# EAL Building Services Engineering (Level 3) - Heating and Ventilating Installation C00/4278/5

## Qualification Manual

**Version 1.2 – November 2022**

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**Version information**

| Version and publication date | Changes |
|---|---|
| v1 June 2021 | Original document |
| V1.1 December 2021 | Updated website link for Assessment Pack<br>Structure of the qualification text updated |
| 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) - Heating and Ventilating Installation 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. |
| 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. Learners may also progress to the EAL Building Services Engineering (Level 3) – Heating and Ventilating Craftsperson qualification C00/4278/6. |

| | |
|---|---|
| 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. |

## 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.

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 structure

## Rule of combination

To achieve the EAL Building Services Engineering (Level 3) - Heating and Ventilating Installation qualification learners must successfully undertake all the units in this qualification **achieving a Pass grade or higher in the assessment methods and successfully complete the safety critical assessment.**

| 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 |
| 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 |
| 315HV | Understand Intermediate Scientific Principles for Mechanical Building Engineering Services | 70 |
| 316HV | Understand How to Prepare, Fabricate and Install Heating and Ventilation Systems | 55 |
| 317HV | Understand Cold Water Systems for Industrial and Commercial Buildings | 28 |

| | | |
|---|---|---|
| 318HV | Understand Hot Water Systems for Industrial and Commercial Buildings | 28 |
| 319HV | Understand Hydronic Heating Systems for Industrial and Commercial Buildings | 28 |
| 320HV | Understand Chilled Water Systems for Industrial and Commercial Buildings | 28 |
| 321HV | Understand the Techniques for Decommissioning, Testing, Flushing and Charging of Industrial and Commercial Pipework Systems | 28 |
| 322HV | Prepare, Fabricate and Install Heating and Ventilation Pipework Systems | 93 |
| N/A | Assessment (Graded and Safety Critical Assessment) | 109 |
| | **Total GLH** | 672 |

## 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 the qualification is specified below.

| Qualification | TQT | Credits |
|---|---|---|
| EAL Level 3 Building Services Engineering – Heating and Ventilating Installation | 792 | 79 |

## 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 requirements for this qualification can be found 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 (IQA), 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 is internally assessed and externally verified.**
**The Professional Discussion is 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 learner on a regular basis can be nominated and confirmed with the learning provider/centre to support evidence gathering while apprentices undertake the Practical Project. Expert witnesses do not make assessment decisions/judgements, their role is to provide information, context and an experienced perspective on the work completed by the learner 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 the Consortium
    - 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 are 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 EAL's 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 the 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
- 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 Practical Project 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 EAL Smarter Touch.

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 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 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 (Tests 1 and 2) | Externally-set, externally marked | 20% |
| Practical Project | Internally-set, internally-marked, externally verified | 60% |
| Professional Discussion | Externally-set, externally-marked, externally verified | 20% |
| Safety Critical Test (Practical Assessments) | Externally-set, internally marked | N/A |

The Safety Critical Test consists of practical assessment tasks. It is a 'hurdle test' only and does not contribute toward the grade of this qualification, it must be passed for the qualification to be awarded.

An Assessment Pack detailing the requirements of the assessment can be downloaded from 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.

## 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.

## Safety Critical Test (practical assessment)

The purpose of the safety critical assessment is to ensure learners are equipped with the key relevant skills to work safely.

Key points:

- The assessment has a set time and is marked at the centre by an assessor. Learners may only achieve a Pass or be referred.
- The assessment does not contribute toward the grade of this qualification.
- Time on each task is finite and cannot be shared between tasks.
- Learners who fail either component task are permitted to re-take after any appropriate feedback and subsequent learning has taken place.
- The assessment must be achieved for the qualification to be awarded.

The assessment aims to facilitate the learners safe working and to reduce the risk of electric shock (or electrocution).
It comprises of component tasks, which between them cover:

- Electrical Safe Isolation
- Safe use of electrical equipment.

## 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 must be completed before the point of booking the discussion with EAL. The unit content covered by the Professional discussion is outlined in the table below.

| **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 criterion, 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: BESA, and CIBSE.

Awareness of BESA being industry owned and controlled, and CIBSE is a professional engineering institution. 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: BESA Skillcard and the types of cards available.

Learners will know the role of card issuers, 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 CIBSE, 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 (type 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 including an

understanding of local geology, and the accessibility of these materials, including local quarries and transportation links both past and present. Learner's will know permeable nature of lime and earth mortars. Specific to this time period, learners will develop an understanding of the transportation and supply chain of materials; the benefits of using materials available within the region local to work sites, and the barriers/problems associated with using materials not local to work sites.

**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 in 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.

Learners will appreciate the older building services currently in service or in situ relevant to the heating and ventilation trade. Learners will appreciate low carbon steel and some plastic pipe is still sized in imperial as well as metric sizes. The older wiring colours and

older components in existing systems. The replacement of older components with new components that meet the current regulations (such as the Water Regulations). Some components no longer meet the requirements of the current regulations but only need to be changed or upgraded if a failure occurs and they need to be replaced. 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 were unsafe building services are discovered.

**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 where applicable) such as: Building Management Systems (BMS), improved temperature controls, condensing boilers, geothermal heat pumps, ground and air source heat pumps and solar thermal. The use of localised hot water (for hot water installations). Unvented condensing water heaters, heat interface units. Air conditioning systems using plate heat exchangers for heat exchange, cooling the chilled water. The use of air-cooling towers instead of water-cooling towers. Locally installed fan coil units. CHP, CCHP and chilled beams. Move to recycled water. The use of plastic pipe jointing methods. Offsite pre-fabrication and press fit installation on site. Learners will know 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.

**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. Pre-

fabrication and mass housing booms: post WWII war housing, off-site modern pre-fabrication. 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, plant, equipment, products, 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 approach 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

| 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, 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**

**Criteria**

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 and 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 overcurrent 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, HSE 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 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, 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 the 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 such as land contamination, air pollution and pollution of water courses. The current requirements and good working practices for processing waste on-site. The requirements and good working practices for recycling and dealing with hazardous waste and landfill.

**10**
Learners will be able to state the procedures for manual handling, including 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 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 system.

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 rescheduling 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 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 coordinated, 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 plan and implement work allocations and the duties of operatives for whom they are responsible, and their effective coordination.

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 and regulations relevant to their work: 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 not 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 315HV: Understand Intermediate Scientific Principles for Mechanical Building Engineering Services

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

## What is this unit about?

This unit provides knowledge and understanding of essential scientific principles that underpin the installation, commissioning and maintenance requirements of systems and components in the mechanical building services industry. The unit also requires the learner to carry out a range of fundamental calculations relevant to mechanical building engineering services.

Learners will develop their knowledge and understanding of:

- units of measurement
- properties of materials
- energy, heat, and power
- force and pressure
- mechanical principles
- principles of electricity.

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

- What are units of measurement and how are they applied in my trade?
- What are the properties and applications of solid materials, liquids and gases?
- What is the relationship between energy, heat and power?
- How do the principles of force and pressure apply in the systems?
- What are the key mechanical and electrical principles?

## Learning outcome:

**1. Understand units of measurement used in the mechanical building engineering services industries**

## 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 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 and 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
**Range (**gases): air and 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 fundamental 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 fundamental principles of force and pressure and their application in mechanical building engineering services**

## 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
**Range (**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
**Range** (pressure calculations): static pressure, dynamic pressure, draught, forced draught

4.5 **T**he 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 fundamental mechanical principles**

**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 and reaction, centre of gravity, equilibrium, velocity and ratio, mechanical advantage

**Learning outcome:**

**6. Understand fundamental principles of electricity**

**Criteria**

6.1 The fundamental principles of electron flow

**Range:** current, flow, voltage, 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 circuits

**Range:** Ohm's law, power consumption in electrical circuits, basic over-current protection device rating, voltage, current and resistance in simple series and parallel circuits

6.4 The requirements for earthing of electrical circuits

## Delivery outcomes (depth of content)

**1**

Learners will understand 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 include derived SI units for area, volume, density, and velocity.

**2**

Learners will 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 mechanical building engineering services, 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 mechanical building engineering services, giving examples of their applications.

Learners will understand the principles of Boyle's and Charles's law and how they apply in mechanical building engineering services.

**3**

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

Learners will understand the different states matter can exist in solid, liquid, and gaseous forms, and what causes a change of state.

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

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

Learners will be aware that the unit of energy is 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. Learners will develop 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 will understand the units of force and pressure, they will appreciate pressure and flow rate units of measurements and their application.

Learners will be able to carry out simple force and pressure calculations and will develop an understanding of velocity, pressure, and flow rate:

- effects of increasing/reducing pressure
- effects of increasing/reducing pipe size

-and understand the 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 appreciate the different theories of how a siphon works.

**5**

Learners will develop an understanding of simple machines, levers, pulleys, and Archimedes screws, and will understand the use of pulley systems for lifting heavy objects.

**6**

Learners will develop an understanding of fundamental electrical circuits including the theory of electron flow (and current measurement), conductivity, resistance and A.C and D.C. Learners will utilise the units of electrical measurements and be able to carry out fundamental electrical calculations of power, voltage, current, and resistance. Learners will be able to calculate values of resistance in simple series and parallel combinations.

Learners will gain an appreciation of the requirements for earthing of basic electrical circuits.

# Unit 316HV: Understand How to Prepare, Fabricate and Install Heating and Ventilation Systems

| | |
|---|---|
| **GLH:** | 55 |

## What is this unit about?

This unit covers the knowledge and understanding of how to prepare and carry out the fabrication and installation of industrial and commercial pipework systems and their related components.

Learners will develop their knowledge and understanding of:

- how to verify that job information, site drawings and documentation is current and relevant
- how to confirm that the work area is suitable for installation work to proceed
- the types of fixings, fittings, materials, brackets and supports used within industrial and commercial pipework installation
- how to use hand and power tools specific to industrial and commercial pipework installation
- how to fit, fix, and connect the selected pipework, equipment, components, and accessories using suitable jointing methods
- ensuring that any variations to the planned programme of work will not introduce a hazard.

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

- What drawings and diagrams are required to install heating and ventilation systems?
- What are the different types of support systems and fixings used to install heating ventilation systems?
- What are the methods and techniques required to safely install heating and ventilation systems?

## Learning outcome:

**1. Understand how to verify that job information, site drawings and documentation is current and relevant**

## Criteria

1.1 The documentation used within the building engineering systems installation project
**Range:** job specifications, work programmes, variation order, delivery notes, time sheets, policy documentation – health and safety, environmental, customer service, manufacturer guidance, installation instructions, user instructions, customer information, quotations, estimates, invoices/statements, statutory cancellation rights, handover information, British Standards, legislation

1.2 The types of drawings used within the building engineering systems installation project
**Range:** plan drawings, approved drawings, proposed drawings, installation, as fitted, schematic

1.3 Interpreting diagrams and drawings for the fabrication and installation of heating and ventilation systems
**Range:** location of site services, the planned location of the system and components, accessories and equipment, heights, datum points, scale, symbols, 'taking off' from drawings

## Learning outcome:

**2. Understand how to confirm that the work area is suitable for installation work to proceed**

## Criteria

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

2.2 The purpose and use of risk assessments and method statements used within the building engineering systems installation project

2.3 The purpose and use of the permit to work system within the building engineering systems installation project

2.4 The methods and procedures used to protect the customers property

2.5 The methods used to check that plant, instruments, access equipment and tools are fit for purpose

**Range** (methods): manufacturers literature, checking against British Standards, specification documents, test certificates, PAT labels, physical inspection

**Range** (plant, instruments, access equipment and tools): pipe machinery, cutting equipment, 110 V equipment, battery powered equipment, slinging equipment, chains and chain hoists, hand tools, test gauges, test pumps, ladders, scaffolds, powered access equipment

## Learning outcome:

**3. Understand types of fixings, fittings, materials, brackets and supports used within industrial and commercial pipework installation**

## Criteria

3.1 The types and applications of fittings and jointing methods

**Range:** malleable iron, screwed and socketed, carbon steel, crimped, collar, grooved, flanged, welded fittings, copper, end feed, internal solder ring, compression, brazing, brass, ABS, solvent weld, MDPE, fusion weld

3.2 The types and applications of pipework material

**Range:** LCS (heavy/medium), carbon steel, stainless steel, galvanised steel, copper, plastics

3.3 The types of fixings and consumables used in the installation of industrial and commercial pipework

**Range:** wall plugs, anchor bolts, toggle bolts, wedge type anchors, concrete screws, cartridge fired fixings, chemical fixings, plasterboard fixings, screws, bolts, washers, nuts, rod

3.4 The types of brackets, hangers and accessories for use in industrial and commercial pipework installation

**Range:** malleable iron clips, rubber lined split band clips, roller and chair, U bolt, phenolic blocks, plastic clips, brass clips, channel strut, anti-vibration mounts, channel nuts, L brackets, power arms, wire hangers, beam clamps, lightweight channel systems

3.5 The basic elements of a building and its structure

**Range:** substructure, foundations, superstructure, vapour barrier, damp-proof membranes

3.6 The types and applications of valves and specialist fittings within industrial and commercial pipework installations

**Range** (valves): gate, globe, lever, double regulating, stop tap, service, butterfly, Pressure reducing, pressure relief, temperature relief, thermostatic radiator, lock shield, differential pressure, drain, float operated, solenoid, two/three/four port

**Range** (specialist fittings): gauges, air vents, actuator, expansion vessel, expansion loop, expansion bellow, strainers, air dirt separators, commissioning points, sight glass, dosing pots

## Learning outcome:

**4. Understand how to use hand and power tools specific to industrial and commercial pipework installation**

## Criteria

4.1 The operation of common hand tools

**Range:** pipe wrench, hacksaw, pipe cutters, rod cutter, bending tools, hand stocks, chain tools, screwdrivers, files, Allen keys, pliers, chisels, flange bars, rivet guns, hammers, water level, boat level

4.2 The operation of common power tools

**Range:** drills, reciprocating saw, pipe threading machine, grooving tools, crimping tools, grinding tools, chop saw

4.3 The use of different drill bits for a range of materials

**Range:** brick, blockwork, concrete, stone materials, wood and timber, plasterboard, metalwork

4.4 The maintenance checks and inspections required for hand and power tools

4.5 The training requirements and prohibitions for persons operating and maintaining power tools

## Learning outcome:

**5. Understand how to fit, fix, and connect the selected pipework, equipment, components, and accessories using suitable jointing methods**

## Criteria

5.1 The procedures used to bend and set a range of pipework materials
**Range:** heat bends, hydraulic bending, manual bending, spring bending, LCS, copper

5.2 The requirements for sleeving and fire stopping pipework and the clipping and clearance distances for pipework systems

5.3 The installation methods to accommodate for linear expansion in pipework
**Range:** expansion loops, expansion bellows, use of natural bends, expansion brackets, hangers and sliders

5.4 The methods to improve installation efficiency
**Range:** pre-fabrication, modular installation, housekeeping, storage, the types and properties of pipework insulation

5.5 The approved standards relevant to fittings and materials

5.6 The types and applications of valves and specialist fittings within industrial and commercial pipework installations

**Range** (valves): gate, globe, lever, double regulating, stop tap, service, butterfly, pressure reducing, pressure relief, temperature relief, thermostatic radiator, lock shield, differential pressure, drain, float operated, solenoid, two/three/four port

**Range** (specialist fittings): gauges, air vents, actuator, expansion vessel, expansion loop, expansion bellow, strainers, air dirt separators, commissioning points, sight glass, dosing pots

5.7 Types of measurements and checks for pipework installations

## Learning outcome:

**6. 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

6.1 Methods of communication used within the project to share information between other trades, the client, and peers
**Range:** BIM, site meetings, email, written letter, phone calls, remote working, and the use of IT based systems

6.2 The purpose and use of variation orders

6.3 Producing work programmes to ensure a project can follow a critical path

6.4 Producing risk assessments for a range of planned tasks

6.5 How to produce method statements for a planned task

**Delivery outcomes (depth of content)**

**1**
Learners will understand the documentation used within the industrial and commercial building engineering systems project. Learners will know how these documents are applied to the project and for what purpose. Learners will understand the range of drawings used within the project, how to confirm information within them and how to produce materials lists using this information. Learners will also know why it is necessary to check that plant and equipment are suitable and safe for the task and what procedures are in place to confirm this.

**2**
Learners will understand the specific documents used to plan for safety during the installation project, how they are used and when they are used. This will include RAMS documentation and permits to work. Learners will consider the types of risk and hazard within installation tasks, how property can be protected and the arrangements for storage and pre-fabrication of pipework.

**3**
Learners will know the types, applications limitations, and advantages of a range of pipe materials, pipe fittings and jointing methods. Pipe materials will include: LCS (heavy/medium), carbon steel, stainless steel, galvanised steel, copper and plastics and the associated jointing methods and fittings used with each.

Learners will also identify the various building elements of a range of building types including traditional Welsh construction methods and stone building methods. Learners will know how to make fixings into a range of materials and fix brackets to carry a range of pipework materials.

**4**
Learners will develop their knowledge of the procedures and practices which must be followed to use hand tools and power tools safely and efficiently when installing industrial and commercial building engineering systems pipework systems. Learners will understand how to use cutting, crimping, and threading equipment and how to check these pieces of equipment are safe for use. Learners will know the different types of drill bits for use with a range of material types.

**5**
Learners will know how to install a range of pipework materials and how to produce bends within this pipework. Learners will know functional methods to check for levels and make measurements from set datums. Learners will know the reasons for set clipping distances and why different materials have different set centres. It is not expected that learners remember all these measurements but instead know why it must be considered and how to find the relevant information to check before installing clips, brackets and pipework.

Learners will understand the use of fire stops and how pipework should be installed through structures to prevent damage and the spread of fire and smoke. Learners will understand the methods to prevent damage through linear expansion and will also understand the properties, basic methods and types of thermal insulation for pipework and components.

**6**
Learners will know the methods of communication between parties and the use of modern and traditional documents and systems to allow the project to progress along a critical path. Learners will understand how to produce a basic programme of works and the importance of critical path planning through a project. Learners will know the use of BIM in modern site operations and will be able to produce a simple risk assessment for a task (this will complement Unit 304).

# Unit 317HV: Understand Cold Water Systems for Industrial and Commercial Buildings

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

## What is this unit about?

This unit covers the knowledge and understanding of the installation and operating principles of industrial and commercial cold water systems. Learners will have an understanding of the purpose of Water Regulations and the impact this has on their work.

Learners will understand how to work 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 requirements for cold water supplies to industrial and commercial buildings
- the operation, applications, advantages, and limitations of cold water systems
- the applications, advantages and limitations of system equipment, components, and accessories in relation to the working environment
- the appropriate industry standards and regulations relevant to installing cold water systems.

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

- How is cold water supplied to industrial and commercial buildings?
- What are the advantages and limitations of cold water systems?
- What are the different types of cold water system components and how are they applied?
- What are the industry standards and regulations relevant to cold water systems in industrial and commercial buildings?

## Learning outcome:

**1. Understand the requirements for cold water supplies to industrial and commercial buildings**

## Criteria

1.1 The sources of water supply to industrial and commercial premises
**Range**: surface source, underground source, private source

1.2 The **methods** of water filtration and treatments
**Range**: sand filters, ultraviolet, water softeners, osmosis

1.3 The requirements for pipework entry to buildings
**Range:** depth, pressures, boundaries, protection, relation to other services

1.4 The types of suitable supply pipework materials

1.5 The methods used to make connections to the mains supply

## Learning outcome:

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

## Criteria

2.1 The working principles of cold water systems
**Range:** direct, indirect and boosted

2.2 The application of cold water systems relevant to building layout and use
**Range:** commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments and pre-1919 traditional/historic buildings

2.3 The advantages and limitations of various cold water system types

2.4 The installation requirements specific to cold water pipework within the building
**Range**: pipework types, clipping and bracketry, routes and positions and typical sizes

2.5 The methods to protect, insulate and identify cold water pipework

2.6 The types and installation requirements for cold water storage cisterns
**Range:** storage cisterns, break tanks, sectional, plastic, GRP

2.7 The operation of rainwater and grey water harvesting systems and their components

2.8 The advantages and limitations of rainwater and greywater harvesting systems

## Learning outcome:

**3. Understand the applications, advantages and limitations of system equipment, components, and accessories in relation to the working environment**

## Criteria

3.1 Types of valves and components used within industrial and commercial cold water systems
**Range:** stop valves, gate valves, servicing valves, check valves, float operating valves, RPZ, lever valves, butterfly valves, drain cocks, pressure reducing valves, blending valves, pumps, level switches, accumulator, drinking water header

3.2 The position of valves and components used within industrial and commercial cold water systems

3.3 The advantages, limitations and requirements of valves and components used within industrial and commercial cold water systems

## Learning outcome:

**4. Understand the appropriate industry standards and regulations relevant to installing cold water systems**

## Criteria

4.1 The regulations, standards and guidance documents relevant to cold water systems
**Range:** The Water Supply (Water Fittings) Regulations, British Standards; BS EN 806, BS 6700, Water Regulation Advisory Scheme (WRAS), Legionnaires' disease, L8

4.2 The purpose of the Water Regulations

4.3 Fluid categories

4.4 The principles of legionella and the conditions which promote its growth

4.5 The practices for the prevention of legionella

4.6 Types of backflow prevention
**Range:** mechanical and non-mechanical

**Delivery outcomes (depth of content)**

**1**
Learners will understand the processes involved within the supply of potable water to the building. Learners will learn about the sources of cold water and the potential effects of those sources on the property of the water. The learners will have an understanding of the filtration and treatment stages for the supply of potable water, the principles of distribution both nationally and locally and the arrangements for the connection local to the building.

**2**
Learners will understand the principles of system layouts including direct, indirect, and boosted applications. Learners will know the limitations of the system types and how they are applied to a range of building types including the position and installation requirements for cisterns. Learners will also know how to protect and identify cold water pipework systems.

Learners will know the pipework requirements, the advantages, and limitations to the pipework within the specific system and the use of water saving technologies such as rainwater and greywater harvesting.

**3**
Learners will understand how common cold water system components, equipment and accessories are installed within the system. Learners will know the basic function and operation of these pieces of equipment, components, and accessories and how they affect the function of the system.

**4**
Learners will be introduced to the Water Regulations and understand the main requirements to provide water while preventing waste, undue consumption, misuse or contamination. Learners will know the purpose of a range of guidance documents, regulations, and standards. Learners will know the fluid categories and the level of protection required for backflow dependent on that fluid category.

# Unit 318HV: Understand Hot Water Systems for Industrial and Commercial Buildings

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

## What is this unit about?

This unit covers the knowledge and understanding for the installation and operating principles of industrial and commercial hot water systems. The unit will cover both traditional open vented, unvented, storage and non-storage, localised and centralised plant hot water systems. This unit will understand the components and controls relevant to the safe and functional operation of hot water systems and the specific methods required for installing hot water system pipework. Methods for the generation of hot water using both traditional generators and energy saving alternatives will be considered. Learners will also have a basic understanding of the purpose of Building Regulation Part G3 and the impact this has on their work.

Learner's 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 operation, applications, advantages, and limitations of hot water systems
- the applications, advantages and limitations of hot water system equipment, components, controls, and accessories in relation to the working environment
- the appropriate industry standards and regulations relevant to the installation of hot water systems.

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

- What are the advantages and limitations of hot water systems?
- What are the different types of hot water system components and how are they applied?
- What are the industry standards and regulations relevant to hot water systems in industrial and commercial buildings?

## Learning outcome:

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

## Criteria

1.1 The working principles of hot water systems

**Range** (principles): expansion, temperature, pressure and its effect on the boiling point of water

**Range** (hot water systems): vented systems, indirect hot water, unvented systems, thermal storage, secondary circuits, storage systems, non-storage systems, localised, central plant

1.2 The application of hot water systems relevant to building layout and use
**Range:** commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments and pre-1919 traditional/historic buildings

1.3 The advantages and limitations of various hot water system types

1.4 The methods to protect, insulate and identify hot water pipework

1.5 The installation requirements specific to hot water pipework within the building
**Range**: pipework types, clipping and bracketry, routes and positions and typical sizes

1.6 Types of hot water generators installed on industrial and commercial hot water systems
**Range:** storage and non-storage calorifiers, heat exchangers, multi-point/single-point, direct fire storage heaters

1.7 The application and operating principles of renewable energy sources for hot water generation
**Range**: solar thermal hot water systems, ground source heat pumps, air source heat pumps

1.8 The advantages and limitations of renewable energy sources for hot water generation

## Learning outcome:

**2. Understand the applications, advantages and limitations of hot water system components, controls and accessories in relation to the working environment**

## Criteria

2.1 The basic operating principles and positions of functional control components used within industrial and commercial hot water systems
**Range:** strainers, pressure reducing valves, secondary pumps, cisterns, expansion vessels, automatic valves, service valves, blending valves, sacrificial anodes, heat exchangers, buffer vessels

2.2 The basic operating principles and positions of safety control components used within industrial and commercial hot water systems
**Range:** thermostats, energy cut-outs, pressure and temperature relief valves, expansion relief valves, open vent pipes, time control devices

2.3 The specialist terminal fittings installed on commercial hot water systems
**Range:** infared taps, concussive taps, vented taps, mixer taps

2.4 The storage and delivery temperatures of industrial and commercial hot water systems

2.5 The methods used to prevent scalding
**Range:** thermostatic mixing valves, maximum delivery temperatures, energy cut-out devices, signage

2.6 The methods used to prevent contamination
**Range:** storage temperatures, dead legs, insulation, secondary circulation, trace heating, sacrificial anode

2.7 The reasons for and effects of limescale within hot water systems

## Learning outcome:

**3. Understand the appropriate industry standards and regulations relevant to the installation of hot water systems**

## Criteria

3.1 The current regulations and standards relevant to industrial and commercial hot water systems

**Range:** The Building Regulations (G3 hot water supply and systems, L2A conservation of fuel and power in new buildings other than dwellings, L2B Conservation of fuel and power in existing buildings other than dwellings), British Standards (BS EN 806, BS EN 12897)

3.2 The limitations to authority for work on hot water systems

**Delivery outcomes (depth of content)**

**1**

Learners will understand the principles of hot water system generation and the requirements for accommodating the expansion of water in this type of system. Learners will know the different types of system layouts and the advantages and limitations to each along with their suitability to different applications and building types. The installation methods specific to hot water system pipework, the methods of protecting against damage, temperature loss and identification along with methods of generating hot water using energy saving technologies such as solar thermal systems.

**2**

Learners will understand the operating principles of the controls which allow hot water systems to function efficiently and safely. This includes safety and functional controls for vented and unvented systems. Learners will gain knowledge of time and temperature control of hot water systems and specific components which prevent contamination within the hot water system, the temperature controls which prevent scalding and the impact of limescale on items such as heat exchangers and pipework.

**3**

Learners will know the relevant industrial standards, Building Regulations and guidance documents relevant to the installation of hot water systems within industrial and commercial buildings. Learners will be aware of the current legal limits to their authority and practice relating to the specific licenses to practice for the installation of these systems such as unvented hot water certification.

# Unit 319HV: Understand Hydronic Heating Systems for Industrial and Commercial Buildings

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| **GLH:** | 28 |

## What is this unit about?

This unit covers the knowledge and understanding of the principles for hydronic heating systems and related components. Learners will gain an understanding of the system layouts, circuits, components, controls, heat generating equipment, heat emitters and the regulations, guidance and standards available to assist the learner to install these system components.

Learners will develop their knowledge and understanding of:

- the operation, applications, advantages, and limitations of hydronic heating systems
- the applications, advantages and limitations of hydronic heating systems components, controls, and accessories in relation to the working environment
- the types and applications of heat emitters used within industrial and commercial hydronic heating systems
- the appropriate industry standards and regulations relevant to the installation of hydronic heating systems.

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

- How do hydronic heating systems work?
- What are the installation requirements for hydronic heating systems?
- What are the different types of heat emitters, and how are they applied?
- What industry standards and regulations are relevant to the installation of hydronic heating systems in industrial and commercial buildings?

## Learning outcome:

**1. Understand the operation, applications, advantages, and limitations of industrial and commercial hydronic heating systems**

## Criteria

1.1 The working principles of hydronic heating systems

**Range** (principles): expansion, temperature, pressure and its effect on the boiling point of water, flow

**Range** (hydronic heating systems): one pipe system, two pipe parallel system, two pipe reversed return, up feed system, down feed system, ladder systems, open vented systems, sealed heating systems, LTHW, MTHW, HTHW, steam, underfloor heating, district heating, constant temperature circuits, variable temperature circuits

1.2 The application of hydronic heating systems relevant to building layout and use
**Range:** commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments and pre-1919 traditional/historic buildings

1.3 The operating temperatures of hydronic heating systems

1.4 The advantages and limitations of various hydronic heating system types

1.5 The methods to protect, insulate and identify hydronic heating system pipework
**Range:** painting, galvanising, water treatment, insulation types, BS 1710 pipe identification, pipe bandings, wrapping pipework

1.6 The installation requirements specific to hydronic heating system pipework within the building
**Range**: Pipework types, clipping and bracketry, routes and positions and typical sizes

1.7 Types of boilers and heat generating equipment installed within industrial and commercial hydronic heating systems
**Range:** modular, high efficiency, cast iron sectional, steel shell, water tube, low water content, plate heat exchangers, non-storage calorifiers, wall hung, cascade systems

1.8 The methods used to install boilers in position

1.9 The application and operating principles of renewable energy sources for hydronic heating systems
**Range**: solar thermal hot water systems, ground source heat pumps, air source heat pumps

1.10 The advantages and limitations of renewable energy sources for hot water generation

## Learning outcome:

**2. Understand the applications, advantages and limitations of industrial and commercial hydronic heating system components, controls, and accessories in relation to the working environment**

## Criteria

2.1 The basic operating principles and positions of components and accessories used within industrial and commercial hydronic heating systems
**Range:** expansion vessels, low loss headers, expansion bellows, expansion loops, dosing pots, air and dirt separators, pressurisation unit, feed and expansion cisterns, open vent pipe, manifold, temperature and pressure relief, motorised, gate, lockshield, DRV, NRV, test/metering station, 3 port diverting, 3 port mixing valve, 2 port valve, TRV, differential pressure control

2.2 The basic operating principles and positions of control devices used within industrial and commercial hydronic heating systems
**Range**: time controls, optimum start controllers, compensators, thermostats, BMS

2.3 The basic operating principles of circulating pumps for hydronic heating systems
**Range:** centrifugal pumps, shunt pump, variable temperature pump, constant temperature pump, primary pump, direct driven pump, belt driven pump

2.4 The installation methods and positioning of circulating pumps within hydronic heating systems

## Learning outcome:

**3. Understand the types and applications of heat emitters used within industrial and commercial hydronic heating systems**

## Criteria

3.1 The types and positioning of heat emitters used in industrial and commercial hydronic heating systems
**Range:** radiators, convector heaters, fan convectors, fan coil units, perimeter heating coils, radiant panels, LST radiators

3.2 The applications of heat emitters relevant to building use and layout
**Range:** commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments and pre-1919 traditional/historic buildings, maximum recommended surface temperatures for at risk ocupants

3.3 The advantages and limitations of various heat emitter types relevant to building type and use

3.4 The installation requirements specific to heat emitter types
**Range:** marking and measuring for radiators and wall mounted heat emitters, heights, final connection types, connection orientation

## Learning outcome:

**4. Understand the appropriate industry standards and regulations relevant to the installation of industrial and commercial hydronic heating systems**

## Criteria

4.1 Current regulations and standards relevant to hydronic heating systems
**Range:** (The Building Regulations): Part L2 – Conservation of fuel and power, L2a other than new dwellings, L2b other than in existing dwellings (British Standards): BS EN 14511 Heat Pumps, BS EN 303-5 Heating Boilers, BS EN 15316-4-7 Heating Plant, BS EN 378 Refrigeration and Heat Pumps, BSRIA Guide to renewable technologies, BESA TR20

**Delivery outcomes (depth of content)**

**1**
Learners will understand the principles behind hydronic heating. Learners will know the different system types including the methods to fill and charge, such as open vented and pressurised sealed systems. Learners will know the different piping arrangements and circuits within hydronic heating systems along with their operating temperatures and limitations within different scenarios. Learners will know the different types of heat generating equipment used to produce heat including boilers, heat exchangers and the use of energy saving technologies.

**2**
Learners will understand the key components, controls and accessories used within the hydronic system which maintain safe, functional, and efficient operation. This will include the control devices for time and temperature. Learners will also know the types of pumps used, their relative positions and the effect these positions have on the operation of the system.

**3**
Learners will know the types of heat emitters used within a range of industrial and commercial premises. Learners will know the types of heat emitter available and their advantages and limitations relative to their use and application. Learners will understand the temperature limits for heat emitter surfaces and suitable positions for fixing. Learners will know the installation methods specific to heat emitter types including connection arrangements, fixing and measurements.

**4**
Learners will be aware of the regulations, standards, and guidance documents applicable to the installation of hydronic heating systems and their related components. Learners will be able to identify the relevant documents but would not necessarily be expected to state all regulative statements within the documents at this stage. Learners will know where to find relevant guidance to enable them to install these systems.

# Unit 320HV: Understand Chilled Water Systems for Industrial and Commercial Buildings

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| **GLH:** | 28 |

## What is this unit about?

This unit covers the knowledge and understanding of the principles for chilled water systems and related components. Learners will gain an understanding of the system layouts, circuits, components and controls used within the system. Within this unit learners will know the basic principles behind the cooling of the water through the refrigerant cycle and learners will gain knowledge of chillers, heat absorption equipment, cooling towers, simple air conditioning systems which use heat pumps and also the regulations, guidance and standards available to assist the learner to install these system components.

Learners will develop their knowledge and understanding of:

- the operation, applications, advantages and limitations of chilled water systems
- the applications, advantages and limitations of chilled water system components, controls, and accessories in relation to the working environment
- the types and applications of terminal units and appliances used within chilled water systems
- the appropriate industry standards and regulations relevant to the installation of chilled water systems.

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

- How do chilled water systems work?
- What are the different types of chillers used?
- What are the different types of controls and accessories used in chilled water systems in industrial and commercial buildings?
- What are the industry standards and regulations that apply to chilled water systems in industrial and commercial buildings?

## Learning outcome:

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

## Criteria

1.1 The working principles of chilled water systems
**Range:** heat rejection systems, sealed circuits, air cooled systems, water cooled systems, primary circuits, secondary circuits

1.2 The application of chilled water systems relevant to building layout and use
**Range:** commercial, industrial, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments and pre-1919 traditional/historic buildings

1.3 The operating temperatures of chilled water systems

1.4 The advantages and limitations of various chilled water system types

1.5 The methods to protect, insulate and identify chilled water system pipework
**Range:** painting, galvanising, water treatment, insulation types, BS 1710 pipe identification, pipe bandings, wrapping pipework

1.6 The installation requirements specific to chilled water system pipework within the building
**Range**: pipework types, clipping and bracketry, phenolic blocks, routes and positions and typical sizes, vapour barriers, anti-vibration mountings

1.7 Types of **chillers** installed within chilled water systems
**Range:** air cooled chillers, water cooled chillers, absorption chillers

1.8 The basic principles of the refrigerant cycle
**Range:** vapour compression cycle, compressor, condenser, evaporator, expansion valve

1.9 The principles of cooling towers used in conjunction with water cooled chillers

1.10 The operating principles of **heat pump** technology for cooling systems
**Range:** air source heat pumps, ground source heat pumps

## Learning outcome:

**2. Understand the applications, advantages and limitations of chilled water system components, controls and accessories in relation to the working environment**

## Criteria

2.1 The basic operating principles and positions of components, controls and accessories used within chilled water systems
**Range:** two port valves, three port valves, four port valves, heat exchangers, buffer vessels, pumps, strainers, commissioning stations, commissioning valves, anti-vibration mountings, BMS

2.2 The advantages and limitations of components, controls and accessories used within chilled water systems

2.3 The basic operating principles of circulating pumps for chilled water systems
**Range:** centrifugal pumps, variable temperature pump, constant temperature pump, direct driven pump, belt driven pump

2.4 The installation methods and positioning of circulating pumps within chilled water systems

## Learning outcome:

**3. Understand the types and applications of terminal units and appliances used within chilled water systems**

## Criteria

3.1 The types of terminal units and appliances used in chilled water systems
**Range:** fan coil units, chilled beams, chilled ceilings, air handling units

3.2 The advantages and limitations of various terminal units and appliance types relevant to building type and use

3.3 The specific installation and connection requirements for terminal units and appliances used within chilled water systems
**Range:** pipework material types, flexible connections, drip trays, condenser connections, two/three/four port valves, actuators and motorised valves

## Learning outcome:

**4. Understand the appropriate industry standards and regulations relevant to the installation of chilled water systems**

## Criteria

4.1 Current regulations and standards relevant to chilled water systems

**Range:** The Water Supply (Water Fittings) Regulations, Document L – Conversation of Fuel and Power, TR/20 Installation and testing of pipework systems Part Six - Chilled water, manufacturer's instructions

**Delivery outcomes (depth of content)**

**1**

Learners will understand the principles and requirements for heat rejection from industrial and commercial buildings. Learners will understand the system layouts including primary circuits and secondary circuits to terminal units. Learners will know the types of chillers and the differences between air- and water-cooled chillers including the use of condenser circuits. Learners will understand the basic vapour compression cycle and the principles of how this is used to cool water within the chiller. Learners will know the specific requirements for the installation of chilled water systems including the need for a vapour barrier and they will be aware of the operating temperatures within the system. Learners will also be aware of the alternate methods of cooling using heat pumps and air conditioning systems.

**2**

Learners will understand the types, operation and basic advantages and limitations of selected components controls and accessories within the chilled water system. Learners will understand the principles behind basic controls such as BMS and terminal valves. They will know the types and positions of circulating pumps used within chilled water systems.

**3**

Learners will understand the types, operation, limitations, and specific installation requirements of a range of terminal units and appliances for the absorption of heat within a building. This will include air handling units, chilled beams, and fan coil units. Learners will also know the components, valves and materials used to make final connections to these units and appliances.

**4**

Learners will be aware of the regulations, standards, and guidance documents applicable to the installation of chilled water systems and their related components. Learners will be able to identify the relevant documents but would not necessarily be expected to state all regulative statements within the documents at this stage. Learners will know where to find relevant guidance to enable them to install these systems.

# Unit 321HV: Understand the Techniques for Decommissioning, Testing, Flushing and Charging of Industrial and Commercial Pipework Systems

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

## What is this unit about?

This unit covers the knowledge and understanding of the procedures used to make a system and its components safe through decommissioning. It will cover the procedures for flushing the system, for testing its integrity and for charging and filling with water. Learners are not expected to be able to commission a system at this stage but will know the procedures for filling and venting a system. The procedures for testing using gas or a liquid will be covered, as will the types of additives which should be included to each specific system.

Learners will develop their knowledge and understanding of:

- decommissioning of heating and ventilation equipment
- the appropriate testing procedures for confirming the system's integrity
- the methods and techniques for cleaning and flushing the system
- the charging of industrial and commercial pipework systems.

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

- What is the sequence of activities required to install typical heating and ventilation systems?
- What are the safe procedures for testing, commissioning and decommissioning heating and ventilation systems?

## Learning outcome:

**1. Understand the decommissioning of heating and ventilation equipment**

## Criteria

1.1 The purpose and types of decommissioning within the installation project
**Range**: permanent, temporary, sectional and zoned isolation

1.2 Ensuring the system is safe and ready to be decommissioned
**Range**: cold water supplies, cold water systems, hot water systems, hydronic heating systems, chilled water systems, steam and high temperature systems

1.3 Ensuring the components are safe and ready to be decommissioned
**Range:** pumps, pressurisation units, boilers, vessels, heat exchangers, terminal units, motorised valves, safety devices

1.4 The procedures for safe decommissioning of pipework systems and components
**Range:** identifying valves, labelling, preventing vacuums, locking off, double block and bleed, isolation procedure, method statement, risk assessments, permits to work, draining at low level

1.5 The procedures to follow when shutting off devices and components used to decommission and empty the system malfunction

1.6 Handling and disposing of system water

1.7 The electrical safe isolation procedure relevant to industrial and commercial building engineering systems
**Range:** single-phase isolation, three-phase isolation, pumps, actuators, boilers, pressurisation units

## Learning outcome:

**2. Understand the appropriate testing procedures for confirming the system's integrity**

## Criteria

2.1 Confirming that pipework systems are ready to receive soundness tests
**Range:** hot, cold, heating, chilled

2.2 Soundness testing procedures
**Range:** hydraulic test, pneumatic test

2.3 Equipment and plant for soundness testing
**Range:** types of test pumps, electrical, manual, gauges, stool pieces, safety barriers, signage

2.4 Quality assurance procedures to ensure that the test is successful

2.5 Actions that must be taken when inspection and testing reveal defects in pipework systems

## Learning outcome:

**3. Understand the methods and techniques for cleaning and flushing the system**

## Criteria

3.1 The purpose and advantages for flushing and cleaning the system

3.2 The equipment for flushing pipework systems
**Range:** power flushing equipment, hoses, chemical additives

3.3 The procedures for flushing and cleaning the system

## Learning outcome:

**4. Understand the charging of industrial and commercial pipework systems**

## Criteria

4.1 The differences in charging procedures between sealed and open systems

4.2 The pre-fill checks to be carried out before charging the systems
**Range:** check for open ends, valve positions, components which may be need specific fill procedures, visual inspection, customer liaison

4.3 Identifying supply sources and relevant valves before charging commences

4.4 The filling and charging procedures for pipework systems

4.5 The methods of air removal from charged systems

4.6 The types and properties of chemicals for use within pipework systems
**Range:** glycol, inhibitor, chlorine solutions, cleaners

4.7 The methods for chemical treatment of pipework systems including the handling and disposal of water and chemicals for treatment of pipework systems

**Delivery outcomes (depth of content)**

**1**

During site activities, learners may be expected to decommission existing systems to enable modification or replacement. This will enable learners to safely isolate, shut down and drain pipework systems including the safe and proper disposal of the system contents. Learners will know relevant valves and supply sources which will allow the system and its components to be isolated and they will know the isolation procedure for items such as appliances and pumps. The specific system isolation and decommissioning procedures should be covered for cold, hot, heating, and chilled systems including the prevention of air locks and vacuums. Learners will know the methods of disposal for system contents and what actions to take if valves and components for decommissioning have failed. Learners will know and understand the electrical safe isolation procedure and be able to carry this out. This will be carried out practically as part of the safety critical assessment. Learners will be able to utilise voltage indicating devices compliant with HSE GS 38 (Electrical test equipment for use on low voltage electrical systems). Learners will understand the need for safe isolation and understand the consequences of not following the procedure given in Electrical Safety First's Best Practice Guide for safe isolation or using equipment non-compliant with GS 38. Learners will understand the implications of safe isolation to the electrical equipment on the premises, and any resultant affects to people on the premises.

**2**

Learners will understand the specific procedures for ensuring that pipework systems are sound and leak free. This should include the procedures before testing, during the test period and the arrangements for witnessing and documenting the test results. Learners will understand the testing procedures for both hydraulic and pneumatic tests and the differences between the two - including the potential energy within pneumatic testing. Learners will know the actions to take when testing reveals defects in systems and components and they will be aware of the specific items which may not withstand test pressures, and the actions to take to ensure they are not damaged by testing.

**3**

Learners will gain an understanding of the importance of flushing and cleaning pipework installations. Learners will know the equipment required for the procedure and the specific chemicals used to flush the pipework and its components and will know the procedure for the flushing.

**4**

Learners will know how to charge and fill pipework within cold, hot, chilled, and heating systems. Learners will know the theory behind filling and air removal. Learners will know the methods for preventing air locks in the various system types. Learners will also know what checks to carry out before the system is charged to prevent damage to the system and the building fabric. Learners will know the visual checks which are required. Learners will know the advantages and the purpose of the different chemical additive types as well as the procedures for handling and disposing of the chemicals and system water content as required.

# Unit 322HV: Prepare, Fabricate and Install Heating and Ventilation Pipework Systems

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|---|---|
| **GLH:** | 105 |

## What is this unit about?

This is a performance unit and is for learners who install and carry out installation and fundamental testing and decommissioning of industrial and commercial heating and ventilating pipework systems.
The person performing this work must be able to comply with the correct procedures and practices.

The learner's work must 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, understanding and skills of:

- plan and prepare to install pipework systems
- install heating and ventilation systems
- decommissioning.

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

- What is the sequence of activities required to install typical heating and ventilation systems?
- What are the safe procedures that I will need to follow?

# Plan and Prepare to Install Pipework Systems

## Performance Criteria

**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**

**Criteria:** plant:

1.1 generators
1.2 transformers for low voltage hand tools
1.3 lifting equipment
1.4 access equipment

**Learning outcome:**

2. **Confirm that the site services are compatible with the system's design**

**Criteria:** site services:

2.1 electricity
2.2 water
2.3 gas
2.4 oil

**Learning outcome:**

3. **Produce a risk assessment and method statement in accordance with organisational procedures for the work to be carried out, including the identification and use of personal protective equipment**

**Learning outcome:**

**4. 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:** work location and work area:

4.1 new build construction – building or structure
4.2 an existing building or structure

**Criteria:** work location and work area (internal and/or external):

4.3 commercial
4.4 industrial
4.5 agricultural
4.6 horticultural
4.7 leisure and entertainment
4.8 residential medical and care facilities
4.9 public services establishments
4.10 pre-1919 traditional/historic buildings

**Learning outcome:**

**5. Select the equipment, components, and accessories to be installed ensuring they are fit for purpose and suitable for the working environment in which they are to be installed**

**Learning outcome:**

**6. Determine at the outset, that the plans for positioning and fixing equipment, components and accessories are in accordance with the working environment and manufacturer instructions**

**Learning outcome:**

**7. Comply with industry practices and organisational procedures to ensure the coordination of site services and the activities of other trades**

**Criteria:** organisational procedures:

7.1 information management
7.2 communication with relevant people
7.3 customer service

## Install Heating and Ventilation Systems

**Learning outcome:**

**8. Measure and mark out locations for fitting and fixing the selected equipment, components and accessories in accordance with the system's design and manufacturer instructions**

**Criteria:** equipment, components, and accessories:

8.1 pumps
8.2 heat emitters
8.3 valves (including motorised)
8.4 filters
8.5 traps and strainers
8.6 measuring instruments
8.7 prefabricated modules
8.8 supports and fixings
8.9 pipework

**Learning outcome:**

**9. Prepare, fit, fix, and connect the selected pipework and equipment, components and accessories using suitable jointing methods in accordance with the working environment and manufacturer instructions**

**Criteria:** jointing methods:

9.1 crimped/press fit
9.2 threaded
9.3 grooved
9.4 flanges
9.5 compression
9.6 adhesive

**Criteria:** pipework (systems):

9.7 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
9.8 hot water heating (low, medium, and high temperature)
9.9 cold water – storage/non storage
9.10 chilled water systems – air conditioning, refrigeration, heat rejection
9.11 steam

## Inspect, Test and Pre-Commission

**Learning outcome:**

**10. Perform inspection and pre-commissioning activities and procedures in accordance with:**

- **the system's design**
- **the working environment**
- **manufacturer instructions**
- **organisational procedures**

**Learning outcome:**

11. **Perform appropriate testing to confirm the integrity of the system and its associated equipment, accessories, and components**

**Criteria:** testing

11.1 pressure

**Criteria:** equipment, accessories, and components

11.2 pipework and fittings
11.3 valves
11.4 heat emitters
11.5 heat exchangers
11.6 prefabricated modules

**Learning outcome:**

12. **Carry out cleaning and flushing of the system**

**Criteria:** system

12.1 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
12.2 hot water heating (low, medium, and high temperature)
12.3 cold water – storage/non storage
12.4 chilled water systems

**Learning outcome:**

**13. Complete relevant documentation in accordance with organisational procedures**

## Decommission

**Learning outcome:**

**14. Decommission the system and its associated equipment, components, and accessories in accordance with the system's design, organisational procedures, the working environment and manufacturer instructions**

**Criteria:** system

14.1 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
14.2 hot water heating (low, medium and high temperature)
14.3 cold water – storage/non storage
14.4 chilled water systems – air conditioning, refrigeration, heat rejection
14.5 steam

**Learning outcome:**

15. **Ensure that the system cannot be accidently reactivated or become dangerous**