

# Scottish Qualifications Authority

## Workplace Assessed Unit Specification

### General information

**Unit Number** F8XR 04 **Publication date:** June 2010

**Title** Inspect, Service and Maintain Heat Pump Systems

#### **GENERAL COMPETENCE FOR UNIT:**

The aim of this Unit is to allow candidates to develop the knowledge and skills required to inspect, service and maintain heat pump system installations. The Unit focuses upon systems up to 45kW load and include air source and ground source systems. The Unit covers the requirements for appropriate qualifications as required by The Fluorinated Greenhouse Gases Regulations 2008, in relation to heat pump service and maintenance work but the Unit does not cover aspects of heat pump service and maintenance work that involves handling fluorinated greenhouse gases or working on the heat pump refrigerant circuit.

#### **OUTCOMES**

- 1 Identify and describe the requirements to inspect, service and maintain heat pump system installations
- 2 inspect, service and maintain heat pump system installations

#### **ACCESS STATEMENT:**

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 units F8XJ 04 Working Principles, Installation Options and Regulatory Requirements for Micro-renewable Technologies, Water Harvesting and Recycling Technologies and F8XM 04 Install, Test, Commission and Handover Heat Pump Systems.

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# Workplace Assessed Unit Specification

## Statement of standards

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain 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 inspect, service and maintain heat pump system installations.

### PERFORMANCE CRITERIA

- (a) Identify the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations
- (b) Describe how to diagnose faults in heat pump system installations
- (c) Describe how to rectify faults in heat pump system installations

### RANGE STATEMENT

- (a) Confirm which documentation needs to be available to enable routine service and maintenance work on heat pump system installations

(EVTS 5, Kn c)

Confirm typical routine service and maintenance requirements for an air source heat pump installation in relation to:

- ◆ visual inspection requirements
- ◆ cleaning of components
- ◆ checking of system water content
- ◆ functional tests

(EVTS 5, Kn b,d)

Confirm typical routine service and maintenance requirements for a ground source heat pump installation in relation to:

- ◆ visual inspection requirements
- ◆ cleaning of components
- ◆ checking of system water content
- ◆ functional tests

(EVTS 5, Kn b,d)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

Confirm the industry requirements for the recording and reporting of routine service and maintenance work on heat pump system installations

(EVTS 5, Kn e)

State the action to take in the event of a failure or suspected failure of the refrigerant circuit and/or a suspected refrigerant circuit defect

(b) Confirm the information that needs to be available to enable fault diagnosis

(EVTS 6, Kn a)

Confirm the work action and sequences required to diagnose the following faults:

- ◆ heat pump low pressure trip/alarm activated by a collector circuit malfunction
- ◆ heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- ◆ poor or no collector circuit performance
- ◆ Insufficient heat output to emitter circuit
- ◆ domestic hot water heat up is satisfactory but space heating is not operating
- ◆ system noise and/or vibration

(EVTS 6, Kn e)

(c) Confirm the work action and sequences required to rectify the following faults:

- ◆ heat pump low pressure trip/alarm activated by a collector circuit malfunction
- ◆ heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- ◆ poor or no collector circuit performance
- ◆ Insufficient heat output to emitter circuit
- ◆ domestic hot water heat up is satisfactory but space heating is not operating
- ◆ system noise and/or vibration

## 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:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

### OUTCOME 2

Inspect, service and maintain heat pump system installations

### PERFORMANCE CRITERIA

- (a) Undertake the non-refrigerant circuit routine service and maintenance of an air source heat pump system installation
- (b) Undertake the routine service and maintenance of a ground source heat pump system installation
- (c) Undertake fault diagnosis work on an air or ground source heat pump system installation
- (d) Undertake fault rectification work on an air or ground source heat pump system installation

### RANGE STATEMENT

- (a) Obtain the relevant information required to enable the work

(No specific NOS reference)

Undertake a visual service and maintenance inspection of an air source heat pump installation to include checks in relation to:

- ◆ compliance with manufacturer's installation instructions
- ◆ compliance with statutory regulations
- ◆ condition of system components including cleanliness
- ◆ checking the system fluid levels
- ◆ checking the system pressure levels
- ◆ checks to ensure that electrical controls and temperature sensors are set correctly
- ◆ leakage and/or dampness
- ◆ correct positioning of system components
- ◆ pipework insulation is of the correct grade, in good condition and is firmly in place
- ◆ provision of information and safety labels
- ◆ security of fixing of system components

(EVTS 5, Perf 3, 4, 5)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

Undertake routine servicing of relevant components an air source heat pump installation to include checks in relation to:

- ◆ checking for protection of the system water against freezing
- ◆ cleaning and lubrication of system components
- ◆ adjustment of system controls

(EVTS 8, Perf 1, 2)

Undertake routine service and maintenance functional tests on an air source heat pump installation to confirm:

- ◆ safe operation
- ◆ efficient operation
- ◆ the correct functioning of system components/controls
- ◆ no undue noise or vibration

(EVTS 8, Perf 1, 2)

Complete the relevant service and maintenance records in accordance with industry recognised procedures

(EVTS 5, Perf 6, EVTS 8, Perf 3)

(b) Obtain the relevant information required to enable the work

(No specific NOS reference)

Undertake a visual service and maintenance inspection of an ground source heat pump installation to include checks in relation to:

- ◆ compliance with manufacturer's installation instructions
- ◆ compliance with statutory regulations
- ◆ condition of system components including cleanliness
- ◆ checking the system fluid levels
- ◆ checking the system pressure levels
- ◆ checks to ensure that electrical controls and temperature sensors are set correctly
- ◆ leakage and/or dampness
- ◆ correct positioning of system components
- ◆ pipework insulation is of the correct grade, in good condition and is firmly in place

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

- ◆ provision of information and safety labels
- ◆ security of fixing of system components

(EVTS 5, Perf 3, 4, 5)

Undertake routine servicing of relevant components a ground source heat pump installation to include checks in relation to:

- ◆ checking for protection of the system water against freezing
- ◆ cleaning and lubrication of system components
- ◆ adjustment of system controls

(EVTS 8, Perf 1, 2)

Undertake routine service and maintenance functional tests on a ground source heat pump installation to confirm:

- ◆ safe operation
- ◆ efficient operation
- ◆ the correct functioning of system components/controls
- ◆ no undue noise or vibration

(EVTS 8, Perf 1, 2)

Complete the relevant service and maintenance records in accordance with industry recognised procedures

(EVTS 5, Perf 6, EVTS 8, Perf 3)

(c) Obtain the relevant information required to enable the fault diagnosis work

(EVTS 6, Perf 1)

Diagnose the cause of a minimum of **four** separate faults from the following list:

- ◆ heat pump low pressure trip/alarm activated by a collector circuit malfunction
- ◆ heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- ◆ poor or no collector circuit performance
- ◆ insufficient heat output to emitter circuit
- ◆ domestic hot water heat up is satisfactory but space heating is not operating
- ◆ system noise and/or vibration

(EVTS 6, Perf 3)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

Agree with the relevant person(s) fault rectification procedures for the faults identified

(EVTS 6, Perf 4)

(d) Obtain the relevant information required to enable the fault rectification work

(EVTS 6, Perf 1)

Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work

(EVTS 7, Perf 3)

Take relevant precautionary actions to minimize the risk of injury to self or others during the fault rectification work

(EVTS 7, Perf 3)

Rectify a minimum of **two** separate faults from the following list:

- ◆ heat pump low pressure trip/alarm activated by a collector circuit malfunction
- ◆ heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- ◆ poor or no collector circuit performance
- ◆ insufficient heat output to emitter circuit
- ◆ domestic hot water heat up is satisfactory but space heating is not operating
- ◆ system noise and/or vibration

(EVTS 7, Perf 1)

Undertake post-rectification functional tests in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures to confirm that the system is in a safe, functional and efficient condition.

(EVTS 7, Perf 2)

# Workplace Assessed Unit Specification

## Statement of standards (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

### EVIDENCE REQUIREMENTS

A practical assessment is required to demonstrate the candidate's ability to inspect service and maintain Solar Thermal Hot water Systems. The Unit focuses upon systems up to 45kW load and include air source and ground source systems.

### 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.



# Workplace Assessed Unit Specification

## Support notes

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump 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.

### LINKS TO NATIONAL OCCUPATIONAL STANDARDS

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

### 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

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.

# Workplace Assessed Unit Specification

## Support notes (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

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 below.

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

# Workplace Assessed Unit Specification

## Support notes (cont)

**UNIT NUMBER:** F8XR 04

**UNIT TITLE:** Inspect, Service and Maintain Heat Pump Systems

### 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;
- ◆ 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).