 2005).*

CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.