



Qualification Specification

DPH-003

**BPEC Level 3 NVQ Diploma in Domestic
Plumbing and Heating** (Environmental Technology)

Qualification Number – **600/6863/2**

Content

About BPEC	2
1. Introduction to the Qualification	3
1.1. Qualification Overview	3
1.2. Who this Qualification is for	3
1.3. The Purpose of the Qualification	3
1.4. Support and Accreditation	3
1.5. Relationship to Other Qualifications	3
1.6. Pre-requisites for the qualification	3
2. Qualification Structure	4
3. The Learners	6
3.1. Qualifications that the Learner must have completed before taking the Qualification	6
3.2. Knowledge, skills or understanding that the Learner is required to have before taking the qualification	6
3.3. The Units the Learner must have completed before the Qualification will be awarded	6
3.4. Any other requirements which a Learner must have satisfied before the Learner will be assessed or before the Qualification is awarded	6
3.5. Qualification achievement	6
4. Delivery requirements	7
4.1. Centre Recognition	7
4.2. Qualification Approval	7
4.3. Physical Resources	7
4.4. Assessor/Trainer Requirements	7
4.4.1. Assessor occupational competence	8
4.4.2. T/502/9157 - Understand and carry out electrical work on domestic plumbing and heating systems and components	8
4.4.3. Assessor occupational competence (Optional Pathways)	8
4.4.4. Assessor continuing professional development	8
4.5. IQA occupational competence	8
4.6. External Quality Assurers (EQAs)	9
5. Support Materials	9
5.1. Qualification Specification	9
5.3. Textbooks	9
6. Unit Details	10
7. Assessment Requirements for Individual Units	104
7.1. L3 Generic Units	105
7.2. L3 Environmental Technology units	106
7.3. L3 Solar Thermal Hot Water units	106
7.4. L3 Heat Pump units	107
7.5. L3 Rainwater Harvesting/Grey water units	108
8. Marking Strategies	109
8.1. On-line Multiple-Choice Tests	109
8.2. Performance Assessments	110
8.3. Written Design Assignment	110
8.4. Learner Result Submission Form	110
9. Further Information	111

About BPEC

BPEC Certification Ltd was initially established in 1997 to act as an accredited certification body to oversee competence assessment of individuals working in the gas industry. It has extended its coverage and now offers a range of assessment and certification services to meet the needs of operatives working in the Building Services Sector.

In 2010 BPEC established a recognised Awarding Organisation, offering a suite of regulated qualifications. These have been developed with the input of industry and learning providers to meet the skills needs of the Building Services Engineering sector.

The Company is committed to high levels of customer service and providing support to organisations who deliver our qualifications. We are also committed to offering qualifications, assessments and learning materials, which meet the needs of employers, learners, and training providers on an ongoing basis.

BPEC Certification is a not-for-profit company, and any surplus funds are gift aided to the BPEC Charity. The focus of the Charity is to raise the knowledge and skills of those who work in the UK plumbing and heating industry and support associated projects, grants, and awards.

Should you wish to learn more about BPEC (including our charity work) please contact:

BPEC Certification Ltd
1-2 Mallard Way
Pride Park
Derby
DE24 8GX

Tel: 01332 376000

Or visit our website at:

www.bpec.org.uk

1. Introduction to the Qualification

1.1. Qualification Overview

Qualification Title	BPEC Level 3 NVQ Diploma in Domestic Plumbing and Heating (Environmental Technologies).				
Qualification Number (QN)	600/6863/2				
BPEC Qualification Code	DPH-003 EN1, EN2 and EN3				
Assessment Method/s	Online MCT's, Written Design Assignment, In Centre Practical Assessments, Summative Environmental Assessments, On-site Assessments				
Entry Requirements	Learners must be 16 years old or over				
GLH	549	TQT	680	Credits	68
Mandatory Units	8				
Last Registration Date	31/07/2023				
Last Certification Date	31/07/2026				

1.2. Who this Qualification is for?

This Qualification is for those Learners currently employed in the Plumbing and Domestic Heating industry as an apprentice plumber/domestic heating engineer. Learners will be required to demonstrate the necessary abilities, skills, and knowledge to be able to plan, select, install, and commission all aspects of plumbing and heating systems. In addition to this, Learners will also demonstrate a knowledge of service, maintenance and fault diagnosis and rectification of plumbing and heating systems.

1.3. The Purpose of the Qualification

For Learners to be able to further develop those skills learned at Level 2 deemed necessary for a career in the Plumbing and Domestic Heating industry.

1.4. Support and Accreditation

This qualification is supported by industry and regulated by OFQUAL.

1.5. Relationship to Other Qualifications

This Level 3 qualification is part of a suite of three (3) BPEC NVQ Diploma qualifications in domestic plumbing and heating.

Successful completion of this qualification proves that learners are competent to install, commission, decommission service and maintain domestic plumbing and heating systems, components, and appliances.

Successful completion of this qualification also allows Learners to pursue a Higher National Certificate (Level 4 HNC) or Higher National Diploma (Level 5 HND) in Building Services Engineering (mechanical).

1.6. Pre-requisites for the qualification

The Learner must have completed a BPEC NVQ Level 2 in Domestic Plumbing and Heating or equivalent.

2. Qualification Structure

This is a Level 3 qualification of 68 credits and 549 guided learning hours consisting of 8 mandatory units with an additional 4 units from EN1, EN2 or EN3. 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 solar thermal hot water systems, heat pump systems or water harvesting systems. The qualification and unit details are shown below:

Unit Ref.	Unit Type	Unit Title	Level	Credit Value	TQT	GLH
Mandatory Units						
R/602/2498	K	Understand how to organise resources within BSE	3	3		26
K/502/8930	K/P	Understand and apply domestic cold water system installation, commissioning, service, and maintenance techniques	3	9		76
K/502/9155	K/P	Understand and apply domestic hot water system installation, commissioning, service, and maintenance techniques	3	9		76
M/502/9156	K/P	Understand and apply domestic central heating system installation, commissioning, service, and maintenance techniques	3	12		98
T/502/9157	K/P	Understand and carry out electrical work on domestic plumbing and heating systems and components	3	12		102
D/502/9296	K/P	Understand and apply domestic sanitation system installation, commissioning, service, and maintenance techniques	3	8		72
K/602/3138	K	Understand the Fundamental Principles and Requirements of Environmental Technology Systems	3	2		15
K/502/9298	P	Install, commission, service and maintain domestic plumbing and heating systems	3	3		4

Optional Units – Solar Thermal EN1						
F/602/3100	K	Know the requirements to install, commission and handover solar thermal hot water systems	3	4		35
L/602/3102	P	Install, commission and handover 'active' solar thermal hot water systems	3	2		15
Y/602/3104	K	Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems	3	2		15
K/602/3107	P	Inspect, service and maintain 'active' solar thermal hot water systems	3	2		15
Totals			---	68	680	549

Optional Units – Heat Pumps EN2						
Y/602/3054	K	Know the requirements to install, commission and handover heat pump systems (non-refrigerant circuits)	3	4		35
D/602/3072	P	Install, commission and handover heat pumps (non-refrigerant circuits)	3	2		15
F/602/3078	K	Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits)	3	2		15
L/602/3083	P	Inspect, service and maintain heat pump installations (non-refrigerant circuits)	3	2		15
Totals			---	68	680	549

Optional Units – Water Recycling EN3						
T/602/3109	K	Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems	3	4		35
K/602/3110	P	Install, commission and handover rainwater harvesting and greywater reuse systems	3	2		15
M/602/3111	K	Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems	3	2		15
A/602/3130	P	Inspect, service and maintain rainwater harvesting and greywater reuse systems	3	2		15
Totals			---	68	680	549

3. The Learners

3.1. Qualifications that the Learner must have completed before taking the Qualification

BPEC NVQ Level 2 in Domestic Plumbing and Heating or equivalent

3.2. Knowledge, skills or understanding that the Learner is required to have before taking the qualification

a) Specific

None that are applicable

b) General

The centre should:

- Undertake initial assessment of each Learner to ensure that they have the minimum levels of numeracy and literacy to comply with the health and safety aspects of the qualification and the completion of the Learning Outcomes and assessments.
- Establish if the Learner has any specific training needs.
- Identify any support and guidance the Learner may require when working towards the qualification.

3.3. The Units the Learner must have completed before the Qualification will be awarded

Learners will need to complete 8 mandatory Units, plus 4 optional units included in the chosen pathway.

3.4. Any other requirements which a Learner must have satisfied before the Learner will be assessed or before the Qualification is awarded

None identified

3.5. Qualification achievement

The Qualification will be awarded when all necessary Units have been completed.

4. Delivery requirements

4.1. Centre Recognition

Centres wishing to deliver this qualification will need to gain Centre Recognition and Qualification Approval. For full details of the recognition process please contact:

BPEC Certification

1-2 Mallard Way

Pride Park

Derby

DE24 8GX

Tel: 01332 376000

aoadmin@bpec.org.uk

4.2. Qualification Approval

- Centres wishing to deliver this Qualification who are already recognised (see 5.1) should complete and submit a Qualification Approval Form to BPEC Certification Ltd.
- Before submission, centres should ensure that they can meet the delivery requirements.
- Centres who are approved to deliver this qualification and wish to extend delivery to satellite sites must seek approval for each additional site.

4.3. Physical Resources

- General – Centres must provide a safe environment for Learners and staff with appropriate policies and procedures in place which are adhered to.
- Teaching Provision – Centres must provide adequate facilities and equipment to allow the effective teaching of the qualification including any practical provision.
- Assessments/Exam Provision – Centres must provide facilities and equipment which allow assessments and exams to be conducted in accordance with the assessment criteria/guidance and exam procedures.

4.4. Assessor/Trainer Requirements

Assessors must:

- Hold, or be working towards TAQA (A1/A2 – D32/33 updated) standards and continue to practice to these standards and possess CPD evidence of personally maintaining these standards, or
- Have other suitable equivalent assessor qualifications endorsed by BPEC.
- ‘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).

4.4.1. Assessor occupational competence

For the purposes of this qualification, occupational competence will be deemed to have been demonstrated by the verifiable evidence of all the following:

- A relevant level 3 plumbing qualification:
 - If older qualifications are held – such as city & guilds craft or advanced craft certificates – the assessor must be able to evidence through CPD activity a thorough knowledge of the qualification standards and requirements
 - If other MES-related NVQ/SVQ qualifications are held – such as domestic gas (wet central heating), heating and ventilation installation (domestic), domestic heating – the assessor must be able to evidence plumbing competence through CPD activity
- A relevant, current CPD record including relevant qualifications.
- A verifiable CV of industry experience and current knowledge of industry practice and techniques relevant to the occupational area in which they assess.
- A thorough knowledge and understanding of the qualification standards and requirements.

4.4.2. T/502/9157 - Understand and carry out electrical work on domestic plumbing and heating systems and components

The person responsible for assessing this unit must be competent in the technical areas of the unit. This means that assessors must have an NVQ in the technical area and/or relevant up to date CPD, such as the BPEC Level 3 Electricity for Plumbers Certificate. An assessor without this evidence of competence must engage a qualified electrician to directly observe all the critical safety aspects of the assessment.

4.4.3. Assessor occupational competence (Optional Pathways)

The person responsible for assessing optional pathway units must also be competent in the technical area of the pathway. This means the assessor must hold a relevant renewable qualification(s) and up to date CPD covering the relevant specialism.

4.4.4. Assessor continuing professional development

The occupational competence of assessors must be updated on a regular basis and be periodically confirmed via continuing professional development (CPD) via the Assessment Centre. Evidence of CPD will be sought by the External Quality Assurer (EQA) for all approved Assessors at the Centre.

It is the responsibility of each assessor to identify and make use of opportunities for CPD, such as industry conferences, access to trade journals, and Professional Body/Trade Association events, at least on an annual basis to enhance and upgrade their professional development and technical knowledge.

It is imperative that records are kept of all such CPD opportunities/occasions and that they provide evidence of cascading such technical knowledge and industry intelligence to all relevant colleagues.

4.5. IQA occupational competence

For the purposes of this qualification, occupational competence will be deemed to have been demonstrated by the verifiable evidence of one of the following:

- A Level 3 NVQ in Plumbing

- A related building services qualification with proven technical expertise
- A related building services qualification with access to plumbing technical expertise when undertaking IQA activities.

4.6. External Quality Assurers (EQAs)

EQAs must:

- Hold or be working towards TAQA (V2 or D36 updated)
- Hold a Level 3 NVQ in plumbing or a related building services engineering qualification.

5. Support Materials

5.1. Qualification Specification

This Qualification Specification provides details of all Units, Learning Outcomes, Assessment Criteria, and specific advice regarding the assessment process.

5.2. Textbooks

BPEC Qualification Textbooks are available from BPEC direct.

6. Unit Details

R/602/2498 - Understand how to organise resources within BSE

Unit level	3	<i>This knowledge unit provides learning in the basic supervisory skills required to organise and co- ordinate the work of self and a small team of craft operatives in undertaking work in the building services industry.</i>	
GLH	26		
Unit			
R/602/2498 - Understand how to organise resources within BSE			
Learning Outcomes			Assessment Criteria
LO1	Know the responsibilities of relevant people in the building services industry		1.1 – 1.6
LO2	Know how to oversee building services work		2.1 – 2.3
LO3	Know how to produce risk assessments and method statements for the building services industry		3.1 – 3.4
LO4	Know how to plan work programmes for work tasks in the building services industry		4.1 – 4.6

Learning Outcome 1	
Know the responsibilities of relevant people in the building services industry	
Assessment Criteria	
1.1	Define the types of clients that are encountered when working: <ul style="list-style-type: none"> a) Private customer b) Direct communication c) Through customer representatives managing agents d) Contracting customer e) Internal customer – within same company
1.2	Specify the types of communication that may be required with clients throughout the progress of a job
1.3	Specify the types of communication that may be required with the site management team: <ul style="list-style-type: none"> a) Architect b) Quantity surveyor c) Buyer/Estimator d) Surveyor e) Project manager/Clerk of Works f) Structural engineer g) Building services engineer h) Construction manager
1.4	Define the typical site responsibilities for craft operatives in the workplace: <ul style="list-style-type: none"> a) Apprentices/trainees b) Level 2 craft level qualified staff c) Limited self-responsibility d) Level 3 craft level qualified staff e) Supervision of self and other staff members

Learning Outcome 1	
Know the responsibilities of relevant people in the building services industry	
Assessment Criteria (continued)	
1.5	Specify the different methods of supervising individuals that can be used: <ul style="list-style-type: none"> a) Styles of supervision b) Methods of motivating staff
1.6	Define the job responsibilities when supervising staff: <ul style="list-style-type: none"> a) Identifying the competence of subordinates to undertake work b) Identifying when direct supervision or detailed direction is required c) Specific health and safety issues d) Responsibility for planning safe working for subordinates e) How to adjust work schedules when health and safety problems delay works

Learning Outcome 2	
Know how to oversee building services work	
Assessment Criteria	
2.1	Specify how to deal with variations to works: <ul style="list-style-type: none"> a) Prescribed by the work environment b) Communication to the client c) Agreement to extra time and costs d) Prescribed by the customer e) Agreement to extra time and costs
2.2	Clarify how to undertake ongoing monitoring of the work progress against the work programme to ensure: <ul style="list-style-type: none"> a) Safety b) Cost effectiveness c) Quality
2.3	Clarify how to deal with problems that arise with deficiencies in work performance that could affect: <ul style="list-style-type: none"> a) Safety b) Cost effectiveness c) Quality

Learning Outcome 3	
Know how to produce risk assessments and method statements for the building services industry	
Assessment Criteria	
3.1	Define the levels of risk presented by work situations
3.2	Define the hazards presented by work situations
3.3	Specify the methods used to carry out a risk assessment for a task: <ul style="list-style-type: none"> a) Methods of assessing risk b) Risk calculation formula c) Presentation of a risk assessment

Learning Outcome 3	
Know how to produce risk assessments and method statements for the building services industry	
Assessment Criteria (continued)	
3.4	Identify how to produce a method statement for areas of work with safety risk: <ul style="list-style-type: none"> a) Information to be provided in a method statement b) Presentation of a method statement

Learning Outcome 4	
Know how to plan work programmes for work tasks in the building services industry	
Assessment Criteria	
4.1	Specify the types of work programme that would be used for: <ul style="list-style-type: none"> a) Private installation work b) Private service/maintenance work c) New-build installation contract work d) Service/maintenance contract work
4.2	State the process for planning work activities against job specifications: <ul style="list-style-type: none"> a) The scope, purpose, and requirements of the work b) Identification of work responsibilities c) External factors that affect timeframe
4.3	State the process for selecting the required resources against the job specification: <ul style="list-style-type: none"> a) Materials b) Plant c) Vehicles d) Equipment
4.4	Specify material delivery requirements against work programmes and the impact that the non-availability of materials may have on work progress: <ul style="list-style-type: none"> a) Work in private properties b) Work on new-build housing c) Work on commercial contracts d) Avoiding loss of materials on site (theft)
4.5	Define the factors which affect working time allocation to work activities: <ul style="list-style-type: none"> a) Labour resources b) Planning work with other trades c) Material deliveries
4.6	Identify how to produce simple work programmes: <ul style="list-style-type: none"> a) Simple bar (progress) charts

K/502/8930 - Understand and apply domestic cold water system installation, commissioning, service, and maintenance techniques

Unit level	3	<i>This combination unit provides learning in the design, maintenance, and commissioning of a complex range of cold-water system/component types in dwellings including those in multi-storey properties and single occupancy dwellings fed by private water supplies. The unit covers compliance with the requirements of the Water Supply (Water Fittings) Regulations and Building Regulations applicable to this type of system.</i>	
GLH	76		
Unit			
K/502/8930 - Understand and apply domestic cold water system installation, commissioning, service, and maintenance techniques			
Learning Outcomes			Assessment Criteria
LO1	Know the legislation relating to the installation and maintenance of cold water supplied for domestic purposes		1.1 – 1.3
LO2	Know the types of cold-water system layout used in multi-storey dwellings		2.1 – 2.4
LO3	Know the types of cold-water system layout used with single occupancy dwellings fed by private water supplies		3.1 – 3.4
LO4	Know the requirements for backflow protection in plumbing systems		4.1 – 4.5
LO5	Know the uses of specialist components in cold water systems		5.1 – 5.2
LO6	Know the design techniques for cold water systems		6.1 – 6.4
LO7	Be able to apply design techniques for cold water systems		7.1 – 7.3
LO8	Know the fault diagnosis and rectification procedures for cold water systems and components		8.1 – 8.7
LO9	Be able to diagnose and rectify faults in cold water systems and components		9.1 – 9.3
LO10	Know the commissioning requirements of cold-water systems and components		10.1 – 10.10
LO11	Be able to commission cold water systems and components		11.1 – 11.7

Learning Outcome 1	
Know the legislation relating to the installation and maintenance of cold water supplied for domestic purposes	
Assessment Criteria	
1.1	Interpret the legislation controlling the installation and use of water systems: a) Supplied from a water undertaker b) Supplied from a private source
1.2	Clarify the notification requirements for work on wholesome and recycled water systems: a) Water undertaker b) Building control or self-certification
1.3	Differentiate between installer and user responsibilities under water legislation

Learning Outcome 2	
Know the types of cold-water system layout used in multi-storey dwellings	
Assessment Criteria	
2.1	State the cold-water system component layout features for multi-storey dwellings: a) Supplied direct from the main b) Using break cistern arrangements c) Providing drinking water

Learning Outcome 2	
Know the types of cold-water system layout used in multi-storey dwellings	
Assessment Criteria (continued)	
2.2	State the system layout features for large scale storage cisterns used in multi-storey cold-water systems for dwellings: <ul style="list-style-type: none"> a) Warning/overflow pipe b) Alternative filling methods using c) Float switches and solenoid valves d) Specialist inlet valves e) Interlinking multiple cisterns f) Use of sectional cisterns
2.3	State the system layout features for break cisterns used in multi-storey cold water systems for dwellings
2.4	Define the function of components used in boosted cold water systems in multi-storey dwellings: <ul style="list-style-type: none"> a) Booster pumps b) Sets with integral controls c) Self-assembled sets d) Pressure/expansion vessels e) Pressure switch (transducer) f) Float switch

Learning Outcome 3	
Know the types of cold-water system layout used with single occupancy dwellings fed by private water supplies	
Assessment Criteria	
3.1	Propose the methods of providing private water supplies to single occupancy dwellings: <ul style="list-style-type: none"> a) Pumped from wells and boreholes b) Collected from surface water sources – streams and springs c) Use of externally sited break cisterns
3.2	Propose the methods of treating water for use in single occupancy dwellings: <ul style="list-style-type: none"> a) Localised water filtration units b) Localised water treatment units – ultraviolet
3.3	State the system layout features for cold water systems fed from private water supplies: <ul style="list-style-type: none"> a) Conventional direct or indirect systems from an incoming supply b) Boosted (pumped) supply from a well or borehole c) Boosted (pumped) supply from a low level internal or external break cistern
3.4	Define the method of operation of the components used in a boosted (pumped) cold water supply system from private sources for single occupancy dwellings: <ul style="list-style-type: none"> a) Small booster pump sets which incorporate all controls and components b) Boosted system with separate controls and components c) Use of accumulators in increasing system flow rate

Learning Outcome 4	
Know the requirements for backflow protection in plumbing systems	
Assessment Criteria	
4.1	Interpret the five fluid risk levels as laid down in water legislation
4.2	Define terminology used when selecting and applying backflow prevention devices: <ul style="list-style-type: none"> a) Point of use protection b) Whole site or zone protection
4.3	Propose the installation situations in which non-mechanical backflow prevention devices may be used: <ul style="list-style-type: none"> a) Type AA – air gap with unrestricted discharge above spill over level b) Type AB – air gap with weir overflow c) Type AD – air gap with injector d) Type AG – air gap with minimum size circular overflow e) Type AUK1 – air gap with interposed cistern f) Type AUK2 – air gaps for taps and combination taps g) Type AUK3 – air gaps for taps and combination taps h) Type DC pipe interrupter with permanent atmospheric vent
4.4	Propose the installation situations in which mechanical backflow prevention devices may be used: <ul style="list-style-type: none"> a) Type BA – reduced pressure zone valve b) Type DB – pipe interrupter with permanent atmospheric vent and moving element c) Type EC/ED – double check valves d) Type HUK1 – hose union tap with double check valves e) Type CA – non verifiable disconnecter f) Type EA/EB – single check valves g) Type HA – hose union backflow preventer h) Type HC – diverter with automatic return
4.5	Determine methods of preventing cross connection in systems that contain non-wholesome water sources

Learning Outcome 5	
Know the uses of specialist components in cold water systems	
Assessment Criteria	
5.1	Analyse the working principles of cold-water system components: <ul style="list-style-type: none"> a) Infra-red operated taps b) Concussive taps c) Combination baths tap and shower head d) Flow limiting valves e) Spray taps f) Urinal – water conservation controls g) Shower pumps – single and twin impellor h) Pressure reducing valves i) Shock arrestors/mini expansion vessels

Learning Outcome 5	
Know the uses of specialist components in cold water systems	
Assessment Criteria (continued)	
5.2	Evaluate the use of components in cold water systems to overcome temperature and pressure effects caused by the installation of backflow prevention devices

Learning Outcome 6	
Know the design techniques for cold water systems	
Assessment Criteria	
6.1	Interpret information sources when undertaking design work on cold water systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer
6.2	Clarify how to take measurements of building features to carry out design calculations: <ul style="list-style-type: none"> a) From plans, drawings, and specifications b) From site
6.3	Calculate the size of cold-water system components used in single occupancy dwellings: <ul style="list-style-type: none"> a) Cistern b) Pipework c) Pump d) Pressure vessel
6.4	Clarify how to present design calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 7	
Be able to apply design techniques for cold water systems	
Assessment Criteria	
7.1	Use information sources when undertaking design work for cold water systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer
7.2	Calculate the size of cold-water system components used in single occupancy dwellings: <ul style="list-style-type: none"> a) Cistern b) Pipework c) Pump d) Pressure vessel
7.3	Present design calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 8	
Know the fault diagnosis and rectification procedures for cold water systems and components	
Assessment Criteria	
8.1	State the methods of obtaining details of system faults from end users
8.2	Interpret manufacturer instructions and industry standards to establish the diagnostic requirements of cold-water system components
8.3	Propose routine checks and diagnostics on cold water system components as part of a fault-finding process: <ul style="list-style-type: none"> a) Checking components for correct operating pressures and flow rates b) Cleaning system components (including dismantling and reassembly) c) Checking for correct component operation d) Pumps e) Pressure switches (transducers) f) Float switches g) Expansion and pressure vessels h) Gauges and controls i) Checking for correct operation of treatment devices j) Water filters k) Water softeners
8.4	Specify methods of repairing faults in cold water system components: <ul style="list-style-type: none"> a) Pumps b) Expansion/pressure vessels c) Pressure switches (transducers) d) Float switches e) Gauges and controls
8.5	Specify methods of safely isolating cold water systems or components to prevent them being brought into operation before the work has been fully completed
8.6	Define procedures for carrying out diagnostic tests to locate faults in cold water system components: <ul style="list-style-type: none"> a) Booster (pump) set to a system b) Backflow prevention devices
8.7	Specify methods for diagnosing and preventing corrosion within cold water system pipework: <ul style="list-style-type: none"> a) Electrolytic corrosion b) Blue water corrosion

Learning Outcome 9	
Be able to diagnose and rectify faults in cold water systems and components	
Assessment Criteria	
9.1	Use manufacturer instructions and industry standards to establish the diagnostic requirements of cold-water system components
9.2	Isolate cold-water systems or components to prevent them being brought into operation before the work has been fully completed

Learning Outcome 9	
Be able to diagnose and rectify faults in cold water systems and components	
Assessment Criteria (continued)	
9.3	Carry out diagnostic tests to locate faults in cold water system components and carry out repair work: <ul style="list-style-type: none"> a) Booster (pump) set to a system b) Backflow prevention devices

Learning Outcome 10	
Know the commissioning requirements of cold-water systems and components	
Assessment Criteria	
10.1	Interpret information sources required to complete commissioning work on cold water systems
10.2	State how to fill cold water pipework with water at normal operating pressure and check for leakage
10.3	Identify how to conduct a soundness test on cold water systems: <ul style="list-style-type: none"> a) Metallic systems b) Plastic pipework systems
10.4	Specify the disinfection procedures for cold water systems and the circumstances in which disinfection should be applied
10.5	State the flushing procedure for cold water systems and components
10.6	Clarify how to take flow rate and pressure readings from new and existing cold water systems
10.7	Specify the actions that must be taken when commissioning reveals defects in cold water systems: <ul style="list-style-type: none"> a) Dealing with systems that do not meet correct installation requirements b) Micro-biological contamination within a cold-water system c) Remedial work associated with defective components
10.8	State the procedure for notifying works carried out to the relevant authority
10.9	Propose the range of information that would be detailed on a commissioning record for a cold water system
10.10	Propose the points to be covered when handing over a completed system to the end-user

Learning Outcome 11	
Be able to commission cold water systems and components	
Assessment Criteria	
11.1	Carry out a visual inspection of a boosted cold-water system to confirm that it is ready to be filled with water
11.2	Charge cold water pipework with water at normal operating pressure and check for leakage

Learning Outcome 11	
Be able to commission cold water systems and components	
Assessment Criteria (continued)	
11.3	Perform a soundness test to industry requirements on cold water systems pipework and components
11.4	Perform a disinfection procedure on a cold-water system to industry requirements
11.5	Flush the system with wholesome water on completion of soundness testing
11.6	Use test instruments to take readings of the water supply pressure and flow rate
11.7	Adjust and set controls to achieve system design requirements: <ul style="list-style-type: none"> a) Pressure at outlets b) Flow rate at outlets

K/502/9155 - Understand and apply domestic hot water system installation, commissioning, service, and maintenance techniques

Unit level	3	<i>This combination unit provides learning in the design, installation, maintenance, and commissioning of a complex range of hot water system/component types in single occupancy dwellings. The unit also covers the requirements of statutory legislation for the installation, maintenance, and commissioning of unvented hot water storage systems.</i>
GLH	76	
Unit		
K/502/9155 - Understand and apply domestic hot water system installation, commissioning, service, and maintenance techniques		
Learning Outcomes		Assessment Criteria
LO1	Know the types of hot water system and their layout requirements	1.1 – 1.9
LO2	Know the uses of specialist components in hot water systems	2.1 – 2.2
LO3	Know the design techniques for hot water systems	3.1 – 3.6
LO4	Be able to apply design techniques for hot water systems	4.1 – 4.3
LO5	Know the installation requirements of hot water systems and components	5.1 – 5.4
LO6	Be able to install hot water systems and components	6.1 – 6.2
LO7	Know the fault diagnosis and rectification procedures for hot water systems and components	7.1 – 7.7
LO8	Be able to diagnose and rectify faults in hot water systems and components	8.1 – 8.4
LO9	Know the commissioning requirements of hot water systems and components	9.1 – 9.11
LO10	Be able to commission hot water systems and components	10.1 – 10.6

Learning Outcome 1	
Know the types of hot water system and their layout requirements	
Assessment Criteria	
1.1	Compare the types of hot water supply systems used in dwellings: <ul style="list-style-type: none"> a) Centralised systems b) Unvented hot water systems c) Open vented hot water systems d) Localised systems e) Unvented point of use heaters f) Instantaneous heaters
1.2	Identify hot water system pipework layout features for dwellings: <ul style="list-style-type: none"> a) Centralized unvented hot water systems b) Larger systems requiring a secondary circulation system
1.3	Confirm the recommended design temperatures within hot water systems: <ul style="list-style-type: none"> a) Hot water storage vessel b) Hot water outflow c) Secondary return d) At point of use e) Instantaneous heaters f) Storage system g) Thermostatic mixing valve installations

Learning Outcome 1	
Know the types of hot water system and their layout requirements	
Assessment Criteria (continued)	
1.4	Evaluate the various types of unvented hot water system: <ul style="list-style-type: none"> a) Indirect storage systems b) Direct storage systems c) Electrically heated d) Gas or oil fired e) Small point of use (under sink)
1.5	Clarify the use of cold-water accumulators in unvented hot water systems
1.6	Define the function of components in unvented hot water systems: <ul style="list-style-type: none"> a) Safety devices b) Control thermostat c) Overheat thermostat (thermal cut-out) d) Temperature relief valve e) Functional devices f) Line strainer g) Pressure reducing valve h) Single check valve i) Expansion device (vessel or integral to cylinder) j) Expansion relief valve k) Tundish arrangements l) Application of composite valves
1.7	Specify the layout features for temperature and expansion relief pipe in unvented hot water systems
1.8	Specify the layout features for pipework systems incorporating secondary circulation: <ul style="list-style-type: none"> a) Pump type and location b) Timing devices c) Prevention of reverse circulation d) Methods of balancing circuits
1.9	State how trace heating can be used as an alternative to a secondary circulation system

Learning Outcome 2	
Know the uses of specialist components in hot water systems	
Assessment Criteria	
2.1	Analyse the working principles of hot water system components: <ul style="list-style-type: none"> a) Infra-red operated taps b) Concussive taps c) Combination baths tap and shower head d) Flow limiting valves e) Spray taps f) Shower pumps – single and twin impellor g) Pressure reducing valves h) Show arrestors/mini expansion vessels

Learning Outcome 2	
Know the uses of specialist components in hot water systems	
Assessment Criteria (continued)	
2.2	Evaluate the use of components in hot water systems to overcome temperature and pressure effects caused by the installation of backflow prevention devices

Learning Outcome 3	
Know the design techniques for hot water systems	
Assessment Criteria	
3.1	Define the factors which affect the selection of hot water systems for single occupancy dwellings
3.2	State the criteria used then selecting hot water system and component types: <ul style="list-style-type: none"> a) Customer needs b) Building layout and features c) Suitability of system d) Energy efficiency e) Environmental impact
3.3	Interpret information sources when undertaking design work on hot water systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer
3.4	Clarify how to take measurements of building features to carry out design calculations: <ul style="list-style-type: none"> a) From plans, drawings, and specifications b) From site
3.5	Calculate the size of hot water system components used in single occupancy dwellings: <ul style="list-style-type: none"> a) Cistern b) Hot water storage vessel c) Pipework d) Secondary circulation pump e) Booster pump (shower and full system)
3.6	Clarify how to present calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 4	
Be able to apply design techniques for hot water systems	
Assessment Criteria	
4.1	Use information sources when undertaking design work for hot water systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer

Learning Outcome 4	
Be able to apply design techniques for hot water systems	
Assessment Criteria (continued)	
4.2	Calculate the size of hot water system components used in single occupancy dwellings: <ul style="list-style-type: none"> a) Cistern b) Cylinder c) Pipework d) Secondary circulation pump e) Booster pump (shower and full system)
4.3	Present design calculations in an acceptable format <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for a work in a small-scale dwelling

Learning Outcome 5	
Know the installation requirements of hot water systems and components	
Assessment Criteria	
5.1	Define the terms balanced and unbalanced supply pressures in unvented hot water storage systems
5.2	Specify the positioning and fixing requirements of components and unvented hot water systems: <ul style="list-style-type: none"> a) Safety devices b) Control thermostat c) Overheat thermostat (thermal cut-out) d) Temperature relief valve e) Functional devices f) Line strainer g) Pressure reducing valve h) Single check valve i) Expansion relief valve (vessel or integral to cylinder) j) Tundish arrangements k) Application of composite valves
5.3	State the pipe size and positioning methods for safety relief pipework connected to unvented hot water cylinder safety valves: <ul style="list-style-type: none"> a) D1 section b) Tundish c) D2 pipework d) Correction termination

Learning Outcome 5	
Know the installation requirements of hot water systems and components	
Assessment Criteria (continued)	
5.4	State the positioning and fixing requirements of components of secondary circulation systems: <ul style="list-style-type: none"> a) System pipework b) Pump c) Control valves d) Timing devices e) Reverse circulation control valves f) Pipework insulation

Learning Outcome 6	
Be able to install hot water systems and components	
Assessment Criteria	
6.1	Connect pipework to an unvented hot water system: <ul style="list-style-type: none"> a) Incoming supply pipework b) Line strainer c) Pressure reducing valve d) Expansion vessel e) Storage cylinder f) Check valve
6.2	Position, fix and connect new hot water safety relieve pipework: <ul style="list-style-type: none"> a) D1 pipework b) Tundish c) D2 pipework d) Correction termination

Learning Outcome 7	
Know the fault diagnosis and rectification procedures for hot water systems and components	
Assessment Criteria	
7.1	Specify the periodic servicing requirements of hot water systems
7.2	State the methods of obtaining details of system faults from end users
7.3	Interpret manufacturer instructions and industry standards to establish the diagnostic requirements of hot water system components

Learning Outcome 7	
Know the fault diagnosis and rectification procedures for hot water systems and components	
Assessment Criteria (continued)	
7.4	<p>Propose routine checks and diagnostics on hot water system components as part of a fault finding process:</p> <ul style="list-style-type: none"> a) Checking components for correct operating pressures, temperatures, and flow rates b) Cleaning system components (including dismantling and reassembling) c) Checking for correct operation of system components d) Thermostats e) Pumps f) Timing devices g) Expansion and pressure levels h) Gauges and controls i) Checking for correct operation of system safety valves: j) Temperature relief k) Expansion
7.5	<p>Specify methods of repairing faults in hot water system components:</p> <ul style="list-style-type: none"> a) Pumps b) Expansion/pressure c) Vessel's safety valves d) Temperature relief e) Expansion relief f) Thermostats g) Gauges and controls
7.6	Specify methods of safety isolation hot water systems or components to prevent them being brought into operation before work has been fully completed
7.7	<p>Define procedures for carrying out diagnostic tests to locate faults in hot water system components:</p> <ul style="list-style-type: none"> a) Shower booster pump unit b) Safety devices c) Expansion devices d) Thermostats

Learning Outcome 8	
Be able to diagnose and rectify faults in hot water systems and components	
Assessment Criteria	
8.1	Use manufacturer instructions and industry standards to establish the diagnostic requirements of hot water system components
8.2	Isolate hot water systems or components to prevent them being brought into operation before the work has been fully completed

Learning Outcome 8	
Be able to diagnose and rectify faults in hot water systems and components	
Assessment Criteria (continued)	
8.3	Carry out diagnostic tests to locate faults in hot water system components and carry out repair work <ul style="list-style-type: none"> a) Shower booster pump unit b) Safety devices c) Expansion devices d) Thermostats
8.4	Carry out the periodic service of an unvented hot water storage system

Learning Outcome 9	
Know the commissioning requirements of hot water systems and components	
Assessment Criteria	
9.1	Interpret information sources required to complete commissioning work on hot water systems
9.2	State the checks to be carried out during a visual inspection of an unvented hot water storage system to confirm that it is ready to be filled with water
9.3	State how to fill hot water pipework with water at normal operating pressure and check for leakage
9.4	Identify how to conduct a soundness test on hot water systems: <ul style="list-style-type: none"> a) Metallic systems b) Plastic pipework systems
9.5	State the flushing procedure for hot water systems and components
9.6	Clarify how to take flow rate and pressure readings from new and existing hot water outlets
9.7	State how to balance a secondary circulation system during commissioning activities
9.8	Specify the actions that must be taken when commissioning reveals defects in hot water systems: <ul style="list-style-type: none"> a) Dealing with systems that do not meet correct installation requirements b) Remedial work associated with defective components
9.9	State the procedure for notifying works carried out to the relevant authority
9.10	Propose the range of information that would be detailed on a commissioning record for a hot water system
9.11	Propose the points to be covered when handing over a completed system to the end-user

Learning Outcome 10	
Be able to commission hot water systems and components	
Assessment Criteria	
10.1	Carry out a visual inspection of an unvented hot water system to confirm that it is ready to be filled with water

Learning Outcome 10	
Be able to commission hot water systems and components	
Assessment Criteria (continued)	
10.2	Charge hot water pipework with water at normal operating pressure and check for leakage
10.3	Perform a soundness test to industry requirements on hot water systems pipework and components
10.4	Flush the system with wholesome water on completion of soundness testing
10.5	Use test instruments to take readings of the water supply pressure and flow rate
10.6	Adjust and set system controls to achieve system design requirements: <ul style="list-style-type: none"> a) Pressure at outlets b) Flow rate at outlets

M/502/9156 - Understand and apply domestic central heating system installation, commissioning, service, and maintenance techniques

Unit level	3	<i>This combination unit provides learning in the design, installation, maintenance, and commissioning of a complex range of central heating system/component types in single occupancy dwellings. The unit also covers the requirements of statutory legislation relating to the energy conservation of heating systems. The scope of the unit also covers underfloor heating systems, complex control systems and multiple boiler installations in larger dwellings using low loss headers.</i>
GLH	98	
Unit		
M/502/9156 - Understand and apply domestic central heating system installation, commissioning, service, and maintenance techniques		
Learning Outcomes		Assessment Criteria
LO1	Know the types of central heating system and their layout requirements	1.1 – 1.7
LO2	Know the design techniques for central heating systems	2.1 – 2.13
LO3	Be able to apply design techniques for central heating systems	3.1 – 3.3
LO4	Know the installation requirements of central heating systems and components	4.1 – 4.3
LO5	Be able to install central heating systems and components	5.1 – 5.2
LO6	Know the fault diagnosis and rectification procedures for central heating systems and components	6.1 – 6.7
LO7	Be able to diagnose and rectify faults in central heating systems and components	7.1 – 7.3
LO8	Know the commissioning requirements of central heating systems and components	8.1 – 8.10
LO9	Be able to commission central heating systems and components	9.1 – 9.5

Learning Outcome 1	
Know the types of central heating system and their layout requirements	
Assessment Criteria	
1.1	Define the space heating zoning requirements under statutory legislation for larger single occupancy dwellings
1.2	Define the function of components used in central heating systems: <ul style="list-style-type: none"> a) Zone control valves for multiple space heating applications with appropriate time and temperature control arrangements b) Controllers c) Weather compensation d) Delayed start e) Optimum start f) Home automation systems
1.3	Analyse the operating principles of environmental heat sources used in conjunction with central heating systems: <ul style="list-style-type: none"> a) Heat pumps b) Ground source c) Air source d) Micro combined heat and power
1.4	Identify the layout features of underfloor central heating systems

Learning Outcome 1	
Know the types of central heating system and their layout requirements	
Assessment Criteria (continued)	
1.5	Analyse the working principles of underfloor central heating system pipework and components <ul style="list-style-type: none"> a) Use of manifolds b) Controls system application - time and temperature to space heating zones c) Underfloor pipework arrangements from manifold to room
1.6	Identify the system layout features for multiple boiler installations incorporating low loss headers
1.7	Analyse functional flow wiring diagrams to determine the method of control operation for central heating systems: <ul style="list-style-type: none"> a) Pumped heating only systems b) Pumped heating systems with combination boilers c) Pumped heating with gravity hot water systems d) Fully pumped incorporating 3 port valves – mid position and diverter valves e) Fully pumped incorporating 2 x two port valves f) Fully pumped incorporating hot water and multiple space heating zones g) Fully pumped incorporating weather compensation, optimum start, or delayed start controllers h) Multiple boiler controls application i) Application of frost thermostats and boilers with pump overrun facility

Learning Outcome 2	
Know the design techniques for central heating systems	
Assessment Criteria	
2.1	Define the factors which affect the selection of central heating systems for dwellings
2.2	State the criteria used when selecting heating system and component types: <ul style="list-style-type: none"> a) Customers' needs b) Building layout and features c) Suitability of system d) Energy efficiency e) Environmental impact
2.3	Interpret information sources when undertaking design work on central heating systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer
2.4	Clarify how to take measurements of building features to carry out design calculations: <ul style="list-style-type: none"> a) From plans, drawings, and specifications b) From site
2.5	Justify the selection of system and control types for single family dwellings

Learning Outcome 2	
Know the design techniques for central heating systems	
Assessment Criteria (continued)	
2.6	State the principles of heat loss and gain in dwellings: <ul style="list-style-type: none"> a) Through the building fabric b) Due to ventilation
2.7	Evaluate the heating requirements of rooms in dwellings when designing a central heating system: <ul style="list-style-type: none"> a) Room size b) Temperature required – indoor to outdoor c) Air change rate
2.8	Specify the methods of sizing pipework and circulators for central heating systems: <ul style="list-style-type: none"> a) Pipe sizing calculations – space heating and hot water circuits b) Pump sizing calculations
2.9	Justify the selection criteria for boilers in dwellings: <ul style="list-style-type: none"> a) Space heating load b) Hot water heating load c) Heat loss from pipework d) Factors for intermittent heating
2.10	Clarify how to size expansion vessels for sealed central heating systems and feed and expansion cisterns for open vented systems
2.11	Clarify the design principles for underfloor central heating systems: <ul style="list-style-type: none"> a) Combined with radiators b) Stand alone
2.12	Calculate the size of central heating components used in single occupancy dwellings: <ul style="list-style-type: none"> a) Heat emitter size b) Hot water heating load c) Pipe size d) Pump size e) Boiler size
2.13	Clarify how to present design calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 3	
Be able to apply design techniques for central heating systems	
Assessment Criteria	
3.1	Use information sources when undertaking design work for central heating systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer

Learning Outcome 3	
Be able to apply design techniques for central heating systems	
Assessment Criteria (continued)	
3.2	Calculate the size of central heating components used in single occupancy dwellings: <ul style="list-style-type: none"> a) Heat emitter size b) Hot water heating load c) Pipe size d) Pump size e) Boiler size
3.3	Present design calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 4	
Know the installation requirements of central heating systems and components	
Assessment Criteria	
4.1	Specify the positioning and fixing requirements of components in underfloor central heating systems: <ul style="list-style-type: none"> a) Manifolds b) Pipework arrangements (cabling) c) Pipework installation techniques d) Solid floor e) Suspended timber floor
4.2	Specify the positioning, fixing and connection requirements of new central heating components for sealed central heating systems: <ul style="list-style-type: none"> a) Connections to a boiler b) Fully pumped central heating control components – mid position or 2 x two port valve arrangement c) Sealed system components d) Connections to panel radiators or underfloor heating manifold e) Connections to hot water cylinder
4.3	Specify the positioning and fixing requirements of multiple boiler installations with low loss headers

Learning Outcome 5	
Be able to install central heating systems and components	
Assessment Criteria	
5.1	Connect pipework to an underfloor central heating system

Learning Outcome 5	
Be able to install central heating systems and components	
Assessment Criteria (continued)	
5.2	Position, fix and connect new central heating components for a sealed central heating system: <ul style="list-style-type: none"> a) Connections to a boiler b) Fully pumped central heating control components – mid position or 2 x two port valve arrangement c) Sealed system components d) Connections to panel radiators or underfloor heating manifold e) Connections to hot water cylinder

Learning Outcome 6	
Know the fault diagnosis and rectification procedures for central heating systems and components	
Assessment Criteria	
6.1	Specify the periodic servicing requirements of central heating systems
6.2	State the methods of obtaining details of system faults from end users
6.3	Interpret manufacturer instructions and industry standards to establish the diagnostic requirements of central heating system components
6.4	Propose routine checks and diagnostics on central heating system components as part of a fault-finding process: <ul style="list-style-type: none"> a) Checking components for correct operation – pressure settings, temperature, and circulation b) Cleaning system components (including dismantling and reassembly) c) Checking for blockages in heat emitters and pipework d) Checking for correct operation of system components e) Circulating pumps f) Control components g) Expansion vessels h) Pressure relief valves i) Feed and expansion cisterns
6.5	Specify methods of repairing faults in central heating system components: <ul style="list-style-type: none"> a) Sealed and open vented – fill and vent pipework and components b) Circulating pumps c) Central heating control components d) Motorised valves e) Timing devices f) Thermostats g) Specialist controls – weather compensation, delayed and optimum start h) Blockages in heat emitters and pipework by power flushing
6.6	Specify methods of safely isolating central heating systems or components to prevent them being brought into operation before the work has been fully completed

Learning Outcome 6	
Know the fault diagnosis and rectification procedures for central heating systems and components	
Assessment Criteria (continued)	
6.7	Define procedures for carrying out diagnostic tests to locate faults in central heating system components: <ul style="list-style-type: none"> a) Replacement of circulating pumps b) Sealed heating system components c) Control components

Learning Outcome 7	
Be able to diagnose and rectify faults in central heating systems and components	
Assessment Criteria	
7.1	Use manufacturer instructions and industry standards to establish the diagnostic requirements of central heating system components
7.2	Isolate central heating systems or components to prevent them being brought into operation before the work has been fully completed
7.3	Carry out diagnostic tests to locate faults in central heating system components and carry out repair work: <ul style="list-style-type: none"> a) Replacement of a circulating pump b) Sealed heating system components c) Control components d) Clean system components using power

Learning Outcome 8	
Know the commissioning requirements of central heating systems and components	
Assessment Criteria	
8.1	Interpret information sources required to complete commissioning work on central heating systems
8.2	State the checks to be carried out during a visual inspection of a central heating system to confirm that it is ready to be filled with water
8.3	State how to fill central heating pipework with water at normal operating pressure and check for leakage
8.4	Identify how to conduct a soundness test on central heating systems: <ul style="list-style-type: none"> a) Metallic systems b) Plastic pipework systems

Learning Outcome 8	
Know the commissioning requirements of central heating systems and components	
Assessment Criteria (continued)	
8.5	Specify the flushing requirements including the use of chemical treatments for new and existing central heating systems: <ul style="list-style-type: none"> a) Cold and hot flushing b) Power flushing c) System additives d) Neutralisers e) Control components f) Cleansers g) Corrosion inhibitors
8.6	Specify the method required to balance a central heating system during commissioning activities
8.7	Specify the actions that must be taken when commissioning reveals defects in central heating systems: <ul style="list-style-type: none"> a) Dealing with systems that do not meet correct installation requirements b) Defects in the connection of components in systems c) Unbalanced systems – poor circulation d) Poor boiler connection into a low loss header e) Remedial work associated with defective components
8.8	Propose the range of information that would be detailed on a commissioning record for a central heating system
8.9	State the procedure for notifying works carried out to the relevant authority
8.10	Propose the points to be covered when handing over a completed system to the end-user

Learning Outcome 9	
Be able to commission central heating systems and components	
Assessment Criteria	
9.1	Carry out a visual inspection of a central heating system to confirm that it is ready to be filled with water
9.2	Charge central heating components with water at normal operating pressure and check for leakage
9.3	Perform a soundness test to industry requirements on central heating systems pipework and components
9.4	Flush and treat a central heating system with appropriate additives: <ul style="list-style-type: none"> a) System cleanser/neutraliser b) System inhibitor
9.5	Balance a central heating system to meet design requirements

T/502/9157 - Understand and carry out electrical work on domestic plumbing and heating systems and components

Unit level	3	<i>This combination unit provides learning in work preparation, installation, inspection, testing and fault diagnosis/rectification of electrical components, equipment, and connections to Domestic MES systems. This unit also cover the requirements for completing associated documentation required upon completion of electrical installation, inspection, testing and maintenance activities.</i>
GLH	102	
Unit		
T/502/9157 - Understand and carry out electrical work on domestic plumbing and heating systems and components		
Learning Outcomes		Assessment Criteria
LO1	Know the electrical standards that apply to the mechanical services industry	1.1 – 1.3
LO2	Know the principles of electricity supply to dwellings	2.1 – 2.3
LO3	Know the layout features of electrical circuits in dwellings	3.1 – 3.8
LO4	Understand the electrical industry safe isolation procedure	4.1 – 4.3
LO5	Be able to carry out the electrical industry safe isolation procedure	5.1 – 5.2
LO6	Know the site preparation techniques for the electrical connection of mechanical services components in dwellings	6.1 – 6.7
LO7	Be able to apply site preparation techniques for the electrical connection of mechanical services components in dwellings	7.1 – 7.2
LO8	Understand the installation and connection requirements of electrically operated mechanical services components	8.1 – 8.6
LO9	Be able to install and connect electrically operated mechanical services components	9.1 – 9.3
LO10	Know the inspection and testing requirements of electrically operated mechanical services components	10.1 – 10.6
LO11	Be able to inspect and test electrically operated mechanical services components	11.1 – 11.2
LO12	Know the procedures for safely diagnosing and rectifying faults in electrically operated mechanical services components	12.1 – 12.7
LO13	Be able to safely diagnose and rectify faults in electrically operated mechanical services components	13.1 – 13.3

Learning Outcome 1	
Know the electrical standards that apply to the mechanical services industry	
Assessment Criteria	
1.1	State the statutory legislation and guidance information that applies to electrical supply and control of domestic mechanical services systems and their components <ul style="list-style-type: none"> a) General legislation b) Construction specific legislation c) Mechanical services specific legislation <ul style="list-style-type: none"> a. Professional body guidance d) Codes of practice e) Manufacturer installation & service/maintenance instructions f) Manufacturer user instructions

Learning Outcome 1	
Know the electrical standards that apply to the mechanical services industry	
Assessment Criteria (continued)	
1.2	Identify the range of information that would be detailed on a minor works certificate for an electrical system or component
1.3	Specify the procedure for notifying works carried out to the relevant authority

Learning Outcome 2	
Know the principles of electricity supply to dwellings	
Assessment Criteria	
2.1	Specify the methods by which electricity is generated: <ul style="list-style-type: none"> a) Basic power station operation b) Principles of generation c) Types of supply d) Single phase e) Three-phase and neutral
2.2	Specify the methods by which generated electricity is distributed to dwellings: <ul style="list-style-type: none"> a) Basic operation of the national grid and local distribution systems b) Sub-stations c) Supply transformers d) Local distribution of three – and single-phase supplies to premises
2.3	State the purpose of electrical components at entry to the property: <ul style="list-style-type: none"> a) Main fuse (single phase) and cable head connection b) Meter c) Consumer unit d) Main earth terminal

Learning Outcome 3	
Know the layout features of electrical circuits in dwellings	
Assessment Criteria	
3.1	Define the system layout features for electrical circuits in dwellings: <ul style="list-style-type: none"> a) Ring main circuit b) Radial circuit c) Fixed appliance supplies d) Cooker e) Immersion heater f) Instantaneous shower g) Lighting h) Macerator WC i) Central heating controls j) Shower pump/Jacuzzi k) Heat producing or cooling appliances
3.2	Specify the types of cables and cords used for the installation of electrical equipment in domestic mechanical services systems

Learning Outcome 3	
Know the layout features of electrical circuits in dwellings	
Assessment Criteria (continued)	
3.3	State the applications and limitations of the types of cable and conductors used for the installation of electrical equipment in mechanical services systems
3.4	Clarify the difference between class 1 and class 2 electrical equipment
3.5	<p>Define the function of electrically operated components used in domestic mechanical services systems:</p> <ul style="list-style-type: none"> a) Flame rectification devices b) Flame suppression devices c) Solenoid valves d) Thermistors e) Thermocouples f) Micro switches g) Relays h) Printed circuit boards i) Pressure switches j) Pumps k) Fans l) Control components m) Thermostats n) Programmers/timers o) Electrically operated control valves p) Wiring centres q) Switches r) Rocker plate (with/without cpc) – single and double pole s) Pull cord
3.6	<p>Define the operating principles of electrical circuit protection devices:</p> <ul style="list-style-type: none"> a) Miniature circuit breakers b) Residual current devices including RCBOs c) Fuses d) Re-wireable e) Cartridge f) High breaking capacity
3.7	<p>Clarify the need for, and requirements of earthing systems:</p> <ul style="list-style-type: none"> a) Main earthing systems <ul style="list-style-type: none"> 1) TT system 2) TN - S system 3) TN-C-S system b) Protective equipotential bonding c) High risk rooms (zones) in dwellings d) Supplementary earthing (bonding) e) Temporary continuity bonding
3.8	Identify the warning notices to be applied to consumer units

Learning Outcome 4	
Understand the electrical industry safe isolation procedure	
Assessment Criteria	
4.1	Identify the test equipment required to prove that circuits to be worked on are dead: <ul style="list-style-type: none"> a) Approved voltage indicating device b) Proving unit
4.2	Specify the electrical industry agreed procedure for safe isolation of electrical circuits: <ul style="list-style-type: none"> a) Select the approved voltage indicating device and test on a known supply b) Locate and identify the isolation point for the equipment to be worked on c) Isolate the supply and prevent re-energisation d) Verify that the equipment is dead e) Fit warning labels f) Re-check the approved voltage indicating on a known supply for correct function
4.3	Clarify the methods of ensuring that circuits cannot be re-activated while work is taking place on them: <ul style="list-style-type: none"> a) Use of locking devices b) Device retention (fuse removal)

Learning Outcome 5	
Be able to carry out the electrical industry safe isolation procedure	
Assessment Criteria	
5.1	Check to ensure that test equipment is safe to be used
5.2	Carry out the safe isolation procedure to industry standards

Learning Outcome 6	
Know the site preparation techniques for the electrical connection of mechanical services components in dwellings	
Assessment Criteria	
6.1	Identify the required sources of information when carrying out work on electrical systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions
6.2	Identify the preparatory work required to be carried out to the building fabric to install, commission, decommission or maintain electrical systems or components
6.3	State the types of pre-existing damage to the existing building fabric or customer property that may be encountered before commencing work on electrical systems and components: <ul style="list-style-type: none"> a) Building wall/floor surfaces b) Existing electrical system components c) Building décor and carpets

Learning Outcome 6	
Know the site preparation techniques for the electrical connection of mechanical services components in dwellings	
Assessment Criteria (continued)	
6.4	State how to carry out simple electrical calculations: a) Ohm's law b) Power consumption of electrical circuits c) Basic over-current protection device size d) Voltage, current and resistance in series and parallel circuits
6.5	Identify the protection measures to be applied to the building fabric or customer property, during and on completion of work on electrical systems and components: a) Building wall/floor surfaces b) Existing and new electrical systems and kitchen furniture c) Building décor and carpets
6.6	Identify the cable, materials and fittings required to complete work on electrical systems
6.7	Identify the hand and power tools required to complete work on electrical systems

Learning Outcome 7	
Be able to apply site preparation techniques for the electrical connection of mechanical services components in dwellings	
Assessment Criteria	
7.1	Check the safety of the work location for the work to safely proceed: a) Safe access and exit b) Immediate work location e.g., tripping hazards c) Appropriate risk assessments/ method statements are followed
7.2	Wear Personal Protective Equipment relevant to the installation, decommissioning or maintenance tasks being carried out

Learning Outcome 8	
Understand the installation and connection requirements of electrically operated mechanical services components	
Assessment Criteria	
8.1	Define the method used to identify that existing electrical supplies and circuits are suitable for the proposed installation of electrical equipment used in domestic mechanical services systems
8.2	a) State the procedure for sizing electrical materials and components: b) Basic cable sizing procedure domestic type cables and cords c) Basic circuit protection device sizing procedure –domestic circuit types
8.3	Specify the method used to select suitable cables and cords for components and circuits: a) Selection of appropriate multi-core cable b) Selection of appropriate multi-core cords c) Selection of pvc single conductors

Learning Outcome 8	
Understand the installation and connection requirements of electrically operated mechanical services components	
Assessment Criteria (continued)	
8.4	<p>Specify the requirements for protecting cables installed in the building fabric and terminating in enclosures:</p> <ul style="list-style-type: none"> a) Protection methods in wall and floor surfaces b) Embedded (sheathing) – depth of cover, application of RCD protection c) Exposed (mini trunking) d) Within ducting e) Within timber stud partitions f) Within timber floor structures g) Junction boxes h) Switch/socket boxes i) Countersunk j) Pattresses k) Surface mounted l) Wiring centres
8.5	<p>Define the types of cable termination methods approved for use in dwellings</p> <ul style="list-style-type: none"> a) Screw terminals b) Pillar terminals c) Claw and washer terminals d) Crimping e) Strip connectors
8.6	<p>Specify the method of installation and wiring termination for fixed electrical appliances</p> <p><u>From consumer unit</u></p> <ul style="list-style-type: none"> a) Macerator WC b) Central heating control system c) Instantaneous shower d) Immersion heater e) Shower pump/Jacuzzi <p><u>From fused-spur connection unit</u></p> <ul style="list-style-type: none"> a) Central heating control system b) Shower pump/Jacuzzi <p><u>From existing appliance supply point</u></p> <ul style="list-style-type: none"> a) Macerator WC b) Central heating control system c) Shower pump/Jacuzzi d) Immersion heater e) Shower

Learning Outcome 9	
Be able to install and connect electrically operated mechanical services components	
Assessment Criteria	
9.1	Carry out the electrical wiring of a central heating control system from an existing fused spur connection unit: <ul style="list-style-type: none"> a) Fully pumped system incorporating all necessary control components b) Positioning and fixing of all necessary enclosures, switches, and circuit protection devices c) Correct routing, installation and termination of appropriate cables and cords to control system components d) Correct earthing provision for all components and exposed metallic parts of the system
9.2	Carry out the replacement of electrical cords from an existing isolation point to the fixed appliance: <ul style="list-style-type: none"> a) Immersion heater b) WC macerator unit c) Shower pump
9.3	Apply temporary continuity bonding to metallic pipework prior to making pipework connections

Learning Outcome 10	
Know the inspection and testing requirements of electrically operated mechanical services components	
Assessment Criteria	
10.1	Specify the requirements of a visual inspection of completed electrical installation work for domestic mechanical services systems prior to electrical inspection and testing
10.2	Define the equipment used for electrical testing of mechanical services components and its calibration requirements
10.3	Identify the importance of carrying out tests on dead circuits wherever possible
10.4	State the purpose of the electrical testing procedures for new and existing circuits: <ul style="list-style-type: none"> a) Polarity b) Earth continuity c) Insulation resistance d) Earth fault loop impedance e) Residual current device
10.5	Clarify the requirements for carrying out functional testing of electrical components
10.6	Clarify the procedure for final handover of electrical circuits that supply electrically operated domestic mechanical services components: <ul style="list-style-type: none"> a) Installation completion of certification b) Demonstration to the user

Learning Outcome 11	
Be able to inspect and test electrically operated mechanical services components	
Assessment Criteria	
11.1	Carry out the inspection and testing of a completed central heating controls system: <ul style="list-style-type: none"> a) Visual inspection b) Selection and use of appropriate test equipment c) Appropriate circuit testing d) Polarity e) Earth continuity f) Insulation resistance g) Functional testing h) Completion of a minor works certificate
11.2	Carry out the inspection and testing of existing electrical circuits following replacement of electrical cords: <ul style="list-style-type: none"> a) Immersion heater b) WC macerator unit c) Shower pump

Learning Outcome 12	
Know the procedures for safely diagnosing and rectifying faults in electrically operated mechanical services components	
Assessment Criteria	
12.1	State the methods of obtaining details of system faults from end users
12.2	Identify and use manufacturer instructions and industry standards to establish the diagnostic requirements of electrical system components
12.3	Identify the electrical test equipment used to undertake fault diagnostics
12.4	Identify the situations in which dead testing of components can be carried out
12.5	Identify the situations in which live testing of components may be necessary and the safety precautions required

Learning Outcome 12	
Know the procedures for safely diagnosing and rectifying faults in electrically operated mechanical services components	
Assessment Criteria	
12.6	<p>Define how to perform a range of routine checks and diagnostics on electrical system components as part of a fault-finding process. Checking for correct operation of:</p> <ul style="list-style-type: none"> a) Appliance components b) Flame rectification devices c) Flame suppression devices d) Solenoid valves e) Thermistors f) Thermocouples g) Micro switches h) Relays i) Pressure switches j) Printed circuit boards k) Pumps l) Fans m) Control components n) Thermostats o) Programmers/timers p) Electrically operated control valves q) Wiring centres r) Switches s) Rocker plate (with/without cpc) - single and double pole t) Pull cord
12.7	<p>State the methods of correcting deficiencies in electrical components:</p> <ul style="list-style-type: none"> a) Inadequate earthing provision b) Defective cable positioning (aged cables/ proximity to other services) c) Failed electrical components d) Incorrect polarity e) Provision of inadequate circuit protection devices

Learning Outcome 13	
Be able to safely diagnose and rectify faults in electrically operated mechanical services components	
Assessment Criteria	
13.1	Safely isolate electrical systems or components to prevent them being brought into operation before the work has been fully completed
13.2	<p>Carry out diagnostic checks to electrical circuits:</p> <ul style="list-style-type: none"> a) Inadequate earthing provision b) Defective cable routing c) Defective termination d) Incorrect polarity e) Provision of inadequate circuit protection devices

Learning Outcome 13	
Be able to safely diagnose and rectify faults in electrically operated mechanical services components	
Assessment Criteria (continued)	
13.3	<p>State the methods of correcting deficiencies in electrical components:</p> <ul style="list-style-type: none"> a) Replacement of a motorised valve head gear b) Boiler components replacement c) Thermistor d) Thermocouples e) Pressure switches f) Control components g) Thermostats h) Programmers/timers i) Shower control components

D/502/9296 - Understand and apply domestic sanitation system installation, commissioning, service, and maintenance techniques

Unit level	3	<i>This combination unit provides learning in the design, installation, maintenance, and commissioning of a complex range of sanitation system/component types in single occupancy dwellings and multiple storey dwellings up to 3 storeys. The unit also covers the requirements of work on WC macerator units and sink waste disposal units.</i>	
GLH	72		
Unit			
D/502/9296 - Understand and apply domestic sanitation system installation, commissioning, service, and maintenance techniques			
Learning Outcomes			Assessment Criteria
LO1	Know the types of sanitation system and their layout requirements		1.1 – 1.5
LO2	Know the design techniques for sanitation and rainwater systems		2.1 – 2.10
LO3	Be able to apply design techniques for sanitation and rainwater systems		3.1 – 3.4
LO4	Understand the installation requirements of sanitation system components		4.1 – 4.5
LO5	Know the fault diagnosis and rectification procedures for sanitary pipework systems and components		5.1 – 5.6
LO6	Be able to diagnose and rectify faults in sanitary pipework systems and components		6.1 – 6.3
LO7	Know the commissioning requirements of sanitary pipework systems and components		7.1 – 7.9
LO8	Be able to commission sanitary pipework systems and components		8.1 – 8.4

Learning Outcome 1	
Know the types of sanitation system and their layout requirements	
Assessment Criteria	
1.1	State the use of air admittance valves in above ground sanitary pipework systems: <ul style="list-style-type: none"> a) Types of air admittance valves b) Their suitability of use in the various types of pipework system c) Application on multi-dwelling housing estates
1.2	Clarify the statutory requirements for the provision of sanitary facilities and equipment in dwellings for the disabled: <ul style="list-style-type: none"> a) Spacing requirements of the human body b) Appliance space requirements for the disabled
1.3	Analyse the working principles and layout features for foul tanks in sanitation systems: <ul style="list-style-type: none"> a) Cesspits b) Septic tanks
1.4	State the periodic maintenance and cleaning requirements of foul tanks: <ul style="list-style-type: none"> a) Cesspits b) Septic tanks
1.5	Analyse the working principles and system layout features of specialist sanitary components: <ul style="list-style-type: none"> a) WC macerators b) Waste water lifters c) Sink waste disposals

Learning Outcome 2	
Know the design techniques for sanitation and rainwater systems	
Assessment Criteria	
2.1	Define the factors which affect the selection of sanitation systems for dwellings
2.2	State the criteria used when selecting sanitation systems and appliances: <ul style="list-style-type: none"> a) Customers' needs b) Building layout and features c) Suitability of system d) Energy efficiency e) Environmental impact
2.2	Interpret information sources required when undertaking design work for sanitation systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer
2.3	Specify the fire stopping arrangements required under statutory legislation as they apply to sanitary pipework passing between fire compartments in a dwelling
2.4	Calculate the sanitary provision requirements for dwellings
2.5	Clarify the method of sizing and selecting the correct gradient for branch pipework used in sanitary pipework systems
2.6	Clarify the methods used when designing a sanitary pipework system: <ul style="list-style-type: none"> a) Main stack size b) Branch pipework sizes c) Ventilation requirements d) Air admittance valves e) Ventilating pipes
2.7	Clarify the methods used when designing a rainwater system: <ul style="list-style-type: none"> a) Roof area calculations b) Gutter type selection c) Outlet positioning
2.8	Calculate the size of sanitary pipework used in single occupancy dwellings: <ul style="list-style-type: none"> a) Main stack size b) Branch pipework size c) Stack vent size
2.9	Calculate the size of rainwater system components used with single occupancy and multiple terraced properties: <ul style="list-style-type: none"> a) Outlet requirements b) Gutter requirements c) Rainwater pipe requirements
2.10	Clarify how to present design calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 3	
Be able to apply design techniques for sanitation and rainwater systems	
Assessment Criteria	
3.1	Use information sources when undertaking design work for sanitation systems: <ul style="list-style-type: none"> a) Statutory regulations b) Industry standards c) Manufacturer technical instructions d) Verbal and written feedback from the customer
3.2	Calculate the size of sanitary pipework used in single occupancy dwellings. Simple calculations of: <ul style="list-style-type: none"> a) Main stack size b) Branch pipework size c) Stack vent size
3.3	Calculate the size of rainwater system components used with single occupancy and multiple terraced properties: <ul style="list-style-type: none"> a) Outlet requirements b) Gutter requirements c) Rainwater pipe requirements
3.4	Present design calculations in an acceptable format: <ul style="list-style-type: none"> a) Using basic not to scale line drawings b) Details for insertion into a quotation or tender for work in a small-scale dwelling

Learning Outcome 4	
Understand the installation requirements of sanitation system components	
Assessment Criteria	
4.1	State the layout features for walk in wet rooms in dwellings
4.2	Specify the installation and fixing methods for components of walk-in wet rooms used in dwellings <ul style="list-style-type: none"> a) Glass sanitary appliances b) Antique style sanitary appliances c) Sanitary appliances with floor mounted taps
4.3	State how to assemble and prepare for the installation of sanitation system components: <ul style="list-style-type: none"> a) WC macerator b) Waste water lifter c) Sink waste disposal unit
4.4	Specify the methods for positioning and fixing WC macerators and waste water lifters: <ul style="list-style-type: none"> a) Reference to manufacturer's instructions b) Vertical lift position c) Use of long radius bends d) Pipework material selection and assembly
4.5	Specify the methods for positioning and fixing sink waste disposal units: <ul style="list-style-type: none"> a) Reference to manufacturer's instructions b) Trapping and branch discharge pipework requirements

Learning Outcome 5	
Know the fault diagnosis and rectification procedures for sanitary pipework systems and components	
Assessment Criteria	
5.1	State the methods of obtaining details of system faults from end users
5.2	Interpret manufacturer instructions and industry standards to establish the diagnostic requirements of sanitation system components
5.3	Propose routine checks and diagnostics on sanitation system components as part of a fault finding process: Checking for correct operation of system components WC macerators Waste water lifters Sink waste disposal units
5.4	Specify methods of repairing faults in sanitation components: a) WC macerators b) Waste water lifters c) Sink waste disposal units d) Air admittance valves
5.5	Specify methods of safely isolating sanitation system components to prevent them being brought into operation before the work has been fully completed
5.6	Define procedures for diagnosing faults in macerator units

Learning Outcome 6	
Be able to diagnose and rectify faults in sanitary pipework systems and components	
Assessment Criteria	
6.1	Use manufacturer instructions and industry standards to establish the diagnostic requirements of sanitation system components
6.2	Isolate sanitation system components to prevent them being brought into operation before the work has been fully completed
6.3	Carry out diagnostic tests to locate faults in macerator units

Learning Outcome 7	
Know the commissioning requirements of sanitary pipework systems and components	
Assessment Criteria	
7.1	Interpret information sources required to complete commissioning work on sanitation systems
7.2	State the checks to be carried out during a visual inspection of a sanitation system to confirm that it is ready to be operated
7.3	Identify how to carry out an air test on a sanitary pipework system to industry requirements
7.4	State how to performance test sanitation systems to test for trap seal retention
7.5	Specify the commissioning procedures for macerator type WCs
7.6	Specify the actions that must be taken when commissioning reveals defects in sanitation systems

Learning Outcome 7	
Know the commissioning requirements of sanitary pipework systems and components	
Assessment Criteria (continued)	
7.7	Propose the range of information that would be detailed on a commissioning record for a sanitation system
7.8	State the procedure for notifying works carried out to the relevant authority
7.9	Propose the points to be covered when handing over a completed system to the end-user

Learning Outcome 8	
Be able to commission sanitary pipework systems and components	
Assessment Criteria	
8.1	Carry out a visual inspection of a sanitation system to confirm that it is ready to be operated
8.2	Perform an air test on a sanitary pipework system to industry requirements
8.3	Carry out a performance test on a sanitary pipework system to check for effective trap seal retention: <ul style="list-style-type: none"> a) Branch discharge pipework b) Test for self-siphonage c) Test for induced siphonage d) Main discharge stack e) Test for induced siphonage and compression
8.4	Commission a WC with macerator pump installation

K/502/9298 - Install, commission, service and maintain domestic plumbing and heating systems

Unit level	3	<i>This performance unit confirms job competence at Level 3 in the selection of components, installation, commissioning, and fault diagnosis & rectification of a range of advanced plumbing & heating systems and components in dwellings and industrial/commercial properties (of similar size and scope to domestic dwellings).</i>	
GLH	4		
Unit			
K/502/9298 - Install, commission, service and maintain domestic plumbing and heating systems			
Learning Outcomes			Assessment Criteria
LO1	Be able to select plumbing and heating systems and components for application the workplace		1.1 – 1.6
LO2	Be able to prepare work sites for the installation of plumbing and heating systems and components in the workplace		2.1 – 2.12
LO3	Be able to install plumbing and heating systems and components in the workplace		3.1 – 3.8
LO4	Be able to commission plumbing and heating systems in the workplace		4.1 – 4.11
LO5	Be able to diagnose faults in plumbing and heating components in the workplace		5.1 – 5.8
LO6	Be able to rectify faults in plumbing and heating components in the workplace		6.1 – 6.17

Learning Outcome 1	
Be able to select plumbing and heating systems and components for application the workplace	
Assessment Criteria	
1.1	Obtain details of the customer job requirement: a) By face-to-face site visit b) By taking details from plans, drawings, and specifications
1.2	Discuss and agree initial system and component options with the customer: a) Cold water systems b) Hot water systems c) Central heating systems d) Sanitation systems and sanitary appliances e) Gravity rainwater systems
1.3	Calculate the size and quantities of components required for systems installation
1.4	Present design calculations and information to the customer
1.5	Obtain agreement from the customer to progress plumbing and heating work: a) Items of small jobbing (maintenance) type work b) Full system/component installation work
1.6	Apply changes to customer job requirements and obtain customer agreement to those changes

Learning Outcome 2	
Be able to prepare work sites for the installation of plumbing and heating systems and components in the workplace	
Assessment Criteria	
2.1	Use job information to plan the installation work
2.2	Confirm the position of pipework and components with other persons before commencing the installation work
2.3	Comply with health and safety requirements when carrying out the installation work
2.4	Prepare a safe and unobstructed access route to the work areas to carry out the installation work
2.5	Arrange for all tools, equipment, and materials to be available to undertake the installation work
2.6	Use job information to identify the location of the building fabric that requires preparatory work to be carried out
2.7	Prepare a safe and unobstructed access route to the work areas to carry out the installation work
2.8	Arrange for all tools, equipment, and materials to be available to undertake the installation work
2.9	Use job information to identify the location of the building fabric that requires preparatory work to be carried out
2.10	Report any pre-existing damage to the building fabric or customer property to other persons before carrying out the installation work
2.11	Provide protection to the building fabric or customer property as the work progresses
2.12	Carry out preparatory work to the building fabric

Learning Outcome 3	
Be able to install plumbing and heating systems and components in the workplace	
Assessment Criteria	
3.1	Confirm that the incoming or outgoing main supplies meet the requirements of the system or component being installed
3.2	Measure and mark out the position of the components to be installed: <ul style="list-style-type: none"> a) System pipework b) Main system components c) System controls
3.3	Make pipework and component fixings to the building fabric
3.4	Position and fix pipework and components to the building fabric: <ul style="list-style-type: none"> a) Copper b) Plastics
3.5	Connect pipework to system controls and main components: <ul style="list-style-type: none"> a) Cold water systems b) Hot water systems c) Central heating systems d) Sanitation systems

Learning Outcome 3	
Be able to install plumbing and heating systems and components in the workplace	
Assessment Criteria (continued)	
3.6	Connect system pipework to incoming supplies or outgoing services: <ul style="list-style-type: none"> a) Existing system pipework and components b) Cold water supply pipework c) Below ground drainage pipework
3.7	Carry out installation work minimising the wastage of equipment and materials
3.8	Take precautions to ensure that the system cannot be brought into operation before the installation work is fully completed

Learning Outcome 4	
Be able to commission plumbing and heating systems in the workplace	
Assessment Criteria	
4.1	Carry out a visual inspection of the system to be tested to make sure that it is ready to be filled with water
4.2	Charge the system to normal operating pressure and check for leakage: <ul style="list-style-type: none"> a) Cold water systems b) Hot water systems c) Central heating systems
4.3	Perform a soundness test to industry requirements on the installed system: <ul style="list-style-type: none"> a) Cold water systems b) Hot water systems c) Central heating systems d) Sanitation systems
4.4	Flush the system with cold water on completion of soundness testing
4.5	Rectify any leakage from the system found during the soundness test procedure
4.6	Re-fill the system treating the contents with additives as appropriate
4.7	Operate the system and take performance readings to compare them too the design specifications <ul style="list-style-type: none"> a) Mechanical component readings b) Electrical component readings
4.8	Adjust system controls to establish that the system operates to its design specifications
4.9	Carry out remedial work to systems when commissioning reveals that the system does not work to the design specifications
4.10	Prepare commissioning records for completed systems
4.11	Instruct the customer in the efficient and effective operation of the system

Learning Outcome 5	
Be able to diagnose faults in plumbing and heating components in the workplace	
Assessment Criteria	
5.1	Use job information to plan the fault diagnosis work
5.2	Comply with health and safety requirements when carrying out fault diagnosis work
5.3	Prepare a safe and unobstructed access route to the work areas to carry out the fault diagnosis work
5.4	Arrange for all required tools, equipment, and materials to be available to undertake the fault diagnosis work
5.5	Report any pre-existing damage to the building fabric or customer property to other persons before carrying out the fault diagnosis work
5.6	Provide protection to the building fabric or customer property as the work progresses
5.7	Establish details of the fault from other persons
5.8	Test the component to diagnose the cause of the fault

Learning Outcome 6	
Be able to rectify faults in plumbing and heating components in the workplace	
Assessment Criteria	
6.1	Liaise with other persons to reach agreement on the rectification work to be carried out
6.2	Isolate unsafe components that are not to be rectified and leave the component in a safe condition
6.3	Isolate the component from the supply source or outgoing service: <ul style="list-style-type: none"> a) Turn off the electricity and fuel supply to the component b) Turn off the water supply to the component c) Prevent the use of sanitary appliances
6.4	Drain the component contents
6.5	Take precautions to ensure that the component cannot be brought back into operation before the rectification work is complete
6.6	Carry out the rectification or replacement of the component to industry requirements
6.7	Reinstate the supply or service to the component
6.8	Liaise with other persons to reach agreement on the rectification work to be carried out
6.9	Isolate unsafe components that are not to be rectified and leave the component in a safe condition
6.10	Isolate the component from the supply source or outgoing service: <ul style="list-style-type: none"> a) Turn off the electricity and fuel supply to the component b) Turn off the water supply to the component c) Prevent the use of sanitary appliances
6.11	Drain the component contents
6.12	Take precautions to ensure that the component cannot be brought back into operation before the rectification work is complete
6.13	Carry out the rectification or replacement of the component to industry requirements
6.14	Reinstate the supply or service to the component
6.15	Test the component for effective operation

Learning Outcome 6	
Be able to rectify faults in plumbing and heating components in the workplace	
Assessment Criteria (continued)	
6.16	Advise other persons that work on the system or component has been successfully completed
6.17	Complete the details contained in a maintenance record for the system or component

K/602/3138 - Understand the Fundamental Principles and Requirements of Environmental Technology Systems

Unit level	3	To allow learners to develop the knowledge and understanding required to be able to communicate with others in relation to the fundamental working principles, potential to install and regulatory requirements for micro-renewable energy and water conservation technologies. To prepare learners to progress to the specialist units for the installation, commissioning, handover, inspection, service and maintenance of micro-renewable energy and water conservation technologies.	
GLH	15		
Unit			
K/602/3138 - Understand the Fundamental Principles and Requirements of Environmental Technology Systems			
Learning Outcomes			Assessment Criteria
LO1	Know the fundamental working principles of micro-renewable energy and water conservation technologies		1.1 – 1.4
LO2	Know the fundamental requirements of building location/building features for the potential to install micro-renewable energy and water conservation systems to exist		2.1 – 2.9
LO3	Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies		3.1 – 3.2
LO4	Know the typical advantages and disadvantages associated with micro-renewable energy and water conservation technologies		4.1 – 4.2

Learning Outcome 1	
Know the fundamental working principles of micro-renewable energy and water conservation technologies	
Assessment Criteria	
1.1	Identify the fundamental working principles for each of the following heat producing micro-renewable energy technologies: a) solar thermal (hot water) b) ground source heat pump c) air source heat pump d) biomass
1.2	Identify the fundamental working principles for each of the following electricity producing micro-renewable energy technologies: a) solar photovoltaic b) micro-wind c) micro-hydro
1.3	Identify the fundamental working principles of the following co-generation technologies: a) micro-combined heat and power (heat-led)
1.4	Identify the fundamental working principles for each of the following water conservation technologies: a) rainwater harvesting b) greywater re-use

Learning Outcome 2	
Know the fundamental requirements of building location/building features for the potential to install micro-renewable energy and water conservation systems to exist	
Assessment Criteria	
2.1	Clarify the fundamental requirements for the potential to install a solar water heating system to exist
2.2	Clarify the fundamental requirements for the potential to install a solar photovoltaic system to exist
2.3	Clarify the fundamental requirements for the potential to install a ground source heat pump system to exist
2.4	Clarify the fundamental requirements for the potential to install an air source heat pump system to exist
2.5	Clarify the fundamental requirements for the potential to install a biomass system to exist
2.6	Clarify the fundamental requirements for the potential to install a micro wind system to exist
2.7	Clarify the fundamental requirements for the potential to install a micro hydro system to exist
2.8	Clarify the fundamental requirements for the potential to install a micro-combined heat and power (heat led) system to exist
2.9	Clarify the fundamental requirements for the potential to install a rainwater harvesting/greywater re-use system to exist

Learning Outcome 3	
Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies	
Assessment Criteria	
3.1	<p>Confirm what would be typically classified as 'permitted development' under town and country planning regulations in relation to the deployment of the following technologies:</p> <ul style="list-style-type: none"> a) Solar thermal (hot water) b) Solar photovoltaic c) Ground source heat pump d) Air source heat pump e) Micro-wind f) Biomass g) Micro-hydro h) Micro-combined heat and power (heat-led) i) Rainwater harvesting j) Greywater re-use

Learning Outcome 3	
Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies	
Assessment Criteria (continued)	
3.2	<p>Confirm which sections of the current building regulations/building standards apply in relation to the deployment of the following technologies:</p> <ul style="list-style-type: none"> a) Solar thermal (hot water) b) Solar photovoltaic c) Ground source heat pump d) Air source heat pump e) Micro-wind f) Biomass g) Micro-hydro h) Micro-combined heat and power (heat-led) i) Rainwater harvesting j) Greywater re-use

Learning Outcome	
Know the typical advantages and disadvantages associated with micro-renewable energy and water conservation technologies:	
Assessment Criteria	
4.1	<p>Identify typical advantages associated with each of the following technologies:</p> <ul style="list-style-type: none"> a) Solar thermal (hot water) b) Solar photovoltaic c) Ground source heat pump d) Air source heat pump e) Micro-wind f) Biomass g) Micro-hydro h) Micro-combined heat and power (head-led) i) Rainwater harvesting j) Greywater re-use
4.2	<p>Identify typical disadvantages associated with each of the following technologies:</p> <ul style="list-style-type: none"> a) Solar thermal (hot water) b) Solar photovoltaic c) Ground source heat pump d) Air source heat pump e) Micro-wind f) Biomass g) Micro-hydro h) Micro-combined heat and power (heat-led) i) Rainwater harvesting j) Greywater re-use

F/602/3100 - Know the requirements to install, commission and handover solar thermal hot water systems

Unit level	3	<i>The unit focuses upon the knowledge required to plan and prepare for, install (including testing and commissioning) and handover of fully filled and drain back solar thermal hot water systems. The emphasis is upon ‘active’ systems, but the unit also includes some content relating to ‘passive’ systems. The unit also covers fundamental design techniques but does not cover detailed design. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area.</i>
GLH	35	
Unit		
F/602/3100 - Know the requirements to install, commission and handover solar thermal hot water systems		
Learning Outcomes		Assessment Criteria
LO1	Know the health and safety risks and safe systems of work associated with solar thermal hot water system installation work	1.1 – 1.2
LO2	Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work	2.1 – 2.2
LO3	Know the types and layouts of solar thermal hot water system	3.1 – 3.2
LO4	Know the purpose of components used within solar thermal hot water system installations	4.1
LO5	Know the types and key operating principles of solar collectors	5.1 – 5.3
LO6	Know the information requirements to enable system component selection and sizing	6.1 – 6.2
LO7	Know the fundamental techniques used to select, size and position components for solar thermal hot water systems	7.1 – 7.9
LO8	Know how the performance of solar hot water systems is measured	8.1 – 8.2
LO9	Know the preparatory work required for solar thermal hot water system installation work	9.1 – 9.2
LO10	Know the requirements for connecting solar thermal hot water system collector circuits to combination boiler domestic hot water circuits	10.1 – 10.2
LO11	Know the requirements for installing solar collector arrays	11.1 – 11.4
LO12	Know the requirements for installing for solar thermal hot water system pipework	12.1 – 12.5
LO13	Know the requirements to test and commission solar thermal hot water system installations	13.1 – 13.7
LO14	Know the requirements to handover solar thermal hot water systems	14.1 – 14.2

Learning Outcome 1	
Know the health and safety risks and safe systems of work associated with solar thermal hot water system installation work	
Assessment Criteria	
1.1	<p>Confirm which aspects of solar thermal hot water system installation work pose risk of:</p> <ul style="list-style-type: none"> a) electrocution/electric shock b) burns c) toxic poisoning d) injury through flash to steam of system heat transfer fluid e) a fall from height f) personal injury through component / equipment handling
1.2	<p>Confirm safe systems of work for solar thermal hot water system installation work in relation to prevention of:</p> <ul style="list-style-type: none"> a) electrocution/electric shock b) burns c) toxic poisoning d) injury through flash to steam of system heat transfer fluid e) a fall from height f) personal injury through component/equipment handling

Learning Outcome 2	
Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work	
Assessment Criteria	
2.1	<p>Interpret building regulation/building standards guidance documentation as relevant to solar thermal hot water system installation work to identify the requirements in relation to:</p> <ul style="list-style-type: none"> a) maintaining the structural integrity of the building b) mandating the fire-resistant integrity of the building c) the prevention of moisture ingress (building water tightness) d) notification of work requirements e) control of temperature in primary and secondary circuits including primary circuits connected to unvented hot water storage systems f) energy conservation g) testing and commissioning requirements h) compliance certification
2.2	<p>Interpret industry recognised water regulation/byelaw guidance documentation as relevant to solar thermal hot water system installation work to identify the requirements in relation to:</p> <ul style="list-style-type: none"> a) prevention of contamination of the wholesome water supply b) energy conservation c) safe operation d) testing and commissioning requirements

Learning Outcome 3	
Know the types and layouts of solar thermal hot water system	
Assessment Criteria	
3.1	Identify the following solar thermal hot water system types: <ul style="list-style-type: none"> a) Fully filled (active) b) Drain back (active) c) Passive (thermo-siphon)
3.2	Identify the following solar thermal hot water system storage vessel types and collector circuit arrangements: <ul style="list-style-type: none"> a) direct (fully filled) DHW storage cylinder only b) indirect, sealed collector circuit, DHW storage cylinder only (solar primary coil only) c) indirect, sealed collector circuit, DHW storage cylinder only (dual coil) d) indirect, sealed collector circuit, pre-heat cylinder and DHW storage cylinder e) indirect, sealed collector circuit, thermal store

Learning Outcome 4	
Know the purpose of components used within solar thermal hot water system installations	
Assessment Criteria	
4.1	Confirm the purpose of the following solar thermal hot water system components: <ul style="list-style-type: none"> a) differential temperature controller b) cylinder sensor(s) c) solar collector sensor d) drain back vessel e) flow meter f) flow regulator (mechanical) g) expansion vessel

Learning Outcome 5	
Know the types and key operating principles of solar collectors	
Assessment Criteria	
5.1	Identify the following types of solar collector <ul style="list-style-type: none"> a) unglazed collector b) flat plate glazed collector c) roof integrated glazed collector d) evacuated tube collector – direct flow e) evacuated tube collector – heat pipe
5.2	Confirm the key operating principles for: <ul style="list-style-type: none"> a) flat plate collectors b) evacuated tube collector – direct flow c) evacuated tube collector – heat pipe
5.3	Identify the effect that the temperature difference between the solar primary circuit/collector temperature and the ambient temperature has on the relative efficiency of the following types of solar collector: <ul style="list-style-type: none"> a) unglazed collector b) flat plate glazed collector c) evacuated tube collector

Learning Outcome 6	
Know the information requirements to enable system component selection and sizing	
Assessment Criteria	
6.1	Confirm the information requirements in relation to: <ul style="list-style-type: none"> a) building design b) building dimensions/angles c) building location and orientation d) building fabric/material details e) existing input services f) existing hot water/heating systems
6.2	Confirm the information requirements in relation to: <ul style="list-style-type: none"> a) building occupancy b) required hot water usage pattern

Learning Outcome 7	
Know the fundamental techniques used to select, size and position components for solar thermal hot water systems	
Assessment Criteria	
7.1	Confirm how to determine typical domestic hot water system storage vessel requirements in relation to: <ul style="list-style-type: none"> a) daily demand (Vd) (litres/day per person or litres/day per m² of floor area) b) boiler volume (Vb) c) dedicated solar volume (Vs) (litres per m² of collector area or as a % of Vd) d) total cylinder volume (Vt) e) solar heat exchange coil surface area (m² of surface area in relation to collector flow rate and collector surface area)
7.2	Confirm how to determine typical domestic hot water system collector area requirements in relation to: <ul style="list-style-type: none"> a) building occupancy b) proposed angle of collector installation c) proposed orientation of collector installation d) Shading that may affect collector performance
7.3	Confirm how to determine the annual irradiation yield as a % of optimum in relation to: <ul style="list-style-type: none"> a) collector orientation b) collector angle c) collector over shading
7.4	State typical recommended solar primary circuit circulation rates
7.5	Confirm how to determine solar primary circuit pipe size requirements in relation to: <ul style="list-style-type: none"> a) primary circuit circulation rates b) collector area c) primary circuit pipework length
7.6	Confirm how to determine total solar primary circuit water content volume
7.8	Confirm how to determine total solar primary circuit expansion vessel size requirements in relation to: <ul style="list-style-type: none"> a) primary circuit water content volume b) collector height above cylinder
7.8	Identify typical sizing requirements for drain back vessels in relation to: <ul style="list-style-type: none"> a) net collector area b) total volume of the system

Learning Outcome 7	
Know the fundamental techniques used to select, size and position components for solar thermal hot water systems	
Assessment Criteria (continued)	
7.9	Confirm how to determine solar primary circuit dynamic pressure drop and circulating pump size requirements for: <ul style="list-style-type: none"> a) fully filled systems b) drain back systems

Learning Outcome 8	
Know how the performance of solar hot water systems is measured	
Assessment Criteria	
8.1	Define the meaning of the term 'solar fraction'
8.2	Identify factors that affect the solar fraction

Learning Outcome 9	
Know the preparatory work required for solar thermal hot water system installation work	
Assessment Criteria	
9.1	State the requirements in relation to: <ul style="list-style-type: none"> a) authorisation for the work to proceed b) the availability of appropriate access to all required work areas
9.2	Confirm the requirements of pre-installation checks in relation to: <ul style="list-style-type: none"> a) the suitability of the building structure and the building fabric in relation to the installation of system components b) verification that the generation capacity of the proposed solar hot water system installation is appropriate to the hot water system energy load and usage c) the inspection of existing hot water/heating system installations d) water quality e) the availability of a suitable electrical input service f) the proposed siting of key internal system components

Learning Outcome 10	
Know the requirements for connecting solar thermal hot water system collector circuits to combination boiler domestic hot water circuits	
Assessment Criteria	
10.1	Confirm how to determine the suitability of combination boilers to receive preheated water
10.2	Confirm the pipework layout and components required for connecting a solar thermal hot water system to a combination boiler to include the: <ul style="list-style-type: none"> a) arrangements for prevention of backflow b) arrangements for ensuring that the combination boiler cold inlet supply water is provided at an appropriate temperature c) arrangements for allowing stored hot water to be used directly from the store when the temperature of the stored water is appropriate

Learning Outcome 11	
Know the requirements for installing solar collector arrays	
Assessment Criteria	
11.1	<p>Confirm the positioning and fixing requirements and where appropriate the weathering requirements for the following solar collector types:</p> <ul style="list-style-type: none"> a) flat plate, surface mounted, inclined roof with single lap roof covering b) flat plate, surface mounted, inclined roof with double lap roof covering c) flat plate, integrated, inclined single lap roof covering d) flat plate, integrated, inclined double lap roof covering e) evacuated tube, inclined single lap roof covering f) evacuated tube, inclined double lap roof covering g) frame mounted, horizontal (roof or ground)
11.2	<p>Confirm the pipework layout, component requirements and component positioning requirements for the following system types and collector array connection arrangements:</p> <ul style="list-style-type: none"> a) fully filled system, collector array connected in series b) fully filled system, collector array connected in parallel c) fully filled system, collector array connected with east/west split d) drain back system, single collector array
11.3	<p>Confirm the requirements to achieve durable weather-tightness of buildings where the collector array connection pipework passes through the building fabric</p>
11.4	<p>State when specialist equipment is required in relation to preventing irradiation reaching collector absorbers during installation</p>

Learning Outcome 12	
Know the requirements for installing for solar thermal hot water system pipework	
Assessment Criteria	
12.1	<p>Propose suitable pipework materials in relation to:</p> <ul style="list-style-type: none"> a) system operating temperatures b) system operating pressures c) system chemicals
12.2	<p>Confirm the requirements for pipework supports in relation to:</p> <ul style="list-style-type: none"> a) suitable materials b) spacing of pipework supports
12.3	<p>State suitable pipework jointing methods in relation to:</p> <ul style="list-style-type: none"> a) system operating temperatures b) system operating pressures c) system chemicals
12.4	<p>Confirm the requirements for pipework insulation for solar thermal hot water system installation work in relation to:</p> <ul style="list-style-type: none"> a) system operating temperatures b) system efficiency and performance c) potential exposure of the insulation to ultra-violet rays/light d) potential exposure of the insulation e) to adverse weather f) the sections of installations that must be insulated g) the sections of installations that must not be insulated h) resistance to vermin attack

Learning Outcome 12	
Know the requirements for installing for solar thermal hot water system pipework	
Assessment Criteria (continued)	
12.5	Confirm the requirements for installing pressure relief valve discharge pipework in relation to: <ul style="list-style-type: none"> a) routing of pipework b) termination of pipework

Learning Outcome 13	
Know the requirements to test and commission solar thermal hot water system installations	
Assessment Criteria	
13.1	Confirm the requirements to prepare for testing and commissioning in relation to: <ul style="list-style-type: none"> a) compliance with the system design and specification b) compliance with system/component manufacturer requirements c) suitability of electrical supply circuit arrangements d) flushing the system of installation debris e) selection of suitable heat transfer fluid f) filling and venting the hydraulic circuits g) checking system water quality h) protection against freezing i) provision of system labelling
13.2	State what specialist equipment is required in relation to: <ul style="list-style-type: none"> a) the introduction and checking of system freeze protection fluids b) setting system pressure c) checking the corrosion protection of the system
13.3	Confirm the testing requirements for hydraulic circuits within solar thermal hot water system installations in relation to: <ul style="list-style-type: none"> a) hydraulic test pressure b) hydraulic test duration
13.4	Confirm the commissioning requirements for a fully filled indirect sealed collector circuit installation in relation to: <ul style="list-style-type: none"> a) setting of the expansion vessel charge pressure b) setting of the system fluid level c) setting of mechanical controls d) setting of electrical controls and temperature sensors e) system functional tests
13.5	Confirm the commissioning requirements for a fully filled drain back installation in relation to: <ul style="list-style-type: none"> a) setting of the system fluid level b) setting of mechanical controls c) setting of electrical controls and temperature sensors d) system functional tests
13.6	Confirm the commissioning requirements for multiple collector arrays connected in series
13.7	State the recording requirements for the commissioning of solar thermal hot water system installations

Learning Outcome 14	
Know the requirements to handover solar thermal hot water systems	
Assessment Criteria	
14.1	Confirm the pre-handover checks that need to be carried out
14.2	Confirm industry handover procedures in relation to the: <ul style="list-style-type: none"> a) provision of written information b) provision of diagrammatic information c) provision of verbal information/demonstration relating to system operation and use

L/602/3102 - Install, commission and handover 'active' solar thermal hot water systems

Unit level	3	<i>The unit focuses upon the occupational competence required to plan and prepare for, install (including testing and commissioning) and handover of ‘active’ fully filled and drain back solar thermal hot water systems. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area</i>	
GLH	15		
Unit			
L/602/3102 - Install, commission and handover ‘active’ solar thermal hot water systems			
Learning Outcomes			Assessment Criteria
LO1	Plan and prepare for the installation of ‘active’ solar thermal hot water system		1.1 – 1.3
LO2	Install solar thermal hot water system components		2.1
LO3	Test and commission an ‘active’ solar thermal hot water system		3.1 – 3.5
LO4	Handover an ‘active’ solar thermal hot water system		4.1 – 4.5

Learning Outcome 1		
Plan and prepare for the installation of 'active' solar thermal hot water system		
Assessment Criteria		
1.1	Undertake pre-installation checks for a solar hot water system installation to include checks relating to: <ul style="list-style-type: none"> a) authorisation for the work to proceed b) verification that the generation capacity of the proposed solar hot water system installation is appropriate to the hot water system load c) the availability of appropriate access to all required work areas d) the inspection of existing domestic hot water/heating system installations e) the availability of a suitable electrical input service f) the proposed siting of key internal system components g) the suitability of the building structure in relation to the proposed installation h) the suitability of the proposed location and position of the solar collector panel(s). 	
1.2	... for optimum collection capacity <ul style="list-style-type: none"> a) the suitability of the building fabric in relation to the installation of the solar collector panel(s) 	
1.3	Confirm that the tools, materials, and equipment required for the installation work are available and are in a safe, usable condition	

Learning Outcome 2	
Install solar thermal hot water system components	
Assessment Criteria	
2.1	<p>Install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures, key system components on either a fully filled or drain back, 'active' solar thermal hot water system to include as a minimum the positioning, fixing and connection of the following components:</p> <p>Fully filled systems:</p> <ul style="list-style-type: none"> a) solar collector b) expansion vessel c) solar circulating pump <p>Drain back systems:</p> <ul style="list-style-type: none"> a) solar collector b) drain back vessel c) solar circulating pump

Learning Outcome 3	
Test and commission an 'active' solar thermal hot water system	
Assessment Criteria	
3.1	<p>Prepare a fully filled or drain back solar thermal hot water system for testing and commissioning to include checks/actions to confirm:</p> <ul style="list-style-type: none"> 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 g) adequate provision of system labelling
3.2	Test the system for hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements, and industry recognised procedures
3.3	<p>Identify the commissioning requirements for the installation in relation to:</p> <ul style="list-style-type: none"> 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 a fully filled or drain back system 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	
Handover an 'active' solar thermal hot water system	
Assessment Criteria	
4.1	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
4.2	Explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures
4.3	Identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements
4.4	Obtain acceptance by the end user of the system according to the industry agreed handover procedures
4.5	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

Y/602/3104 - Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems

Unit level	3	<i>The unit focuses upon the knowledge required to inspect, service and maintain fully filled and drain back ‘active’ solar thermal hot water systems. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area.</i>	
GLH	15		
Unit			
Y/602/3104 - Know the requirements to inspect, service and maintain ‘active’ solar thermal hot water systems			
Learning Outcomes			Assessment Criteria
LO1	Know the requirements for the routine service and maintenance of ‘active’ solar thermal hot water systems		1.1 – 1.4
LO2	Know how to diagnose faults in ‘active’ solar thermal hot water system installations		2.1 – 2.2
LO3	Know how to rectify faults in ‘active’ solar thermal hot water systems		3.1

Learning Outcome 1		
Know the requirements for the routine service and maintenance of 'active' solar thermal hot water systems		
Assessment Criteria		
1.1	Confirm which documentation needs to be available to enable routine service and maintenance work on 'active' solar thermal hot water systems	
1.2	Confirm the typical routine service and maintenance requirements for fully filled systems in relation to: <ul style="list-style-type: none"> a) visual inspection requirements b) cleaning of components c) checking of system water content d) functional tests 	
1.3	Confirm the typical routine service and maintenance requirements for drainback systems in relation to: <ul style="list-style-type: none"> 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 solar thermal hot water systems	

Learning Outcome 2	
Know how to diagnose faults in 'active' solar thermal hot water 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: <ul style="list-style-type: none"> a) loss of system pressure without evidence of discharge b) discharge from pressure relief valve on the solar primary circuit c) insulation melting on solar collector circuit pipework d) overheating of solar collector circuit e) lack of circulation within the solar collector circuit f) poor or no system performance g) system noise and/or vibration

Learning Outcome 3	
Know how to rectify faults in 'active' solar thermal hot water systems	
Assessment Criteria	
3.1	Confirm the work action and sequences required to rectify the following faults: <ul style="list-style-type: none"> a) loss of system pressure without evidence of discharge b) evidence of discharge valve on the solar primary circuit c) insulation melting on solar collector circuit pipework d) overheating of solar collector circuit e) lack of circulation within the solar collector circuit f) poor or no system performance g) system noise and/or vibration

K/602/3107 - Inspect, service and maintain 'active' solar thermal hot water systems

Unit level	3	<i>The unit focuses upon the occupational competence required to inspect, service and maintain ‘active’ fully filled, and drain back solar thermal hot water systems. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m2 of solar collector area.</i>	
GLH	15		
Unit			
K/602/3107 - Inspect, service and maintain ‘active’ solar thermal hot water systems			
Learning Outcomes			Assessment Criteria
LO1	Undertake the routine service and maintenance of an ‘active’ solar thermal hot water system		1.1 – 1.5
LO2	Undertake fault diagnosis work on ‘active’ solar thermal hot water system installations		2.1 – 2.3
LO3	Undertake fault rectification work on ‘active’ solar thermal hot water system installations		3.1 – 3.5

Learning Outcome 1		
Undertake the routine service and maintenance of an 'active' solar thermal hot water system		
Assessment Criteria		
1.1	Obtain the relevant information required to enable the work	
1.2	Undertake a visual service and maintenance inspection of a fully filled or drain back, 'active' solar thermal hot water system installation to include checks in relation to: <ul style="list-style-type: none"> a) compliance with manufacturer's installation instructions b) compliance with statutory regulations c) condition of system components including cleanliness d) correct positioning of system components e) security of fixing of system components 	
1.3	Undertake routine servicing of relevant components on a fully filled or drain back, 'active' solar thermal hot water system to include: <ul style="list-style-type: none"> a) checking the system water levels b) checking provision for the expansion of system water c) checking for protection of the system water against freezing d) cleaning of system components e) adjustment of system controls 	
1.4	Undertake routine service and maintenance functional tests on a fully filled or drain back solar thermal hot water system to confirm: <ul style="list-style-type: none"> a) safe operation b) efficient operation c) the correct functioning of system components/controls 	
1.5	Complete the relevant service and maintenance records in accordance with industry recognised procedures	

Learning Outcome 2	
Undertake fault diagnosis work on 'active' so thermal hot water system installations	
Assessment Criteria	
2.1	Obtain the relevant information required to enable the fault diagnosis work
2.2	Identify the cause of a minimum of FOUR separate faults from the following list: <ul style="list-style-type: none"> a) loss of system pressure without evidence of discharge b) discharge from pressure relief valve on the solar primary circuit c) insulation melting on solar collector circuit pipework d) overheating of solar collector circuit e) lack of circulation within the solar collector circuit f) poor or no system performance g) system noise and/or vibration
2.3	Agree with the relevant person(s) fault rectification procedures for the faults identified

Learning Outcome 3	
Undertake fault rectification work on 'active' solar thermal hot water system installations	
Assessment Criteria	
3.1	Obtain the relevant information required to enable the fault rectification work
3.2	Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work
3.3	Take relevant precautionary actions to minimise the risk of injury to self or others during the fault rectification work
3.4	Rectify a minimum of TWO separate faults from the following list: <ul style="list-style-type: none"> a) loss of system pressure without evidence of discharge b) discharge from pressure relief valve on the solar primary circuit c) insulation melting on solar collector circuit pipework d) overheating of solar collector circuit e) lack of circulation within the solar collector circuit f) poor or no system performance g) system noise and/or vibration
3.5	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)

Unit level	3	<i>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</i>	
GLH	35		
Unit			
Y/602/3054 - Know the requirements to install, commission and handover heat pump systems (non-refrigerant circuits)		<i>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.</i>	
Learning Outcomes			Assessment Criteria
LO1	Know the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant circuits)		1.1 – 1.2
LO2	Know the requirements of relevant regulations/standards relating to practical installation, testing, and commissioning activities for heat pump installation work		2.1 – 2.3
LO3	Know the purpose and operational characteristics of heat pump unit and heat pump system components		3.1 – 3.2
LO4	Know the different types of heat pump units and system arrangements for hydraulic emitter circuits		4.1 – 4.6
LO5	Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps		5.1 – 5.24
LO6	Know the fundamental design principles for ground source ‘closed loop’ heat pump collector circuit design, component sizing and installation		6.1 – 6.12
LO7	Know the layouts of ‘open loop’ water filled heat pump collector circuits		7.1
LO8	Know the fundamental design considerations and principles that are specific to air source heat pumps		8.1 – 8.3
LO9	Know the preparatory work required for heat pump installation work		9.1 – 9.2
LO10	Know the requirements to install and test heat pump systems (non-refrigerant circuits)		10.1 – 10.6
LO11	Understand the requirements to commission heat pump system installations		11.1 – 11.4
LO12	Understand the requirements to handover heat pump system installations		12.1 – 12.4

Learning Outcome 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: <ul style="list-style-type: none"> a) electrocution/electric shock b) burns c) toxic poisoning personal injury through component/equipment handling
1.2	Confirm safe systems of work for heat pump installation work in relation to prevention of: <ul style="list-style-type: none"> a) electrocution/electric shock b) burns c) toxic poisoning d) personal injury through component/equipment handling

Learning Outcome 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 e) gases from heat pump refrigerant circuits

Learning Outcome 3	
Know the purpose and operational characteristics of heat pump unit and heat pump system components	
Assessment Criteria	
3.1	<p>Confirm the purpose and operational characteristics of the following components:</p> <ul style="list-style-type: none"> 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	
Know the different types of heat pump units and system arrangements for hydraulic emitter circuits	
Assessment Criteria	
4.1	<p>Recognise the following heat source/heat sink heat pump packages that can be deployed with a hydraulic 'heat sink' emitter circuit:</p> <ul style="list-style-type: none"> 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	<p>Identify the different types of heat pump unit within the categories:</p> <ul style="list-style-type: none"> 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	<p>Confirm the meaning of the terms:</p> <ul style="list-style-type: none"> a) monovalent system b) bivalent system
4.4	<p>Identify the following monovalent hydraulic emitter circuits:</p> <ul style="list-style-type: none"> 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

Learning Outcome 4	
Know the different types of heat pump units and system arrangements for hydraulic emitter circuits	
Assessment Criteria (continued)	
4.5	Identify the following parallel bivalent hydraulic emitter circuits that incorporate a secondary heat source other than an immersion heater: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> a) in series b) in parallel

Learning Outcome 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: <ul style="list-style-type: none"> heat pump input temperature heat pump emitter temperature
5.3	Confirm the effect that ambient temperature can have on: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> system performance/efficiency heat pump operation
5.10	State the effect that undersizing of a heat pump has on: <ul style="list-style-type: none"> system performance/efficiency 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: <ul style="list-style-type: none"> output charts 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

Learning Outcome 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 (continued)	
5.15	Confirm how heat pump output capacity is affected by: <ul style="list-style-type: none"> a) heat pump input temperature b) heat pump output temperature
5.16	Identify the suitability of the following types of hydraulic heating system emitter for suitability with heat pump systems: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 centigrade)
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: <ul style="list-style-type: none"> a) heating only b) heating and domestic hot water
5.24	State how heat pump annual operating hours may vary in relation to the: <ul style="list-style-type: none"> a) type of building b) geographical location of the installation

Learning Outcome 1	
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: <ul style="list-style-type: none"> 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

Learning Outcome 6	
Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation	
Assessment Criteria (continued)	
6.2	<p>Confirm the requirements of horizontal 'closed' loop brine filled hydraulic heat pump collector circuits in relation to:</p> <ul style="list-style-type: none"> 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	<p>Confirm the typical requirements of vertical borehole 'closed' loop brine filled hydraulic heat pump collector circuits in relation to:</p> <ul style="list-style-type: none"> 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	<p>Identify the typical components required in relation to:</p> <ul style="list-style-type: none"> 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	<p>Confirm the typical layout of components in relation to:</p> <ul style="list-style-type: none"> 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 m ² 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)
6.8	<p>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:</p> <ul style="list-style-type: none"> 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	<p>Confirm how the total ground area (m²) requirements for horizontal collector loops is</p> <ul style="list-style-type: none"> a) determined using the following data: b) refrigeration capacity (kW) c) specific extraction output (W/m²)

Learning Outcome 6	
Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation	
Assessment Criteria (continued)	
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 (m ²) 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 (m ²) 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

Learning Outcome 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	
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	
Know the preparatory work required for heat pump installation work	
Assessment Criteria	
9.1	<p>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:</p> <ul style="list-style-type: none"> 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 proposed installation
9.2	Confirm the pre-installation checks that are specific to the positioning of fan coil units

Learning Outcome 10	
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	<p>Identify the requirements where brine circuit pipework passes through the external building fabric in relation to:</p> <ul style="list-style-type: none"> a) provision for movement b) protection against freezing c) prevention of water ingress
10.4	<p>Confirm the charging and flushing requirements for closed loop collector circuits in relation to:</p> <ul style="list-style-type: none"> 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	<p>Confirm the hydraulic test requirements for:</p> <ul style="list-style-type: none"> a) closed loop collector circuits b) hydraulic emitter circuits

Learning Outcome 1	
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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> a) setting of mechanical controls b) setting of electrical controls and temperature sensors c) functional tests

Learning Outcome 1	
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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> a) provision of written information b) provision of diagrammatic information c) provision of verbal information/demonstration relating to system operation and use

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

Unit level	3	<i>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.</i>	
GLH	15		
Unit			
D/602/3072 - Install, commission and handover heat pumps (non-refrigerant circuits)			
Learning Outcomes			Assessment Criteria
LO1	Plan and prepare for the installation of heat pumps (non-refrigerant circuits)		1.1 – 1.2
LO2	Install air and ground source heat pump units (non-refrigerant circuits)		2.1 – 2.2
LO3	Test and commission a ground source heat pump installation (non-refrigerant circuits)		3.1 – 3.5
LO4	Test and commission an air source heat pump installation (non-refrigerant circuits)		4.1 – 4.3
LO5	Handover an air or ground source heat pump installation		5.1 – 5.5

Learning Outcome 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: <ul style="list-style-type: none"> 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	
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	
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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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	
Assessment Criteria	
4.1	<p>Prepare an air source heat pump system for testing and commissioning to include checks/actions to confirm:</p> <ul style="list-style-type: none"> 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	<p>Identify the commissioning requirements for the installation in relation to:</p> <ul style="list-style-type: none"> 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	<p>Commission the installation in accordance with manufacturer's guidance, design requirements, client's requirements and statutory requirements and/or industry recognised procedures</p>

Learning Outcome 5	
Assessment Criteria	
5.1	<p>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</p>
5.2	<p>Explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures</p>
5.3	<p>Identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements</p>
5.4	<p>Obtain acceptance by the end user of the system according to the industry agreed handover procedures</p>
5.5	<p>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</p>

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

Unit level	3	<i>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.</i>
GLH	15	
Unit		
F/602/3078 - Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits)		
Learning Outcomes		Assessment Criteria
LO1	Know the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations	1.1 – 1.5
LO2	Know how to diagnose faults in heat pump system installations	2.1 – 2.2
LO3	Know how to rectify non-refrigerant circuit faults in heat pump system installations	3.1

Learning Outcome 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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	
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: <ul style="list-style-type: none"> 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	
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: <ul style="list-style-type: none"> 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)

Unit level	3	<i>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.</i>
GLH	15	
Unit		
L/602/3083 - Inspect, service and maintain heat pump installations (non-refrigerant circuits)		
Learning Outcomes		Assessment Criteria
LO1	Undertake the non-refrigerant circuit routine service and maintenance of an air source heat pump system installation	1.1 – 1.5
LO2	Undertake the non-refrigerant circuit routine service and maintenance of an ground source heat pump system installation	2.1 – 2.5
LO3	Undertake non-refrigerant circuit fault diagnosis work on an air or ground source heat pump system installation	3.1 – 3.3
LO4	Undertake non-refrigerant circuit fault rectification work on an air or ground source heat pump system installation	4.1 – 4.5

Learning Outcome 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> a) checking for protection of the system water against freezing b) cleaning and lubrication of system components c) adjustment of system controls 	

Learning Outcome 1	
Undertake the non-refrigerant circuit routine service and maintenance of an air source heat pump system installation	
Assessment Criteria (continued)	
1.4	Undertake routine service and maintenance functional tests on a air source heat pump installation to confirm: <ul style="list-style-type: none"> 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	
Undertake the non-refrigerant circuit routine service and maintenance of a 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 a ground source heat pump installation to include checks in relation to: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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	
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: <ul style="list-style-type: none"> 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 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: <ul style="list-style-type: none"> 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

T/602/3109 - Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems

Unit level	3	<i>This unit provides learning in health and safety risks and safe systems of work associated with rainwater harvesting and greywater reuse systems, regulations and standards relating to the installation, testing and commissioning, the purpose and characteristics, different types, fundamental principles of selection, design layouts, and the preparation of work needed.</i>
GLH	35	
Unit		
T/602/3109 - Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems		
Learning Outcomes		Assessment Criteria
LO1	Know the health and safety risks and safe systems of work associated with rainwater harvesting and greywater reuse system installation work	1.1 – 1.2
LO2	Know the requirements of relevant regulations/standards relating to practical installation, testing, and commissioning activities for solar thermal hot water system installation work	2.1 – 2.2
LO3	Know the types and layouts of rainwater harvesting and greywater reuse system used for single premises installations	3.1 – 3.3
LO4	Know the purpose of components used within rainwater harvesting and greywater reuse systems	4.1
LO5	Know the information requirements to enable rainwater harvesting and greywater reuse system component selection and sizing	5.1 – 5.2
LO6	Know the fundamental techniques used to select, size and position components for rainwater harvesting and greywater reuse systems	6.1 – 6.9
LO7	Know options and requirements for the treatment of water in biological, physical, biomechanical and hybrid rainwater harvesting/greywater recycling systems	7.1 – 7.4
LO8	Know the preparatory work required for rainwater harvesting and greywater recycling system installation work	8.1 – 8.2
LO9	Know the requirements for installing rainwater harvesting and greywater reuse storage tanks	9.1 – 9.2
LO10	Know the requirements for installing rainwater harvesting and greywater recycling system pipework	10.1 – 10.3
LO11	Know the requirements to test and commission rainwater harvesting and greywater re-use system installations	11.1 – 11.6
LO12	Know the requirements to handover rainwater harvesting and greywater recycling systems.	12.1 – 12.2

Learning Outcome 1	
Know the health and safety risks and safe systems of work associated with rainwater harvesting and greywater reuse system installation work	
Assessment Criteria	
1.1	<p>Confirm which aspects of rainwater harvesting and greywater reuse system installation work pose risk of:</p> <ul style="list-style-type: none"> a) electrocution/electric shock b) infection c) toxic poisoning d) asphyxiation e) personal injury though component/equipment handling
1.2	<p>Confirm safe systems of work for rainwater harvesting and greywater reuse system installation work in relation to prevention of:</p> <ul style="list-style-type: none"> a) electrocution/electric shock b) infection c) toxic poisoning d) asphyxiation e) personal injury though component/equipment handling

Learning Outcome 2	
Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for rainwater harvesting and greywater reuse system installation work	
Assessment Criteria	
2.1	<p>Interpret building regulation/building standards guidance documentation as relevant to rainwater harvesting and greywater reuse system installation work to identify the requirements in relation to:</p> <ul style="list-style-type: none"> a) maintaining the fire-resistant integrity of the building b) the prevention of moisture ingress (building water tightness) c) notification of work requirements d) energy conservation e) roof drainage system installation f) rainwater and greywater storage tank installation g) cold water supply requirements <ul style="list-style-type: none"> 1. water quality 2. water efficiency h) compliance certification
2.2	<p>Interpret industry recognised water regulation/byelaw guidance documentation as relevant to rainwater harvesting and greywater reuse system installation work to identify the requirements in relation to:</p> <ul style="list-style-type: none"> a) the physical installation of the system b) notification of the work c) backflow and contamination prevention requirements d) marking and labelling requirements e) use of the harvested/reused water

Learning Outcome 3	
Know the types and layouts of rainwater harvesting and greywater reuse system used for single premises installations	
Assessment Criteria	
3.1	Identify the following rainwater harvesting system types: <ul style="list-style-type: none"> a) gravity supply b) direct pumped c) pumped to storage cistern d) gravity distribution
3.2	Identify the following greywater reuse system types: <ul style="list-style-type: none"> a) direct reuse b) short retention c) basic physical/chemical d) biological e) bio-mechanical f) hybrid
3.3	Confirm where in system layouts the following backflow prevention arrangements for wholesome back up water supply are required: <ul style="list-style-type: none"> a) type AA air gap b) type AB air gap

Learning Outcome 4	
Know the purpose of components used within rainwater harvesting and greywater reuse systems	
Assessment Criteria	
4.1	Confirm the purpose of the following rainwater harvesting and greywater reuse system components: <ul style="list-style-type: none"> a) outside air/water b) anti-surge valve c) calmed inlet d) inlet filter e) level sensor/float switch f) module (including pump and air gap) g) pump control unit h) system control unit i) expansion vessel (direct systems) j) water level gauge.

Learning Outcome 5	
Know the information requirements to enable rainwater harvesting and greywater reuse system component selection and sizing	
Assessment Criteria	
5.1	Confirm the information requirements in relation to: <ul style="list-style-type: none"> a) building design b) building dimensions c) building location and orientation d) building fabric/material details e) existing wholesome water supply systems f) existing rainwater and waste water systems g) proposed use of the harvested rainwater/greywater
5.2	Confirm the information requirements in relation to: <ul style="list-style-type: none"> a) building occupancy b) demand/usage c) any special features

Learning Outcome 6	
Know the fundamental techniques used to select, size and position components for rainwater harvesting and greywater reuse systems	
Assessment Criteria	
6.1	Confirm how to determine the storage capacity (litres) of a greywater reuse system within a single premises using the simplified approach in relation to: <ul style="list-style-type: none"> a) ground 'closed' loop horizontal b) occupancy c) greywater yield d) greywater demand/usage
6.2	Confirm how to determine the storage capacity (litres) of a rainwater harvesting system within a single premises using the simplified approach in relation to: <ul style="list-style-type: none"> a) suitable pipework materials b) roof plan area (tiled pitched roofs) c) average annual rainfall depth for the location d) building occupancy
6.3	Confirm which materials are typically suitable for the manufacture of rainwater harvesting and greywater reuse tanks and cisterns suitable pipework materials
6.4	Confirm the requirements for durability in relation to the materials selected for rainwater harvesting and greywater reuse system tanks and components single circuit 'closed' loop collector circuits

Learning Outcome 6	
Know the fundamental techniques used to select, size and position components for rainwater harvesting and greywater reuse systems	
Assessment Criteria (continued)	
6.5	<p>Confirm the design requirements for rainwater harvesting and greywater reuse storage tank/cistern installation in relation to:</p> <ul style="list-style-type: none"> a) single circuit collector circuits b) prevention of stagnation of the stored water c) provision of covers and vents d) prevention of contamination/microbial growth e) keeping the stored water dark and cold f) provision and sizing of an overflow g) prevention of surcharging via overflow pipework h) termination of overflows from rainwater harvesting storage tanks i) termination of overflows from greywater reuse storage tanks j) proximity to trees k) contaminated ground l) groundwater levels m) ground strength and stability n) proximity to utilities and foundations
6.6	confirm the options for providing a back-up water supply within a rainwater harvesting or greywater reuse system
6.7	<p>Confirm the requirements of pump installation within a rainwater harvesting or greywater reuse system in relation to:</p> <ul style="list-style-type: none"> a) prevention of dry-running b) prevention of sound and vibration transfer c) prevention of overheating d) provision of non-return valves e) provision of isolating valves f) provision of a pump failure alarm g) provision of controls h) provision for monitoring
6.8	Confirm which materials are suitable for rainwater harvesting and greywater reuse system collection and distribution pipework and fittings
6.9	State typical collection and distribution system pipe sizes for rainwater harvesting and greywater reuse systems for pipework between the storage tank and the system control unit.

Learning Outcome 7	
Know options and requirements for the treatment of water in biological, physical, biomechanical and hybrid rainwater harvesting/greywater recycling systems	
Assessment Criteria	
7.1	<p>State when the inclusion of a water treatment arrangement in rainwater harvesting and greywater recycling systems:</p> <ul style="list-style-type: none"> a) ground 'open' loop vertical borehole b) is a regulatory requirement c) may be beneficial or good practice

Learning Outcome 7	
Know options and requirements for the treatment of water in biological, physical, biomechanical and hybrid rainwater harvesting/greywater recycling systems	
Assessment Criteria (continued)	
7.2	Confirm the working principles of a UV disinfection system
7.3	Confirm the typical installation arrangements for a UV disinfection system in relation to: <ul style="list-style-type: none"> a) water sample points b) filters c) flow restrictors d) isolation valves
7.4	Confirm the options for the chemical treatment of water in rainwater harvesting and greywater recycling systems.
7.1	State when the inclusion of a water treatment arrangement in rainwater harvesting and greywater recycling systems: <ul style="list-style-type: none"> a) ground 'open' loop vertical borehole b) is a regulatory requirement c) may be beneficial or good practice

Learning Outcome 8	
Know the preparatory work required for rainwater harvesting and greywater recycling system installation work	
Assessment Criteria	
8.1	State the requirements in relation to: <ul style="list-style-type: none"> a) operating noise (including the potential effect on neighbouring properties) b) authorisation for the work to proceed c) the availability of appropriate access to all required work areas
8.2	Confirm the requirements of pre-installation checks in relation to the suitability of the proposed installation in relation to: <ul style="list-style-type: none"> a) yield b) usage c) suitability of the building structure and the building fabric in relation to the installation of system components d) inspection of the existing water supply installation e) inspection of the existing rainwater and/or greywater installation f) availability of a suitable electrical input service g) proposed siting of key internal system components.

Learning Outcome 9	
Know the requirements for installing rainwater harvesting and greywater reuse storage tanks	
Assessment Criteria	
9.1	Confirm the requirements to maintain the structural integrity of the tank if holes need to be cut within a storage tank during the installation process
9.2	Confirm the requirements for mounting and supporting above ground tanks and cisterns.

Learning Outcome 10	
Know the requirements for installing rainwater harvesting and greywater recycling system pipework	
Assessment Criteria	
10.1	Confirm the requirement of the connection arrangement where rainwater and greywater overflow and drainage pipework connects to the underground drainage system
10.2	Confirm which jointing methods are acceptable for rainwater and greywater pipework collection pipework
10.3	Confirm which jointing methods are acceptable for rainwater and greywater pipework distribution pipework.

Learning Outcome 11	
Know the requirements to test and commission rainwater harvesting and greywater re-use system installations	
Assessment Criteria	
11.1	Confirm the requirements to prepare for testing and commissioning in relation to: <ul style="list-style-type: none"> a) compliance with the system design and specification b) compliance with system/component manufacturer requirements c) suitability of electrical supply circuit arrangements d) flushing the system of installation debris e) filling the storage tank f) provision of marking and labelling to system pipework and components
11.2	Confirm the testing requirements for hydraulic testing of the distribution system in relation to: <ul style="list-style-type: none"> a) setting of mechanical controls b) test pressure c) test duration d) permitted leakage e) pass criteria
11.3	Confirm the test procedure to check that cross-connections have not been introduced
11.4	Confirm the typical commissioning requirements for a rainwater harvesting system installation in relation to: <ul style="list-style-type: none"> a) setting of mechanical controls b) setting of the system fluid levels c) setting of mechanical controls d) setting of electrical controls e) system functional tests f) water quality checks
11.5	Confirm the commissioning requirements for a greywater re-use system installation in relation to: <ul style="list-style-type: none"> a) setting of the system fluid levels b) setting of mechanical controls c) setting of electrical controls d) system functional tests e) water quality checks
11.6	State the recording requirements for the commissioning of rainwater harvesting and greywater re-use system installations.

Learning Outcome 12	
Know the requirements to handover rainwater harvesting and greywater recycling systems	
Assessment Criteria	
12.1	Confirm the pre-handover checks that need to be carried out
12.2	Confirm industry handover procedures in relation to the: <ul style="list-style-type: none"> a) provision of written information b) provision of diagrammatic information c) provision of verbal information/demonstration relating to system operation and d) use.

K/602/3110 - Install, commission and handover rainwater harvesting and greywater reuse systems

Unit level	3	<i>The unit focuses upon the occupational competence required to demonstrate occupational competence in how to plan and prepare for installation. To install, test, commission, and hand over rainwater harvesting and greywater reuse systems.</i>	
GLH	15		
Unit			
K/602/3110 - Install, commission and handover rainwater harvesting and greywater reuse systems			
Learning Outcomes			Assessment Criteria
LO1	Be able to plan and prepare for the installation of rainwater harvesting and greywater reuse systems		1.1 – 1.2
LO2	Be able to install rainwater harvesting and greywater reuse system components		2.1
LO3	Be able to test and commission rainwater harvesting and greywater reuse systems		3.1 – 3.6
LO4	Be able to handover rainwater harvesting and greywater reuse systems.		4.1 – 4.5

Learning Outcome 1		
Be able to plan and prepare for the installation of rainwater harvesting and greywater reuse systems.		
Assessment Criteria		
1.1	Undertake pre-installation checks for a rainwater harvesting or greywater reuse system installation to include checks relating to: <ol style="list-style-type: none"> the suitability of the proposed installation in relation to: <ul style="list-style-type: none"> yield usage any special features the suitability of the building structure and the building fabric in relation to the installation of: <ul style="list-style-type: none"> system components the inspection of the existing water supply installation the inspection of the existing rainwater and/or greywater installation the availability of a suitable electrical input service the proposed siting of key internal system components 	
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	
Be able to install rainwater harvesting and greywater reuse system components.	
Assessment Criteria	
2.1	<p>Install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures, key system components on either a rainwater harvesting or greywater reuse system to include as a minimum the positioning, fixing and connection of the following components: the suitability of the proposed installation in relation to:</p> <ul style="list-style-type: none"> a) storage tank (connection to tank only) b) system control unit (water connections only) c) pump

Learning Outcome 3	
Be able to test and commission rainwater harvesting and greywater reuse systems.	
Assessment Criteria	
3.1	<p>Prepare a rainwater harvesting or greywater reuse system for testing and commissioning to include checks/actions to:</p> <ul style="list-style-type: none"> a) confirm compliance with the system design and specification b) confirm compliance with system/component manufacturer requirements c) confirm the suitability of electrical supply circuit arrangements d) flushing the system of installation debris e) filling the storage tank f) confirm the provision of appropriate marking and labelling to system pipework and components
3.2	Test a rainwater harvesting or greywater reuse distribution system for hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements, and industry recognised procedures.
3.3	Undertake the relevant test procedure to check that cross-connections have not been introduced.
3.4	<p>Identify the commissioning requirements for a rainwater harvesting or greywater reuse installation in relation to:</p> <ul style="list-style-type: none"> 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
3.5	Commission a rainwater harvesting and greywater reuse system in accordance with manufacturer's guidance, design requirements, client's requirements, and statutory requirements and/or industry recognised procedures
3.6	Complete relevant documentation to record the rainwater harvesting or greywater reuse system commissioning activities.

Learning Outcome 4	
Be able to handover rainwater harvesting and greywater reuse systems.	
Assessment Criteria	
4.1	Undertake relevant checks on either a rainwater harvesting or greywater reuse system 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.
4.2	Explain and demonstrate to the end user the operation and use of either a rainwater harvesting or greywater reuse system using manufacturer's guidance and industry agreed handover procedures.
4.3	Identify and explain to the end user any aspects of the rainwater harvesting or greywater reuse system that varies from the agreed specifications and requirements.
4.4	Obtain acceptance by the end user of the rainwater harvesting or greywater reuse system according to the industry agreed handover procedures.
4.5	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

M/602/3111 - Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems

Unit level	3	<i>The unit focuses upon the underpinning knowledge required to enable learners to demonstrate occupational competence in inspection, servicing, and maintenance, diagnostic and rectification of faults.</i>	
GLH	15		
Unit			
M/602/3111 - Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems			
Learning Outcomes			Assessment Criteria
LO1	Know the requirements for the routine service and maintenance of rainwater harvesting and reuse systems		1.1 – 1.6
LO2	Know how to diagnose faults in rainwater harvesting and greywater reuse systems		2.1 – 2.2
LO3	Know how to rectify faults in rainwater harvesting and greywater reuse systems		3.1

Learning Outcome 1		
Know the requirements for the routine service and maintenance of rainwater harvesting and reuse systems.		
Assessment Criteria		
1.1	Confirm which documentation needs to be available to enable routine service and maintenance work on rainwater harvesting and greywater reuse systems.	
1.2	Confirm the typical routine service and maintenance requirements for a rainwater harvesting system in relation to: <ul style="list-style-type: none"> a) visual inspection requirements b) cleaning of components c) functional tests 	
1.3	Confirm the typical routine service and maintenance requirements for greywater reuse systems in relation to: <ul style="list-style-type: none"> a) visual inspection requirements b) cleaning of components c) functional test 	
1.4	Confirm the relevant guideline values for the general monitoring of water quality in rainwater harvesting and greywater reuse systems in relation to: <ul style="list-style-type: none"> a) dissolved oxygen (stored rainwater) b) suspended solids c) colour d) turbidity e) pH f) residual chlorine g) residual bromine 	
1.5	State what equipment is required to monitor water quality in rainwater harvesting and greywater reuse systems.	
1.6	Confirm the industry requirements for the recording and reporting of routine service and maintenance work on rainwater harvesting and greywater reuse systems.	

Learning Outcome 2	
Know the requirements for the routine service and maintenance of rainwater harvesting and reuse systems.	
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: visual inspection requirements: <ul style="list-style-type: none"> a) poor or no flow into storage tank b) system pump fails to operate c) back-up water supply fails to operate d) water quality is unacceptable e) undue system noise or vibration.

Learning Outcome 3	
Know how to rectify faults in rainwater harvesting and greywater reuse systems.	
Assessment Criteria	
3.1	Confirm the work action and sequences required to rectify the following faults: <ul style="list-style-type: none"> a) poor or no flow into storage tank b) system pump fails to operate c) back-up water supply fails to operate d) water quality is unacceptable e) undue system noise or vibration

A/602/3130 - Inspect, service and maintain rainwater harvesting and greywater reuse systems

Unit level	3	<i>This unit focuses upon the occupational competence required to enable learners to demonstrate inspection, servicing, and maintenance, diagnostic and rectification of faults</i>	
GLH	15		
Unit			
A/602/3130 - Inspect, service and maintain rainwater harvesting and greywater reuse systems			
Learning Outcomes			Assessment Criteria
LO1	Be able to undertake the routine service and maintenance of rainwater harvesting and greywater reuse systems		1.1 – 1.5
LO2	Be able to undertake fault diagnosis work on rainwater harvesting and greywater reuse systems installations		2.1 – 2.3
LO3	Be able to undertake fault rectification work on rainwater harvesting and greywater reuse systems installations.		3.1 – 3.5

Learning Outcome 1		
Be able to undertake the routine service and maintenance of rainwater harvesting and greywater reuse systems		
Assessment Criteria		
1.1	Obtain the relevant information required to enable the work pool or no flow into storage tank	
1.2	Undertake a visual service and maintenance inspection of a rainwater harvesting or greywater reuse system installation to include checks in relation to: <ul style="list-style-type: none"> a) compliance with manufacturer's installation instructions b) compliance with statutory regulations c) condition of system components including cleanliness d) correct positioning of system components e) security of fixing of system components 	
1.3	Undertake routine servicing of relevant components on a rainwater harvesting or greywater reuse system to include: <ul style="list-style-type: none"> a) checking the system water levels b) checking the system water quality c) cleaning of system components d) adjustment of system controls 	
1.4	Undertake routine service and maintenance functional tests on a rainwater harvesting or greywater reuse system to confirm: <ul style="list-style-type: none"> a) safe operation b) efficient operation c) the correct functioning of system components/controls 	
1.5	Complete the relevant service and maintenance records in accordance with industry recognised procedures	

Learning Outcome 2	
Be able to undertake fault diagnosis work on rainwater harvesting and greywater reuse systems installations	
Assessment Criteria	
2.1	Obtain the relevant information required to enable the fault diagnosis work
2.2	Diagnose the cause of a minimum of four separate faults on a rainwater harvesting and/or greywater reuse system from the following list: <ul style="list-style-type: none"> a) poor or no flow into storage tank b) system pump fails to operate c) back-up water supply fails to operate d) water quality is unacceptable e) undue system noise or vibration
2.3	Agree with the relevant person(s) fault rectification procedures for the faults identified

Learning Outcome 3	
Be able to undertake fault rectification work on rainwater harvesting and greywater reuse systems installations	
Assessment Criteria	
3.1	Obtain the relevant information required to enable the fault rectification work
3.2	Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work
3.3	Take relevant precautionary actions to minimise the risk of injury to self or others during the fault rectification work
3.4	Rectify a minimum of two separate faults on a rainwater harvesting and/or greywater reuse system from the following list: <ul style="list-style-type: none"> a. poor or no flow into storage tank b. system pump fails to operate c. back-up water supply fails to operate d. water quality is unacceptable e. undue system noise or vibration
3.5	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

7. Assessment Requirements for Individual Units

7.1. L3 Generic Units

Unit Ref: R/602/2498 – Understand how to organise resources within BSE

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

Unit Ref: K/502/8930 – Understand and apply domestic cold water system installation, commissioning, service, and maintenance techniques

To achieve the completion of this combination unit, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification). You must also complete the appropriate practical performance activities in simulated conditions as per the requirements of BPEC Practical Assessment no.1 as detailed in the BPEC L3 Plumbing and Heating practical assessment manual.

Unit Ref: K/502/9155 – Understand and apply domestic hot water system installation, commissioning, service, and maintenance techniques

To achieve the completion of this combination unit, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification). You must also complete the appropriate practical performance activities in simulated conditions as per the requirements of BPEC Practical Assessment no.2 as detailed in the BPEC L3 Plumbing and Heating practical assessment manual.

Unit Ref: M/502/9156 – Understand and apply domestic central heating system installation, commissioning, service, and maintenance techniques

To achieve the completion of this combination unit, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification). You must also complete the appropriate practical performance activities in simulated conditions as per the requirements of BPEC Practical Assessment no.3 as detailed in the BPEC L3 Plumbing and Heating practical assessment manual.

Unit Ref: T/502/9157 – Understand and carry out electrical work on domestic plumbing and heating systems and components

To achieve the completion of this combination unit, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification). You must also complete the appropriate practical performance activities in simulated conditions as per the requirements of BPEC Practical Assessment no.4 as detailed in the BPEC L3 Plumbing and Heating practical assessment manual.

Unit Ref: D/502/9296 – Understand and apply domestic sanitation system installation, commissioning, service, and maintenance techniques

To achieve the completion of this combination unit, you must satisfactorily complete the applicable knowledge assessment for the knowledge learning outcomes within the unit (detail contained with BPEC assessment specification). You must also complete the appropriate practical performance activities in

simulated conditions as per the requirements of BPEC Practical Assessment no.5 as detailed in the BPEC L3 Plumbing and Heating practical assessment manual.

Unit Ref: K/502/9298 – Install, commission, service and maintain domestic plumbing and heating systems

To achieve the completion of this performance unit, you must provide satisfactory evidence of having met the requirements of the Learning Outcomes and Assessment Criteria from a real working environment. The performance-based learning outcomes for this unit will be assessed by utilising practical activities in a real working environment, for at least 2 of the following 5 types of plumbing system (cold water, hot water, central heating, rainwater, and above ground drainage) at a minimum of two separate work locations and on a minimum of two occasions.

7.2. L3 Environmental Technology units

Unit Ref: K/602/3138 Understand the Fundamental Principles and Requirements of Environmental Technology Systems

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).

7.3. L3 Solar Thermal units

Unit Ref: F/602/3100 Know the requirements to install, commission and handover solar thermal hot water systems

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/602/3102 Install, commission, and handover ‘active’ solar thermal hot water systems

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 EVTSST-03 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/602/3104 Know the requirements to inspect, service and maintain ‘active’ solar thermal hot water systems

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: K/602/3107 Inspect, service and maintain ‘active’ solar thermal hot water systems

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 EVTSST-03 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

7.4. L3 Heat Pumps units

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).

Unit Ref: D/602/3072 Install, commission, and handover heat pumps (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 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.

7.5. L3 Rainwater Harvesting and Greywater Reuse units

Unit Ref: T/602/3109 Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems

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: K/602/3110 Install, commission and handover rainwater harvesting and greywater reuse systems

To achieve the completion of this performance unit you must:

- Complete the appropriate practical performance activities in simulated condition as per the requirements for unit K/602/3110 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: M/602/3111 Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems

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: A/602/3130 Inspect, service and maintain rainwater harvesting and greywater reuse systems

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 A/602/3130 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

8. Marking Strategies

8.1. On-line Multiple-Choice Tests

These are the Multiple-Choice Tests:

Unit		No. of Questions	Open or closed book
R/602/2498	Understand how to organise resources within BSE	20	Closed book
K/502/8930	Understand and apply domestic cold water system installation, commissioning, service, and maintenance techniques	45	Open book
K/502/9155	Understand and apply domestic hot water system installation, commissioning, service, and maintenance techniques	45	Open book
M/502/9156	Understand and apply domestic central heating system installation, commissioning, service, and maintenance techniques	30	Open book
T/502/9157	Understand and carry out electrical work on domestic plumbing and heating systems and components	49	Open book
D/502/9296	Understand and apply domestic sanitation system installation, commissioning, service, and maintenance techniques	25	Open book

All Environmental Pathways			
K/602/3138	Understand the Fundamental Principles and Requirements of Environmental Technology Systems	50	Open book

Pathway EN1: Solar Thermal Hot Water Systems			
F/602/3100	Know the requirements to install, commission and hand over solar thermal hot water systems	50	Open book

Pathway EN2: Heat Pumps			
F/602/3078	Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits)	7	Open book
Y/602/3054	Know the requirements to install, commission and handover heat pump systems (non-refrigerant circuits) PAPER 1	60	Open book
Y/602/3054	Know the requirements to install, commission and handover heat pump systems (non-refrigerant circuits) PAPER 2	60	Open book

Pathway EN3 – Water Recycling			
T/602/3109	Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems	61	Open book
M/602/3111	Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems	17	Open book

The pass rate for all **on-line** exams is **60%**.

If the pass rate of 60% is not achieved a full re-sit will be required. The centre should use the exams summary report to identify any areas that would need further training before offering any re-sits.

The centre should not enter any Learner into any exams without first confirming they are ready.

8.2. Performance Assessments

The pass mark for the practical assessments is pass/fail.

First Attempt – Learners are given a first attempt in all areas of the performance assessment.

Second Attempt – performance areas not satisfactorily completed will be re-attempted. At the assessor's discretion, the Learner is re-assessed by oral questioning and/or observing the performance to establish competence in all remaining areas. 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.

8.3. Written Design Assignment

The pass mark for written assignments is 100%

8.4. Learner Result Submission Form

Learner Result Submission Forms have been produced for the L3 Plumbing qualification. 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 Submission Forms shall be sent to BPEC Certification Ltd. for certification. Copies of the Learner Result Form shall also be retained in the Learner Portfolio and the Centre Portfolio.

9. Further Information

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

BPEC Certification Ltd. 1-2 Mallard Way, Pride Park, Derby, DE24 8GX

T: 01332 376000

E: AAdmin@bpec.org.uk

W: www.bpec.org.uk