

# Scottish Qualifications Authority

## Workplace Assessed Unit Specification

### General information

**Unit Number** F8XM 04 **Publication date:** June 2010

**Title** Install, Test, Commission and Handover Heat Pump Systems

#### GENERAL COMPETENCE FOR UNIT:

The aim of this Unit is to allow candidates to develop the knowledge and skills required to install, commission and handover heat pump system installations. The Unit focuses upon systems up to 45kW load and include air source, water source and ground source systems. The Unit covers connection to collector loops and the fundamental requirements of collector loop design and installation. However, the Unit does not cover collector loops installation in detail. The Unit covers the requirements for appropriate qualifications as required by The Fluorinated Greenhouse Gases Regulations 2008, in relation to heat pump work but the Unit does not cover aspects of heat pump work that involves handling fluorinated greenhouse gases.

#### OUTCOMES

- 1 Identify and describe the requirements to install, test, commission and handover heat pump systems
- 2 Install, test, commission and handover heat pump systems

#### ACCESS STATEMENT:

Access to this Unit is subject to the following pre-requisites:

Candidates must be qualified in an appropriate Mechanical Engineering Services or Building Services Engineering discipline to SVQ level 3 or equivalent and must have achieved the Unit F8XJ 04: Working Principles, Installation Options and Regulatory Requirements for Micro-renewable Technologies, Water Harvesting and Recycling Technologies.

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# Workplace Assessed Unit Specification

## Statement of standards

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump 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 the Scottish Qualifications Authority.

### OUTCOME 1

Identify and describe the requirements to install, test, commission and handover heat pump systems

### PERFORMANCE CRITERIA

- (a) Identify the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant systems)
- (b) Identify the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for heat pump installation work
- (c) Identify the components and operational characteristic of heat pump units
- (d) Identify the purpose and operational characteristics of heat pump unit and heat pump system components
- (e) Identify the different types of heat pump units and system arrangements for hydraulic emitter circuits
- (f) Describe the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps
- (g) Describe the fundamental design principles for ground source 'closed loop' heat pump collector circuit design and component sizing
- (h) Identify the layouts of 'open loop' water filled heat pump collector circuits
- (i) Describe the fundamental design considerations that are specific to air source heat pumps
- (j) Identify the preparatory work required for heat pump installation work
- (k) Identify the requirements to install and test heat pump systems
- (l) Identify the requirements to commission heat pump system installations
- (m) Identify the requirements to handover heat pump system installations

### RANGE STATEMENT

- (a) Confirm which aspects of heat pump installation work pose risk of:

- ◆ electrocution/electric shock
- ◆ burns
- ◆ toxic poisoning personal injury through component/equipment handling

(EVT S1, Kn c)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm safe systems of work for heat pump installation work in relation to prevention of:

- ◆ electrocution/electric shock
- ◆ burns
- ◆ toxic poisoning
- ◆ personal injury through component/equipment handling

(EVTS1, Kn c)

(b) Interpret building regulation/building standards guidance documentation as relevant to heat pump installation work to identify the requirements in relation to:

- ◆ maintaining the structural integrity of the building
- ◆ maintaining the fire resistant integrity of the building
- ◆ the prevention of moisture ingress (building water-tightness)
- ◆ notification of work requirements
- ◆ physical installation requirements
- ◆ energy conservation
- ◆ testing and commissioning requirements
- ◆ compliance certification

(EVTS1, Kn b)

Interpret industry recognised water regulation/byelaw guidance documentation as relevant to heat pump installation work to identify the requirements in relation to:

- ◆ the physical installation of the system
- ◆ energy conservation
- ◆ safe operation
- ◆ testing and commissioning requirements

(EVTS1, Kn b)

State the requirements of the current fluorinated greenhouse gases regulations in relation to:

- ◆ the competence of personnel installing heat pumps where the refrigerant circuit has been assembled and tested by the product manufacturer
- ◆ the competence of personnel installing heat pumps where the refrigerant circuit is to be assembled and tested in the location where the heat pump is to be installed and operated
- ◆ the competence of personnel undertaking leakage checking on heat pump refrigerant circuits

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- ◆ the competence of personnel undertaking recovery of fluorinated greenhouse gases from heat pump refrigerant circuits

(EVTS1, Kn b)

(c) Confirm the purpose and operational characteristics of the following components:

- ◆ vaporator
- ◆ Low pressure switch
- ◆ Compressor
- ◆ High pressure switch
- ◆ Condenser
- ◆ Dryer/receiver
- ◆ Sight glass
- ◆ Expansion valve
- ◆ Expansion valve phial
- ◆ Refrigerant four way valve
- ◆ Brine pump
- ◆ Emitter circuit electromechanical valves
- ◆ Fan coil
- ◆ Integrated buffer tank
- ◆ Ground loop heat exchanger

(EVTS2, Kn c, EVTS4, Kn h)

Confirm the vapour compression refrigerant circuit within a heat pump unit operates.

(EVTS3, Kn c, EVTS4, Kn h)

(d) Recognise the following heat source/heat sink heat pump packages that can be deployed with a hydraulic 'heat sink' emitter circuit:

- ◆ outside air/water
- ◆ exhaust air/water
- ◆ brine (closed loop)/water
- ◆ water (open loop)/water
- ◆ DX (closed loop)/water

(EVTS2, Kn c)

Identify the different types of heat pump unit within the categories:

- ◆ ground source — packaged (indoor)
- ◆ ground source — packaged (outdoor)
- ◆ air source — external air, packaged (indoor)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- ◆ air source — external air, packaged (outdoor)
- ◆ air source — external air, internal heat pump unit with brine circuit between fan coil unit and heat pump unit

(EVTS2, Kn c)

Confirm the meaning of the terms:

- ◆ monovalent system
- ◆ bivalent system

(EVTS2, Kn c)

Identify the following monovalent hydraulic emitter circuits:

- ◆ heating only
- ◆ heating with buffer tank
- ◆ heating with buffer tank and indirect stored domestic hot water
- ◆ heating with buffer tank and indirect stored domestic hot water with solar coil
- ◆ heating with thermal store

(EVTS2, Kn c)

Identify the following parallel bivalent hydraulic emitter circuits that incorporate a secondary heat source other than an immersion heater:

- ◆ heating with buffer tank
- ◆ heating with buffer tank and indirect stored domestic hot water
- ◆ heating with buffer tank and indirect stored domestic hot water with solar coil
- ◆ heating with buffer tank and thermal store

(EVTS2, Kn c)

Confirm the arrangements for connecting buffer tanks:

- ◆ in series
- ◆ in parallel

(EVTS2, Kn c)

(e) Confirm the meaning of the term 'Coefficient of Performance'

(Linked to M8, Kn i)

Confirm the relationship between Coefficient of Performance and the:

- ◆ heat pump input temperature

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- ◆ heat pump emitter temperature

(Linked to M8, Kn i)

Confirm the effect that ambient temperature can have on:

- ◆ coefficient of performance
- ◆ heat pump output

Confirm the meaning of the term 'Seasonal Performance Factor'

Identify the factors that can affect the Seasonal Performance Factor

Confirm the meaning of the term 'System Efficiency'

Identify the factors that can affect the 'System Efficiency'

(Linked to M8, Kn i)

Confirm why achieving minimum heat loss from the building is particularly important when designing a heat pump system

(Linked to M8, Kn i)

State the effect that oversizing and undersizing of a heat pump has on:

- ◆ system performance/efficiency
- ◆ heat pump operation

(M8, Kn i)

Confirm how to identify heat pump hydraulic flow rate requirements.

Confirm how to use manufacturers data to select heat pump units:

- ◆ output charts
- ◆ other data

(M8, Kn i)

Confirm the meaning of the term 'bivalent points' in relation to heat pump output charts

(Linked to M8, Kn i)

Confirm how 'bivalent points' are used to determine auxiliary heat requirements

(M8, Kn i)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm how heat pump output is affected by:

- ◆ heatpump input temprature
- ◆ heatpump output temprature

Identify the suitability of the following types of hydraulic heating system emitter for suitability with heat pump systems:

- ◆ underfloor heating
- ◆ fan assisted convector heaters
- ◆ standard panel radiators

(Linked to M8, Kn i)

State the typical mean water temperature recommended when designing a hydraulic emitter circuit that incorporates:

- ◆ underfloor heating
- ◆ fan assisted convector heaters
- ◆ standard panel radiators

(Linked to M8, Kn i)

Confirm how correction factors are used to determine panel radiator output requirements in relation to mean water temperature and room temperature difference ( $^{\circ}\text{C}$ )

(Linked to M8, Kn i)

Confirm the potential benefits of including a buffer tank in the system design.

(Linked to M8, Kn i)

Identify the potential disadvantages of including a buffer tank in the system design.

(Linked to M8, Kn i)

Confirm the typical allowance in litres (l) per kilowatt (kW) of heat pump output that would be allowed for sizing a buffer tank when there is no requirement for heat during compressor 'off' periods

(Linked to M8, Kn i)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm using available external temperature, heat load and system flow temperature data, the required size (heat output in kW) of a heat pump to be connected to a hydraulic heat emitter circuit using a monovalent system design

(M8, Kn i)

State the typical annual operating hours for a heat pump that is being used for:

- ◆ heating only
- ◆ heating and domestic hot water

(Linked to M8, Kn i)

State how heat pump annual operating hours may vary in relation to the:

- ◆ type of building
- ◆ geographical location of the installation

(g) Identify the following brine filled heat pump collector circuit configurations:

- ◆ ground 'closed' loop horizontal
- ◆ ground 'closed' loop compact collector
- ◆ ground 'closed' loop slinky
- ◆ ground 'closed' loop vertical borehole
- ◆ lake 'closed' loop
- ◆ vertical borehole closed' loop

(EVTS2, Kn c)

Confirm the requirements of horizontal 'closed' loop brine filled hydraulic heat pump collector circuits in relation to:

- ◆ suitable pipework materials
- ◆ below ground jointing
- ◆ protection against frost damage
- ◆ protection against mechanical damage
- ◆ separation distances to avoid thermal interference
- ◆ separation distances from other services and adjacent buildings
- ◆ achieving balanced loop/collector circuits

(EVTS2, Kn c)



# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm the typical requirements of vertical borehole 'closed' loop brine filled hydraulic heat pump collector circuits in relation to:

- ◆ suitable pipework materials
- ◆ below ground jointing
- ◆ protection against frost damage
- ◆ protection against mechanical damage
- ◆ separation distances to avoid thermal interference
- ◆ separation distances from other services and adjacent buildings
- ◆ achieving balanced loop/collector circuits

(EVTS2, Kn c)

Identify the typical components required in relation to:

- ◆ single circuit 'closed' loop collector circuits
- ◆ multi-circuit 'closed' loop collector circuits
- ◆ brine circuits between outside air source units and internal heat pump units

(EVTS2, Kn c)

Confirm the typical layout of components in relation to:

- ◆ single circuit collector circuits
- ◆ multi-circuit collector circuits
- ◆ brine circuits between outside air source units and internal heat pump units

(EVTS2, Kn c)

Confirm which factors determine the year round average energy available in Watts (W) per m<sup>2</sup> of ground area

(Linked to M8, Kn i)

Confirm how to determine the energy requirement (refrigeration capacity) from the ground loop (kW) using the total heat pump capacity (kW) and the electrical energy input rating (kW)

(Linked to M8, Kn i)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm how the specific heat extraction capacity (in  $W/m^2$  for horizontal/vertical trench collectors and  $W/m$  for vertical borehole collectors) of the ground collector circuit can be affected by:

- ◆ ground conditions/soil types
- ◆ annual heat pump operating hours
- ◆ type of backfill material
- ◆ geographical location — ground rest temperature
- ◆ ground loop configuration

(Linked to M8, Kn i)

Confirm how the total ground area ( $m^2$ ) requirements for horizontal collector loops is determined using the following data:

- ◆ refrigeration capacity (kW)
- ◆ specific extraction output ( $W/m^2$ )

(Linked to M8, Kn i)

Confirm how the pipe length (m) requirement for a horizontal 'loop' collector circuit is determined using the following data:

- ◆ total ground area ( $m^2$ )
- ◆ collector loop pipe spacing (m)

(Linked to M8, Kn)

Confirm how the pipe length (m) requirement for a 'slinky' collector circuit is determined using the following data:

- ◆ total ground area ( $m^2$ )
- ◆ centre to centre spacing of the slinky collector (m)

(Linked to M8, Kn i)

Confirm how the typical collector length (m) requirement for a vertical borehole collector circuit is determined using the following data:

- ◆ heat pump refrigeration capacity (kW)
- ◆ ground condition
- ◆ annual heat pump operating hours

(Linked to M8, Kn i)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm how a collector circuit brine pump size (Kg/h) is determined using the following data:

- ◆ design flow rate
- ◆ brine viscosity
- ◆ heat pump refrigeration capacity (kW)
- ◆ specific thermal capacity of brine (kj/kg)
- ◆ temperature difference between brine circuit flow and return pipework ( $^{\circ}\text{C}$ )

(M8, Kn i)

(h) Identify the following 'open loop' water filled heat pump collector circuit configurations:

- ◆ ground 'open' loop vertical borehole
- ◆ lake 'open' loop

(EVTS2, Kn c)

(i) Identify the factors that need to be considered when selecting and positioning air source heat pump fan coil units in relation to:

- ◆ operating noise (including the potential effect on neighbouring properties)
- ◆ air turbulence during operation
- ◆ confirm how to size a buffer tank to provide for an air source heat pump defrost cycle

(M8, Kn i)

Identify the design options to provide for the defrost cycle for an air source heat pump

(M8, Kn i)

(j) Confirm the common requirements of pre-installation checks for air or ground source heat pump unit installations connected to hydraulic emitters circuits in relation to:

- ◆ authorisation for the work to proceed
- ◆ the availability and collation of all relevant information
- ◆ verification of the suitability of the hydraulic emitter circuit for connection to the heat pump unit
- ◆ verification that the heat output capacity of the heat pump unit is matched to the required proportional contribution of the total building heat load

## Workplace Assessed Unit Specification

### Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- ◆ verification that the buffer tank sizing correct
- ◆ the availability of appropriate access to all required work areas
- ◆ the availability and condition of a suitable electrical input service
- ◆ adequate provision for the siting of key internal system components
- ◆ the suitability of the building structure in relation to the proposed installation

(EVTS1, Kn d,e)

Confirm the pre-installation checks that are specific to the positioning of fan coil units

(EVTS1, Kn e, EVTS2, Kn c)

- (k) Confirm the requirements for moving and handling heat pump units to avoid damage to the unit.

(EVTS1, Kn d)

Confirm the requirements to avoid undue noise and or vibration transmission from the heat pump unit to the building structure during the operation of the heat pump.

(EVTS2, Kn c, d)

Identify the requirements where brine circuit pipework passes through the external building fabric in relation to:

- ◆ provision for movement
- ◆ protection against freezing
- ◆ prevention of water ingress

(EVTS2, Kn c)

Confirm the charging and flushing requirements for closed loop collector circuits:

- ◆ purging of air and installation debris
- ◆ addition of antifreeze protection and suitable biocides
- ◆ checking flow rates

(EVTS3, Kn a)

State what equipment is needed for system charging and flushing

(EVTS3, Kn a)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Confirm the hydraulic test requirements for:

- ◆ closed loop collector circuits
- ◆ hydraulic emitter circuits

(EVTS3, Kn a)

- (l) Confirm the conditions that are required to implement commissioning activities for ground source heat pump systems

(EVTS4, Kn b)

Confirm the commissioning requirements for ground source heat pump systems in relation to:

- ◆ setting of mechanical controls
- ◆ setting of electrical controls and temperature sensors
- ◆ functional tests

(EVTS4, Kn c)

Confirm the conditions that are required to implement commissioning activities for air source heat pump systems

(EVTS4, Kn b)

Confirm the commissioning requirements for air source heat pump systems in relation to:

- ◆ setting of mechanical controls
- ◆ setting of electrical controls and temperature sensors
- ◆ functional tests

(EVTS4, Kn c)

- (m) Confirm the pre-handover checks that need to be carried out for an ground source heat pump system installation

(EVTS4, Kn g)

Confirm the industry handover procedures for an ground source heat pump system installation in relation to the:

- ◆ provision of written information

## Workplace Assessed Unit Specification

### Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- ◆ provision of diagrammatic information
- ◆ provision of verbal information/demonstration relating to system operation and use

(EVTS4, Knowledge)

Confirm the pre-handover checks that need to be carried out for an air source heat pump system installation

(EVTS4, Knowledge)

Confirm the industry handover procedures for an air source heat pump system installation in relation to the:

- ◆ provision of written information
- ◆ provision of diagrammatic information
- ◆ provision of verbal information/demonstration relating to system operation and use

(EVTS4, Knowledge)

### EVIDENCE REQUIREMENTS

Written and/or oral evidence is required to demonstrate knowledge defined in the PCs and must be produced in controlled supervised, open-book conditions. This may be done by a balance of multiple choice, short answer, restricted response and structured questions.

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

### OUTCOME 2

Install, test, commission and handover heat pump systems

### PERFORMANCE CRITERIA

- (a) Plan and prepare for the installation of heat pumps (non-refrigerant systems)
- (b) Install air and ground source heat pump units
- (c) Test and commission a ground source heat pump installation
- (d) Test and commission an air source heat pump installation
- (e) Handover an air or ground source heat pump installation

### RANGE STATEMENT

- (a) Undertake pre-installation checks for a heat pump installation to include checks relating to:
  - ◆ authorisation for the work to proceed
  - ◆ the availability of appropriate access to all required work areas
  - ◆ the availability and collation of all relevant information
  - ◆ verification of the suitability of the proposed location of the fan coil unit (air source heat pumps only)
  - ◆ verification that the collector circuit is appropriate to the heat pump rating (ground source heat pumps only)
  - ◆ verification that the heat pump rating is suitable for the emitter circuit load (heating and/or heating and hot water)
  - ◆ verification of the suitability of the proposed location of the heat pump unit
  - ◆ verification that the emitter circuit design or existing installation is compatible with the proposed heat pump installation.
  - ◆ Verification that the buffer tank size (where relevant) is appropriate
  - ◆ verification of the suitability of the availability of a suitable electrical input service
  - ◆ the proposed siting of key internal system components
  - ◆ the suitability of the building structure in relation to the proposed installation

(EVTS 1, Perf. 1, 6, 9)

Confirm that the tools, materials and equipment required for the installation work are available and are in a safe usable condition.

(EVTS 1, Perf. 2)

## Workplace Assessed Unit Specification

### Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- (b) Install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures an air source heat pump to include as a minimum the connection of the heat pump unit to the hydraulic emitter circuit

Install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures a ground source heat pump to include as a minimum the connection of the heat pump unit to the collector circuit

- (c) Prepare a ground source heat pump system for testing and commissioning to include checks/actions to confirm:

- ◆ compliance with the system design and specification
- ◆ compliance with system/component manufacturer requirements
- ◆ the suitability of electrical supply circuit arrangements
- ◆ correct flushing the system of installation debris
  
- ◆ correct filling and venting the hydraulic circuits
- ◆ protection of the system against freezing

(EVTS 2, Perf. 12, EVTS 3, Perf. 1,2, 4)

Test the collector circuit for hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures

(EVTS 3, Perf. 3)

Identify the commissioning requirements for the installation in relation to:

- ◆ the system/component manufacturer(s) requirements
- ◆ system design/specification requirements
- ◆ the client/end user requirements
- ◆ statutory regulations and/or industry recognised procedures

(EVTS 3, Perf. 4, EVTS 4, Perf. 1)

Commission the installation in accordance with manufacturer's guidance, design, client's and statutory and/or industry recognised procedures

(EVTS 4, Perf. 3, 4)

Complete relevant documentation to record the commissioning activities

(EVTS 4, Perf.5)



## Workplace Assessed Unit Specification

### Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

(d) Prepare an air source heat pump system for testing and commissioning to include checks/actions to confirm:

- ◆ compliance with the system design and specification
- ◆ compliance with system/component manufacturer requirements
- ◆ the suitability of electrical supply circuit arrangements
- ◆ correct flushing the system of installation debris
- ◆ correct filling and venting the hydraulic circuits
- ◆ protection of the system against freezing

(EVTS 2, Perf. 12, EVTS 3, Perf. 1,2, 4)

Identify the commissioning requirements for the installation in relation to:

- ◆ the system/component manufacturer(s) requirements
- ◆ system design/specification requirements
- ◆ the client/end user requirements
- ◆ statutory regulations and/or industry recognised procedures

(EVTS 3, Perf. 4, EVTS 4, Perf. 1)

Commission the installation in accordance with manufacturer's guidance, design, client's and statutory requirements and/or industry recognised procedures

(EVTS 4, Perf. 3, 4)

(e) Undertake relevant checks to ensure that the system is ready for handover and compliant with manufacturer's guidance, the system design/specification, client's, regulatory and/or industry recognised requirements

(EVTS 4, Perf. 5)

Explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures

(EVTS 4, Perf. 5)

Identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements

(EVTS 4, Perf. 5)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Obtain acceptance by the end user of the system according to the industry agreed handover procedures

(EVTS 4, Perf. 5)

Ensure that all relevant handover documentation is correctly completed and recorded in the appropriate information systems and passed to the end user in accordance with manufacturer's guidance and industry recognised procedures

(EVTS 4, Perf. 5)

### EVIDENCE REQUIREMENTS

A practical assessment is required to demonstrate the candidate's ability to Install, test, commission and handover Heat Pump Systems. The Unit focuses upon systems up to 45kW load and include air source, water source and ground source systems. The Unit covers connection to collector loops and the fundamental requirements of collector loop design and installation.

### ASSESSMENT

In order to achieve this Unit, candidates are required to present sufficient evidence that they have met all the Performance Criteria for each Outcome within the range specified. Details of these requirements are given for each Outcome. The assessment instruments used should follow the general guidance offered by the SQA assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes).

Accurate records should be made of the assessment instruments used showing how evidence is generated for each Outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

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 60 hours.

# Workplace Assessed Unit Specification

## Support notes

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

### LINKS TO NATIONAL OCCUPATIONAL STANDARDS

**Please Note:** Where the learning outcomes include reference to heat pump refrigerant circuits and/or components, this is included to ensure that heat pump installers can recognise and differentiate between refrigerant and non-refrigerant circuits only. These learning outcomes do not provide the underpinning knowledge required for assessment of occupational competence relating refrigeration or air-conditioning occupations.

Throughout the Unit and where appropriate we have identified where the evidence relates to the SummitSkills National Occupation Standards (NOS) for Environmental Technology Systems for example:

EVTS 1 Kn b relates to the NOS	
EVTS 1	Plan for Environmental Technology Systems, Equipment and Components
Kn b	Knowledge Criteria b
EVTS, Perf 1	
EVTS 2	Plan for Environmental Technology Systems, Equipment and Components
Perf 1	Performance Criteria 2

The outcomes of this Unit are aligned to the relevant heat pump system installation (non-refrigerant circuit) minimum technical competence requirements for the following schemes.

- ◆ Building Regulations Competent Person Schemes (England and Wales)
- ◆ Microgeneration Certification Scheme (MCS)
- ◆ Certifier of Construction Scheme (Scotland)

### APPROACHES TO GENERATING EVIDENCE

Written and/or oral evidence is required to demonstrate knowledge defined in the PCs and must be produced in controlled supervised, open-book conditions.

Assessment of performance shall be carried out using either:

- ◆ evidence sourced from the workplace; and/or
- ◆ through simulation

# Workplace Assessed Unit Specification

## Support notes (cont)

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Use of simulation for the assessment of performance Outcomes

As agreed with sector stakeholders, within the building services engineering sector footprint, simulation is only normally to be used as an assessment method for performance Outcome assessment in:

- ◆ those extremely rare circumstances where candidate/learner is unable to access the required range of work circumstances and as a result the candidate/learner lacks evidence for completion of the Unit(s); or
- ◆ those circumstances where safety critical and/or technical critical aspects of performance need to be assessed.

SQA and Summitskills recognise that due to the evolving nature of environmental technologies and their integration into the sector, environmental technology system installation, service and maintenance work may not yet be a regular work activity for some sector businesses and as a result restricted or no access to the required range of work circumstances may be more commonplace than for the more established work activities within the sector footprint. In recognition of this SQA and Summitskills considers it appropriate for additional flexibility regarding the use of simulation to be available whilst environmental technology system installation, service and maintenance work becomes more established and commonplace within the sector. However, this flexibility is given on the basis that it will be withdrawn or reduced at an appropriate stage. In order to allow for an initial period of stability in the assessment of environmental technology units the first review of this flexibility will take place in December 2011.

The use of simulation in the assessment of performance Outcomes for environmental technology units is either permissible OR mandatory. Simulation is permitted for all units and all assessed Outcomes until December 2011. This permission is subject to compliance with the requirement for realistic working environment to be used for the simulated activity.

Simulation must take place for key safety critical/technical critical aspects of the environmental technology units. The building services engineering industries cannot afford for the candidates to make mistakes within the workplace and so it is required that candidates, as appropriate, will demonstrate competence of those key safety critical activities and their technical competence in simulated conditions, and under direct assessor observation, as outlined by technology overleaf.

# Workplace Assessed Unit Specification

## Support notes

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

Technology	Mandatory simulation requirements
Solar Thermal	Commissioning of completed new installations
	All fault identification and rectification activities
Solar Photovoltaic	Installation of solar photovoltaic d.c. circuits and components
	Inspection and testing of the completed installation including both a.c and d.c circuits
	All fault identification and rectification activities
Heat Pumps	Commissioning of completed new installations All fault identification and rectification activities
Biomass	To be agreed at upon completion of the Units
Bio-liquids	To be agreed at upon completion of the Units
Water recycling	To be agreed at upon completion of the Units
Micro-wind	To be agreed at upon completion of the Units
Micro-hydro	To be agreed at upon completion of the Units

### APPROACHES TO ASSESSMENT

In this Unit an appropriate instrument of assessment for Outcome 1 could be a question paper consisting of a balance of multiple choice, short answer, restricted response and structured questions.

Assessment of underpinning knowledge shall be carried out under controlled supervised, open-book conditions using:

- ◆ centre set, centre marked assessment instruments

SQA will ensure that robust quality assurance arrangements are in place for the assessment of underpinning knowledge.

Realistic working environments for simulated practical activities

SQA are required to ensure that approved centres have appropriately realistic working environments for simulated assessment activities. SQA does not wish to be fully prescriptive regarding the requirements of such facilities as this may restrict the ability of some delivering centres to meet SQA approval requirements. However, the following requirements must be met:

- ◆ installation, testing, commissioning, service and maintenance and fault rectification activities shall be assessed using full size systems that replicate installations in a real working environment;

# Workplace Assessed Unit Specification

## Support notes

**UNIT NUMBER:** F8XM 04

**UNIT TITLE:** Install, Test, Commission and Handover Heat Pump Systems

- ◆ the use of mobile rigs and scaled models of system installations shall not be used for the assessment of installation, testing, commissioning, service and maintenance and fault rectification activities.

### **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)

### **REFERENCES**

- 1 For a fuller discussion on assessment issues, please refer to SQA's Guides to Assessment and Quality Assurance.
- 2 Procedures for special needs statements are set out in SQA's guide 'Guidance on Special Assessment Arrangements'. (AA0645/3).
- 3 For details of other SQA publications, please consult SQA's publications list. (FD037).