EAL Progression in Building Services Engineering (Level 2) C00/4169/0

Qualification Manual

Version 1.1 – September 2022

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Version information

Version and publication date	Changes
v1 June 2021	Original document
v1.1 September 2022	MI Cable removed from Unit 208E

Qualification purpose

	Description
Who is the qualification for?	The EAL Progression in Building Services Engineering (Level 2) has been developed as a post-16 qualification for individuals working in or intending to work in the building services engineering (BSE) sector. This qualification will enable learners to go on to study other Level 3 BSE courses relevant to their chosen trade. The qualification is primarily designed for learners to follow on a full time one-year programme of learning. It is aimed at learners who have achieved the Foundation in Construction and Building Services Engineering (Level 2) but do not yet have an apprenticeship. It is suitable for: • learners aged 16+ currently working in or intending to work in the BSE sector. • learners who have achieved the Foundation in Construction and the Built Environment qualification but do not yet have an employer to continue to an apprenticeship.
What does the qualification cover?	All learners will complete three mandatory core units which holistically cover employment, employability skills and general BSE practices in the sector over time. Learners will also need to show their development of their planning and evaluation skills within a BSE related area. Learners will be required to choose a trade specialism in the BSE sector. Learners will focus on developing their knowledge, skills and understanding contained in the relevant standards for that trade, as well as deepening their understanding of how practice in this trade has changed, and is still changing, over time.
What opportunities for progression are there?	On completion, the qualification will provide learners with the knowledge, understanding and skills to progress into employment within a building services engineering related area or onto further study. This includes progression to the following qualifications: • EAL Building Services Engineering (Level 3) – Heating and Ventilating Installation C00/4278/5 • EAL Building Services Engineering (Level 3) – Heating and Ventilating Craftsperson C00/4278/6

	Description
	• EAL Building Services Engineering (Level 3) – Plumbing and Heating C00/4278/7 • EAL Building Services Engineering (Level 3) – Electrotechnical Installation C00/4278/8 • City & Guilds Construction (Level 3) - Bricklaying C00/4169/3 • City & Guilds Construction (Level 3) - Architectural Joinery C00/4327/5 • City & Guilds Construction (Level 3) - Site Carpentry C00/4283/1 • City & Guilds Construction (Level 3) - Timber Frame Erection C00/4327/4 • City & Guilds Construction (Level 3) - Solid Plastering C00/4327/7 • City & Guilds Construction (Level 3) - Dry Lining C00/4327/0 • City & Guilds Construction (Level 3) - Painting and Decorating C00/4327/6 • City & Guilds Construction (Level 3) - Roof Slating and Tiling C00/4327/1 • City & Guilds Construction (Level 3) - Wall and Floor Tiling C00/4327/8 • City & Guilds Construction (Level 3) - Civil Operations – Groundworks C00/4327/2
Who did we develop the qualification with?	The content has been developed by the consortium[1] in conjunction with stakeholders, tutors, training providers and employers from across the sector.

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

Qualification aims and objectives

The EAL Progression in Building Services Engineering (Level 2) enables learners to develop their:

- understanding of social, economic and environmental sustainability as appropriate to BSE
- understanding of aspects of employment and employability in the sector
- employability skills and understanding of how these are relevant to contemporary practice in a chosen BSE trade
- their knowledge of and ability to apply the health and safety requirements of working on sites, with equipment and with others when working in a chosen BSE trade
- understanding of the types of work and projects undertaken in a chosen BSE trade, and the interdependencies of this work with work by other tradespeople, at the design, construction, use and maintenance stages
- understanding of the tools, techniques, materials and technologies used in a chosen BSE trade and of how they change, and have changed, over time
- knowledge and understanding required in a chosen trade route, as set out in this document to the relevant national standards
- practical skills in carrying out a wide range of tasks in a chosen BSE trade
- ability to effectively plan and evaluate their performance in carrying out a wide range of tasks in a chosen BSE trade.

Qualification structure

Rules of combination

To achieve the **Progression in Building Services Engineering (Level 2)** learners must successfully achieve:

- **3 mandatory core units (201, 202, 204)** and
- **All units from one of the optional trade specific pathways listed below**

achieving a Pass grade or higher in the three assessment methods, totalling 540 GLH.

Progression in Building Services Engineering (Level 2)		
Unit number	**Unit title**	**GLH**
201	Employment and Employability in the Building Services Engineering Sector	30
202	Changing Practices Over Time	45
204	Planning and Evaluating Work in the Building Services Engineering Sector in Wales	25
Assessment		
N/A	All Forms of Assessment	62

Trade specific Pathways. Learners must complete one of the following pathways

Pathway A: Plumbing and Heating		
205PH	Understand Scientific Principles	70
206PH	Understand Core Plumbing and Heating Systems	65
207PH	Understand Cold Water Systems	25
208PH	Understand Hot Water Systems	25
209PH	Understand Central Heating Systems	36
210PH	Understand Rainwater Systems	8
211PH	Understand Sanitation Systems	13
212PH	Performing Plumbing and Heating System Installation	136

Pathway B: Electrotechnical Systems and Equipment Installation		
204E	Understand How to Install Enclosures for Electrical Cables, Conductors and Wiring Systems	70
205E	Understand How to Install and Connect Electrical Cables, Conductors, Wiring Systems and Equipment	67
206E	Understand How to Inspect and Test De-Energised Electrical Circuits	25
207E	Understand Intermediate Electrical Science and Principles	80
208E	Performing Electrical Installation	136

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

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

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

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

The TQT for this qualification is specified below.

Qualification	TQT	Credits
EAL Progression in Building Services Engineering (Level 2) (all trade pathways)	600	60

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 a centre's ability to meet the centre approval Criteria. The approval for this qualification can be found in the following document:

- Application for Centre & Qualification Approval.

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

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

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

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

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

Registration, results issuing and certification

Please consult the Consortium 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 in-line with the requirements of EAL- Quality Assurance Requirements (Guidance on being a Quality Assurer) which can be viewed via EAL Smarter Touch Documents
- internal standardisation of learner marks awarded for the Practical Project and Guided Discussion.

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

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

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

Internal quality assurers

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

IQAs must:

- prepare for and participate in relevant EAL meetings and events, such as induction, Continuing Professional Development (CPD)/training and standardisation events
- ensure any personal action/ improvement plans are achieved, within agreed timescales and to the required standards
- have a minimum level of occupational experience 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 and Guided Discussion is internally 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 or equivalent) qualifications. All Building Services Engineering (BSE) 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 or 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:

- Understanding the Principles and Practices of Assessment*
- 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 an up to date 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.

External associates/appointees

Associates/Appointees are the terms adopted by EAL to refer to individuals appointed by EAL to undertake specific roles on their behalf, for example, Exam Writers.

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

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

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

There are no set entry requirements for the Progression qualification, EAL recommend that a learner should have achieved the Foundation in Building Services Engineering (level 2) qualification before they proceed to Progression.

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 or assessment they have already completed which is relevant to the qualification e.g. Foundation in Construction and Building Services Engineering (Level 2)
- the appropriate type and level of qualification.

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

Support materials

The following resources are available for this qualification:

Description	How to access
Assessment pack	Consortium website

Internal quality assurance

Centres must have a written Internal Quality Assurance strategy.

This will help ensure that Internal Quality Assurance procedures:

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

Moderation of internal assessment arrangements

External Quality Assurance processes are in place for checking the validity and reliability of assessment decisions made by centre staff, as appropriate to this qualification.

The assessment will be internally assessed and subject to risk-based monitoring and sampling by external quality assurers to ensure the consistency and validity of centre assessment decisions. Quality assurance activities will be undertaken by appropriately qualified and trained assessment associates. In all instances of sampling for quality assurance purposes, formal written feedback will be provided by EAL.

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

Internal appeal

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

Malpractice

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

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

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

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

Access arrangements

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

Special consideration

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

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

Summary of assessment

The **Progression in Building Services Engineering (Level 2)** is assessed using 3 assessment methods:

Assessment type	Approach to assessment	Weighting Contribution to overall qualification grade)
On-screen assessment	Externally-set, externally-marked	20%
Practical Project	Externally-set, internally-marked	60%
Guided Discussion	Externally-set, internally-marked	20%

An assessment pack detailing the requirements of the assessment can be downloaded from the Consortium website.

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

First assessments can be taken from January 3rd 2022.

Assessment timings and phasing

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

- all required 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.

Learners must have completed the Practical Project assessment prior to undertaking the Guided 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 the Consortium 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.

Guided Discussion

Guided Discussions 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, grades are then submitted to EAL via Online Services. These provisional grades are then aggregated based on the assessment weighting, in line with the grade aggregation guidance provided within the assessment pack, to provide an overall qualification grade which will be issued by EAL.

Overall qualification results

Provisional grades for the Practical Project and Guided 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 both the Practical Project and Guided Discussion (and following successful completion of the On-screen assessment). More information on this process and timings can be found in the Centre Administration Guide for Construction and Building Services Engineering Qualifications in Wales.

Resubmission/re-sit of assessment

If the learner fails to successfully achieve any of the assessments, they are permitted to re-sit/resubmit. When resitting/resubmitting learners can achieve the full range of marks and grades available.

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

On-screen assessment specifications can be found in the Appendix 1 of the Assessment Pack.

Practical Project

The Practical Project covers all content from the trade specific unit, please refer to the assessment pack.

Guided Discussion

The discussion covers **two** content areas as shown below.

Knowledge, Skills and Understanding of:	
Core content (assessment criteria)	**Unit Ref**
1 Discussion area: Planning and evaluation	
3.1 The importance of effective and appropriate communication with others 3.2 The importance of emotional intelligence in effective communication. 3.3 How to plan and manage one's own time. 3.4 How to set targets and success Criteria. 3.5 The importance of reflective practice. 4.1 Recognise problems that may occur within building services projects. 4.2 How to identify solutions to problems. 4.3 How to test and evaluate solutions.	201 (LO3, LO4)
1.1 The main techniques used for estimating jobs/projects in building services engineering. 1.2 How to identify resource requirements. 1.3 How to estimate time requirements. 2.1 Identify resources required to complete the task. 2.2 Plan the activities and the ordering/phasing of work to complete the task. 2.3 Identify success Criteria for the task. 3.1 Evaluate completed work against the task brief and success criteria.	204 (LO1, LO2, LO3)

2 Discussion area: Self-employment	
1.1 The trade bodies and organisations relevant to the trade. 1.2 The role of trade bodies and organisations 2.1 The characteristics of self-employment. 2.2 The advantages and disadvantages of self-employment. 2.3 The responsibilities of being self-employed. 2.4 Patterns in employment and rises and falls in demand. 2.5 The duty of care in ensuring products and work are safe for end users.	201 (LO1, LO2)

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 trade bodies and organisations within the building services engineering sector.

Learning outcome:

3. Know the trade bodies and organisations within the building services engineering sector.

Criteria

The 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.

Criteria

3.1 The importance of effective and appropriate communication with others.

Range

Range contains information about the breadth required for a specific assessment Criteria. 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:*** *team members/colleagues, other trades, senior personnel, customers/clients, and members of the public.*

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)

3.1 Learners will be able to identify an appropriate method for communication, and the communication requirements of technical and functional information including: reports, formal letters, emails, and text messages, etc. Learners will recognise the importance of communication for good working relations with team members/colleagues, other trades, senior personnel, customers/clients, and members of the public. Learners will understand the implications of poor communication to the work being undertaken and the effect poor communication has to the site team and co-workers. This includes undertaking work to the one's best ability and being a good employee/worker. Co-operating with the employer and/or customer during work activities.

Core unit content

Unit 201: Employment and Employability in the Building Services Engineering Sector

GLH:	30

What is this unit about?

This unit provides the learner with knowledge of some of the wider aspects within the building services engineering sector.

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

- the trade relevant bodies and organisations within the building services engineering sector
- the main principles of self-employment in the building services engineering sector
- the importance of inter- and intra-personal skills
- solving problems within their scope of responsibility.

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

- What trade bodies and organisations do I need to be aware of in my chosen trade?
- What is the competence card scheme used in my trade, and what type of cards are available?
- What do I need to consider about being self-employed?

Learning outcome:

1. Know the trade relevant 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 for the trade

1.4 Professional registration as an Engineering Technician

Learning outcome:

2. Know the main principles of self-employment in the building services engineering sector

Criteria

2.1 The characteristics of self-employment

2.2 The advantages and disadvantages of self-employment

2.3 The responsibilities of being self-employed

2.4 Patterns in employment and rises and falls in demand
Range: peaks and troughs in construction work, recruitment shortfall, skills shortage forecasts, trend predictions, vacancies

2.5 The duty of care in ensuring products and work are safe for end users

Learning outcome:

3. Know the importance of inter- and intra-personal skills

Criteria

3.1 The importance of effective and appropriate communication with others

Range: team members/colleagues, other trades, management, customers/clients, and members of the public

3.2 The importance of emotional intelligence in effective communication

3.3 How to plan and manage one's own time

3.4 How to set targets and success criteria

3.5 The importance of reflective practice

Learning outcome:

4. Know how to solve problems within their scope of responsibility

Criteria

4.1 Recognise problems that may occur within building services projects

Range: resource shortages (materials, people, money, plant, equipment), communication breakdown, incorrect information, process problems, problems arising from changes to the specification, scheduling changes, faulty products/equipment (including counterfeit products), non-compliances, and technical/physical faults of the system being installed

4.2 How to identify solutions to problems

4.3 How to test and evaluate solutions

Delivery outcomes (depth of content)

1.1 – 1.2
Learners will know the trade bodies and organisations relevant to their trade and their roles. Cover either depending on the learner's chosen pathway:

- Electrical: ECA, JIB, Certsure, NICEIC, ELECSA, NAPIT, IET, and CIBSE.
  Or,
- Plumbing and heating: APHC, HETAS, OFTEC, Gas Safe, IGEM, CIPHE and CIBSE.

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

1.3
Learners will know the card/recognition schemes for their BSE Trade. Cover either depending on the learner's chosen pathway:

- Electrical: ECS, and types of cards available
  Or,
- Plumbing and heating: JIB UK-PHMES CSCS, and Gas Safe/Gas Service Engineer Gold Registration Card; and the types of cards available.

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

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

2.1
Learners will recognise that if you start working for yourself, you are classed as a sole trader. This means you are self-employed - even if you have not yet told HM Revenue and Customs (HMRC).

2.2
Learners will know that to be successful in self-employment they will need to be responsible, autonomous and self-motivated. Learners will recognise key advantages, such as being your own boss, having greater opportunities to earn more, utilise expenses, having greater flexibility in working arrangements, and selecting your own customers.

2.3
Learners will recognise the key responsibilities of tax, administration, and planning. The potential disadvantages of responsibility for the work, lack of security, social isolation, capital needed to purchase tools and equipment, insurance costs, no wider team to rely on, and no employee benefits.

2.4
Learners will be able to recognise historical patterns in the industry including key peaks and troughs. Learners will know what is meant by shortfall and skills shortages and identify how trends are predicted. Learners will be able to recognise local labour market intelligence and the opportunities that are available.

2.5
Learners will know that they must have the skills, knowledge, experience and, where relevant, the organisational capability to carry out the work safely and without risk to health. Learners will know that they will be responsible for ensuring the work complies with relevant regulations (such as CDM, wiring regulations etc.).

3.1
Learners will be able to identify the most appropriate method of communication, and the communication requirements of technical and functional information including reports, formal letters, emails, and text messages. Learners will recognise the importance of communication for good working relations with team members, colleagues, other trades, managers, consultants, customers/clients, and members of the public. Learners will understand the implications of poor communication to the work being undertaken and the effect poor communication has to the site team and co-workers. This includes undertaking work to the one's best ability and being a good employee/worker and cooperating with the employer and/or customer during the work activities.

3.2
Learners will know what is meant by emotional intelligence and its importance to effective communication. Learners will understand that it can foster good relations with the people listed in the range in 3.1. Emotional intelligence can facilitate clear, concise, effective, and positive communication. Learners will recognise the need for self-awareness and self-management, social awareness, and relationship management.

3.3
Learners will understand the importance of planning and managing one's own time. How planning can alleviate confusion (and subsequent stress). The use of software such as a phone calendar, sharing a calendar, and scheduling of priorities, and keeping track of activities and priorities.

3.4
Learners will recognise the importance of setting targets (which can be SMART/SMART+C targets) and achieving results. Learners will understand what is meant by success criteria as the 'qualitative or quantitative criteria by which the successful project is judged'. Learners will also know what success factors are and how they can augment success. Learners will be able to relate this to the importance of inter-and intra-personal skills.

3.5
Learners will understand the importance of reflective practice both in delivering a project (completing the work) and in personal relations. Learners will recognise learning from practice/experiential learning– which is an essential skill to grow one's skills and abilities. Learners will be able utilise basic models of learning from practice.

4.1
Learners will know the types of problems (and issues) that can occur within building services engineering projects. Problems can occur from a wide range of causes, and may manifest in technical problems, problems in communication, faulty or defective equipment (which may have implications to health and safety); and non-compliances and other faults/problems or issues.

4.2
Learners will have an awareness of and be able to utilise two problem solving strategies and methods. Such as trial and error, root cause analysis, research, lateral thinking, divide and conquer, brainstorming or other appropriate method.

4.3
Learners will know how to safely test and evaluate solutions within their scope of responsibility to rectify typical problems in BSE work.

Unit 202: Changing Practices Over Time

GLH:	45

What is this unit about?

The purpose of this unit is for learners to understand how materials, tools and techniques have changed and adapted from pre-1919 practices to the current practices, as well as looking to the future.

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

- 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
- connected practice in the construction and building services engineering.

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

- What are the changes in building services engineering methods used between 1900 and the present day?
- What are the relationships between trades and the environment?
- Why are we dependent on good communication with other trades?

Learning outcome:

1. Know the changing construction and built environment sector

Criteria

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

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

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

Learning outcome:

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

Criteria

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

2.2 Post-1919 and modern construction techniques and building services
Range: evolution of solid to cavity wall (brick, block, and modern timber framing), prefabricated floor, wall, roof and joinery components; modern heating and ventilation systems, electrical installations, water and waste management systems

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

Learning outcome:

3. Understand the relationship between trades and the environment

Criteria

3.1 Industry regulation, sustainability and the natural environment

3.2 Ecological considerations and principles

3.3 Sustainable approaches

Range: heat recovery and ventilation, rainwater harvesting, fuel cells, solar panels, heat and cooling pumps, zero carbon buildings

3.4 Waste disposal in building services

Range: waste reduction, waste disposal, recycling principles in the learners' trade area

Learning outcome:

4. Understand connected practice in construction and building services engineering

Criteria

4.1 Interdependencies between trades

Delivery outcomes (depth of content)

1.1
Learners will appreciate local needs (types and uses of structures, needs of industry, cultural needs). Geographical influences- local availability of resources, local climate (weather considerations) locally influenced methods and styles; local distinctiveness. Learners will know the basic qualities and uses of mortars, aggregates, binders, internal and external functional and decorative finishes, stone, slate, timber, and earth. Learners will develop an understanding of construction materials available within their locality 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.

1.2
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.

1.3
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 should 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.

2.1
Learners will know the typical method of construction for pre-1919 buildings that they may work in such as, solid stone, brick, and timber walling; traditional flooring and roofing; internal and external functional and decorative finishes. Learners will know the traditional ground floor flooring (timber suspended), and infill (solid earth, waste, flag) techniques. Embedded timber methods (lintels, first floor and above). Cover the risks and potential results of applying the wrong materials/techniques to structures (e.g., for making good on chases). A knowledge of traditional structures and decorative finishes (renders, plasters, and paints).

The considerations for routing and installing building services. The older building services currently in service or in situ relevant to their trade. Cover either depending on the learner's chosen pathway:

- Plumbing and heating: imperial sized pipes services, and identification. Traditional sources of heating and plumbing (chimneys, open fire, range; lead and clay pipes). The use of plastic pipework on domestic services. Press fit/push fit pipework.
  Or,
- Electrical installation: types of historic wiring, and older colours, imperial sized conduits, and cables.

Learners will appreciate the life span of a building service and what constitutes unsafe or unsound building service that should be recommended to be removed (key requirements only). The actions to be taken where unsafe building services are discovered. The lifespan of a building service – as applicable: due to overload, corrosion, electrolysis, age, wear and tear, environmental conditions, verdigris/oxidation of copper, usage, changes to regulations, materials, and safety requirements etc. Cover the key requirements only as this unit is not about periodic inspection of services.

2.2
The learner will understand the development of brick cavity methods of construction and later variations of cavity wall design. 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. Reference to the Building Regulations applicable to installation of the service (key requirements only).

2.3
Learners will have an awareness of the new/emerging technologies relevant to their trade (and main advantages and disadvantages). Cover either depending on the learner's chosen pathway:

- Plumbing and heating: environmental technologies (heat pumps etc.), hydrogen as a new mains gas
  Or,
- Electrical installation: electric vehicle charging points, smart metering, battery technologies

and for both trades smart homes, and controls, 3D modelling/printing, and immersive technology.

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.

3.1
Learners will know the key aspects of the Environment (Wales) Act 2016, Environmental Protection Act, The Hazardous Waste Regulations, The Site Waste Management Plans Regulations, Pollution Prevention and Control Act, Control of Pollution Act, The Waste Electrical and Electronic Equipment Regulations. Relevant aspects of BREEAM and Passivhaus codes of good practice. The Conservation of Habitats and Species Regulations 2010 and the Penalties for breaking the law (e.g. disturbing a bat roost or a Newt Colony). Recap/cover Control of Substances Hazardous to Health (COSHH) Regulations as relevant.

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

3.2
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.

3.3
Learners should be able to identify the sustainable considerations used in CBE and recognise the scope of their use to maintain a healthy building. Learners should also be able to identify the ways in which buildings can off-set their carbon footprint.

3.4
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 should 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.

4.1
Learners will appreciate the relationships between their chosen trade and other trades in different contexts from new build to repairing traditional structures. Learners should be able to 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.

Unit 204: Planning and Evaluating Work in the Building Services Engineering Sector in Wales

GLH:	25

What is this unit about?

This unit provides the learner with the knowledge of how to plan and evaluate work. Learners will be able to read and interpret plans and documentation required in performing a wide range of tasks in the trade area. Learners will be able to plan the completion of a wide range of tasks in the trade area, using the required literacy and numeracy skills and set their own performance criteria for given tasks.

Learners will evaluate their own performance in carrying out a wide range of tasks in this trade area both in relation to the set requirements and their own success criteria.

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?

Guidance: where relevant this unit can be delivered in conjunction with the trade units being delivered and learning outcome 3 and 4 of the Employment and Employability in the Building Services Engineering Sector. The skills in this outcome will be important to enable the learner to plan, perform, and evaluate their work in the Practical Project assessment.

Learning outcome:

1. Know how to calculate costs and determine resource requirements

Criteria

1.1 The main techniques used for estimating jobs/projects in building services engineering

1.2 How to identify resource requirements

1.3 How to estimate time requirements

Learning outcome:

2. Plan the work required to complete the task(s)

Criteria

2.1 Identify resources required to complete the task
Range: tools, plant, equipment, products, materials

2.2 Plan the activities and the ordering/phasing of work to complete the task

2.3 Identify success criteria for the task
Range: key elements of the work, recognising areas that may be challenging

Learning outcome:

3. Evaluate completed work

Criteria

3.1 Evaluate completed work against the task brief and success criteria
Range: output fit for purpose, safe and in line with task parameters/tolerances, quality of work, tool selection, were success criteria set appropriate, material usage and waste generated, approach taken to phasing/ordering work

Delivery outcomes (depth of content)

1.1
The learner will gain an awareness of estimating techniques used for calculating prime cost, overheads, profit margin and methods of determining price.

1.2
Learners will recognise types of resources as:

- consumable (replenishable), such as materials and money.
- re-useable, such as plant, equipment and people.

Learners will have an appreciation of the resources required for building services projects and when they are required and how to avoid waste. Learners will have an appreciation of scheduling and the need to avoid resource overloads.

1.3
Learners will acquire a fundamental knowledge of how to estimate the time requirements for simple building services projects. This will include design, planning, preparation, installation, commissioning and administration for the projects.

2.1 – 2.2
Learners will know how to plan the completion of well-defined, generally routine tasks and address straightforward problems. Learners will be able to select (and use) relevant skills and procedures to carry out their chosen trade. Learners will know how carry out the necessary planning to enable the completion of work, this includes risk and methods statements (RAMS), cost and pricing (e.g. customer estimates), and utilising/creating diagrams or drawings with correct information from appropriate sources of information.

Learners will identify, gather, and use relevant information to inform actions. Learners will be able to identify and produce relevant documentation for tools and materials required to complete tasks (e.g. resource list); and plan the ordering/phasing of work (e.g. schedule of works), so work is completed safely, efficiently, and effectively (creating plans with activities, milestones, and dependencies).

2.3
Learners will be able to identify success criteria for the task, such as milestones, key activities, material usage, and finished quality etc. Learners will recognise areas which they will find challenging enabling them to address this as much as possible in the planning and preparation stages of the work.

3.1
Learners will be able to evaluate their performance in carrying out the tasks, both in relation to the set requirements and their own success criteria.

Learners will be able to evaluate their own performance against the given plan in relation to key aspects such as:

- whether an alternative approach could have been taken
- identify how effective their actions have been
- strengths/weaknesses
- lessons learnt.

Pathway A: Plumbing and Heating

Unit 205PH: Understand Scientific Principles

GLH:	70

What is this unit about?

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

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

Learners will develop their knowledge and understanding of:

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

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

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

Learning outcome:

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

Criteria

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

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

1.3 The use of conversion tables for non-SI units

Learning outcome:

2. Understand the properties of materials

Criteria

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

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

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

2.4 The methods of preventing corrosion

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

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

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

Learning outcome:

3. Understand the relationship between energy, heat and power

Criteria

3.1 The relationship between the Celsius and Kelvin temperature scales

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

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

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

3.5 How **units** of energy and heat are related and derived
Range: Energy – Joules (J), Specific heat capacity (kJ/kg/°C), Power – Watts (W), maximum density, coefficient of linear expansion

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

Learning outcome:

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

Criteria

4.1 How **units of force and pressure** are derived from SI units
Range: acceleration (m/s^2), force due to gravity, force - newton (N), pressure (N/m^2), atmospheric pressure, flow rate (m^3/s)

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

4.3 The application of pressure and flow rate measurements

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

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

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

4.7 The principles of a siphon

Learning outcome:

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

Criteria

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

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

Learning outcome:

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

Criteria

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

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

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

6.4 The requirements for earthing of electrical circuits

Delivery outcomes (depth of content)

1

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

2

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

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

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

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

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

3

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

Learners will understand the different states matter can exist

- Solid
- Liquid
- Gaseous

and what causes a change of state.

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

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

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

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

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

4

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

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

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

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

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

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

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

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

5

Learners will develop an understanding of the simple machines

- Levers
- Pulleys
- Archimedes screws

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

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

6

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

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

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

Unit 206PH: Understand Core Plumbing and Heating Systems

GLH:	65

What is this unit about?

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

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

Learners will develop their knowledge and understanding of:

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

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

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

Core knowledge

Learning outcome:

1. Understand the appropriate industry standards and regulations relevant to

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

of plumbing and heating systems

Criteria

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

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

Learning outcome:

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

Criteria

2.1 **Workplace information**

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

Learning outcome:

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

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

Criteria

3.1 The levels of risk presented by work situations

3.2 The hazards presented by work situations

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

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

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

Range: information to be provided in a method statement, presentation of a method statement

Learning outcome:

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

Criteria

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

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

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

Personal conduct; manual handling, working at heights

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

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

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

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

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

Learning outcome:

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

Delivery outcomes (depth of content)

1

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

2

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

3

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

4

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

5

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

Inspect and pre commission

Learning outcome:

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

Learning outcome:

7. **Understand the methods and techniques for inspecting and pre-commissioning the plumbing and heating system in accordance with:**
   - **the plumbing and heating system's design**
   - **the working environment**
   - **manufacturers' instructions**
   - **the appropriate testing procedures for confirming the systems' integrity**

Learning outcome:

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

Delivery outcomes (depth of content)

6

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

7

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

8

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

Decommission

Learning outcome:

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

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

Criteria

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

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

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

Range: permanent, temporary

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

Learning outcome:

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

Criteria

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

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

Learning outcome:

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

Delivery outcomes (depth of content)

9

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

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

10

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

11

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

Unit 207PH: Understand Cold Water Systems

GLH:	25

What is this unit about?

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

- install and test cold water systems.

Learners will develop their knowledge and understanding of:

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

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

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

Core knowledge

Learning outcome:

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

Criteria

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

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

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

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

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

1.6 The advantages and disadvantages of cold water systems

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

Learning outcome:

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

Criteria

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

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

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

Delivery outcomes (depth of content)

1

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

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

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

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

2

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

- Appliances
- Taps, outlets and valves

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

Install

Learning outcome:

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

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

Criteria

3.1 How to fill and vent cold water systems

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

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

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

3.4 How to install cold water systems

Range: cistern, bath, WHB, WC,

Pipework; plastic, copper

Learning outcome:

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

Criteria

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

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

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

Pipework; metal pipework, plastic pipework

Delivery outcomes (depth of content)

3

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

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

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

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

4

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

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

Unit 208PH: Understand Hot Water Systems

GLH:	25

What is this unit about?

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

- install and test hot water systems.

Learners will develop their knowledge and understanding of:

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

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

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

Core knowledge

Learning outcome:

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

Criteria

1.1 The advantages and disadvantages of hot water systems

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

Learning outcome:

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

Criteria

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

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

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

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

Delivery outcomes (depth of content)

1

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

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

2

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

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

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

Install

Learning outcome:

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

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

Criteria

3.1 How to fill and vent hot water systems

3.2 The insulation requirements and system frost protection

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

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

3.4 How to install hot water systems

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

Pipework; plastic, copper

Learning outcome:

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

Criteria

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

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

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

Pipework; metal pipework, plastic pipework

Delivery outcomes (depth of content)

3

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

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

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

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

4

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

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

Unit 209PH: Understand Central Heating Systems

GLH:	36

What is this unit about?

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

- install and test central heating systems.

Learners will develop their knowledge and understanding of:

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

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

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

Core knowledge

Learning outcome:

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

Criteria

1.1 The advantages and disadvantages of central heating systems

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

Learning outcome:

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

Criteria

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

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

Delivery outcomes (depth of content)

1
Learners should have an understanding of the different types of central heating systems, including Pumped heating and gravity hot water, Fully pumped; 2 x two port valves (S plan), Fully pumped; 3 x two port valves (S plan+), Fully pumped; 3 port valve (mid position/diverting) (Y/W plans), Combination boiler and layout principles including one pipe, two pipe, manifold (micro and minibore), and District heating from the domestic perspective and be able to state the advantages and disadvantages of each type and typical applications.

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

2
Learners should be aware of the working principles of mechanical controls and electrical controls used on central heating systems, including the positioning, fixing, connection and operation of the controls.

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

Install

Learning outcome:

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

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

Criteria

3.1 How to fill and vent central heating systems

3.2 The insulation requirements and system frost protection

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

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

3.4 How to install central heating systems

Range: boiler/jig, radiator, radiator valves

Pipework; plastic, copper

Learning outcome:

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

Criteria

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

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

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

Pipework; metal pipework, plastic pipework

Delivery outcomes (depth of content)

3

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

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

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

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

4

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

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

Unit 210PH: Understand Rainwater Systems

GLH:	8

What is this unit about?

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

Learners will develop their knowledge and understanding of:

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

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

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

Core knowledge

Learning outcome:

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

Criteria

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

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

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

Range: Rainwater systems;

Pipe (RWP); round section, square section

Gutter; half round, square, ogee, high capacity

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

Learning outcome:

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

Criteria

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

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

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

2.2 The expansion and contraction in rainwater systems and negative effects

2.3 The working principles of rainwater recycling systems

Delivery outcomes (depth of content)

1

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

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

2

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

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

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

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

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

Unit 211PH: Understand Sanitation Systems

GLH:	13

What is this unit about?

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

- install and test sanitation systems.

Learners will develop their knowledge and understanding of:

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

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

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

Core knowledge

Learning outcome:

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

Criteria

1.1 The advantages and disadvantages of sanitary appliances and pipework systems

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

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

Learning outcome:

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

Criteria

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

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

Delivery outcomes (depth of content)

1

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

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

2

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

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

Including the positioning, fixing, connection of sanitary appliances.

Install

Learning outcome:

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

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

Criteria

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

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

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

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

Learning outcome:

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

Criteria

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

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

Delivery outcomes (depth of content)

3

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

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

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

4

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

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

Unit 212PH: Performing Plumbing and Heating System Installations

GLH:	136

What is this unit about?

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

- inspect and pre-commission plumbing and heating systems
- decommission plumbing and heating systems
- install and test plumbing and heating systems

Learners will develop their skills in:

- decommissioning systems and appliances
- measuring and marking out the locations for fitting and fixing the selected appliances, components and accessories
- fit, fix and connect the selected appliances, components and accessories
- carrying out a wide range of tasks in this trade area
- inspecting and pre commissioning appliances and components
- testing completed work to industry standards

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

- What is the sequence of activities required to carry out typical tasks in my chosen trade?
- How do I joint and bend different pipework materials?
- How do I test the completed work?

Decommission

Learning outcome:

1. **Decommission appliances, components and accessories**

Learning outcome:

2. **Ensure that the plumbing and heating system cannot be accidently reactivated or become dangerous**

Install

Learning outcome:

3. **Determine at the outset, that the plans for positioning and fixing the appliances, components and accessories are in accordance with:**
   - **the plumbing and heating system's design**
   - **the working environment**
   - **manufacturer instructions**

Criteria

3.1 Systems
Range: cold water systems, hot water systems, central heating systems, sanitation systems

3.2 The Pipework
Range: copper, plastic pressure pipe, plastic (sanitary)

Learning outcome:

4. **Measure and mark out the locations for fitting and fixing the selected appliances, components and accessories in accordance with:**
   - **the plumbing and heating system's design**
   - **manufacturer instructions**

Learning outcome:

5. Fit, fix and connect the selected appliances, components and accessories in accordance with:

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

Criteria

5.1 Jointing methods

Range: compression, push fit plastic pressure, push fit waste, soft soldered

5.2 Components

Range: WC, wash hand basin, cylinder, boiler (connections), soil stack system, radiator

Inspect and pre commission

Learning outcome:

6. Confirm appliances, components and accessories installed are:

- **of the right type and size**
- **fit for purpose in accordance with the plumbing and heating system's design**
- **suitable for the working environment in which they are installed**

Learning outcome:

7. Determine that the appliances, components and accessories have been fitted in accordance with:

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

Criteria

7.1 Preparatory work

Range: safe and unobstructed access to work areas, safe storage of materials tools and equipment, reporting pre-existing damage, protecting the building fabric.

Drilling walls or floors, cutting holes and notches in timber floor joists, cutting chases in wall or floor surfaces

Learning outcome:

8. **Inspect and pre-commission appliances, components and accessories in accordance with:**
   - **the plumbing and heating system's design**
   - **manufacturer instructions**

Learning outcome:

9. **Confirm the integrity of the installed system using appropriate testing procedures**

Delivery outcomes (depth of content)

Learners will gain essential plumbing and heating installation skills through training and practice in the centre's workshop. Learners will be able to plan plumbing and heating installation work and carry out work safely using hand tools and equipment correctly.

Learners will gain (or progress their skills) in measuring and marking out and gain confidence in their abilities.

Learners will gain skills in a range of components. This will include WC, wash hand basin, cylinder, boiler (connections), soil stack system, radiator.

Learners will have skills to bend and joint the range of pipework and materials as listed within the unit.

Learners will utilise their knowledge of how to carry out visual checks and testing of pipework systems as part of the completed work. Learners will be able to evaluate their work against their own planning.

The skills in this unit will be important to enable the learner to perform their trade in the Practical Project assessment.

Pathway B: Electrotechnical Systems and Equipment Installation

Unit 204E: Understand How to Install Enclosures for Electrical Cables, Conductors and Wiring Systems

GLH:	70

What is this unit about?

This unit covers the knowledge and understanding for the installation of enclosures for electrical cables, conductors and wiring systems internally and externally for electrical systems. Learners will gain the key knowledge and understanding of electrical systems and circuits and their requirements.

The learner must be able to comply with the procedures and methods for installing enclosures for electrical cables, conductors and wiring systems 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 know the different types of enclosures for electrical cables, conductors and wiring systems, their limitations, applications and the techniques for the positioning, fitting, fixing and connection of the enclosures, their components, and accessories.

Learners will develop their knowledge and understanding of:

- the operation, applications, advantages, and limitations of different electrical systems
- the appropriate industry standards, regulations, and requirements relevant to installing enclosures
- the applications, advantages, and limitations of types of enclosures.

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

- What types of circuits supply electrical loads?
- What is meant by earthing?
- What are the different types of wiring systems used?

Guidance: within this unit learners will know the main relating requirements of the IET On-Site Guide.

Learning outcome:

1. Understand the operation, applications, advantages, and limitations of different electrical systems

Criteria

1.1 The types and requirements of typical circuits

Range: lighting circuits, ring final socket circuits, standard radial final socket circuits, standard circuit arrangements for loads and equipment, components of lighting and power circuits, division of an installation into circuits, polarity requirements for circuits, general requirements of isolation and switching

1.2 Earthing systems and earthing and protective conductors

Range: characteristics of earthing systems: TN-S, TN-C-S and TT, protective conductors and the purpose of earthing and protective conductors when used for protection, components which provide automatic disconnection of supply (including exposed conductive parts and extraneous conductive parts), components of the earth loop impedance path, general requirements for the installation of main protective bonding

1.3 Devices used for safety and protection in electrical systems

Range: overcurrent and overcurrent protection: the types of and reasons for overcurrent, fuses, circuit breakers, RCDs, RCBOs, characteristics, general applications, maximum disconnection time for standard circuits, an awareness of SPDs and AFDDs

Learning outcome:

2. Understand the appropriate industry standards, regulations, and requirements relevant to installing enclosures

Criteria

2.1 Industry standards and regulations

Range: the requirements of the IET On-Site Guide, recognition of the main industry standards and regulations

2.2 How to produce a risk assessment and method statement for the work to be carried out

2.3 How to verify that job information and documentation is current and relevant and that the plant, instruments, access equipment and tools are fit for purpose

2.4 The applications, advantages, and limitations of types of personal protective equipment

Learning outcome:

3. Understand the applications, advantages, and limitations of types of enclosures

Criteria

3.1 The applications, advantages, and limitations of types of enclosures

Range: conduit (PVC and metallic), trunking (PVC and metallic), cable tray, cable basket, ladder-systems, ducting, modular wiring systems, busbar systems and lighting track

3.2 The industry recognised methods for determining the type and size of enclosures

3.3 How to interpret diagrams and drawings to locate site services and identify the planned location of the enclosures and equipment

3.4 The methods and techniques for fitting, fixing, and connecting the selected enclosures and their components and accessories in accordance with:

- the electrical system's design
- manufacturers' instructions

Delivery outcomes (depth of content)

1

Learners will know and understand typical single-phase circuits. The different circuits and wiring layouts used for lighting: the circuit diagrams for one-way, two-way, intermediate including the conversion method. The typical wiring diagrams. The joint box method, and loop in method of wiring. The block, circuit, and wiring diagrams of circuits. The different components that can be used in lighting circuits including transformers, and an introduction to LED Drivers. Overcurrent protection, different switches: ways, gangs, grid switches, dimmer switches, and back boxes. Cover the lighting outlets and lamps including LED. SELV Transformers, joint boxes, and RB4 and related components. Cover compatibility of dimmer switches with equipment and loads (leading and trailing edge). Learners will appreciate the key aspects of Bluetooth and smart wireless lighting.

Learners will know and understand the requirements of standard ring final socket circuits. Circuits for supplying sockets and connection units and fused connection units (switched and unswitched) to BS 1363 (including USB sockets). The circuit and wiring diagrams of a ring final circuit, and the number of points and number of fused and unfused spurs in relation to sockets (and the requirements for spurs). The maximum floor area, and the division of sockets between circuits. The protective devices and conductor size based on cable type.

Learners will know and understand the requirements of standard radial final socket circuits. Circuits for supplying sockets and connection units and fused connection units (switched and unswitched) to BS 1363 (see circuit types A2 and A3 in the IET OSG). (Refer the learner to number of sockets as shown in the IET On-Site Guide). The general requirements of isolation and switching that apply.

Learners will know and understand the conventional common domestic circuits such as: cooker circuit, shower circuit, immersion heater circuits (see IET OSG and requirements for immersion heater circuits). A basic appreciation of a special location. Cover the circuit and wiring diagrams of common domestic type circuits.

Learners will know and understand why installations are divided up into circuits. (See BS 7671 314: Division of Installation). The typical division of circuits in a dwelling. The requirements for polarity on circuits. The general requirements of isolation and switching that apply (refer to the IET On-Site Guide). The benefit of having the highest rated load next to the consumer unit main switch.

Learners will know and understand the key requirements of electrical systems: earthing systems and earthing and protective conductors: The main underpinning requirements and principles as given in the IET On-Site Guide, with focus principally on simple domestic dwellings and similar installations.

Learners will know and understand the key requirements of electrical systems: overcurrent and overcurrent protection devices. The main aspects of the operation, applications, advantages and limitations of fuses, circuit breakers, RCDs, RCBOs for basic single-phase circuits. The types and reasons for overcurrent: earth fault, short circuit, and overload principally on simple domestic dwellings and similar installations. The common types and ratings of overcurrent protection devices, and fusing factor.

2

Learners will appreciate the industry standards and regulations and the legal status of documents used in the electrical industry. British Standards, Statutory documents, Codes of Practice, Electricity at Work Regulations, Electricity Safety, Quality and Continuity Regulations (ESQCR), The Construction (Design and Management) Regulations, BS 7671 Requirements for Electrical Installations, the key requirements of the IET On-Site Guide. IET Guidance Notes, Best Practice guides from the Electrical Safety First. Building Regulations (Wales and England) and Approved Documents. What is meant statutory and non-statutory. The relation of regulations to the Health and Safety at Work etc. Act. The implications of not complying with regulations, documents, and industry guidance. How to interpret sources of information relevant to the installation of wiring systems and equipment.

Learners will know and understand the requirement to follow safe systems of work including risk assessments and method statements.

Learners will appreciate the industry standard documents used for electrical installation including layout plans, technical data, specifications, site drawings. Learners will know and understand the job information and documentation and the importance of verifying and utilising current and relevant information. Verifying issue numbers of drawings as appropriate and ensuring they are using current requirements.

Learners will know and understand the purpose of PPE such as: high visibility clothing, eye protection, hand protection, head protection, foot protection, hearing protection, respiratory protection, vibration protection, and harnesses. The procedures that should be taken to remove or minimise risks before deciding PPE is needed. The appropriate protective clothing, equipment plant, instruments, access equipment and tools that is required for identified work tasks. The different types of measuring and marking out tools and equipment for wiring systems, equipment, and enclosures and how to use them safely.

3

Learners will appreciate the features, applications, advantages, and limitations of different containment systems. The types of wiring systems and associated equipment used in different installations. An introduction (awareness) of the IP Code. The cable capacities of conduit and trunking as given in the IET On-Site Guide. The procedure for selecting an appropriate size of conduit or trunking.

Learners will know and understand the ratios used in drawings, and conversion from site drawings to ascertain material etc. The graphical symbols used in diagrams and drawings:

- switches: one-way, two-way, intermediate, and pull)
- lighting points: incandescent, fluorescent, wall mounted
- socket outlets: switched, and unswitched
- fused connection units, and switched fused connection units
- consumer control unit
- cooker control unit
- integrated meter (kWH meter), fuse and circuit breaker.

Learners will know and understand the drawings which show site layout, location, and component positioning. How to check that the planned locations of wiring systems are visually acceptable and compatible with other services as well as the specification.

Learners will know and understand the how to install typical wiring system containment such as: conduit (PVC and metallic), trunking (PVC and metallic), cable tray, cable basket, ladder-systems, ducting, modular wiring systems, busbar systems and powertrack. The different fixing and securing methods considering the fabric of the structure, the environment and aesthetics. The methods and procedures used for the installation of wiring systems including sets and bends etc. The maximum bending radius of conduit. The importance of fire barriers and how this relates to the installation of containment. The importance that the installation complies with BS 7671, not detrimental to the environment, and is aesthetically pleasing.

Unit 205E: Understand How to Install and Connect Electrical Cables, Conductors, Wiring Systems and Equipment

GLH:	67

What is this unit about?

This unit covers the knowledge and understanding for the selection, installation and connection of electrical cables, conductors, wiring systems, equipment, accessories, and components for electrical systems.

The learner will be able to comply with the procedures and methods for installing and connecting electrical cables, conductors, wiring systems, equipment, accessories, and components 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.

Their skills will cover the different types of cables, conductors, wiring systems, equipment, accessories and components, their limitations, applications and the techniques for their positioning, fitting, fixing and connection.

Learners will develop their knowledge and understanding of:

- the applications, advantages, and limitations of types of electrical cables, conductors, wiring systems, associated equipment, accessories and components
- the industry recognised methods for determining the type, size and rating of electrical cables, conductors, wiring systems, associated equipment, accessories, and components in relation to the electrical system's design
- how to install and connect types of electrical cables, conductors, wiring systems, associated equipment, accessories, and components.

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

- What types of cables are used?
- How are cables installed?
- Why is designing a circuit important?

Learning outcome:

1. Understand the applications, advantages, and limitations of types of electrical cables, conductors, wiring systems, associated equipment, accessories and components

Criteria

1.1 The applications, advantages, and limitations of electrical cables

Range:

- single and multicore thermosetting insulated cables including flexible cables
- single and multicore thermoplastic (PVC) insulated cables including flexible cables
- PVC/PVC flat profile cable
- MICC (with and without PVC sheath)
- SWA cables (XLPE, PVC)
- armoured/braided flexible cables
- data cables
- fibre optic cable
- fire performance cable
- cable glands

1.2 The requirements of industrial plugs, sockets, and couplers

Learning outcome:

2. Understand the industry recognised methods for determining the type, size and rating of electrical cables, conductors, wiring systems, associated equipment, accessories, and components in relation to the electrical system's design

Criteria

2.1 How to determine the size and rating of electrical cables (basic single-phase circuits to non-reactive loads)

Range: the basic application of diversity, determining the circuit design current, selection of a suitably rated protective device, application of rating factors: Ca, Cg, Cf, Ci, selecting a cable in accordance with the tabulated current carrying capacity, establishing, and confirming the voltage drop is acceptable

Learning outcome:

3. Understand how to install and connect types of electrical cables, conductors, wiring systems, associated equipment, accessories, and components

Criteria

3.1 The methods and techniques for installing and fixing electrical cables, conductors, wiring systems, associated equipment, accessories and components in accordance with:

- the electrical system's design
- manufacturers' instructions

3.2 The different types and methods of terminating and connecting electrical cables and conductors

Delivery outcomes (depth of content)

1
Learners will know and understand the listed range of cables, conductors and associated wiring systems including their common applications, advantages and limitations.

Learners will know the features and characteristics of cables including the operating temperature limits of cables, MICC (with/without PVC sheath) and what the PVC sheath colour indicates, common cable sizes (e.g. what 2L1.5 means in relation to MICC). The different types of glands used for cables (e.g. for SWA: CW, BW etc. and their use). The types of containment systems used in conjunction with cables, and the types of installations where these wiring systems are typically used in domestic, commercial, industrial, and agricultural/horticultural installations. Recognising the common industrial plugs, sockets, and couplers used for 110 V, 230 V and 415 V (BS EN 60309). The application of low temperature PVC insulated and sheathed cable (arctic flex).

2
Learners will know what is meant by diversity factors and the application of IET On-Site Guide in determining the maximum demand of typical circuits after diversity has been applied. The application of IET On-Site Guide in selecting a cable for a given application.

Learners will be accustomed to utilising tabulated data to select a cable for a simple single-phase load considering the circuit design current, selection of the protective device, identifying and using rating factors, selecting a cable, and calculating and confirming voltage drop is acceptable. Learners will know the maximum voltage drop % for single-phase circuits.

3
Learners will know how to install, fix and connect electrical cables, conductors, wiring systems, associated equipment, accessories, and components. The procedures used for selecting and safely using tools and equipment for terminating cables (including the use of eye protection). The bending radius of cables. The methods and techniques used to draw cables into conduit and trunking. The methods used to fix and support cables to buildings and structures in accordance with the key aspects of BS 7671 and the IET On-Site Guide and industry practices. The use of grommets. Considering migration of plasticiser from PVC Cables and the need to keep cables clear of polystyrene granules, and wood preservatives etc. The requirements for cables in joists, wall, or partition. The effects of eddy currents when cables pass through ferrous enclosures (line and neutral together, or a slot cut between). The meaning and requirements for voltage bands (Band I and Band II). The key requirements of proximity of wiring systems to other services.

Learners will know and understand the advantages, disadvantages of connection methods: screw, crimped, soldered, non-screw compression, insulation displacement. The procedures for verifying that terminations and connections are electrically and mechanically sound. The consequences of terminations not being electrically and mechanically sound (the insidious nature of high resistance joints). The different types of crimps, connectors and terminals commonly used. (Refer to the requirements of accessibility and electrical

connections in BS 7671). An awareness of splicing fibre optic cables. The methods and techniques for the connection, termination of the range of cables given and their identification (such as sleeving/tags).

Unit 206E: Understand How to Inspect and Test De-Energised Electrical Circuits

GLH:	25

What is this unit about?

This unit covers the knowledge and understanding of the fundamental inspections and de-energised tests required for single-phase circuits.

The learner will be able to comply with the processes and procedures for fundamental inspections and de-energised tests in accordance with the current versions of the appropriate industry standards and regulations, the specification and industry recognised working practices.

Learners will develop their knowledge and understanding of:

- how to select the instruments to be used for carrying out relevant tests
- the methods and procedures for conducting a visual inspection on the enclosures cables, conductors and wiring systems
- the correct procedure for safe isolation
- the methods and processes to carry out correctly the tests that ensure safe and efficient operation of the electrical system.

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

- Why is electrical work inspected and tested?
- Why is safe isolation essential?

Guidance: the emphasis in this unit is on the learner correctly carrying out fundamental inspections and de-energised tests on typical common circuits to include ring and radial final circuits and lighting circuits. Learners will be able to utilise test equipment, evaluate test results and record outcomes accurately.

Learning outcome:

1. Understand how to select the instruments to be used for carrying out relevant tests

Criteria

1.1 The test instruments required for de-energised tests on standard single-phase circuits
Range: continuity tester, insulation resistance tester, test leads and accessories

1.2 How to confirm that the test instruments are fit for purpose and have a current calibration certificate

Learning outcome:

2. Understand the methods and procedures for conducting a visual inspection on the enclosures cables, conductors and wiring systems

Criteria

2.1 How to confirm the installed electrical equipment is located and secured correctly and electrically and mechanically sound

2.2 How to carry out a visual inspection of the main/key aspects of standard single-phase circuits

Learning outcome:

3. Understand the correct procedure for safe isolation

Criteria

3.1 The safe isolation procedure
Range: reasons for safe isolation, pre-isolation considerations to others and connected equipment/circuits, the correct procedure for safe isolation

Learning outcome:

4. Understand the methods and processes to carry out correctly the tests that ensure safe and efficient operation of the electrical system

Criteria

4.1 How to carry out de-energised tests on standard single-phase circuits
Range: continuity of protective bonding conductors, continuity of circuit protective conductors, continuity of ring final circuit conductors, insulation resistance, polarity

Learning outcome:

5. Understand methods for providing clear and accurate information to relevant people

Criteria

5.1 How to record outcomes from basic inspections and dead tests clearly and accurately

Delivery outcomes (depth of content)

1
The learner will understand the fundamental aspects of how to select and safely use test instruments and accessories to carry out de-energised tests on single-phase circuits. The pre-use checks, and the importance of equipment calibration. The application of GS 38.

2
The learner will understand the fundamental aspects of how to carry out a basic visual inspection of completed work against an installation specification and the requirements of the IET On-Site Guide (covering key common aspects). Learners will know how to carry out inspections - such as how to ensure conductors are adequately terminated, and electrically sound (low resistance, doubled over/filling the terminal), mechanically sound ('tug test'), and correct cable identification. The application of the human senses during an inspection. Learners will know that the work should be inspected as it is being completed, and the actions to be taken where non-compliances are found.

3
The learner will understand how to carry out the electrical safe isolation procedure in accordance with the Electrical Safety First's Best Practice Guide No.2. The implications of electrical self-isolation to self, others, and the building's electrical systems. The implications of not carrying out the safe isolation procedure. Safely isolating all forms of energy, including back-up supplies. The requirements of GS 38 for the voltage indicator.

4
The learner will understand how to carry out tests on single-phase de-energised circuits. The pre-test procedure to include nulling leads and selecting the correct scale and setting for the test. Learners will know the reason and procedures for carrying out relevant tests and be able to interpret the test results. Why test instruments, leads and accessories should be handled with care. How to record the outcomes of inspections and tests of simple circuits on relevant documentation, and why this needs to be in a clear and accurate format. The implication of carrying out IR tests which can damage sensitive loads such as dimmer switches and USB outlets in sockets. Dangers of charging capacitors (latent energy).

Unit 207E: Understand Intermediate Electrical Science and Principles

GLH:	80

What is this unit about?

This unit covers the fundamental science and principles relevant to electrical work. These principles underpin the knowledge understanding and performance requirements of all units within this qualification.

Learners will develop their knowledge and understanding of:

- fundamental mathematical principles which are appropriate to electrical installation work
- standard units of measurement used in electrical installation and design work
- basic mechanics and the relationship between force, work, energy, and power
- the fundamental relationship between resistance, resistivity, voltage, current and power
- fundamental principles which underpin the relationship between magnetism, electricity, generation, and supply systems.

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

- What is the relationship of science and principles to electrical work?
- What is electricity?
- How is electricity generated, transmitted, and distributed to installations?

Learning outcome:

1. Understand fundamental mathematical principles which are appropriate to electrical installation work

Criteria

1.1 The appropriate mathematical principles which are relevant to electrical work tasks
Range: fractions and percentages, algebra, transposition, indices and square roots

Learning outcome:

2. Understand standard units of measurement used in electrical installation and design work

Criteria

2.1 The internationally recognised base and derived (SI) units of measurement for general quantities
Range: length, area, volume, mass**,** density**,** time, temperature**,** and velocity

2.2 The values of base and derived SI units which apply specifically to electrical quantities
Range: resistance, resistivity, power, frequency, current, voltage, and energy

2.3 The appropriate electrical instruments for the measurement of different electrical quantities
Range: resistance, power, current, voltage, and energy

Learning outcome:

3. Understand basic mechanics and the relationship between force, work, energy and power

Criteria

3.1 What is meant by mass and weight

3.2 The principles of basic mechanics as they apply to levers, gears, and pulleys
Range: Class I, Class II and Class III

3.3 The main principles of mechanical principles and their inter-relationships
Range: force, work, energy (kinetic and potential), power, and efficiency

3.4 Calculation of mechanical energy, power, and efficiency

Learning outcome

4. Understand the fundamental relationship between resistance, resistivity, voltage, current and power

Criteria

4.1 The basic principles of electron theory

4.2 Materials which are good conductors and insulators

4.3 What is meant by resistance and resistivity in relation to electrical circuits

4.4 The relationship between current, voltage and resistance in parallel and series D.C circuits

4.5 The values of current, voltage and resistance in parallel and series D.C circuits

4.6 The values of power in parallel and series D.C circuits

4.7 What is meant by the term voltage drop in relation to electrical circuits

4.8 The chemical and thermal effects of electric currents

Learning outcome:

5. Understand fundamental principles which underpin the relationship between magnetism, electricity, generation, and supply systems

Criteria

5.1 The effects of magnetism in terms of attraction and repulsion

5.2 The difference between magnetic flux and flux density

5.3 The magnetic effects of electrical currents in terms of:

- production of a magnetic field
- force on a current carrying conductor in a magnetic field
- electromagnetism
- electromotive force

5.4 The basic principles of A.C generation in terms of:

- a single-loop generator
- sinewave
- frequency
- EMF
- magnetic flux
- three-phase systems

5.5 The characteristics of sinewaves

Range: root mean square (rms) value, average value, peak to peak value, periodic time, frequency, and amplitude

5.6 The features and characteristics of a generation, transmission, and distribution system

Range: power stations, fossil fuels, hydro, nuclear, super-grid and standard grid system, transformers, transmission voltages, distribution voltages, sub-stations, above and below ground distribution

Delivery outcomes (depth of content)

1

Learners will understand how to utilise the fundamental mathematical principles that underpin this unit and electrical work. Learners will understand how to use the basic functions on a scientific calculator and the relevant order of operations and how to transpose simple equations and formulas. The emphasis is on the learner gaining the relevant underpinning mathematical knowledge and skills to succeed in this unit and this qualification.

2

Learners will gain an appreciation of SI units of measurement for both general quantities and electrical quantities. Learners will be able to state units of measurement together with commonly used multiples and submultiples in electrical installation work. Learners will be able to state which instruments are required for the measurement of voltage and energy together with resistance power and current.

3

Learners will gain an appreciation of the difference between mass and weight and the SI units of each. Learners will recognise that mass is a measure of how much matter there is in an object and weight is a measure of the pull of gravity on the object. Learners will understand the main principles of; and the basic mechanical formulas used for: force work energy power and mechanical efficiency %. Learners will know what is meant by mechanical advantage.

4

Learners will gain an appreciation of the fundamental theory of electrical circuits and will be able to calculate resistance and resistivity with the resistivity values of common conductors used for electrical installation. Learners will be able to carry out calculations for voltage current and resistance for resisters in series and parallel circuits and combined combinations. Learners will be able to calculate power dissipated at loads in series and parallel circuits and combined combinations and understand voltage drop in relation to electrical circuits. Learners will know the chemical and thermal effects of electric currents.

5

Learners will gain an appreciation of magnetism and electromagnetism. Learners will be able to identify how a sine wave is generated and the key features and characteristics of sine waves together with determining relevant A.C values: root mean square (RMS) value, average value, peak to peak value, periodic time, frequency, amplitude. Learners will know how electricity is generated, transmitted, and distributed to consumers. The transmission and distribution voltages to different types of consumer and basic power loss. Learners will understand the main characteristics of electrical supplies. The reasons for using alternating current transmission and distribution. The reasons for the neutral conductor. The advantages of distributing loads evenly over the three lines.

Unit 208E: Performing Electrical Installation

GLH:	136

What is this unit about?

This unit covers the skills required to carry out electrical work. It will enable the learner to practice and be assessed on a range of electrical systems and equipment safely at the centre. The content reflects industry recognised performance statements which facilitate the learner's progression into an apprenticeship.

Learners will develop their skills in:

- reading and interpreting plans and documentation required in performing a wide range of tasks in the trade area
- carrying out a wide range of tasks in the trade area in ways that promote their own health and safety and that of others.

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

- What is the sequence of activities required to carry out typical tasks in my chosen trade?
- What PPE will I need to carry out typical tasks?
- How can i continually improve my skills in my chosen trade?

Learning outcome:

1. **Assess and apply appropriate procedures to include**
   - **adopting appropriate PPE**
   - **following a safe system of work (e.g. working in accordance with a risk assessment and method statement)**
   - **selecting appropriate tools/equipment for the installation work**

Learning outcome:

2. **Use sources of information to enable the installation of wiring systems, enclosures, and associated equipment to be carried out**

Learning outcome:

3. **Use appropriate measuring and marking out techniques which are appropriate to the wiring system, wiring enclosure and/or associated equipment that is being installed**

Learning outcome:

4. **Install cables in accordance with BS 7671, the installation specification and programme of work**

Learning outcome:

5. **Install the wiring systems in accordance with BS 7671, the installation specification and agreed planned programme of work**

Learning outcome:

6. **Terminate and connect cables and conductors in accordance with manufacturer's instructions, BS 7671, and any relevant drawing or specification**

Criteria

6.1 Cables:

- single core cable (singles)
- multicore insulated cable
- PVC / PVC flat profile cable (twin and earth)
- fire performance cable (such as FP 200 etc.)
- SWA cable
- GSWB galvanised steel wire braid
- data cable

Learning outcome:

7. Install electrical equipment and accessories, in accordance with BS 7671, the installation specification, manufacturers' instructions and the programme of work

Learning outcome:

8. Connect to electrical equipment in accordance with manufacturer's instructions, BS 7671, and any relevant drawing or specification

Learning outcome:

9. Terminate and connect conductors, using appropriate methods

Learning outcome:

10. Ensure that terminations and connections are electrically and mechanically sound

Learning outcome:

11. Ensure cables have appropriate identification in accordance with BS 7671

Learning outcome:

12. Carry out a visual inspection

Criteria

12.1 Fundamental inspections on completed work

Learning outcome:

13. Select the correct test instruments and their accessories for tests

Learning outcome:

14. Carry out tests in accordance with the installation specification

Criteria

14.1 Tests on single-phase circuits**:**

- continuity of conductors
- insulation resistance
- polarity

Learning outcome:

15. Verify test results

Learning outcome:

16. Dispose of waste materials in accordance with site procedures

Delivery outcomes (depth of content)

Learners will gain essential electrical installation skills through training and practice in the centre's workshop. Learners will be able to plan electrical installation work and carry out work safely using hand tools and equipment correctly.

Learners will gain (or progress their skills) in measuring and marking out and gain confidence in their abilities.

Learners will gain skills in a range of electrical systems. This will include PVC and steel conduit and sets and bends. Cutting and drilling skills and fabricating sets in trunking.

Learners will be able to wire circuits correctly using relevant information such as drawings/diagrams and specifications. Learners will have skills to terminate and connect the range of cables as listed within the unit.

Learners will utilise their knowledge of how to carry out fundamental inspection and testing of deenergised circuits to inspect and test their completed work. Learners will be able to evaluate their work against their own planning.

The skills in this unit will be essential to enable the learner to perform their trade in the Practical Project assessment.