# EAL Building Services Engineering (Level 3) – Plumbing and Heating C00/4278/7

## Qualification Manual

**Version 1.2 – November 2022**

# Contents

## Version information

| Version and publication date | Changes |
|---|---|
| v1 June 2021 | Original document |
| v1.1 December 2021 | Structure of the qualification text updated (p7)<br>Support materials - website address updated (p17) |
| v1.2 November 2022 | Unit 302: Removal of reference to ARBED, and inclusion of UKCA marking. |

# Qualification purpose

| | Description |
|---|---|
| Who is the qualification for? | The EAL Building Services Engineering (Level 3) – Plumbing and Heating qualification has been developed to allow those in work-based learning to demonstrate and enhance their occupational knowledge, skills and understanding within their BSE trade.<br><br>It is aimed at learners who have either achieved the Foundation in Construction and the Built Environment (Level 2), or will be completing the Core in Construction and Building Services Engineering Level 2 learning and assessments while in their apprenticeship. This qualification will enable learners to go on to study other Level 3 BSE courses relevant to their choice of trade.<br><br>It is suitable for:<br><br>• learners aged 16+ currently working in the trade area<br>• learners who have either passed the Foundation in Construction and the Built Environment qualification or will be completing their Foundation learning and assessments while in their apprenticeship<br>• learners who have completed the EAL Progression in Building Services Engineering (Level 2) Plumbing and Heating. |
| What does the qualification cover? | Learners will develop their knowledge, skills and understanding for the trade, as contained in the recognised standards.<br><br>The qualification will allow learners to plan and perform projects in their trade, against recognised standards, before reviewing and evaluating the quality of the project outputs.<br><br>The qualification will be portable throughout the UK and is aimed to develop learners' ability to meet the demands of the BSE sector in Wales. |
| What opportunities for progression are there? | On completion, the qualification will provide learners with the skills and knowledge required for the learner to be capable of working in their trade across the UK. |

| | Description |
|---|---|
| Who did we develop the qualification with? | The content has been developed by the Consortium[1] in conjunction with stakeholders, tutors, training providers and employers from across the sector. |

[1] The Consortium consists of the City & Guilds of London Institute and EAL who worked jointly to develop and deliver all of the qualifications in the Construction and BSE suite

# Qualification aims and objectives

This qualification enables learners to develop their:

- ability to effectively plan work projects using the appropriate skills for their trade in a work environment
- ability to effectively review and evaluate the quality of their completed work for their trade in the work environment
- knowledge and understanding of the tools, techniques, materials, and technologies used in their trade, and how they have changed over time
- employability skills and their ability to utilise them in a work environment
- understanding of social, economic, and environmental sustainability
- occupational knowledge and understanding of their trade
- occupational performance of their trade in a work context.

# Qualification structure

## Rule of combination

To achieve the EAL Building Services Engineering (Level 3) – Plumbing and Heating qualification learners must undertake all units listed below.

**Achieving a Pass grade or higher in the three assessment methods, totalling 960 GLH.**

| Unit | Unit title | GLH |
|---|---|---|
| 301 | Understanding Building Services Engineering Practice in Wales | 40 |
| 302 | Working in the Building Services Engineering Sector in Wales | 40 |
| 304 | Planning and Evaluating Work in the Building Services Engineering Sector in Wales | 35 |
| 303 | Understand Health and Safety and Environmental Legislation in The Building Services Engineering Sector | 21 |
| 305PH | Understand Scientific Principles | 70 |
| 306PH | Understand Core Plumbing and Heating Systems | 65 |
| 307PH | Understand Cold Water Systems | 25 |
| 308PH | Understand Hot Water Systems | 25 |
| 309PH | Understand Central Heating Systems | 36 |
| 310PH | Understand Rainwater Systems | 8 |
| 311PH | Understand Sanitation Systems | 13 |
| 312 | Apply Health and Safety and Environmental Legislation in the Building Services Engineering Sector | 15 |
| 313 | Establish and Maintain Relationships in the Building Services Engineering Sector | 26 |
| 314 | Coordinate a Work Site in the Building Services Engineering Sector | 28 |

| | | |
|---|---|---|
| 315PH | Understand Cold Water System Installation, Commissioning, Service and Maintenance Techniques | 50 |
| 316PH | Understand Hot Water System, Installation, Commissioning, Service and Maintenance Techniques | 50 |
| 317PH | Understand Central Heating System, Installation, Commissioning, Service and Maintenance Techniques | 70 |
| 318PH | Understand Rainwater System, Installation and Maintenance Techniques | 15 |
| 319PH | Understand Sanitation System, Installation, Commissioning, Service and Maintenance Techniques | 40 |
| 320PH | Performing Electrical Work on Plumbing and Heating Systems | 70 |
| 321PH | Performing Plumbing and Heating Systems Installation, Commissioning, Service and Maintenance Techniques | 143 |
| N/A | All Forms of Assessment | 75 |
| | **Total GLH** | 960 |

## Guided Learning Hours (GLH) and Total Qualification Time (TQT)

Guided Learning Hours (GLH) gives an indication to centres of the amount of supervised learning and assessment that is required to deliver a unit and can be used for planning purposes.

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and undertaking some formative assessment activities.

Credit is calculated using a formula that equates to the TQT value divided by 10.

The TQT for this qualification is specified below.

| Qualification | TQT | Credits |
|---|---|---|
| EAL Building Services Engineering (Level 3) – Plumbing and Heating | 1400 | 140 |

## Centre requirements

This qualification will require centre and qualification approval. This will include both desk-based and face to face activity.

Centre approval is based upon an organisation's ability to meet the centre approval criteria. The approval for this qualification can be found detailed in the following document:

- Application for Centre & Qualification Approval.

Prospective centres will be advised to seek centre and qualification approval, as appropriate, prior to starting to deliver the qualification.

EAL aims to provide the centre and qualification approval decision within 30 working days of the submission of the completed application, with four possible outcomes:

- Centre approval and qualification approval granted
- Centre approval and qualification approval granted subject to action plan
- Centre approval and qualification approval withheld subject to action plan
- Centre approval and qualification approval denied.

Centre and qualification approval are deemed to have been granted when EAL confirms the status in writing to the centre, and not before.

Centres will be required to apply for approval for this qualification and to meet the specific centre requirements outlined in this document related to delivery staff and assessor competence. These requirements will be checked and monitored as part of the qualification approval process and on-going monitoring of this qualification.

## Registration, results issuing and certification

Please consult the EAL website for details on qualification registration and certification processes, timelines and procedures.

## Quality assurance

### Internal quality assurance

The focus of internal quality assurance for this qualification is:

- the quality assurance of assessment procedures, including standardisation of assessment practice across different assessors within the centre
- ensuring the approximate GLH figures for the Practical Project are consistently met, with significant or continued variance investigated
- internal standardisation of learner marks awarded for the Practical Project.

All centres approved to deliver this qualification must have robust internal quality assurance (IQA) processes in place. This will help ensure that Internal Quality Assurance procedures:

- provide accuracy and consistency between Assessors in the use and interpretation of the guidance in the qualification and/or assessment documentation
- maintain validity and reliability of assessment decisions and continue to meet approval criteria.

IQA evidence will be scrutinised as part of EAL's external quality assurance activities. Centres will be expected to retain evidence in-line with the requirements of EAL- Quality Assurance Requirements detailed within the EAL Centre recognition document which can be viewed via EAL Smarter Touch and should be retained for a minimum of three years.

## Internal quality assurers

The centre must provide EAL with the details of personnel who they plan to undertake Internal Quality Assurance, so that they can be approved prior to them carrying out this role. Prior to the first assessments taking place, Internal Quality Assurer's (IQAs) must also complete EAL training. This is to ensure the reliability of assessment at centres over time.

IQAs must:

- prepare for and participate in relevant EAL meetings and events, such as induction, Continuing Professional Development (CPD)/training and standardisation events, and ensure any personal action/ improvement plans are achieved, within agreed timescales and to the required standards
- technically and occupationally competent in the trade area or related BSE area evidenced by having a building services engineering related qualification or proven sector competence/experience at least equivalent to the level of the qualification, to enable them to conduct their role as an IQA. This evidence is quality assured by EAL
- be working towards (registered before carrying out any quality assurance activity), or have achieved the following units:
    - Understanding the Principles and Practices of Internally Assuring the Quality of Assessment*
    - Internally Assure the Quality of Assessment*

  * Legacy Qualifications (D32/D32/D34, A1 and V1) will be accepted.
- be able to demonstrate evidence of being up to date with the relevant trade/industry. This can be evidenced for example by either accessing trade publications, undertaking courses of learning, attending networking events relevant to this qualification and/or attending industry events.

The IQA has a pivotal role in ensuring that centre marked assessment is standardised. They should work with assessors to ensure that the correct procedures are always being followed and ensure that assessment decisions taken by different assessors are consistent, fair and reliable. Key activities will include:

- meeting with assessors (individually and collectively) throughout the qualification to discuss quality assurance and standardisation issues and provide support and guidance where needed
- observing assessors and giving them feedback to help improve their assessment technique
- sampling evidence across different cohorts to ensure that appropriate standards have been met
- arranging cross-marking of assessments to compare results and agree benchmarks in-line with EAL training.

EAL will provide guidance to centre IQAs throughout the change management process.

## External quality assurance

**The Practical Project must be internally assessed and externally verified.**
**The Professional Discussion must be externally assessed and externally verified.**
Our team of technically competent, External Quality Assurers (EQAs) will externally verify centre assessment decisions and internal quality assurance processes to ensure the validity and reliability of results. Our EQAs follow robust verification processes. They monitor centres' assessment systems, practice and outcomes in-line with regulatory requirements. Their sampling strategies are based on 'CAMERA' (ensuring a representative sample of Candidates/Learners, Assessors, Methods of assessment, Evidence, Records, Assessment sites).

EAL will:

- carry out necessary quality assurance of this assessment which can include direct observation, assessment sampling, and feedback from learners
- have a robust appeals procedure in place for learners.

## External quality assurers

EQAs are inducted, trained, and standardised to ensure a consistent approach. They are regularly updated on changes to qualifications and subject to on-going monitoring and sampling of their work. Thorough vetting ensures required knowledge, including attainment of EQA Training Assessment and Quality Assurance (TAQA) qualifications. All Building Services Engineering (BSE) and Construction EQAs will be briefed on the Sector Review including the new qualification suite.

External Quality Assurers must:

- be accountable to EAL
- have achieved or be working towards the TAQA award have achieved V2 or D35 and possess CPD evidence of practicing to the TAQA Standards
  and
- understand the assessment process and apply the marking process consistently
- have no conflict of interest with the assessment centre, in order to maintain objectivity
- have requisite and relevant technical/occupational understanding in the qualification(s)/unit(s) being externally quality assured
- be able to provide centres with advice and guidance on assessment and IQA procedures.

They must be able to demonstrate evidence of being up to date with the relevant trade/industry. This can be evidenced for example by either accessing trade publications, undertaking courses of learning, attending networking events relevant to this qualification and/or attending industry events.

EAL will

- carry out necessary quality assurance of the assessment process which can include direct observation, assessment sampling, and feedback from learners
- have a robust appeals procedure in place for learners.

# Roles, responsibilities and quality assurance

## Internal assessor profile

The centre must provide EAL with the details of personnel who they plan to undertake assessment, so that they can be approved prior to them carrying out this role. Prior to the first assessments taking place, assessors must also complete EAL training. This is to ensure the reliability of assessment at centres over time.

Assessors must be working towards (registered before carrying out any assessments) or have achieved the following units:

- Unit: Understanding the Principles and Practices of Assessment*
- Unit: Assess occupational competence in the work environment*
- Unit: Assess vocational skills, knowledge and understanding*

**and** continue to practice to that standard.

* Legacy Qualifications (D32/D32/D34, A1 and V1) will be accepted.

Assessors must be occupationally competent. Evidence which supports this is by the assessor holding a relevant NVQ or equivalent* to the full occupational competence threshold of the trade and/or having registration with a relevant trade body or having appropriate recognition which clearly evidences the assessor as competent in the trade.

*Assessors who qualified before NVQs were developed should provide evidence of how they are occupationally competent (such as through a CV or CPD Log together with any relevant references).

## Internal assessor requirements

Internal Assessors must:

- carry out and document assessment in-line with EAL and regulatory arrangements including:
    - acting in a professional and courteous manner at all times when conducting the assessment
    - marking the assessments, in accordance with grading criteria
- maintain a knowledge of assessment policies and procedures
- maintain and document CPD (to be submitted on request)
- understand the sector, the qualification, and the assessment requirements
- be occupationally competent
- produce clear, accurate and concise documentation and relevant records (written and electronic), and ensure they are controlled and administered in accordance with the awarding bodies procedures
- make robust assessment decisions
- handle relevant information in accordance with GDPR requirements
- prepare for and participate in relevant EAL meetings and events – such as induction, CPD/training and standardisation events, and ensure any personal action/ improvement plans are achieved, within agreed timescales and to required standards
- report to the IQA any suspicion of malpractice or maladministration, including academic misconduct

- declare any conflicts of interest (such as between the assessor and the learner)
- provide access to information and records when requested
- complete and submit all reports within specified timeframes.

## Expert witness (to provide supporting evidence for Practical Project)

Expert witnesses who work with the Employer on a regular basis can be nominated and confirmed with the learning provider/centre to support evidence gathering whilst apprentices undertake the Practical Project. Expert witnesses do not make assessment decisions/judgements, their role must be to provide information, context and an experienced perspective on the work completed by the apprentice as part of their specified project task(s).

In order to be confirmed as an expert witness employer representative(s) must:

- be occupationally competent – holding a relevant qualification, being able to demonstrate relevant experience in the industry/trade and/or being a member of/or recognition by a relevant trade body
- understand the sector, the qualification, and the assessment requirements.

## External assessor profile (For the Professional Discussion)

Assessors for the Professional Discussion assessment will be appointed by EAL and will conduct the assessment on behalf of EAL. They will be independent of the centre. Prior to the first assessments taking place, assessors must also complete EAL training.

Assessors must be working towards or have achieved a relevant recognised assessor qualification **and** continue to practice to that standard. Assessors who hold earlier qualifications (A1, D32 or D33) should have CPD evidence to the most current standards.

Assessors must be occupationally competent. Evidence which supports this is by the assessor holding a relevant NVQ* to the full occupational competence threshold of the trade and/or having registration with a relevant trade body or having appropriate recognition which clearly evidences the assessor as competent in their trade.

*Assessors who qualified before NVQs were developed should provide evidence of how they are occupationally competent (such as through a CV together with any relevant references).

Prior to the first assessments taking place, assessors must also complete EAL training. This is to ensure the reliability of assessment over time.

## External assessor requirements (for the Professional Discussion)

External Assessors must:

- fully prepare the Professional Discussion utilising the project evidence
- carry out and document the Professional Discussion assessment in-line with EAL and regulatory arrangements including:
    - acting in a professional and courteous manner at all times when conducting the assessment on behalf of EAL
    - arriving at the centre at least 45 minutes prior to the assessment and staying at the centre for the duration of the assessment (when conducting a face-to-face assessment)
    - marking the Assessments, in accordance with grading criteria
- maintain a thorough knowledge of assessment policies and procedures
- maintain and document CPD (to be submitted on request)
- understand the sector, the apprenticeship, and the assessment requirements
- be familiar with the latest technologies used within the industry
- be occupationally competent
- produce clear, accurate and concise documentation and relevant records (written and electronic), and ensure they are controlled and administered in accordance with the awarding bodies procedures
- make robust assessment decisions
- handle relevant information in accordance with and GDPR requirements
- prepare for and participate in relevant EAL meetings and events – such as induction, CPD/training and standardisation events, and ensure any personal action/ improvement plans are achieved, within agreed timescales and to required standards
- report to EAL any suspicion of malpractice or maladministration, including academic misconduct
- declare any conflicts of interest (such as between the assessor and the apprentice)
- provide access to information and records when requested
- complete and submit all reports within specified timeframes.

They must be able to demonstrate evidence of being up to date with the relevant trade/industry. This can be evidenced for example by either accessing trade publications, undertaking courses of learning, attending networking events relevant to this qualification and/or attending industry events.

## External associates/appointees

Associates/Appointees are the terms adopted by EAL to refer to individuals appointed by City & Guilds or EAL to undertake specific roles on their behalf, for example, External Quality Assurers (EQAs).

There are criteria set by EAL to ensure that all associates/appointees have the right occupational knowledge, experience and skills to perform the specific role.

EAL will ensure that all associates/appointees undertaking a quality assurance role in centre approval, qualification approval and assessment decisions are trained, appropriately qualified and occupationally competent. Training and attendance at standardisation events is mandatory.

All associates/appointees are performance managed by staff within EAL. If concerns are identified with an individual, EAL will take corrective action which may include improvement actions and close monitoring or in some instances quality issues in performance may lead to the EAL contract with the associate/appointee being terminated.

EAL will ensure that sufficient bilingual associates/appointees are recruited to meet the needs of Welsh-medium centres and learners. The level of quality assurance activity will be consistent across provision in both English and Welsh mediums. Provision will be made for monitoring and standardisation to take place for both languages.

# Welsh context

For individuals who have not previously conducted assessment activities in Wales, it is suggested that having an awareness of Welsh language and an understanding of Welsh culture, policy and context would be beneficial to support their roles.

# Continuing professional development

Centres are expected to support their staff in ensuring that their knowledge and competence in the occupational area is current and of best practice in delivery, mentoring, training, assessment and quality assurance and that it takes account of any national or legislative developments.

# Delivering the qualification

## Learner entry requirements

EAL does not set entry requirements for this qualification. However, centres must ensure that learners have the potential and opportunity to gain the qualification successfully.

If taken as part of an apprenticeship, then specific requirements must be met as part of the apprenticeship framework.

Entries for the qualification can be made via Online Services, see EAL website for further details.

### Age restrictions

EAL cannot accept any registrations for learners under 16 years of age as this qualification is not approved for those under 16.

## Initial assessment and induction

An initial assessment of each learner should be made before the start of their programme to identify:

- if the learner has any specific training needs
- support and guidance, they may need when working towards their qualification
- any learning and attainment already completed which is relevant to the qualification (e.g. a relevant trade from the Progression in Building Services Engineering (Level 2)
- recognition of prior achievement can be gained for Test 1 where learners have achieved the Progression in Building Services Engineering (Level 2) in Plumbing and Heating
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the learner fully understands the requirements of the qualification, their responsibilities as a learner, and the responsibilities of the centre. This information can be recorded on a learning contract.

## Support materials

The following resources are available for this qualification:

| Description | How to access |
|---|---|
| Assessment pack | EAL Online Services or www.skillsforwales.wales |

## Internal quality assurance

Centres must have a written Internal Quality Assurance strategy.

This will help ensure that Internal Quality Assurance procedures:

- provide accuracy and consistency between Assessors in the use and interpretation of the guidance in the qualification and/or assessment documentation
- are efficient and cost effective.

## Moderation of internal assessment arrangements

External Quality Assurance processes are in place for checking the validity and reliability of assessment decisions made by centre staff, as appropriate to this qualification.
The assessment will be internally assessed and subject to risk-based monitoring and sampling by external quality assurers to ensure the consistency and validity of centre assessment decisions. Quality assurance activities will be undertaken by appropriately qualified and trained assessment associates. In all instances of sampling for quality assurance purposes, formal written feedback will be provided by EAL.

Significant non-compliance or areas of concern identified during external monitoring will be subject to investigation by EAL. As a result of this activity appropriate improvement actions and/or sanctions may be put in place. In some instances, investigations may result in de-registration for the centre(s) in question.

### Internal appeal

Centres must have an internal process in place for learners to appeal the marking of internally marked assessments. The internal process must include learners being informed of the results the centre has given for internally assessed components, as they will need these to make the decision about whether or not to appeal.

### Malpractice

Please refer to the EAL Malpractice & Maladministration Policy. This policy applies to anyone involved in the development, delivery and award of EAL approved qualifications or units, within or outside the UK, who identifies or suspects potential malpractice/maladministration. The policy provides definitions and the process by which a suspected or alleged instance of malpractice or maladministration can be reported. It also describes responsibilities and the way EAL will manage such cases to ensure that all malpractice and maladministration investigations are conducted in a consistent manner. Centres can access this in the document tab on the EAL Smarter Touch website.

Examples of learner malpractice are detailed below (please note that this is not an exhaustive list):

- falsification of assessment evidence or results documentation
- plagiarism of any nature
- collusion with others
- copying from another learner (including the use of ICT to aid copying), or allowing work to be copied
- deliberate destruction of another's work
- false declaration of authenticity in relation to assessments
- impersonation.

These actions constitute malpractice, for which a penalty (e.g. disqualification from assessment) will be applied.

Please refer to the form in the document *Managing cases of suspected malpractice in examinations and assessments*.

## Access arrangements

Access arrangements are adjustments that allow individuals with additional needs and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

It is the responsibility of the centre to ensure at the start of a programme of learning that learners will be able to access the requirements of the qualification.

Please refer to the EAL Reasonable Adjustment & Special Considerations policy *the* document is available on the EAL Smarter Touch: https://eal.org.uk/support/document-library/centre-support/policies-and-important-documents/44-reasonable-adjustments-and-special-considerations-policy

## Special consideration

We can give special consideration to learners who have had a temporary illness, injury or indisposition at the time of assessment.

Applications for either access arrangements or special consideration should be submitted to EAL by the Centre Coordinator at the centre. For more information please consult the current version of the EAL Reasonable Adjustment & Special Considerations policy *the* document is available on the EAL Smarter Touch: https://eal.org.uk/support/document-library/centre-support/policies-and-important-documents/44-reasonable-adjustments-and-special-considerations-policy

## Summary of assessment

This qualification is assessed using the following assessment methods:

| Assessment type | Approach to assessment | Weighting (Contribution to overall qualification grade) |
|---|---|---|
| On-screen Assessment (Test 1 and 2) | Externally-set, externally marked | 20% |
| Practical Project | Internally set, externally verified, internally marked | 60% |
| Professional Discussion | Externally set, verified and marked | 20% |

An assessment pack detailing the requirements of the assessment can be downloaded from the EAL Online Services or www.skillsforwales.wales.

Details of the coverage of each assessment can be found in the assessment specifications within the assessment pack.

Recognition of prior achievement can be gained for Test 1 where learners have achieved the Progression in Building Services Engineering (Level 2) in Plumbing and Heating, further details of this are available within the Assessment Pack.

## Assessment timings and phasing

The following must be applied to the assessment of this qualification:

- all units must be undertaken, and related requirements must be completed and assessed within the learner's period of registration.

Assessments can be taken on-demand, centres must ensure that learners have undertaken all required learning and are adequately prepared to undertake each assessment.

**The Employer Confirmation must have been completed prior to commencement of the Professional Discussion.**

**Learners must have completed the Practical Project assessment prior to undertaking the Professional Discussion assessment.**

# Result release

## On-screen assessment

On-screen assessments are auto marked, and results will be received by the centre the same day the assessment is completed. A result release process will be followed by EAL when new assessment versions are released.

## Practical Project

Practical Projects are internally marked and externally verified. Provisional marks awarded following internal assessment are translated into grades using the marking and grading tables provided in the assessment pack, provisional grades are then submitted to EAL Online Services.

The assessor will use the Practical Project grading table within the Assessment Pack to calculate a provisional grade for the learner. Notification of this provisional grade will be given to the learner within one week of completion of the assessment, with guidance given on the provisional nature of the grade. Provisional results will be subject to both internal and external quality assurance.

## Professional Discussion

The Professional Discussion is externally marked and externally verified. The marking and grading tables provided in the Assessment Pack will be used by the external assessor to mark and allocate a grade. The provisional mark for this assessment will be released by EAL within 30 working days of the Professional Discussion taking place.

On receipt of the internally assessed grades for the practical project, the grades for this and the on-screen assessment and professional discussion will be aggregated based on the assessment weighting, in line with the grade aggregation guidance provided within the Assessment Pack, and an overall qualification grade awarded which will be issued by EAL.

## Overall qualification results

Provisional grades for the Practical Project and Professional Discussion must be provided to learners within one week of completion of each assessment. Guidance should be given around the provisional nature of these results, with recognition that they will undergo internal and external quality assurance activities, and final qualification grading by EAL.

Final qualification grades will be notified to centres following completion of external quality assurance activities. This notification will be within eight weeks of centre submission of learner results for the Practical Project (following successful completion of the On-screen assessment and Professional Discussion).

## Resubmission/re-sit of assessment

If the learner fails to successfully achieve any of the assessments, they are permitted to re-sit/resubmit.

Guidance on the re-sit/resubmission procedures for each assessment can be found in the Assessment Pack for this qualification which can be downloaded from EAL's website.

If a learner is required to re-sit or resubmit any of the assessments, appropriate feedback and support must be provided to enable the learner to do so within an appropriate timeframe.

If a learner does not meet the required marking criteria the centre should work with the learner to address criteria failed and opportunities for improvement to support them in preparing to reach the standard required.

If learners are unhappy with their assessment outcomes, they should be informed of their right to appeal.

Centres must record any actions taken and/or any additional support given to the learner. There will be no limit on the number of resits or resubmissions which can take place.

For further information on the approach to resubmitting/resitting any specific assessments, please see information within the Assessment Pack.

# Assessment specifications

## On-screen assessment

The test specifications for both On-screen assessments (Tests 1 and 2) can be found in the Assessment Pack.

Recognition of prior achievement can be gained for Test 1 where learners have achieved the Progression in Building Services Engineering (Level 2) in Plumbing and Heating, further details of this are available within the Assessment Pack.

Test 2 will cover the generic and trade-based knowledge and understanding content contained in the level 3 qualification only.

## Practical Project

Please refer to the Practical Project section of the Assessment Pack.

## Professional Discussion

The Professional Discussion will be conducted by the external assessor. The centre will be required to agree a date for the discussion with EAL and to ensure that a suitable assessment environment is provided for this discussion. The Employer Confirmation off must be completed before the point of booking the discussion with EAL.

| **Learner reflection on the Practical Project**: It will utilise the project evidence to augment the Professional Discussion. **What the learner did, and why they did it.** | |
|---|---|
| **Reflection on knowledge and understanding of and skills of:** | **Unit ref** |
| 1.1 Organise the resources required.<br>1.2 Set success criteria for the task(s).<br>1.3 Carry out effective planning<br>1.4 Rationalise why the proposed approach is the most appropriate<br>1.5 Recognise cost and waste implications of the work.<br>1.6 Manage risks associated with completing the task and recognise the steps to be taken to stop risks becoming problems.<br>1.7 Identify the handover requirements of work.<br><br>2.1 Review the appropriateness of success criteria set.<br>2.2 Evaluate the resource selection and usage<br>2.3 Evaluate the finished output<br>2.4 Evaluate own performance<br>2.5 Review the achievement of timescales.<br>2.6 Evaluate the handover. | 304 – (LO1, LO2) |
| 2.1 How to develop and maintain productive working relationships<br>2.2 How to communicate effectively with clients, employers, colleagues and with other stakeholders throughout built environment projects. | 302 – LO2 |
| 4.1 The considerations required when performing building services engineering work on pre-1919 buildings and structures.<br>4.2 Post-1919 and modern construction techniques and building services<br>4.3 The new and emerging technologies in the building services engineering trade and the impact they are having/may have on existing practice**.** | 301 – LO4 |

## Qualification grading

This qualification is graded **Pass, Merit, Distinction.** If a learner fails, they will not receive a certificate.

Details of how these grades can be achieved and are calculated can be found in the Assessment Pack.

# Content key

The information below aims to provide an overview of how unit content is structured and how the areas of content relate to each other as well as qualification delivery and assessment.

## Learning outcomes

Learning outcomes group together chunks of related practical skills and/or knowledge and are presented as the result of the learning process i.e. what learners must understand or be able to do following teaching and learning. All learning outcomes are supported by a number of assessment criteria. In the below for example, this learning outcome is about the different processes for stacking, storing and preparing.

***Learning outcome:***

***2.*** *Understand the processes of* ***stacking, storing and preparing materials*** *for building brick, block and stone walls.*

## Criteria

Assessment criteria break down the learning outcome into smaller areas to be covered, these criteria are what will be assessed in connection with the learning outcome. In the below for instance, assessment criteria 2.1 is about the reasons for stacking and storing materials, which has been written and will be assessed against the learning outcome.

***Criteria***

*2.1 Reasons for* ***stacking and storing*** *materials*

## Range

Range contains information about the breadth required for a specific assessment criteria, for example, the actual reasons for stacking and storing materials. The range is not an exhaustive list, there may be other examples that could fit within that topic area, however those that are listed in the range are key for the delivery of the unit content – **all elements listed in the range must be covered as part of the delivery of the unit.**

***Range:*** *Protection, efficiency, security*

## Depth of content

Depth of content outlines the depth of coverage that needs to be covered. This allows the teaching to be focused at the right level in order for the learner to be ready for assessment. For example, 'learners should recognise the reasons' highlights that learners need to have some understanding of the 'how' or 'why' in relation to the range.

***Delivery outcomes (depth of content)***

*2.1 Learners will recognise the reasons for **storing** materials prior to use to protect them from the weather, damage, and theft. Learners will also recognise the reasons for **stacking and storing** materials for efficiency in relation to **preparing** for work.*

# Unit content

# Unit 301: Understanding Building Services Engineering Practice in Wales

| | |
|---|---|
| **GLH:** | 40 |

## What is this unit about?

The purpose of this unit is for learners to explore and understand the wide and changing scope of the construction sector in Wales from pre-1919 practices to future development. It will provide an overview and set the scene for working in the building services engineering sector in Wales.

Learners will develop their knowledge, understanding and where relevant skills of:

- the trade relevant bodies and organisations within the building services engineering sector
- connected practice in the construction and building services engineering
- the changing construction and built environment sector
- the changes in building services engineering materials, tools, and techniques over time
- the relationship between trades and the environment.

Learners may be introduced to this unit by asking themselves questions such as:

- Why do tradespeople require cards for access to commercial sites?
- What impact does my trade have on other trades?
- Why does the construction and built environment sector change over time?
- What influences the changes to materials, tools, and techniques used in the trade?
- What impact may my trade have on the environment?
- What impact does my trade have on other trades?

**It is recommended this unit is delivered prior to Unit 302.**

**Learning outcome:**

**1. Know the relevant trade bodies and organisations within the building services engineering sector**

**Criteria**

1.1 The trade bodies and organisations relevant to the trade

1.2 The role of the relevant trade bodies and organisations

1.3 The competence card schemes within the building services engineering sector and the types of cards available

1.4 Professional registration as an Engineering Technician

**Learning outcome:**

**2. Understand connected practice in construction and building services engineering**

**Criteria**

2.1 Interdependencies between trades

**Learning outcome:**

**3. Know the changing construction and built environment sector**

**Criteria**

3.1 The factors influencing pre-1919 construction
**Range:** geographical influences, local need, sourcing of materials

3.2 The factors influencing post 1919 to modern construction
**Range:** supply chain, industry demand, population, materials (standardisation, innovation)

3.3 The factors influencing 21st century construction
**Range:** climate change, carbon footprint, resource availability, materials, new methods and techniques

## Learning outcome:

**4. Know the changes in building services engineering materials, tools, and techniques over time**

## Criteria

4.1 The considerations required when performing building services engineering work on pre-1919 buildings and structures

4.2 Post-1919 and modern construction techniques and building services
**Range:** evolution of buildings; modern heating and ventilation systems, electrical installations, water and waste management systems

4.3 The new and emerging technologies in the building services engineering trade and the impact they are having/may have on existing practice

## Learning outcome:

**5. Understand the relationship between trades and the environment**

## Criteria

5.1 Industry regulation and sustainability and the natural environment

5.2 Ecological considerations and principles

5.3 Sustainable approaches
**Range:** heat recovery and ventilation, rainwater harvesting, fuel cells, solar panels, heat and cooling pumps, zero-carbon buildings

5.4 Waste disposal in building services
**Range:** waste reduction, waste disposal, recycling principles in the learners' trade area

**Delivery outcomes (depth of content)**

1.1 – 1.2
Learners will know the trade bodies and organisations relevant to the trade and their roles: APHC, HETAS, OFTEC, Gas Safe, IGEM, CIPHE and CIBSE.

Learners will have an awareness of some being industry owned and controlled, some commercial organisations, and some are professional engineering institutions. Learners will know the role of competent person schemes offered by the relevant bodies.
Learners will have an awareness of Unite the Union, and their services/benefits.

1.3
Learners will know the card/recognition scheme for their trade: JIB UK-PHMES CSCS, and Gas Safe/Gas Service Engineer Gold Registration Card; and the types of cards available.

Learners will know the role of card issuers, and registration requirements and the need for industry recognised qualifications.

1.4
Learners will recognise the benefits of professional registration as an Engineering Technician (EngTech) with the relevant professional engineering institution such as: higher earning potential, improved career prospects and employability, enhanced status leading to higher self-esteem, international recognition of competence and commitment, evidence of expertise, greater influence within own organisation and industry, and recognition as a counter signatory.

2.1
Learners will appreciate the relationships between their chosen trade and other trades in different contexts from new build to repairing traditional structures.
Learners will understand how individual trades work with each other and interact. This could be shown on a Gantt chart with an overview of dependencies. Learners will understand for example first and second fix, and the types of problems that can arise and how to mitigate them. Interdependencies can be linked to safe working practices, planning, type of premises/context, and good working relations and communication.
Learners will understand how different trades interact across different scenarios and how these interactions and roles have changed overtime.

In learning outcome 3 the learner will gain a holistic understanding of the construction sector. It is recommended this outcome is delivered before outcome 1 of Unit 302.

3.1
Learners will appreciate local needs (types and uses of structures, needs of industry, cultural needs). Geographical influences- local availability of resources, local climate (weather considerations) locally influenced methods and styles; local distinctiveness. Learners will know the basic qualities and uses of mortars, aggregates, binders, internal and external functional and decorative finishes, stone, slate, timber, and earth. Learners will develop an understanding of construction materials available within their locality and the barriers/problems (specific to this time period) associated with using materials not local to work sites, also the benefits of using materials available local to work sites. Learner's will know permeable nature of lime and earth mortars.

3.2
Learners will know the developments in transport that influenced the supply chain since the industrial revolution. An awareness of the sources of building materials, comparing materials found locally and those imported to a region and the distance and method used for transportation.

The learner will know that for traditional buildings, the choice of materials also often reflected the status of the building (decorative design features etc.) Learners will know basic qualities of construction materials: concrete slabs, brick and block, steel, glass, plastics, composite materials, standardisation of materials, and damp-proof membranes. The role that materials such as cement, glass and steel have played in the industry, and the effect that material innovations have had on the scale and speed of construction. Learners will understand why damp-proof membranes (DPC, DPM) are included post-1919 builds.

3.3
Learners will know the increasing pressures of climate change and the carbon footprint of the construction industry. Recognising benefits from energy efficiency and embodied energy. Learners will understand the importance of the Well-being of Future Generations (Wales) Act 2015 for the construction industry. Learners will need to know the qualities and uses of different types of materials such as lime and natural building materials and engineered materials. Comparing carbon footprint and relative longevity and sustainability of these materials such as insulation, bricks, timber, plasterboard, and plastics. Recognising the need for sustainability of traditional and vernacular buildings, including the re-use of buildings, rather than their demolition and the construction of new ones. The thermal performance of traditional buildings. Learners will appreciate the reasons for and recognise new methods and techniques: off-site manufacturing; modular buildings, prefabricated construction components and digital construction technologies.

4.1
Learners will know the typical methods of construction for pre-1919 buildings that they may work in, including solid stone, brick, and timber walling; traditional flooring and roofing. Recognising the risks and potential results of applying the wrong materials/techniques to structures (e.g. for making good on chases). The older building services currently in service or in situ relevant to the trade. Cover the life span of a building service and what constitutes unsafe or unsound building service that should be recommended to be removed (key requirements only). The actions to be taken where unsafe building services are discovered. Imperial sized pipes services, and

identification. Traditional sources of heating and plumbing (chimneys, open fire, range; lead and clay pipes). The use of plastic pipework on domestic services. Press fit/push fit pipework.

4.2
Learners will have an awareness of the evolution of buildings and the development of brick cavity methods of construction and later variations. The main tools, materials and techniques and their application in current practice in the building services engineering trade, which enables the safe and effective planning, installation, and commissioning of the building service. The materials that can be detrimental to the building service such as polystyrene insulation causing 'plasticiser migration' from PVC. Learners will connect this to their trade.

4.3
Learners will have an awareness of the new/emerging technologies in their trade (and main advantages and disadvantages): environmental technologies, (heat pumps etc.), hydrogen as a new mains gas, smart controls, 3D modelling/printing, and immersive technology.

How to access information on new developments in their trade – such as through professional engineering institutions, industry bodies and trade associations, articles, trade press, formal CPD, manufacturers information etc. Learners will be able to recognise how keeping up to date with industry initiatives and developments can help BSE businesses, the sector, and the environment.

Note that learning outcome 5 can be delivered with Unit 303.

5.1
Learners will know the key aspects of the Environment (Wales) Act 2016, Environmental Protection Act, The Hazardous Waste Regulations, The Site Waste Management Plans Regulations**,** Pollution Prevention and Control Act, Control of Pollution Act, The Waste Electrical and Electronic Equipment Regulations. Relevant aspects of BREEAM and Passivhaus codes of good practice. The Conservation of Habitats and Species Regulations 2010 and the Penalties for breaking the law (e.g. disturbing a bat roost or a Newt Colony). Recap/cover Control of Substances Hazardous to Health (COSHH) Regulations as relevant.

Learners will know the key aspects of PAS 2030 (and 2035) and the PAS 2030 installer scheme (a scheme that supports those installing energy efficiency measures). For BSE, PAS 2030 covers heating, electrical and renewable technologies. Learners will know how design of the building services can help with energy efficiency. Link to smart homes and smart technologies, such as sensors and controls. The essentials of building energy management systems. Link to the environmental technologies covered in learning outcome 2. Cover main aspects of relevant Building Regulations Part L, and Documents L1A and L1B, and the Domestic Building Services Compliance Guide.

5.2

Learners will have an awareness of ecological considerations and principles and how this relates to their trade. A basic appreciation of endangered habitats, areas of flood plains, biodiversity offsetting, and wildlife legislation, and primary protected species.

5.3
Learners will be able to identify the sustainable considerations used in CBE and recognise the scope of their use to maintain a healthy building. Learners will also be able to identify the ways in which buildings can off-set their carbon footprint.

5.4
Learners will know how different materials can reduce environmental impact in their trade area, and the principles of the '3 Rs' of waste management (reduce, re-use and recycle).

The learner will be aware of the importance of accurately ordering materials in order to reduce site waste and save money (and reduce waste disposal costs). Storing materials in an appropriate manner and appropriate sorting of waste on site. Learners will be aware of good practice guidance such as WRAP for industry waste management. The nature of recyclable and biodegradable materials and the impact on landfill and cost to the environment.

Recognising how scrap materials can hold value (such as copper as it is a finite resource) and the public register of scrap metal dealers in Wales. How to dispose of hazardous waste including cement-bonded and fibrous asbestos waste collection. The use of licensed waste carriers, brokers and dealers. The consequences to self, others, and the environment of not following best practice, and relating statutory requirements in relation to waste disposal.

# Unit 302: Working in The Building Services Engineering Sector in Wales

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| **GLH:** | 40 |

## What is this unit about?

This unit provides the learner with a holistic understanding of the built environment in Wales, how it has changed, and the need for a safe built environment and delivering safe projects/work.

Learners will also appreciate the importance of planning and reviewing work, and how to carry out effective planning and evaluation. Learners will understand the importance of working and communicating effectively with others.

Learners will develop their knowledge, understanding and where relevant skills of:

- the built environment in Wales
- how to work effectively with others.

Learners may be introduced to this unit by asking themselves questions such as:

- What is meant by the built environment?
- What factors influence change in the built environment?
- Why is it important to have productive working relationships?

**It is recommended prior to undertaking this unit learners should have been taught Unit 301.**

## Learning outcome:

**1. Understand the built environment in Wales**

## Criteria

1.1 Building stock in Wales

**Range:** forms, purposes, energy efficiency, performance

1.2 Factors influencing change in the built environment in Wales

**Range:** political, environmental, social, technological, legal, and economic

1.3 Safety of the built environment

**Range**: design, compliance with regulations and industry guidance, utilising appropriate materials

## Learning outcome:

**2. Understand how to work effectively with others**

## Criteria

2.1 How to develop and maintain productive working relationships

2.2 How to communicate effectively with clients, employers, colleagues and with other stakeholders throughout built environment projects

**Delivery outcomes (depth of content)**

**In learning outcome 1 the learner will gain a holistic understanding of the construction sector. This outcome builds upon the Unit 301.**

**1.1**
Learners will recognise the forms and purposes of the following:

Houses: attached and detached:pre-1919: solid stone, solid brick and traditional timber frame. Learners will recognise terraces of the industrial revolution with the polite and vernacular architecture of less industrial times.

Cavity wall structures: brick and brick and block, modern timber frame – timber with block outer (a response to material standardisation and improvements in material strength). Learners will consider the re-use of buildings and buildings available for multiple/adaptable purposes. Learners will appreciate bridges and roads as part of the built environment.

Learners will understand the need for energy efficient housing including an awareness of the following factors:

- Retrofit - bringing the buildings up to current regulatory standards
- The need for compliance with Building Regulations
- BREEAM (this is the UK's most widely used means of reviewing and enhancing the environmental performance and minimising the environmental impacts of both new and existing buildings)
- Passivhaus (Passivhaus buildings provide a high level of occupant comfort while using very little energy for heating and cooling. They are built with meticulous attention to detail and rigorous design and construction according to principles developed by the Passivhaus Institute in Germany and can be certified through an exacting quality assurance process).

**1.2**
Learners will recognise PESTLE influences such as:

- political: how government initiatives/changes in government affect the construction sector and the built environment, laws, taxes and how this affects demand
- environmental: targets to cut emissions, preservation of the natural/built environment
- social: age of population/demographic, cultural requirements, population growth
- technological: new technologies and application of technology, changes in materials and innovations
- legal: new/changes to regulations etc. such as the Building Regulations consent/planning permissions, safety of buildings and building services
- economic: affordability, unemployment/employment, and the economy.

Learners will identify the key reasons for increases and decreases in housing demand over the last 100 years and the way that this has caused fluctuations in housebuilding. Prefabrication and mass housing booms: post WWII war housing, off-site modern prefabrication. Flats and high rise apartments. Learners will understand the purpose behind pre-fabrication – largely economies of scale and ability and need to provide better quality housing within a short time frame. Learners will understand the importance of energy

efficiency and embodied energy in meeting the zero-carbon target. Learners will have an appreciation of the sustainability and carbon saving value of maintaining and repairing the current housing stock compared to replacing the existing 20th century buildings with new buildings.

**1.3**
Learners will be able to identify advances in architectural design and material science, and their influence on modern construction, while also recognising the requirement for a focus on long term user safety when adapting, creating, and maintaining buildings. This will include building materials, products and services and the role of the CDM Regulations (The Construction (Design and Management) Regulations). The foreseeable necessary information to be provided for future maintenance, repairs, and cleaning of the building. Learners will have an awareness of the WELL Building Standard. (WELL is a performance-based system for measuring, certifying, and monitoring features of the built environment that impact human health and well-being, through air, water, nourishment, light, fitness, comfort and mind). Learners will understand quality assurance marking of products (such as the UKCA mark) and the applicability of the Construction Products Regulations. The Building Regulations guidance Approved Document 7: materials and workmanship, the BSI Kitemark, the Declaration of Conformity, and trade specific requirements for products (such as BASEC approved cables). Learners will also have awareness of other applicable guidance such as RSPA (Royal Society for the Prevention of Accidents) safer by design.

Learners will understand the implications to a lack of regard to safety (using examples such as asbestos and the Grenfell Tower disaster). They will have an awareness of the Welsh Government's plan to reform regulations and fire safety in high rise buildings, and the actions with regards to the 'Road Map to Safer Buildings in Wales'.

Learners will understand the considerations and implications of making changes to buildings and the responsibilities of the customer/client and the contractor. How this relates to the Building Regulations and relevant Approved Documents and technical guidance. Learners will know that there are different applicable requirements in Wales and England (e.g. the requirement for automatic fire suppression in Wales). Learners will understand the need for relevant consent/permissions for work to be carried out (which could be required for minor work on a listed building in Wales), complying with Building Regulations (following Approved Documents) and utilisation of appropriate materials.

Learners will understand it is incumbent on the contractor to carry out safe work and deliver safe projects for the customer/client. Learners will understand the consequences of not carrying out safe work/delivering unsafe projects/work. Learners will understand the importance of using suitable materials, parts and products that are appropriate for the building task, and that maintain the safety of buildings for building users for the long term. Learners will understand that importance of deferring to qualified colleagues, when and if necessary, to check or complete work to ensure that the safety of building/premises users is maintained.

**2.1**
Learners will appreciate the range of communication techniques and mediums and their suitability e.g. face to face, active/passive listening, written, oral, and electronic. Learners will understand the importance of the needs of individuals by applying the principles of equality and diversity.
Learners will understand how to maintain and encourage both formal and informal good working relationships to promote goodwill and trust with the relevant people. This can involve keeping promises and undertakings, being honest and building constructive relationships, co-operating, and having appropriate and good dialogue.

Learners will recognise the stages of Tuckman's team-development model as:

- forming
- storming
- norming
- performing.

Learners will understand how to discuss proposals with relevant people and discuss alternative suggestions - appreciating that they should encourage questions and requests for clarification and comments.

Learners will recognise the benefits of a high-performance team. Learners will understand how to resolve differences of opinion in ways which minimise offence and maintain the goodwill, trust, and respect, and why this is important.

**2.2**
Learners will understand how to confirm and communicate the requirements relating to the work to the relevant people e.g. colleagues, employers, customers, contractors, suppliers of products and services and those affected by the work/project with the right level of detail and with an appropriate degree of urgency. These details can involve work progress, results, achievements, occupational problems, occupational opportunities, health and safety requirements and the coordination of work (e.g. with other trades/colleagues). Learners will recognise the benefits of good customer care to current and potential future customers (such as referrals, repeat business, good feedback, satisfied customers, more revenue opportunity).

Learners will understand the possible impact of the work (e.g., noise and vehicles) to those in the vicinity of the work (such as residential neighbours) and recognise their customer care extends to these potential future customers.

# Unit 304: Planning and Evaluating Work in the Building Services Engineering Sector in Wales

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| **GLH:** | 35 |

## What is this unit about?

This unit provides the learner with the competencies of how to plan and evaluate work in their trade. Learners will be able to plan work to ensure that it is carried out safely and to any relevant industry standards; acceptance and success criteria that apply.

Learners will be able to organise resources and plan the use of these resources and their time. Learners will organise their own work activities, dealing with typical problems that arise in their work, and seeking advice from others if required. Learners will be able to communicate the work requirements to customers, colleagues, and members of the public other trades.

Learners will be able to evaluate their completed work and how effective they were in planning and performing stages; identifying strengths and weaknesses and using reflective practice to facilitate continual improvement.

Learners will develop their knowledge, understanding and skills of:

- how to calculate costs and determine resource requirements
- planning work
- the importance of evaluation of the work.

Learners may be introduced to this unit by asking themselves questions such as:

- What is meant by a resource?
- Why is planning important?
- What is likely to happen if a new task is not properly planned?
- What is evaluation, and why is it important?
- How will I evaluate the completed work to measure my success?

## Learning outcome:

**1. Plan the work required to complete the task(s)**

## Criteria

1.1 Organise the resources required
**Range:** tools, equipment, materials

1.2 Set success criteria for the task(s)

1.3 Carry out effective planning
**Range:** timescales, scheduling, quality, cost

1.4 Rationalise why the proposed approach is the most appropriate

1.5 Recognise cost and waste implications of the work
**Range:** financial, environmental

1.6 Manage risks associated with completing the task and recognise the steps to be taken to stop risks becoming problems
**Range:** nature of the task, other trades, resources, the work environment, timescales, contingent tasks, alterations, access, any other relevant external factors

1.7 Identify the handover requirements of work
**Range:** information, documentation, communication

## Learning outcome:

**2. Evaluate the work completed against the task brief and success criteria**

## Criteria

2.1 Review the appropriateness of success criteria set

2.2 Evaluate the resource selection and usage
**Range:** tools, plant, equipment, products, materials

2.3 Evaluate the finished output
**Range:** fit for purpose, safe, meets task brief/acceptance criteria, success criteria

2.4 Evaluate own performance
**Range:** methods, techniques, processes**,** effectiveness, strengths, weaknesses, lessons learnt, continual improvement

2.5 Review the achievement of timescales

2.6 Evaluate the handover

**Delivery outcomes (depth of content)**

**1.1**
Learners will be able to identify resources from available data, using estimation techniques as required (such as: analytical (bottom up), comparative (top down/historic), and parametric). Learners will have an appreciation of the 'estimating funnel'. Learners will recognise types of resources as: consumable (replenishable), such as materials and money, and re-useable, such as plant, equipment, and people.

Learners will be able to organise the resources required to carry out the task/s. Learners will be able to recognise the need for, and plan the use of tools, plant, equipment, products, and materials. Learners will understand how to seek clarification and advice where the resources required are not available e.g. from: the customer/customer's representative, manufacturer's technical information, trade literature or referring to the organisation's procedures.

**1.2**
Learners will be able to identify success criteria for the task and the key elements of the work, and which areas may be challenging and the steps they can take to reduce these challenges. The risks to achieving the success criteria these challenges could create and the steps they will take if the challenge creates a problem. Learners will understand (and know the difference between) typical success factors and success criteria.

**1.3**
Learners will use effective planning methods to calculate time required to successfully complete tasks, scheduling task activities to enable tasks to be completed to the standard required within the timescale set. Learners will identify different types of dependencies between tasks and factor this into their planned phasing of work. Learners will rationalise why the approach planned for tasks is the most appropriate and will allow them to achieve quality and timescale requirements.

**1.4**
Learners will be able to identify work methods that will make the best use of resources and meet project, statutory and contractual requirements**.** Learners will understand the need to carefully consider the scope of the work to avoid underestimating what is required

**1.5**
Learners will be able to plan the use of methods of work to help achieve zero or low carbon outcomes and be considerate of resource usage and wastage - evidencing environmental and financial awareness. Learners will understand planning methods, and planning for efficiency, cost control/savings, limited wastage, timely delivery, and a clear handover.

**1.6**
Learners will understand in the planning stage that problems can be anticipated and therefore can be more easily managed (proactive instead of reactive). Learners will be able to carry out mitigation planning for potential problems/issues. Recognising problems can arise from the weather conditions, nature of the task, other trades, resource availability etc. Learners will be able to assess the effects resulting from alterations to the work programme and be able to manage risks (within their control) that would impact on completing the tasks.

**1.7**
Learners will be able to communicate progress to relevant stakeholders such as employer/supervisor or the customer. Learners will know the measures to manage access to the site (Section 3 of Health and Safety at Work etc. Act 1974 requires the conducting of business without putting members of the public at risk). This includes the public and other workers who may be affected by the work. Learners will be able to identify the relevant document (as appropriate) required for a handover and be able to plan the handover, using the appropriate information, documentation, and communication (and demonstration) methods as relevant to the completed trade service provided.

**2.1**
The learner will be able to evaluate whether the success criteria supported successful and efficient achievement of the task, did they create any unnecessary hurdles/barriers? Learners will reflect on whether different/additional criteria may have helped.

**2.2**
The learner will be able to evaluate their resource selection and usage, the appropriateness of tool selection, the quantity of materials selected, efficiency of material selection and usage. Evaluation of impact to cost and the environment.

**2.3**
The learner will be able to evaluate the quality of their completed work to industry standards and safety requirements. Learners will be able to evaluate the work to the task brief and the employer/customer requirements.

**2.4**
The learner will be able to evaluate the overall fit and finish, and reflect on what could they have done differently to improve their output. Learners will be able to evaluate their own strengths, weaknesses, and areas for improvement. Learners will be able to communicate their lessons learnt when required.

**2.5**
The learner will be able to recognise the reasons for any delays, and evaluate how these could have been avoided, and how they may be mitigated in future. Learners will recognise reasons for any time savings, and take lessons learnt into future planning.

**2.6**
The learner will be able to evaluate the quality and clarity of the information provided in the handover and to what degree the handover was successful and the communication method/s used.

# Unit 303: Understand Health and Safety and Environmental Legislation in The Building Services Engineering Sector

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| **GLH:** | 21 |

## What is this unit about?

This unit covers the **knowledge and understanding** required for establishing and maintaining working practices and procedures across a specified range of building services engineering sector installation and/or maintenance activities that consider health and safety, the natural environment and the working environment. This would include identifying hazards and risks, applying appropriate procedures and working practices to protect yourself and others.

The learner will possess knowledge and understanding to be able to use building services engineering sector equipment, components, materials and substances effectively, efficiently, in accordance with the specification giving consideration to the natural environment and the working environment in terms of waste materials and if appropriate water usage.

Learners will develop their knowledge and understanding of:

- relevant industry standards and regulations
- responsibilities in accordance with organisational procedures
- the application, advantages and limitations of different working practices
- materials and substances that can potentially be harmful
- the documentation associated with the organisational procedures' requirements
- dealing with the presence of harmful materials and substances
- how to locate relevant health and safety information needed to complete the installation and/or maintenance
- hazards and risks
- the methods for handling of hazardous materials and substances
- safe use, maintenance, handling, transport, and storage of resources
- the warning signs for hazardous materials and substances
- the methods for the safe transport and/or disposal of waste material, substances, and liquids
- procedures relevant to reporting issues.

Learners may be introduced to this unit by asking themselves questions such as:

- What are industry standards and regulations and how will these affect me?
- What are the different working practices used within BSE and what are the advantages and limitations of these practices?
- What harmful materials and substances could be encountered in BSE and how should they be dealt with?
- What is classed as a hazard or a risk?
- How do you safely transport and/or dispose of waste material, substances, and liquids?

## Learning Outcome:

**1. Understand appropriate industry standards and regulations**

## Criteria

1.1 **Sources of information**

**Range:** Statutory regulations, Building Regulations, Industry standards, Manufacturer technical instructions

**Health and safety legislation:** General legislation, construction specific legislation, Building services specific legislation

**Health and safety guidance:** non-statutory regulations, approved code of practice, Health and Safety Executive (HSE) Guidance Notes

1.2 **Health and safety/environmental legislation**

**Range**: The Health and Safety at Work etc. Act 1974, The Electricity at Work Regulations, The Management of Health and Safety at Work Regulations, Workplace (Health and Safety and Welfare) Regulations, Control of Substances Hazardous to Health (COSHH) Regulations, Working at Height Regulations, Personal Protective Equipment at Work Regulations, Manual Handling Operations Regulations, Provision and Use of Work Equipment Regulations, Control of Asbestos at Work Regulations, Environmental Protection Act, The Hazardous Waste Regulations, Pollution Prevention and Control Act, Control of Pollution Act, The Control of Noise at Work Regulations, The Waste Electrical and Electronic Equipment Regulations

## Learning Outcome:

**2. Know your responsibilities in accordance with organisational procedures**

## Criteria

2.1 Members of the **construction team**

**Range:** construction team, employers (including employer representatives), designers, main contractors, sub-contractors, employees, self-employed (labour only), clients (customers)

2.2 **Enforcing authorities.**

**Range:** Health and Safety Executive, Local Authority

2.3 C**ontrol measures of inspectors.**

**Range:** improvement notice, prohibition notice, powers of prosecution, role in providing advice and guidance

## Learning Outcome:

**3. Understand the application, advantages and limitations of different working practices**

3.1 **Working practices**

**Range:** competent persons, electrical safe isolation procedure, permits to work, selection and checking correct power tools, hand tools and portable electrical equipment, safe working practices with equipment and materials: portable power tools (e.g. cartridge gun, drills, grinders) signs and guarding, tools and materials storage facilities. Dangerous substances, e.g. cutting compounds and adhesives

## Learning Outcome:

**4. Know how to recognise materials and substances that can potentially be harmful**

## Criteria

4.1 Common building materials and services components that may contain asbestos

**Range:** flue, soil, rainwater pipes, gutters, tanks and cisterns, Artex, small gaskets and seals, bath panels/panelling, floor tiles, plaster and decorative finishes, in electrical accessories (flash guards and matting in fuse carriers and on distribution board covers)

4.2 The types of **asbestos**

**Range:** white asbestos (chrysotile), brown or grey asbestos (amosite), blue asbestos (crocidolite), asbestos cement materials

4.3 Commonly encountered substances

## Learning Outcome:

**5. Understand the documentation associated with the organisational procedures' requirements**

## Criteria

5.1 The **strategies** used to prevent accidents during work activities

**Range:** method statements, permit to work systems, risk assessments, safety notices, CSCS card and CSCS affiliated cards

## Learning Outcome:

**6. Understand the organisational procedures for dealing with the presence of harmful materials and substances**

## Criteria

6.1 The procedures that must be used to safely work with asbestos cement-based materials

**Range:** work activities for licensed and unlicensed work, licensing requirements for asbestos removal organisations, safe disposal requirements, protection of the workforce and members of the public

## Learning Outcome:

**7. Know where and how to locate relevant health and safety information needed to complete the installation and/or maintenance activity in accordance with organisational procedures**

## Learning Outcome:

**8. Know what constitutes a hazard or risk**

## Criteria

8.1 **Site hazards**

**Range:** constructions sites (all property types), in industrial commercial premises (occupied and unoccupied refurbishment), in dwellings (occupied and unoccupied refurbishment) vehicle use (driving time limits, driving duress)

8.2 Common **electrical dangers** encountered

**Range:** faulty electrical equipment, signs of damaged or worn electrical cables – power tools and property hard wiring system, trailing cables, proximity of cables to services pipework, buried/hidden cables, inadequate over-current protection devices, electric shock, burns, fires and explosions

8.3 **General hazards**

**Range:** presence of dust and fumes, handling and transporting equipment or materials, contaminants and irritants, fire, working at height, hazardous malfunctions of equipment, improper use, maintenance and storage of tools and equipment, bacteria from vermin

## Learning Outcome:

**9. Understand the methods for handling of hazardous materials and substances in accordance with organisational procedures**

## Criteria

9.1 Commonly encountered substances

## Learning Outcome:

**10. Understand the organisational procedures, suppliers' and manufacturers' instructions for safe use, maintenance, handling, transport and storage of:**

- **tools, plant and access equipment**
- **equipment and components**
- **materials and substances**

## Criteria

10.1 **Access equipment** to permit work at heights

**Range;** step ladders, ladders, harnesses, roof ladders and crawling boards, mobile tower scaffolds, fixed scaffolds and edge protection, mobile elevated work platforms including scissor lifts and cherry pickers

10.2 **Personal protective equipment (PPE)**

**Range:** clothing protection including high visibility, eye protection, hand protection, head protection, foot protection, hearing protection, respiratory protection, vibration protection, harnesses

10.3 Excavations and confined spaces

## Learning Outcome:

**11. Understand the warning signs for hazardous materials and substances**

## Criteria

11.1 How the hazards of some substances and mixtures can be identified from the labels on packaging

**Range:** Globally harmonised System (GHS) on the classification and labelling of hazardous substances and mixtures categorisation and hazard classes: physical hazards, health hazards, environmental hazards, the presentation of information (GHS pictogram and signal word)

## Learning Outcome:

**12. Understand the methods for the safe transport and/or disposal of waste material, substances and liquids in accordance with:**

- **organisational procedures**
- **suppliers' and manufacturers' instructions**

## Criteria

12.1 How to deal with commonly encountered substances

## Learning Outcome:

**13. Understand the organisational procedures relevant to reporting issues**

## Criteria

13.1 The procedures for reporting issues relating to:

- health and safety
- harmful substances and material
- emergencies on site

**Delivery outcomes (depth of content)**

**1**

Learners will recognise the health and safety legislation and regulations and relevant guidance materials applicable to building services engineering work, they will also get an understanding of the legal status and relationship between the documents.

**2**

Learners will be able to identify the responsibilities of members of the construction team.

Learners will be aware of the types of procedures in an organisation and how these impact on them and who to ask or where to find these organisational procedures.

Learners will also develop an understanding of the HSE and the Local Authority's role in enforcing health and safety and the control measures of inspectors, including their role in providing advice and guidance

Learners will know why it is important to report any hazards to the environment that arise from work procedures. The actions to be taken in situations which exceed their level of responsibility for health and safety in the workplace. Learners will be able to specify appropriate responsible persons to whom health and safety and welfare related matters should be reported such as the employer, supervisor, customer/client, safety officers, health and safety executive/inspectors, trades union representative and environmental health officers.

**3**

Learners will understand safe working practices within the BSE environment and how these are applied and some of the limitations and advantages using specific practices.

**4**

Learners will be able to state the types of asbestos that may be encountered in the workplace and also the common building materials and services components that may contain asbestos.

**5**

Learners will be able to define strategies used to prevent accidents during work activities. Learners will have knowledge of PASMA requirements.

**6**

Learners will be able to define the procedures that must be used to safely work with asbestos cement-based materials, and the key health dangers of asbestos exposure.

**7**

Learners will be able to state how to obtain health and safety information and documentation relevant to their work and where this is obtained from.

**8**

Learners will understand what is meant by the terms hazard and risk in relation to health and safety. The specific hazards associated with the building services work and the organisational procedures for a range of health and safety related matters. Learners will be able to identify types of site hazards that may be encountered while at work or by members of the public also the identification of common electrical dangers encountered, and the identification of general hazards involved in the work. Recognising that bacteria from vermin can lead to Weil's disease.

**9**

Learners will know how to deal with commonly encountered substances. The procedures that should be followed in the case of accidents which involve injury, including requirements for the treatment of electric shock/electrical burns. Appropriate procedures which should be followed when emergency situations occur in the workplace. The ways in which the environment may be affected by work activities: land contamination, air pollution and pollution of water courses. The current requirements and good working practices for processing waste on site. Requirements of and good working practices for recycling, dealing with hazardous waste and landfill.

**10**

Learners will be able to state the procedures for manual handling, the assessment of a safe load and the safe kinetic lifting technique.

Learners will understand the procedure that should be applied for tools and equipment that fail safety (user) checks.

The methods of safe supply for electrical tools and equipment on site battery powered and 110 V and 230 V supplies. The safe isolation procedure when replacing attachments to power tools (drill bits and cutting blades).

Learners will be able to identify situations where it may be necessary to work at height and state how to select appropriate access equipment to permit work at heights. The safety

checks to be carried out on access equipment. Working in areas of restricted movement e.g. under suspended timber floors in roof spaces and confined spaces.

Learners will be able to identify the three elements of the fire triangle and how combustion takes place and identify the dangers of working with heat producing equipment and how to prevent fires occurring. Learners will know the procedures for dealing with small, localised fires and firefighting equipment: tackling fires to aid escape, types of extinguisher, selection of extinguisher by fire type, the method of use and the evacuation procedures. The appropriate protective clothing and equipment that is required for identified work tasks.

**11**

Learners will have an awareness of the Globally Harmonised System (GHS) on the classification and labelling of hazardous substances and mixtures.

- physical hazards: Explosives, flammable gases, oxidising liquids, corrosive to metals
- health hazards: Acute toxicity, Skin corrosion/irritation, eye damage/irritation, Respiratory/skin sensitisation
- environmental hazards: Hazardous to the aquatic environment
- presentation of information: GHS pictogram and signal word (Danger or Warning) and hazard statement (causes serious eye damage, toxic if swallowed, etc.) and Precautionary statement (wear eye protection, do not eat, drink or smoke when using this product, etc.).

**12 - 13**

Within this outcome learners will know how to use adhesives correctly. Learners will be able to state the requirements for first aid provision in the workplace. Why it is important not to misuse first aid equipment/supplies and to replace first aid supplies once used. The actions that should be taken when an accident or emergency is discovered (including evacuation). Identification of the procedures for dealing with minor injuries such as cuts, minor burns, objects in the eye, exposure to fumes); and major injuries such as: bone fractures, unconscious co-workers, electric shock, and concussion.

Learners will understand the recording procedures for accidents and near misses at work to include statutory requirements, accident books and the details to be recorded on a simple accident/incident report form.

# Unit 305PH: Understand Scientific Principles

| | |
|---|---|
| **GLH:** | 70 |

## What is this unit about?

This unit provides learning in the essential scientific principles that underpin the installation, commissioning and maintenance requirements of systems and components in the plumbing and heating Industry.

The unit also provides learning in a range of basic calculation.

Learners will develop their knowledge and understanding of:

- the units of measurement used in the plumbing and heating industry.
- the properties of materials
- the relationship between energy, heat and power
- the principles of force and pressure and their application in the plumbing and heating industry
- the mechanical principles in the plumbing and heating industry
- the principles of electricity in the plumbing and heating industry.

Learners may be introduced to this unit by asking themselves questions such as:

- What are units of measurement and how are they used?
- What are the properties and applications of solid materials, liquids and gases?
- What do the terms energy, heat and power mean and what is their relationship with each other within the plumbing and heating industry?
- How do the principles of force and pressure apply within the plumbing and heating industry?
- What are mechanical principles?
- What are the principles of basic electron flow?

## Learning outcome:

**1. Understand the units of measurement used in the plumbing and heating industry**

## Criteria

1.1 The internationally recognised (SI) **units of measurement**
**Range:** metre (length) m, kilogram (mass) kg, second (time) s, kelvin (temperature), pascals, bar

1.2 The application and use of **SI derived units**
**Range:** area ($m^2$), volume ($m^3$), litres (l), density ($kg/m^3$), velocity (m/s)

1.3 The use of conversion tables for non-SI units

## Learning outcome:

**2. Understand the properties of materials**

## Criteria

2.1 The **relative densities** of common materials
**Range:** to air, to water

2.2 The properties and applications of **solid materials**
**Range:** pure metals, ferrous metals, alloys including solders, thermo plastics, thermo-setting plastics, fireclays/ceramics

2.3 The reasons why solid materials breakdown
**Range:** atmospheric corrosion, oxidisation of metals, UV damage to plastics, heat damage to plastics, electrolytic corrosion, electromotive series, dissimilar metals in the presence of an electrolyte (water), erosion corrosion

2.4 The methods of preventing corrosion

2.5 The applications of **liquids** and **gases**
**Range: liquids**; water, refrigerants, anti-freeze/glycol mixes, fuel oils, lubricants/greases
**gases;** air & steam, LPG, natural gas, carbon dioxide, refrigerant gases

2.6 The basic properties of liquids
**Range:** water; boiling/freezing point, change of state and molecular changes, volume and pressure increases, density at differing temperatures, to steam/super heated steam, capillarity, acidity/alkalinity (pH value)
Water hardness; Soft, Temporary hard, Permanently hard

2.7 The basic **properties of gases**
**Range:** natural gas, LPG and air; pressure, volume, temperature of gases found within the industry, Charles's law, Boyle's law

## Learning outcome:

**3. Understand the relationship between energy, heat and power**

## Criteria

3.1 The relationship between the Celsius and Kelvin temperature scales

3.2 The principles associated with a **change of state**
**Range:** melting, freezing, boiling, evaporating, condensing

3.3 How the terms latent and sensible heat as they apply to liquids and gases

3.4 The methods of **heat transfer**
**Range:** conduction, convection, radiation

3.5 How **units** of energy and heat are related and derived
**Range:** Energy – Joules (J), Specific heat capacity (kJ/kg/°C), Power – Watts (W), Maximum density, Coefficient of Linear Expansion

3.6 Heat, energy and power **calculations**
**Range:** heat energy required to raise the temperature of a substance, power required to heat a substance

## Learning outcome:

**4. Understand the principles of force and pressure and their application in the plumbing and heating industry**

## Criteria

4.1 How **units of force and pressure** are derived from SI units
**Range:** Acceleration ($m/s^2$), Force due to gravity, Force - Newton (N), Pressure ($N/m^2$), Atmospheric pressure, Flow rate ($m^3/s$)

4.2 The **pressure and flow** rate units of measurements
**Range: Pressure;** Bar / millibar, kPa, Psi, Metre head
**Flow rate;** $m^3/s$, l/s, kg/s

4.3 The application of pressure and flow rate measurements

4.4 Simple force and pressure **calculations**
**Range: Force calculations;** pressure head
**Pressure calculations;** static pressure, dynamic pressure, draught
forced draught

4.5 The relationship between **velocity, pressure and flow rate** in systems
**Range:** effects of increasing/reducing pressure, effects of increasing/reducing pipe size

4.6 How **restrictions** in the pipework affects the flow of liquids and gases
**Range:** changes of direction; bends and tees
pipe size, pipe reductions, roughness of material surface, constrictions such as valves

4.7 The principles of a siphon

### Learning outcome:

**5. Understand the mechanical principles in the plumbing and heating industry**

### Criteria

5.1 The principles of simple machines
**Range:** levers, pulleys, archimedes screws

5.2 The principles of basic mechanics
**Range:** theory of moments, action & reaction, centre of gravity, equilibrium, velocity and ratio, mechanical advantage

### Learning outcome:

**6. Understand the principles of electricity in the plumbing and heating industry**

### Criteria

6.1 The **basic principles** of electron flow theory
**Range:** measurements of electrical flow, material conductivity and resistance, direct and alternating current

6.2 The purpose and application of simple **units** of electrical measurement
**Range:** Current (Amps), Voltage (Volts), Resistance (Ohms), Power (Watts)

6.3 Simple electrical calculations
**Range:** Ohm's law, power consumption of electrical circuits, basic over-current protection device size, voltage, current and resistance in series and parallel circuits

6.4 The requirements for earthing of electrical circuits

## Delivery outcomes (depth of content)

**1**

Learners should have an understanding of the metric system of measurement and that it is an internationally recognised standard of measurement and be able to produce a list of the SI units of measurement (length, mass, time and temperature). Learners will progress their understanding to understand derived SI units to area, volume, density, and velocity.

**2**

Learners should be aware of the densities of common gases in relation to air and common liquids and solids in relation to water.

Learners will be able to list the metals, plastics and fireclay and ceramic materials used in MES, giving examples of their applications.

Learners will understand why solids breakdown and how corrosion affects them and how to apply protective coatings.

Learners will be aware of the liquids and gases used in MES, giving examples of their applications.

Learners will understand the principles of Boyle's and Charle's Laws and how this applies in MES.

**3**

Learners should be aware of the Celsius and Kelvin temperature scale and the relationship between them.

Learners will understand the different states matter can exist:

- Solid
- Liquid
- Gaseous

and what causes a change of state.

Learners will understand the terms latent and sensible heat and how this apply to liquids and gases

Learners will understand how heat transfer is done via conduction, convection, and radiation.

Learners will be aware that the unit of energy as a Joule and state that it derived from the units of power and time and also that the term specific heat capacity of a substance is the amount of heat required to raise the temperature of one gram of a substance through one degree Celsius.

Developing their understanding of specific heat capacity and that it is a unit derived from the units for energy, mass and temperature.

Learners will be aware that the unit of power as a Watt and state that it derived from the units of energy and time.

**4**

Learners should have an understanding of the units of force and pressure used within plumbing and heating and how they are derived from SI units, they will look at pressure and flow rate units of measurements and the application of pressure and flow measurements.

Learners will be able to carry out simple force and pressure calculations.

Learners will develop an understanding of Velocity, pressure and flow rate:

a. Effects of increasing/reducing pressure
b. Effects of increasing/reducing pipe size

And establish that there is a relationship between pressure in fluid systems and fluid velocity and flow rate.

Learners will understand that reducing or increasing pipe sizes alter the velocity and flow rate of fluids.

Learners will develop an understanding of the theory of laminar and turbulent flow in pipes and that there is a frictional resistance created when fluid moves in a pipe and that the diameter of a pipe determines the magnitude of frictional resistance.

Learners will look at the different theories on how a siphon works.

**5**

Learners will develop an understanding of the simple machines:

- Levers
- Pulleys
- Archimedes screws

Learners will understand the use of pulley systems for lifting heavy objects, moving onto wheels and axles.

Learners will know the principles of Archimedes screws and some of their applications with plumbing and heating.

**6**

Learners will develop an understanding of the theory of electron flow, looking at the measurement of electrical flow, conductivity and resistance and the different types of flow AC and DC.

Learners will know the simple units of electrical measurements and be able to carry out simple electrical calculations.

Learners will look at the different requirements of earthing electrical circuits.

# Unit 306PH: Understand Core Plumbing and Heating Systems

| | |
|---|---|
| **GLH:** | 65 |

## What is this unit about?

The purpose of this unit is for learners to explore plumbing and heating systems within a domestic property and industrial and commercial building and the knowledge that underpins work on the different systems. Learners will understand how to:

- inspect and pre-commission plumbing and heating systems
- decommission plumbing and heating systems.

Learners will develop their knowledge and understanding of:

- relevant industry standards and regulations
- how to verify that job information and documentation is current and relevant
- how to produce a risk assessment and method statement for the work to be carried out, including the identification and use of personal protective equipment
- the procedures for confirming, before work starts, that the work location and work area can be accessed safely and has been checked for the risk to other personnel on the site, and for taking appropriate action if a risk is present
- the methods for the safe transport and/or disposal of waste materials, substances and liquids
- the methods for determining that the appliances, components and accessories are fit for purpose
- the methods and techniques for inspecting and pre-commissioning the plumbing and heating system
- how to complete relevant documentation
- the methods and techniques for decommissioning the system
- the methods and techniques to ensure the plumbing and heating system cannot be accidentally reactivated or become dangerous.

Learners may be introduced to this unit by asking themselves questions such as:

- What types of job information would you need to work on a plumbing and heating system and what documentation must I complete?
- What is inspecting and pre-commissioning a plumbing and heating system?
- What is meant by decommissioning and why does it need to be done correctly?

## Core knowledge

### Learning outcome:

**1. Understand the appropriate industry standards and regulations relevant to**

- **decommissioning**
- **installing and testing**

**of plumbing and heating systems**

### Criteria

1.1 The **sources of information** required when undertaking work on plumbing and heating systems

**Range:** Statutory regulations, Building Regulations, Industry standards, Manufacturer technical instructions

### Learning outcome:

**2. Understand how to verify that job information and documentation is current and relevant and that the plant, instruments, access equipment and tools are fit for purpose**

### Criteria

2.1 **Workplace information**

**Range:** job specifications, plans/drawings, work programmes, variation order, delivery notes, time sheets, policy documentation – health & safety, environmental, customer service, manufacturer guidance, installation instructions, service & maintenance instructions, user instructions, customer information, quotations, estimates, invoices/statements, statutory cancellation rights, handover information

## Learning outcome:

**3. Understand how to produce a risk assessment and method statement for the work to be carried out, including the identification and use of personal protective equipment, in accordance with:**

- **the plumbing and heating system's design**
- **the conditions of the working environment**

## Criteria

3.1 The levels of risk presented by work situations

3.2 The hazards presented by work situations

3.3 The methods used to carry out a risk assessment for a task

**Range:** methods of assessing risk, risk calculation formula, presentation of a risk assessment

3.4 How to produce a method statement for areas of work with safety risk

**Range:** Information to be provided in a method statement, Presentation of a method statement

## Learning outcome:

**4. Understand the procedures for confirming, before work starts, that the work location and work area can be accessed safely and has been checked for the risk to other personnel on the site, and for taking appropriate action if a risk is present**

## Criteria

4.1 The types of general site hazards that may be encountered while at work

**Range: Site/work area cleanliness**; tripping hazards, slipping hazards

**Using equipment;** inadequate or lack of personal protective equipment, defective (unsafe) equipment

**Personal conduct;** manual handling, working at heights

4.2 The potential dangers to the workforce and members of the public when work is carried out

**Range:** on construction sites (all property types), in industrial commercial premises (occupied and unoccupied refurbishment), in dwellings (occupied and unoccupied refurbishment)

4.3 The methods that can be used to prevent accidents or dangerous situations occurring during work activities

**Range: Working practices** (use and understanding of); method statements, permit to work systems, risk assessments

**Safety notices** (use and understanding of); mandatory signs, prohibition signs, hazard signs, firefighting signs, safe condition signs, combination signs

## Learning outcome:

**5. Understand the methods for the safe transport and/or disposal of waste materials, substances and liquids in accordance with suppliers' and manufacturers' instructions**

### Delivery outcomes (depth of content)

**1**
Learners will be able to identify different sources of information available to them while working on cold water systems, including those required to complete testing and commissioning.

**2**
Learners will know what job information is required and how to check its currency and how to check the equipment they will be using is fit for purpose.

**3**
Learners will know how to develop a risk assessment and a method statement.

**4**
Learners will be aware of what procedures need to be followed prior to undertaking work and any actions that should be followed to ensure there is no risk to them or others.

**5**
Learners will know what is required when it comes to safe storage, transportation and disposal of waste materials, substances and liquids in accordance with suppliers' and manufacturers' instructions.

## Inspect and pre commission

### Learning outcome:

**6. Understand the methods for determining that the appliances, components and accessories are fit for purpose**

### Learning outcome:

**7. Understand the methods and techniques for inspecting and pre-commissioning the plumbing and heating system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**
- **the appropriate testing procedures for confirming the systems' integrity**

### Learning outcome:

**8. Understand how to complete relevant documentation**

### Delivery outcomes (depth of content)

**6**

Learners will develop their basic knowledge of the types of appliances, components and accessories and be able to look at basic installations and determine what would be suitable for those applications and what procedures they should follow whilst determining the suitability.

**7**

Learners will know what is required when inspecting systems prior to commencing work and how to pre commission the system to allow for the preceding works to be carried out in a safe manner.

**8**

Learners will know the relevant documentation relevant to the working environment and what needs to be completed and when.

## Decommission

### Learning outcome:

**9. Understand the methods and techniques for decommissioning the system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

9.1 The working methods that reduce the time periods during which plumbing, and heating systems need to be isolated

9.2 The information that needs to be provided to other persons before decommissioning work takes place

9.3 The **procedures** for decommissioning **systems**

**Range:** permanent, temporary

**Procedures;** notify relevant person, isolation of the fuel/electricity supply to the system as appropriate, isolate water supply, apply warning notices and signs, drain system to a suitable location, appropriately dispose of contents and any additives, continuity bonding as required, temporary capping of pipework sections as required, notify building users, alternative supplies as required

### Learning outcome:

**10. Understand the methods and techniques to ensure the plumbing and heating system cannot be accidentally reactivated or become dangerous**

### Criteria

10.1 The methods used during the decommissioning process to prevent the end-user from operating plumbing and heating system components

**Range:** temporary capping of pipework sections, use of warning notices and signs

### Learning outcome:

11. **Understand how to complete relevant documentation**

## Delivery outcomes (depth of content)

**9**

Learners will know ways in which disruption to the cold water supply can be kept to a minimum during work activities. Learners will also be aware the people that will be affected by the decommissioning of a cold water system and how they will be affected and the reasons they will be affected and also the importance of communication throughout the task and different levels of information the affected people need.

Learners will be able to describe appropriate and safe isolation methods for temporarily decommissioning a cold water system and components and develop a work programme for the permanent decommissioning of a cold water system. Underline any hazards or risks to health.

**10**

Learners will know the means of capping off pipework, including temporary methods and the most appropriate positions of notices or signs warning of a decommissioned system and the information that should be provided.

**11**

Learners will know what documentation should be completed during the decommissioning process and what information they need to supply and also where the documentation goes once completed.

# Unit 307PH: Understand Cold Water Systems

| | |
|---|---|
| **GLH:** | 25 |

## What is this unit about?

The purpose of this unit is for learners to explore cold water systems within a domestic property and industrial and commercial building and the knowledge that underpin work on the different systems. Learners will understand how to:

- install and test cold water systems.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of cold water systems
- the applications, advantages and limitations of appliances, components and accessories in relation to the working environment
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the appropriate testing procedures for confirming the systems' integrity.

Learners may be introduced to this unit by asking themselves questions such as:

- How do you get a cold water supply to a domestic property?
- Why are there different types of cold water systems?
- How do you install a cistern, bath, wash hand basin or toilet to cold water supply?
- How do you test a cold water system?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of cold water systems**

### Criteria

1.1 The two main types of water **supply** to dwellings and how these are regulated
**Range:** Mains, Private

1.2 The **fluid categories** of water and uses of water supplied to dwellings
**Range:** 1-5

1.3 The mains water treatment process and typical mains water distribution system from treatment works to property

1.4 The mains water **service to the property** and isolation points
**Range:** connection methods to the main, communication pipe detail, service pipe detail, main external stop valve location and meter housings, installation requirements, methods of entry of the service pipework to a property

1.5 The requirements to provide water whilst preventing waste, undue consumption, misuse or contamination

1.6 The advantages and disadvantages of cold water systems

1.7 The types and typical pipe sizes used in cold water systems within dwellings

## Learning outcome:

**2. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

## Criteria

2.1 The working principles of cold water systems, positioning fixing, connection and operation of **components**

**Range: Appliances;** baths, WCs, wash hand basins, sinks,

**Taps, outlets and valves;** mixer taps, pillar taps, stop valves, servicing valves, full way gate valves, drain valves

## Delivery outcomes (depth of content)

**1**

Learners will understand the main types of cold water supply to dwellings and look at the different fluid categories, moving onto the mains water treatment process and typical mains water distribution system from treatment works to property and finally looking at how the property is connected to the mains via the service pipe and connection types.

Learners will be introduced to the water regulations and look at the main requirements to provide water whilst preventing waste, undue consumption, misuse or contamination.

Learners should have an understanding of the different types of cold water systems, including direct and indirect systems and be able to state the advantages and disadvantages of each type and typical applications.

Learners will work on their understanding of system types and understand typical sizes used in cold water systems, looking at the supply pipe, distributing pipe and service pipe.

**2**

Learners should be aware of the working principles of the following;

- Appliances
- Taps, outlets and valves

Including the positioning, fixing, connection and operation of components listed above.

# Install

## Learning outcome:

**3. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Criteria

3.1 How to fill and vent cold water systems

3.2 The insulation requirements, system frost protection and prevention of undue warming of cold water systems

3.3 The positioning and fixing of pipework within the **building fabric**

**Range:** suspended timber floors, solid floors, embedded in walls, in areas of the building subject to frost, weight distribution of cisterns and cylinders

3.4 How to install cold water systems

**Range:** cistern, bath, WHB, WC

Pipework; plastic, copper

## Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

## Criteria

4.1 The visual inspection of a cold water system to confirm that it is ready to be soundness tested

4.2 A **soundness test** to industry requirements on cold water systems **pipework** and components

**Range: Soundness test;** visual inspection, notify, initial fill, stabilisation, test to required pressure, check for leaks, check pressures after test period, complete documentation and notify as required

**Pipework;** metal pipework, plastic pipework

## Delivery outcomes (depth of content)

**3**

Learners will be able to list the stages of filling the system with water and the additional fitting that will have to be added prior to the soundness test.

Learners will also have a basic knowledge of the requirements of the Water Regulation related to frost protection of cold water pipework and cisterns and what sections of pipework are most vulnerable during cold conditions and basic methods of protection including trace heating.

Learners will know the industry standard methods of connecting system pipework to the outlets and components and how to interpret typical installation drawing showing outlets identified, and how to produce a fitting schedule.

Learners will be able to identify different types of building fabric and the precautions to be taken when installing pipework and components within them and industry clipping distances.

**4**

Learners will know the process of and reasons for a visual inspection prior to filling with water and an insight into some of the types of problem that the inspection might uncover.

Learners will know the equipment used for pressure testing and the British Standard soundness test including stabilisation time for rigid and plastic pipe.

# Unit 308PH: Understand Hot Water Systems

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|---|---|
| **GLH:** | 25 |

## What is this unit about?

The purpose of this unit is for learners to explore hot water systems within a domestic property and industrial and commercial building and the knowledge that underpin work on the different systems. Learners will understand how to:

- install and test hot water systems.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of hot water systems
- the applications, advantages and limitations of appliances, components and accessories in relation to the working environment
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the appropriate testing procedures for confirming the systems' integrity.

Learners may be introduced to this unit by asking themselves questions such as:

- Why are there different types of hot water systems?
- How do you install a cylinder, bath or wash hand basin to the hot water supply?
- How do you test a hot water system?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of hot water systems**

### Criteria

1.1 The advantages and disadvantages of hot water systems

1.2 The types and typical pipe sizes used in hot water systems within dwellings

### Learning outcome:

**2. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

2.1 The working principles of hot water systems, positioning fixing, connection and operation of **components**

**Range: Cylinders (vented and unvented);** various grades available, sizes available, direct, indirect, primatic, quick recovery, duel coil, combination, thermal store

**Appliances;** baths, WCs, over the rim bidets, wash hand basins, sinks

**Taps, outlets and valves;** mixer taps, pillar taps, mixer taps, stop valves, full way gate valves, thermostatic mixing valve, drain valves

### Delivery outcomes (depth of content)

**1**

Learners should have an understanding of the different types of hot water systems, including direct and indirect systems also vented and unvented hot water systems and be able to state the advantages and disadvantages of each type and typical applications.

Learners will work on their understanding of system types and understand typical pipe layouts and pipe sizes used in open vented and unvented systems.

**2**

Learners should be aware of the working principles of the following;

- Cylinders (vented and unvented)
- Appliances
- Taps, outlets and valves

Including the positioning, fixing, connection and operation of components listed above.

## Install

### Learning outcome:

**3. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

3.1 How to fill and vent hot water systems

3.2 The insulation requirements and system frost protection

3.3 The positioning and fixing of pipework within the **building fabric**

**Range:** suspended timber floors, solid floors, embedded in walls, in areas of the building subject to frost, weight distribution of cisterns and cylinders

3.4 How to install hot water systems

**Range:** cylinder (open vented), cylinder (unvented), bath, WHB,

Pipework; plastic, copper

### Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

### Criteria

4.1 The visual inspection of a hot water system to confirm that it is ready to be soundness tested

4.2 A **soundness test** to industry requirements on hot water systems **pipework** and components

**Range: Soundness test;** visual inspection, notify, initial fill, stabilisation, test to required pressure, check for leaks, check pressures after test period, complete documentation and notify as required

**Pipework;** metal pipework, plastic pipework

## Delivery outcomes (depth of content)

**3**

Learners will be able to list the stages of filling the system with water and the additional fitting that will have to be added prior to the soundness test.

Learners will also know why pipework; storage cylinders and cisterns need insulating and how this is done to comply with Building Regulations.

Learners will know the industry standard methods of connecting system pipework to the outlets and components and how to interpret typical installation drawing showing outlets identified, and how to produce a fitting schedule.

Learners will be able to identify different types of building fabric and the precautions to be taken when installing pipework and components within them and industry clipping distances.

**4**

Learners will know the process of and reasons for a visual inspection prior to filling with water and an insight into some of the types of problem that the inspection might uncover.

Learners will know the equipment used for pressure testing and the British Standard soundness test including stabilisation time for rigid and plastic pipe.

# Unit 309PH: Understand Central Heating Systems

| | |
|---|---|
| **GLH:** | 36 |

## What is this unit about?

The purpose of this unit is for learners to explore central heating systems within a domestic property and industrial and commercial building and the knowledge that underpin work on the different systems. Learners will understand how to:

- install and test central heating systems.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of central heating systems
- the applications, advantages and limitations of appliances, components and accessories in relation to the working environment
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the appropriate testing procedures for confirming the systems' integrity.

Learners may be introduced to this unit by asking themselves questions such as:

- Why are there different types of central heating systems?
- How do you install a boiler/jig, radiator, radiator valves as part of a heating system?
- How do you test a central heating system?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of central heating systems**

### Criteria

1.1 The advantages and disadvantages of central heating systems

1.2 The typical pipe sizes used in central heating systems within dwellings

### Learning outcome:

**2. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

2.1 The working principles of central heating systems types, positioning fixing, connection and operation of **components**

**Range:** radiator valves – thermostatic and manual valves, automatic air vents, filling loop, pressure gauge, feed and expansion cisterns, circulating pumps, thermo-mechanical cylinder control valves, anti-gravity valves, drain valves, zone valves (2 port, 3 port, mid position and diverter)

## Delivery outcomes (depth of content)

**1**

Learners should have an understanding of the different types of central heating systems, including Pumped heating and gravity hot water, Fully pumped; 2 x two port valves (S plan), Fully pumped; 3 x two port valves (S plan+), Fully pumped; 3 port valve (mid position/diverting) (Y/W plans), Combination boiler and layout principles including one pipe, two pipe, manifold (micro and minibore), and District heating from the domestic perspective and be able to state the advantages and disadvantages of each type and typical applications.

Learners will work on their understanding of pipe sizes used in dwellings.

**2**

Learners should be aware of the working principles of mechanical controls and electrical controls used on central heating systems, including the positioning, fixing, connection and operation of the controls.

Learners will develop an understanding of heat transfer and the different heat emitters available on central heating systems.

## Install

### Learning outcome:

**3. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

3.1 How to fill and vent central heating systems

3.2 The insulation requirements and system frost protection

3.3 The positioning and fixing of pipework within the **building fabric**

**Range:** suspended timber floors, solid floors, embedded in walls, in areas of the building subject to frost, weight distribution of cisterns and cylinders

3.4 How to install central heating systems

**Range:** boiler/jig, radiator, radiator valves,

Pipework; plastic, copper

### Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

### Criteria

4.1 The visual inspection of a central heating system to confirm that it is ready to be soundness tested

4.2 A **soundness test** to industry requirements on central heating systems **pipework** and components

**Range: Soundness test;** visual inspection, notify, initial fill, stabilisation, test to required pressure, check for leaks, check pressures after test period, complete documentation and notify as required

**Pipework;** metal pipework, plastic pipework

## Delivery outcomes (depth of content)

**3**

Learners will be able to list the stages of filling and venting the system with water and the additional fitting that will have to be added prior to the soundness test.

Learners will also know why pipework; storage cylinders and cisterns need insulating and how this is done to comply with Building Regulations.

Learners will know the industry standard methods of connecting system pipework to the outlets and components and how to interpret typical installation drawing showing outlets identified, and how to produce a fitting schedule.

Learners will be able to identify different types of building fabric and the precautions to be taken when installing pipework and components within them and industry clipping distances.

**4**

Learners will know the process of and reasons for a visual inspection prior to filling with water and an insight into some of the types of problem that the inspection might uncover.

Learners will know the equipment used for pressure testing and the British Standard soundness test including stabilisation time for rigid and plastic pipe.

# Unit 310PH: Understand Rainwater Systems

| | |
|---|---|
| **GLH:** | 8 |

## What is this unit about?

The purpose of this unit is for learners to explore rainwater systems within a domestic property and industrial and commercial building and the knowledge that underpin work on the different systems.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of rainwater systems
- the applications, advantages and limitations of appliances, components and accessories in relation to the working environment.

Learners may be introduced to this unit by asking themselves questions such as:

- Why are there different types of rainwater systems?
- What are the limitations of various rainwater systems and components?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of rainwater systems**

### Criteria

1.1 The types and layout features of **rainwater systems**

1.2 The advantages and disadvantages of **rainwater systems**

1.3 The typical sizes and **materials** used in **rainwater systems**

**Range: Rainwater systems;**

Pipe (RWP); round section, square section

gutter; half round, square, ogee, high capacity

**Materials**; PVC-U, extruded aluminium, cast iron, specialist, copper, lead, fusion welded

### Learning outcome:

**2. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

2.1 The working principles of rainwater systems, positioning fixing, connection and operation of **components**

**Range: Pipe (RWP);** offsets, angles, branches, hopper heads, shoes, specialist connectors to the drainage system

**Gutter;** running outlets, gutter angles, gutter unions, stop ends, specialist unions between different gutter materials, syphonic outlet

2.2 The expansion and contraction in rainwater systems and negative effects

2.3 The working principles of rainwater recycling systems

## Delivery outcomes (depth of content)

**1**

Learners should have an understanding of the working principles of gravity rainwater systems as guttering that collect water from pitched and flat roofs also the working principles of gravity rainwater systems as down pipes which drain Guttering convey the water to the drain and be able to state the advantages and disadvantages of each type and typical applications.

Learners will work on their understanding of gravity rainwater systems and understand typical pipe layouts and pipe sizes used.

**2**

Learners should be aware of the working principles of the following;

- the procedures and processes for joining plastic guttering
- the procedures and processes for joining metallic guttering
- the jointing method employed in the connecting of PVC-U gutters and fall pipes
- the jointing method employed in the connecting of aluminium gutters and fall pipes
- the jointing method employed in the connecting of cast iron gutters and rainwater pipes.

Including the positioning, fixing, connection and operation of components listed above.

Learners will develop their understanding of expansion and contraction of pipework and measures to take when installing pipework in different situations.

Learners will develop their understanding of the key points of rainwater recycling and typical system layouts.

# Unit 311PH: Understand Sanitation Systems

| | |
|---|---|
| **GLH:** | 13 |

## What is this unit about?

The purpose of this unit is for learners to explore sanitation systems within a domestic property and industrial and commercial building and the knowledge that underpin work on the different systems. Learners will understand how to:

- install and test sanitation systems.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of sanitary appliances and pipework systems
- the applications, advantages and limitations of appliances, components and accessories in relation to the working environment
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the appropriate testing procedures for confirming the systems' integrity.

Learners may be introduced to this unit by asking themselves questions such as:

- Why are there different types of sanitation systems?
- How do you install a wash hand basin and toilet to a primary ventilated stack system?
- How do you test a primary ventilated stack system?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of sanitary appliances and pipework systems**

### Criteria

1.1 The advantages and disadvantages of sanitary appliances and pipework systems

1.2 The typical pipe sizes and maximum distances permitted in sanitary appliances pipework **systems** within dwellings

**Range: Systems;** primary ventilated stack system, secondary ventilated stack system, ventilated branch discharge system, stub stack system

### Learning outcome:

**2. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

2.1 The **types** of sanitary appliances pipework systems

**Range:** primary ventilated stack system, secondary ventilated stack system, ventilated branch discharge system, stub stack system

### Delivery outcomes (depth of content)

**1**

Learners should have an understanding of the different types of sanitary appliances and pipework systems, including various stack systems and be able to state the advantages and disadvantages of each type and typical applications.

Learners will work on their understanding of system types and understand typical pipe layouts and pipe sizes used for different sanitary appliances.

**2**

Learners should be aware of the working principles of the following;

- Primary ventilated stack system,
- Secondary ventilated stack system,
- Ventilated branch discharge system,
- Stub stack system

Including the positioning, fixing, connection of sanitary appliances.

## Install

### Learning outcome:

**3. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

3.1 The requirements of sanitary facilities and equipment in dwellings for the disabled including wet rooms

3.2 The **jointing methods** used in sanitary appliances pipework systems
**Range:** ring seal joints, solvent weld joints, compression joints, fusion welded

3.3 The positioning and fixing of pipework within the **building fabric**
**Range:** suspended timber floors, solid floors, embedded in walls, in areas of the building subject to frost, underground

3.4 How to install sanitary appliances, pipework systems and components
**Range:** WHB, WC, primary ventilated stack

### Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

### Criteria

4.1 The visual inspection of a sanitation system to confirm that it is ready to be soundness tested

4.2 A **soundness test** to industry requirements on sanitary appliances and pipework systems **pipework** and components
**Range: Soundness test;** visual inspection, notify, air test, initial fill, wet test, check for leaks, complete documentation and notify as required

## Delivery outcomes (depth of content)

**3**

Learners will be able to list the stages of checking the system with water and the additional fitting that will have to be added prior to the soundness test.

Learners will know the industry standard methods of connecting system pipework to the outlets and components and how to interpret typical installation drawing showing outlets identified, and how to produce a fitting schedule.

Learners will be able to identify different types of building fabric and the precautions to be taken when installing pipework and components within them and industry clipping distances.

**4**

Learners will know the process of and reasons for a visual inspection and an insight into some of the types of problem that the inspection might uncover (unsecure pipe, open ends, loose fittings).

Learners will know the equipment used for pressure testing and how to complete an air test and the pressures used.

# Unit 312: Apply Health and Safety and Environmental Legislation in the Building Services Engineering Sector

| | |
|---|---|
| **GLH:** | 15 |

## What is this unit about?

This is a performance unit and is about establishing and maintaining working practices and procedures to health and safety, the natural environment and the working environment. This would include identifying hazards and risks, applying appropriate procedures and working practices to protect yourself and others.

The learner must possess the skills and knowledge to be able to use building services engineering sector equipment, components, materials and substances effectively, efficiently, in accordance with the specification giving consideration to the natural environment and the working environment in terms of waste materials.

Learners will develop their skills of:

- the appropriate industry standards and regulations
- relevant organisational procedures
- identification of hazards and risks
- completing documentation
- the organisational procedures to ensure that they will not cause potential hazards and risks
- safe use, maintenance, handling, transport, and storage of resources
- reporting to the relevant people in accordance with organisational procedures potential hazards and risks, potentially harmful materials, and substances
- confirming that the conduct of people when undertaking the installation and/or maintenance
  activity does not cause potential hazards and risks
- complying with organisational procedures in the event of injuries to self and/or others, emergencies, and evacuation procedures
- the safe transport and/or disposal of waste material, substances, and liquids in accordance with suppliers' and manufacturers' instructions.

Learners may be introduced to this unit by asking themselves questions such as:

- How do I establish and maintain a safe working process?
- What are the types of hazards typically encountered at work?
- How should I respond to an emergency?

## Performance Criteria

**Learning Outcome:**

**1. Identify the appropriate industry standards and regulations**

**Learning Outcome:**

**2. Apply relevant organisational procedures**

**Criteria:** organisation procedures:

2.1 information management
2.2 method statement
2.3 project management
2.4 risk assessment
2.5 implementing and monitoring health and safety requirements and issues
2.6 implementing and monitoring issues relating to the natural environment
2.7 customer services
2.8 accident reporting
2.9 emergencies
2.10 communication with relevant people

**Learning Outcome:**

**3. Identify hazards and risks**

**Criteria:** hazards and risks (internal and/or external):

3.1 domestic
3.2 non-domestic (commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public highways and parks, public services establishments, pre-1919 traditional/historic buildings)

**AND**

**Criteria:** site:

3.3 new build construction – building or structure
3.4 existing building or structure

**Learning Outcome:**

**4. Complete documentation in accordance with the requirements of the organisational procedures**

**Learning Outcome:**

**5. Review the organisational procedures to ensure that they will not cause potential hazards and risks**

**Criteria:** potential hazards and risks:

5.1 disposal of substances and materials
5.2 installation and/or maintenance methods and techniques
5.3 lifting and handling (manual and mechanically assisted)
5.4 presence of vehicle thoroughfares
5.5 storage of liquids, substances and materials
5.6 use of appliances, tools and equipment
5.7 use of access equipment
5.8 use of personal protective equipment (PPE)
5.9 working in a potentially hazardous atmosphere (e.g. presence of asbestos, dust, fumes or vapour)
5.10 working at height
5.11 working in confined spaces

**Learning Outcome:**

**6. Implement organisational procedures, suppliers' and manufacturers' instructions appropriate to the safe use, maintenance, handling, transport and storage of:**

- **tools, plant and access equipment**
- **equipment and components**
- **materials and substances**

**Learning Outcome:**

**7. Report to the relevant people in accordance with organisational procedures potential hazards and risks, potentially harmful materials and substances**

**Criteria:** relevant people:

7.1 customers/clients
7.2 client representatives
7.3 supervisors
7.4 site/contract manager
7.5 other contractors/trades
7.6 members of the public
7.7 work colleagues

**Learning Outcome:**

**8. Confirm that the conduct of people when undertaking the installation and/or maintenance activity does not cause potential hazards and risks**

**Learning Outcome:**

**9. Comply with organisational procedures in the event of: injuries to self and/or others, emergencies, evacuation procedures**

**Criteria:** injuries/emergencies/evacuation:

9.1 fire
9.2 flood
9.3 explosion
9.4 toxic atmosphere
9.5 electric shock
9.6 injury to person(s)

**Learning Outcome:**

**10. Implement organisational procedures for the safe transport and/or disposal of waste material, substances and liquids in accordance with suppliers' and manufacturers' instructions**

# Unit: 313: Establish and Maintain Relationships in the Building Services Engineering Sector

| | |
|---|---|
| **GLH:** | 26 |

## What is this unit about?

This unit consists of knowledge, understanding and performance and enables learners to develop and maintain positive relationships with clients and customers associated with the installation and/or maintenance activities in the building services engineering sector in accordance with:

- appropriate industry standards and regulations
- the specification
- working practices
- the working and natural environment.

The learner will have the responsibility for establishing and maintaining client and customer relationships and will be able to:

- present and provide accurate technical and functional information, advice and guidance
- liaise with clients and customers with respect to their needs and expectations
- respond as appropriate to client and customer needs and expectations.

Learners will develop their knowledge understanding and skills of:

- the types of technical and functional information that is available for the installation and/or maintenance activity
- the procedures for supplying technical and functional information to relevant people
- the importance of customer service in relation to installation and/or maintenance activity
- supplying technical and functional information
- providing accurate guidance and advice to the clients and customers on technical and functional matters
- handover procedures
- maintaining productive working relationships with clients and customers
- respond effectively to requests for technical and functional information
- following procedure for any variations
- complying with organisational standards for appearance and behaviour.

Learners may be introduced to this unit by asking themselves questions such as:

- What is the technical and functional information required for my work?
- How can I provide excellent customer service?
- Why is data protection important?

## Learning Outcome:

**1. Understand the types of technical and functional information that is available for the installation and/or maintenance activity**

## Criteria

1.1 The sources of technical and functional information

**Range:** manufacturer information and data, supplier information and data, information from their employing organisation, installation specifications, client/customer specifications, specifications, drawings, and diagrams

1.2 Interpret technical and functional information and data

**Range:** manufacturer/supplier information and data; materials, components, equipment, information from their employing organisation, installation specifications, client/customer specifications, specifications, drawings and diagrams

## Learning Outcome:

**2. Understand the procedures for supplying technical and functional information to relevant people**

## Criteria

2.1 The stakeholders that require technical and functional information

**Range:** clients, customers, major contractors, other services, site managers

2.2 The limits of responsibility of own job role with respect to supplying technical and functional information

2.3 The methods of providing technical and functional information

2.4 The importance of ensuring that:

- information provided is accurate and complete
- information is provided clearly, courteously, and professionally
- copies of information provided are retained
- the installation, on completion, functions in accordance with the specification, is safe and complies with industry standards

2.5 The methods for checking that relevant persons have an adequate understanding of the technical and non-technical information provided

## Learning Outcome:

**3. Understand the importance of customer service in relation to installation and/or maintenance activity**

## Criteria

3.1 The methods and organisational procedures for establishing positive relations with clients and customers

3.2 The working requirements and practices of the clients and customers in the working environment where the installation and/or maintenance activity is taking place

3.3 The opportunities and regulations that affect the way that technical and functional information is delivered to clients and customers

3.4 The clients' and customers' rights including any contractual agreements

**Delivery outcomes (depth of content)**

**1**

Learners will understand what is meant by technical and functional information and their responsibilities (as relevant) for the accurate and precise recording, retention and handover of technical and functional information.

Learners will understand a range of technical and functional information that can be utilised and provided and its implications on the operation of the building services engineering system and/or its equipment, accessories and components that have been installed and/or maintained.

**2**

Learners will understand situations which warrant written technical and functional information, including appropriate health and safety information. They will understand the procedures for supplying technical and functional information to relevant people.

**3**

Learners will understand the appropriateness of different customer relations and procedures and they will understand the importance of technical communication to others.

Learners will understand the main requirements to process technical and functional information in compliance with the key principles of the Data Protection Act (the UK's implementation of the General Data Protection Regulation (GDPR)) and the clients/customers basic rights under the Consumer Rights Act. The main points of the Equality Act.

## Performance Criteria

**Learning Outcome:**

1. **Identify the clients and customers that need to be supplied with technical and functional information**

**Learning Outcome:**

2. **Obtain the current and relevant technical and functional information that needs to be provided to the clients and customers**

**Learning Outcome:**

3. **Provide accurate guidance and advice to the clients and customers on technical and functional matters associated with the building services engineering system that has been installed and/or maintained in terms of:**
    - **health and safety issues**
    - **safe and effective operation**

**Learning Outcome:**

4. **Provide information in accordance with organisational procedures**

**Criteria:** organisation procedures:

4.1 information management
4.2 method statement
4.3 project management
4.4 risk assessment
4.5 implementing and monitoring health and safety requirements and issues
4.6 implementing and monitoring issues relating to the natural environment
4.7 customer services
4.8 accident reporting
4.9 emergencies
4.10 communication with relevant people

**Learning Outcome:**

5. **Demonstrate to the clients and customers, as appropriate, the operation of the building services engineering system that has been installed and/or maintained**

**Criteria:** working environment of the system (internal and/or external):

5.1 domestic
5.2 non-domestic (commercial, industrial, agricultural, horticultural, leisure and entertainment,
residential medical and care facilities, public highways and parks, public services establishments, pre-1919 traditional/historic buildings)

**Learning Outcome:**

6. **Confirm in relation to the installation and/or maintenance activity:**
    - **the client and customer expectations and requirements**
    - **the building services engineering system is in a satisfactory condition**
    - **the hand over process**

**Learning Outcome:**

7. **Establish and maintain productive working relationships with clients and customers, including dealing with disagreements in an amicable and constructive way, so that good relationships are maintained**

**Learning Outcome:**

8. **Respond effectively to requests for technical and functional information from clients and customers**

**Learning Outcome:**

9. **Report, record and recommend, in accordance with organisational procedures and as appropriate, any variation to the installation and/or maintenance activity to the clients, customers and other relevant people**

**Criteria:** relevant people:

9.1 customers/clients
9.2 client representatives
9.3 supervisors
9.4 site/contract manager
9.5 other contractors/trades
9.6 members of the public
9.7 work colleagues

**Learning Outcome:**

10. **Comply with organisational standards for appearance and behaviour**

# Unit 314: Coordinate a Work Site in the Building Services Engineering Sector

| | |
|---|---|
| **GLH:** | 28 |

## What is this unit about?

This unit consists of knowledge, understanding and performance. It covers how to coordinate the work site for the installation and/or maintenance activities associated with the building services engineering systems.

It covers the responsibility for the coordination of the work site and learners must be able to oversee, as relevant, the work of other operatives and/or other contractors, in accordance with relevant industry standards, regulations and the specification, working practices, the working environment and the natural environment to confirm:

- the work to be undertaken
- a programme of work with relevant people
- the organisation of the appropriate resources
- that equipment, accessories and components are fit for purpose
- that work is carried out safely
- all relevant documentation is completed accurately.

The learner will understand the extent of their role and responsibilities, including how best to motivate, monitor and communicate with others in accordance with organisational procedures.

Learners will develop their knowledge understanding and skills of:

- the requirements for organising and overseeing work activities
- the procedures for re-scheduling work to coordinate with changing conditions in the workplace and to coincide with other trades
- the requirements for organising the provision and storage of resources that are required for work activities
- producing a risk assessment and method statement
- allocating duties and responsibilities to operatives
- coordinate effectively, when relevant, the work of other contractors
- ensuring the work is fit for purpose
- liaising with others to ensure to resolve issues.

Learners may be introduced to this unit by asking themselves questions such as:

- How can I plan my own work and that of others, so the work is co-ordinated, safe, and effective?
- What is the best way to manage resources required for the work?

## Learning outcome:

**1 Understand the requirements for organising and overseeing work activities**

## Criteria

1.1 How to plan and implement:

- the monitoring and implementation of health and safety on the work site
- the work to be undertaken
- the allocation of roles and responsibilities
- the resources required

1.2 The procedures for re-scheduling work to coordinate with changing conditions in the workplace and to coincide with other trades

1.3 How to coordinate operatives you are responsible for in relation to:

- supervision and motivation
- identification of competence
- planning work allocations, duties, and responsibilities

1.4 How to communicate effectively with relevant people

1.5 The current versions of appropriate industry standards and regulations relevant to the identified building services engineering system

1.6 The organisational procedures for:

- completing the necessary documentation
- agreeing a programme of work with relevant people
- confirming that the installation and/or maintenance work is completed

## Learning outcome:

**2 Understand the requirements for organising the provision and storage of resources that are required for work activities**

## Criteria

2.1 The methods that will verify that the equipment, accessories, and components are:

- compatible to the working environment
- in accordance with the specification
- of the required and correct type
- delivered on time and undamaged
- suitable and safely stored

2.2 How to manage the available storage facility at the work site

**Delivery outcomes (depth of content)**

**1**
Learners will understand their responsibilities in overseeing and organising work activities and the work environment. Learners will understand how to ascertain the competence of different relevant colleagues and workers, how to allocate work activities and how to monitor that the work is being completed on time to the work schedule.

Learners will understand how to interpret the installation specification and work programme to identify resource requirements. Learners will understand how to create schedules of work including the use of a Gantt chart, and recognise the critical path. Learners will understand how the work completion time is estimated considering influential factors such as the deployment and availability of suitable personnel, the delivery and availability of equipment, components and materials, the weather conditions, and the work to be completed by other services. The procedures for dealing with changes to an original contract specification including variation orders, and day work sheets.

Learners will understand how to how to plan and implement work allocations and the duties of operatives for whom they are responsible and the effective coordination with other services and personnel.

Learners will ensure that they maintain the safety of the work environment, cost effectiveness, and ensure compliance with the specification and work schedule. Learners will understand how to communicate effectively with others for the purpose of motivation, instruction, monitoring, co-operation, and teamwork.

Learners will recognise the industry standards of regulations relevant to their work. The general legislation that applies includes the Employment Rights Act, Equality Act, and the Human Rights Act.

**2**
Learners will understand the requirements for the equipment, accessories, and components and the storage and transportation requirements for the required materials.

Learners will recognise the possible consequences of not completing work within the scheduled time, or not using the specified materials, or not installing materials and equipment as specified or meeting the requirements of the programme of work.

## Performance Criteria

**Learning Outcome:**

**1 Produce a risk assessment and method statement for the work to be carried out on the identified building services engineering system**

**Criteria:** working environment of the system (internal and/or external):

1.1 domestic

1.2 non-domestic (commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public highways and parks, public services establishments, pre-1919 traditional/historic buildings)

**Learning Outcome:**

**2 Allocate duties and responsibilities to operatives, when appropriate, to make best use of their competence**

**Learning Outcome:**

**3 Instruct the operatives, where relevant, about their duties and responsibilities clearly and concisely**

**Learning Outcome:**

**4 Confirm that any instructions given are understood**

**Learning Outcome:**

**5 Coordinate effectively, when relevant, the work of other contractors**

**Learning Outcome:**

**6 Monitor, as appropriate, that the work of operatives is safe, fit-for- purpose, cost effective and in accordance with:**

- **industry recognised working practices**
- **the specification**
- **the current versions of appropriate industry standards and regulations**

**Learning Outcome:**

**7 Ensure that safe and appropriate action is taken promptly where a non-compliance is identified during the programme of work**

**Learning Outcome:**

**8 Ensure that all documentation associated with the installation and/or maintenance work is in accordance with organisational procedures, the current versions of appropriate industry standards and regulations**

**Criteria:** organisation procedures:

8.1 information management
8.2 method statement
8.3 maintenance (planned and reactive)
8.4 project management
8.5 risk assessment
8.6 implementing and monitoring health and safety requirements and issues
8.7 implementing and monitoring issues relating to the natural environment
8.8 customer services
8.9 accident reporting
8.10 emergencies
8.11 communication with relevant people

**Learning Outcome:**

**9 Liaise with the relevant people to resolve issues which are outside the scope of your job role**

**Criteria:** relevant people:

9.1 customers/clients
9.2 client representatives
9.3 supervisors
9.4 site/contract manager
9.5 other contractors/trades
9.6 members of the public
9.7 work colleagues

**Learning Outcome:**

**10 Verify that the equipment, accessories, and components are:**

- **compatible to the working environment**
- **in accordance with the specification**
- **of the required and correct type**
- **delivered on time and undamaged**
- **suitable and safely stored**

**Learning Outcome:**

**11 Confirm that the installation and/or maintenance work completed is in accordance with:**

- **the specification**
- **the current versions of appropriate industry standards and regulations**

# Unit 315PH: Understand Cold Water System Installation, Commissioning, Service and Maintenance Technique

| | |
|---|---|
| **GLH:** | 50 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore cold water systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- install and test cold water systems
- commission cold water systems
- service and maintain cold water systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of appliances, components and accessories
- the appropriate industry standards and regulations
- the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken
- the appropriate testing procedures for confirming the systems' integrity
- how to complete relevant documentation in accordance with organisational procedures
- the methods for determining the type of size of appliances, components and accessories
- how to interpret diagrams and drawings for the system to identify the planned location of the appliances, components and accessories
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected
- the methods and techniques for commissioning the system
- the methods for determining the type of size of replacement appliances, components and accessories
- the methods and techniques for servicing and maintaining appliances, components and accessories
- the methods and techniques for replacing/repairing the appliances, components and accessories
- basic fault-finding techniques.

Learners may be introduced to this unit by asking themselves questions such as:

- What are complex cold water systems?
- What steps must you take to design a cold water system including appliances, components and accessories?
- What steps are part of commissioning appliances, components and accessories on a cold water system?
- How do you service and maintain appliances, components and accessories on a cold water system?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

1.1 The working principles of cold water systems, positioning fixing, connection and operation of **components**

**Range: Appliances;** over the rim bidets, urinals, refrigerators, washing machines, dishwashers.

**Taps, outlets and valves;** outside taps, bib taps, bi-flow mixer taps, ceramic disc taps, spherical plug valves, float operated valves (part 1-4)

**Water meters**

**Showers;** gravity, instantaneous electric, digital shower valves, bath shower mixer, pumped (single and twin impeller), mixer valve

**Water treatment;** water softeners, water filters, water conditioners

**Cisterns;** cold water storage cisterns, cold water feed cisterns, combined feed and expansion cisterns, WC/urinal flushing cisterns, break cisterns, sectional (1000 litre+)

**Boosted system components;** float switch, pressure switch, accumulator/pressure vessel, booster pump sets, pressure relief valve, pressure gauge, drinking water header

**Sprinkler systems**

1.2 The **layout and installation requirements** for protected plastic storage cisterns

**Range:** typical cistern sizes for small dwellings, warning pipe (overflow) arrangements, inlet/ outlet position, position of float operated valve, position of cistern vent, position of open vent pipe connection, requirement for a rigid close fitting lid, service valve requirements, insect screens, insulation, support, drilling requirement, maintenance and access requirements, prevention of stagnation, linking multiple cisterns

1.3 The operating principles of rainwater harvesting and greywater re-use

## Learning outcome:

**2. Understand the appropriate industry standards and regulations relevant to**

- **decommissioning**
- **installing and testing**
- **commissioning**
- **service and maintenance**

**of cold water systems**

## Criteria

2.1 The **backflow risk** and required **methods** of prevention
**Range: Backflow;** Back siphonage, Back pressure
**Methods:** air gaps; AA, AB, AD, AG, $AUK_1$, $AUK_2$, $AUK_3$, DC mechanical; BA, CA, DB, EA/EB, EC/EDHA, $HUK_1$, HC

2.2 The information sources required to complete testing and commissioning

## Learning outcome:

**3. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken**

## Criteria

3.1 What may be communicated to the client through the progress of a job

3.2 The types of communication that may be required with the site management team
**Range:** architect, quantity surveyor, buyer/estimator, surveyor, project manager/clerk of works, structural engineer, building services engineer, contracts manager, construction manager

3.3 The importance of complying with company policies and procedures

3.4 The impact when materials are not delivered on time against the work programme

3.5 The factors which affect working time allocation to work activities

## Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

## Criteria

4.1 The information sources required to complete testing and commissioning

4.2 How to fill and vent cold water systems

4.3 A soundness test to industry requirements on cold water systems pipework and components

## Learning outcome:

**5. Understand how to complete relevant documentation in accordance with organisational procedures**

## Criteria

5.1 The range of information that would be provided on commissioning, installation and maintenance records

5.2 The procedure for handing over to the end-user

## Delivery outcomes (depth of content)

**1**

Learners should be aware of the working principles of the following;

- Appliances
- Taps, outlets and valves
- Water meters
- Showers
- Water treatment
- Cisterns
- Boosted system components
- Sprinkler systems.

Including the positioning, fixing, connection and operation of components listed above.

Learners will develop their understanding of expansion and contraction of pipework and measures to take when installing pipework in different situations.

Learners will develop their understanding of protected plastic storage cisterns looking at the key requirements. Learners will be able to state where these devices are sited in relation to industry standards and how faults affect the safety of these systems.

Learners will understand the cold water pipework and cisterns positioning that are most vulnerable to freezing and actions to take to insulate them and also the effects of warming cold water supplies and how to avoid this using insulation techniques.

Learners will be aware of the requirements for fitting sprinkler systems in dwellings and the types of sprinkler systems used in dwellings.

Learners will develop their understanding of the layout and operation of rainwater harvesting and grey water re-use water conservation systems.

**2**

Learners will understand backflow risks on cold water systems and be able to state different methods of prevention as per the Water Regs.

**3**

Learners will have an understanding of different ways of communicating while at work and with different stakeholders from the customer to the site foreman, also the company policy and procedures that are available and how they impact the work being undertaken.

Learners will also be able to identify any changes to the work program and how to respond to these changes.

**4**
Learners will know the method of applying a soundness test using pressure testing equipment on metallic pipework systems and on plastic pipework systems.

Learners will also be able to state the reason for a timed stabilisation period prior to carrying out a soundness test.

Learners will also understand that any leaks must be rectified and re-tested before a test certificate is issued.

Learners will know how to fill and vent the system after a successful test.

**5**
Learners will understand the types of information that should be contained within a commissioning document and that soundness test results, flow rates and discharge point pressure readings should be recorded on a commissioning record.

Learners will understand how to comply with the Water Supply (Water Fittings) Regulation's notification has to be given when work is carried out on cold water systems and the procedure for notifying relevant authorities of work carried out on cold water systems.

Learners will understand the types of additional information that should be contained within a maintenance record for cold water systems.

Learners will be able to give the appropriate advice on the safe use of a cold water system to the customer and understand that component manufacturer's instructions should be left and explained to the customer on hand over.

## Install

### Learning outcome:

**6. Understand the methods for determining the type of size of appliances, components and accessories in accordance with industry recognised organisational procedures**

### Criteria

6.1 The **factors** which affect the selection of cold water systems for dwellings.

**Range:** customer needs, building layout and features, energy efficiency, environmental impact, occupancy and purpose, appliance location, cost, storage type/location, legislation

6.2 The **information sources** required to size and select cold water systems and components

**Range:** Regulations, Industry standards, Manufacturer technical instructions, verbal and written feedback from the customer, plans and drawings, specifications, pre-determined data

6.3 The recommended **design temperatures** within cold water systems

**Range:** condensation consideration, storage (frost protection and undue warming), appliance outlet

6.4 How to calculate cold water **system requirements** used in dwellings

**Range:** storage requirements, pipe size, outlet size and type

6.5 How to Select cold water **components** in accordance with calculations from predetermined data

**Range:** storage requirements, pipe size, accumulator, safety device, booster pump

### Learning outcome:

**7. Understand how to interpret diagrams and drawings for the cold water system to identify the planned location of the appliances, components and accessories**

### Criteria

7.1 Interpret information to complete a detailed **materials list**.

**Range:** quantities and grades; pipework, consumables, fittings, components, appliances

7.2 Present calculations and information in a suitable format for quotation and tender

## Learning outcome:

8. **Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**
    - **the plumbing and heating system's design**
    - **the working environment**
    - **manufacturers' instructions**

## Criteria

8.1 How to install cold water systems

**Range:** booster set, shower

Pipework; plastic, copper

## Delivery outcomes (depth of content)

**6**

Learners will be introduced to the factors that affect the selection of systems, looking at it from the prospective of the customer, size of household and affordability and type of property and also consider external factors such as environmental considerations and current legislation.

Learners will consider the different types of information sources available to help and influence selection and that will help in the calculation of the required system.

Learners will be introduced to the requirement for design temperatures and how these impact on selection and positioning.

Learners will bring all the above together and start using the chosen system requirements and different sources of information and calculate system components using pre-determined data, this will focus on the procedures for calculating;

- the capacity of a cold water storage cistern
- the sizes of pipework using demand units suitable to meet the system design
- the required head pressure and mass flow rate of booster pumps
- the capacity of an expansion vessel based on system volume.

Once learners have completed the calculations, they will determine how to make the required selection of components.

**7**

Learners will be able to look at diagrams and drawings and develop a comprehensive materials list.

Learners will be introduced to the use of scale drawings and understand the formula to determine full scale measurements from the drawings and develop this understanding and look at the contents of drawings, plans and specifications.

Learners will also know the process of using specifications when carrying out design calculations.

Learners will know how to prepare line drawings to present design calculations and how to prepare a quotation from design information and calculations and understand the method of presenting and producing a tender.

**8**

Learners will know the requirements and methods to fit the selected components, appliances and accessories and what documentation and procedures to follow.

## Commission

### Learning outcome:

**9. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

9.1 A visual inspection of a cold water system to confirm that it is ready to be soundness tested

### Learning outcome:

**10. Understand the methods and techniques for commissioning the cold water system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

10.1 The flushing requirements including the use of system additives for new and existing cold water systems

**Range: Flushing requirements;** cold, disinfection

**System additives;** neutralisers, cleanser, water softener (salt)

10.2 The **operational checks** required during commissioning

**Range:** temperature, flow rate, pressures, operation of controls

10.3 The commissioning **procedures** for cold water **systems**

**Range: Procedure;** visual inspection, fill and vent, soundness test, flush, operational checks, commissioning documentation, handover

10.4 The actions that must be taken when commissioning reveals defects

## Delivery outcomes (depth of content)

**9**

Learners will know the reasons for a visual inspection prior to charging a system with water and what is required on a visual inspection looking for the correct appliances, components and accessories, they will be able to list the visual checks required to a cold water system before it is filled.

As part of the visual inspection learners will know the procedure for inspecting pipework supports and how to check the back or underside of soldered fittings in awkward positions on cold water systems.

Learners will also understand the procedure to follow if they identify installation faults on cold water systems whilst carrying out a visual inspection.

**10**

Learners will understand why commissioning systems is important and the procedure they should follow.

Learners will know as part of the commissioning procedure they will carry out operational checks, including;

- how to take and record flow rates and pressure reading from cold water discharge points
- how to check the correct operation of controls.

Learners will know the process for dealing with situations where installations do not meet expectations of specifications and standards and what to do if defective components are identified.

Learners will know the acceptable processes for flushing cold water systems before putting to work and the system additives that can be used and their intended purpose.

Learners will develop their understanding of the commissioning procedure and that systems should be disinfected in-line with the Water Supply (Water Fittings) Regulations and have an overview of the procedure for disinfecting cold water system, they will also be aware of the procedures for dealing with suspected infestations of micro-biological contamination in cold water systems.

## Service and maintain

### Learning outcome:

**11. Understand the methods for determining the type of size of replacement appliances, components and accessories in accordance with industry recognised organisational procedures**

### Learning outcome:

**12. Understand the methods and techniques for servicing and maintaining appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

12.1 How to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components

12.2 The **routine checks** required on cold water system components and pipework as part of a periodic maintenance programme

**Range:** visual inspection of pipework for leakage; adequate support and insulation effective operation of terminal fittings, effective operation of float operated valves, effective operation of valves, condition of cold water storage cisterns, strainer/filter inspection and cleaning, pump operation, float and pressure switch operation, pressure relief valves

12.3 The requirements for Legionella and bacterial growth control measures

### Learning outcome:

**13. Understand the methods and techniques for replacing/repairing the appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Learning outcome:

**14. Understand basic fault-finding techniques**

## Criteria

14.1 The repair and rectification **procedures** to deal with a range of faults

**Range:** diagnose, notify client, safely isolate, decommission, rectify, re-commission, hand over

14.2 The methods of obtaining **information** on system **faults**

**Range: Information;** end-user, manufacturer instruction, fault diagnosis flow chart, service history

**Faults:** incorrect pressures, accumulator expansion vessel failure, blockages, system debris, pump failure, control failure, pressure relief valve, incorrect support to system pipework and storage cisterns, excessive noise in pipework systems, cistern failure, leakage from below ground cold water service pipework.

leakage or ineffective operation of; terminal fittings, float operated valves, stop and service valves

## Delivery outcomes (depth of content)

**11**
Learners will know how to utilise the knowledge achieved when calculating the sizes of appliances, components and accessories for new installations on existing and replacement systems.

**12**
Learners will know the routine checks required to confirm the effective operation of the components identified, including:

- Signs of wear; taps, valves passing water
- Correct operation as per design
- Conforms with regulations, e.g. isolation.

Learners will have an overview of the Legionella and bacterial growth control measures and the procedures for dealing with suspected infestations of micro-biological contamination in cold water systems.

**13**
Learners will know the how to apply the knowledge they have developed on decommissioning systems and working on systems safely and then how to the commissioning and testing procedures and how these can be used while replacing/repairing the appliances, components and accessories.

**14**
Learners will understand the procedure for extracting information from manufacturer's instructions to diagnose system component faults and how to use industry standards to identify system faults.

Learners will also know the types of instruments and measuring devices used fault diagnosis techniques and the method of checking system components for correct operation and the methods of repairing faults in cold water system components.

# Unit 316PH: Understand Hot Water System, Installation, Commissioning, Service and Maintenance Technique

| | |
|---|---|
| **GLH:** | 50 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore hot water systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- install and test hot water systems
- commission hot water systems
- service and maintain hot water systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of appliances, components and accessories
- the appropriate industry standards and regulations
- the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken
- the appropriate testing procedures for confirming the systems' integrity
- how to complete relevant documentation in accordance with organisational procedures
- the methods for determining the type of size of appliances, components and accessories
- how to interpret diagrams and drawings for the system to identify the planned location of the appliances, components and accessories
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected
- the methods and techniques for commissioning the system
- the methods for determining the type of size of replacement appliances, components and accessories
- the methods and techniques for servicing and maintaining appliances, components and accessories
- the methods and techniques for replacing/repairing the appliances, components and accessories
- basic fault-finding techniques.

Learners may be introduced to this unit by asking themselves questions such as:

- What are complex hot water systems?
- What steps must you take to design a hot water system including appliances, components and accessories?
- What steps are part of commissioning appliances, components and accessories on a hot water system?
- How do you service and maintain appliances, components and accessories on a hot water system?

# Core knowledge

## Learning outcome:

**1. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

## Criteria

1.1 The working principles of hot water systems, positioning fixing, connection and operation of **components**

**Range: Cylinders (vented and unvented);** various grades available, sizes available, direct, indirect, primatic, quick recovery, duel coil, combination, thermal store

**Appliances;** baths, WCs, over the rim bidets, wash hand basins, sinks, washing machines, dishwashers.

**Taps, outlets and valves;** mixer taps, outside taps, pillar taps, bib taps, mixer taps, bi-flow mixer taps, ceramic disc taps, infra-red operated taps, concussive taps, flow limiting taps and valves, stop valves, spray taps, servicing valves, full way gate valves, spherical plug valves, thermostatic mixing valve, drain valves, float operated valves (part 1-4)

**Water meters**

**Showers;** gravity, digital shower valves, bath shower mixer, pumped (single and twin impeller), mixer valve

**Secondary pump**

**Cisterns**

1.2 The expansion and contraction in hot water systems and negative effects

1.3 The location and function of **unvented system components**

**Range:** cylinder, isolation valve, strainer, expansion vessel, pressure reducing valve, expansion (pressure) relief valve, temperature relief valve, balanced cold connection, check valve, D1, D2 discharge pipework requirements, composite valve, tundish, control thermostat, overheat thermostat (thermal cut-out)

1.4 Secondary circulation and how trace heating can be used

1.5 The operating principles of solar thermal

## Learning outcome:

**2. Understand the appropriate industry standards and regulations relevant to**

- **decommissioning**
- **installing and testing**
- **commissioning**
- **service and maintenance**

**of hot water systems**

## Criteria

2.1 The **backflow risk** and required **methods** of prevention
**Range: Backflow;** back siphonage, back pressure
**Methods:** air gaps; AA, AB, AD, AG, $AUK_1$, $AUK_2$, $AUK_3$, DC mechanical; BA, CA, DB, EA/EB, EC/EDHA, $HUK_1$, HC

2.2 The information sources required to complete testing and commissioning

## Learning outcome:

**3. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken**

## Criteria

3.1 What may be communicated to the client through the progress of a job

3.2 The types of communication that may be required with the site management team
**Range:** architect, quantity surveyor, buyer/estimator, surveyor, project manager/clerk of works, structural engineer, building services engineer, contracts manager, construction manager.

3.3 The importance of complying with company policies and procedures

3.4 The impact when materials are not delivered on time against the work programme

3.5 The factors which affect working time allocation to work activities

## Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

## Criteria

4.1 How to fill and vent hot water systems

4.2 A soundness test to industry requirements on hot water systems pipework and components

## Learning outcome:

**5. Understand how to complete relevant documentation in accordance with organisational procedures**

## Criteria

5.1 The types of information to be provided on commissioning, installation and maintenance records

## Delivery outcomes (depth of content)

**1**

Learners should be aware of the working principles for the following;

- Cylinders (vented and unvented)
- Appliances
- Taps, outlets and valves
- Water meters
- Showers
- Secondary pump
- Cisterns

Including the positioning, fixing, connection and operation of components listed above.

Learners will develop their understanding of expansion and contraction of pipework and measures to take when installing pipework in different situations.

Learners will develop their understanding of unvented hot water systems looking at;

- Safety devices
- Functional devices

Learners will be able to state where these devices are sited in relation to industry standards and how faults affect the safety of these systems.

Learners will understand what secondary circulation and trace heating is and why it is needed on pipework systems.

Learners will develop an understanding of the layout and operation of solar thermal renewable energy systems.

**2**

Learners will understand backflow risks on hot water systems and be able to state different methods of prevention as per the Water Regs.

**3**

Learners will be aware of what procedures need to be followed prior to undertaking work and any actions that should be followed to ensure there is no risk to them or others.

**4**

Learners will know the method of applying a soundness test using pressure testing equipment on metallic pipework systems and on plastic pipework systems.

Learners will also understand that any leaks must be rectified and re-tested before a test certificate is issued.

Learners will also be able to state the reason for a timed stabilisation period prior to carrying out a soundness test.

Learners will know how to fill and vent the system after a successful test.

**5**
Learners will understand the types of information that should be contained within a commissioning document and that soundness test results, flow rates and discharge point pressure readings should be recorded on a commissioning record.

Learners will understand that to comply with the Water Supply (Water Fittings) Regulations notification has to be given when work is carried out on cold water systems and the procedure for notifying relevant authorities of work carried out on cold water systems.

Learners will be able to give the appropriate advice on the safe use of a hot water system to the customer and understand that component manufacturer's instructions should be left and explained to the customer on hand over.

Learners will understand the types of additional information that should be contained within a maintenance record for hot water systems.

# Install

## Learning outcome:

**6. Understand the methods for determining the type of size of appliances, components and accessories in accordance with industry recognised organisational procedures**

## Criteria

6.1 The **factors** which affect the selection of hot water systems for dwellings.

**Range:** customer needs, building layout and features, energy efficiency, environmental impact, occupancy and purpose, appliance location, cost, storage type/location, legislation

6.2 The **information sources** required to size and select hot water systems and components

**Range:** Regulations, Industry standards, Manufacturer technical instructions, verbal and written feedback from the customer, plans and drawings, specifications, pre-determined data

6.3 The recommended **design temperatures** within hot water systems

**Range:** pipework, secondary circulation, storage, appliance outlet

6.4 How to calculate hot water **system requirements** used in dwellings

**Range:** storage requirements, pipe size

6.5 How to Select hot water **components** in accordance with calculations from predetermined data

**Range:** storage vessel, pipe, pump, expansion vessel, safety device

## Learning outcome:

**7. Understand how to interpret diagrams and drawings for the hot water system to identify the planned location of the appliances, components and accessories**

## Criteria

7.1 Interpret information to complete a detailed **materials list**.

**Range:** quantities and grades; pipework, consumables, fittings, components, appliances

7.2 Present calculations and information in a suitable format for quotation and tender

## Learning outcome:

**8. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Criteria

8.1 How to install hot water systems

**Range:** cylinder (open vented), cylinder (unvented), bath, WHB, shower, Pipework; plastic, copper

## Delivery outcomes (depth of content)

**6**

Learners will be introduced to the factors that affect the selection of systems, looking at it from the prospective of the customer, size of household and affordability and type of property and also consider external factors such as environmental considerations and current legislation.

Learners will consider the different types of information sources available to help and influence selection and that will help in the calculation of the required system.

Learners will be introduced to the requirement for design temperatures and how these impact on selection and positioning.

Learners will bring all the above together and start using the chosen system requirements and different sources of information and calculate system components using pre-determined data, this will focus on the procedures for calculating;

- the capacity of a storage vessel/cistern
- the sizes of pipework using demand units suitable to meet the system design
- the required head pressure and mass flow rate of booster pumps (shower and full system)
- the secondary circulation pump.

Once learners have completed the calculations, they will determine how to make the required selection of components.

**7**

Learners will be able to look at diagrams and drawings and develop a comprehensive materials list.

Learners will be introduced to the use of scale drawings and understand the formula to determine full scale measurements from the drawings and develop this understanding and look at the contents of drawings, plans and specifications.

Learners will also know the process of using specifications when carrying out design calculations.

Learners will know how to prepare line drawings to present design calculations and how to prepare a quotation from design information and calculations and understand the method of presenting and producing a tender.

**8**

Learners will know the requirements and methods to fit the selected components, appliances and accessories and what documentation and procedures to follow.

## Commission

### Learning outcome:

**9. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

9.1 A visual inspection of a hot water system to confirm that it is ready to be soundness tested

### Learning outcome:

**10. Understand the methods and techniques for commissioning the hot water system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

10.1 The flushing requirements including the use of system additives for new and existing hot water systems

10.2 The **operational checks** required during commissioning
**Range:** temperature, flow rate, pressures, controls

10.3 The commissioning **procedures** for hot water **systems**
**Range: Procedure;** visual inspection, fill and vent, soundness test, flush, operational checks, commissioning documentation, handover
**Systems;** vented, unvented

10.4 The range of information that would be detailed on commissioning documentation

10.5 The actions that must be taken when commissioning reveals defects

10.6 The procedure for handing over to the end-user

## Delivery outcomes (depth of content)

**9**

Learners will know the reasons for a visual inspection prior to charging a system with water and what is required on a visual inspection looking for the correct appliances, components and accessories, they will be able to list the visual checks required to a hot water system before it is filled.

As part of the visual inspection learners will know the procedure for inspecting pipework supports and how to check the back or underside of soldered fittings in awkward positions on hot water systems.

Learners will also understand the procedure to follow if they identify installation faults on hot water systems whilst carrying out a visual inspection.

**10**

Learners will understand why commissioning systems is important and the procedure they should follow.

Learners will know as part of the commissioning procedure they will carry out operational checks, including;

- how to take and record flow rates and pressure reading from discharge points
- how to check the temperature and alter to align to manufacturer and industry standards
- how to check the correct operation of controls

Learners will know the process for dealing with situations where installations do not meet expectations of specifications and standards and what to do if defective components are identified.

Learners will know the acceptable processes for flushing hot water systems before putting to work and the system additives that can be used and their intended purpose.

Learners will develop their understanding of the commissioning procedure and how to balance a secondary circulation system.

## Service and maintain

### Learning outcome:

**11. Understand the methods for determining the type of size of replacement appliances, components and accessories in accordance with industry recognised organisational procedures**

### Learning outcome:

**12. Understand the methods and techniques for servicing and maintaining appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

12.1 How to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components

12.2 The **routine checks** required on hot water system components and pipework as part of a periodic maintenance programme

**Range:** visual inspection of pipework for leakage; adequate support and insulation effective operation of terminal fittings, effective operation of float operated valves, effective operation of service valves, condition of hot water cylinder, condition of storage cisterns, unvented cylinder and controls, effective operation of thermostatic control devices, temperature and pressure relief valve, expansion vessel, composite valve, pumps

12.3 The types of information to be provided on a maintenance record for hot water systems

12.4 The requirements for Legionella and bacterial growth control measures

### Learning outcome:

**13. Understand the methods and techniques for replacing/repairing the appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Learning outcome:

### 14. Understand basic fault-finding techniques

## Criteria

14.1 The repair and rectification **procedures** to deal with a range of faults

**Range:** diagnose, notify client, safely isolate, decommission, rectify, re-commission, hand over

14.2 The methods of obtaining **information** on system **faults**

**Range: Information;** end-user, manufacturer instruction, fault diagnosis flow chart, service history

**Faults:** motorised valves not operating, incorrect pressures, expansion vessel failure, heat exchanger, blockages, system debris, pump failure, thermostat, programmer, expansion valve, pressure relief valve, stratification of cylinders, incorrect support to hot water system pipework and storage cisterns, excessive noise in pipework systems, cistern failure, hot water storage cylinder/ heater failure.

leakage or ineffective operation of; terminal fittings, float operated valves, stop and service valves, mixer showers, thermostatic mixing valves

## Delivery outcomes (depth of content)

**11**
Learners will know how to utilise the knowledge achieved when calculating the sizes of appliances, components and accessories for new installations on existing and replacement systems.

**12**
Learners will know the routine checks required to confirm the effective operation of the components identified, including:

- Thermostats
- Pumps
- Timing devices
- Expansion and pressure vessels
- Gauges and controls

Checking for correct operation of system safety valves

- Temperature relief
- Expansion relief.

**13**
Learners will know the how to apply the knowledge they have developed on decommissioning systems and working on systems safely and then how to the commissioning and testing procedures and how these can be used while replacing/repairing the appliances, components and accessories.

**14**
Learners will understand the procedure for extracting information from manufacturer's instructions to diagnose system component faults and how to use industry standards to identify system faults.

Learners will also know the types of instruments and measuring devices used fault diagnosis techniques and the method of checking system components for correct operation and the methods of repairing faults in cold water system components.

# Unit 317PH: Understand Central Heating System Installation, Commissioning, Service and Maintenance Techniques

| | |
|---|---|
| **GLH:** | 70 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore central heating systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- install and test central heating systems
- commission central heating systems
- service and maintain central heating systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of appliances, components and accessories
- the appropriate industry standards and regulations
- the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken
- the appropriate testing procedures for confirming the systems' integrity
- how to complete relevant documentation in accordance with organisational procedures
- the methods for determining the type of size of appliances, components and accessories
- how to interpret diagrams and drawings for the system to identify the planned location of the appliances, components and accessories
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected
- the methods and techniques for commissioning the system
- the methods for determining the type of size of replacement appliances, components and accessories
- the methods and techniques for servicing and maintaining appliances, components and accessories
- the methods and techniques for replacing/repairing the appliances, components and accessories
- basic fault-finding techniques.

Learners may be introduced to this unit by asking themselves questions such as:

- What are complex central heating systems?
- What steps must you take to design a central heating system including appliances, components and accessories?
- What steps are part of commissioning appliances, components and accessories on a central heating system?
- How do you service and maintain appliances, components and accessories on a central heating system?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

1.1 The working principles of central heating systems types, positioning fixing, connection and operation of **components**

**Range:** programmer, timer, thermostats, programmable room stat, optimizer, frost stat, wiring centre, cylinder stat, expansion vessel, automatic by-pass, bespoke heat emitters, panel radiators, column radiators, low surface temperature radiators, fan convectors, plinth heaters, towel warmers, underfloor heating components, manifolds, pump control unit, insulation, pipework, manifold isolation ball valves, supports, controls, additives, low loss headers, buffers, pressure relief valves, expansion joints, corrosion filters, low loss headers for multiple boiler installation, multiple heat producing appliances installation

1.2 The expansion and contraction in central heating systems and negative effects

1.3 The importance of pump positioning

1.4 The **operating principles** for system control

**Range:** time, temperature weather compensation, delayed start, optimum start, home automation systems, smart control systems and associated equipment correct connection to home wi-fi networks, internet of things (IoT), multiple boiler controls, zoning requirements

1.5 The insulation requirements and system frost protection

1.6 The operating principles of air and ground source heat pumps

## Learning outcome:

**2. Understand the appropriate industry standards and regulations relevant to**

- **decommissioning**
- **installing and testing**
- **commissioning**
- **service and maintenance**

**of central heating systems**

## Criteria

2.1 The zoning and control requirements of central heating systems in accordance with statutory legislation

2.2 The information sources required to complete testing and commissioning

## Learning outcome:

**3. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken**

## Criteria

3.1 What may be communicated to the client through the progress of a job

3.2 The types of communication that may be required with the site management team
**Range:** architect, quantity surveyor, buyer/estimator, surveyor, project manager/clerk of works, structural engineer, building services engineer, contracts manager, construction manager

3.3 The importance of complying with company policies and procedures

3.4 The impact when materials are not delivered on time against the work programme

3.5 The factors which affect working time allocation to work activities

## Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

## Criteria

4.1 How to fill and vent central heating systems

4.2 A soundness test to industry requirements on central heating systems pipework and components

## Learning outcome:

**5. Understand how to complete relevant documentation in accordance with organisational procedures**

## Criteria

5.1 The types of information to be provided on commissioning, installation and maintenance records

## Delivery outcomes (depth of content)

**1**

Learners will develop their understanding of expansion and contraction of pipework and measures to take when installing pipework in different situations.

Learners will develop their understanding of the key points to consider when looking at pump position and the factors to consider on positive and negative system pressure.

Learners will understand the appropriate positions of motorised zone valves used in controlling different zones and the requirements for zonal area control domestic heating systems. Learners will also have an overview of the time and temperature control strategies for domestic heating systems.

Learners will understand the operating principles of the following controllers:

- Weather compensated
- Delayed start
- Optimum start
- Home automation systems.

Learners will be aware of multiple boiler installations and the controls required for these system types.

Learners will understand the insulation requirements on different parts of the central heating system.

Learners will develop an understanding of the layout and operation of both air and ground source heat pump renewable energy systems.

**2**

Learners will understand zoning and control requirements of central heating systems in accordance with statutory legislation.

**3**

Learners will have an understanding of different ways of communicating while at work and with different stakeholders from the customer to the site foreman, also the company policy and procedures that are available and how they impact the work being undertaken.

Learners will also be able to identify any changes to the work program and how to respond to these changes.

Learners will understand time management whilst on installations, keeping track of their time using organisational procedures such as timesheets and the overall impact these hours could have on any overarching schedule of work.

**4**

Learners will know the method of applying a soundness test using pressure testing equipment on metallic pipework systems and on plastic pipework systems.

Learners will also understand that any leaks must be rectified and re-tested before a test certificate is issued.

Learners will also be able to state the reason for a timed stabilisation period prior to carrying out a soundness test.

Learners will know how to fill and vent the system after a successful test.

**5**

Learners will understand the types of information that should be contained within a commissioning document and be familiar with the Benchmark Logbook.

Learners will understand the types of additional information that should be contained within a maintenance record for central heating systems.

Learners will understand that to comply with the Building Regulations notification has to be given when work is carried out on CH systems and the procedure for notifying relevant authorities of work carried out.

Learners will be able to give the appropriate advice on the safe use of a central heating system to the customer and understand that component manufacturer's instructions should be left and explained to the customer on hand over.

# Install

## Learning outcome:

**6. Understand the methods for determining the type of size of appliances, components and accessories in accordance with industry recognised organisational procedures**

## Criteria

6.1 The **factors** which affect the selection of central heating systems for dwellings.

**Range:** customer needs, building layout and features, energy efficiency, environmental impact, occupancy and purpose, appliance location, cost, storage type/location, legislation

6.2 The **information sources** required to size and select central heating systems and components

**Range:** Regulations, Industry standards, Manufacturer technical instructions, verbal and written feedback from the customer, plans and drawings, specifications, pre-determined data

6.3 The principles of **heat loss and gain** and how this affects heating requirements

**Range:** electrical equipment, occupancy, solar, building fabric, ventilation, internal and external design temperatures, pipework

6.4 How to calculate central heating **system requirements** used in dwellings

**Range:** total heat load, emitter load, hot water allowance, pipe size, pump size, emitter size, expansion

6.5 How to Select central heating **components** in accordance with calculations from predetermined data

**Range:** emitter, boiler, pipe, pump, expansion vessel

## Learning outcome:

**7. Understand how to interpret diagrams and drawings for the central heating system to identify the planned location of the appliances, components and accessories**

## Criteria

7.1 Interpret information to complete a detailed **materials list**.

**Range:** quantities and grades; pipework, consumables, fittings, components, appliances

7.2 Present calculations and information in a suitable format for quotation and tender

## Learning outcome:

**8. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Criteria

8.1 How to install central heating systems

**Range:** boiler/jig, pump, motorised valve, expansion vessel, radiator, radiator valves, underfloor heating, controls, valves

Pipework; LCS, plastic, copper

## Delivery outcomes (depth of content)

**6**

Learners will be introduced to the factors that affect the selection of systems, looking at it from the prospective of the customer, size of household and affordability and type of property and also consider external factors such as environmental considerations and current legislation.

Learners will consider the different types of information sources available to help and influence selection and that will help in the calculation of the required system.

Learners will be introduced to the requirement for design temperatures and how these impact on selection and positioning.

Learners will bring all the above together and start using the chosen system requirements and different sources of information and calculate system components using pre-determined data, this will focus on the procedures for calculating;

- the heating load for domestic hot water
- suitable pipe sizes for a given central heating system
- the head pressure and discharge for circulator pumps
- the size of a suitable boiler for a given central heating systems whole house boiler sizing for replacement boilers as per chess doc.

Once learners have completed the calculations, they will determine how to make the required selection of components.

**7**

Learners will be able to look at diagrams and drawings and develop a comprehensive materials list.

Learners will be introduced to the use of scale drawings and understand the formula to determine full scale measurements from the drawings and develop this understanding and look at the contents of drawings, plans and specifications.

Learners will also know the process of using specifications when carrying out design calculations.

Learners will know how to prepare line drawings to present design calculations and how to prepare a quotation from design information and calculations and understand the method of presenting and producing a tender.

**8**

Learners will know the requirements and methods to fit the selected components, appliances and accessories and what documentation and procedures to follow.

## Commission

### Learning outcome:

**9. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

9.1 A visual inspection of a central heating system to confirm that it is ready to be soundness tested

### Learning outcome:

**10. Understand the methods and techniques for commissioning the central heating system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

10.1 The flushing requirements including the use of system additives for new and existing central heating systems

10.2 The **operational checks** required during commissioning
**Range:** temperature, flow rate, pressures, controls

10.3 The commissioning **procedures** for central heating **systems**
**Range: Procedure;** visual inspection, fill and vent, soundness test, flush, operational checks, commissioning documentation, handover

10.4 The range of information that would be detailed on commissioning documentation

10.5 The actions that must be taken when commissioning reveals defects

10.6 The procedure for handing over to the end-user

## Delivery outcomes (depth of content)

**9**

Learners will know the reasons for a visual inspection prior to charging a system with water and what is required on a visual inspection and have an overview on;

- the method of filling a sealed system with water using a temporary filling loop
- the method of filling an open vented system with water through the feed and expansion
- why the system should be filled to normal working pressure and inspected for leaks.

Learners will be able to list the visual checks required to a central heating system before it is filled.

Learners will also understand the procedure to follow if they identify installation faults on central heating systems whilst carrying out a visual inspection.

**10**

Learners will understand why commissioning systems is important and the procedure they should follow.

Learners will know as part of the commissioning procedure they will carry out operational checks, including;

- how to check the temperature and alter to align to manufacturer and industry standards
- how to check the correct operation of controls.

Learners will know the process for dealing with situations where installations do not meet expectations of specifications and standards and what to do if defective components are identified.

Learners will know the acceptable processes for flushing central heating systems both hot and cold before putting to work and the system additives and inhibitors that can be used and their intended purpose.

Learners will develop their understanding of the commissioning procedure and how to balance the system.

## Service and maintain

### Learning outcome:

**11. Understand the methods for determining the type of size of replacement appliances, components and accessories in accordance with industry recognised organisational procedures**

### Learning outcome:

**12. Understand the methods and techniques for servicing and maintaining appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

12.1 How to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components

12.2 The **routine checks** required on central heating system components and pipework as part of a periodic maintenance programme

**Range:** visual inspection of pipework for leakage, adequate support and insulation, effective operation of terminal fittings, effective operation of float operated valves, effective operation of valves, condition of cisterns, effective operation of thermostatic control devices, temperature and pressure relief valve, expansion vessel, pumps, heat emitter, performance checks

12.3 The types of information to be provided on a maintenance record for central heating systems

### Learning outcome:

**13. Understand the methods and techniques for replacing/repairing the appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Learning outcome:

**14. Understand basic fault-finding techniques**

## Criteria

14.1 The repair and rectification **procedures** to deal with a range of faults

**Range:** diagnose, notify client, safely isolate, decommission, rectify, re-commission, hand over

14.2 The methods of obtaining **information** on system **faults**

**Range: Information;** end-user, manufacturer instruction, fault diagnosis flow chart, service history

**Faults:** pumping over, persistent venting, emitter cold spots, stuck trvs, motorised valves not operating, incorrect pressures, expansion vessel failure, heat exchanger, blockages, pump failure, thermostat, programmer, pressure relief valve, incorrect support to system pipework and components, excessive noise in pipework systems, feed and expansion cistern failure

leakage or ineffective operation of; terminal fittings, stop and service valves, pipework

## Delivery outcomes (depth of content)

**11**
Learners will know how to utilise the knowledge achieved when calculating the sizes of appliances, components and accessories for new installations on existing and replacement systems.

**12**
Learners will know the routine checks required to confirm the effective operation of the components identified, including:

- Circulating pumps
- Central heating control components
    - Motorised valves
    - Timing devices
    - Thermostats
    - Specialist controls – weather compensation, delayed and optimum start
- Blockages in heat emitters and pipework by power flushing.

**13**
Learners will know the how to apply the knowledge they have developed on decommissioning systems and working on systems safely and then how to the commissioning and testing procedures and how these can be used while replacing/repairing the appliances, components and accessories.

**14**
Learners will understand the procedure for extracting information from manufacturer's instructions to diagnose system component faults and how to use industry standards to identify system faults.

Learners will also know the types of instruments and measuring devices used fault diagnosis techniques and the method of checking system components for correct operation and the methods of repairing faults in cold water system components.

# Unit 318PH: Understand Rainwater System Installation and Maintenance Techniques

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|---|---|
| **GLH:** | 15 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore rainwater systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- install and test rainwater systems
- commission rainwater systems
- service and maintain rainwater systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

Learners will develop their knowledge and understanding of:

- the appropriate industry standards and regulations
- the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the appropriate testing procedures for confirming the systems' integrity
- how to complete relevant documentation in accordance with organisational procedures
- the methods for determining the type of size of appliances, components and accessories
- how to interpret diagrams and drawings for the system to identify the planned location of the appliances, components and accessories
- the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected
- the methods and techniques for commissioning the system
- the methods for determining the type of size of replacement appliances, components and accessories
- the methods and techniques for servicing and maintaining appliances, components and accessories
- the methods and techniques for replacing/repairing the appliances, components and accessories
- basic fault-finding techniques.

Learners may be introduced to this unit by asking themselves questions such as:

- How do you install a rainwater system?
- How do you test a rainwater system?
- What steps must you take to design a rainwater system including appliances, components and accessories?
- What steps are part of commissioning appliances, components and accessories on a rainwater system?
- How do you service and maintain appliances, components and accessories on a rainwater system?

## Core knowledge

### Learning outcome:

**1. Understand the appropriate industry standards and regulations relevant to**

- **decommissioning**
- **installing and testing**
- **commissioning**
- **service and maintenance**

**of rainwater systems**

### Criteria

1.1 The information sources required to complete testing and commissioning

### Learning outcome:

**2. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken**

### Criteria

2.1 What may be communicated to the client through the progress of a job

2.2 The types of communication that may be required with the site management team
**Range:** architect, quantity surveyor, buyer/estimator, surveyor, project manager/clerk of works, structural engineer, building services engineer, contracts manager, construction manager

2.3 The importance of complying with company policies and procedures

2.4 The impact when materials are not delivered on time against the work programme

2.5 The factors which affect working time allocation to work activities

## Delivery outcomes (depth of content)

**1**

Learners will understand the different requirements they need to follow when working on rainwater systems in accordance with statutory legislation.

**2**

Learners will have an understanding of different ways of communicating while at work and with different stakeholders from the customer to the site foreman, also the company policy and procedures that are available and how they impact the work being undertaken.

Learners will also be able to identify any changes to the work program and how to respond to these changes.

## Install

### Learning outcome:

**3. Understand the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

3.1 The **factors** affecting gutter bracket selection and fixing for buildings

**Range**: fascia boards, exposed rafters, no fascia board or exposed rafters, gutter and rainwater material selection

3.2 How to install rainwater systems

**Range:** gutter; running outlets, gutter angles, gutter unions, stop ends, brackets pipe (RWP); offsets, shoes, clips

### Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

### Criteria

4.1 The **visual inspection** of a rainwater system to confirm that it is ready to be soundness tested

**Range:** checks, leakage, adequate support, damage, gutters are clear of debris, signs of damp on the building surface

4.2 A **soundness test** to industry requirements on rainwater systems **pipework** and components

**Range: Soundness test;** visual inspection, notify, initial fill, wet test, check for leaks, complete documentation and notify as required

**Pipework;** metal pipework, plastic pipework

### Learning outcome:

**5. Understand how to complete relevant documentation in accordance with organisational procedures**

### Criteria

5.1 The types of information to be provided on commissioning, installation and maintenance records

## Learning outcome:

**6. Understand the methods for determining the type of size of appliances, components and accessories in accordance with industry recognised organisational procedures**

## Criteria

6.1 The **factors** which affect the selection of rainwater systems for dwellings.

**Range:** customer needs, building layout and features, energy efficiency, environmental impact, cost, legislation, rainfall intensity, roof area, roof pitch, running outlet position, gutter fall, changes of direction in the gutter run

6.2 The **information sources** required to size and select rainwater systems and components

**Range:** Regulations, Industry standards, Manufacturer technical instructions, verbal and written feedback from the customer, plans and drawings, specifications, pre-determined data

6.3 How to calculate rainwater system requirements used in dwellings

6.4 How to Select rainwater components in accordance with calculations from predetermined data

## Learning outcome:

**7. Understand how to interpret diagrams and drawings for the rainwater system to locate site services and system supply**

## Learning outcome:

**8. Understand how to interpret diagrams and drawings for the rainwater system to identify the planned location of the appliances, components and accessories**

## Criteria

8.1 Interpret information to complete a detailed **materials list**.

**Range:** quantities and grades; pipework (RWP), consumables, fittings, components, appliances, gutter

8.2 Present calculations and information in a suitable format for quotation and tender

## Delivery outcomes (depth of content)

**3**

Learners will know the industry standard methods of connecting gravity rainwater system pipework to the outlets and components and how to interpret typical installation drawing showing outlets identified, and how to produce a fitting schedule.

Learners will be able to identify different types of building fabric and the precautions to be taken when installing gravity rainwater pipework and components within them and industry clipping distances.

**4**

Learners will know the process of and reasons for a visual inspection prior to testing and an insight into some of the types of problem that the inspection might uncover.

Learners will know the method of applying a soundness test on gravity rainwater systems.

Learners will also understand that any leaks must be rectified and re-tested before a test certificate is issued.

**5**

Learners will understand the types of information that should be contained within a commissioning document.

Learners will understand the types of additional information that should be contained within a maintenance record for rainwater systems.

Learners will be able to give the appropriate advice on the safe use of a gravity rainwater system to the customer and understand that component manufacturer's instructions should be left and explained to the customer on hand over.

**6**

Learners will be introduced to the factors that affect the selection of systems, looking at it from the prospective of the customer, size of household and affordability and type of property and also consider external factors such as environmental considerations and current legislation.

Learners will consider the different types of information sources available to help and influence selection and that will help in the calculation of the required system.

Learners will be introduced to the requirement for outlet, gutter and rainwater pipe requirements and how these impact on selection and positioning.

Learners will bring all the above together and start using the chosen system requirements and different sources of information and calculate system components using pre-determined data, this will focus on the procedures for calculating;

- Outlet size
- Gutter size
- Rainwater pipe size.

Once learners have completed the calculations, they will determine how to make the required selection of components.

**7**
Learners will be able to look at diagrams and drawings and develop a comprehensive materials list.

Learners will be introduced to the use of scale drawings and understand the formula to determine full scale measurements from the drawings and develop this understanding and look at the contents of drawings, plans and specifications.

Learners will also know the process of using specifications when carrying out design calculations.

Learners will know how to prepare line drawings to present design calculations and how to prepare a quotation from design information and calculations and understand the method of presenting and producing a tender.

**8**
Learners will know the requirements and methods to fit the selected components, appliances and accessories and what documentation and procedures to follow.

## Commission

### Learning outcome:

**9. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

9.1 The **visual inspection** of a rainwater system to confirm that it is ready to be soundness tested

**Range:** checks, leakage, adequate support, damage, gutters are clear of debris, signs of damp on the building surface

### Learning outcome:

**10. Understand the methods and techniques for commissioning the rainwater system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

10.1 The **operational checks** required during commissioning

**Range:** correct fall, no spill over, no leaks

10.2 The commissioning **procedures** for rainwater **systems**

**Range: Procedure;** visual inspection, soundness test, operational checks, commissioning documentation, handover

10.3 The range of information that would be detailed on commissioning documentation

10.4 The actions that must be taken when commissioning reveals defects

10.5 The procedure for handing over to the end-user

## Delivery outcomes (depth of content)

**9**

Learners will know the reasons for a visual inspection prior to the gravity rainwater system receiving water and what is required on a visual inspection and have an overview on;

- the correct support and joint alignment

Learners will be able to list the visual checks required before it receives water.

Learners will also understand the procedure to follow if they identify installation faults on gravity rainwater systems whilst carrying out a visual inspection.

**10**

Learners will understand why commissioning systems is important and the procedure they should follow.

Learners will know as part of the commissioning procedure they will carry out operational checks, including;

- correct fall
- correct size
- correct support.

Learners will know the process for dealing with situations where installations do not meet expectations of specifications and standards and what to do if defective components are identified.

## Service and maintain

### Learning outcome:

**11. Understand the methods for determining the type of size of replacement appliances, components and accessories in accordance with industry recognised organisational procedures**

### Learning outcome:

**12. Understand the methods and techniques for servicing and maintaining appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Learning outcome:

**13. Understand the methods and techniques for replacing/repairing the appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Learning outcome:

**14. Understand basic fault-finding techniques**

### Criteria

14.1 The repair and rectification **procedures** to deal with a range of faults

**Range:** diagnose, notify client, decommission, rectify, re-commission, hand over

14.2 The methods of obtaining **information** on system **faults**

**Range: Information;** end-user, manufacturer instruction, visual inspection

**Faults:** leaks, blockages/debris, inadequate or broken support, broken gutter/pipe (RWP), incomplete systems, incorrect fall, lack of provision for expansion and contraction

## Delivery outcomes (depth of content)

**11**
Learners will know how to utilise the knowledge achieved when calculating the sizes of appliances, components and accessories for new installations on existing and replacement systems.

**12**
Learners will know the routine checks required to confirm the effective operation of the components identified, including:

- Leakage from systems
- Blockages in systems
- Improper support to PVC-u gutter systems.

**13**
Learners will know the how to apply the knowledge they have developed on decommissioning systems and working on systems safely and then how to the commissioning and testing procedures and how these can be used while replacing/repairing the appliances, components and accessories.

**14**
Learners will understand the procedure for extracting information from manufacturer's instructions to diagnose system component faults and how to use industry standards to identify system faults.

Learners will also know the types of instruments and measuring devices used fault diagnosis techniques and the method of checking system components for correct operation and the methods of repairing faults in cold water system components.

# Unit 319PH: Understand Sanitation System Installation, Commissioning, Service and Maintenance Techniques

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|---|---|
| **GLH:** | 40 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore sanitation systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- inspect and pre-commission sanitation systems.
- decommission sanitation systems
- install and test sanitation systems
- commission sanitation systems
- service and maintain sanitation systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of appliances, components and accessories
- the appropriate industry standards and regulations
- the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken
- the appropriate testing procedures for confirming the systems' integrity
- how to complete relevant documentation in accordance with organisational procedures
- the methods for determining the type of size of appliances, components and accessories
- how to interpret diagrams and drawings for the system to identify the planned location of the appliances, components and accessories
- the methods and techniques for fitting, fixing and connecting the selected appliances, components and accessories
- the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected
- the methods and techniques for commissioning the system
- the methods for determining the type of size of replacement appliances, components and accessories
- the methods and techniques for servicing and maintaining appliances, components and accessories
- the methods and techniques for replacing/repairing the appliances, components and accessories
- basic fault-finding techniques.

Learners may be introduced to this unit by asking themselves questions such as:

- What are complex sanitation systems?
- What steps must you take to design a sanitation system including sanitary appliances and pipework systems and components?
- What steps are part of commissioning sanitary appliances and pipework systems and components?
- How do you service and maintain sanitary appliances and pipework systems and components?

## Core knowledge

### Learning outcome:

**1. Understand the applications, advantages and limitations of appliances, components and accessories in relation to the working environment**

### Criteria

1.1 The **types** and **layout** features of sanitary appliances pipework systems

**Range: Systems;** primary ventilated stack system, secondary ventilated stack system, ventilated branch discharge system, stub stack system

**Layout;** discharge stacks; soil stack sizes based on wc outlet size, waste stack sizes serving waste appliances only, use and types of bends, proximity of low level connections

branch discharge; layout of unventilated and ventilated branch discharge pipework, maximum pipework lengths and gradients, sizes of branch discharge pipework for soil and waste appliances, use of traps and self-sealing valves, methods of ventilating branch discharge pipework, methods of connecting multiple waste appliances to branch discharge pipework, methods of connecting branch discharge pipework into the main stack

stack ventilation; proximity of vent outlet to openable windows, use of air admittance valves

systems and appliances; waste appliance connections to gullies, waste appliance connections direct to drain, wc connection direct to drain

1.2 The working principles of sanitary appliances pipework systems, positioning fixing, connection and operation of **components**

**Range:** bend 92.5 degree, bend 135 degree, bend (male-female), access bend, offset bend, branch tee, boss, boss socket, vent terminal, waste manifold, pan connectors, traps, waterless trap, air admittance valve, clips/brackets, coupler, socket plug, socket rodding access, floor gullies

1.3 The expansion and contraction in sanitary appliances and pipework systems and negative effects

1.4 The different types of sanitary appliances and components used in dwellings

**Range:** conventional WC, flushing cisterns (automatic and manual), waste disposal units, baths, bidets, wash hand basins, shower tray, bath/shower screens and cubicles, sinks, urinals, WC macerators, waste water lifters used in domestic dwellings, sink waste disposals

1.5 The factors that lead to trap seal loss in sanitary pipework systems

1.6 The working principles of greywater recycling systems

1.7 The suitability of below ground drainage systems to receive waste water
**Range:** below ground drainage systems; combined drainage systems, separate drainage systems, partially separate drainage systems, soakaway, cesspit, septic tanks waste water; foul, soil, waste, condensate water

### Learning outcome:

**2. Understand the appropriate industry standards and regulations relevant to**
- **decommissioning**
- **installing and testing**
- **commissioning**
- **service and maintenance**

**of sanitary appliances and pipework systems**

### Criteria

2.1 The information sources required to complete testing and commissioning

### Learning outcome:

**3. Understand the organisational procedures for confirming with the relevant people the appropriate actions to be taken to ensure that any variations to the planned programme of work will not introduce a hazard and have minimum negative impact on the installation work to be undertaken**

### Criteria

3.1 What may be communicated to the client through the progress of a job

3.2 The types of communication that may be required with the site management team
**Range:** architect, quantity surveyor, buyer/estimator, surveyor, project manager/clerk of works, structural engineer, building services engineer, contracts manager, construction manager

3.3 The importance of complying with company policies and procedures

3.4 The impact when materials are not delivered on time against the work programme

3.5 The factors which affect working time allocation to work activities

## Learning outcome:

**4. Understand the appropriate testing procedures for confirming the systems' integrity**

## Criteria

4.1 A soundness test to industry requirements on sanitary appliances and pipework systems pipework and components

## Learning outcome:

**5. Understand how to complete relevant documentation in accordance with organisational procedures**

## Criteria

5.1 The information sources required to complete commissioning installation and maintenance records

## Delivery outcomes (depth of content)

**1**

Learners should have an understanding of the different types of sanitary appliances and pipework systems, including

- Primary ventilated stack system
- Secondary ventilated stack system
- Ventilated branch discharge system
- Stub stack system.

and be able to state the advantages and disadvantages of each type and typical applications.

Learners will develop their understanding of system types and understand typical pipe sizes and maximum distances permitted in sanitary appliances pipework systems within dwellings.

Learners will develop their understanding of expansion and contraction of pipework and measures to take when installing pipework in different situations.

Learners will develop their understanding of sanitary appliances and pipework systems looking at;

- Sanitary appliances
- Below ground drainage systems
- Wastewater.

Learners will be able to state where these devices are sited in relation to industry standards and how faults affect the safety of these systems.

Learners will understand the factors which lead to trap seal loss.

**2**

Learners will be able to identify different sources of information available to them while working on sanitary appliances and pipework systems, including those required to complete testing and commissioning.

**3**

Learners will have an understanding of different ways of communicating while at work and with different stakeholders from the customer to the site foreman, also the company policy and procedures that are available and how they impact the work being undertaken.

Learners will also be able to identify any changes to the work program and how to respond to these changes.

**4**

Learners will know the method of applying an air test using testing equipment.

Learners will also understand that any leaks must be rectified and re-tested before a test certificate is issued.

**5**

Learners will understand the types of information that should be contained within a commissioning document and the types of information to be provided on a maintenance record for sanitary appliances and pipework systems.

Learners will understand that to comply with the Building Regulations notification has to be given when work is carried.

Learners will be able to give the appropriate advice on serviceable components and highlight specific instructions and understand that relevant component manufacturer's instructions should be left and explained to the customer on hand over.

# Install

## Learning outcome:

**6. Understand the methods for determining the type of size of appliances, components and accessories in accordance with industry recognised organisational procedures**

## Criteria

6.1 The **factors** which affect the selection of sanitary appliances and pipework systems for dwellings

**Range:** customer needs, building layout and features, energy efficiency, environmental impact, cost, legislation, appliance type, drainage system type, pipework routes, access requirements

6.2 The **information sources** required to size and select sanitary appliances and pipework systems and components

**Range:** Regulations, Industry standards, Manufacturer technical instructions, verbal and written feedback from the customer, plans and drawings, specifications, pre-determined data

6.3 How to **calculate** sanitation system requirements used in dwellings

**Range:** gradient, diameter, length, material, system type

6.4 How to Select sanitation **components** in accordance with calculations from predetermined data

## Learning outcome:

**7. Understand how to interpret diagrams and drawings for the sanitation system to locate site services and system supply**

## Learning outcome:

**8. Understand how to interpret diagrams and drawings for the sanitation system to identify the planned location of the appliances, components and accessories**

## Criteria

8.1 Interpret information to complete a detailed **materials list**

**Range:** quantities and grades; pipework, consumables, fittings, components, appliances

8.2 Present calculations and information in a suitable format for quotation and tender

## Delivery outcomes (depth of content)

**6**

Learners will be introduced to the factors that affect the selection of systems, looking at it from the prospective of the customer, size of household and affordability and type of property and also consider external factors such as environmental considerations and current legislation.

Learners will consider the different types of information sources available to help and influence selection and that will help in the calculation of the required system.

Learners will be introduced to the requirement for design temperatures and how these impact on selection and positioning.

Learners will bring all the above together and start using the chosen system requirements and different sources of information and calculate system components using pre-determined data, this will focus on the procedures for calculating;

- the main stack size
- branch pipework size
- stack vent size.

Once learners have completed the calculations, they will determine how to make the required selection of components.

**7**

Learners will be able to look at diagrams and drawings and develop a comprehensive materials list.

Learners will be introduced to the use of scale drawings and understand the formula to determine full scale measurements from the drawings and develop this understanding and look at the contents of drawings, plans and specifications.

Learners will also know the process of using specifications when carrying out design calculations.

Learners will know how to prepare line drawings to present design calculations and how to prepare a quotation from design information and calculations and understand the method of presenting and producing a tender.

**8**

Learners will know the requirements and methods to fit the selected components, appliances and accessories and what documentation and procedures to follow.

## Commission

### Learning outcome:

**9. Understand the visual and manual checks required to confirm that the appliances, components and accessories have been fixed, fitted and connected in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

9.1 A visual inspection of sanitary appliances, pipework systems to confirm that it is ready to be soundness tested

**Range:** checks, leakage, adequate support, damage, signs of damp on the building surface

### Learning outcome:

**10. Understand the methods and techniques for commissioning the sanitation system in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **organisational procedures**

### Criteria

10.1 The flushing requirements including the use of system additives for new and existing sanitary appliances and pipework systems

10.2 The **operational checks** required during commissioning

**Range:** correct fall, no trap seal loss, no leaks, adequate support, waste removed satisfactory

10.3 The commissioning procedures for sanitary appliances, pipework systems and components

**Range: Procedure;** visual inspection, soundness test, operational checks, commissioning documentation, handover

10.4 The range of information that would be detailed on commissioning documentation

10.5 The actions that must be taken when commissioning reveals defects

10.6 The procedure for handing over to the end-user

## Delivery outcomes (depth of content)

**9**

Learners will know the reasons for a visual inspection prior to completing an air test and what is required on a visual inspection.

Learners will be able to list the visual checks required on sanitary pipework systems and components before an air test is completed.

Learners will also understand the procedure to follow if they identify installation faults on sanitary pipework systems and components whilst carrying out a visual inspection.

**10**

Learners will understand why commissioning systems is important and the procedure they should follow.

Learners will know as part of the commissioning procedure they will carry out operational and performance checks, including;

- the recommended depth of seal on the traps of common appliances
- the method of carrying out a performance test
- how to ensure the seal on traps meets the recommended depth after a performance test
- the correct commissioning procedures for a macerator WC and the reasons that such components need to be correctly commissioned.

Learners will know the process for dealing with situations where installations do not meet expectations of specifications and standards and what to do if defective components are identified.

## Service and maintain

### Learning outcome:

**11. Understand the methods for determining the type of size of replacement appliances, components and accessories in accordance with industry recognised organisational procedures**

### Learning outcome:

**12. Understand the methods and techniques for servicing and maintaining appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

12.1 How to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components

12.2 The **routine checks** required on sanitation system components and pipework as part of a periodic maintenance programme

**Range:** visual inspection of pipework for leakage; adequate support effective operation of terminal fittings, effective operation of float operated valves, effective operation of valves, condition of cisterns, operation of flushing cisterns/mechanisms, fitting of effective waste outlet plugs, effective operation of appliance traps/ self-sealing valves, pumps, performance checks, appliance support

12.3 The types of information to be provided on a maintenance record for sanitary appliances and pipework systems

### Learning outcome:

**13. Understand the methods and techniques for replacing/repairing the appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

## Learning outcome:

**14. Understand basic fault-finding techniques**

## Criteria

14.1 The repair and rectification **procedures** to deal with a range of faults

**Range:** diagnose, notify client, decommission, rectify, re-commission, hand over

14.2 The methods of obtaining **information** on system **faults**

**Range: Information;** end-user, manufacturer instruction, visual inspection

**Faults:** leaks, blockages, inadequate or broken support, trap seal loss, debris, expansion and contraction, cistern faults, appliance faults, WC macerators, wastewater lifters, sink waste disposal units, air admittance valves, pipework, condensing boiler condensate

## Delivery outcomes (depth of content)

**11**
Learners will know how to utilise the knowledge achieved when calculating the sizes of appliances, components and accessories for new installations on existing and replacement systems.

**12**
Learners will know the routine checks required to confirm the effective operation of the components identified, including:

- WC macerators
- Wastewater lifters
- Sink waste disposal units
- Air admittance valves.

**13**
Learners will know the how to apply the knowledge they have developed on decommissioning systems and working on systems safely and then how to the commissioning and testing procedures and how these can be used while replacing/repairing the appliances, components and accessories.

**14**
Learners will understand the procedure for extracting information from manufacturer's instructions to diagnose system component faults and how to use industry standards to identify system faults.

Learners will also know the types of instruments and measuring devices used fault diagnosis techniques and the method of checking system components for correct operation and the methods of repairing faults in cold water system components.

# Unit 320PH: Performing Electrical Work on Plumbing and Heating Systems

| | |
|---|---|
| **GLH:** | 70 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore electrical systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- inspect and pre-commission electrical systems
- decommission / install and test electrical systems
- commission electrical systems
- maintain electrical systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

This unit is for people who are required to carry out work on electrical supplies and/or circuits for the control of plumbing and heating systems which:

- do not require the addition of a circuit to the existing fixed electrical installation
- will only be associated with the disconnection, installation and/or connection of electrical equipment and components associated with the supply and/or control of mechanical services systems.

The person performing this work must be able to comply with the correct procedures and practices for disconnecting, installing and/or connecting electrical equipment and components that supply and/or control plumbing and heating systems. This work must be in accordance with the current versions of the appropriate industry standards and regulations, the specification, industry recognised working practices, the working and natural environment. It will not involve the testing and commissioning of the fixed electrical installation and its constituent parts. They must know and understand the types, applications and limitations of electrical supplies, safe isolation and control equipment, earthing and over-current protection and /cables/wiring associated with plumbing and heating systems.

Learners will develop their knowledge and understanding and skills of:

- the limitations of your responsibility when carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems
- the applications, advantages and limitations of electrical supplies
- the applications, advantages and limitations of different electrical equipment, cables/wiring, accessories and components in relation to the working environment
- the appropriate industry standards and regulations relevant to carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems
- methods for selecting electrical equipment, cables/wiring, accessories and components to ensure that they are fit for purpose
- methods and techniques for disconnecting, installing and/or connecting electrical equipment, cables/wiring, accessories and components
- Interpret diagrams and drawings for the mechanical building services system
- Industry recognised methods and procedures for the functional testing of the electrical equipment, accessories and components associated with the electrical supply and/or control of the mechanical building services system
- Identification and rectification of electrical faults in the mechanical building services system.

Learners may be introduced to this unit by asking themselves questions such as:

- What are the advantages and disadvantages of different electrical equipment, cables/wiring, accessories and components?
- How do you select and install electrical systems and components?
- What steps are part of commissioning and maintaining electrical systems and components?
- How do you carryout functional testing on electrical systems and components?

## Core knowledge

### Learning outcome:

**1. Understand the limitations of your responsibility when carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems**

### Learning outcome:

**2. Understand the applications, advantages and limitations of electrical supplies**

### Criteria

2.1 Electrical systems

**Range:** Extra low voltage and/or low voltage single and/or multi-phase provision for; control, communication, heating, lighting, power

### Learning outcome:

**3. Understand the applications, advantages and limitations of different electrical equipment, cables/wiring, accessories and components in relation to the working environment**

### Criteria

3.1 Electrical equipment

**Range:** isolators, circuit breakers, fuses, switches, socket-outlets/fused-spurs, earthing protection, motor control equipment, control panels – environmental control, control devices – electrical, electronic; electro-mechanical, smart controls

3.2 Cables and wiring

**Range:** thermosetting insulated cables including flexes, single and multicore thermoplastic and thermosetting insulated cables, flat profile cable, mineral insulated cables, single wire armoured cables, armoured/braided flexible cables and cords, fire resistant cable.

3.3 Components

**Range:** boiler, central heating controls; zone valves (2 port, 3 port, mid position and diverter), programmer, timer, thermostats, programmable room stat, optimizer, frost stat, wiring centre, cylinder stat, Wi-fi routers, Wi-Fi range extenders.

wiring centres, immersion heater, instantaneous shower, shower pump, jacuzzi bath/hot tub, macerator WC, heat producing or cooling appliances, pumps, fans

3.4 Working environment (internal or external)

**Range;** commercial, industrial, domestic, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments, Pre 1919 traditional/historic buildings

## Learning outcome:

**4. Understand the appropriate industry standards and regulations relevant to carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems**

## Criteria

4.1 Electrical systems

**Range**: extra low voltage and/or low voltage single and/or multi-phase provision for; control, communication, heating, lighting, power

4.2 The information sources required to complete testing and commissioning

**Delivery outcomes (depth of content)**

**1**

Learners will be able to appreciate the requirements of the Electricity at Work Regulations 1989 in particular Regulation 16. Refer also to the HSE publication HSR25. Learners will fully appreciate the limits of their responsibilities and the dangers associated with electricity, especially given that as little as 50 mA, can potentially be lethal. Learners should understand (and be able to perform) the electrical safe isolation procedure in accordance with industry guidance such as GS 38 and the Electrical Safety First's Guidance for low voltage installations.

**2**

Learners should be aware of the working principles for both alternating and direct current supplies. Examining, generation, transmission and distribution of the electrical supply grid. Learners also need to grasp how voltages are classified including any safety aspects, such as extra low voltage (touch voltage). In addition, how single and 3 phase supplies are utilised and what is meant by RMS and frequency. Learners should also be made aware of the application, advantages, disadvantages and limitation of a range of different cables such as twin & earth (thermoplastic), PVC singles, fire resistant, SWA and thermosetting applications, such as those who are used as the final connection to water heaters. Where necessary, learners should be able to reference the On Site Guide (BS7671) in order to recognise the requirements for RCD's, especially when protecting socket-outlets or when cables are not enclosed in metal enclosures or embedded in walls by 50 mm. Furthermore, Appendix H (Standard Circuits) details the limitations and sizing of ring and radial circuits, alongside the requirements to provide water heaters >15 litres with a dedicated supply. In addition, learners, should be made aware of the differences involved with electrical loads, especially within central heating systems.

**3**

Learners will be able to identify all the basic components that go to make up an electrical circuit such as an '18th Edition consumer Unit' (split board, highest loads positioned nearest the switch), types of protective devices including breaking capacity and switching (double pole switch/isolation for large loads). Furthermore, understanding what is meant by basic and fault protection, alongside Class 2 equipment. Learners need to especially understand how earthing requires all electrical connections to be low in resistance. This not only will avoid electrical fires, but ensure that a fault current will remain high, which then leads to a quick disconnection of the protective device in the required time. Learners will therefore need to be able to interpret Appendix B accordingly, by reading values directly.

**4**

Learners will know the process of both the inspection process including using where necessary relevant human senses. Learners need to be mindful of how both dead and live tests are applied and sequenced to a variety of different voltage and phasing requirements. Learners need to understand how the requirements of Part P of the Building Regulations are interpreted. In particular, how the installation of a new circuit differs from alterations, especially in certification. Installing a spur socket for instance, would require a minor electrical installation works certificate. Learners would therefore have to be able to establish the: system earthing arrangement, Zs (earth fault loop impedance) at distribution board, presence of adequate main protective conductors and equipotential bonding conductors, type and rating of protective device, R1 + R2 values, continuity of ring final circuit conductors, insulation resistance and polarity (which can be carried out visually). In addition, learners need to prove RCD operation.

Learners will be aware of the correct testing equipment to be used when carrying out tests on faulty components and systems.

## Inspect and pre commission

### Learning outcome:

**5. Identify methods for selecting electrical equipment, cables/wiring, accessories and components to ensure that they are fit for purpose**

### Criteria

5.1 The electrical supply is suitable for the plumbing and domestic heating systems

**Delivery outcome (depth of content)**

**5**

Learners will know the common types of cables and accessories used in a domestic setting and how to use sources of information such as the IET On Site Guide to select a cable for a given application.

## Decommission / Install

### Learning outcome:

6. **Carryout the methods and techniques for disconnecting, installing and/or connecting electrical equipment, cables/wiring, accessories and components in accordance with:**
    - **the mechanical building services (plumbing and heating) system's design**
    - **manufacturers' instructions**
    - **the correct procedures for safe isolation**

### Criteria

6.1 The correct means of electrical isolation prior to commencing **work**
**Range:** disconnection, installation, connection

6.2 The **status** of the electrical supply
**Range:** live, dead

6.3 The safe isolation of **electrical equipment** and **components** associated with the **electrical supply** of the plumbing and domestic heating system
**Range: Electrical equipment**; isolators, circuit breakers, fuses, switches, socket-outlets/fused-spurs, earthing protection, motor control equipment, control panels – environmental control, control devices - electrical; electronic; electro-mechanical, smart controls
**Electrical supply**; extra low voltage and/or low voltage single -phase provision for; control, communication, heating, lighting, power
**Components;** boiler, central heating controls; zone valves (2 port, 3 port, mid position and diverter), programmer, timer, thermostats, programmable room stat, optimizer, frost stat, wiring centre, cylinder stat, Wi-fi routers, Wi-Fi range extenders.
wiring centres, immersion heater, instantaneous shower, shower pump, jacuzzi bath/hot tub, macerator WC, heat producing or cooling appliances, pumps, fans

6.4 The work on electrical equipment, cables/wiring and **components** associated with the electrical supply and control of the plumbing and domestic heating system

**Range:** boiler, central heating controls; zone valves (2 port, 3 port, mid position and diverter), programmer, timer, thermostats, programmable room stat, optimizer, frost stat, wiring centre, cylinder stat, Wi-fi routers, Wi-Fi range extenders.

wiring centres, immersion heater, instantaneous shower, shower pump, jacuzzi bath/hot tub, macerator WC, heat producing or cooling appliances, pumps, fans

6.5 The electrical equipment, cables/wiring and components are in accordance with the requirements of the plumbing and domestic heating system

6.6 The electrical equipment, cables/wiring and **components** are of proper construction in accordance with the requirements of the plumbing and domestic heating system

**Range:** insulation, mechanical strength, protection

## Learning outcome:

7. **Interpret diagrams and drawings for the mechanical building services system to identify the location of the:**
    - **site services**
    - **electrical equipment, accessories and components**

## Criteria

7.1 The electrical equipment, cables/wiring and components are in accordance with the requirements of the plumbing and domestic heating system

7.2 The electrical equipment, cables/wiring and **components** are of proper construction in accordance with the requirements of the plumbing and domestic heating system

**Range:** insulation, mechanical strength, protection

**Delivery outcomes (depth of content)**

**6**
Learners will be able to perform safe isolation procedure and understand the importance of safe isolation, in accordance with industry approved procedures (refer to the guidance from Electrical Safety First). Learners will be able to connect and terminate electrical cables in accordance with industry approved procedures to ensure connections are electrically and mechanically sound.

Learners will understand the consequences of not performing the safe isolation procedure properly to themselves, other workers, members of the public/people on the premises.

Learners will understand the electrical circuitry, and electrical equipment associated with plumbing and domestic heating systems, the types of controls and their operation and purpose. Learners will understand how this circuitry enables the plumbing / domestic heating system to function as intended / as per system design.

**7**
Learners will be able to interpret circuit and wiring diagrams to safely, and correctly connect electrical circuits an equipment to ensure correct function of the plumbing / domestic heating system and be able to ensure that cables have adequate mechanical protection.

## Commission

### Learning outcome:

**8. Carryout Industry recognised methods and procedures for the functional testing of the electrical equipment, accessories and components associated with the electrical supply and/or control of the mechanical building services system**

**Delivery outcome (depth of content)**

**8**
Learners will be able to carry out functional testing off the installed system to ensure correct operation. Learners will be able to carry out visual inspections of their completed work.

## Maintain

### Learning outcome:

9. **Identify and rectify electrical faults in the mechanical building services system in accordance with:**
    - **industry recognised methods**
    - **the limitations of your responsibility**

### Criteria

9.1 How to rectify electrical faults and deficiencies on plumbing and domestic heating systems

**Range: Appliance components;** micro switches, relays, pressure switches, printed circuit boards, pumps, fans

**Control components;** thermostats, programmers / timers, electrically operated control valves, wiring centres

**Deficiencies;** inadequate earthing provision, defective cable routing, defective termination, incorrect polarity, provision of inadequate circuit protection device

## Delivery outcome (depth of content)

**9**

Learners will understand the Importance of ensuring the electrical work is safe and has been carried out in accordance with industry approved procedures and in compliance with BS 7671. Learners will understand the typical faults that occur on electrical circuits for mechanical building services systems, and how to identify and rectify these faults. Learners will be able to Identify types, causes and consequences of electrical faults such as:

- Loss of supply
- Low voltage/voltage drop
- Component/equipment malfunction/failure
- Operation of overload or fault current devices
- Arcing - loose connection
- High resistance - e.g. loose connection etc.
- Excess current - overload
- Insulation failure - deterioration, mechanical damage
- Short-circuit, Open Circuit and Earth fault.
- Signal faults.
- Inherent faults – faults that occur through poor design and incorrect termination (cross connections)

Learners will understand and be able to follow the logical stages of fault diagnosis; identification of symptoms, collection and analysis of data, use of sources/types of information, checking and testing (e.g. supply, protective devices), interpreting results/information, fault correction, functional testing, restoration.

Learners will know the factors which can affect repair or replacement of equipment. Such as: cost, availability of replacement parts, resources and staff, down time (planning), legal and personal responsibility (e.g. contracts, warranties, relevant personnel), gaining access to systems and equipment, provision of emergency or stand by supplies; client demand (continuous supply, out of hours working).

Learners will be able to determine and follow the procedures for verifying that the fault has been corrected suitable for the situation using technical analysis such as: functional testing/checking. Testing for: continuity, insulation resistance, polarity, earth fault loop impedance, RCD operation, current and voltage measurement/ checking presence of supply; phase sequencing.

Learners will know the methods to ensure the safe disposal of any waste and that the work area is left in a safe and clean condition.

# Unit 321PH: Performing Plumbing and Heating Systems Installation, Commissioning, Service and Maintenance Techniques

| | |
|---|---|
| **GLH:** | 143 |

## What is this unit about?

The purpose of this unit is for learners to obtain trade experience in plumbing and heating installations.

The purpose of this unit is for learners to explore plumbing and heating systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- inspect and pre-commission plumbing and heating systems
- decommission plumbing and heating systems
- install and test plumbing and heating systems
- commission plumbing and heating systems
- service and maintain plumbing and heating systems.

This work will be in accordance with the current versions of the appropriate industry standards and regulations; the specification; industry recognised working practices; the working environment and the natural environment.

Learners will develop their skills of:

- Verifying that the job information and documentation are current and relevant and that the plant, instruments, access equipment and tools are fit for purpose
- Confirming before work starts that the work location and work area can be accessed safely and has been checked for the risk to other personnel on the site, and take appropriate action if a risk is present
- Selecting appliances, components and accessories
- Confirming that the site services and system supply are compatible
- Producing a risk assessment and method statement for the work to be carried out, including the identification and use of personal protective equipment
- Complying with industry practices and organisational procedures to ensure the coordination of site services and system supply and the activities of other trades
- the safe transport and/or disposal of waste material, substances, and liquids in accordance with suppliers' and manufacturers' instructions
- completing documentation
- Confirming appliances, components and accessories are installed correctly
- Inspecting and pre-commissioning appliances, components and accessories
- Decommission appliances, components and accessories
- Ensuring that the plumbing and heating system cannot be accidentally reactivated or become dangerous
- Measure and mark out the locations for fitting and fixing the selected appliances, components and accessories
- Fit, fix and connect the selected appliances, components and accessories
- Confirming the integrity of the installed system using appropriate testing procedures
- Performing visual and manual checks to ensure that the appliances, components and accessories have been fixed, fitted and connected correctly
- Commissioning appliances, components and accessories, adjusting safely and effectively the control features
- Carrying out service and maintenance activities and procedures
- Accurately identifying the cause of faults and those parts/components that need to be repaired/replaced
- Completing repairs/replacements as necessary.

Learners may be introduced to this unit by asking themselves questions such as:

- How do you inspect and pre-commission plumbing and heating systems?
- How do you decommission plumbing and heating systems?
- How do you install and test plumbing and heating systems?
- How do you commission plumbing and heating systems?
- How do you service and maintain plumbing and heating systems?

## Core Skills

### Learning outcome:

1. **Verify that the job information and documentation are current and relevant and that the plant, instruments, access equipment and tools are fit for purpose**

### Learning outcome:

2. **Confirm before work starts that the work location and work area can be accessed safely and has been checked for the risk to other personnel on the site, and take appropriate action if a risk is present**

### Criteria

2.1 The Access and exit routes

**Range:** candidates must be assessed on three of the following: adequate lighting, routes free from obstruction, follow safety signs and notices, emergency exit routes in place, appropriate barriers

### Learning outcome:

3. **Select appliances, components and accessories and confirm that they are:**
    - **of the right type and size**
    - **fit for purpose in accordance with the plumbing and heating system's design**
    - **suitable for the working environment in which they are to be installed**

### Criteria

3.1 System design

**Range:** candidates must be assessed on one of the following:

**Cold water**

Calculate **system requirements** used in dwellings

**Range:** storage requirements, pipe size, outlet size and type

Select **components** in accordance with calculations from predetermined data

**Range:** storage requirements, pipe size, accumulator, safety device, booster pump

**Hot water**

Calculate **system requirements** used in dwellings

**Range:** storage requirements, pipe size

Select **components** in accordance with calculations from predetermined data

**Range:** storage vessel, pipe, pump, expansion vessel, safety device

**Central Heating**

Calculate central heating **system requirements** used in dwellings

**Range:** total heat load, emitter load, hot water allowance, pipe size, pump size, emitter size, expansion

Select **components** in accordance with calculations from predetermined data

**Range:** emitter, boiler, pipe, pump, expansion vessel

**Rainwater**

Calculate system requirements used in dwellings

Select components in accordance with calculations from predetermined data

**Sanitation**

Calculate system requirements used in dwellings

**Range:** gradient, diameter, length, material, system type

Select **components** in accordance with calculations from predetermined data

**Learning outcome:**

**4. Confirm that the site services and system supply are compatible with the plumbing and heating system's design**

**Learning outcome:**

**5. Produce a risk assessment and method statement for the work to be carried out, including the identification and use of personal protective equipment, in accordance with the working environment**

**Learning outcome:**

**6. Comply with industry practices and organisational procedures to ensure the coordination of site services and system supply and the activities of other trades**

**Learning outcome:**

**7. Confirm with the relevant people:**

- **those necessary variations to the planned programme of work**
- **the actions to be taken to ensure that any variations to the planned programme of work will minimise the potential for hazard and risk**

**Learning outcome:**

**8. Implement organisational procedures for the safe transport and/or disposal of waste material, substances and liquids in accordance with suppliers' and manufacturers' instructions**

**Learning outcome:**

**9. Complete relevant documentation in accordance with organisational procedures**

**Criteria**

9.1 Documentation

**Range:** candidates must be assessed on **three** of the following: variation order, timesheets, work programme, requisitions, delivery note

## Inspect and pre commission

### Learning outcome:

**10. Confirm appliances, components and accessories installed are:**

- **of the right type and size**
- **fit for purpose in accordance with the plumbing and heating system's design**
- **suitable for the working environment in which they are installed**

### Learning outcome:

**11. Determine that the appliances, components and accessories have been fitted in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturer instructions**

### Criteria

11.1 Preparatory work

**Range:** candidates must be assessed on **all** of the following: safe and unobstructed access to work areas, safe storage of materials tools and equipment, reporting pre-existing damage, protecting the building fabric

Candidates must be assessed on: drilling walls or floors, cutting holes and notches in timber floor joists, cutting chases in wall or floor surfaces

### Learning outcome:

**12. Inspect and pre-commission appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **manufacturer instructions**

## Decommission

### Learning outcome:

**13. Decommission appliances, components and accessories in accordance with industry practices and organisational procedures**

### Learning outcome:

**14. Ensure that the plumbing and heating system cannot be accidentally reactivated or become dangerous**

## Install

### Learning outcome:

**15. Determine at the outset, that the plans for positioning and fixing the appliances, components and accessories are in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturer instructions**

### Criteria

15.1 Systems

**Range:** candidates must be assessed **on** cold and hot water systems and then **one** from the remaining three: central heating systems, sanitation systems, gravity rainwater systems

### Learning outcome:

**16. Measure and mark out the locations for fitting and fixing the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **manufacturer instructions**

### Criteria

16.1 Systems

**Range:** candidates must be assessed **on** cold and hot water systems and then **one** from the remaining three: central heating systems, sanitation systems, gravity rainwater systems

16.2 The Pipework

**Range:** candidates must be assessed on **three** of the following: copper, plastic pressure pipe, steel (screwed or pressed), stainless steel, plastic (sanitary), rainwater

## Learning outcome:

**17. Fit, fix and connect the selected appliances, components and accessories in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturer instructions**

## Criteria

17.1 Systems

**Range:** candidates must be assessed **on** installing cold and hot water systems and then **one** from the remaining three: central heating systems, sanitation systems, gravity rainwater systems

17.2 The Pipework

**Range:** candidates must be assessed on installing pipework using **three** of the following: copper, plastic pressure pipe, steel (screwed or pressed), stainless steel, plastic (sanitary), rainwater

17.3 Jointing methods

**Range:** candidates must be assessed on jointing using **four** of the following: compression, push fit plastic pressure, push fit waste, threaded/screwed, soft soldered, crimped, glues/adhesives, fusion welded

**17.4 Components**

**Range:** Candidates must be assessed on **six** components from **Group A** with at least three on more than one occasion and **three** unique components from **Group B**:

| Group A | Group B |
|---|---|
| • bath<br>• WC<br>• wash hand basin<br>• sink<br>• shower and tray<br>• cylinder<br>• boiler (connections)<br>• soil stack system<br>• rain water/guttering system<br>• F&E/CWSC Cistern<br>• pump<br>• motorised valves<br>• radiator<br>• water conditioners/filters | • urinal<br>• bidet<br>• booster pump/shower pump<br>• accumulators/expansion vessels<br>• fan convector<br>• low loss header<br>• macerator or waste water lifter/pump<br>• greywater/rainwater station<br>• water softener/filter<br>• refrigerator cold connection<br>• washing machine/dishwasher<br>• underfloor heating circuit and underfloor manifold<br>• outside tap installation<br>• backflow protection components i.e. ea, eb, ec or ed back flow protection |

### Learning outcome:

**18. Confirm the integrity of the installed system using appropriate testing procedures**

## Commission

### Learning outcome:

**19. Confirm appliances, components and accessories installed are:**

- **of the right type and size**
- **fit for purpose in accordance with the plumbing and heating system's design**
- **suitable for the working environment in which they are installed**

### Criteria

19.1 A visual inspection of the plumbing and heating system to confirm that it is ready to be soundness tested

### Learning outcome:

**20. Perform visual and manual checks to ensure that the appliances, components and accessories have been fixed, fitted and connected in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Learning outcome:

**21. Confirm the integrity of the installed system using appropriate testing procedures**

### Learning outcome:

**22. Commission appliances, components and accessories, adjusting safely and effectively the control features in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturers' instructions**

### Criteria

22.1 Systems

**Range:** candidates must be assessed **on** cold and hot water systems and then **one** from the remaining three: central heating systems, sanitation systems, gravity rainwater systems

## Service and maintain

### Learning outcome:

**23. Determine at the outset, that the plans for servicing and maintaining the appliances, components and accessories are in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturer instructions**

### Learning outcome:

**24. Carry out service and maintenance activities and procedures in accordance with:**

- **the plumbing and heating system's design**
- **the working environment**
- **manufacturer instructions**

### Criteria

24.1 Systems

**Range:** candidates must be assessed **on** cold and hot water systems and then **one** from the remaining three: central heating systems, sanitation systems, gravity rainwater systems

### Learning outcome:

**25. Accurately identify the cause of faults and those parts/components that need to be repaired/replaced**

## Learning outcome:

**26. Complete repairs/replacements as necessary**

## Criteria

| **26.1 Faults**<br>**Range:** Candidates must be assessed on **three** from **Group A** (common faults) and **three** from **Group B (**system faults**)**: | |
|---|---|
| **Group A** | **Group B** |
| • system debris<br>• pump failure<br>• leakage<br>• trap seal loss<br>• expansion and contraction<br>• cistern failure<br>• pumping over/persistent venting<br>• emitter cold spots<br>• TRV/ valve<br>• tap/valve failure | • accumulator expansion vessel failure<br>• motorised valves not operating<br>• heat exchanger failure<br>• expansion valve<br>• WC macerators/waste water lifter<br>• sink waste disposal units<br>• control failure<br>• pressure relief valve<br>• thermostat<br>• programmer<br>• air admittance valves<br>• condensing boiler condensate<br>• component failure |

## Learning outcome:

**27. Complete appropriate testing procedures in-line with industry practices**