National Unit Specification: general information

UNIT Energy: Domestic Solar Hot Water Systems (Intermediate 2)

CODE F3FS 11

COURSE Energy (Intermediate 2)

SUMMARY

This Unit is a mandatory Unit of the Intermediate 2 Skills for Work Energy Course. It is intended for candidates who are interested in a career in the energy sector, or who wish to gain some practical skills and knowledge of how the solar hot water energy sector operates. This Unit can also be taken as a stand-alone Unit.

The Unit will introduce a microgeneration heating system which generates heat from solar energy and transfers this heat energy to other appliances through a heat exchanger. The solar panel will be suitable for use in domestic or small scale industrial installations. The learning will take place through a strong focus on practical tasks which will give candidates the opportunity to develop manufacturing, assembly, and testing skills required to build a small domestic solar hot water system.

The development of generic employability skills valued by employers will be an important part of this Unit.

OUTCOMES

1 Connect copper pipes from a pipe work diagram.
2 Produce a team plan for the production and testing of a small scale domestic solar hot water system to a given specification.
3 Contribute as a member of a team to the assembly and testing of a small scale domestic solar hot water system to a given specification.
4 Evaluate the solar hot water panel and the team working process.

RECOMMENDED ENTRY

Entry is at the discretion of the centre.

Administrative Information

Superclass: QB

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Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

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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

There is no automatic certification of Core Skills in this Unit.

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

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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

Connect copper pipes from a pipe work diagram.

(a) Appropriate tools are selected for the task.
(b) Tools and materials are used correctly for the intended purpose.
(c) All steps to complete the task are followed in the correct sequence.
(d) Health and safety requirements are adhered to throughout the activity.
(e) A quality check is carried out on the completed work.

OUTCOME 2

Produce a team plan for the production and testing of a small scale domestic solar hot water system to a given specification.

(a) Contribute constructively to team discussions to establish roles and realistic timescales.
(b) Contribute constructively to team discussions on resources.
(c) Contribute constructively to team discussions on tasks.
(d) Co-operate with others to finalise a comprehensive plan of roles, resources required, and tasks set out in sequence.

OUTCOME 3

Contribute as a member of a team to the assembly and testing of a small scale domestic solar hot water system to a given specification.

(a) Co-operate with others in the organising, sharing, and safe use of tools and materials.
(b) Co-operate with others in maintaining a safe, tidy working area.
(c) Adhere to the agreed plan and work positively to complete tasks in the agreed timescale.
(d) In an agreed role, carry out practical tasks which contribute to the assembly of the solar hot water system.
(e) In an agreed role, carry out practical tasks which contribute to the testing of the system.
(f) Participate in a quality check of the finished work against the given specification.

OUTCOME 4

Evaluate the solar hot water panel and the team working process.

(a) Evaluate the strengths and weaknesses of the planning, assembly, and testing of the solar hot water panel.
(b) Evaluate the advantages and disadvantages of team working.
(c) Evaluate own contribution to work of the team.
(d) Identify action points for improvement in the production of the product and the team working process.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria. Performance and written/oral evidence is required for this Unit. The evidence should be gathered at appropriate points throughout the Unit in supervised, open-book conditions, in response to a given brief.

Performance evidence — Outcome 1

Performance evidence will be generated in response to an assignment consisting of practical activities carried out in supervised workshop conditions. An assessor observation checklist must be completed and signed for each candidate. The practical activities will involve bending and joining of copper pipe for a small scale solar hot water panel from a component drawing. In each task, candidates must demonstrate that they can:

- select appropriate tools for the task
- use tools and materials correctly for the intended purpose
- complete all steps for the task in the correct sequence
- adhere to health and safety requirements throughout the activity
- carry out a quality check on the completed work

Performance and product evidence — Outcomes 2 and 3

Performance evidence will be generated in response to a group assignment which will involve the planning, assembly, and testing of a small scale domestic solar hot water system. Practical activities must be carried out in supervised workshop conditions. An assessor observation checklist must be completed and signed for each candidate to confirm achievement. A completed group plan and the finished product should be retained by each group and used by the assessor in discussions with each candidate. The achievement of each candidate is based on his/her individual contribution to the process and not on the final group products. The assessor checklist should be based clearly on the Performance Criteria for Outcomes 2 and 3.

Written/oral evidence — Outcome 4

Each candidate must evaluate the product and process of team working. The evaluation will take the form of a presentation, which could be written, oral, diagrammatical, and electronic. It may be an individual evaluation or a contribution to a group evaluation, provided that all Performance Criteria are met by each candidate. The evidence will be a completed and signed observation checklist for each candidate.

The National Assessment Bank (NAB) item for this Unit contains an appropriate brief which covers the investigation and presentation requirements of the Unit and an assessor observation checklist. Centres wishing to devise their own assessments must refer to the NAB to ensure a comparable standard.

National Unit Specification: support notes

UNIT Energy: Domestic Solar Hot Water Systems (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

The *Energy: Domestic Hot Water Systems* Unit has been designed to provide candidates with a range of practical skills focused within plumbing technology. Other engineering based skills will also be developed during the assembly of the solar hot water panel. The focus of this Unit is on practical skills and team working skills that the candidate will use to access and organise relevant information, and finally, to present their findings in a clear format.

Candidates will gain knowledge and understanding of using solar energy to generate a source of heat suitable for use in domestic buildings to give hot water, or to provide heat for an underfloor heating system.

Candidates will perform short practical exercises which will demonstrate their competence in joining and bending of copper pipe.

The assembly of a flat plate solar collector panel will consist of pre-prepared parts ready for use in the assembly. Candidates, working in teams, will follow drawings and instructions to produce the solar panel, and test and evaluate, the assembled solar panel's effectiveness.

Candidates will measure any increase in water temperature and draw conclusions on the system's effectiveness.

This solar panel will be a flat plate collector system where the components consist of a frame, flat plate collector, heating pipe/coil, small tank/reservoir, insulation, and clear cover. A small pump to give pressurised fluid flow around the system may be used to simulate a complete installation and to allow the panel to have a greater variety of positions.

Outcome 1 has been developed to ensure each candidate has the opportunity to demonstrate competence in the practical skills required for this Unit. This is good preparation for the team working exercise in Outcomes 2 and 3, ie when building, assembling, and testing the solar panel. Testing of the system should include the use of a thermometer to measure the rise in temperature over a set time.

Technical evaluations should include a comparison of completed work against the criteria given in the brief.

Personal and team working evaluations should be included to highlight the advantages and disadvantages of working in a team and comparing this against the advantages and disadvantages of working as an individual.

National Unit Specification: support notes (cont)

UNIT Energy: Domestic Solar Hot Water Systems (Intermediate 2)

Team working tasks and roles within the team that candidates should consider during the assembly of the solar hot water panel are:

- Roles:
  - leader
  - worker
  - finisher
  - problem solver

- Tasks:
  - completing the assembly within time
  - working co-operatively with others
  - building up relationships between team members
  - getting encouragement from team members
  - giving encouragement to other team members

Teams should ideally be made up of two candidates, but teams of three candidates would be acceptable.

The generic employability skills which are developed in this Unit are:

- maintaining good timekeeping and attendance
- maintaining a tidy work place
- seeking feedback and advice
- following instructions
- working co-operatively with others
- selecting and using tools correctly and for the purpose they were designed
- using Personal Protective Equipment correctly and working safely
- following basic drawings correctly
- checking quality of work
- working to agreed deadlines
- organising work effectively
- working confidently
- willingness to learn new skills or techniques
- working independently
- reflecting on own performance
- learning from past experiences
- developing presentation skills
- developing creativity skills

National Unit Specification: support notes (cont)

UNIT Energy: Domestic Solar Hot Water Systems (Intermediate 2)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is important that there is an induction to the Unit that will include employability skills and health and safety awareness. This Unit involves experiential learning through the various practical experiences and activities. 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 tools and equipment, are integrated with practical activities 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 practical work by lecturers. Short lessons on specific aspects of domestic energy related practice and the correct use of tools will prove invaluable at intervals throughout the learning experience. These may be followed by brief practical sessions in which the candidates practice the skill emphasised in the demonstration.

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.

In order to raise the candidate's awareness of local industries and the realities of the workplace, visits to local energy related companies could be arranged, if appropriate. Equally, visiting speakers from local energy related firms should be encouraged. Additional useful material and employment opportunities can be resourced by researching local domestic energy related companies, manufacturer's literature, or from the internet.

This Unit should be delivered in a workshop environment. Practical demonstrations and practical exercises should be used to ensure candidates have the necessary skills and knowledge to carry out the practical tasks.

It is essential that all candidates have the opportunity to develop the full range of skills. This can be more difficult when candidates are working in teams. It is recommended that all candidates work on small individual exercises in the first instance. This will ensure all candidates can play a full role in this project based Unit. The team working tasks which should be included in the learning and teaching are:

- Compression joints — tools: pipe grips, spanner, jointing compound, pipe cutter
- Solder joints — tools: wire wool, flux, and heating torch
- Pipe cutting and bending — equipment: bend template/former or pipe bender
- The main solar panel elements and their functions — frame, glass, back plate, heating tube, insulation, installation system elements, and their functions — pump, hot water tank, under floor heating, both types of systems — evacuated tube and flat plate collector.

The assembly and testing of the solar panel could include a 12v pump powered by a wind turbine or PV solar panel. This would demonstrate the importance of energy integration and the design of a self sustaining energy system.

The assembly of the domestic hot water panel should start with the team members drawing up a plan which lists the tasks to be undertaken to assemble the solar panel, along with the names of the individuals who have agreed to carry out the set tasks. All the components for the solar panel will be prepared and ready for assembly, although a limited amount of plumbing work will be needed. Once the solar panel has been assembled it will be ready for testing. Initial testing can be carried out in the workshop by placing it by a window and checking for any increase in water temperature. Testing in an outside environment should supplement the initial testing where the actual solar heat available will give a more realistic idea of the effectiveness of the assembled solar panel.

Candidates will be given responsibility, following lecturer/teacher support, for making choices on the format and style of the presentation of their key findings.

Where this Unit is delivered as part of the Intermediate 2 Energy Course, there are good opportunities to integrate the practical skills with the development and assessment of generic employability skills in the *Energy: Employability and Careers* Unit. The candidate's review of progress in employability skills could be based on the practical activities carried out in this Unit.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

In this Unit there are opportunities for candidates to develop the Core Skill of *Problem Solving* during the assembly of the solar hot water panel and in the use of drawings and specifications to solve the build sequence, method, and tools to be used.

There are opportunities to develop aspects of the Core Skill of *Communication*, both in the investigation and presentation, of findings.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

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), SQA Guidelines on e-assessment for Schools (BD2625, June 2005).*

Formative assessment exercises involving candidates in identifying solar hot water systems, sub-systems, and components, including their functions. Practical exercises, including the testing of the assembled solar panel, will play an important part in building up the candidate's knowledge, understanding, and confidence in relation to this Unit.

National Unit Specification: support notes (cont)

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The recommended approach to summative assessment in this Unit is as follows:

Outcome 1

Candidates will carry out practical exercises according to a given brief. In doing this they will produce artefacts which will be used as the basis for a discussion between the assessor and the candidate. The assessment evidence will be the completed signed assessor observation checklist which will detail the essential steps in the process as expressed in the Performance Criteria.

Outcomes 2 and 3

Teams will carry out a practical exercise according to a given brief. In doing this, they will produce and test a small solar hot water panel which will be used as the basis for a discussion between the assessor and the individual. The assessment evidence will be the completed signed assessor observation checklist which will detail the essential steps in the process as expressed in the Performance Criteria.

Outcome 4

The assessment is based on the end product of the Outcome which will be a presentation in a form of the team's choosing. Forms of presentation might include, for example, a short talk, poster, leaflet, diagram, or PowerPoint presentation.

An assessor checklist identifying the critical aspects of the presentation, regardless of form, should be completed and retained for each candidate.

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)**.