



National Unit specification: general information

Unit title: Domestic Solar Hot Water Systems

Unit code: FF2F 12

Superclass: XH

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Version: 01

Summary

This Unit is designed to provide candidates with the necessary knowledge and understanding on the provision of domestic hot water, using typical solar domestic hot water systems. The unit will introduce candidates to the basic design principles, systems components and characteristics of domestic solar hot water systems. The unit will also introduce candidates to fundamental health and safety and installation requirements.

The Unit is suitable for candidates who are undertaking this study for the first time or wish to obtain a basic knowledge of domestic solar hot water systems. The Unit will allow for those currently employed in the building services industry to develop further knowledge specifically related to domestic solar hot water systems.

Outcomes

- 1 Describe the basic design principles of domestic solar hot water systems.
- 2 Describe typical domestic solar hot water systems, their components, characteristics and issues of installation.
- 3 State the relevant Standards, Regulations and Codes of Practice used when installing and commissioning domestic solar hot water systems.

Recommended entry

Entry is at the discretion of the centre.

National Unit specification: General information (cont)

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Credit points and level

1 National Unit credit at SCQF level 6: (6 SCQF credit points at SCQF level 6*)

**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

Opportunities to develop aspects of Core Skills are highlighted in the support notes of this Unit specification.

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

National Unit specification: statement of standards

Unit title: Domestic Solar Hot Water Systems

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

Describe the basic design principles of domestic solar hot water systems.

Performance Criteria

- (a) Describe clearly the terms solar radiation and solar geometry with respect to a domestic solar hot water system.
- (b) Describe clearly the term annual solar fraction, in the context of a particular location.
- (c) In the context of a) and b) above, identify correctly the seasonal variations of solar hot water systems for a given location in Scotland.
- (d) State the main advantages of using solar domestic hot water systems against that of traditional systems.
- (e) Show by means of a basic sketch how the domestic solar hot water system integrates with a traditional domestic hot water heating system.

Outcome 2

Describe typical domestic solar hot water systems, their components, characteristics and issues of installation.

Performance Criteria

- (a) Describe the typical solar thermal collector types found in the UK and provide details of their efficiencies and their variance with respect to optimising solar gain.
- (b) Describe clearly direct and indirect primary domestic solar hot water systems.
- (c) With reference to a) and b) above, provide advantages and disadvantages of each system.
- (d) Describe clearly the two main techniques through which pre-heat storage can be achieved in domestic solar hot water systems.
- (e) Describe clearly how the design of the solar store can affect the performance of the domestic solar hot water systems.

National Unit specification: statement of standards (cont)

Unit title: Domestic Solar Hot Water Systems

Outcome 3

State the relevant Standards, Regulations and Codes of Practice used when installing and commissioning domestic solar hot water systems.

Performance Criteria

- (a) Clearly state the risks associated with installing and commissioning domestic solar hot water systems.
- (b) Clearly state how to minimize risk for personnel when installing solar collectors.
- (c) Clearly state how the Water Regulations and Building Standards apply to domestic solar hot water systems.
- (d) Clearly state the basic need for earthing requirements for collectors and system components of the domestic solar hot water system.
- (e) Clearly state the basic planning requirements and procedures in relation to the installation of domestic solar hot water systems.

Evidence Requirements for this Unit

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria. The evidence should be produced in the form of 'open-book' supervised and controlled conditions.

The evidence may be produced by one or more than one assessment covering all outcomes. A suitable instrument of assessment covering all outcomes could be by short answer, restricted response and structured questions, lasting no more than 90 minutes in duration. An alternative is for candidates to achieve outcomes and performance criteria through an integrated assignment. This will be continually assessed in 'open book' conditions.

Outcome 1

- (a) The candidate must clearly describe, in relation to a domestic solar hot water system, the terms:
 - ◆ solar radiation
 - ◆ solar geometry
- (b) The candidate must clearly describe the term annual solar fraction, in the context of a particular location.

National Unit specification: statement of standards (cont)

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- (c) In the context of (a) and (b) above identify correctly the seasonal variations of solar hot water systems, for a given location in Scotland.
- (d) State at least two main advantages of using solar domestic hot water systems against that of traditional systems.
- (e) Show by means of a basic sketch how the domestic solar hot water system integrates with a traditional domestic hot water heating system.

Outcome 2

- (a) The candidate must clearly describe at least two typical solar thermal collector types found in the UK and provide details of their efficiencies and their variance with respect to optimising solar gain.
- (b) Describe clearly at least two of each of the following:
 - ◆ direct primary domestic solar hot water systems
 - ◆ indirect primary domestic hot water systems
- (c) With reference to (a) and (b) above, provide advantages and disadvantages of each system.
- (d) Describe clearly the two main techniques through which pre-heat storage can be achieved in domestic solar hot water systems.
- (e) Describe clearly how the design of the solar store can affect the performance of the domestic solar hot water systems.

Outcome 3

- (a) The candidate must clearly state the risks associated with installing and commissioning domestic solar hot water systems. This must include:
 - ◆ contamination of water
 - ◆ frost temperature protection
 - ◆ excess temperature protection
 - ◆ installation of panels
 - ◆ panel and associated pipe work support (both structural and thermal)
- (b) The candidate must clearly state how to minimize risks for personnel when installing and commissioning domestic solar hot water systems.
- (c) The candidate must clearly state how the Water Regulations and Building Standards apply to domestic solar hot water systems.

National Unit specification: statement of standards (cont)

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- (d) The candidate must clearly state the basic need for earthing requirements for collectors and system components for domestic solar hot water installations.
- (e) The candidate must clearly state the basic planning requirements and procedures in relation to the installation of domestic solar hot water systems.

National Unit specification: support notes

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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

The candidate must be able to describe the terms solar radiation and solar geometry with respect to a domestic solar hot water system, direct and diffuse solar radiation, preparation for calculation of solar irradiance on vertical, horizontal and pitched surfaces.

Typical output of a domestic solar hot water heating system in relation to classic 2-3-4 bedroom household hot water consumption. Conversion to kilowatt hours per annum and understanding of differences between collected and delivered energy.

Variations in collector output relative to orientation, pitch, geographical location and collector type.

Outcome 2

Evidence of the two main configurations of domestic solar hot water systems must be demonstrated. This can be achieved by candidates completing a partially produced sketch/diagram. This can be achieved either by using a 'pre-heat' vessel or a larger store, for example a twin coil storage vessel.

Main types of indirect solar primary that can be encountered, for example; pressurised, drain-back, vented and thermosiphon.

Knowledge of main difference between traditional domestic hot water systems and domestic solar thermal systems.

Candidates must display fundamental systems components knowledge of collector types/size and water usage and storage size. This can be achieved by identification of either a working model of a pressurised or drain back system or by breakdown of individual components. Candidates should consider system efficiencies hence system performance should be evaluated. Unvented cylinders should be given due consideration in the context.

National Unit specification: support notes (cont)

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Outcome 3

Within the delivery of this unit current relevant Regulations, Standards and Codes of Practice associated with respect to domestic solar hot water systems should be integrated in the teaching and learning process.

Candidates must be able to identify and describe the risks associated with installing and using domestic solar hot water systems. Candidate must detail the measures to be taken to minimise risks. In particular, the following risks should be detailed: contamination of water, frost and excess temperature protection, installation of panels etc at height, and panel and associated pipe work support (both structural and thermal).

Guidance on learning and teaching approaches for this Unit

It is recommended that the Outcomes are delivered in the sequence presented in the Unit specification. The Unit may be delivered by a combination of lectures, tutorial work and practical laboratory work. The Unit should be taught very much in an electrical engineering/energy context and as such relevant engineering/energy examples should be used throughout Unit delivery.

While the majority of the Unit can be delivered in a classroom, centres should allow candidates to undertake practical experiments so that they have opportunities to relate theory learnt in the classroom to practice. For example, where solar hot water equipment exists candidates should be allowed to carry out simple performance tests on these systems.

The Internet contains a rich source of materials on Renewable Energy and domestic solar hot water systems. Candidates should be aware of the different regulations, climates etc when using non UK based web sites.

Domestic solar hot water kits can be used to support the learning. Candidates can assemble and test small systems and form opinions/evaluations on the merits or otherwise of domestic solar hot water systems.

The Unit should be fully supported with relevant learning materials (e.g. handouts in paper and electronic form, textbooks, on-line materials etc).

This unit is not intended to endorse successful candidates as competent operatives of domestic solar hot water systems.

National Unit specification: support notes (cont)

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Opportunities for developing Core Skills

Elements of *Numeracy* at SCQF level 5 may be developed in Outcome 1 during conversion of kilowatt hours per annum and Outcome 3 where various aspects of workshop techniques require numerical skills particularly carrying out planning and marking out of panels and pipe work. Using Graphical Information at SCQF level 5 may be developed in Outcome 1 where candidates are given graphical information to interpret solar geometry.

The Core Skill *ICT* at SCQF level 5 may be developed in Outcome 2 where candidates may access and interpret information, research and select differing solar thermal collector types and pre-heat storage techniques.

The Critical Thinking component of *Problem Solving* at SCQF level 5 may be developed in Outcome 1 while candidates are interpreting drawings and diagrams relating to solar radiation, solar geometry and solar fraction. Candidates are also required to Review and Evaluate the effectiveness of their work while verifying components conform to prescribed specifications in Outcomes 2 and 3.

Elements of *Working with Others* Core Skill at SCQF level 4 may be developed in Outcome 3 while candidates complete marking out, setting out pipe work and work co-operatively with others. Further development at SCQF level 4 may be found in Outcome 3 in practical situations where team working is required while sharing service engineering workshop space, tools and equipment. Although candidates have to demonstrate practical skills independently, formative activities could enhance the skills of working with others. Good practice in using and sharing service engineering workshop areas, tools and equipment could be discussed in terms of the nature and scope of team goals, roles and responsibilities. Candidates could be given constructive feedback to encourage review and evaluation of their approaches to practical work including their contribution to team working.

National Unit specification: support notes (cont)

Unit title: Domestic Solar Hot Water Systems

Guidance on approaches to assessment for this Unit

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge and understanding of domestic solar hot water systems.

Summative assessment may take the following form:

Outcomes 1 and 2

Assessment may comprise of a single assessment paper covering the outcome and performance criteria requirements for both Outcomes. The assessment paper should be taken at a single assessment event lasting 1 hour and comprise of a suitable balance of short answer, restricted response or structured questions.

Outcome 3

Assessment may comprise of a single assessment paper covering the outcome and performance criteria requirements. The assessment paper should be taken at a single assessment event lasting 1 hour and comprise of a suitable balance of; multiple choice, short answer, restricted response or structured questions.

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 Communication 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)*.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes to Unit

| Version | Description of change | Date |
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