Qualification Guide

BPEC 600/6606/4 - Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)

Level 3 Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)

Introduction

This Guide has been produced in conjunction with SummitSkills who have developed the 'National Occupational Standards' and Units of Assessment for the suite of Environmental Technology qualifications (including Heat Pumps). This guide details the requirements for both centres delivering the Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits), and learners undertaking the qualification - and aims to provide:

- An overview of the structure of the qualification
- An overview of the assessment strategy for the qualification
- Guidance notes for assessors and other centre staff for the qualification

The L3 Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits) requires the completion of both centre based knowledge and practical assessments* and is designed for individuals carrying out the installation, commissioning, de-commissioning, servicing and maintenance of Heat Pumps Systems (Non-refrigerant Circuits).

**Workplace-based performance assessments are also available if learners are already actively involved in the installation and maintenance of Heat Pump systems.*

Contents

Rules of Combination

Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)

This is a Level 3 qualification of 10 credits and 80 guided learning hours consisting of 4 mandatory units. **ALL** units must be achieved to achieve the overall qualification.

Successful completion of this qualification proves that learners are competent to install, commission, decommission, service and maintain heat pump systems (Non-refrigerant circuits). The qualification and unit details are shown below:

Qualification Title	Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)				
BPEC Qualification Number	600/6606/4				
Last Registration Date	31/12/2018				
Last Certification Date	31/12/2020				
Unit Ref	**Unit Title**	**Level**	**Credit Value**	**Total Qualification Time**	**Guided Learning Hours**
D/602/3072	Install, commission and handover heat pumps non-refrigerant circuits	3			
F/602/3078	Know the requirements to inspect, service and maintain heat pump system installations non-refrigerant circuits	3			
L/602/3083	Inspect, service and maintain heat pump installations non- refrigerant circuits	3			
Y/602/3054	Know the requirements to install, commission and handover heat pump systems non-refrigerant circuits	3			
	Totals		10	88	80

Note

Total Qualification Time (TQT) is comprised of the following two elements:
(a) the number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and

(b) an estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by – but, unlike Guided Learning, not under the Immediate Guidance or Supervision of – a lecturer, supervisor, tutor or other appropriate provider of education or training.

Unit Details

The next pages detail the requirements of the 4 individual Units that make up this Award:

D/602/3072 - Install commission and handover heat pumps non-refrigerant circuits

The unit focuses upon the occupational competence required to plan and prepare for, install (including testing and commissioning) and handover of heat pump 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 loop design or installation in detail. Upon completion of the unit the learner will be able to:

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

Learning Outcome 1

1. Plan and prepare for the installation of heat pumps (non-refrigerant circuits)

Assessment Criteria

1.1 Undertake pre-installation checks for a heat pump installation to include checks relating to:

a. authorisation for the work to proceed
b. the availability of appropriate access to all required work areas
c. the availability and collation of all relevant information
d. verification of the suitability of the proposed location of the fan coil unit (air source heat pumps only)
e. verification that the emitter circuit design or existing installation is compatible with the proposed heat pump installation
f. verification that the buffer tank size (where relevant) is appropriate
g. verification that the collector circuit is appropriate to the heat pump rating (ground source heat pumps only)
h. verification that the heat pump rating is suitable for the emitter circuit load (heating and/or heating and hot water)
i. verification of the suitability of the proposed location of the heat pump unit
j. verification of the suitability of the availability of a suitable electrical input service
k. the proposed siting of key internal system components
l. the suitability of the building structure in relation to the proposed installation

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

Learning Outcome 2

2. Install air and ground source heat pump units (non- refrigerant circuits)

Assessment Criteria

2.1 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

2.2 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

Learning Outcome 3

3. Test and commission a ground source heat pump installation (non-refrigerant circuits)

Assessment Criteria

3.1 Prepare a ground source heat pump system for testing and commissioning to include checks/actions to confirm:

a. compliance with the system design and specification
b. compliance with system/component manufacturer requirements
c. the suitability of electrical supply circuit arrangements
d. correct flushing the system of installation debris
e. correct filling and venting the hydraulic circuits
f. protection of the system against freezing

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

3.3 Identify the commissioning requirements for the installation in relation to:

a. the system/component manufacturer(s) requirements
b. system design/specification requirements
c. the client/end user requirements
d. statutory regulations and/or industry recognised procedures

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

3.5 Complete relevant documentation to record the commissioning activities

Learning Outcome 4
4. Test and commission an air source heat pump installation (non-refrigerant circuits)
Assessment Criteria
4.1 Prepare an air source heat pump system for testing and commissioning to include checks/actions to confirm: a. compliance with the system design and specification b. compliance with system/component manufacturer requirements c. the suitability of electrical supply circuit arrangements d. correct flushing the system of installation debris e. correct filling and venting the hydraulic circuits f. protection of the system against freezing
4.2 Identify the commissioning requirements for the installation in relation to: a. the system/component manufacturer(s) requirements b. system design/specification requirements c. the client/end user requirements d. statutory regulations and/or industry recognised procedures
4.3 Commission the installation in accordance with manufacturer's guidance, design requirements, client's requirements and statutory requirements and/or industry recognised procedures

Learning Outcome 5
5. Handover an air or ground source heat pump installation
Assessment Criteria
5.1 Undertake relevant checks to ensure that the system is ready for handover and compliant with manufacturer's guidance, the system design/specification, client's requirements, regulatory requirements and/or industry recognised requirements
5.2 Explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures
5.3 Identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements
5.4 Obtain acceptance by the end user of the system according to the industry agreed handover procedures
5.5 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

F/602/3078 - Know the requirements to inspect, service and maintain heat pump system installations non-refrigerant circuits

The unit focuses upon the underpinning knowledge 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 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. Upon completion of the unit the learner will:

- Know the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations
- Know how to diagnose faults in heat pump system installations
- Know how to rectify non-refrigerant circuit faults in heat pump system installations

Learning Outcome 1
1. Know the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations
Assessment Criteria
1.1 Confirm which documentation needs to be available to enable routine service and maintenance work on heat pump system installations
1.2 Confirm typical routine service and maintenance requirements for an air source heat pump installation in relation to: a. visual inspection requirements b. cleaning of components c. checking of system water content d. functional tests
1.3 Confirm typical routine service and maintenance requirements for a ground source heat pump installation in relation to: a. visual inspection requirements b. cleaning of components c. checking of system water content d. functional tests
1.4 Confirm the industry requirements for the recording and reporting of routine service and maintenance work on heat pump system installations
1.5 State the action(s) to take in the event of a failure or suspected failure of the refrigerant circuit and/or a suspected refrigerant circuit defect

Learning Outcome 2
2. Know how to diagnose faults in heat pump system installations
Assessment Criteria
2.1 Confirm the information that needs to be available to enable fault diagnosis 2.2 Confirm the work action and sequences required to diagnose the following faults: a. heat pump low pressure trip/alarm activated by a collector circuit malfunction b. heat pump high pressure trip/alarm activated by an emitter circuit malfunction c. poor or no collector circuit performance d. Insufficient heat output to emitter circuit e. domestic hot water heat up is satisfactory but space heating is not operating f. system noise and/or vibration

Learning Outcome 3
3. Know how to rectify non-refrigerant circuit faults in heat pump system installations
Assessment Criteria
3.1 Confirm the work action and sequences required to rectify the following faults: a. heat pump low pressure trip/alarm activated by a collector circuit malfunction b. heat pump high pressure trip/alarm activated by an emitter circuit malfunction c. poor or no collector circuit performance d. insufficient heat output to emitter circuit e. domestic hot water heat up is satisfactory but space heating is not operating f. system noise and/or vibration

L/602/3083 - Inspect, service and maintain heat pump installations non-refrigerant circuits

The unit focuses upon the occupational competence 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 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. Upon completion of the unit the learner will be able to:

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

Learning Outcome 1

1. Undertake the non-refrigerant circuit routine service and maintenance of an air source heat pump system installation

Assessment Criteria

1.1 Obtain the relevant information required to enable the work

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

a. compliance with manufacturer's installation instructions
b. compliance with statutory regulations
c. condition of system components including cleanliness
d. checking the system fluid levels
e. checking the system pressure levels
f. checks to ensure that electrical controls and temperature sensors are set correctly
g. leakage and/or dampness
h. correct positioning of system components
i. pipework insulation is of the correct grade, in good condition and is firmly in place
j. provision of information and safety labels
k. security of fixing of system components

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

a. checking for protection of the system water against freezing
b. cleaning and lubrication of system components
c. adjustment of system controls

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

a. safe operation
b. efficient operation
c. the correct functioning of system components/controls
d. no undue noise or vibration

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

Learning Outcome 2

2. Undertake the non-refrigerant circuit routine service and maintenance of an ground source heat pump system installation

Assessment Criteria

2.1 Obtain the relevant information required to enable the work

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

a. compliance with manufacturer's installation instructions
b. compliance with statutory regulations
c. condition of system components including cleanliness
d. checking the system fluid levels
e. checking the system pressure levels
f. checks to ensure that electrical controls and temperature sensors are set correctly
g. leakage and/or dampness
h. correct positioning of system components
i. pipework insulation is of the correct grade, in good condition and is firmly in place
j. provision of information and safety labels
k. security of fixing of system components

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

a. checking for protection of the system water against freezing
b. cleaning and lubrication of system components
c. adjustment of system controls

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

a. safe operation
b. efficient operation
c. the correct functioning of system components/controls
d. no undue noise or vibration

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

Learning Outcome 3
3. Undertake non-refrigerant circuit fault diagnosis work on an air or ground source heat pump system installation
Assessment Criteria
3.1 Obtain the relevant information required to enable the fault diagnosis work 3.2 Identify the cause of a minimum of FOUR separate faults from the following list: a. heat pump low pressure trip/alarm activated by a collector circuit malfunction b. heat pump high pressure trip/alarm activated by an emitter circuit malfunction c. poor or no collector circuit performance d. insufficient heat output to emitter circuit e. domestic hot water heat up is satisfactory but space heating is not operating f. system noise and/or vibration 3.3 Agree with the relevant person(s) fault rectification procedures for the faults identified

Learning Outcome 3
4. Undertake non-refrigerant circuit fault rectification work on an air or ground source heat pump system installation
Assessment Criteria
4.1 Obtain the relevant information required to enable the fault rectification work 4.2 Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work 4.3 Take relevant precautionary actions to minimize the risk of injury to self or others during the fault rectification work 4.4 Rectify a minimum of TWO separate faults from the following list: a. heat pump low pressure trip/alarm activated by a collector circuit malfunction b. heat pump high pressure trip/alarm activated by an emitter circuit malfunction c. poor or no collector circuit performance d. insufficient heat output to emitter circuit e. domestic hot water heat up is satisfactory but space heating is not operating f. system noise and/or vibration 4.5 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

Y/602/3054 - Know the requirements to install, commission and handover heat pump systems non-refrigerant circuits

The unit focuses upon the underpinning knowledge required to plan and prepare for, install (including testing and commissioning) 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 fundamental heat pump system design awareness and component selection but does not include detailed system design

The unit covers connection to collector loops and the fundamental requirements of collector loop design and installation; however, the unit does not cover collector loop design or installation in detail. The unit covers the requirements for appropriate personnel competence 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 or working on the heat pump refrigerant circuit. On completion of the unit the learner will:

- Know the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant circuits)
- Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for heat pump installation work
- Know the purpose and operational characteristics of heat pump unit and heat pump system components
- Know the different types of heat pump units and system arrangements for hydraulic emitter circuits
- Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps
- Know the fundamental design principles for ground source ‘closed loop’ heat pump collector circuit design, component sizing and installation
- Know the layouts of ‘open loop’ water filled heat pump collector circuits
- Know the fundamental design considerations and principles that are specific to air source heat pumps
- Know the preparatory work required for heat pump installation work
- Know the requirements to install and test heat pump systems (non-refrigerant circuits)
- Understand the requirements to commission heat pump system installations
- Understand the requirements to handover heat pump system installations

Learning Outcome 1

1. Know the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant circuits)

Assessment Criteria

1.1 Confirm which aspects of heat pump installation work pose risk of:

a. electrocution/electric shock
b. burns
c. toxic poisoning personal injury though component/equipment handling

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

a. electrocution/electric shock
b. burns
c. toxic poisoning
d. personal injury though component/equipment handling

Learning Outcome 2

2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for heat pump installation work

Assessment Criteria

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

a. maintaining the structural integrity of the building
b. maintaining the fire resistant integrity of the building
c. the prevention of moisture ingress (building water tightness)
d. notification of work requirements
e. physical installation requirements
f. energy conservation
g. testing and commissioning requirements
h. compliance certification

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

a. the physical installation of the system
b. energy conservation
c. safe operation
d. testing and commissioning requirements

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

a. the competence of personnel installing heat pumps where the refrigerant circuit has been assembled and tested by the product manufacturer
b. 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
c. the competence of personnel undertaking leakage checking on heat pump refrigerant circuits
d. the competence of personnel undertaking recovery of fluorinated greenhouse gases from heat pump refrigerant circuits

Learning Outcome 3
3. Know the purpose and operational characteristics of heat pump unit and heat pump system components
Assessment Criteria
3.1 Confirm the purpose and operational characteristics of the following components: a. evaporator b. low pressure switch c. compressor d. high pressure switch e. condenser f. dryer/receiver g. sight glass h. expansion valve i. expansion valve phial j. refrigerant four-way valve k. brine pump l. emitter circuit electro-mechanical valves m. fan coil n. integrated buffer tank o. ground loop heat exchanger 3.2 Confirm how the vapour compression refrigerant circuit within a heat pump unit operates

Learning Outcome 4
4. Know the different types of heat pump units and system arrangements for hydraulic emitter circuits
Assessment Criteria
4.1 Recognise the following heat source/heat sink heat pump packages that can be deployed with a hydraulic 'heat sink' emitter circuit: a. outside air/water b. exhaust air/water c. brine (closed loop)/water d. water (open loop)/water e. DX (closed loop)/water
4.2 Identify the different types of heat pump unit within the categories: a. ground source – packaged (indoor) b. ground source – packaged (outdoor) c. air source - external air, packaged (indoor) d. air source - external air, packaged (outdoor) e. air source - external air, internal heat pump unit with brine circuit between fan coil unit and heat pump unit
4.3 Confirm the meaning of the terms: a. monovalent system b. bivalent system
4.4 Identify the following monovalent hydraulic emitter circuits: a. heating only b. heating with buffer tank c. heating with buffer tank and indirect stored domestic hot water d. heating with buffer tank and indirect stored domestic hot water with solar coil e. heating with thermal store
4.5 Identify the following parallel bivalent hydraulic emitter circuits that incorporate a secondary heat source other than an immersion heater: a. heating with buffer tank b. heating with buffer tank and indirect stored domestic hot water c. heating with buffer tank and indirect stored domestic hot water with solar coil d. heating with buffer tank and thermal store
4.6 Confirm the arrangements for connecting buffer tanks: a. in series b. in parallel

Learning Outcome 5
5. Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps
Assessment Criteria
5.1 Confirm the meaning of the term 'Coefficient of Performance' 5.2 Confirm the relationship between Coefficient of Performance and the: a. heat pump input temperature b. heat pump emitter temperature 5.3 Confirm the effect that ambient temperature can have on: a. monovalent system b. bivalent system 5.4 Confirm the meaning of the term 'Seasonal Performance Factor' 5.5 Identify the factors that can affect the Seasonal Performance Factor 5.6 Confirm the meaning of the term 'System Efficiency' 5.7 Identify the factors that can affect the 'System Efficiency' 5.8 Confirm why achieving minimum heat loss from the building is particularly important when designing a heat pump system 5.9 State the effect that oversizing of a heat pump has on: a. system performance/efficiency b. heat pump operation 5.10 State the effect that undersizing of a heat pump has on: a. system performance/efficiency b. heat pump operation 5.11 Confirm how to identify heat pump hydraulic flow rate requirements 5.12 Confirm how to use manufacturer's data to select heat pump units: a. output charts b. other data 5.13 Confirm the meaning of the term 'bivalent points' in relation to heat pump output charts 5.14 Confirm how 'bivalent points' are used to determine auxiliary heat requirements 5.15 Confirm how heat pump output capacity is affected by: a. heat pump input temperature b. heat pump output temperature

Learning Outcome 5
5. Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps (Cont.)
Assessment Criteria
5.16 Identify the suitability of the following types of hydraulic heating system emitter for suitability with heat pump systems: a. underfloor heating b. fan assisted convector heaters c. standard panel radiators
5.17 State the typical mean water temperature recommended when designing a hydraulic emitter circuit that incorporates: a. underfloor heating b. fan assisted convector heaters c. standard panel radiators
5.18 Confirm how correction factors are used to determine panel radiator output requirements in relation to mean water temperature and room temperature difference (degrees centrigrade)
5.19 Confirm the potential benefits of including a buffer tank in the system design
5.20 Identify the potential disadvantages of including a buffer tank in the system design
5.21 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
5.22 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
5.23 State the typical annual operating hours for a heat pump that is being used for: a. heating only b. heating and domestic hot water
5.24 State how heat pump annual operating hours may vary in relation to the: a. type of building b. geographical location of the installation

Learning Outcome 6

6. Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation

Assessment Criteria

6.1 Identify the following brine filled heat pump collector circuit configurations:

a. ground 'closed' loop horizontal
b. ground 'closed' loop compact collector
c. ground 'closed' loop slinky
d. ground 'closed' loop vertical borehole
e. lake 'closed' loop
f. vertical borehole closed' loop

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

a. suitable pipework materials
b. below ground jointing
c. protection against frost damage
d. protection against mechanical damage
e. separation distances to avoid thermal interference
f. separation distances from other services and adjacent buildings
g. achieving balanced loop/collector circuits

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

a. suitable pipework materials
b. below ground jointing
c. protection against frost damage
d. protection against mechanical damage
e. separation distances to avoid thermal interference
f. separation distances from other services and adjacent buildings
g. achieving balanced loop/collector circuits

6.4 Identify the typical components required in relation to:

a. single circuit 'closed' loop collector circuits
b. multi-circuit 'closed' loop collector circuits
c. brine circuits between outside air source units and internal heat pump units

6.5 Confirm the typical layout of components in relation to:

a. single circuit collector circuits
b. multi-circuit collector circuits
c. brine circuits between outside air source units and internal heat pump units

6.6 Confirm which factors determine the year round energy available in Watts (W) per m2 of ground area

6.7 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)

Learning Outcome 6

6. Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation (Cont.)

Assessment Criteria

6.8 Confirm how the specific heat extraction capacity (in W/m2 for horizontal/vertical trench collectors and W/m for vertical borehole collectors) of the ground collector circuit can be affected by the:

a. ground conditions/soil types
b. type of backfill material
c. geographical location – ground rest temperature
d. ground loop configuration
e. annual heat pump operating hours

6.9 Confirm how the total ground area (m2) requirements for horizontal collector loops is determined using the following data:

a. refrigeration capacity (kW)
b. specific extraction output (W/m2)

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

a. total ground area (m2)
b. collector loop pipe spacing (m)

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

a. total ground area (m2)
b. collector loop pipe spacing (m)

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

a. total ground area (m2)
b. centre to centre spacing of the slinky collector (m)

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

a. heat pump refrigeration capacity (kW)
b. ground condition
c. annual heat pump operating hours

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

a. design flow rate
b. brine viscosity
c. heat pump refrigeration capacity (kW)
d. specific thermal capacity of brine (kJ/kg)
e. temperature difference between brine circuit flow and return pipework (degrees centigrade)

Learning Outcome 7
7. Know the layouts of 'open loop' water filled heat pump collector circuits
Assessment Criteria
7.1 Identify the following 'open loop' water filled heat pump collector circuit configurations: a. ground 'open' loop vertical borehole b. lake 'open' loop

Learning Outcome 8
8. Know the fundamental design considerations and principles that are specific to air source heat pumps
Assessment Criteria
8.1 Identify the factors that need to be considered when selecting and positioning air source heat pump fan coil units in relation to: a. operating noise (including the potential effect on neighbouring properties) b. air turbulence during operation 8.2 Identify the design options to provide for the defrost cycle for an air source heat pump 8.3 Confirm how to size a buffer tank to provide for an air source heat pump defrost cycle

Learning Outcome 9
9. Know the preparatory work required for heat pump installation work
Assessment Criteria
9.1 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: a. authorisation for the work to proceed b. the availability and collation of all relevant information c. verification of the suitability of the hydraulic emitter circuit for connection to the heat pump unit d. verification that the heat output capacity of the heat pump unit is matched to the required proportional contribution of the total building heat load e. verification that the buffer tank sizing is correct f. the availability of appropriate access to all required work areas g. the availability and condition of a suitable electrical input service h. adequate provision for the siting of key internal system components i. the suitability of the building structure in relation to the ... 9.2 ... proposed installation 9.3 Confirm the pre-installation checks that are specific to the positioning of fan coil units

Learning Outcome 10
10. Know the requirements to install and test heat pump systems (non-refrigerant circuits)
Assessment Criteria
10.1 Confirm the requirements for moving and handling heat pump units to avoid damage to the unit 10.2 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 10.3 Identify the requirements where brine circuit pipework passes through the external building fabric in relation to: a. provision for movement b. protection against freezing c. prevention of water ingress 10.4 Confirm the charging and flushing requirements for closed loop collector circuits in relation to: a. purging of air and installation debris b. addition of antifreeze protection and suitable biocides c. checking flow rates 10.5 State what equipment is needed for system charging and flushing 10.6 Confirm the hydraulic test requirements for: a. closed loop collector circuits b. hydraulic emitter circuits

Learning Outcome 11
11. Understand the requirements to commission heat pump system installations
Assessment Criteria
11.1 Confirm the conditions that are required to implement commissioning activities for ground source heat pump systems 11.2 Confirm the commissioning requirements for ground source heat pump systems in relation to: a. setting of mechanical controls b. setting of electrical controls and temperature sensors c. functional tests 11.3 Confirm the conditions that are required to implement commissioning activities for air source heat pump systems 11.4 Confirm the commissioning requirements for air source heat pump systems in relation to: a. setting of mechanical controls b. setting of electrical controls and temperature sensors c. functional tests

Learning Outcome 12
12. Understand the requirements to handover heat pump system installations
Assessment Criteria
12.1 Confirm the pre-handover checks that need to be carried out for a ground source heat pump system installation 12.2 Confirm the industry handover procedures for a ground source heat pump system installation in relation to the: a. provision of written information b. provision of diagrammatic information c. provision of verbal information/demonstration relating to system operation and use 12.3 Confirm the pre-handover checks that need to be carried out for an air source heat pump system installation 12.4 Confirm the industry handover procedures for an air source heat pump system installation in relation to the: a. provision of written information b. provision of diagrammatic information c. provision of verbal information/demonstration relating to system operation and use

Assessment of Requirements for Individual Units

Unit Ref: D/602/3072 Install, commission and handover heat pumps non-refrigerant

To achieve the completion of this **performance unit** you must:

- complete the appropriate practical performance activities in simulated conditions as per the requirements for unit Y/602/3054 as specified in the BPEC Practical Assessment manual for this qualification.

Or

- provide satisfactory evidence of having met the requirements of the Learning Outcomes and Assessment Criteria from a real working environment

Unit Ref: F/602/3078 Know the requirements to inspect, service and maintain heat pump system installations non-refrigerant circuits

To achieve the completion of this **knowledge unit**, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification).

Unit Ref: L/602/3083 Inspect, service and maintain heat pump installations non- refrigerant circuits

To achieve the completion of this **performance unit** you must:

- complete the appropriate practical performance activities in simulated conditions as per the requirements for unit F/602/3078 as specified in the BPEC Practical Assessment manual for this qualification.

Or

- provide satisfactory evidence of having met the requirements of the Learning Outcomes and Assessment Criteria from a real working environment.

Unit Ref: Y/602/3054 Know the requirements to install, commission and handover heat pump systems non-refrigerant circuits

To achieve the completion of this **knowledge unit**, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification).

SummitSkills Assessment Strategy for Building Services Engineering (Knowledge and Performance requirements)

Knowledge unit/Knowledge Learning Outcome assessment requirements	
3.5	The assessment instruments for **Knowledge Units** must be as identified in the "Additional Information" of the unit, be fit-for-purpose and be one or more of; 3.5.1 Knowledge tests - centrally set, centrally marked and quality assured by the Awarding Organisations who offer a unit(s) or qualification(s) identified in this strategy. 3.5.2 Knowledge based projects or assignments that are centrally set, centre marked and quality assured by the Awarding Organisations who offer a unit(s) or qualification(s) identified in this strategy. 3.5.3 Knowledge based professional discussion that is centre devised following centrally specified guidance, centre marked and quality assured by the Awarding Organisations who offer a unit(s) or qualification(s) identified in this strategy.
Performance unit/Performance Learning Outcome assessment requirements (simulated)	
3.6	The environment in which the evidence and the quantity of evidence for **Performance Units** must be assessed, i.e. sourced from the real working environment or simulated conditions, will be detailed in the "Additional Requirements" for each Performance Unit. This could be applicable to all the Learning Outcomes in the unit or particular Learning Outcomes.
Performance unit/Performance Learning Outcome assessment requirements (real working environment)	
3.7	Evidence that is sourced from the real working environment for **Performance Units** must be naturally occurring and can be generated by; 3.7.1 Direct observation of performance in the workplace by a qualified assessor and/or testimony from an expert witness subject to the activity being assessed (Also see 3.6 above). This will be the primary source of evidence. 3.7.2 Candidate's reflective account of performance. (Write up of work completed) 3.7.3 Work plans and work based products e.g. diagrams, drawings, specifications, customer testimony, authorised & authenticated photographs/ images an audiovisual records of work completed. 3.7.4 Evidence from prior achievements that demonstrably match the requirements of the Performance Unit. 3.7.5 Witness testimony

Scheme Documentation

The following documentation will also be supplied by BPEC Certification Ltd. to support the delivery of the Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits).

- Combined qualification assessment manual, including:
  - Assessment documentation
    - In centre practical performance assessment guidance
    - In centre practical performance assessment material
    - On the job workplace performance assessment guidance
    - On the job workplace performance guidance material
- Knowledge assessment papers and question specifications *(centre only)*
- Off the job performance training guidance
- Portfolio building guidance
- On site assessment guidance
- Delivery support materials
  - Scheme of work and sample lesson plans
  - Full training manual)
  - Supporting Powerpoint presentations
  - Links to manufacturer's and other useful sources of information
- Sample teaching file including exemplar tracking documentation

Assessment Documentation

Simulated Performance Assessments

For all 'Performance units' where evidence is not being provided from site, learners will be required to successfully complete a number of different performance assessments. All appropriate information and supporting documentation is contained within the BPEC performance assessment manual for the qualification which applies to the following units:

- D/602/3072 – Install, commission and handover heat pumps non-refrigerant circuits
- L/602/3083 – Inspect, service and maintain heat pump installations non- refrigerant circuits

Marking Performance Assessments

The pass rate for the performance assessments is 100%

1. First Attempt - learners are given a first attempt in all areas of the performance assessment
2. Second Attempt – performance areas not satisfactorily completed will be re-attempted
3. At the assessors discretion, the learner is re-assessed by oral questioning and/or observing the performance in an attempt to establish competence in all remaining areas
4. Learners who have not achieved the 100% pass mark at this stage will be deemed to have failed the performance assessment. Learners wishing to retake the assessment will be required to re-attempt the full performance assessment in its entirety

Knowledge and Understanding Assessments

The units listed below all require the learner to complete a knowledge assessment. The knowledge assessments (and supporting rationale) are provided by BPEC Certification Ltd.

- F/602/3078 – Know the requirements to inspect, service and maintain heat pump system installations non-refrigerant circuits
- Y/602/3054 – Know the requirements to install, commission and handover heat pump systems non-refrigerant circuits

*The completed knowledge assessment papers (questions and answers) must be retained in the centre portfolio – **KNOWLEDGE ASSESSMENT QUESTIONS AND ANSWERS MUST NOT BE RETAINED IN THE LEARNER PORTFOLIO**

Marking Knowledge Assessments

The pass rate for the knowledge assessments is 100%

On line exam

1. The learner will complete the first attempt on line
2. If the learner does not achieve the 100% pass mark, they will be given a second on line attempt at answering any questions answered incorrectly on the first attempt
3. Oral Verification - providing a level of achievement of 80% has been attained, the learner will be orally questioned in an attempt to establish competence in all remaining areas
4. Learners who have not achieved the 80% pass mark after their second attempt will be deemed to have failed the knowledge assessment. Learners wishing to retake the assessment will be required to re-attempt the full theory exam in its entirety

Learner Result Form

A Learner Result Form has been produced for the Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits). This document shall be used to record that the learner has completed the whole qualification in a satisfactory manner. The document shall be completed and signed by the centre assessor and the internal verifier.

The completed Learner Result Form shall be sent to BPEC Certification Ltd. (with attached passport photo) for certification. Copies of the Learner Result Form shall also be retained in the Learner Portfolio and the Centre Portfolio.

Evidence Forms

BPEC Certification Ltd. has designed evidence forms which may be used to capture evidence relating to a learners performance in the workplace. Such evidence may include:

- Assessor feedback to the learner
- Records of supplementary questions posed by the assessor and the learner responses
- Learner feedback – statements made by the learner to clarify their competence
- Witness testimony – statements made by witnesses e.g. supervisor, customer etc. relating to the competence of the learner

These evidence forms are contained in the Qualification Assessment Manual and have been designed so that they can be copied/reprinted as many times as is required.

Portfolio Contents

The table below identifies the contents to be retained within the learner and the centre portfolios:

	Learner Portfolio	Centre Portfolio
Previous qualifications	✓	✓
Learner result form	✓	✓
Evidence collected e.g. work records, evidence forms	✓	
Knowledge assessment documentation		✓
Performance assessment documentation (contained in qualification assessment manual)	✓	✓

Staff Qualification Requirements

Assessors

Assessors **MUST** be vocationally and occupationally competent in the areas they are assessing and have a thorough knowledge of the National Occupational Standards and Units of Assessment.

The assessor must be able to provide appropriate documented evidence that demonstrates they have a minimum of 5 years proven occupational experience in the activities they will be assessing e.g. a signed and dated CV. This verifiable evidence must be at or above the level of competence being assessed.

Qualifications

Assessors shall be technically qualified in Plumbing/H&V Installation, and must be able to provide evidence in one or more of the following ways:

- A relevant qualification (e.g. NVQ/SVQ or equivalent in Plumbing/H&V Installation)
- Registration with the appropriate industry registration body at the relevant occupational level and grade.

The assessor must also hold one of the following assessor qualifications:

- QCF Level 3 Award "Assessing Vocational Related Achievement – in Centres/Colleges or Training Providers" or
- QCF Level 3 Certificate "Assessing Vocationally Related Achievement – in Centres/Colleges and The Workplace" or
- A1 or D32 /D33 with an Upgrade to A1 as a minimum *

'Workplace Assessors' MUST hold:

- QCF Level 3 Award "Assessing Competence in the Workplace Environment" or
- QCF Level 3 Certificate "Assessing Vocationally Related Achievement – in Centres/Colleges and The Workplace" or
- A2 or D32 with an upgrade to A2 as a minimum*

Assessors holding D units must have evidence of Continuing Professional Development (CPD) to demonstrate compliance with the A units. Evidence of CPD will be sought by the External Verifier for all Assessors approved to assess for the centre.

'Candidate assessors' who are working towards their assessor qualifications must always be supervised by a qualified assessor. They should have a clear action plan for achieving the assessor qualification(s), (assessor approval will be withdrawn if the assessor qualification/units have not been attained within a period of 18 months).

Internal Verifiers

The main focus of IV's is with the quality assurance of assessment procedures.
The IV is required to have a minimum of occupational experience evidenced by having a Building Services Engineering sector related qualification or proven sector competence/experience plus access to relevant "occupational expertise" to enable them to conduct their role as internal verifier appropriately. This evidence and access to "occupational expertise" is quality assured by the Awarding Organisation

Qualifications

Internal Verifiers must hold the following:

- QCF Level 3 Certificate "Assessing Vocationally Related Achievement – in Centres/Colleges and The Workplace"
- QCF Level 4 Award " Internal Quality assurance of assessment processes and practice" or
- QCF Level 4 Certificate "leading the Internal Quality assurance of assessment processes and practice" or
- A1 or D32/D33 with an upgrade to A1 as a minimum*
- V1 or D34 with an upgrade to V1 as a minimum*

*The Teaching Qualification for Secondary Education (TQSE) or the Teaching Qualification for Further Education (TQFE) (which is recognised in Scotland) these awards are acceptable providing they are the versions that are recognised as equivalents to the A1 award. Internal Verifiers holding D units must have evidence of CPD to demonstrate compliance with the A and V units.

It is recommended that 'Candidate Internal Verifiers' have a clear action plan for achieving the Internal Verifier qualification(s). Internal Verifier approval will be withdrawn if the qualification/units have not been attained within the approved period (18 months).

Continuing Professional Development (CPD)

The occupational competence of assessors and internal verifiers must be updated on a regular basis and be periodically reconfirmed via continuing professional development (CPD) which is recorded by the assessment centres.

Further Information

Requests for further information regarding centre/scheme approval or any aspect of assessment of the BPEC qualifications please contact:

BPEC Certification Ltd. 2 Mallard Way, Pride Park, Derby, DE24 8GX
T 0845 644 6558 F 0845 121 1931 E AOadmin@bpec.org.uk W www.bpec.org.uk

Annex 1 - Funding

BPEC Certification Ltd. does not provide details on funding as this may vary between regions. Centres should contact the appropriate funding body to check eligibility for funding and any regional/national arrangements which may apply to the centre or learners.

For funding regulatory purposes, learners should not be entered for a qualification of the same type, level and content as that of a qualification they already hold. Please see below for where to find out more about the funding arrangements.

England
Skills Funding Agency
Cheylesmore House
Quinton Road
Coventry
CV1 2WT

Email: qualifications@sfa.bis.gov.uk

https://www.gov.uk/government/collections/qualifications-approved-for-public-funding

http://data.gov.uk/dataset/learning-aim-reference-service

Scotland
Colleges should contact the Scottish Further Education Funding Council, at www.sfc.ac.uk

Training providers should contact Scottish Enterprise at www.scottish-enterprise.com or one of the Local Enterprise Companies.

Northern Ireland
Please contact the Department for Employment and Learning at www.delni.gov.uk

Wales
Centres should contact the department for education, lifelong learning and skills: www.new.wales.gov.uk

Annex 2 – Sector Skills Councils

The Sector Skills Councils have the responsibility for development of the national occupational standards and in many cases, facilitating the development of relevant sector vocational qualifications. Similarly, the Sector Skills Councils formulate the 'assessment strategy' for these qualifications, contact details of the relevant Sector Skills Council(s) are shown below:

SummitSkills Limited, Vega House, Opel Drive, Fox Milne, Milton Keynes, MK15 0DF
T: 01908 303960 W: www.summitskills.org.uk