



## **National Unit specification: general information**

**Unit title:** Domestic Wind Systems

**Unit code:** FF2R 12

**Superclass:** XH

**Publication date:** February 2011

**Source:** Scottish Qualifications Authority

**Version:** 01

### **Summary**

This unit will provide candidates with the necessary knowledge and understanding of typical domestic wind systems. The unit will introduce candidates to the basic design principles of domestic wind systems and domestic wind system components with respect to location, function and characteristics. The unit will also introduce candidates to fundamental health and safety and installation requirements and appropriate Building Regulations and Standards.

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

### **Outcomes**

- 1 Describe basic design principles of typical domestic wind systems.
- 2 Describe typical domestic wind system components and their characteristics.
- 3 Identify the relevant Building Standards and Regulations used when installing, commissioning and maintaining domestic wind systems.

### **Recommended entry**

Entry is at the discretion of the centre.

## **National Unit specification: General information (cont)**

**Unit title:** Domestic Wind Systems

### **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 Wind 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 basic design principles of typical domestic wind systems.

#### **Performance Criteria**

- (a) Describe clearly the factors relevant in wind turbine design and location.
- (b) Describe clearly the terms swept area, capacity factor and power coefficient.
- (c) Solve calculations for domestic wind systems.
- (d) Describe clearly the basic aerodynamics of wind turbines.

### **Outcome 2**

Describe typical domestic wind system components and their characteristics.

#### **Performance Criteria**

- (a) Illustrate by means of a diagram the location of the main component parts of a domestic wind system.
- (b) Describe clearly the function and characteristics of the main component parts of domestic wind systems.
- (c) Describe clearly two methods of electrical connection for domestic wind systems.
- (d) Illustrate by means of a diagram the electrical components and connections to a battery bank for a domestic wind system.

### **Outcome 3**

Identify the relevant Building Standards and Regulations used when installing, commissioning and maintaining domestic wind systems.

#### **Performance Criteria**

- (a) Identify clearly and state the risks associated with installing and commissioning domestic wind systems.
- (b) Identify clearly how the Building Standards and Regulations apply to domestic wind systems.
- (c) Identify clearly basic planning procedures required in relation to the installation of domestic wind systems.
- (d) Identify clearly performance appraisal and maintenance procedures of domestic wind systems.
- (e) Identify clearly alternative methods of installation of domestic wind systems.

## National Unit specification: statement of standards (cont)

**Unit title:** Domestic Wind 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.

#### Outcome 1

- (a) The candidates must correctly describe the factors relevant in wind turbine design and location. This description must include:
- ◆ horizontal axis wind turbines
  - ◆ vertical axis wind turbines
  - ◆ number of blades
  - ◆ wind operating speed
  - ◆ wind cut off speed
  - ◆ wind direction
  - ◆ site conditions in terms of wind disturbance, proximity to buildings and the height of turbine
- (b) The candidates must correctly describe the terms swept area, capacity factor and power coefficient. This description must include:
- ◆ swept area in terms of blade length, wind speed and power output
  - ◆ capacity factor in terms of actual energy output
  - ◆ power coefficient in terms of turbine efficiency
- (c) The candidate must correctly solve calculations for domestic wind systems. These calculations must include:
- ◆  $\text{Power} = 0.5 \times \text{swept area} \times \text{wind speed cubed}$
  - ◆  $\text{Units of electricity produced} = \text{Rated Capacity} \times \text{Capacity Factor} \times 8760$
- (d) The candidate must correctly describe the basic aerodynamics of wind turbines. This description must include:
- ◆ lift
  - ◆ drag
  - ◆ wind direction
  - ◆ shape of blade

## National Unit specification: statement of standards (cont)

**Unit title:** Domestic Wind Systems

### Outcome 2

(a) The candidate must show by production of a diagram the location of the main component parts of a domestic wind system. The diagram must indicate eight of the following components:

- ◆ nose cone
- ◆ blades
- ◆ hub assembly
- ◆ alternator
- ◆ alternator shaft
- ◆ tail vane
- ◆ mounting tower
- ◆ tower liner
- ◆ mounting brackets
- ◆ anti vibration pads
- ◆ battery bank
- ◆ battery charger
- ◆ battery monitor
- ◆ regulator
- ◆ fuse
- ◆ inverter
- ◆ braking switch
- ◆ voltmeter
- ◆ ammeter

## National Unit specification: statement of standards (cont)

### Unit title: Domestic Wind Systems

(b) The candidate must correctly describe the function and characteristics of the main component parts of a domestic wind system. This description must include eight of the following components:

- ◆ nose cone
- ◆ blades
- ◆ hub assembly
- ◆ alternator
- ◆ alternator shaft
- ◆ tail vane
- ◆ mounting tower
- ◆ tower liner
- ◆ mounting brackets
- ◆ anti vibration pads
- ◆ battery bank
- ◆ battery charger
- ◆ battery monitor
- ◆ regulator
- ◆ fuse
- ◆ inverter
- ◆ braking switch
- ◆ voltmeter
- ◆ ammeter

(c) The candidate must correctly describe two methods of electrical connection of domestic wind systems. This description must include:

- ◆ AC and DC generation
- ◆ rectifiers and inverters

(d) The candidate must show by production of a diagram the electrical components and connections to a battery bank for a domestic wind system. This diagram must include:

- ◆ battery bank
- ◆ electrical components
- ◆ electrical connections

## National Unit specification: statement of standards (cont)

**Unit title:** Domestic Wind Systems

### Outcome 3

- (a) The candidate must clearly identify the measures required to minimise risk to personnel and building occupiers when installing domestic wind systems. This must include the following:
- ◆ avoidance of electric shock
  - ◆ avoidance of noise transmission and vibration
  - ◆ avoidance of danger from working from heights
  - ◆ avoidance of mechanical failure
  - ◆ avoidance of electrical damage
  - ◆ avoidance of manual handling injuries
- (b) The candidate must correctly identify how Standards and the Building Regulations apply to domestic wind systems.
- (c) The candidate must correctly identify the basic planning procedures required in relation to the installation of domestic wind systems. This must include the following:
- ◆ mechanical checklists
  - ◆ electrical checklists
  - ◆ noise and vibration checklists
- (d) The candidate must clearly identify the performance appraisal and maintenance procedures of domestic wind systems. This must include:
- ◆ wind direction and site conditions
  - ◆ power output monitoring
  - ◆ manufacturers' maintenance instructions
- (e) The candidate must clearly identify alternative methods of installation of domestic wind systems. These methods must include:
- ◆ terrestrial installation using guyed towers
  - ◆ terrestrial installation using free standing structures

## National Unit specification: support notes

### Unit title: Domestic Wind Systems

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

Candidates must be able to demonstrate clearly the factors relevant to wind turbine design and location with respect to domestic wind systems. Knowledge of the following factors must be displayed; horizontal and vertical axis wind turbines, number of blades, wind speed operating and cut off speeds, wind direction upwind or downwind, site conditions in relation to proximity of buildings, wind disturbance and the height of the turbine.

Candidates must display knowledge and understanding of the terms swept area with respect to the relationship between blade length, cubed wind speed and power output, the capacity factor with respect to actual energy output and the power coefficient with respect to turbine efficiency.

Candidates must be able to solve calculations for domestic wind systems:

Power = 0.5 x Swept Area x Wind Speed Cubed

The estimated annual energy output for a domestic wind system using  
Units of Electricity Produced = Rated Capacity x Capacity Factor x 8760

Candidates must be able to describe clearly the basic aerodynamics of wind turbines with respect to lift, drag, wind direction and shape of blade.

#### Outcome 2

Candidates must be able to demonstrate knowledge of the location and function of the main component parts of a typical domestic wind system. Eight typical components to be identified and located in a diagram from the following (dependent on type of domestic wind turbine and connection); Nose Cone, Blades, Hub Assembly, Alternator, Alternator Shaft, Yaw Shaft, Tail Vane, Mounting Tower, Tower Liner, Mounting Brackets, Anti-vibration Pads, Battery Bank, Battery Charger, Battery Monitor, Regulator, Fuse, Inverter, Braking Switch, Voltmeter, Ammeter. (Note: The identification of a connection for domestic wind systems that are small scale embedded generators for ring main supply 230v 50Hz is also suitable). The candidates must also be able to describe clearly the basic function and characteristics of eight of these identified components.

Candidates must be able to describe clearly two methods of electrical connection for domestic wind systems by displaying an understanding of A.C. and D.C. generation and the use of rectifiers and inverters. Candidates must be able to illustrate by means of a diagram the electrical components and connections to a battery bank for a domestic wind system.



## **National Unit specification: support notes (cont)**

**Unit title:** Domestic Wind Systems

### **Outcome 3**

Candidates must demonstrate awareness of the measures required to minimise risks when installing and commissioning domestic wind systems. In particular, the following risks should be detailed: risk of electric shock, transmission of noise and vibration into the building structure, working at heights, mechanical failure of wind turbine components caused by incorrect assembly, damage to electrical components caused by incorrect circuit connection and the manual handling of sharp blade trailing edges.

Within the delivery of this unit current relevant building regulations and standards with respect to domestic wind systems should be integrated in the teaching and learning process. Candidates must be able to identify the basic planning procedures for the installation of domestic wind systems including the use of mechanical and electrical checklists and noise and vibration checklists.

Candidates must be able to identify the factors involved in the post installation performance monitoring of domestic wind systems including wind direction and site conditions, power output monitoring and the basic maintenance procedures required for domestic wind systems.

Candidates must demonstrate knowledge of alternative methods of installation of domestic wind systems including terrestrial installation using guyed towers and terrestrial installation using free standing structures.

### **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 domestic wind 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 Wind Installations. Candidates should be aware of the different regulations, climates etc when using non UK based web sites.

Small domestic wind systems 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 wind systems.

This Unit is not intended to endorse successful candidates as competent operatives of domestic wind systems.

## National Unit specification: support notes (cont)

**Unit title:** Domestic Wind Systems

### Opportunities for developing Core Skills

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

Elements of *Numeracy* at SCQF level 5 may be developed in Outcome 1 particularly when carrying out power calculations associated with domestic wind systems. Using Graphical Information at SCQF level 5 may be developed in Outcome 1 where candidates are given graphical information to interpret the basic aerodynamics of domestic wind systems.

The Core Skill *ICT* at SCQF level 5 may be developed in Outcome 2 where candidates may access and interpret information, research and select component parts of domestic wind systems.

The Critical Thinking component of *Problem Solving* at SCQF level 5 may be developed in Outcome 3 while candidates are interpreting the performance appraisal of domestic wind systems.

The Planning and Organising component of *Problem Solving* at SCQF level 5 may be developed in Outcome 3 when candidates are developing engineering skills pertinent to the alternative methods of installation. The Planning and Organising component will also be developed in Outcome 3 where a candidate is planning basic installation procedures.

Elements of *Working with Others* Core Skill at SCQF level 4 may be developed in Outcome 3 whilst working co-operatively with others in basic planning procedures for domestic wind systems. Although candidates do not have to demonstrate practical skills, formative activities could enhance the skills of working with others. Candidates could be given constructive feedback to encourage review and evaluation of their approaches to practical work including their contribution to team working.

### 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 wind 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.

## **National Unit specification: support notes (cont)**

**Unit title:** Domestic Wind Systems

### **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](http://www.sqa.org.uk/assessmentarrangements).

## History of changes to Unit

Version	Description of change	Date

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