REGULATED QUALIFICATION FRAMEWORK (RQF)

QUALIFICATION SPECIFICATION

1. **LCL Awards Level 3 Award in the Installation and Maintenance of Air Source Heat Pump Systems (non-refrigerant circuits)**

2. **LCL Awards Level 3 Award in the Installation and Maintenance of Ground Source Heat Pump Systems (non-refrigerant circuits)**

3. **LCL Awards Level 3 Award in the Installation and Maintenance of Heat Pump Systems (non-refrigerant circuits)**

1.0 Qualification Objectives

The Objectives of the Qualification are to:

1. Prepare learners to progress to a qualification in the same subject area but at a higher level or requiring more specific knowledge, skills and understanding
2. Prepare learners to progress to a qualification in another subject area.

2.0 Prior qualifications, knowledge, skill or understanding which learners are required to have achieved before taking the qualification

An Initial Assessment conducted by the Approved Centre (AC) on application for the qualification will determine the learner's capability to complete the qualification.

Learners holding a level 2 or 3 vocational qualification in the Building Engineering Services (BES) Sector which includes the current WRAS Water Regulations/Water Byelaws or equivalent will confirm their capability to complete the qualification.

Learners not holding a qualification above, will be required to provide evidence to the AC of an alternative suitable qualification and or provide confirmation of their related work experience and skills.

3.0 Other requirements which a learner must have satisfied before the learner will be assessed or before the qualification will be awarded

None.

4.0 Qualification Framework

The qualification framework comprises of 3 qualification routes. Unit LCL-R3035 is a mandatory core unit, and at least one or both of units (LCL-R3036 and/or LCL-R3037) must be undertaken to gain the qualification.

Unit Title	LCL Reference Number	Type of Unit	Level	Credit Value
Core unit in Heat Pump Technology (Non-Refrigerant Circuit)	LCL-R3035	Knowledge	3	2
Air Source unit in Heat Pump Technology (Non-Refrigerant Circuit)	LCL-R3036	Knowledge and Performance	3	1
Ground Source unit in Heat Pump Technology (Non-Refrigerant Circuit)	LCL-R3037	Knowledge and Performance	3	1

4.1 Qualification Time and Credit Value

- **Level 3 Award in the Installation and Maintenance of Heat Pump Systems (non-refrigerant circuits) LCL Awards:**
  - The Total Qualification Time (TQT) is 40 hours
  - The Guided Learning Hours (GLH) are 30
  - The total credit value of the qualification is 4.

- **Level 3 Award in the Installation and Maintenance of Air Source Heat Pump Systems (non-refrigerant circuits) LCL Awards:**
  - The Total Qualification Time (TQT) is 30 hours
  - The Guided Learning Hours (GLH) are 20
  - The total credit value of the qualification is 3.

- **Level 3 Award in the Installation and Maintenance of Ground Source Heat Pump Systems (non-refrigerant circuits) LCL Awards:**
  - The Total Qualification Time (TQT) is 30 hours
  - The Guided Learning Hours (GLH) are 20
  - The total credit value of the qualification is 3.

4.2 Qualification Level

The qualifications have been assigned at level 3.

4.3 Grading Structure

The grading structure for each qualification is that learners are required to achieve a result of **Pass** to be awarded credit for each unit.

This qualification will be achieved when learners have successfully completed:

- The LCL Awards set and marked multiple choice knowledge examination
- The LCL Awards set and AC marked performance assessments.

4.4 Assessment Methods

The assessment methods within the qualification include an online multiple choice knowledge examination and an AC marked performance assessment.

The assessment methods have been designed to assess the knowledge, understanding and skills of learners.

The online multiple choice knowledge examination is set and marked by LCL Awards.

The performance assessment is set by LCL Awards and marked by an LCL Awards approved assessor at the AC.

5.0 The criteria against which learners' level of attainment will be measured

The Learning Outcomes and Assessment Criteria against which learners' level of attainment will be measured are detailed in the examination and assessment specification for each unit below.

Unit Learning Outcomes and Assessment Criteria

LCL-R3035: Core Unit in Heat Pump Technology (Non-Refrigerant Circuit)

Learning Outcome 01 The learner will know what a heat pump is, the principle of the vapour compression system and system components.

The learner will demonstrate knowledge of:

1.1 The purpose and operational characteristics of the following components:

- Evaporator
- Low pressure switch
- Compressor
- High pressure switch
- Condenser
- Dryer/receiver
- Expansion valve
- Expansion valve phial

- Refrigerant four-way valve
- Evaporator fan coil
- Fan
- Heat transfer fluid pump.

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

Learning Outcome 2. The learner will know the different operational characteristics of each type of heat pump unit and system arrangement.

The learner will demonstrate knowledge of*:*

2.1 The different type of heat pump within their categories and recognise their individual heat source:

- Air Source heat pump
  - Monobloc, fixed speed, inverter driven
  - Split
  - Air to air.
- Ground source heat pump
  - Fixed speed, inverter driven
  - Closed loop
  - Open loop.
- Exhaust air heat pump
  - Fixed speed, inverter driven
  - Heating and hot water
  - Hot water only
  - Air to air.

2.2 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 and charging split air source 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
- The competence of personnel undertaking servicing of a split air source heat pumps
- The competence of personnel undertaking recovery of fluorinated greenhouse gases from heat pump refrigerant circuits
- Flammability of certain refrigerants.

Learning Outcome 3. The learner will know the fundamental principles of heat pump efficiency and design selection that are common for heat pumps.

The learner will demonstrate knowledge of:

3.1 The meaning of the term 'Coefficient of Performance'
3.2 The relationship between Coefficient of Performance and the:
- Heat pump input temperature
- Heat pump emitter temperature.

3.3 The effect that ambient temperature can have on:
- Coefficient of performance
- Heat pump output.

3.4 The meaning of the term 'Seasonal Coefficient of Performance'
3.5 The factors that can affect the Seasonal Coefficient of Performance
3.6 The understanding of a products Energy-related Product (ErP) label and product Fiche
3.7 The meaning of the term 'System Efficiency'
3.8 The factors that can affect the 'System Efficiency'
3.9 The understanding of a products package label
3.10 Why is achieving minimum heat loss from the building is particularly important when designing a heat pump system
3.11 The factors that need to be considered when selecting a heat pump in relation to:
- Heat load based on a heat loss calculation based on worst case outside temperature
- Flow temperature
- Hot water requirements.

3.12 Identify suitable electrical supply in relation to:
- Distribution Network Operator (DNO) connection
- Isolation switches
- Fuse rating.

3.13 The effect that oversizing of a heat pump has on:
- System performance/efficiency
- Heat pump operation.

3.14 The effect that under-sizing of a heat pump has on:
- System performance/efficiency
- Heat pump operation.

3.15 The meaning of the terms:
- Monovalent system
- Bivalent system
- Hybrid system.

3.16 How to use manufacturer's data to select heat pump units:
- Output charts
- Other data.

3.17 The meaning of the term 'bivalent points' in relation to heat pump output charts
3.18 How 'bivalent points' are used to determine auxiliary heat requirements
3.19 How heat pump output capacity is affected by:
- Heat pump input temperature

- Heat pump output temperature.

3.20 The typical mean water temperature recommended when designing a hydraulic emitter circuit that incorporates:
- Standard panel radiators
- Underfloor heating
- Fan assisted convector heaters
- Fan coils.

3.21 The typical annual operating hours for a heat pump that is being used for:
- Heating only
- Heating and domestic hot water.

3.22 How heat pump annual operating hours may vary in relation to the:
- Type of building
- Geographical location of the installation.

Learning Outcome 4. The learner will know the fundamental principles of domestic hot water cylinder selection and system design that are common for heat pumps.

The learner will demonstrate knowledge of:

4.1 The different type of heat pump hot water cylinders:
- Heat pump, hot water packaged unit
- Coiled indirect cylinder
- Tank in tank cylinder
- Thermal store
- Solar cylinder.

4.2 The volume of hot water cylinder required for the building

4.3 The output required from heat pump to heat the hot water cylinder

4.4 The correct selection of hot water cylinder for the heat pump

4.5 The correct zone valve selection for heat pump and hot water cylinder

4.6 The requirements for secondary hot water circulation.

4.7 The safe system design in relation to regulations for:
- Legionella protection
- Hot water temperature protection and prevention of scalding.

Learning Outcome 5. The learner will know the fundamental principles of hydraulic system design that are common for heat pumps.

The learner will demonstrate knowledge of:

5.1 The suitability of the following types of hydraulic heating system emitter for heat pump systems:
- Standard panel radiators
- Underfloor heating
- Fan assisted convector heaters
- Combined systems (radiators, underfloor heating)

- Multiple zones.

5.2 How to identify heat pump hydraulic flow rate requirements and circulation pump selection
5.3 How to identify heat pump pipe size requirements in relation to designed flow temperature
5.4 Why a buffer vessel maybe required in the system design
5.5 How to size a buffer vessel in the system design
5.6 The correct piping alternatives for buffer vessels in the system design.

Learning Outcome 6. The learner will know the fundamental principles of heat pump controls.

The learner will demonstrate knowledge of:

6.1 The common control systems for heat pump units in relation to:
- Weather compensation
- Indoor and outdoor sensors
- Heat curves
- Scheduling
- Optimisation
- Accessories
- Internet connections and apps.

Learning Outcome 7. The learner will know how to plan and prepare for the installation of heat pumps.

The learner will demonstrate knowledge of:

7.1 The common requirements of pre-installation checks for heat pump unit installations connected to hydraulic emitters circuits in relation to:
- Verification that the heat output capacity of the heat pump unit is matched to the required proportional contribution of the total building heat load
- The availability and condition of a suitable electrical input service
- Verify the correct fuse rating for heat pump
- Adequate provision for the siting of key internal system components
- The suitability of the building structure in relation to the proposed installation.
- DNO notification
- Building regulation and assignment of rights.

7.2 Undertake pre-installation checks for a heat pump installation to include checks relating to:
- Authorisation for the work to proceed
- Client/end user requirements
- Statutory regulations and/or industry recognised procedures
- Manufacturers requirements
- The availability of appropriate access to all required work areas
- The availability and collation of all relevant information
- 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.

Learning Outcome 8. The learner will know the requirements to install and test heat pump systems (non-refrigerant circuits).

The learner will demonstrate knowledge of:

8.1 The requirements for moving and handling heat pump units to avoid damage to the unit

8.2 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

8.3 The requirements where heat transfer fluid circuit pipework passes through the external building fabric in relation to:

- Provision for movement
- Protection against freezing
- Prevention of water ingress.

8.4 The charging and flushing requirements for hydraulic system in relation to:

- Correct filling and venting
- Purging of air and installation debris
- Addition of antifreeze protection and suitable cleansers and or inhibitors.
- Checking for leaks
- Check filters for debris.

8.5 The hydraulic test requirements.

Learning Outcome 9. The learner will know the requirements to commission heat pump system installations (non-refrigerant circuits).

The learner will demonstrate knowledge of:

9.1 The conditions that are required to implement commissioning activities for heat pump systems

9.2 The commissioning requirements for heat pump systems in relation to:

- Setting of mechanical controls
- Setting of electrical controls and temperature sensors
- Functional tests
- Hydraulic balancing
- Checking flow rates.
- Checking the designed delta t
- Checking start and stop temperatures.

Learning Outcome 10. The learner will know the requirements to handover heat pump system installations.

The learner will demonstrate knowledge of:

10.1 The pre-handover checks that need to be carried out for a heat pump system installation
10.2 The industry handover procedures for a heat pump system installation in relation to the:
- Provision of completed commissioning sheet
- Provision of diagrammatic information
- Provision of verbal information/demonstration relating to system operation and use.

Learning Outcome 11. The learner will know the requirements for the handover of a heat pump installation (non-refrigerant circuits).

The learner will demonstrate knowledge of:

11.1 The 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
11.2 The requirements to explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures
11.3 The requirements to explain to the end user any aspects of the system that varies from the agreed specifications and requirements
11.4 Obtaining acceptance by the end user of the system according to the industry agreed handover procedures
11.5 The requirements for ensuring 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.

Learning Outcome 12. The learner will know the requirements for routine service and maintenance of a heat pump system installation (non-refrigerant circuits).

The learner will demonstrate knowledge of:

12.1 Which documentation needs to be available to enable routine service and maintenance work on heat pump system installations
12.2 A typical routine service and maintenance requirements for a heat pump installation in relation to:
- Visual inspection requirements
- Cleaning of components
- Checking of system water content
- Functional tests.

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

12.4 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 13. The learner will know how to undertake fault diagnosis work on a heat pump system installation.

The learner will demonstrate knowledge of:

13.1 The cause of 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.

13.2 The relevant person(s) fault rectification procedures for the faults identified.

LCL-R3036: Air Source unit in Heat Pump Technology (Non-Refrigerant Circuit).

Learning Outcome 1. The learner will know the preparatory work required for the installation of an air source heat pump.

The learner will demonstrate knowledge of:

1.1 The factors that need to be considered when positioning an air source heat pump in relation to:

- Operating noise and proximity to habitable rooms and neighbouring properties
- Planning considerations and permitted development
- Ensuring adequate airflow and clearances.

1.2 The factors that need to be considered when wall or floor mounting an air source heat pump

1.3 The requirement for moving and handling air source heat pumps units to avoid damage and personal injury

1.4 The options to deal with the condensate produced from normal and defrost cycle operation of an air source heat pump.

Learning Outcome 2. The learner will know the common requirements for the installation of an air source heat pump connected to hydraulic emitter circuits.

The learner will demonstrate knowledge of:

2.1 The installation requirements where flow and return pipework passes through the external building fabric in relation to:

- Provision for movement
- Prevention of water ingress.

2.2 If a buffer vessel is required in the system design and correctly sized
2.3 The heat pump hydraulic flow rate requirements and circulation pump selection.
2.4 The installation requirements for suitable insulation of external pipework in relation to:

- Thermal loss
- Protection against freezing
- UV protection
- Animal protection.

Learning Outcome 3. The learner will be able to install heat pump units (non-refrigeration units).

The learner will be able to:

3.1 Install a heat pump in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures, to include as a minimum the connection of the heat pump unit to the hydraulic emitter circuit.

Learning Outcome 4. The learner will be able to test and commission an air source heat pump system (non-refrigerant circuits).

The learner will be able to:

4.1 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.

4.2 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.

4.3 Commission the installation in accordance with manufacturer's guidance, design requirements, client's requirements, and statutory requirements and/or industry recognised procedures
4.4 Complete relevant documentation to record the commissioning activities.

Learning Outcome 5. The learner will be able to undertake routine service and maintenance of an air source heat pump system (non-refrigerant circuits).

The learner will be able to:

5.1 Obtain relevant documentation required to be enable a routine service and maintenance work on air source heat pump system installations

5.2 Undertake servicing of an air source heat pump in accordance with manufacturer's instructions

5.3 Carry out the routine servicing of relevant components of an air source heat pump installation, including checks in relation to:

- External isolation is used
- Evaporator fins for any blockage
- Evaporator fins are cleaned
- Fan is not obstructed and moving freely
- Outer casing
- Condensate drain functioning and not blocked
- Condition of flexible hoses
- Condition and grade of pipe insulation
- Signs of system water leakage
- Oil leaks or deposits
- Condition and security of fixing system
- Anti-vibration mounts
- Verify the correct fuse rating for the heat pump.

5.4 Carry out the routine servicing of an air source heat pump connected to hydraulic emitter circuits and controls, including checks in relation to:

- Signs of system water leakage
- Heating system water pressure
- Heating system water content and makeup
- Expansion vessel size and pressure
- Pressure relief valve (prv) operation
- System filters
- System bypass
- Buffer vessel if installed
- Circulation pumps
- Mechanical valves
- Condition and grade of pipe insulation
- Control unit and alarm logs
- Heating settings
- Hot water settings
- Indoor and outdoor sensors or thermostats.

5.5 Undertake and maintenance functional tests on an air source heat pump to include:

- Safe operation
- Sufficient operation
- The function of system components and controls

- Noise and vibration levels.

5.6 Complete service and maintenance records.

LCL-R3037: Ground Source Unit in Heat Pump Technology (Non-Refrigerant Circuit).

Learning Outcome 1. The learner will know the fundamental design principles for ground source heat pump collector circuits, design, component sizing and installation.

The learner will demonstrate knowledge of:

1.1 The different types of ground source collectors in relation to:
- Horizontal ground loop
- Compact collector
- Slinky collector
- Vertical bore hole "closed loop"
- Vertical bore hole "open loop"
- Lake collector "closed loop"
- Lake collector "open loop".

1.2 The principles of ground collector design in relation to:
- Collector type used
- Ground conditions and type
- Specific heat capacity w/m² of the ground
- Annual heat pump operating hours.

1.3 The ground collector installation in relation to:
- Collector type used
- Suitable pipework materials
- Below ground jointing
- Protection of mechanical damage
- Separation distances to avoid thermal transfer
- Separation distances from other services and adjacent buildings
- Type of backfill material
- Achieving balanced collector circuits.

1.4 The requirements where ground collector pipework passes through the external building fabric in relation to the:
- Provision for movement
- Protection against freezing
- Prevention of water ingress
- Prevention of condensation.

1.5 The requirements of charging and flushing of closed loop ground collector's relation to:
- Purging air and installation debris
- Addition antifreeze protection and suitable biocides
- Checking flow rates
- State equipment needed for system charging and flushing
- Pressure testing.

Learning Outcome 2. The learner will know the common requirements for the installation of a ground source heat pump connected to hydraulic emitter circuits.

The learner will demonstrate knowledge of*:*

2.1 If a buffer vessel is required in the system design and correctly size
2.2 The heat pump hydraulic flow rate requirements and circulation pump selection.

Learning Outcome 3. The learner will be able to test and commission a ground source heat pump system.

The learner will be able to:

3.1 Install a heat pump in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures, to include as a minimum the connection of the heat pump unit to the hydraulic emitter circuit.

Learning Outcome 4. The learner will be able to test and commission a ground source heat pump system.

The learner will be able to:

4.1 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
- Pressure test collector circuit to ensure hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements, and industry recognised procedures.

4.2 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.

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

4.4 Complete relevant documentation to record the commissioning activities.

Learning Outcome 5. The learner will be able to undertake the routine service and maintenance of a ground source heat pump system (non-refrigerant circuits).

The learner will be able to:

5.1 Obtain relevant documentation required to be enable a routine service and maintenance work on ground source heat pump system installations

5.2 Undertake serving of a ground source heat pump in accordance with manufacturer's instructions

5.3 Carry out the routine servicing of relevant components of a ground source heat pump ground collector circuit installation, including checks in relation to:

- Check system fluid levels
- Check the system pressure levels
- Signs of system fluid leakage
- Check anti-freeze with suitable refractometer
- Check particle filter
- Check pressure or filling vessel
- Condition and grade of pipe insulation
- Condition of casing
- Pipe connections
- Verify the correct fuse rating for the heat pump.

5.4 Carry out the routine servicing of a ground source heat pump connected to hydraulic emitter circuits and controls, including checks in relation to:

- Signs of system water leakage
- Heating system water pressure
- Heating system water content and makeup
- Expansion vessel size and pressure
- Pressure relief valve (PRV) operation
- System filters
- System bypass
- Buffer vessel if installed
- Circulation pumps
- Mechanical valves
- Condition and grade of pipe insulation
- Control unit and alarm logs
- Heating settings
- Hot water settings
- Indoor and outdoor sensors or thermostats.

5.5 Undertake functional tests on a ground source heat pump to include:

- Safe operation
- Efficient operation
- The function of system components and controls
- Noise and vibration levels.

5.6 Complete service and maintenance records.

6.0 Other Information

Qualification Regulator Numbers:

LCL Awards Level 3 Award in the Installation and Maintenance of Air Source Heat Pump Systems (non-refrigerant circuits)

- Ofqual QAN – 603/7790/2
- Qualifications Wales - C00/4532/0

LCL Awards Level 3 Award in the Installation and Maintenance of Ground Source Heat Pump Systems (non-refrigerant circuits)

- Ofqual QAN – 603/7791/4
- Qualifications Wales - C00/4532/1

LCL Awards Level 3 Award in the Installation and Maintenance of Heat Pump Systems (non-refrigerant circuits)

- Ofqual QAN – 603/7792/6
- Qualifications Wales - C00/4532/2

Sector Skills Area: SSAs: 5.2 Building and Construction.

Age suitability: 16 plus.

Last Qualification Review Date October 2023

Next Qualification Review Date: 31.10.2026

Amended April 2024