

EAL Building Services Engineering (Level 3) – Refrigeration, Air Conditioning and Heat Pumps C00/5331/4

Qualification Handbook

Version 1.0 – June 2026



Contents

Qualification purpose	4
Qualification aims and objectives	5
Qualification structure	6
Delivering the qualification	16
Summary of assessment	19
Assessment specifications	22
Content key	23
Unit content	25
Unit 301: Understanding Building Services Engineering Practice in Wales	26
Unit 302: Working in The Building Services Engineering Sector in Wales	33
Unit 303: Understand Health and Safety and Environmental Legislation in The Building Services Engineering Sector	38
Unit 304: Planning and Evaluating Work in the Building Services Engineering Sector in Wales	46
Unit 305RACHP: Understand Scientific Principles	50
Unit 306RACHP: Understand Core Refrigeration, Air Conditioning and Heat Pump Systems	58
Unit 307RACHP: Performing Electrical Work on Refrigeration, Air Conditioning and Heat Pump Systems	70
Unit 308RACHP: Understand Refrigeration, Air Conditioning and Heat Pump System Installation, Commissioning and Decommissioning Techniques	80
Unit 309RACHP: Understand Refrigeration, Air Conditioning and Heat Pump system Service and Maintenance Techniques	88
Unit 310RACHP: Performing Refrigeration, Air Conditioning and Heat Pump system Installation, Commissioning and Decommissioning Techniques	93
Unit 311RACHP: Performing Refrigeration, Air Conditioning and Heat Pump System Service and Maintenance Techniques	99
Unit 312: Apply Health and Safety and Environmental Legislation in the Building Services Engineering Sector	102
Unit 313: Establish and Maintain Relationships in the Building Services Engineering Sector	106
Unit 314: Coordinate a Work Site in the Building Services Engineering Sector	111

Version information

Version and publication date	Changes
v1 June 2026	Original document

Qualification purpose

	Description
Who is the qualification for?	The EAL Building Services Engineering (Level 3) – Refrigeration, Air Conditioning and Heat Pumps qualification has been developed to allow those in work-based learning to demonstrate and enhance their occupational knowledge, skills and understanding within their Building Services and Engineering (BSE) trade. On completion, the qualification will provide learners with the skills and knowledge required to work effectively and competently in their trade across the UK. It is suitable for: • learners aged 16+ currently working in the BSE trade area • learners who have completed a suitable EAL Progression qualification in Building Services Engineering (Level 2)
What does the qualification cover?	Learners will develop their knowledge, skills and understanding of the trade, as contained in the recognised standards. The qualification will allow learners to plan and perform projects in their trade, against recognised standards, before reviewing and evaluating the quality of the project outputs. The qualification will be portable throughout the UK and is aimed to develop learners' ability to meet the demands of the BSE sector in Wales.
What opportunities for progression are there?	Successful completion of this qualification supports learners looking to progress into related areas such as low-carbon technologies, system design and building energy management, as well as those seeking progression into supervisory roles. It also provides a foundation for further study on other Level 3 BSE courses or at higher levels, such as, Level 4 technical qualifications and beyond.
Who did we develop the qualification with?	The content has been developed by the Consortium¹ 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 the qualifications in the Construction and BSE suite

Qualification aims and objectives

This qualification enables learners to develop their:

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

Qualification structure

Rule of combination

To achieve the EAL Building Services Engineering (Level 3) – Refrigeration, Air Conditioning and Heat Pumps qualification learners must undertake all units listed below.

Achieving a Pass grade or higher in the five assessments, totalling 973 GLH.

Unit	Unit title	GLH
301	Understanding Building Services Engineering Practice in Wales	40
302	Working in the Building Services Engineering Sector in Wales	40
303	Understand Health and Safety and Environmental Legislation in The Building Services Engineering Sector	21
304	Planning and Evaluating Work in the Building Services Engineering Sector in Wales	35
305RACHP	Understand Scientific Principles	77
306RACHP	Understand Core Refrigeration, Air Conditioning and Heat Pump Systems	100
307RACHP	Performing Electrical Work on Refrigeration, Air Conditioning and Heat Pump Systems	204
308RACHP	Understand Refrigeration, Air Conditioning and Heat Pump system Installation, Commissioning and Decommissioning Techniques	100
309RACHP	Understand Refrigeration, Air Conditioning and Heat Pump system Service and Maintenance Techniques	45
310RACHP	Performing Refrigeration, Air Conditioning and Heat Pump system Installation, Commissioning and Decommissioning Techniques	117
311RACHP	Performing Refrigeration, Air Conditioning and Heat Pump System Service and Maintenance Techniques	50

312	Apply Health and Safety and Environmental Legislation in the Building Services Engineering Sector	15
313	Establish and Maintain Relationships in the Building Services Engineering Sector	26
314	Coordinate a Work Site in the Building Services Engineering Sector	28
N/A	All Forms of Assessment	75
Total GLH		973

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

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

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

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

The TQT for this qualification is specified below.

Qualification	TQT	Credits
EAL Building Services Engineering (Level 3) – Refrigeration, Air Conditioning and Heat Pumps	1278	128

Centre requirements

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

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

- Application for Centre & Qualification Approval.

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

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

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

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

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

Registration, results issuing and certification

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

Quality assurance

Internal quality assurance

The focus of internal quality assurance for this qualification is:

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

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

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

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

Internal quality assurers

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

IQAs must:

- prepare for and participate in relevant EAL meetings and events, such as induction, Continuing Professional Development (CPD)/training, and standardisation events, and ensure any personal action/improvement plans are achieved, within agreed timescales and to the required standards
- be technically and occupationally competent in the trade area or related BSE area evidenced by having a building services engineering related qualification or proven sector competence/experience at least equivalent to the level of the qualification, to enable them to conduct their role as an IQA. This evidence is quality assured by EAL

- be working towards (registered before carrying out any quality assurance activity), or have achieved the following units:
 - Understanding the Principles and Practices of Internally Assuring the Quality of Assessment*
 - Internally Assure the Quality of Assessment*
- * Legacy Qualifications (D32/D32/D34, A1 and V1) will be accepted.
- be able to demonstrate evidence of being up to date with the relevant trade/industry. This can be evidenced for example, by either accessing trade publications, undertaking courses of learning, attending networking events relevant to this qualification and/or attending industry events.

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

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

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

External quality assurance

The Practical Project must be internally assessed and externally verified.

The Oral Questioning must be internally assessed and externally verified.

The Professional Discussion must be externally assessed and externally verified.

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

EAL will:

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

External quality assurers

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

External Quality Assurers must:

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

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

EAL will:

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

Roles, responsibilities and quality assurance

Internal assessor profile

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

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

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

and continue to practice to that standard.

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

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

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

Internal assessor requirements

Internal Assessors must:

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

Expert witness (to provide supporting evidence for Practical Project)

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

To be confirmed as an expert witness employer representative(s), they must:

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

External assessor profile (For the Professional Discussion)

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

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

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

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

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

External assessor requirements (for the Professional Discussion)

External Assessors must:

- fully prepare the Professional Discussion utilising the project evidence
- carry out and document the Professional Discussion assessment in-line with EAL and regulatory arrangements including:
 - o acting in a professional and courteous manner at all times when conducting the assessment on behalf of EAL
 - o arriving at the centre at least 45 minutes prior to the assessment and staying at the centre for the duration of the assessment (when conducting a face-to-face assessment)
 - o marking the Assessments, in accordance with grading criteria
- maintain a thorough knowledge of assessment policies and procedures
- maintain and document CPD (to be submitted on request)
- understand the sector, the apprenticeship, and the assessment requirements
- be familiar with the latest technologies used within the industry
- be occupationally competent
- produce clear, accurate and concise documentation and relevant records (written and electronic), and ensure they are controlled and administered in accordance with the awarding bodies procedures
- make robust assessment decisions

- handle relevant information in accordance with GDPR requirements
- prepare for and participate in relevant EAL meetings and events – such as induction, CPD/training and standardisation events, and ensure any personal action/improvement plans are achieved, within agreed timescales and to required standards
- report to EAL any suspicion of malpractice or maladministration, including academic misconduct
- declare any conflicts of interest (such as between the assessor and the apprentice)
- provide access to information and records when requested
- complete and submit all reports within specified timeframes.

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

External associates/appointees

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

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

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

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

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

Welsh context

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

Continuing professional development

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

Delivering the qualification

Learner entry requirements

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

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

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

Age restrictions

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

Initial assessment and induction

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

- if the learner has any specific training needs
- support and guidance, they may need when working towards their qualification
- any learning and attainment already completed which is relevant to the qualification
- the appropriate type and level of qualification.

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

Support materials

The following resources are available for this qualification:

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

Internal quality assurance

Centres must have a written Internal Quality Assurance strategy.

This will help ensure that Internal Quality Assurance procedures:

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

Moderation of internal assessment arrangements

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

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

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

Internal appeal

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

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 or maladministration. The policy provides definitions and the process by which a suspected or alleged instance of malpractice or maladministration can be reported. It also describes responsibilities and the way EAL will manage such cases to ensure that all malpractice and maladministration investigations are conducted in a consistent manner. Centres can access this in the document tab on the EAL Smarter Touch website.

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

- falsification of assessment evidence or results documentation
- plagiarism of any nature
- collusion with others

- copying from another learner (including the use of ICT to aid copying), or allowing work to be copied
- deliberate destruction of another's work
- false declaration of authenticity in relation to assessments
- impersonation.

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

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

Access arrangements

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

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

Please refer to the EAL Reasonable Adjustment & Special Considerations policy which is available on the EAL Smarter Touch.

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 which is available on the EAL Smarter Touch.

Summary of assessment

This qualification is assessed using the following assessment methods:

Assessment type	Approach to assessment	Weighting (Contribution to overall qualification grade)
On-screen Assessment (Test 1 and Test 2)	Externally set, externally marked	10% (Test 1 – 5%, Test 2 – 5%)
Practical Project	Internally set, internally marked, externally verified	60%
Oral Questioning	Externally set, internally marked, externally verified	10%
Professional Discussion	Externally set, marked and verified	20%

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

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

Assessment timings and phasing

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

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

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

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

Learners must have completed the Practical Project and Oral Questioning assessments prior to undertaking the Professional Discussion assessment.

Result release

On-screen Assessment

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

Practical Project

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

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

Oral Questioning

The Oral Questioning is 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.

Professional Discussion

The Professional Discussion is externally marked and externally verified. The marking and grading tables provided in the Assessment Pack will be used by the external assessor to mark and allocate a grade. The provisional mark for this assessment will be released by EAL within 30 working days of the Professional Discussion taking place. On receipt of the internally assessed grades for the practical project, the grades for this and the on-screen assessment and professional discussion will be aggregated based on the assessment weighting, in line with the grade aggregation guidance provided within the Assessment Pack, and an overall qualification grade awarded which will be issued by EAL.

Overall Qualification Results

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

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

Resubmission/re-sit of assessment

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

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

If a learner is required to resit 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 that can take place.

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

Assessment specifications

On-screen Assessment

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

Practical Project

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

Professional Discussion

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

Oral Questioning

Please refer to the Oral Questioning section of the Assessment Pack.

Qualification Grading

This qualification is graded **Pass, Merit, Distinction**. If a learner does not achieve at least a pass grade they will not receive a certificate.

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

Content key

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

Learning outcomes

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

Learning outcome:

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

Criteria

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

Criteria

2.1 Reasons for *stacking and storing materials*

Range

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

Range: Protection, efficiency, security

Depth of content

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

Delivery outcomes (depth of content)

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

Unit content

Unit 301: Understanding Building Services Engineering Practice in Wales

GLH:	40
------	----

What is this unit about?

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

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

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

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

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

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

Learning outcome:

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

Criteria

- 1.1 The trade bodies and organisations relevant to the trade
- 1.2 The role of the relevant trade bodies and organisations
- 1.3 The competence card schemes within the building services engineering sector and the types of cards available
- 1.4 Professional registration as an Engineering Technician

Learning outcome:

2. Understand connected practice in construction and building services engineering

Criteria

- 2.1 Interdependencies between trades

Learning outcome:

3. Know the changing construction and built environment sector

Criteria

- 3.1 The factors influencing pre-1919 construction
Range: geographical influences, local need, sourcing of materials
- 3.2 The factors influencing post 1919 to modern construction
Range: supply chain, industry demand, population, materials (standardisation, innovation)
- 3.3 The factors influencing 21st century construction
Range: climate change, carbon footprint, resource availability, materials, new methods and techniques

Learning outcome:

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

Criteria

- 4.1 The considerations required when performing building services engineering work on pre-1919 buildings and structures
- 4.2 Post-1919 and modern construction techniques and building services
Range: evolution of buildings; modern heating and ventilation systems, electrical installations, water and waste management systems

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

Learning outcome:

5. Understand the relationship between trades and the environment

Criteria

5.1 Industry regulation and sustainability and the natural environment

5.2 Ecological considerations and principles

5.3 Sustainable approaches

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

5.4 Waste disposal in building services

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

Delivery outcomes (depth of content)

1

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

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

1.3 Learners will know the card/recognition scheme for their trade: BESA (Building Engineering Services Association) Gold Card, or Gold SKILLcard; and the types of cards available.

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

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

2

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

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

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

3

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

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

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

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

4

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

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

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

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

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

5

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

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

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

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

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

Learners will be aware of the importance of accurately ordering materials in order to reduce site waste and save money (and reduce waste disposal costs). Storing materials in an appropriate manner and appropriate sorting of waste on site. Learners will be aware of good

practice guidance such as WRAP for industry waste management the nature of recyclable and biodegradable materials and the impact on landfill and cost to the environment.

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

Unit 302: Working in the Building Services Engineering Sector in Wales

GLH:	40
------	----

What is this unit about?

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

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

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

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

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

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

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

Learning outcome:

1. Understand the built environment in Wales

Criteria

1.1 Building stock in Wales

Range: forms, purposes, energy efficiency, performance

1.2 Factors influencing change in the built environment in Wales

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

1.3 Safety of the built environment

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

Learning outcome:

2. Understand how to work effectively with others

Criteria

2.1 How to develop and maintain productive working relationships

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

Delivery outcomes (depth of content)

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

1

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

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

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

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

1.2 Learners will recognise PESTLE influences such as:

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

Learners will identify the key reasons for increases and decreases in housing demand over the last 100 years and the way that this has caused fluctuations in housebuilding.

Prefabrication and mass housing booms: post WWII war housing, off-site modern prefabrication. Flats and high rise apartments. Learners will understand the purpose behind pre-fabrication – largely economies of scale and ability and need to provide better quality housing within a short time frame. Learners will understand the importance of energy efficiency and embodied energy in meeting the zero-carbon target. Learners will have an appreciation of the sustainability and carbon saving value of maintaining and repairing the

current housing stock compared to replacing the existing 20th century buildings with new buildings.

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

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

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

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

2

2.1 Learners appreciate the range of communication techniques and mediums and their suitability e.g. face to face, active/passive listening, written, oral, and electronic. Learners will

understand the importance of the needs of individuals by applying the principles of equality and diversity.

Learners will understand how to maintain and encourage both formal and informal good working relationships to promote goodwill and trust with the relevant people. This can involve keeping promises and undertakings, being honest and building constructive relationships, co-operating, and having appropriate and good dialogue.

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

- forming
- storming
- norming
- performing.

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

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

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

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

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

GLH:21

What is this unit about?

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

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

Learners will develop their knowledge and understanding of:

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

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

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

Learning Outcome:

1. Understand appropriate industry standards and regulations

Criteria

1.1 Sources of information

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

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

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

1.2 Health and safety/environmental legislation

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

Learning Outcome:

2. Know your responsibilities in accordance with organisational procedures

Criteria

2.1 Members of the construction team

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

2.2 Enforcing authorities.

Range: Health and Safety Executive, Local Authority

2.3 Control measures of inspectors.

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

Learning Outcome:

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

Criteria

3.1 Working practices

Range: competent persons, electrical safe isolation procedure, permits to work, selection and checking correct power tools, hand tools and portable electrical equipment,

safe working practices with equipment and materials: portable power tools (e.g. cartridge gun, drills, grinders) signs and guarding, tools and materials storage facilities.
Dangerous substances, e.g. cutting compounds and adhesives

Learning Outcome:

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

Criteria

4.1 Common building materials and services components that may contain asbestos

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

4.2 The types of **asbestos**

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

4.3 Commonly encountered substances

Learning Outcome:

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

Criteria

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

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

Learning Outcome:

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

Criteria

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

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

Learning Outcome:

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

Learning Outcome:

8. Know what constitutes a hazard or risk

Criteria

8.1 Site hazards

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

8.2 Common **electrical dangers** encountered

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

8.3 General hazards

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

Learning Outcome:

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

Criteria

9.1 Commonly encountered substances

Learning Outcome:

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

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

Criteria

10.1 Access equipment to permit work at heights

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

10.2 Personal protective equipment (PPE)

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

10.3 Excavations and confined spaces

Learning Outcome:**11. Understand the warning signs for hazardous materials and substances****Criteria**

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

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

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

- organisational procedures
- suppliers' and manufacturers' instructions

Criteria

12.1 How to deal with commonly encountered substances

Range: Oils, solvents, refrigerants, cleaning chemicals

Learning Outcome:**13. Understand the organisational procedures relevant to reporting issues****Criteria**

13.1 The procedures for reporting issues relating to:

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

Delivery outcomes (depth of content)**1**

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

2

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

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

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

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

3

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

4

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

5

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

6

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

7

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

8

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

9

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

10

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

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

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

Learners will be able to identify situations where it may be necessary to work at height and state how to select appropriate access equipment to permit work at heights. The safety checks to be carried out on access equipment. Working in areas of restricted movement e.g. under suspended timber floors in roof spaces and confined spaces.

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

11

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

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

12 - 13

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

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

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

GLH:	35
------	----

What is this unit about?

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

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

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

Learners will develop their knowledge, understanding and skills of:

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

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

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

Learning outcome:

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

Criteria

1.1 Organise the resources required

Range: tools, equipment, materials

1.2 Set success criteria for the task(s)

1.3 Carry out effective planning

Range: timescales, scheduling, quality, cost

1.4 Rationalise why the proposed approach is the most appropriate

1.5 Recognise cost and waste implications of the work

Range: financial, environmental

1.6 Manage risks associated with completing the task and recognise the steps to be taken to stop risks becoming problems

Range: nature of the task, other trades, resources, the work environment, timescales, contingent tasks, alterations, access, any other relevant external factors

1.7 Identify the handover requirements of work

Range: information, documentation, communication

Learning outcome:

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

Criteria

2.1 Review the appropriateness of success criteria set

2.2 Evaluate the resource selection and usage

Range: tools, plant, equipment, products, materials

2.3 Evaluate the finished output

Range: fit for purpose, safe, meets task brief/acceptance criteria, success criteria

2.4 Evaluate own performance

Range: methods, techniques, processes, effectiveness, strengths, weaknesses, lessons learnt, continual improvement

2.5 Review the achievement of timescales

2.6 Evaluate the handover

Delivery outcomes (depth of content)

1

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

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

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

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

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

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

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

and be able to manage risks (within their control) that would impact on completing the tasks.

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

2

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

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

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

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

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

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

Unit 305RACHP: Understand Scientific Principles

GLH:	77
------	----

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 refrigeration, air conditioning and heat pumps 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 refrigeration, air conditioning and heat pumps industry.
- the properties of materials used in the refrigeration, air conditioning and heat pumps industry.
- the relationship between energy, heat and power.
- the principles of force, energy and pressure and their application in the refrigeration, air conditioning and heat pumps industry.
- the mechanical principles in the refrigeration, air conditioning and heat pumps industry.
- the principles of electricity in the refrigeration, air conditioning and heat pumps 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 refrigeration, air conditioning and heat pumps industry?
- How do the principles of force, energy and pressure apply within the refrigeration, air conditioning and heat pumps industry?
- What are mechanical principles?
- What are the principles of basic electron flow, power supplies and motor theory?

Learning outcome:

1. Understand the units of measurement used in the refrigeration, air conditioning and heat pumps industry

Criteria

1.1 The internationally recognised (SI) **units of measurement**

Range: metre (length) m, kilogram (mass) kg, second (time) s, kelvin (temperature) K
ampere (current) A.

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), specific volume (m^3/kg), air velocity (m/s), pressure (Nm/m^2), enthalpy (kJ/kg), kilowatt (j/s), specific humidity (g/kg).

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: air, water, refrigerants, oils.

2.2 The properties and applications of **solid materials**

Range: pure metals, ferrous metals, alloys including solders, thermos-plastics, thermo-setting plastics, ceramics, insulating materials.

2.3 The reasons why solid materials breakdown

Range: atmospheric corrosion, oxidation of metals, ultra-violet (UV) damage to plastics, heat damage to plastics, electrolytic corrosion, electromotive series, dissimilar metals in the presence of an electrolyte (water), erosion corrosion.

2.4 The methods of preventing corrosion

2.5 The applications of **liquids** and **gases**

Range:

Liquids: water, refrigerants, anti-freeze (propylene and ethylene glycol) mixes, fuel oils, lubricants/greases, adhesives.

Gases: air and steam, LPG, natural gas, carbon dioxide, refrigerant gases.

2.6 The basic properties of **liquids**

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

2.7 The basic properties of **gases**

Range: natural gas, LPG and air; pressure, volume, temperature of gases found within the industry, Charles's law, Boyle's law, Gay-Lussac's Law, Combined gas laws, Dalton's Law of partial pressures.

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, 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), Enthalpy (kJ/kg), 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 Refrigeration, Air conditioning and Heat Pumps 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 affect 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 Refrigeration, Air conditioning and Heat Pumps 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 Refrigeration, Air conditioning and Heat Pumps industry

Criteria

6.1 SI derived units for electrical values

Range: voltage, resistance, capacitance, frequency.

6.2 The **basic principles** of electron flow theory

Range: measurements of electrical flow, material conductivity and resistance, direct and alternating current.

6.3 The requirements for earthing of electrical circuits

6.4 Power supplies

Range: alternating current (AC), direct current (DC), capacitance, three-phase, single phase.

6.5 Electrical protection devices

Range: protecting against fire and explosion, earth leakage circuit breaker (ELCB), miniature circuit breaker (MCB) operation, residual current device (RCD) operation, moulded case circuit breaker (MCCB) operation, residual current circuit breaker (RCCB) operation, residual current breaker with over-current (RCBO) operation.

6.6 The purpose and application of simple **units** of electrical measurement

Range: Current (Amps), Voltage (Volts), Resistance (Ohms), Power (Watts).

6.7 Simple electrical calculations

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

6.8 Motor Theory

Range: Magnetic fields, current flow (left hand flux rule), induced motion (right hand motor rule), turning force (torque), motor components, alternating and direct current (AC and DC) motors, electromagnets, speed control and horsepower, AC theory in relation to motors (phase rotation, power factor, induction, reactance: inductive and capacitive, impedance).

Three phase motors: a. squirrel-cage induction, rotor and stator RACHP, rotating magnetic field, two-pole, four-pole, star connection, star and delta connection, direct online (DOL), frequency, motor speed, direction of rotation, DC motors: brushed and brushless.

Single phase motors: split-phase, capacitor-start, permanent split capacitor, capacitor-start capacitor-run (also called two-value capacitor), and shaded-pole.

Learning outcome:

7. Understand how to apply refrigeration, air conditioning and heat pump scientific principles to system design

Criteria

7.1 The **basic principles** of refrigeration, air conditioning and heat pump design

Range: heat load constituents, heat load data from external influences, heat load calculations, how to design systems from a calculated load.

7.2. How the performance of refrigeration and air conditioning and heat pump systems is analysed and reviewed

Range: plotting a pressure enthalpy (P-h) chart, using the chart to identify faults and calculate efficiencies.

7.3 The principles of psychrometric charts

Range: The properties of air, plotting psychrometric charts, using the chart to identify properties of air.

Delivery outcomes (depth of content)

1

Learners should understand the metric system of measurement and that it is an internationally recognised standard of measurement and be able to produce a list of the SI units of measurement. Learners will understand derived SI units to area, volume, density, energy, heat content and velocity and how to use conversion tables.

2

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

Learners will be able to list the metals, plastics and ceramic materials used in refrigeration, air conditioning and heat pumps, 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 properties of liquids and gases used in refrigeration, air conditioning and heat pumps, giving examples of their applications.

Learners will understand the principles of Boyle's, Charles's Laws and the combined gas laws, and how this applies in refrigeration, air conditioning and heat pumps.

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 applies to liquids and gases

Learners will understand how heat transfer occurs via conduction, convection, and radiation. Including an understanding of the vapor compression refrigeration cycle.

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

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

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

4

Learners should understand the units of force and pressure used within refrigeration, air conditioning and heat pumps 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 and the principles of basic mechanics.

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 purpose and application of 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.

Learners will know the difference between power supplies

Learners will know the basic motor theory

Learners will know the different applications for electrical protection devices

7

Learners will develop an understanding of refrigeration, air conditioning and heat pump design and the vapor compression refrigeration cycle.

Learners will be able to calculate efficiencies by plotting key operating parameters on a P-h chart. They will know how to interpret the chart to identify faults and be able to calculate and compare system efficiencies. Learners will understand the principles of a psychrometric chart and how the chart is plotted. They will know how to use the chart to identify properties of air and how this information can be applied to the systems design.

Unit 306RACHP: Understand Core Refrigeration, Air Conditioning and Heat Pump Systems

GLH:	100
------	-----

What is this unit about?

The purpose of this unit is for learners to explore refrigeration, air conditioning and heat pump systems within a domestic property and industrial and commercial building and the knowledge that underpins work on the different systems. Learners will understand the industry standards and regulations in place and the importance of quality when working in the refrigeration, air conditioning and heat pumps industry. The principle of sustainability is an important aspect of this unit, and learners will understand how the efficient use of resources and the control of emissions and waste can be applied during:

- Designing
- Commissioning
- Installation
- Decommissioning
- Servicing and maintenance

of refrigeration, air conditioning and heat pump 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 refrigeration, air conditioning and heat pump system
- how to complete relevant documentation
- the methods and techniques for decommissioning the system
- the methods and techniques to ensure the refrigeration, air conditioning and heat pump 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 require to work on a refrigeration, air conditioning and heat pump system and what documentation must I complete?

- What is meant by servicing and maintaining a refrigeration, air conditioning and heat pump system?
- What is meant by commissioning a refrigeration, air conditioning and heat pump system?
- What is meant by decommissioning and why does it need to be done correctly?

Industry standards, regulations and best practice

Learning outcome:

1. Understand the appropriate industry standards and regulations relevant to
 - commissioning
 - decommissioning
 - installing and testing
 - service and maintenance
 of refrigeration, air conditioning and heat pump systems

Criteria

- 1.1. The sources of information required when undertaking work on refrigeration, air conditioning and heat pump systems
Range: Statutory regulations, building regulations, industry standards, manufacturer technical instructions.
- 1.2. The principles of heritage and conservation and the implications for refrigeration, air conditioning and heat pump systems design.
Range: Heritage (listed buildings, conservation areas, National Parks and areas of outstanding beauty), conservation (permitted development, minimising visual impact, respecting historic fabric), Documentation.
- 1.3. The key requirements of environmental legislation and their relation to refrigeration, air conditioning and heat pump systems and activities.
Range: Climate Change Act, Control on Ozone Depleting Substances, F-Gas Regulations, Environmental Protection Act, Hazardous Waste Regulations.

Learning outcome:

2. Understand the importance of quality when working in the refrigeration, air conditioning and heat pumps industry

Criteria

- 2.1. How quality is measured and maintained
Range: inspections, testing, standards, specifications.
- 2.2. The quality expectation of customers
Range: internal (colleagues, line manager, other departments), external (clients, members of public, neighbours, other trades).
- 2.3. How own activities and behaviours can have a positive or negative effect on quality
Range: negative (being distracted, cutting corners, mistakes, unfinished tasks), positive (keeping people up to date, working to a specification).

Learning outcome:

3. Understand the principles of sustainability and how efficient use of resources and control of emissions and waste can be applied during:

- design
- commissioning
- installation
- decommissioning
- servicing and maintaining

Criteria

3.1. Sources of energy used in refrigeration, air conditioning and heat pump systems and implications for meeting UN Sustainability Development Goals.

Range: UN, EU, UK legislation for reducing carbon emissions from refrigeration, air conditioning and heat pump systems to combat climate change and its impacts, decarbonisation of the grid (nuclear energy, wind power), variety of energy sources to reduce carbon emissions and promote sustainability (heat pumps, solar thermal systems, biomass boilers, electric boilers, systems, hydrogen boilers, hybrid systems).

3.2. How the efficient use of resources and control of emissions and waste is applied to the various stages of work on the different refrigeration, air conditioning and heat pump systems.

Range: Design system to maximise energy efficiency, insulation to reduce heat loss and improve system efficiency, systems operation with smart controls, monitoring and educate users on efficient system operation, regular maintenance protocols to prevent breakdowns and ensure systems operate efficiently.

3.3. Waste and waste products of refrigeration, air conditioning and heat pump systems

Range: Types of waste, materials that can be recycled (metals, plastics, wood/cardboard), potential hazards and risks to the environment and user, safe disposal of recovered fluids (refrigerants, oil, ammonia-contaminated water, secondary refrigerants), water supplies and water quality

3.4. Environmental technologies used to mitigate for negative environmental impacts of refrigeration, air conditioning and heat pump systems.

Range: Energy storage systems, smart grid integration, noise insulation, zero and low-GWP refrigerants, new technology and developments.

Delivery outcomes (depth of content)

1

1.1 Learners will be able to identify different sources of information available to them while working on refrigeration, air conditioning and heat pump systems, including those required to complete testing and commissioning.

1.2 Learners will have a basic understanding of the core principles of heritage and conservation, including the value of the historic environment and the importance of preserving it for future generations. They will understand the implications of this on refrigeration, air conditioning and heat pump design.

1.3 Learners will know the key requirements of the environmental legislations and how they relate to refrigeration, air conditioning and heat pump activities, and an overview of the consequences of non-compliance.

2

2.1 Learners will understand the different ways in which quality can be measured in relation to their role and know the procedures in place to ensure quality is achieved.

2.2 Learners will know the difference between a product and service and have an awareness of brand reputation. For internal customers they will understand the importance of clear communication, timely support and efficient working. For external customers they will have an awareness of how expectations can be shaped by past experiences, reputation and marketing/advertisement messages, and they will understand that expectations will include reliability, value for money, produce performance and professional service. They will understand the range of external customers they could be working with and have an appreciation of how customer expectations can vary in the different types of properties they could be working in (commercial, industrial, residential).

2.3 Learners will be aware of how their own activities and behaviours can impact on quality, including understanding the pressures to show negative behaviours, such as reducing costs, keeping to timescales. Learners will know the risks of using cheaper equipment and components and be able to identify the circumstances when this might or might not be acceptable (e.g. meeting building regulations).

3

3.1 Learners will know the key principles of the legislation for reducing carbon emissions from refrigeration, air conditioning and heat pump systems. They will know the different sources of energy, including renewable and non-renewable options. They will understand how renewable options reduce carbon emissions and support sustainability goals. They will know the energy sources used by most common types of refrigeration, air conditioning and heat pump systems and have an appreciation of advances in technology may improve systems energy efficiency and increase renewable energy usage.

3.2 Learners will know the different ways in which resources can be recycled and repurposed during the various stages of work, and how these activities can impact on a carbon footprint. They will understand how different design elements can maximise energy efficiency, such as choosing energy efficient equipment. They will understand the different types of gasses used, and why alternative refrigerants are more environmentally friendly. They will know the regulations that apply to these and how to identify the information which determines when the old gasses will be phased out and new ones introduced. Learners will be able to appreciate the differences that may occur in the timelines for different Nations.

3.3 Learners will understand the different types of waste equipment and fluids, why they are of concern to the environment and how these must be properly handled. They will understand how to segregate the commercial waste in line with the local and organisational requirements and why this is important.

3.4 Learners will understand why these technologies are important for minimizing the environmental footprint and the principles of how they work.

Operating principles and design

Learning outcome:

4. Understand the operating principles, advantages and limitations of different refrigeration, air conditioning and heat pump systems

Criteria

4.1. The working principles of different refrigeration, air conditioning and heat pump systems, positioning fixing, connection and operation of components

Range: Split systems, Variable Refrigeration Flow (VRF), chiller system, freezers, fridges, Stationary and static, Precision and Portable Air Conditioning (PAC), vapour compression systems, absorption refrigeration systems, low and medium temperature refrigeration systems, chilled system, freezers, fridges, stationary and static, cascade and compound refrigeration systems, transcritical refrigeration systems.

4.2. The advantages and disadvantages of different refrigeration, air conditioning and heat pump systems

4.3. Safety devices applicable to refrigeration, air conditioning and heat pump system

Range: High and low pressure switches, expansion vessels, leak detection systems, bacterial growth control systems, anti-freeze protection, air pressure switches, water flow switches, pressure/temperature relief valve, high and low temperature switches.

4.4 Types of control systems applicable to refrigeration, air conditioning and heat pump systems, including:

- Thermostatic controls
- Pressure controls
- Digital controls
- Mechanical controls

Range: thermostats, controllers, weather compensation, optimisation, scheduling, setbacks, hybrid, hot water priority, thermostatic regulating valves (TRV's), mobile applications and remote monitoring, time and use tariffs, smart grids, including the characteristics, operation and suitability.

Delivery outcomes (depth of content)

4

4.1 Learners will know the working principles of the appliances listed, including how and where they might be used.

4.2 Learners will understand the different variations of refrigeration, air conditioning and heat pump systems (wall units, floor units, indoor, outdoor etc.) and the benefits of these in different situations and environments. They will know the different types of gasses used and the dangers imposed of using these gasses in different environments (flammable and toxic risks).

4.3 Learners will understand the principles of how the safety devices are designed to work and why they are crucial for preventing accidents, preventing damage to the system,

ensuring safe operation of the systems, protecting individuals who work on or with the systems.

4.4 Learners will understand the range of control systems available and how they are designed to operate. They will understand how the control systems can help reduce the impact of a refrigeration, air conditioning and heat pump's operation on the environment, e.g. minimising energy consumption.

Planning and preparing to undertake work

Learning outcome:

5. **Understand the importance of providing clear communication to relevant stakeholders during installation, commissioning, decommissioning, servicing and maintenance of systems**

Criteria

- 5.1 The ethical principles and implications for providing accurate and clear communications to stakeholders

Range: accurate and clear communications about benefits, costs, drawbacks, timescales

- 5.2 The types of communication that may be required with the site management team

Range: architect, quantity surveyor, buyer/estimator, surveyor, project manager/clerk of works, structural engineer, building services engineer, contracts manager, construction manager

Learning outcome:

6. **Understand how to verify that job information and documentation is current and relevant when working on refrigeration, air conditioning and heat pump systems**

Criteria

- 6.1 Types of information and documentation required for working on refrigeration, air conditioning and heat pump systems

Range: cooling load/heat loss calculations, microgeneration certification scheme (MCS), system performance calculation, DNO certificate, commissioning record, maintenance record, delivery note, job specification, working drawings, work programme, plans/drawings, quotations and estimates, permits, invoice, risk assessment, method statement, variation order, manufacture guidance, Installation/service and maintenance/user instructions, statutory cancellation rights, handover information, verbal and written feedback, helplines and mobile/tablet applications.

- 6.2 The ways of checking information and documentation is up to date.

Learning outcome:

7. 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 Refrigeration, Air conditioning and Heat Pump's design
 - the conditions of the working environment

Criteria

7.1 The hazards presented by work situations

7.2 The levels of risk presented by different work situations

7.3 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.

7.4 How to produce a method statement for areas of work where hazards are identified.

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

Learning outcome:

8. 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

8.1. 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

8.2. 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).

8.3. 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, barriers, safe access points.

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

Learning outcome:

- 9. Understand how to check that the identified equipment, components and accessories for the system are**
- of the right type and size
 - fit for purpose in accordance with the system's design
 - suitable for the working environment in which they are to be installed

9.1 The methods that can be used to check equipment, components and accessories

Delivery outcomes (depth of content)

5

5.1 Learners will understand the importance of being truthful and transparent when communicating with stakeholders, whilst respecting the privacy of individuals and confidentiality of information. They will understand the potential impacts of misleading statements or by not communicating all the information. They will know their responsibilities and the responsibilities of others for providing accurate and clear communication when working.

5.2 Learners will understand different ways of communicating while at work and with different members of the site management team, from the surveyor to the site foreman, also the company policy and procedures that are available and how they impact the work being undertaken. Whilst communicating, learners will know how to be considerate to other trades on site. Learners will know the different ways to communicate, email, verbal, messenger etc. and when these methods are appropriate.

6

6.1 Learners will know what job information is required and how to access it.

6.2 Learners will know how to check if information is up to date and valid. Learners will understand the process for managing different versions of a document as it changes over time. Learners will know the organisational procedures for reporting a problem with a document or information contained within it.

7

7.1 Learners will understand how levels of risk are categorised.

7.2 Learners will know the different types of hazards that could occur, such as physical (effects from cold room working), chemical (exposure) ergonomic (repetitive strain injuries), and psychological (stress).

7.3 Learners will know the key principles of a risk assessment and how to develop it.

7.4 Learners will know the key principles and format of a method statement and how to develop it.

8

8.1 Learners will understand the potential dangers they may encounter while at work and ways in which they can prevent them.

8.2 Learners will know the potential dangers when carrying out works, for example when pressure testing, using cranes or lifting equipment and also when preparing for work, for example installing scaffolding

8.3 Learners will be aware of what procedures need to be followed prior to undertaking work and any actions that should be followed to ensure there is no risk to them or others. Learners will also be aware of the legislation that might affect how the placement of signs and barriers (e.g. New Roads & Street Works Act, The Highways Act, The Road Traffic Act, The Traffic Management Act etc.), the permissions they might need and the effect on others. Learners will appreciate how area regulations and local authorities can work in different ways and communication and permission timescales can vary.

9

9.1 Learners will understand the importance of checking the identified equipment, components and accessories for the system and the appropriate time to do so. They will understand that certain gasses and oils may be incompatible with system and the environment in which they are to be installed.

Carrying out work on refrigeration, air conditioning and heat pump systems

Learning outcome:

10. Understand the tools, equipment and materials used for refrigeration, air conditioning and heat pump activities:

- Installation
- Commissioning
- Decommissioning
- Service and maintenance

Criteria

10.1. The range of tools, equipment and materials used

Range: Portable handheld tools and power tools, specialist plant machinery and equipment.

10.2. The operational constraints to be considered when using plant, tools and equipment

Range: Restricted access/space, weather conditions, day/night working, restricted noise/vibration levels, utilities access, use of hot works.

10.3. The procedures for the control of plant, tools, equipment and materials

Range: Sign in/out, record of usage, record of calibration, maintenance requirements, dates (out of date).

Learning outcome:

11. Understand the types of components used in refrigeration, air conditioning and heat pump systems

Criteria

11.1. The range of components used in different types of refrigeration, air conditioning and heat pump systems, including:

Range: Their characteristics, function within the vapour compression cycle components and absorption cycle. system, how they work together to support the operation of the system,

11.2. The factors affecting the choice and suitability of components

Range: Site features, Building Energy Management Systems (BEMS), requirements of the customer, planning considerations.

Learning outcome:

12. Understand the methods, techniques and jointing methods for fitting, fixing and connecting the selected equipment, components and accessories in accordance with:

- the system's design
- the working environment
- manufacturer instructions

Criteria

12.1 The **jointing methods** used in pipework systems

Range: ring seal joints, solvent weld joints, permanent and non-permanent compression joints, fusion welded, brazed joints.

12.2 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

Delivery outcomes (depth of content)

10

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

10.2 Learners will have a basic understanding of how these constraints could change for example customer demands.

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

11

11.1 Learners will understand the vapour compression cycle components and absorption cycle.

11.2 Learners will be able to consider the suitability of a component by analysing a range of factors.

12

12.1 Learners will know the industry standard methods of connecting system pipework to the outlets and components and how to interpret typical installation drawing.

12.2 Learners will know how to produce a fitting schedule.

Unit 307RACHP: Performing Electrical Work on Refrigeration, Air Conditioning and Heat Pump Systems

GLH:	204
------	-----

What is this unit about?

The purpose of this unit is for learners to explore electrical systems within a domestic property and industrial and commercial building and the competences that underpin work on the different refrigeration, air conditioning and heat pump systems. Learners will have the opportunity to:

- inspect and pre-commission electrical systems
- decommission/install and test electrical systems
- commission electrical systems
- maintain electrical systems.

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

This unit is for people who are required to carry out work on electrical supplies and/or circuits for the control of refrigeration, air conditioning and heat pump systems which:

- do not require the addition of a circuit to the existing fixed electrical installation
- will only be associated with the disconnection, installation and/or connection of electrical equipment and components associated with the supply and/or control of mechanical services systems.

The person performing this work must be able to comply with the correct procedures and practices for disconnecting, installing and/or connecting electrical equipment and components that supply and/or control refrigeration, air conditioning and heat pump systems.

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

It will not involve the testing and commissioning of the fixed electrical installation and its constituent parts. They must know and understand the types, applications and limitations of electrical supplies, safe isolation and control equipment, earthing and over-current protection and /cables/wiring associated with refrigeration, air conditioning and heat pump systems.

Learners will develop their knowledge and understanding and skills of:

- the limitations of your responsibility when carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems
- the applications, advantages and limitations of electrical supplies
- the applications, advantages and limitations of different electrical equipment, cables/wiring, accessories and components in relation to the working environment
- the appropriate industry standards and regulations relevant to carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems
- methods for selecting electrical equipment, cables/wiring, accessories and components to ensure that they are fit for purpose
- methods and techniques for disconnecting, installing and/or connecting electrical equipment, cables/wiring, accessories and components
- Interpret diagrams and drawings for the mechanical building services system
- Industry recognised methods and procedures for the functional testing of the electrical equipment, accessories and components associated with the electrical supply and/or control of the mechanical building services system
- Identification and rectification of electrical faults in the refrigeration, air conditioning and heat pumps system.

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

- What are the advantages and disadvantages of different electrical equipment, cables/wiring, accessories and components?
- How do you select and install electrical systems and components?
- What steps are part of commissioning and maintaining electrical systems and components?
- How do you carryout functional testing on electrical systems and components?

Learning outcome:

1. **Understand the limitations of your responsibility when carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems**

Criteria

- 1.1 Responsibilities of persons working on electrical equipment

Range: Safety of themselves and others, maintaining equipment in good order, conduction risk assessment, adhering to relevant regulations and standards, maintaining continual professional development through training.

Learning outcome:

2. **Understand the risks of working with electrical systems**

Criteria

- 2.1 The ways of reducing electrical risks

Range: following safe isolation procedures, earthing and bonding, personal protective equipment (PPE), insulated tools, correctly fitted fuse, regular inspections and maintenance, voltage reduction, protection from water, separation from flammable and combustible materials, training and CPD.

Learning outcome:

3. **Understand the applications, advantages and limitations of electrical supplies**

Criteria

- 3.1 Electrical systems

Range: Extra low voltage and/or low voltage single and/or multi-phase provision for; control, communication, heating, lighting, power.

- 3.2 Protection methods

Range: miniature circuit breakers (MCB), residual current circuit breaker (RCCB), residual current breaker overload (RCBO), thermal overload (bimetal, NTC, PTC), isolators, contactors, overload modules, phase protection, phase rotation.

- 3.3 Monitoring methods

Range: current transformer, tachometer, phase rotation, ammeters, voltmeters, power meters, thermal monitoring

Learning outcome:

4. **Understand the applications, advantages and limitations of different electrical equipment, controls and starting arrangements, cables/wiring, accessories and components in relation to the working environment**

Criteria

- 4.1 Electrical equipment, controls and starting arrangements

Range:

Equipment: isolators, circuit breakers, fuses, switches, socket-outlets/fused-spurs, earthing protection, motor control equipment, control panels – environmental control, control devices – electrical, electronic; electro-mechanical, smart controls

Controls: thermal overload protectors (bimetal. NTC, PTC), Solenoid coils, Relays, Contactors, Overloads, Electric motors (compressor, fan, pump).

Starting arrangements: relays (current coil, potential, solid state), Start/run capacitors, resistance start induction run (RSIR), Capacitor start induction run (CSIR), Capacitor start and run (CSR).

4.2 Cables and wiring

Range: thermosetting insulated cables including flexes, single and multicore thermoplastic and thermosetting insulated cables, flat profile cable, mineral insulated cables, single wire armoured cables, armoured/braided flexible cables and cords, fire resistant cable.

4.3 Components

Range: Compressor motors, fan motors, electro-magnetic solenoid valves, all in one combined refrigeration system/defrost controllers, temperature controllers, timers, liquid level controllers, ice makers (retail and industrial), refrigerant liquid pumps, heaters.

4.4 Working environment (internal or external)

Range: commercial, industrial, domestic, agricultural, horticultural, leisure and entertainment, residential medical and care facilities, public services establishments, Pre 1919 traditional/historic buildings.

Learning outcome:

5. Understand the appropriate industry standards and regulations relevant to carrying out work on electrical supplies and/or circuits for the control of mechanical building services systems

Criteria

5.1 Electrical systems

Range: extra low voltage and/or low voltage single and/or multi-phase provision for; control, communication, heating, lighting, power

5.2 The information sources required to complete testing and commissioning

Delivery outcomes (depth of content)

1

Learners will be able to appreciate the requirements of the Electricity at Work Regulations 1989 in particular Regulation 16. Refer also to the HSE publication HSR25. Learners will fully appreciate the limits of their responsibilities and the dangers associated with

electricity, especially given that as little as 50 mA, can potentially be lethal. Learners should understand (and be able to perform) the electrical safe isolation procedure in accordance with industry guidance such as GS 38 and the Electrical Safety First's Guidance for low voltage installations.

2

Learners should be aware of the risks of working with electrical systems and understand ways in which electrical hazards can be prevented.

3

Learners should be aware of the working principles for both alternating and direct current supplies. Examining, generation, transmission and distribution of the electrical supply grid. Learners also need to grasp how voltages are classified including any safety aspects, such as extra low voltage (touch voltage). In addition, how single and 3 phase supplies are utilised and what is meant by RMS and frequency. Learners should also be made aware of the application, advantages, disadvantages and limitation of a range of different cables such as twin & earth (thermoplastic), PVC singles, fire resistant, SWA and thermosetting applications, such as those who are used as the final connection to a RACHP system.

4

Learners will be able to identify all the basic components that go to make up an electrical circuit such as an '18th Edition consumer Unit' (split board, highest loads positioned nearest the switch), types of protective devices including breaking capacity and switching (double pole switch/isolation for large loads). Furthermore, understanding what is meant by basic and fault protection, alongside Class 2 equipment. Learners need to especially understand how earthing requires all electrical connections to be low in resistance. This not only will avoid electrical fires, but ensure that a fault current will remain high, which then leads to a quick disconnection of the protective device in the required time. Learners will therefore need to be able to interpret Appendix B accordingly, by reading values directly.

5

Learners will know the process of both the inspection process including using where necessary relevant human senses. Learners need to be mindful of how both dead and live tests are applied and sequenced to a variety of different voltage and phasing requirements. Learners need an appreciation of how the requirements of Part P of the Building Regulations. Installing a spur socket for instance, would require a minor electrical installation works certificate. Learners would therefore have an understanding of the system earthing arrangement, Zs (earth fault loop impedance) at distribution board, presence of adequate main protective conductors and equipotential bonding conductors, type and rating of protective device, continuity of ring final circuit conductors, insulation resistance and polarity (which can be carried out visually). In addition, learners need to understand RCD operation.

Learners will be aware of the correct testing equipment to be used when carrying out tests on faulty components and control systems.

Inspect and pre commission

Learning outcome:

6. Identify methods for selecting electrical equipment, cables/wiring, accessories and components to ensure that they are fit for purpose

Criteria

- 6.1 The electrical supply is suitable for the refrigeration, air conditioning and heat pump systems

Delivery outcome (depth of content)

6

Learners will know the common types of cables and accessories used in a domestic setting and how to use sources of information such as the IET On Site Guide to select a cable for a given application.

Decommission/Install

Learning outcome:

- 7 Carryout the methods and techniques for disconnecting, installing and/or connecting electrical equipment, cables/wiring, accessories and components in accordance with:
- the mechanical building services (refrigeration, air conditioning and heat pump) system's design
 - manufacturers' instructions
 - the correct procedures for safe isolation

Criteria

- 7.1 The correct means of electrical isolation prior to commencing **work**

Range: disconnection, installation, connection.

- 7.2 The **status** of the electrical supply

Range: proving unit, live, dead.

- 7.3 The safe isolation of **electrical equipment and components** associated with the **electrical supply** of the refrigeration, air conditioning and heat pump system

Range:

Electrical equipment and components; isolators, circuit breakers, fuses, switches, socket-outlets/fused-spurs, earthing protection, motor control equipment, control panels

– environmental control, control devices - electrical; electronic; electro-mechanical, smart controls.

Electrical supply; extra low voltage and/or low voltage single -phase provision for; control, communication, heating, lighting, power.

- 7.4 The work on electrical equipment, cables/wiring and **components** associated with the electrical supply and control of the refrigeration, air conditioning and heat pump system

Range: Compressor motors, fan motors, electro-magnetic solenoid valves, all in one combined refrigeration system/defrost controllers, temperature controllers, timers, liquid level controllers, ice makers (retail and industrial), refrigerant liquid pumps, heaters, condensate pumps, centralised controllers, probes and sensors, leak detection, PCB, electronic expansion devices, HP and LP switches, defrost heater, crank case heater.

- 7.5 The electrical equipment, cables/wiring and components are in accordance with the requirements of the refrigeration, air conditioning and heat pump system

- 7.6 The electrical equipment, cables/wiring and components are of proper construction in accordance with the requirements of the refrigeration, air conditioning and heat pump system

Range: insulation, mechanical strength, protection

Learning outcome:

- 8 Interpret diagrams and drawings for the mechanical building services system to identify the location of the:**

- **site services**
- **electrical equipment, accessories and components**

Criteria

- 8.1 The common drawing conventions, symbols and markings found on refrigeration, air conditioning and heat pump diagrams and drawings

- 8.2 The electrical equipment, cables/wiring and components are in accordance with the requirements of the refrigeration, air conditioning and heat pump system

- 8.3 The electrical equipment, cables/wiring and **components** are of proper construction in accordance with the requirements of the refrigeration, air conditioning and heat pump system

Range: insulation, mechanical strength, protection

Delivery outcomes (depth of content)

7

Learners will be able to perform safe isolation procedure and understand the importance of safe isolation, in accordance with industry approved procedures (refer to the guidance from Electrical Safety First). Learners will be able to connect and terminate electrical

cables in accordance with industry approved procedures to ensure connections are electrically and mechanically sound.

Learners will understand the consequences of not performing the safe isolation procedure properly to themselves, other workers, members of the public/people on the premises.

Learners will understand the electrical circuitry, and electrical equipment associated with refrigeration, air conditioning and heat pump systems, the types of controls and their operation and purpose. Learners will understand how this circuitry enables the refrigeration, air conditioning and heat pump system to function as intended' as per system design.

8

Learners will be able to interpret circuit and wiring diagrams to safely and correctly connect electrical circuits an equipment to ensure correct function of the refrigeration, air conditioning and heat pump system and be able to ensure that cables have adequate mechanical protection.

Commission

Learning outcome:

9. Carryout industry recognised methods and procedures for the functional testing of the electrical equipment, accessories and components associated with the electrical supply and/or control of the mechanical building services system

Criteria

- 9.1 How to perform electrical circuit safety tests for Split system, VRF interconnecting control and communication wiring, control panel functional testing

Range: Earth continuity, polarity, short circuit tests

Delivery outcome (depth of content)

9

Learners will be able to carry out functional testing off the installed system to ensure correct operation. Learners will be able to carry out visual inspections of their completed work.

Maintain

Learning outcome:

10. Identify and rectify electrical faults in the mechanical building services system in accordance with:
 - industry recognised methods

- the limitations of your responsibility

Criteria

10.1 How to test circuits and fault find

Range: Electricity at Work Regulations (EAWR), Test instruments GS38 instruments, proving unit (continuity, insulation resistance, polarity, functional testing, current, voltage), common electrical faults (short circuit, open circuit, poor wire termination, component failure), circuit test (dead testing, live testing (RCCB/RCD device), safety measures (PPE, warning signs/notices, barriers)

10.2 How to rectify electrical faults and deficiencies on refrigeration, air conditioning and heat pump systems

Range:

Appliance components; micro switches, relays, pressure switches, printed circuit boards, pumps, fans

Control components; thermostats, programmers/timers, electrically operated control valves, wiring centres

Deficiencies; inadequate earthing provision, defective cable routing, defective termination, incorrect polarity, provision of inadequate circuit protection device

Delivery outcome (depth of content)

10

Learners will understand the Importance of ensuring the electrical work is safe and has been carried out in accordance with industry approved procedures and in compliance with BS 7671. Learners will understand the typical faults that occur on electrical circuits for mechanical building services systems (including three phase control and power circuits), and how to identify and rectify these faults. Learners will be able to Identify types, causes and consequences of electrical faults such as:

- Loss of supply
- Low voltage/voltage drop
- Component/equipment malfunction/failure
- Operation of overload or fault current devices
- Arcing - loose connection
- High resistance - e.g. loose connection etc.
- Excess current - overload
- Insulation failure - deterioration, mechanical damage
- Short-circuit, Open Circuit and Earth fault.
- Signal faults.
- Incorrect wiring
- Inherent faults – faults that occur through poor design and incorrect termination (cross connections)

Learners will understand and be able to follow the logical stages of fault diagnosis; identification of symptoms, collection and analysis of data, use of sources/types of information, checking and testing (e.g. supply, protective devices), interpreting results/information, fault correction, functional testing, restoration.

Learners will know the factors which can affect repair or replacement of equipment. Such as: cost, availability of replacement parts, resources and staff, down time (planning), legal and personal responsibility (e.g. contracts, warranties, relevant personnel), gaining access to systems and equipment, provision of emergency or stand by supplies; client demand (continuous supply, out of hours working).

Learners will be able to determine and follow the procedures for verifying that the fault has been corrected suitable for the situation using technical analysis such as functional testing/checking. Testing for: continuity, insulation resistance, polarity, earth fault loop impedance, RCD operation, current and voltage measurement/checking presence of supply; phase sequencing.

Learners will know the methods to ensure the safe disposal of any waste and that the work area is left in a safe and clean condition.

Unit 308RACHP: Understand Refrigeration, Air Conditioning and Heat Pump System Installation, Commissioning and Decommissioning Techniques

GLH:	100
------	-----

What is this unit about?

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

- install and test refrigeration, air conditioning and heat pumps systems
- commission refrigeration, air conditioning and heat pumps systems
- decommission refrigeration, air conditioning and heat pumps systems

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

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

- How can I minimise the impact of my work on stakeholders?
- How can I communicate information about my work to different people?
- What key planning and design factors do I need to consider when installing a refrigeration, air conditioning or heat pump?
- How do you select and install a refrigeration, air conditioning or heat pump?
- What are the advantages and disadvantages of different appliances, accessories and components?
- What steps are part of commissioning a refrigeration, air conditioning or heat pump system?
- What steps are part of decommissioning a refrigeration, air conditioning or heat pump system?

Working with others

Learning outcome:

1. Understand the potential impact of works on the relevant stakeholders and how these can be minimised

Criteria

- 1.1 The factors which can impact stakeholders

Range: Isolation of services, preparation of temporary services, access, site security, noise, dust, disruptions to traffic, impact on businesses.

- 1.2 The methods for minimising the impact of potential works on stakeholders

Range: communication, advanced notice, noise barriers, alternative routes for traffic and pedestrians.

Learning outcome:

2. Understand the organisational procedures for confirming with the relevant people the planned programme of work and any necessary variations

Criteria

- 2.1 Suitable methods to inform the relevant people about work activities in the appropriate level of detail and urgency

Range: estimate, quotation, invoice, performance document, compliance certificate, handover documents, demonstrations of controls.

- 2.2 The appropriate methods to confirm variations to the planned programme of work

- 2.3 How to confirm client/customer acceptance of the installation, commissioning and decommissioning works.

Range: signed documents (e-certificates, paper reports).

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

Range: Increased costs, missed deadlines, fines, reputational damage.

- 2.5 The factors which affect working time allocation to activities

Delivery outcomes (depth of content)

1

- 1.1 Learners will know the expectations of various stakeholders in terms of service provision and how the works will have an impact on these. They will be able to identify a range of potential positive and negative impacts for a range of stakeholders.

- 1.2 Learners will understand how to evaluate the potential impact on a range of stakeholders and suggest strategies to mitigate the effects.

2

2.1 Learners will have an understanding of the relevant people they need to inform about work activities and how this might vary in a commercial or residential setting. They will know the level of detail required for each type of communication and how to present this in the appropriate communication format – email, text, face to face etc. Learners will be able to determine the level of urgency required and respond appropriately.

2.2 Learners will understand how to communicate a variation to a planned programme of works. They will know their own level of authority and that of other personnel required. Learners will understand the importance of keeping a record of any variations and the implications of not having traceable confirmation.

2.3 Learners will know how to determine the acceptance criteria of the works, for example specific system requirements, testing and verification of the system, document sign off, customer feedback. They will understand the importance of confirming acceptance to prevent future disputes and to increase customer satisfaction.

2.4 Learners will understand the impacts of materials not being delivered on time and know a range of mitigations strategies to deal with this, for example, sourcing alternative materials, effective communication with suppliers.

2.5 Learners will understand the factors which can affect working time allocation, such as sickness, extremes of weather, delays with materials, delays with other trades and local authority permits, and the impact this might have on the programme of works.

Installation

Learning outcome:

3. Understand the planning and design principles for refrigeration, air conditioning and heat pump systems installation

Criteria

3.1 Planning and design principles and considerations

Range: Buildability, integration of services, quality and cost (materials/equipment/labour and VAT/total cost), embodied carbon, fabric first approach, adaptability, life cycle and end of life disposal, noise emissions.

3.2 Factors affecting the system design

Range: Planning legislation (restrictions on unit location/proximity to other dwellings/buildings, localised initiatives), devolved administrations, mayoral authorities, areas of outstanding beauty, National Park's planning.

Learning outcome:

4. Understand installation practices and techniques for refrigeration, air conditioning and heat pump systems, in accordance with:

- The system design
- The working environment
- Manufacturers' instructions

Criteria

4.1 The layout and installation requirements

Range: typical system requirement, suitability for the environment, clearance requirements, security (location, damage, theft), weather conditions (location considerations (coastal, acidic)), access, drainage.

4.2 The tools and equipment required for fitting, fixing and connecting the range of system components to a wall/floor/ceiling

4.3 The information sources required for systems and types of pipework and its suitability for different purposes

Range: copper, steel, aluminium.

4.4 How to charge

4.5 A leak test to industry requirements on pipework and components

Delivery outcomes (depth of content)

3

3.1 Learners will understand the range of principles and considerations to ensure the final installation meets its intended purpose and objective.

3.2 Learners will understand the range of factors which can affect the system design and how Welsh regulations may differ from those in England.

4

4.1 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. 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 positioning, fixing, connection and operation of components for a range of systems.

4.2 Learners will develop their knowledge of the different types of power tools, hand tools, materials, jointing methods e.g. brazing, glueing, compression, press fit, push fit.

4.3 Learners will know the different information sources required and how to find out relevant information e.g. using technical bulletins and apps to identify types of refrigerants.

4.4 Learners will understand the process for charging a system:

Connect service manifold to system

Perform oxygen free nitrogen (OFN) pressure leak & strength test

Evacuating non condensable gases from the system

Check the level of dehydration achieved on the system

Next steps will depend on the system application (refrigeration/air conditioning):

Refrigeration:

- Check refrigerant is correct for the application

- Connect service manifold to refrigerant cylinder

- Check the quantity of refrigerant in cylinder

- Charge the system to the specific weight as per manufacturer's instructions

- Electronic leak test

- Analyse system operation (superheat/subcooling)

- Add additional refrigerant to ensure efficient operation

- Remove service manifold gauge with no loss of refrigerant

- Electronic leak test of final system

- Label unit with installed refrigerant weight and CO2 equivalent levels

Air conditioning/heat pump:

- Compare pipework length to manufacturers pre charge data.

- Add additional refrigerant due to excess installed pipework

- Open system valves to release pre charged refrigerant

- Electronic leak test

- Analyse system operation

- Safely remove the manifold and lines

- Electronic leak test of final system

- Label unit with installed refrigerant weight and CO2 equivalent levels

Learners will understand the appropriate conditions for charging different systems and with different refrigerant safety classifications (A1, A2L, A3) i.e. Fluorinated (FGAS), Hydrocarbon (HC),

4.5 Learners will understand the requirements for a leak check on pipework and components to confirm the system is leak free.

Commissioning

Learning outcome:

5. Understand the methods for determining that the appliances, components and accessories are fit for purpose in accordance with:

- the refrigeration, air conditioning and heat pump's design
- the working environment
- manufacturers' instructions
- the appropriate testing procedures for confirming the systems' integrity

Criteria

5.1 The importance of commissioning activities

Range: Manufacturer's warranty, sustainable system operation, safeguards electrical safety of systems, ensures the system performs to the design parameters.

5.2 The system operation requirements to be checked

Range: flow and return temperatures, sub-cooling and superheat values, system pressure, motor current, control system calibration, safety checks, system flushing and cleaning, chemical treatment of water systems.

5.3 The inspection **techniques** used in commissioning a range of **systems**

Range:

Techniques: visual inspection (and use of senses), pre commissioning checks, the importance of inspection.

Systems: Direct expansion (DX) multi evaporator, flooded evaporator and pump overfeed, compound, cascade and trans critical, variant refrigerant flow (VRF) (2 and 3 pipe) air conditioning, reverse cycle heat pump systems, secondary cooling circuits.

5.4 The testing techniques applicable to commissioning a system

Range: Soundness (initial fill, stabilisation, test to required pressure, check for leaks, check pressures), operational checks (temperature, flow rate, pressure, controls), testing techniques (air testing, hydraulic pressure testing, safety component operation, soundness testing, performance testing), superheat, sub cooling, coil delta 1, pipework pressure drop, air flow, air distribution, oil pressure, system pressures, relative humidity.

5.5 The documentation required for commissioning and verification of commissioning

Range: commissioning record, service sheet, warranty information, manufacturer's guarantees, self-certification, handover pack, instructions, user guides, service requirements.

Delivery outcomes (depth of content)

5

5.1 Learners will understand that the commissioning activities are crucial for ensuring the safe, efficient, and reliable operation of the systems.

5.2 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.

5.3 Learners will know the reasons for an inspection prior to charging a system and what is required, they will be able to list the inspection and checks required and know the importance of this. Learners will also understand the procedure to follow if they identify installation faults whilst carrying out an inspection.

5.4 Learners will understand the testing techniques applicable and the sequence in which they are to be carried out. They will know how to record any findings and the procedures to follow if they identify any issues.

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

Decommissioning

Learning outcome:

6. **Understand decommissioning methods and techniques for refrigeration, air conditioning and heat pump systems**
- Domestic
 - Industrial and Commercial

Criteria

- 6.1 The procedures for isolation and decommissioning (permanent and temporary)
Range: notify relevant person, visual inspection for hazards, wear correct PPE, risk assessment, method statement, isolate fuel/electricity supply to the system as appropriate, isolate water supply, apply warning notices and signs, drain system to a suitable location, appropriately remove and dispose of contents and any additives, continuity bonding as required, temporary capping of pipework sections as required, notify building users, alternative supplies as required, disposal of waste in accordance with relevant waste legislation and guidance, record system refrigerant removal record as required, apply label to indicate system is decommissioned.
- 6.2 The working methods that reduce the time periods during which refrigeration, air conditioning and heat pump need to be isolated
- 6.3 The documentation required for decommissioning and verification of decommissioning
Range: job sheet, decommissioning record sheet, waste transfer notes, refrigerant logbook, electrical locks and labels permit to work systems.

Learning outcome:

7. **Understand the methods and techniques to ensure the system and its equipment, components and accessories cannot be accidentally reactivated or become dangerous**

Criteria

- 7.1 The methods used during the decommissioning process to prevent the end-user from operating refrigeration, air conditioning and heat pump system components
Range: temporary capping of pipework sections, use of warning notices and signs, Isolation of electrical circuits

Delivery outcomes (depth of content)

6

6.1 Learners will be able to describe appropriate and safe isolation methods for temporarily decommissioning a system and components and develop a work programme for the permanent decommissioning of a refrigeration, air conditioning and heat pump system. Underline any hazards or risks to health.

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.

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

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

7

7.1 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.

Unit 309RACHP: Understand Refrigeration, Air Conditioning and Heat Pump System Service and Maintenance Techniques

GLH:	45
------	----

What is this unit about?

The purpose of this unit is for learners to explore refrigeration, air conditioning and heat pump systems within a domestic property and industrial and commercial building and the competences that underpin servicing and maintenance work on the different systems. Learners will have the opportunity to:

- Service and maintain systems.
- Diagnose faults in systems.

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

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

- How can I find out information relating to the service and maintenance task?
- How do you perform routine maintenance on a refrigeration, air conditioning or heat pump system?
- How can I gather more information on a refrigeration, air conditioning or heat pump system fault?
- What can cause faults in a refrigeration, air conditioning or heat pump system?
- What are the steps can I take to identify and resolve a fault in the system or equipment?
- What actions do I take when a fault cannot be fixed?
- What steps are part of testing and confirming the refrigeration, air conditioning or heat pump system is safe to use?

Communicating with others

Learning outcome:

1. Understand how to source and interpret the task requirements from information and data presented in a range of formats

Criteria

- 1.1 The different types of information and data that could contain task requirements
Range: schedule, project plan, technical specifications, emails, reports
- 1.2 Communication techniques that support problem solving and decision making
- 1.3 Questioning techniques used to obtain and identify additional information

Delivery outcomes (depth of content)

1

- 1.1 The learner will understand the different types of information and data that could contain task requirements and what information these might contain and how these might be presented. They will also explore less formal types of information such as conversations and the risks associated such as misunderstandings, lack of clarity, cultural and language barriers, potential for projects to expand beyond agreed scope of work 'scope creep'.
- 1.2 The learner will understand the range of communication techniques that will support problem solving and decision making throughout their projects. This should include understanding the techniques and benefits of actively listening, seeking constructive feedback, sharing information. They will also know the benefits of advanced communications with the customer such as to clear a room for access.
- 1.3 The learner will understand how and when to use the following types of questions, open, closed, clarifying.

Routine service and maintenance

Learning outcome:

2. Understand routine service and maintenance practices and techniques applicable to:
 - Refrigeration, air conditioning and heat pumps
 - Electrical and electronic control systems

Criteria

- 2.1 The service and maintenance requirements of refrigeration, air conditioning and heat pump systems
Range: Condition based, periodic and manufactures recommendations.

2.2 The range of precautions that can be taken to prevent damage to surrounding area, equipment and components when undertaking servicing and maintenance activities

Range: Dust sheets, barriers, signage, overshoes.

2.3 The methods and techniques for cleaning/replacing/adjusting components

2.4 The information and data required to confirm the system is operating correctly

2.5 Service and maintenance recording methods and requirements

Learning outcome:

3. Understand basic fault-finding techniques

Criteria

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

Range: gathering information, notify client, safely isolate, rectify, re-commission, hand over.

3.2 The methods of obtaining information on system faults

Range: Information (end-user, manufacturer instruction, fault diagnosis flow chart, service history). Faults (incorrect pressures, accumulator expansion vessel failure, blockages, system debris, pump failure, control failure, pressure relief valve, incorrect support to system pipework and storage cisterns, excessive noise in pipework systems, leakage or ineffective operation of; terminal fittings, float operated valves, stop and service valves).

Delivery outcomes (depth of content)

2

2.1 The learner will understand how the regulations and the different types of equipment can provide information or impact on how often the system or equipment is serviced.

2.2 The learner will understand the range of equipment and techniques they can use to prevent damage to the equipment, components and surrounding area and will know the importance of preparing the work area before servicing and maintenance works begin.

2.3 The learner will know what is required when cleaning/adjusting/replacing components on a range of systems and the tools and equipment they will require.

2.4 The learners will know the information and data required to confirm the system is operating correctly and be able to record this accurately.

2.5 The learner will understand how to record any issues encountered, observations for remedial work and complete an onsite record for refrigerant additions/removals/leak tests (F gas record).

3

3.1 Learners will know the basic fault-finding techniques used to identify and resolve issues in systems or equipment.

3.2 Learners will understand the procedure for extracting information from manufacturer's instructions to diagnose system component faults and how to use industry standards to identify system faults. They will be able to retrieve a fault code from a system and understand what this code means and confirm the correct code is showing.

Fault finding**Learning outcome:****4. Understand fault-finding methods and techniques and their suitability for different situations****Criteria**

4.1 Types of fault-finding and diagnosis techniques and how they are applied in practice

Range: visual inspection, listening for unusual noises, asking questions, component testing, software diagnostics, fault codes, indirect testing.

4.2 Types of actions to be taken when faults cannot be rectified

Range: replacement of components or system, system upgrade, temporary solutions (e.g. providing alternative cooling methods), system decommissioning, legal and regulatory compliance, communication and transparency.

Learning outcome:**5. Understand the causes of typical faults found in refrigeration, air conditioning and heat pump systems****Criteria**

5.1 The causes of common faults in refrigeration, air conditioning and heat pump systems

Range: poor installation, inadequate design, user error, environmental factors, component malfunction, lack of maintenance.

5.2 The causes of technical faults in refrigeration, air conditioning and heat pump systems

Range:

Refrigeration Circuit Faults (refrigerant leaks, compressor failure, expansion valve issues, system restrictions)

Airflow and heat exchange problems (dirty air filters, frozen coils, dirty condenser coils)

Electrical and mechanical failures (failed capacitors, worn contactors, fan motor issues)

Control and drainage faults (thermostat malfunctions, clogged condensate drains, defrost cycle failure)

Learning outcome:

6. Understand the procedures and tests to confirm the integrity of the system

Criteria

6.1 The procedures and tests to confirm the integrity of the system

Delivery outcomes (depth of content)

4

4.1 Learners will also know the types of instruments and measuring devices used in fault diagnosis techniques and the method of checking system components for correct operation and the methods of repairing faults in system components. The learner will know the suitability of each fault finding and diagnosis techniques in different situations.

4.2 Learner will understand the types of actions to be taken when faults cannot be rectified and their own responsibilities. The learner will also understand the implications to the customer/stakeholder of when a fault cannot be rectified.

5

5.1 Learners will understand the causes of a range of common faults.

5.2 Learners will understand the typical faults found and will be able to describe the problems that these will cause.

6

6.1 Learners will know the method of applying a test using testing equipment. Learners will also understand that any leaks must be rectified and re-tested before a test record/certificate is issued.

Unit 310RACHP: Performing Refrigeration, Air Conditioning and Heat Pump System Installation, Commissioning and Decommissioning Techniques

GLH:	117
------	-----

What is this unit about?

The purpose of this unit is for learners to explore installation, commissioning and decommissioning techniques in refrigeration, air conditioning and heat pump systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- install and test refrigeration, air conditioning and heat pump systems
- commission refrigeration, air conditioning and heat pump systems
- decommission refrigeration, air conditioning and heat pump systems

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

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

- How do you confirm the information you have about the work is correct?
- How do you make sure the work can be done safely?
- How do you install and commission a refrigeration, air conditioning or heat pump system?
- How do you confirm the system is installed correctly?
- How do you decommission a refrigeration, air conditioning or heat pump system?
- How do you complete all the paperwork required for the work?

The core skills in this unit are relevant to unit 311RACHP: Performing Refrigeration, Air Conditioning and Heat Pump System Service and Maintenance Techniques.

Core skills

Planning and preparation

Learning outcome:

1. **Verify that the work information and documentation are current and relevant and that the plant, instruments, access equipment and tools are fit for purpose**

Learning outcome:

2. **Confirm before work starts that the work location and work area can be accessed safely and has been checked for the risk to other personnel on the site, and take appropriate action if a risk is present**

Criteria

- 2.1 The access and exit routes

Range: candidates must be assessed on three of the following: adequate lighting set up, routes free from obstructions, safety signs and notices (followed and in place), emergency exit routes in place, appropriate barriers installed.

Learning outcome:

3. **Confirm the site services and system supply are compatible with the system design**

Learning outcome:

4. **Select appliances, components and accessories and confirm that they are:**
 - of the right type and size
 - fit for purpose in accordance with the refrigeration, air conditioning and heat pump system's design
 - suitable for the working environment in which they are to be installed

Criteria

- 4.1 System design

Range: candidates must be assessed on one of the following systems: refrigeration, air conditioning; heat pump.

Range: candidates must be assessed on two of the following: pipe sizing, component selection, calculations, leak detection, safety requirements (pressure relief valves).

Learning outcome:

5. **Produce a risk assessment and method statement for the work to be carried out, including the identification of hazards, use of suitable tools and equipment and personal protective equipment, in accordance with the working environment**

Learning outcome:

6. Comply with industry practices and organisational procedures to ensure the coordination of site services and system supply and the activities of other trades

Learning outcome:

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

Learning outcome:

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

Learning outcome:

9. Complete relevant documentation in accordance with organisational procedures

Criteria

9.1 Documentation

Range: candidates must be assessed on **three** of the following: variation order, timesheets, work programme, requisitions, delivery note, waste consignment note.

Installation

Learning outcome:

10. Determine at the outset, that the plans for positioning and fixing the systems, components and accessories are in accordance with:
 - the refrigeration, air conditioning and heat pump system's design
 - the working environment
 - manufacturer instructions

Criteria

10.1 Systems

Range: candidates must be assessed on **one** of the following systems: refrigeration, air conditioning: heat pump.

Learning outcome:

11. Measure and mark out the locations for fitting and fixing the selected systems, components and accessories in accordance with:
 - the refrigeration, air conditioning and heat pump system's design
 - manufacturer instructions

Criteria

11.1 Systems

Range: candidates must be assessed on **one** of the following systems: refrigeration, air conditioning: heat pump.

11.2 The Pipework

Range: candidates must be assessed on **two** of the following: copper, plastic, steel, aluminium.

Learning outcome:

12. Fit, fix and connect the selected systems, components and accessories in accordance with:

- the refrigeration, air conditioning and heat pump system's design
- the working environment
- manufacturer instructions

Criteria

12.1 Systems

Range: candidates must be assessed on **one** of the following systems: refrigeration, air conditioning: heat pump.

12.2 The pipework

Range: candidates must be assessed on **two** of the following: copper, plastic, steel, aluminium.

12.3 Jointing methods

Range: candidates must be assessed on jointing using **two** of the following: compression, push fit (waste), threaded/screwed, brazed, flared, crimped, glues/adhesives, fusion welded, flange, press fitting, grooved, soft soldering.

12.4 Components

Range: Candidates must be assessed on **five** of the following components

- Evaporator
- Condenser
- Condensing unit
- Branch box
- Ref net
- Dryer
- Sight glass
- Compressor
- Solenoid valve
- Expansion device
- HP Switch
- LP Switch
- Controller
- Sensor
- Condensate pump
- Unit bracket

- Service valves
- Condensing unit cage
- PRV valves
- Hydrobox
- Leak detection system
- Vacuum pump
- Line and regulating valves
- Accumulators
- Grilles/diffusers/fans/filters
- Liquid receivers
- Air handling units

Learning outcome:

13. Confirm the integrity of the installed system using appropriate testing procedures

Commission

Learning outcome:

14. Confirm systems, components and accessories installed are:

- of the right type and size
- fit for purpose in accordance with the refrigeration, air conditioning and heat pump system's design
- suitable for the working environment in which they are installed

Criteria

14.1 A visual inspection of the refrigeration, air conditioning and heat pump system to confirm that it is ready to be soundness tested

Learning outcome:

15. Perform visual and manual checks to ensure that the systems, components and accessories have been fixed, fitted and connected in accordance with:

- the refrigeration, air conditioning and heat pump system's design
- the working environment
- manufacturers' instructions

Learning outcome:

16. Confirm the integrity of the installed system using appropriate testing procedures

Learning outcome:

17. Commission systems, components and accessories, adjusting safely and effectively the control features in accordance with:

- the refrigeration, air conditioning and heat pump system's design

- the working environment
- manufacturers' instructions

Criteria

17.1 Systems

Range: candidates must be assessed on **one** of the following systems: refrigeration, air conditioning: heat pump

Decommission

Learning outcome:

18. Decommission systems and safe isolation of associated electrical/electronic controls in accordance with:

- the refrigeration, air conditioning and heat pump system's design
- the working environment
- manufacturers' instructions

Criteria

18.1 A visual inspection of the refrigeration, air conditioning and heat pump system to identify any hazards

18.2 Wear the correct personal protective equipment

18.3 Follow the procedures and techniques for the safe decommissioning of systems

Range: candidates must be assessed on **one** of the following systems: refrigeration, air conditioning: heat pump.

18.4 Record decommissioning activities

Unit 311RACHP: Performing Refrigeration, Air Conditioning and Heat Pump System Service and Maintenance Techniques

GLH:	50
------	----

What is this unit about?

The purpose of this unit is for learners to explore service and maintenance techniques in refrigeration, air conditioning and heat pump systems within a domestic property and industrial and commercial building and the competences that underpin work on the different systems. Learners will have the opportunity to:

- service and maintain refrigeration, air conditioning and heat pump systems

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

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

- How do you confirm the information you have about the work is correct?
- How do you service and maintain a refrigeration, air conditioning or heat pump system?
- How do you identify any faults in the refrigeration, air conditioning or heat pump system?
- How to you repair any faults found with the refrigeration, air conditioning or heat pump system?
- How do you test the refrigeration, air conditioning or heat pump system to make sure it is working correctly?

The core skills in unit 310RACHP: Performing Refrigeration, Air Conditioning and Heat Pump System Installation, Commissioning and Decommissioning Techniques are relevant to this unit.

Service and maintain

Learning outcome:

1. Determine at the outset, that the plans for servicing and maintaining the systems, components and accessories are in accordance with:
 - the refrigeration, air conditioning and heat pump system's design
 - the working environment
 - manufacturer instructions

Learning outcome:

2. Carry out service and maintenance activities and procedures in accordance with:
 - the refrigeration, air conditioning and heat pump system's design
 - the working environment
 - manufacturer instructions

Criteria

2.1 Systems

Range: candidates must be assessed on **one** of the following systems: refrigeration, air conditioning; heat pump

Learning outcome:

3. Accurately identify the cause of faults and those parts/components that need to be repaired/replaced

Learning outcome:

4. Carry out repairs/replacements as necessary when faults are identified

Criteria

4.1 Faults

Range: Candidates must be assessed on **three** of the following faults:

- Compressor motor fault
- Solenoid fault
- HP fault
- LP fault
- Earth fault
- Temperature controller setting incorrect
- Communication errors
- Water leaks
- Fans
- Fan motor
- Refrigerant leaks
- Defrost controller fault
- Pressure relief valve
- Thermostat setting
- Programmer fault

- Evaporator pressure regulator setting
- Condenser pressure regulator setting
- Motor overload setting
- NTC/PTC probe setting and faults
- Controller
- PCB fault

Learning outcome:

- 5. Complete appropriate testing procedures in-line with industry practices**

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

GLH:	15
------	----

What is this unit about?

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

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

Learners will develop their skills of:

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

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

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

Performance Criteria

Learning Outcome:

1. Identify the appropriate industry standards and regulations

Learning Outcome:

2. Apply relevant organisational procedures

Criteria: organisation procedures:

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

Learning Outcome:

3. Identify hazards and risks

Criteria

hazards and risks (internal and/or external):

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

AND

Criteria

site:

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

Learning Outcome:

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

Learning Outcome:

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

Criteria

potential hazards and risks:

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

Learning Outcome:

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

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

Learning Outcome:

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

Criteria

relevant people:

- 7.1 customers/clients
- 7.2 client representatives
- 7.3 supervisors

- 7.4 site/contract manager
- 7.5 other contractors/trades
- 7.6 members of the public
- 7.7 work colleagues

Learning Outcome:

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

Learning Outcome:

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

Criteria

injuries/emergencies/evacuation:

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

Learning Outcome:

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

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

GLH: 26

What is this unit about?

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

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

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

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

Learners will develop their knowledge understanding and skills of:

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

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

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

Learning Outcome:

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

Criteria

- 1.1 The sources of technical and functional information

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

- 1.2 Interpret technical and functional information and data

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

Learning Outcome:

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

Criteria

- 2.1 The stakeholders that require technical and functional information

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

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

- 2.3 The methods of providing technical and functional information

- 2.4 The importance of ensuring that:

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

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

Learning Outcome:

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

Criteria

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

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

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

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

Delivery outcomes (depth of content)

1

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

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

2

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

3

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

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

Performance Criteria

Learning Outcome:

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

Learning Outcome:

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

Learning Outcome:

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

- health and safety issues
- safe and effective operation

Learning Outcome:

4. Provide information in accordance with organisational procedures

Criteria

organisation procedures:

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

Learning Outcome:

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

Criteria

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

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

Learning Outcome:

6. Confirm in relation to the installation and/or maintenance activity:

- the client and customer expectations and requirements
- the building services engineering system is in a satisfactory condition
- the hand over process

Learning Outcome:

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

Learning Outcome:

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

Learning Outcome:

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

Criteria

relevant people:

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

Learning Outcome:

10. Comply with organisational standards for appearance and behaviour

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

GLH:	28
------	----

What is this unit about?

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

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

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

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

Learners will develop their knowledge understanding and skills of:

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

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

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

Learning outcome:

1 Understand the requirements for organising and overseeing work activities

Criteria

1.1 How to plan and implement:

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

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

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

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

1.4 How to communicate effectively with relevant people

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

1.6 The organisational procedures for:

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

Learning outcome:

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

Criteria

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

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

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

Delivery outcomes (depth of content)

1

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

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

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

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

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

2

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

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

Performance Criteria

Learning Outcome:

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

Criteria

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

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

Learning Outcome:

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

Learning Outcome:

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

Learning Outcome:

- 4 Confirm that any instructions given are understood**

Learning Outcome:

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

Learning Outcome:

- 6 Monitor, as appropriate, that the work of operatives is safe, fit-for- purpose, cost effective and in accordance with:**
 - industry recognised working practices
 - the specification
 - the current versions of appropriate industry standards and regulations

Learning Outcome:

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

Learning Outcome:

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

Criteria

organisation procedures:

- 8.1 information management

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

Learning Outcome:

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

Criteria

relevant people:

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

Learning Outcome:

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

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

Learning Outcome:

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

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