EAL Building Services Engineering (Level 3) – Heating and Ventilating Craftsperson C00/4278/6

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 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 Craftsperson 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 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. It is suitable for: • learners aged 16+ currently working in the trade area • 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 • learners who have completed the EAL Building Services Engineering (Level 3) – Heating and Ventilating Installation C00/4278/5 and are progressing to become a 'Heating and Ventilation Craftsperson'.
What does the qualification cover?	Learners will develop their knowledge, skills and understanding for the trade, as contained in the recognised standards. 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. The qualification will be portable throughout the UK and is aimed to develop learners' ability to meet the demands of the BSE sector in Wales.
What opportunities for progression are there?	On completion, the qualification will provide learners with the skills and knowledge required for the learner to be capable of working in their trade across the UK.

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

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.

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

Qualification structure

Rule of combination

To achieve Level 3 Building Services Engineering – Heating and Ventilating Craftsperson 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
323HV	Understand Complex Cold Water Systems for Industrial and Commercial Buildings	40
324HV	Understand Complex Hot water Systems for Industrial and Commercial Buildings	40
325HV	Understand Fuel Systems for Industrial and Commercial Heating and Ventilation Systems	50
326HV	Understand Complex Hydronic Heating and Chilled Water Systems for Industrial and Commercial Buildings	50
327HV	Understand Commissioning of Heating and Ventilation Systems for Industrial and Commercial Buildings	25
328HV	Understand how to Join Pipework by Welding	155
329HV	Install, Test, Commission and Decommission Complex Building Service Engineering Pipework Systems	105
N/A	Assessment (Graded and Safety Critical Assessment)	109
	Total GLH	1044

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 Building Services Engineering (Level 3) – Heating and Ventilating Craftsperson	1176	118

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 ongoing 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 ongoing 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.

*Learners who have achieved the Building Services Engineering (Level 3) – Heating and Ventilating Installation qualification may have recognition of prior achievement to the 'craftsperson' qualification's Test 1.

Therefore, where applicable learners who have completed the Building Services Engineering (Level 3) – Heating and Ventilating Installation qualification would have to achieve the following assessments only in the Building Services Engineering (Level 3) – Heating and Ventilating Craftsperson qualification to successfully achieve:

- Test 2 (HV Craftsperson)
- Practical Project
- Professional Discussion.

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 1.2 Set success criteria for the task(s) 1.3 Carry out effective planning 1.4 Rationalise why the proposed approach is the most appropriate 1.5 Recognise cost and waste implications of the work 1.6 Manage risks associated with completing the task and recognise the steps to be taken to stop risks becoming problems 1.7 Identify the handover requirements of work. 2.1 Review the appropriateness of success criteria set 2.2 Evaluate the resource selection and usage 2.3 Evaluate the finished output 2.4 Evaluate own performance 2.5 Review the achievement of timescales 2.6 Evaluate the handover.	304 – (LO1, LO2)
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.	302 – LO2
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 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

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

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

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

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

4.7 The principles of a siphon

Learning outcome:

5. Understand the 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

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

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 licences 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

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

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 323HV: Understand Complex Cold Water Systems for Industrial and Commercial Buildings

GLH:	40

What is this unit about?

This unit covers the knowledge and understanding of complex cold water systems. Learners will develop their knowledge of the specifics of the Water Supply (Water Fittings) Regulations and its requirements. Learners will develop their understanding of boosted cold water systems for industrial and commercial buildings and reclaimed water systems and will know the operation of control systems and components which are required to allow the system to operate. Learners will understand the processes involved in selecting and sizing the pipework and components for industrial and commercial cold water systems. This unit does not provide learners with the full approved status to a recognised approved contractor scheme for the understanding of the Current Water Supply (Water **F**ittings) Regulations.

Learners will develop their knowledge and understanding of:

- the requirements of The Water Supply (Water Fittings) Regulations
- the applications of complex systems, equipment, components and accessories in relation to the working environment
- the methods for determining the type and size of equipment, components and accessories for the system.

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

- How do the Water Regulations apply to cold water systems in industrial and commercial buildings?
- How can I determine the suitability of cold water systems to the building type?
- Why is it important to adequately size pipe work for cold water systems in industrial and commercial buildings?

Learning outcome:

1. Understand the requirements of the Water Supply (Water fittings Regulations)

Criteria

1.1 The requirements of the Water Regulations
Range: scope of the regulations, restrictions, persons installing water fittings, penalties, water undertakers responsibilities, British Standards

1.2 The key factors and terms within the interpretation of the Water Regulations

1.3 Suitability of materials and substances for use with potable water installations
Range: pipework materials, fittings, jointing compounds, above and below ground, plastics, corrosion, galvanic action, dezincification

1.4 The requirements for installed water fittings
Range: water tightness, prevention of ingress from contaminants, prevention from damage by freezing and other causes, prevention from deterioration by permeation, the supporting pipework, the fixings for water fittings, pressure tolerances

1.5 The notification requirements for the installation of water fittings

1.6 The different categories of water in relation to wholesome and non-wholesome water

1.7 The backflow prevention fluid categories

1.8 The requirements for backflow, back pressure and back siphonage prevention
Range: accessibility of the mechanical backflow protection device, location, the installation of line strainers, the lowest point of discharge from the ground and termination with a Type AA air gap, upstream and downstream, mechanical, air gaps, whole site and zone protection

1.9 The requirements for the installation of cold water to appliances and water fittings
Range: sinks, wash hand basins, baths, water heaters, boilers, showers, WCs, cisterns, hot water systems, terminal fittings, urinals

1.10 The requirements for water supplies for outside use

1.11 The requirements for appliances which are supplied by or incorporate a pump

1.12 The requirements for water supplies incorporating water re-use systems
Range: rainwater systems, grey water systems

1.13 The requirements for the provision, location, and operation of valves
Range: stop valves, drain off valves, servicing valves, pressure reducing valves, float operated valves, pressure flushing valves

1.14 The prevention of dead legs within cold water pipework systems

1.15 The distribution temperature of cold water systems

Learning outcome:

2. Understand the applications of complex systems, equipment, components and accessories in relation to the working environment

Criteria

2.1 The installation layouts of industrial and commercial cold water distribution systems within the building
Range: direct systems, indirect systems, boosted systems, rainwater harvesting systems, greywater systems

2.2 The control of boosted cold water systems

2.3 The operation of control devices and components used within boosted cold water systems
Range: pumps, pressure reducing valves, break cisterns, float operated valves, float operated switches, level switches, pressure switches, pressure vessels, automatic air vents, delayed action float valves, transducers, low level switches, accumulators

2.4 The suitability of cold water systems relative to the building type
Range: high demand, low demand, intermittent use, regular use, building height, building use, the requirement for storage, pressure requirements

Learning outcome:

3. Understand the methods for determining the type and size of equipment, components, and accessories for the system

Criteria

3.1 The factors to be taken into consideration when designing complex water systems
Range: daily consumption, maximum average flow rates required, availability of mains supply, variances and surges in pressure, environmental considerations

3.2 The methods used to calculate the size of water pipework for cold water services

3.3 The methods used to calculate the requirements of water system components
Range: pump, accumulator, cistern

Delivery outcomes (depth of content)

1
Learners will understand the requirements of the Water Regulations and will gain the knowledge associated with installation of cold water systems in a compliant manner.

Learners will understand the suitability of materials and fittings, key terms and factors, notifications, backflow prevention, temperatures, contamination, and the requirements for equipment and appliances.

2
Learners will advance their knowledge of cold water systems by considering more complex systems such as boosted cold water and reclaimed water systems in more detail. Learners will understand how systems are controlled and the control devices used, such as: level controls, accumulators, pressure switches and transducers. Learners will understand the operation and control of grey water and rainwater systems and will consider the applications of complex systems within a range of industrial and commercial buildings. Learners will know the factors which contribute to the suitability of such systems in industrial and commercial buildings such as: height, pressure, and demand.

3
Learners will understand the design elements applicable to cold water systems. Learners will know how to correctly size cold water pipework for industrial and commercial buildings and select suitable components and equipment. Learners will calculate the size of pipework, pumps, accumulators and cisterns.

Unit 324HV: Understand Complex Hot Water Systems for Industrial and Commercial Buildings

GLH:	40

What is this unit about?

This unit covers the knowledge and understanding of the principles for industrial and commercial complex hot water systems and their installation. Learners will gain an understanding of how to size systems and components for hot water systems and the specific requirements for the installation of unvented hot water systems systems in line with current Building Regulations.

Learners will develop their knowledge and understanding of:

- the layouts and operation of complex hot water systems for industrial and commercial buildings
- the requirements for installing unvented hot water systems in accordance with the relevant Building Regulations
- the methods for determining the type and size of equipment components and accessories for complex hot water systems.

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

- What are the typical configurations of vented and unvented hot water systems?
- What are the applicable Building Regulations for hot water systems in industrial and commercial buildings?
- How is the size of the equipment, components, and accessories determined for hot water systems?

Learning outcome:

1. Understand the layouts and operation of complex hot water systems for industrial and commercial buildings

Criteria

1.1 The types and configurations of vented hot water systems
Range: centralised systems, open vented hot water systems, localised systems, instantaneous vented heaters, indirect storage systems (include water jacketed tube heaters), direct storage systems, electrically heated, gas or oil fired, bulk storage heaters (combination tank)

1.2 The types and configurations of unvented hot water systems
Range: unvented point of use heaters, localised, centralised, indirect storage systems, combination boilers, internal expansion cylinders

1.3 The types and configurations of solar thermal hot water systems

1.4 The pipework layout features of complex hot water systems for industrial and commercial buildings
Range: direct and indirect, vented and unvented, direct and indirect, cylinders, calorifiers, solar thermal, thermal stores, combination boilers, secondary circulation, location of pump and type automated timing devices methods of balancing systems, control systems including BMS

Learning outcome:

2. Understand the requirements for installing unvented hot water systems in accordance with the relevant Building Regulations

Criteria

2.1 The documents which should be followed when installing, repairing or maintaining unvented hot water systems
Range: Building Regulation Document G3, Gas Safety (installation and use) Regulations, manufacturers instructions, The Water Supply (Fittings) Regulations

2.2 The recommended design temperatures for hot water systems

2.3 The types and operation of safety controls used within Unvented Hot Water systems
Range: thermostat, ECO, temperature and pressure relief valve

2.4 The types and operation of functional controls used within unvented hot water systems
Range: Line strainer, pressure relief valve, check valves, expansion vessel/integral vessel, tundish, composite valves

2.5 Methods of preventing water exceeding 100°C

2.6 The methods of ensuring balanced pressures within unvented hot water systems

2.7 The installation and positioning requirements for safety discharge pipework

2.8 The specific commissioning requirements for unvented hot water systems
Range: visual checks, temperature adjustment, flow rates, pressures, safety devices

2.9 The cause and rectification methods of common faults related to unvented hot water systems
Range: expansion relief valve discharging, temperature relief valve discharging, low pressure, no heat

2.10 The requirements for competence and limitations to authority when carrying out work on unvented hot water systems

Learning outcome:

3. Understand the methods for determining the type and size of equipment components and accessories for complex hot water systems

Criteria

3.1 The factors to be taken into account when designing complex hot water systems
Range: daily consumption, maximum average flow rates required, availability of mains supply, variances and surges in pressure, environmental considerations

3.2 The methods used to calculate the size of hot water discharge pipework and components

3.3 The methods used to calculate the requirements of hot water systems and components
Range: water heaters, calorifiers, pipework, cisterns

Delivery outcomes (depth of content)

1
Learners will understand the layouts and operation of complex hot water systems for industrial and commercial buildings. Learners will understand the layout of more complex hot water systems used within industrial and commercial buildings. Learners will know the layouts of these systems including unvented systems, indirect centralised systems which incorporate plate heat exchangers, localised and instantaneous heaters and storage calorifiers along with the requirement for secondary circuits. Learners will know the layouts of solar hot water systems and all relevant controls to make these systems operational. Learners will be comfortable with the requirement for control of temperature and time and will know how a BMS are incorporated into a hot water system.

2
Learners will understand the requirements for installing unvented hot water systems in accordance with the relevant Building Regulations

Although this unit will not automatically award learners with a licence to practice on unvented hot water systems, it will give learners the knowledge of what is expected to gain the licence to practice. Learners will know the requirements for the installation of unvented hot water systems in line with the Building Regulations Part G. Learners will know how to install and position the components and controls associated with unvented systems and the specific requirements for the safety discharge pipework. Learners will know the difference between functional and safety controls, the operation, position and order of these controls in relation to the cold water supply and the hot water vessel. Learners will know the basic checks specific to UVHW systems which should be carried out before putting the system into operation and the common faults to be expected on the system along with the methods used to rectify them. It is important that learners know the limitation to their authority when working on UVHW systems.

3
Learners will understand the methods for determining the type and size of equipment components and accessories for complex hot water systems.

Learners will develop their knowledge regarding the selection and design of hot water systems for industrial and commercial buildings. Learners will be able to select suitable system and component types dependent on the building consumption, use and layout. Learners will be able to select and size system and component parts such as heaters, calorifiers, pipework and cisterns. Learners will also be able to calculate the size of the discharge pipework and associated components.

Unit 325HV: Understand Fuel Systems for Industrial and Commercial Heating and Ventilation Systems

GLH:	50

What is this unit about?

This unit covers the knowledge and understanding of the options available for fuel supplies to heat producing equipment in industrial and commercial buildings. Learners will understand the regulations attached to these fuel types and the methods used to select and size, install and test the fuel system pipework in line with current regulations and requirements.

Learners will develop their knowledge and understanding of:

- the applications, advantages and limitations of different fuel supply systems and components used within industrial and commercial heat producing appliances
- the combustion of fuels for industrial and commercial heat producing appliances
- the basic ventilation and fluing requirements for industrial and commercial heat producing appliances
- the appropriate industry standards and regulations relevant to installing fuel systems
- the methods, techniques and jointing methods for fitting, fixing and connecting natural gas and LPG pipework
- the methods and techniques for purging and confirming the integrity of installed fuel systems
- the methods for determining the type and size of equipment and components used in gas systems.

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

- What are the different types of fuels used in heat producing appliances?
- What is the combustion process used in commercial heat producing appliances?
- What are the ventilation fluing requirements?
- How do the industry standards and regulations apply to the installation of fuel systems?

Learning outcome:

1. Understand the applications, advantages and limitations of different fuel supply systems and components used within industrial and commercial heat producing appliances

Criteria

1.1 The types of fuel gases used in industrial and commercial applications
Range: natural gas, LPG, biogas

1.2 The types of solid fuel alternatives in industrial and commercial applications
Range: woodchip, biomass, wood pellets, chipped coal

1.3 The types of fuel oil used in industrial and commercial applications
Range: category C, D, E, F, G oils, kerosene

1.4 The advantages and limitations of the range of fuels
Range: storage requirements, distribution limitations, site location, local restrictions to the use of smoke producing fuels, maintenance requirements, efficiency, environmental factors

1.5 The storage requirements for commercial solid fuels

1.6 The features and requirements of oil storage tanks

1.7 The distribution network for natural gas supplies

1.8 The storage requirements of LPG gases

Learning outcome:

2. Understand the combustion of fuels for industrial and commercial heat producing appliances

Criteria

2.1 The types of heat producing appliances used within industrial and commercial buildings
Range: package boilers, sectional boilers, shell and tube boilers, modular boilers, water heaters, warm air heaters, radiant tube heaters

2.2 The properties of a range of fuels for commercial heat producing appliances
Range: calorific value, flammable limits, stoichiometric mixtures, waxing, flash temperatures, Wobbe index, specific gravity, flame speed, flame temperatures, gross and net efficiency, pressure, natural gas, fuel oil, biomass

2.3 The combustion process as it applies to fuels used in commercial heat producing appliances

2.4 The main causes of incomplete combustion with solid fuels

2.5 The potential effects of carbon monoxide when incomplete combustion takes place

2.6 The measures necessary to ensure that exposure to carbon monoxide does not take place

Learning outcome:

3. Understand the basic ventilation and fluing requirements for industrial and commercial heat producing appliances

Criteria

3.1 The function and operation of a flue

3.2 The types and categories of flues used for industrial and commercial appliances
Range: natural draught, forced draught, induced draught, room sealed, open flue, flue dilution

3.3 Types of materials suitable for flues
Range: twin wall flue pipe, single wall flue pipe, metal flue liner, concrete liner, flue blocks, high alumina cement pipes, kiln burnt/pumice pipes, salt glazed pipe, clay liners, stainless steel, plastics

3.4 The components found within flue systems
Range: primary flue, secondary flue, down draft diverter, terminals, flue draft stabiliser, fans, pressure switches, flow switches, thermal insulation

3.5 The reasons for ventilation

3.6 The methods of providing ventilation
Range: natural ventilation, mechanical ventilation, ducted ventilation, high level, low level, grills, vents, balanced compartment

3.7 The signs of inadequate ventilation

Learning outcome:

4. Understand the appropriate industry standards and regulations relevant to installing fuel systems

Criteria

4.1 The types of statutory legislation, standards and guidance information that applies to the installation of industrial and commercial fuel supply systems
Range: Gas Safety Regulations, IGEM/UP/2, HSL56 Reg 24, OFTEC technical publications, Building Regulation (Part A, Part B Vol. 2, Part F, Part J, Part L2A and L2B, Part P), Institute of Gas Engineers and Managers Standards, British and European standards, Non-Domestic Building Services Compliance Guide, Manufactures information, Control of Substances Hazardous to Health (COSHH), Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), Pressure Systems Safety Regulations (PSSR), Pressure Equipment Directive (PED), Clean Air Act

4.2 The responsibilities and limitations to authority of key personnel relating to the installation of fuel supply systems and equipment

4.3 The procedure for notifying works carried out to the relevant building control body

4.4 The key professional bodies who represent the fuel industry
Range: Gas safe, OFTEC, HETAS

Learning outcome:

5. Understand the methods, techniques and jointing methods for fitting, fixing and connecting natural gas and LPG pipework

Criteria

5.1 The types of **materials** used for gas pipework
Range: copper, LCS, PE, corrugated stainless steel

5.2 The different jointing methods used for gas pipework
Range: welding, flanges (welded and screwed), flange categories, union joints, screwed, semi-ridged couplings, compression fittings, CSST fittings, electro fusion weld, capillary joints, press-fit, swivel joints, quick release coupling, brazing, expansion joints

5.3 The safety control devices used on gas pipework
Range: emergency controls, manual isolation valves, automatic isolation valves, automatic valve shut off times, meters, regulators, non-return valves, filters, solenoids, safety shut off valves, boosters, proving systems, low pressure cut-off valve, pressure/flow switch

5.4 The requirements for supporting gas pipework

5.5 The requirements for sleeving gas pipework through walls

5.6 The restrictions and requirements for installing gas pipework in ducts, voids and underground

5.7 The pressure ranges of gas pipework systems

5.8 The methods of protecting and identifying gas pipework

5.9 The protection of pipework, appliances and equipment against vibration

5.10 The requirements for equipotential bonding of gas pipework and components

5.11 The methods of installing gas pipework in multi-story/multiple dwellings

Learning outcome:

6. Understand the methods, techniques, and jointing methods for fitting, fixing, and connecting oil pipework

Criteria

6.1 The types of materials used for oil pipework
Range: copper, LCS

6.2 The different jointing methods used for oil pipework
Range: threaded, welded, brazed, manipulative joints

6.3 The safety measure used in conjunction with oil pipework
Range: isolation valves, emergency control valves (ECV, AECV), filters, de-aerators, fire valves, fusable links, steel tanks, plastic tanks, integrally bunded tanks, underground tanks, fill pipe, extended fill pipe, vent pipe, drain valve, contents gauge, overfill alarms, fire stops, riser air vents

6.4 The requirements for supporting oil pipework

6.5 The requirements for sleeving oil pipework through walls

6.6 The methods of protecting and identifying oil pipework

6.7 The types of oil supply systems
Range: gravity, pumped, one pipe, two pipe

6.8 The requirements for equipotential bonding of oil pipework and components

Learning outcome:

7. Understand the methods and techniques for purging and confirming the integrity of installed fuel systems

Criteria

7.1 The procedures for testing and purging gas supplies in accordance with IGE/UP1A

7.2 The procedures for testing and purging oil supplies

Learning outcome:

8. Understand the methods for determining the type and size of equipment and components used in gas systems

Criteria

8.1 The methods for sizing and selecting ventilation requirements for gas appliances

8.2 The method for calculating pipe sizes for gas pipework systems

8.3 The methods of determining gas meter size and suitability

8.4 The methods of determining purge point sizes

Delivery outcomes (depth of content)

1
Learners will know and understand the types of fuels available and for use with industrial and commercial heat producing equipment. This will include natural gas, LPG, oil, and solid fuels. Learners will identify the limitations and advantages for each such as the environmental impacts of each along with the restrictions to some fuels and their use in smoke-controlled areas. The limitations also apply to the need for storage for some fuels and the arrangements needed for this storage.

2
Learners will know the properties of fuels used. Learners will understand the individual requirements regarding air ratios, the formulas relative to complete and incomplete combustion and further properties specific gravity and calorific value. Learners will know the difference between gross and net values of a fuel and the different types of heat producing appliance found within an industrial and commercial building. Learners will also know the effects and causes of carbon monoxide from appliances and how carbon monoxide can be prevented.

3
Learners will identify the different flue and ventilation strategies attached to a range of boiler and water heater types, in particular open flued, forced draught and room sealed appliances. Learners will know the category types attached to these arrangements and the relationship between flues and ventilation. Learners will know the difference between open and sealed appliances and how the different burner types fall into the different categories. As well as the principles of these arrangements, learners will know the types of flues in regard to their layout, components and their construction.

4
Learners will be aware of the regulations, standards and guidance which exists in relation to the fuel systems involved. Learners will know the limitations to their authority with regards to the installation of these systems and associated components as well as some of the specific rules and guidance within these documents and publications. This unit is not designed to cover the whole width of these specific Regulations such as The Gas Safety (Installation and use) Regulations but will give the learners a knowledge of the basic requirements. Learners will be able to identify the relevant documents and guidance which may offer the information they require within the workplace. These industry standards and regulations should be relevant to natural gas, LPG, oil systems and solid fuels.

5
Learners will know and understand the installation methods used to install gas pipework. Although it does not generate a licence to practice, it is aimed at giving learners the knowledge to install Gas and LPG pipework in line with IGE/UP/2 and offer them a limited scope understanding of the requirements to install first fix gas pipework within an industrial

and commercial building up to 150mm in diameter in non-domestic premises without connecting to a supply.

6
Learners will know the types of oil pipework arrangements from the tank via all safety and operational controls to the appliance. Learners will know gravity and pumped installation arrangements and will know the methods for installing and joining pipework both externally and internally within the building. It is important that learners know the arrangements for safety components and their suitable location in relation to each other, the tank and the appliance.

7
Although this unit and outcome is not directly associated with a licence to practice and does not generate a certificate to practice it is expected that learners will understand the procedures to carry out a purge (commission and decommission) and a tightness test on gas systems in line with IGE/UP/1a. Learners will know how to specify a strength test and tightness test and describe purging procedures. Learners will know the procedure for ensuring a fuel oil system is sound and ready to receive oil.

8
Learners will know the procedures involved in selecting and sizing gas pipework and components. This will include the basic gas pipework sizing procedure and confirming a meter is adequate for the system. Learners will know how to size basic ventilation openings and due to the complex nature and large range of ventilation types it is expected that this is limited to natural ventilation for open and room sealed appliances. Learners will also know how to determine purge point diameters.

Unit 326HV: Understand Complex Hydronic Heating and Chilled Water Systems for Industrial and Commercial Buildings

GLH:	50

What is this unit about?

This unit covers the knowledge and understanding of the installation of industrial and commercial complex hydronic heating and chilled water systems and its operating principles. Learners will gain an understanding of how to size systems and components for both hydronic heating and chilled water systems.

Learners will develop their knowledge and understanding of:

- the operation and application of complex hydronic heating systems, controls and components
- the operation and application of complex chilled water systems, controls, and components
- the methods for selecting and determining the size of hydronic heating and chilled water systems and components.

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

- What are the circuits and controls applicable to complex hydronic heating and chilled water systems in industrial and commercial buildings?
- What are the methods for selecting components off hydronic heating and chilled water systems?

Learning outcome:

1. Understand the operation and application of complex hydronic heating systems, controls and components

Criteria

1.1 The layout and application of variable temperature constant flow circuits

1.2 The layout and application of constant temperature variable flow circuits

1.3 The controls and components used within variable temperature and constant temperature circuits
Range: pumps, pressure switches, 3 port mixing valves, 3 port diverting valves, flow sensors, gauges, double regulating valves, BMS, compensation control, optimum start control

1.4 The layout of primary and shunt circuits within the plant and boiler room
Range: low loss headers, cascade systems, skids, manifolds, boiler connections, the connection of circuits to low loss headers, cold fill locations

1.5 The controls and components used within primary and shunt circuits
Range: pumps, pressure switches, strainers, air/dirt separators, safety valves, dosing pots

1.6 The configuration of boiler room and plant room pipework layouts

Learning outcome:

2. Understand the operation and application of complex chilled water systems, controls, and components

Criteria

2.1 The layout and application of chilled water circuits

2.2 The controls and components used within chilled water circuits
Range: pumps, pressure switches, 3 port valves, 4 port valves, flow sensors, gauges, double regulating valves, BMS, compensation control, optimum start control

2.3 The connections methods used to connect to chillers
Range: air cooled, water cooled, anti-vibration mountings and connections

2.4 The methods of fixing and connecting to terminal units
Range: air handling units, fan coil units, chilled beams

2.5 The controls and components used within primary and shunt circuits
Range: pumps, pressure switches, strainers, air/dirt separators, cold fill connections, safety valves, dosing pots

Learning outcome:

3. Understand the methods for selecting and determining the size of hydronic heating and chilled water systems and components

Criteria

3.1 The principles of thermal comfort within a building
Range: internal and external heat gains, human factors, locations, degree days

3.2 The methods to determine the heat loss from buildings
Range: calculation, computer software, analogue calculators, fabric loss, ventilation loss, U Values

3.3 The principles of flow requirements through chilled water and hydronic heating pipework systems
Range: mass flow rates, resistance of pipework and fittings, static head, velocity and maximum flow rates, heat input requirements, laminar and turbulent flow

3.4 The methods of calculating pipe sizes for heating and chilled water pipework

3.5 The methods of calculating component sizes for hydronic heating systems
Range: pump size, expansion vessel size, boiler size, heat emitter size

Delivery outcomes (depth of content)

1
Learners will know and understand hydronic heating system layout arrangements moving into more complex system circuits such as boiler room layouts, variable temperature circuits, compensated control and shunt circuits including the use of low loss headers and manifolds (such as cascade systems and skids). Learners will be able to justify the positioning of components.

2
Learners will know and understand chilled water system layout arrangements moving into more complex system circuits such as plant room and roof top pipework layouts, 3 port valves at air handling units, and condenser circuits to cooling towers. Learners will be able to justify why components are positioned and in their given positions.

3
Learners will know and understand the thermal indices and design criteria within the heating and cooling of the building. Learners will know the factors involved in human comfort. Learners will be able to determine the heat losses from a building which could be used to determine the heating system capacity. It is not expected that learners will determine heat gains due to the complex nature of this process and the many variables, but learners will be able to determine flow rates and pipe sizes for chilled water systems and hydronic heating systems (as the process is very similar). Learners will be able to expand this by determining the heat emitter sizes and the requirements for boilers, pumps, and expansion vessels for heating systems.

Unit 327HV: Understand Commissioning of Heating and Ventilation Systems for Industrial and Commercial Buildings

GLH:	25

What is this unit about?

This unit covers the knowledge and understanding of the procedures involved in commissioning cold water, hot water, hydronic heating and chilled water systems.

Learners will develop their knowledge and understanding of:

- the equipment, procedures and checks required in the pre-commissioning and final commissioning of systems
- the adjustments required to ensure its effective performance.

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

- What are the methods and techniques used for commissioning heating and ventilation systems in industrial and commercial buildings?
- What documentation is used to record the performance of the system?

Learning outcome:

1. Understand the methods for confirming that the equipment, components and accessories installed are suitable and fit for purpose

Criteria

1.1 The appropriate industry standards and regulations relevant to inspecting, pre-commissioning and commissioning systems
Range: cold water systems, hot water systems, hydronic heating systems, chilled water systems

1.2 The organisational procedures used to confirm that equipment, components and accessories are installed correctly and are fit for purpose
Range: quality control procedures, specification, snagging lists, installation and as fitted drawings, schematic diagrams, site meetings

1.3 The checks to confirm that the equipment components and accessories are fitted correctly and ready to be commissioned
Range: visual inspection, system design criteria, pre-commission check lists, brackets are suitable, components are fitted, fixed and connected correctly, specification

Learning outcome:

2. Understand the methods and techniques for commissioning the systems and their associated equipment, components and accessories

Criteria

2.1 The types of test equipment and associated components for use in the commissioning of wet systems
Range: metering stations, binder points, double regulating valves, pressure reducing valves, flow metering devices, commissioning sets, manometer, poddy meter, orifice plates, differential meters, weir gauge, pressure gauge, thermometers

2.2 The purpose of and basic operation of test equipment and associated components

2.3 The basic procedures for establishing the performance of installed systems

Range (procedures): how to connect manometers, poddy meters and differential gauges, measuring flow rates and pressures, taking flow and return temperatures

Range (systems): cold water systems, hot water systems, hydronic heating systems, chilled water systems

2.4 The basic procedures for adjusting systems performance when they do not meet design requirements
Range: balancing the system, comparing to design criteria, adjusting flow rates and pressures

2.5 The methods for filling and charging the systems and the removal of air

2.6 The procedures for adding water treatment and chemicals for the protection of the system

2.7 The procedures for recording the performance of commissioned systems
Range: relevant people, customer/client acceptance, completing commissioning documentation, operation and maintenance manuals, handover procedures, water quality checks, biocide tests

Delivery outcomes (depth of content)

1
Learners will know and understand the pre-commissioning checks to be carried out before the system is commissioned and adjusted. This focuses on cold water, hot water, hydronic heating, and chilled water systems and although pre-commissioning checks are relatively generic regardless of the system, this will contextualise the main differences regarding specific components and materials from system to system. Learners will know the procedures and documentation required to pre-commission systems.

2
Learners will know and understand the equipment and components required to commission a system, and the basic methods to connect and establish performance and what can be done to adjust the system to ensure its effective performance. It is not expected that learners will be able to fully commission a system, but they will know the effects of adjusting the components such as double regulating valves and how the adjustments can be checked. Learners will know and understand how balancing is carried out, the methods of filling charging and venting the systems and types of water treatment which should be added.

Unit 328HV: Understand How to Join Pipework by Welding

GLH:	155

What is this unit about?

This unit covers the knowledge, understanding and skills of how to prepare and safely carry out pipe welding procedures using Tungsten Inert Gas (TIG) and Manual Metal Arc (MMA) and Oxy-Acetylene (OA). Learners will understand the quality assurance processes of identifying and rectifying faults in completed pipe welds.

Due to the practical nature of this unit it is expected that learners will spend a suitable period of time within a supervised environment in the centre practicing the relevant skills involved. Both MMA, TIG and OA welding processes are included within this unit and it is expected that the centre will give learners some practical experience of all processes, although it may be desirable to focus on one skill in more depth depending on centre facilities and time constraints. This unit is not designed to generate a competency-based licence to practice but it may be an opportunity to allow learners to reach an industrial standard which could allow them the opportunity to attempt the BESCSA provisional welding test if so desired.

Learners will develop their knowledge, understanding and skills of:

- the safety safe working practices when carrying out welding activities
- the appropriate industry standards and regulations
- the different welding techniques
- the different types of welding equipment and how to assemble, adjust, operate, and maintain them
- the different types of welding consumables and fittings
- the methods and procedures for preparing pipework that is to be welded
- the techniques used to join pipework in fixed, rotated, and restricted positions by welding
- how the mechanical properties of materials change through being joined by welding
- the quality control process and different methods of testing completed welded joints
- how to interpret diagrams and drawings.

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

- Why is it essential to work safely when carrying out welding?
- What are the different methods and techniques used for welding and how do the industry standards and regulations apply?
- How does welding effect the properties of materials?
- What is the process used to quality control and test welded joints?

Learning outcome:

1. Understand the safety safe working practices when carrying out welding activities

Criteria

1.1 The safe working practices when welding

Range: work area, fire watch, method statements, hot work permits, risk assessments, PPE

1.2 The common hazards associated with welding

Range: temperature, noise, fumes, gases, radiant heat, electricity, chemicals, fire

1.3 Precautions to prevent fires and explosions

1.4 PPE for different situations when welding

1.5 The specific safety requirements relating to the various working environments where pipe welding activities can take place

1.6 The requirements for setting up the work area for safe welding of pipework

Range: screens, barriers, noise control, trip hazards, PPE, manual handling, hot work permit, storage of materials, ventilation

1.7 how to store welding consumables and materials safely and identify defects

Learning outcome:

2. Understand the appropriate industry standards and regulations relevant to welding and how to apply them

Criteria

2.1 The current regulations relating to welding pipework

Range: health and safety legislation, Reporting of Injuries, Dangerous Diseases and Occurrences Regulation (RIDDOR), Electricity at Work (EAWR), Provision and Use of Work Equipment Regulations (PUWER), Control of Substances Hazardous to Health (COSHH)

2.2 The specific standards relevant to welding pipework

Range: TR5, Building Engineering Services Competence Assessment (BESCA)

Learning outcome:

3. Understand the applications, advantages, limitations and factors associated with different welding techniques

Criteria

3.1 The different types of pipe welding process

Range: manual metal arc (MMA), tungsten inert gas (TIG), oxy-acetylene gas welding

3.2 The different techniques and positions of pipe welding

Range: down hand, vertical up, horizontal vertical, overhead, set-on branch, fillet, multi-run welds, 1G, 2G, 5G, 6G

3.3 The advantages and limitations of different pipe welding techniques

Learning outcome:

4. Understand the applications, advantages and limitations of different types of welding equipment and how to assemble, adjust, operate and maintain them

Criteria

4.1 The types of welding sets available for a range of welding processes

Range: A.C and D.C/polarity, arc welding sets, gas welding, generators, rectifiers, transformers, inverter

4.2 The methods used to ensure that welding plant is suitable for the welding process and task

4.3 The use of different types of welding plant

4.4 The advantages and limitations of different welding plants

Learning outcome:

5. Understand the applications, advantages and limitations of different types of welding consumables and fittings

Criteria

5.1 The types of pipework, fittings and materials suitable for pipe welding
Range: grades of low carbon steel, stainless steel, flanges, fitting and fixing accessories

5.2 The types and applications of TIG welding and MMA welding consumables and fittings
Range: welding torch, hoses (water or air), gas flow meter, gas source, tungsten, nozzle, collet, gas lenses, collet body, back cap, flange square, electrode holders, cables, clamps, remote controllers, electrodes, flange square, chipping hammer, grinders, files

6. Understand the methods and procedures for preparing pipework that is to be welded

Criteria

6.1 The key welding requirements of joint set up
Range: edge preparation (abrasive and mechanical), tacking procedure, root face, electrode selection, flame cutting, gaps

6.2 The techniques to cut, profile and bevel pipework
Range: mechanical, abrasive, oxy-acetylene, plasma cutting

Learning outcome:

7. Understand the techniques used to join pipework in fixed, rotated and restricted positions by welding

Criteria

7.1 The correct welding techniques for a range of weld types

7.2 The use of manipulators and clamps

7.3 The process of producing route, filler and reinforcing runs in a number of weld types
Range: fillet, branch, horizontal vertical, vertical up

Learning outcome:

8. Understand how the mechanical properties of materials change through being joined by welding

Criteria

8.1 The processes involved in controlling distortion and stresses in pipework during welding

8.2 The terms relating to structural change in metals during welding
Range: full fusion, base metal, filler metal, porosity, heat affected zone

Learning outcome:

9. Understand the quality control process and different methods of testing completed welded joints

Criteria

9.1 The different methods of quality control and testing completed welded joints
Range: visual inspection, soundness testing (hydraulic and pneumatic), destructive testing, non-destructive testing

9.2 The common weld faults
Range: slag inclusion, undercut, overlap, lack of fusion, cracks, lack of penetration, concave/convex profile, porosity

9.3 The methods to repair common weld faults

Learning outcome:

10. Understand how to interpret diagrams and drawings and welding symbols relevant to the system to locate the pipework that needs to be welded

Criteria

10.1 Interpreting engineering drawings and welding specifications to locate pipework that needs to be welded

10.2 The common symbols used on assembly drawings

Delivery outcomes (depth of content)

1

Learners will know the safe practices which must be adhered to when planning and carrying out welds on pipework (this outcome should be delivered before the welding practice is undertaken). Learners will be fully aware of the PPE required for the welding processes including the type and grade of filters for welding screens dependent on the welding process. Learners will know the requirements for flameproof overalls and the standards which they should meet. The types of gloves and gauntlets and the specific head protection for the prevention of burns.

Learners will understand the options for welding face masks and goggles including the settings and methods to operate these including adjustments to reaction and filter settings. It is expected that learners will know the risks involved in the processes including electrical hazards when MMA welding, the use of gases and associated cylinder equipment. Learners will understand the risks from fire and toxic gases which may be created when welding various materials. Learners will understand the methods of setting up a safe working area for welding and be aware of ventilation requirements for the area in which welding is to take place.

2

Learners will understand the relevant standards and legislation suitable to the welding process for pipework within the industry. This will include the standard specifications such as the BESCA TR5 standards and the requirements within this for the industry standard assessment for the 3 year welding licence. Learners will understand the requirements which must be met to allow the craftsperson to achieve the assessment including the options for the positional welds and the tolerances allowed. Learners will also know the specific requirements within the HSE guidance documents regarding hot works and welding activities along with the COSHH requirements relating to the use of gases. Learners will understand PUWER regulations in relation to welding activities, and the specific requirements and responsibilities for the provision and maintenance of PPE, equipment and welfare facilities for operatives carrying out welding activities in the workplace. Learners will know the documentation which should be completed before and after welding activities and how incidents should be reported when required.

3

Learners will understand the principles associated with the different welding processes. Understanding how TIG, MMA and OA welding processes differ from one another and the principle of each process to produce a full fusion weld. Learners will understand the advantages and limitations of each process relevant to its structural strength, the speed of the process, the requirement for space and associated equipment, the aesthetic qualities and the limitations each process has dependant on the specific material and pipe diameter.

Learners will know and understand the terms which refer to the common welding positions and techniques such as down hand, vertical up, horizontal vertical, overhead, set-on branch, fillet, multi-run welds, 1G, 2G, 5G and 6G.

4
Learners will understand the specific equipment required to carry out welds. This will include the range of welding sets including traditional transformer type sets through to modern inverter sets. Learners will know how the settings on these welding sets effect the process and the weld properties.

5
Learners will understand the types of materials and fittings suitable for welding. This will include the types and grades pipe suitable for welding and the types of weldable fittings. Learners will know the limitations to fittings such as pressure ratings and will be aware of the limitations of pipe diameters when setting on branch welds.

Learners will understand the MMA welding electrode types and codes. Learners will be aware of the abbreviations and codes attached to electrodes, their use and limitations regarding positional welds and the types and purposes of flux coatings given to these electrodes. Learners will know the types of filler rods available for use with TIG and OA processes, the ratings of OA welding nozzles and the use and care of TIG welding electrodes. Learners will know the associated equipment which is essential as part of the process such as the different types of electrode holders, the gas equipment such as regulators and flash arrestors and they will know the types of cables and their suitability to the process and environment. This outcome is an opportunity to ensure learners are aware of the types of clamp, squares, manipulators, and magnets available to help the welder set up and complete the process.

6
Learners will understand the importance of, and essential processes involved in the preparation of a weld. This will include edge preparation (abrasive and mechanical), tacking procedure, root face, flame cutting and recommended gaps. Learners will know how to set up faces of fittings and pipes to ensure they are square. Learners will be aware of the equipment available to assist in producing bevels and edge preparation and the techniques to do this manually using grinding and cutting equipment.

7
Learners will understand the practical skills and techniques associated with the actual weld process. Learners will gain knowledge of the practical angles which should be used regarding electrodes and filler rods. Learners will know the approaches that may be taken to allow positional welds to be completed in a more efficient manner such as body positions and the use of jigs and manipulators to allow the welder to create the required angles. Learners will know why certain welds may require a number of passes to complete and the purpose of each pass. Learners will know the suitable electrodes and filler for each pass and

methods to ensure penetration is suitable in fillet, branch, horizontal vertical and vertical up type welds. Learners will be given practical demonstrations of such techniques and allowed practice to develop their skills in these areas with supervision.

8
Learners will appreciate the metallurgical effect of welding on metals. Learners will understand what happens to the heat affected zone of the weld and how these metals should be handled and prepared to ensure the metal and the weld stay suitable to its intended task. A basic knowledge of metallurgy should be ensured. Learners will know how expansion and distortion can be controlled in pipework and the limits to diameters when setting on welds.

9
Learners will understand the range of test methods used to ensure quality of the product. This will include a knowledge of destructive and non-destructive tests (where possible demonstrations of destructive tests including micro etching and reverse bend testing will be given and the process of non-destructive tests explained). Learners will know how tests are carried out within the BESCA welding assessment and the results which should be found in both successful and non-successful attempts. Learners will understand the faults which can occur in welds and the reasons why these faults are present. This will include slag inclusion, undercut, overlap, lack of fusion, cracks, lack of penetration, concave/convex profile, and porosity. Learners will understand the adjustments which should be made to the weld process to prevent these faults and defects from occurring and how to recognise these during the welding procedure itself and during testing and inspection.

10
Learners will understand how to interpret diagrams and drawings and welding symbols relevant to the system to locate the pipework that needs to be welded. Learners will know welding symbols which indicate the position, type, orientation, and quality of a weld. Learners will be able to recognise these symbols on drawings and will be able to produce the required weld type by taking information from the drawing.

Unit 329HV: Install, Test, Commission and Decommission Complex Building Service Engineering Pipework Systems

GLH:	105

What is this unit about?

This is a performance unit and covers the installation, testing, commissioning and decommissioning of complex building service engineering pipework systems, components and equipment in accordance with regulations and guidance.

The learner must be able to comply with the correct procedures and practices. The 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 natural environment.

Learners will develop their skills of:

- installing and testing industrial and commercial heating and ventilating pipework systems
- inspecting and pre-commissioning industrial and commercial heating and ventilating systems
- commissioning industrial and commercial heating and ventilating systems
- decommissioning industrial and commercial heating and ventilating 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?

Install and test industrial and commercial heating and ventilating 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

Criteria: job information and documentation

1.1 materials requisition
1.2 method statements
1.3 risk assessments

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 of the right type and size, fit for purpose, in accordance with the system's design and suitable for the working environment in which they are to be installed

Criteria: equipment, components, and accessories:

5.1 fuel-fired boilers (gas; oil; solid fuel)
5.2 hot water storage vessels
5.3 water heaters
5.4 pumps
5.5 heat emitters
5.6 heat exchangers
5.7 burners
5.8 flues
5.9 cisterns
5.10 calorifiers
5.11 valves (including motorised)
5.12 pressure vessels
5.13 traps and strainers
5.14 measuring instruments
5.15 environmental technology equipment
5.16 prefabricated modules
5.17 supports and fixings

Learning outcome:

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

Criteria: equipment, components, and accessories:

6.1 fuel-fired boilers (gas; oil; solid fuel)
6.2 hot water storage vessels
6.3 water heaters
6.4 pumps
6.5 heat emitters
6.6 heat exchangers
6.7 burners
6.8 flues
6.9 cisterns
6.10 calorifiers
6.11 valves (including motorised)
6.12 pressure vessels
6.13 traps and strainers
6.14 measuring instruments
6.15 environmental technology equipment
6.16 prefabricated modules
6.17 supports and fixings

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 project management
7.3 risk assessment management
7.4 implementing and monitoring health & safety requirements and issues
7.5 implementing and monitoring issues relating to the natural environment
7.6 customer service
7.7 accident reporting
7.8 emergencies
7.9 communication with relevant people

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: (systems) industrial and commercial heating, and ventilating pipework:

8.1 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
8.2 hot water heating (low, medium and high temperature)
8.3 cold water – storage/non storage
8.4 chilled water systems – air conditioning, refrigeration, heat rejection
8.5 steam

Learning outcome:

9. Prepare, fit, fix, and connect the selected pipework and equipment, components and accessories using suitable jointing methods in accordance with the system's design, the working environment, manufacturer instructions and when required, appropriate welding techniques

Criteria: jointing methods:

9.1 welding
9.2 threaded
9.3 grooved
9.4 flanges
9.5 compression
9.6 adhesives
9.7 crimped/press-fit

Criteria: welding (only when required):

9.8 manual arc welding
9.9 oxy-acetylene welding
9.10 tungsten inert welding

Learning outcome:

10. Confirm with the relevant people those necessary variations to the planned programme of work and the correct actions to be taken to ensure that any variations to the planned programme of work will minimise the potential for hazard and risk

Criteria: relevant people:

10.1 customers/clients
10.2 client representatives
10.3 supervisors
10.4 site/contract manager
10.5 other contractors/trades
10.6 members of the public
10.7 work colleagues

Learning outcome:

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

Inspect and pre-commission industrial and commercial heating and ventilating systems

Performance Criteria

Learning outcome:

12. Determine at the outset, that the plans for inspecting and pre- commissioning the system and its equipment, components and accessories are in accordance with the system's design, the working environment, manufacturer instructions and organisational procedures

Criteria: equipment, components, and accessories:

12.1 fuel-fired boilers (gas; oil; solid fuel)
12.2 water storage vessels
12.3 water heaters pumps
12.4 heat emitters and exchangers
12.5 burners
12.6 flues cisterns
12.7 valves (including motorised)
12.8 pressure vessels
12.9 traps and strainers
12.10 measuring instruments
12.11 environmental technology equipment
12.12 prefabricated modules
12.13 supports and fixings

Criteria: industrial and commercial heating and ventilating pipework:

12.14 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
12.15 hot water heating (low, medium and high temperature)
12.16 cold water – storage/non storage
12.17 chilled water systems – air conditioning, refrigeration, heat rejection
12.18 steam

Learning outcome:

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

- **The system's design**
- **The working environment**
- **Manufacturer instructions**
- **Organisational procedures**

Commission industrial and commercial heating and ventilating systems

Performance Criteria

Learning outcome:

14. Commission equipment, components and accessories, adjusting the controls to ensure the configuration, safety and effective performance of the system in accordance with the system's design, the working environment, manufacturer instructions and organisational procedures

Criteria: equipment, components, and accessories:

14.1 terminal units
14.2 measuring instruments
14.3 fuel-fired boilers (gas; oil; solid fuel)
14.4 water storage vessels
14.5 water heaters
14.6 pumps
14.7 heat emitters and exchangers
14.8 burners
14.9 flues
14.10 cisterns
14.11 calorifiers
14.12 valves (including motorised)
14.13 pressure vessels
14.14 traps and strainers
14.15 measuring instruments
14.16 environmental technology equipment
14.17 prefabricated modules

Criteria: (systems) industrial and commercial heating and ventilating pipework:

14.18 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
14.19 hot water heating (low, medium and high temperature)
14.20 cold water – storage/non storage
14.21 chilled water systems – air conditioning, refrigeration, heat rejection
14.22 steam

Learning outcome:

15. Apply the methods, techniques and procedures used to carry out, as required, appropriate testing to confirm the integrity of the system and its associated equipment, accessories and components

Criteria: appropriate testing:

15.1 pressure
15.2 system hygiene and charging
15.3 performance
15.4 hydraulic testing
15.5 pneumatic testing

Learning outcome:

16. Obtain customer/client acceptance of the commissioned system and its associated equipment, components and accessories in accordance with organisational procedures

Decommission industrial and commercial heating and ventilating Systems

Performance Criteria

Learning outcome:

17. 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: equipment, components, and accessories:

17.1 terminal units
17.2 measuring instruments
17.3 fuel-fired boilers (gas; oil; solid fuel) water storage vessels
17.4 water heaters
17.5 pumps
17.6 heat emitters and exchangers
17.7 burners
17.8 flues cisterns
17.9 calorifiers
17.10 valves
17.11 pressure vessels
17.12 traps and strainers
17.13 measuring instruments
17.14 environmental technology equipment
17.15 prefabricated modules

Criteria: (systems) industrial and commercial heating and ventilating pipework:

17.16 hot water – open vented/unvented/indirect/secondary circulation/instantaneous
17.17 hot water heating (low, medium and high temperature)
17.18 cold water – storage/non storage
17.19 chilled water systems – air conditioning, refrigeration, heat rejection
17.20 steam

Learning outcome:

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

Learning outcome:
19. Complete relevant documentation in accordance with organisational procedures

Criteria: documentation:
1.1 pre-commissioning documentation
1.2 test certificates
1.3 job reports
1.4 commissioning documentation