

# Level 2 Technical Certificate in Plumbing (8202-25)

Version 1.3 (April 2022)

**Qualification Handbook Technicals**

## Qualification at a glance

<b>Industry area</b>	Building Service Industries
<b>City &amp; Guilds number</b>	8202-25
<b>Age group</b>	16-18 (Key Stage 5) and 19+
<b>Entry requirements</b>	Centres must ensure that any pre-requisites stated in the <i>What is this qualification about?</i> section are met.
<b>Assessment</b>	To gain this qualification, candidates must successfully achieve the following assessments: <ul style="list-style-type: none"> <li>• One externally set, externally moderated assignment</li> <li>• One externally set, externally marked exam, sat under examination conditions</li> </ul>
<b>Additional requirements to gain this qualification</b>	Employer involvement in the delivery and/or assessment of this qualification is essential for all candidates and will be externally quality assured.
<b>Grading</b>	Pass/Merit/Distinction/Distinction*
<b>Approvals</b>	This qualification requires full centre and qualification approval
<b>Support materials</b>	Sample assessments Guidance for delivery Guidance on use of marking grids
<b>Registration and certification</b>	Registration and certification of this qualification is through the Walled Garden, and is subject to end dates.
<b>External quality assurance</b>	This qualification is externally quality assured by City & Guilds, and its internally marked assignments are subject to external moderation. There is no direct claim status available for this qualification.

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 2 Technical Certificate in Plumbing	360	600	8202-25	603/0284/7

Version and Date	Change Detail	Section
June 2017 V1.1	Addition of the examination paper based module number	1. Introduction – Assessment requirements and employer involvement 5. Assessment 5. Assessment – exam Specification 7. Grading – Awarding grades and reporting results
	Removal of AO 6-8 from Synoptic Assignments	5. Assessment – Assessment Objectives
	Addition of Provisional Grade Boundaries for the Synoptic Assignment	7. Grading
	Revised Exam Specification, Exam Duration and AO weightings	5. Assessment – Exam Specification
	Branding changes	Throughout
November 2017 V1.2	Addition of learning outcome	5. Assessment – Exam specification
April 2022 V1.3	Clarified permitted assessment materials	5. Assessment

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# 1 Introduction

## What is this qualification about?

The following purpose is for the **City & Guilds Level 2 Technical Certificate in Plumbing**.

Area	Description
OVERVIEW	
Who is the qualification for?	This qualification is for you if you are a 16-19 year old learner, who wishes to work towards becoming a plumber in the building services industry. It has been designed to deliver a high level of occupational skills and provide a platform from which to progress through further learning through an apprenticeship programme or into employment. This vocational route at level 2 is a vital step towards becoming a competent plumber.
What does the qualification cover?	<p>The qualification will help you gain an understanding of the skills required within the plumbing sector. You will cover compulsory aspects such as:</p> <ul style="list-style-type: none"><li>• Hot Water</li><li>• Cold Water</li><li>• Sanitation</li><li>• Central Heating</li></ul> <p>Centres and providers work with local employers who will contribute to the knowledge and delivery of training. Employers will provide demonstrations and talks on the industry and where possible work placements will also be provided by the employers. This practically based training is ideal preparation for gaining employment in the plumbing industry or specialist further study.</p>
WHAT COULD THIS QUALIFICATION LEAD TO	
Will the qualification lead to employment, and if so, in which job role and at what level?	This technical qualification focuses on the development of knowledge and practical skills needed for working in the Plumbing industry, and will prepare you to enter a plumbing apprenticeship programme. On completion of the apprenticeship, the learner will be recognised by the industry as a competent plumbing and domestic heating engineer. This qualification is aimed at learners who are not yet employed in the plumbing industry but wish to learn the skills needed to progress further, including the level 3 qualification or help them embark on a plumbing apprenticeship programme.
Why choose this qualification over similar qualifications?	This qualification is aimed at learners who are not yet employed in the plumbing industry but wish to learn the skills needed to progress further, including the level 3 qualification or help them embark on a plumbing apprenticeship programme.

Area	Description
Will the qualification lead to further learning?	This qualification will prepare you for a plumbing apprenticeship programme, which fully qualifies you to work as a plumbing and domestic heating engineer. The apprenticeship will give you an understanding of suitable onsite skills and further knowledge required to work in the plumbing industry. Once qualified, there are many specialist qualifications available, such as environmental technology systems and designing and planning complex water systems.

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**WHO SUPPORTS THIS QUALIFICATION**

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Employer/Higher Education institutions	Founded in 1906, the Chartered Institute of Plumbing and Heating Engineering (CIPHE) is the professional body for the UK plumbing and heating industry. Our membership is made up of individuals from a wide range of backgrounds such as consultants, specifiers, designers, public health engineers, lecturers, trainers, trainees and practitioners. The CIPHE has a membership of around 7,200 including approximately 170 manufacturers and distributors, which support its work as Industrial Associates. Whilst the majority of members live in the UK, some 800 are resident in Hong Kong and a further 300 are resident in over 30 other countries. As the leading professional institution within the plumbing and heating industry we support this qualification for young people to progress into the industry.
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## Qualification structure

For the **Level 2 Technical Certificate in Plumbing** the teaching programme must cover the content detailed in the structure below

City & Guilds unit number	Unit title	GLH
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### Mandatory Units

211	Health and Safety and Industry Practices	60
212	Plumbing Processes	30
213	Electrical and Scientific Principles	30
214	Cold water	60
215	Hot Water	60
216	Central Heating	60
217	Sanitation and Drainage	60

### Total Qualification Time

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 assessment.

Title and level	GLH	TQT
Level 2 Technical Certificate in Plumbing	360	600



## Assessment requirements and employer involvement

To achieve the **Level 2 Technical Certificate in Plumbing** candidates must successfully complete **both** mandatory assessment components.

Component number	Title
<b>Mandatory</b>	
026	Level 2 Plumbing – Synoptic assignment
025 or 525	Level 2 Plumbing – Theory exam

In addition, candidates **must** achieve the mandatory employer involvement requirement for this qualification **before** they can be awarded a qualification grade. For more information, please see guidance in *Section 4: Employer involvement*.

### Employer involvement

Component number	Title
<b>Mandatory</b>	
825	Employer involvement

## 2 Centre requirements

### Approval

New centres will need to gain centre approval. Existing centres who wish to offer this qualification must go through City & Guilds' **full** Qualification Approval Process. There is no fast track approval for this qualification. Please refer to the City & Guilds website for further information on the approval process: [www.cityandguilds.com](http://www.cityandguilds.com)

### Resource requirements

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme, as detailed under the following headings.

#### **Centre staffing**

Staff delivering these qualifications must be able to demonstrate that they meet the following requirements:

- be occupationally competent at or above the level they are delivering
- hold a relevant trade qualification and/or having registration with a relevant trade organisation as 'Approved tradesperson' status or Eng-Tech status
- be able to deliver across the breadth and depth of the content of the qualification being taught
- have recent relevant teaching and assessment experience in the specific area they will be teaching, or be working towards this
- demonstrate continuing CPD.

#### **Physical resources**

Centres must be able to demonstrate that they have access to the equipment and technical resources required to deliver this qualification and their assessments.

#### **Internal Quality Assurance**

Internal quality assurance is key to ensuring accuracy and consistency of tutors and markers. Internal Quality Assurers (IQAs) monitor the work of all tutors involved with a qualification to ensure they are applying standards consistently throughout assessment activities. IQAs must have, and maintain, an appropriate level of technical competence and be qualified to make both marking and quality assurance decisions through a teaching qualification or recent, relevant experience.

### Learner entry requirements

Centres must ensure that all learners have the opportunity to gain the qualification through appropriate study and training, and that any prerequisites stated in the "*What is this qualification about?*" section are met when registering on this qualification.

### Age restrictions

These qualifications are approved for learners aged 16-18, 19+.

### 3 Delivering technical qualifications

#### Initial assessment and induction

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

- if the learner has any specific learning or training needs
- support and guidance they may need when working towards their qualifications
- 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.

#### Employer involvement

Employer involvement is essential to maximise the value of each learner's experience. Centres are required to involve employers in the delivery of technical qualifications at Key Stage 5 and/or their assessment, for every learner. This must be in place or planned before delivery programmes begin in order to gain qualification approval. See Employer involvement for more detail.

#### Support materials

The following resources are available for these qualifications:

Description	How to access
Sample assessments	Available on the qualification pages on the City & Guilds Website: <a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Guidance for delivery	
Guidance on use of marking grids	

## 4 Employer involvement

Employer involvement is a formal component of Key Stage 5 Technical qualifications. It does not contribute to the overall qualification grading, but is a mandatory requirement that all learners must meet. As such it is subject to external quality assurance by City & Guilds.

Department for Education (DfE) requirements state:

*Employer involvement in the delivery and/or assessment of technical qualifications provides a clear 'line of sight' to work, enriches learning, raises the credibility of the qualification in the eyes of employers, parents and students and furthers collaboration between the learning and skills sector and industry.*

*[Technical qualifications] must:*

- *require all students to undertake meaningful activity involving employers during their study; and*
- *be governed by quality assurance procedures run by the awarding organisation to confirm that education providers have secured employer involvement for every student.*

Extract from: *Vocational qualifications for 16 to 19 year olds, 2017 and 2018 performance tables: technical guidance for awarding organisations, paragraphs 89-90*

City & Guilds will provide support, guidance and quality assurance of employer involvement.

### Qualification approval

To be approved to offer City & Guilds technicals, centres must provide an Employer Involvement planner and tracker showing how every learner will be able to experience meaningful employer involvement, and from where sufficient and suitable employer representatives are expected to be sourced.

Centres must include in their planner a sufficient range of activities throughout the learning programme that provide a range of employer interactions for learners. Centres must also plan contingencies for learners who may be absent for employer involvement activities, so that they are not disadvantaged.

As part of the approval process, City & Guilds will review this planner and tracker. Centres which cannot show sufficient commitment from employers and/or a credible planner and tracker will be given an action for improvement with a realistic timescale for completion. **Approval will not be given** if employer involvement cannot be assured either at the start of the qualification, or through an appropriate plan of action to address this requirement before the learner is certificated.

### Monitoring and reporting learner engagement

Employer involvement is a formal component of this qualification and is subject to quality assurance monitoring. Centres must record evidence that demonstrates that each learner has been involved in meaningful employer based activities against the mandatory content before claiming the employer involvement component for learners.

Centres must record the range and type of employer involvement each learner has experienced and submit confirmation that all learners have met the requirements to City & Guilds. If a centre cannot provide evidence that learners have met the requirements to achieve the component, then the learner will not be able to achieve the overall Technical Qualification.

## Types of involvement

Centres should note that to be eligible, employer involvement activities **must** relate to one or more elements of the mandatory content of this qualification.

As the aim of employer involvement is to enrich learning and to give learners a taste of the expectations of employers in the industry area they are studying, centres are encouraged to work creatively with local employers.

Employers can identify the areas of skills and knowledge in their particular industry that they would wish to see emphasised for learners who may apply to work with them in the future. Centres and employers can then establish the type of input, and which employer representative might be able to best support these aims.

To be of most benefit this must add to, rather than replace the centre's programme of learning. Some examples of meaningful employer involvement are listed below. Employer involvement not related to the mandatory element of the qualification, although valuable in other ways, does not count towards this element of the qualification.

The DfE has provided the following examples of what does and does not count as meaningful employer involvement, as follows<sup>1</sup>:

### **The following activities meet the requirement for meaningful employer involvement:**

- *students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification;*
- *students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s);*
- *students take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures;*
- *industry practitioners operate as 'expert witnesses' that contribute to the assessment of a student's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification.*

*In all cases participating industry practitioners and employers must be relevant to the industry sector or occupation/occupational group to which the qualification relates.*

### **The following activities, whilst valuable, do not meet the requirement for meaningful employer involvement:**

- *employers' or industry practitioners' input to the initial design and content of a qualification;*
- *employers hosting visits, providing premises, facilities or equipment;*
- *employers or industry practitioners providing talks or contributing to delivery on employability, general careers advice, CV writing, interview training etc;*
- *student attendance at career fairs, events or other networking opportunities;*
- *simulated or provider-based working environments eg hairdressing salons, florists, restaurants, travel agents, small manufacturing units, car servicing facilities;*
- *employers providing students with job references.*

## Types of evidence

For each employer involvement activity, centres are required to provide evidence of which learners undertook it, e.g. a candidate attendance register. The types of additional evidence required to support a claim for this component will vary depending on the nature of the involvement. E.g. for a guest lecture it is expected that a synopsis of the lecture and register would be taken which each learner and the guest speaker will have signed; expert witnesses will be identified and will have signed the relevant assessment paperwork for each learner they have been involved in assessing; evidence of contribution from employers to the development of locally set or adapted assignments.

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<sup>1</sup> Based on Technical and applied qualifications for 14-19 year olds Key Stage 4 and 16 to 19 performance tables from 2019: technical guidance for awarding organisations, August 2016

## Quality assurance process

As the employer involvement component is a requirement for achieving the KS5 Technical qualifications, it is subject to external quality assurance by City & Guilds at the approval stage and when centres wish to claim certification for learners.

Evidence will be validated by City & Guilds before learners can achieve the employer involvement component. Where employer involvement is not judged to be sufficient, certificates cannot be claimed for learners.

## Sufficiency of involvement for each learner

It is expected that the centre will plan a range of activities that provide sufficient opportunities for each learner to interact directly with a range of individuals employed in the related industry. Centres must also provide contingencies for learners who may be absent for part of their teaching, so they are not disadvantaged. Any absence that results in a learner missing arranged activities must be documented. Where learners are unable to undertake all employer involvement activities due to temporary illness, temporary injury or other indisposition, centres should contact City & Guilds for further guidance.

## Live involvement

Learners will gain most benefit from direct interaction with employers and/or their staff; however the use of technology (e.g. the use of live webinars) is encouraged to maximise the range of interactions. Where learners are able to interact in real time with employers, including through the use of technology, this will be classed as 'live involvement'.

It is considered good practice to record learning activities, where possible, to allow learners to revisit their experience and to provide a contingency for absent learners. This is not classed as live involvement however, and any involvement of this type for a learner must be identified as contingency.

## Timing

A learner who has not met the minimum requirements cannot be awarded the component, and will therefore not achieve the qualification. It is therefore important that centres give consideration to scheduling employer involvement activities, and that enough time is allotted throughout delivery and assessment of the qualification to ensure that requirements are fully met.

## 5 Assessment

### Summary of assessment methods and conditions

Component numbers	Assessment method	Description and conditions
026	Synoptic assignment	<p>The synoptic assignment is <b>externally set and internally marked and externally moderated</b>. The assignment requires candidates to identify and use effectively, in an integrated way, an appropriate selection of skills, techniques, concepts, theories, and knowledge from across the whole content area. Candidates will be judged against the Assessment Objectives</p> <p>Assignments will be released to centres as per dates indicated in the Assessment and Examination timetable published on our website</p> <p>Centres will be required to maintain the security of all live assessment materials until assessment windows are open. Assignments will therefore be password protected and released to centres through a secure method.</p> <p>There will be one opportunity within each academic year to sit the assignment. Candidates who fail the assignment will have <b>one</b> re-sit opportunity. The re-sit opportunity will be in the next academic year, and will be the assignment set for that academic year once released to centres. If the re-sit is failed, the candidate will fail the qualification.</p> <p>Please note that for externally set assignments City &amp; Guilds provides guidance and support to centres on the marking and moderation process.</p>

Component numbers	Assessment method	Description and conditions
025/525	Externally marked exam	<p>The exam is <b>externally set and externally marked</b>, and can be taken either online through City &amp; Guilds' computer-based testing platform, (025) or as a paper based exam (525).</p> <p>The exam is designed to assess candidate's depth and breadth of understanding across the mandatory content in the qualification at the end of the period of learning, and will be sat under invigilated examination conditions. See JCQ requirements for details:  <a href="http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations">http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations</a></p> <p>The exam specification shows the coverage of this exam across the qualification content.</p> <p>Candidates who fail this exam at the first sitting will have <b>one</b> opportunity to re-sit. If the re-sit is failed the candidate will fail the qualification as a whole, and cannot achieve the qualification within that academic year.</p>

## What is synoptic assessment?

Technical qualifications are based around the development of a toolkit of knowledge, understanding and skills that an individual needs in order to have the capability to work in a particular industry or occupational area. Individuals in all technical areas are expected to be able to apply their knowledge, understanding and skills in decision making to solve problems and achieve given outcomes independently and confidently.

City & Guilds technical qualifications require candidates to draw together their learning from across the qualification to solve problems or achieve specific outcomes by explicitly assessing this through the synoptic assignment component.

In this externally set, internally marked and externally moderated assessment the focus is on bringing together, selecting and applying learning from across the qualification rather than demonstrating achievement against units or subsets of the qualification content. The candidate will be given an appropriately levelled, substantial, occupationally relevant problem to solve or outcome to achieve. For example this might be in the form of a briefing from a client, leaving the candidate with the scope to select and carry out the processes required to achieve the client's wishes, as they would in the workplace.

Candidates will be marked against assessment objectives (AOs) such as their breadth and accuracy of knowledge, understanding of concepts, and the quality of their technical skills as well as their ability to use what they have learned in an integrated way to achieve a considered and high quality outcome.



## How the assignment is synoptic for this qualification

The typical assignment brief could be to install sanitary appliances into existing systems. This will draw upon the knowledge, skills and understanding from across the qualification that the candidate has acquired and apply it to this assignment. The candidate will need to show their abilities to plan for a task and the practical skills such as hand skills when marking out, cutting and bending pipe and the installation of hardware. Candidates will also demonstrate they are following health and safety regulations at all times by drawing upon their knowledge of legislation and regulations.

## Exam for stretch, challenge and integration

The exam draws from across the mandatory content of the qualification, using:

- **Multiple choice questions** to confirm breadth of knowledge and understanding.
- **Multiple choice applied knowledge and understanding questions**, giving candidates the opportunity to demonstrate higher level, integrated understanding through application, analysis and evaluation.

## Assessment objectives

The assessments for this qualification are set against a set of assessment objectives (AOs) which are used across all City & Guilds Technicals to promote consistency among qualifications of a similar purpose. They are designed to allow judgement of the candidate to be made across a number of different categories of performance.

Each assessment for the qualification has been allocated a set number of marks against these AOs based on weightings recommended by stakeholders of the qualification. This mark allocation remains the same for all versions of the assessments, ensuring consistency across assessment versions and over time.

The following table explains all AOs in detail, including weightings for the synoptic assignments. In some cases, due to the nature of a qualification's content, it is not appropriate to award marks for some AOs. Where this is the case these have been marked as N/A. Weightings for exams (AOs 1, 2 and 4 only) can be found with the exam specification.

Assessment objective	Level 2 Technical Certificate in Plumbing Typical expected evidence of knowledge, understanding and skills	Approximate weighting
<b>AO1</b> Recalls knowledge from across the breadth of the qualification.	Types of knowledge expected: PPE, Health and Safety, component identification and layout, roles and responsibilities, types of access equipment, guidance material, heat transfer, backflow protection, selection of tools and safety checks, fixings.	10%
<b>AO2</b> Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification.	Explanations/comparisons related to hazardous situations and PPE measures, hot, cold and drainage systems and layouts, Installation requirements, Installation methods, testing and decommissioning, materials and uses, principles of electricity, heat and power, sanitary appliances, water regulations, SI units.	20%

Assessment objective	Level 2 Technical Certificate in Plumbing Typical expected evidence of knowledge, understanding and skills	Approximate weighting
<b>A03</b> Demonstrates technical skills from across the breadth of the qualification.	Working with tools, equipment and materials, promoting health and safety, work methods, installation techniques, work practice, time management, economical use of materials, site safety, communication skills, accuracy and presentation.	40%
<b>A04</b> Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes.	Applying knowledge and understanding to the tasks/ scenario, able to plan activities from information provided. Materials and techniques are used appropriately, correct sequence of operations carried out. Safe working practices demonstrated	20%
<b>A05</b> Demonstrates perseverance in achieving high standards and attention to detail while showing an understanding of wider impact of their actions.	Examples of attending to detail: housekeeping, storage of tools, working within tolerances, detail of drawings, drawings and documentation are accurate, attention to accuracy during work, thinking about and attending to specific requirements of the task, attention to detail in risk assessment and risk reduction/method statements.	10%

## Assessment materials

Subject	Assessment no.	Assessment type	Assessment time	Permitted materials
Level 2 Synoptic Assessment	026	Synoptic assignment	15.5 hours	Non-programmable scientific calculator only.
Level 2 Externally Marked Exam	025/525	Theory Exam	120 minutes (2 hours)	Non-programmable scientific calculator only.

## Exam specification

AO weightings per exam.

Assessment objective	025/525 weighting (approx. %)
<b>AO1</b> Recalls knowledge from across the breadth of the qualification.	48%
<b>AO2</b> Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification.	32%
<b>AO4</b> Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purpose.	20%

The way the exam covers the content of the qualification is laid out in the table below. The learning outcomes in the table identify the content that the theory exam will be based on. Please be aware that there are additional learning outcomes in the units and the below learning outcomes should not be delivered in isolation.

**Assessment type:** Multiple-choice exam

**Assessment conditions:** Invigilated examination conditions\*

**Grading:** Pass/Merit/Distinction

025/525	Duration: 2 hours		
Unit	Learning outcomes	Marks available	Weighting
211	<ol style="list-style-type: none"> <li>1. Understand health and Safety legislation in the plumbing and heating industry</li> <li>2. Understand hazardous situations within the plumbing and heating industry</li> <li>3. Carry out procedures for electrical safety</li> </ol>	8	13
212	<ol style="list-style-type: none"> <li>3. Use clips and brackets to support domestic plumbing and heating</li> <li>4. Install domestic plumbing and heating</li> </ol>	6	10
213	<ol style="list-style-type: none"> <li>1. Understand materials used in the plumbing industry</li> <li>2. Understand properties of water, liquids and gases</li> <li>3. Understand density, force, pressure, flowrate and basic mechanics</li> <li>4. Understand heat and power in the plumbing and heating industry</li> <li>5. Understand the principles of electricity within the plumbing and heating industry</li> </ol>	8	13
214	<ol style="list-style-type: none"> <li>1. Understand cold water supplies to dwellings</li> <li>2. Understand domestic cold water systems</li> </ol>	6	10
215	<ol style="list-style-type: none"> <li>1. Understand hot water systems and their layouts</li> <li>2. Install hot water systems and components</li> </ol>	7	12

025/525	Duration: 2 hours		
216	<ol style="list-style-type: none"> <li>1. Understand central heating systems and their layout</li> <li>3. Understand the decommissioning requirements of central heating systems and their components</li> </ol>	6	10
217	<ol style="list-style-type: none"> <li>1. Understand layouts of gravity rainwater systems</li> <li>3. Understand service, maintenance requirements and commissioning of gravity rainwater systems</li> <li>4. Understand sanitary appliances used in dwellings</li> <li>6. Understand service and maintenance requirements for sanitary appliances and connecting pipework systems</li> </ol>	7	12
Applied knowledge and understanding		12	20
<b>Total</b>		<b>60</b>	<b>100</b>

\*These exams are sat under invigilated examination conditions, as defined by the JCQ:  
<http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations>.

Entry for exams can be made through the City & Guilds Walled Garden.

## 6 Moderation and standardisation of assessment

City & Guilds' externally set assignments for technical qualifications are designed to draw from across the qualifications' content, and to contribute a significant proportion towards the learner's final qualification grade. They are subject to a rigorous external quality assurance process known as external moderation. This process is outlined below. For more detailed information, please refer to 'Marking and moderation - Technicals centre guidance' available to download on the City & Guilds website.

It is vital that centres familiarise themselves with this process, and how it impacts on their delivery plan within the academic year.

### Supervision and authentication of internally assessed work

The Head of Centre is responsible for ensuring that internally assessed work is conducted in accordance with City & Guilds' requirements.

City & Guilds requires both tutors and candidates to sign declarations of authenticity. If the tutor is unable to sign the authentication statement for a particular candidate, then the candidate's work cannot be accepted for assessment.

### Internal standardisation

For internally marked work<sup>2</sup> the centre is required to conduct internal standardisation to ensure that all work at the centre has been marked to the same standard. It is the Internal Quality Assurer's (IQA's) responsibility to ensure that standardisation has taken place, and that the training includes the use of reference and archive materials such as work from previous years as appropriate.

### Internal appeal

Centres must have an internal process in place for candidates to appeal the marking of internally marked components, ie the synoptic assignment and any optional unit assignments. This must take place before the submission of marks for moderation. The internal process must include candidates being informed of the marks (or grades) the centre has given for internally assessed components, as they will need these to make the decision about whether or not to appeal.

Centres cannot appeal the outcome of moderation for individual candidates, only the moderation process itself. A request for a review of the moderation process should be made to [appeals@cityandguilds.com](mailto:appeals@cityandguilds.com).

### Moderation

Moderation is the process where external markers are standardised to a national standard in order to review centre marking of internally marked assessments. These markers are referred to as 'moderators'. Moderators will mark a representative sample of candidates' work from every centre. Their marks act as a benchmark to inform City & Guilds whether centre marking is in line with City & Guilds' standard.

Where moderation shows that the centre is applying the marking criteria correctly, centre marks for the whole cohort will be accepted.

Where moderation shows that the centre is either consistently too lenient or consistently too harsh in comparison to the national standard, an appropriate adjustment will be made to the marks of the whole cohort, retaining the centre's rank ordering.

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<sup>2</sup> For any internally assessed optional unit assignments, the same process must be followed where assessors must standardise their interpretation of the assessment and grading criteria.

Where centre application of the marking criteria is inconsistent, an appropriate adjustment for the whole cohort may not be possible on the basis of the sample of candidate work. In these instances a complete remark of the candidate work may be necessary. This may be carried out by the centre based on feedback provided by the moderator, or carried out by the moderator directly.

Moderation applies to all internally marked assignments. Following standardisation and marking, the centre submits all marks and candidate work to City & Guilds via the moderation platform. The deadline for submission of evidence will be available on Walled Garden. See the *Marking and moderation - Technicals Centre Guidance* document for full details of the requirements and process.

In most cases candidate work will be submitted directly to the moderator for moderation. This includes written work, photographic and pictorial evidence, or video and audio evidence. For some qualifications there will be a requirement for moderators to visit centres to observe practical assessments being undertaken. This will be for qualifications where the assessment of essential learner skills can only be demonstrated through live observation. The purpose of these visits is to ensure that the centre is assessing the practical skills to the required standards, and to provide the moderators with additional evidence to be used during moderation. These visits will be planned in advance with the centre for all relevant qualifications.

### **Post-moderation procedures**

Once the moderation process has been completed, the confirmed marks for the cohort are provided to the centre along with feedback from the moderator on the standard of marking at the centre, highlighting areas of good practice, and potential areas for improvement. This will inform future marking and internal standardisation activities.

City & Guilds will then carry out awarding, the process by which grade boundaries are set with reference to the candidate evidence available on the platform.

### **Centres retaining evidence**

Centres must retain assessment records for each candidate for a minimum of three years. To help prevent plagiarism or unfair advantage in future versions, candidate work may not be returned to candidates. Samples may however be retained by the centre as examples for future standardisation of marking.

## 7 Grading

### Awarding individual assessments

Individual assessments will be graded, by City & Guilds, as pass/merit/distinction where relevant. The grade boundaries for pass and distinction for each assessment will be set through a process of professional judgement by technical experts. Merit will usually be set at the midpoint between pass and distinction. The grade descriptors for pass and distinction, and other relevant information (eg archived samples of candidate work and statistical evidence) will be used to determine the mark at which candidate performance in the assessment best aligns with the grade descriptor in the context of the qualification's purpose. Boundaries will be set for each version of each assessment to take into account relative difficulty.

Please note that as the Merit grade will usually be set at the arithmetical midpoint between pass and distinction, there are no descriptors for the Merit grade for the qualification overall.

### Grade descriptors

#### To achieve a pass, a candidate will be able to

- Demonstrate the knowledge and understanding required to work in the occupational area, its principles, practices and legislation.
- Describe some of the main factors impacting on the occupation to show good understanding of how work tasks are shaped by the broader social, environmental and business environment it operates within.
- Use the technical industry specific terminology used in the industry accurately.
- Demonstrate the application of relevant theory and understanding to solve non-routine problems.
- Interpret a brief for complex work related tasks, identifying the key aspects, and showing a secure understanding of the application of concepts to specific work related tasks.
- Carry out planning which shows an ability to identify and analyse the relevant information in the brief and use knowledge and understanding from across the qualification (including complex technical information) to interpret what a fit for purpose outcome would be and develop a plausible plan to achieve it.
- Achieve an outcome which successfully meets the key requirements of the brief.
- Identify and reflect on the most obvious measures of success for the task and evaluate how successful they have been in meeting the intentions of the plan.
- Work safely throughout, independently carrying out tasks and procedures, and having some confidence in attempting the more complex tasks.

#### To achieve a distinction, a candidate will be able to

- Demonstrate the excellent knowledge and understanding required to work to a high level in the occupational area, its principles, practices and legislation.
- Analyse the impact of different factors on the occupation to show deep understanding of how work tasks are shaped by the broader social, environmental, and business environment it operates within.
- Demonstrate the application of relevant theory and understanding to provide efficient and effective solutions to complex and non-routine problems.
- Analyse the brief in detail, showing confident understanding of concepts and themes from across the qualification content, bringing these together to develop a clear and stretching plan, that would credibly achieve an outcome that is highly fit for purpose.

- Achieve an outcome which shows an attention to detail in its planning, development and completion, so that it completely meets or exceeds the expectations of the brief to a high standard.
- Carry out an evaluation in a systematic way, focussing on relevant quality points, identifying areas of development/ improvement as well as assessing the fitness for purpose of the outcome.

### Awarding grades and reporting results

The overall qualification grade will be calculated based on aggregation of the candidate's achievement in each of the assessments for the mandatory units, taking into account the assessments' weighting. The **Level 2 Technical Certificate in Plumbing** will be reported on a four grade scale: Pass, Merit, Distinction, Distinction\*.

All assessments **must** be achieved at a minimum of Pass for the qualification to be awarded. Candidates who fail to reach the minimum standard for grade Pass for an assessment(s) will not have a qualification grade awarded and will not receive a qualification certificate.

The approximate pass grade boundary(ies) for the synoptic assignment(s) in this qualification are:

Synoptic Assignment	Pass Mark (%)
026	43

Please note that each synoptic assignment is subject to an awarding process before final grade boundaries are confirmed.

The contribution of assessments towards the overall qualification grade is as follows:

Assessment method	Grade scale	% contribution
Synoptic Assignment (026)	X/P/M/D	60%
Exam (025/525)	X/P/M/D	40%

Both synoptic assignments and exams are awarded (see 'Awarding individual assessments', at the start of Section 7, above), and candidates' grades converted to points. The minimum points available for each assessment grade is listed in the table below. A range of points between the Pass, Merit and Distinction boundaries will be accessible to candidates. For example a candidate that achieves a middle to high Pass in an assessment will receive between 8 and 10 points, a candidate that achieves a low to middle Merit in an assessment will receive between 12 and 14 points. The points above the minimum for the grade for each assessment are calculated based on the candidate's score in that assessment.

Assessment method	Pass	Merit	Distinction
Synoptic Assignment (60%)	6	12	18
Theory Exam (40%)	6	12	18

The candidate's points for each assessment are multiplied by the % contribution of the assessment and then aggregated. The minimum points required for each qualification grade are as follows:



Qualification Grade	Minimum points
Distinction*	20.5
Distinction	17
Merit	11
Pass	6

Candidates achieving Distinction\* will be the highest achieving of the Distinction candidates.

## 8 Administration

Approved centres must have effective quality assurance systems to ensure valid and reliable delivery and assessment of qualifications. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality assurance procedures.

Consistent quality assurance requires City & Guilds and its associated centres to work together closely; our Quality Assurance Model encompasses both internal quality assurance (activities and processes undertaken within centres) and external quality assurance (activities and processes undertaken by City & Guilds).

For this qualification, standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external moderation.

In order to carry out the quality assurance role, Internal Quality Assurers (IQAs) must have and maintain an appropriate level of technical competence and have recent relevant assessment experience. For more information on the requirements, refer to *Section 2: Centre requirements* in this handbook.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following procedures are followed:

- suitable training of staff involved in the assessment of the qualification to ensure they understand the process of marking and standardisation
- completion by the person responsible for internal standardisation of the Centre Declaration Sheet to confirm that internal standardisation has taken place
- the completion by candidates and supervisors/tutors of the record form for each candidate's work.

### External quality assurance

City & Guilds will undertake external moderation activities to ensure that the quality assurance criteria for this qualification are being met. Centres must ensure that they co-operate with City & Guilds staff and representatives when undertaking these activities.

City & Guilds requires the Head of Centre to

- facilitate any inspection of the centre which is undertaken on behalf of City & Guilds
- make arrangements to receive, check and keep assessment material secure at all times,
- maintain the security of City & Guilds confidential material from receipt to the time when it is no longer confidential and
- keep completed assignment work and examination scripts secure from the time they are collected from the candidates to their dispatch to City & Guilds.

### Enquiries about results

The services available for enquiries about results include a review of marking for exam results and review of moderation for internally marked assessments.

For further details on enquiries and appeals process and for copies of the application forms, please visit the **appeals page** of the City & Guilds website at **[www.cityandguilds.com](http://www.cityandguilds.com)**.

## Re-sits and shelf-life of assessment results

Candidates who have failed an assessment or wish to re-take it in an attempt to improve their grade, can re-sit assessments **once only**. The best result will count towards the final qualification. See guidance on individual assessment types in Section 5.

## Factors affecting individual learners

If work is lost, City & Guilds should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. Centres should use the JCQ form, JCQ/LCW, to inform City & Guilds Customer Services of the circumstances.

Learners who move from one centre to another during the course may require individual attention. Possible courses of action depend on the stage at which the move takes place. Centres should contact City & Guilds at the earliest possible stage for advice about appropriate arrangements in individual cases.

## Malpractice

Please refer to the City & Guilds guidance notes *Managing cases of suspected malpractice in examinations and assessments*. This document sets out the procedures to be followed in identifying and reporting malpractice by candidates and/or centre staff and the actions which City & Guilds may subsequently take. The document includes examples of candidate and centre malpractice and explains the responsibilities of centre staff to report actual or suspected malpractice. Centres can access this document on the City & Guilds website.

Examples of candidate 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 candidate (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 (eg disqualification from the assessment) will be applied.

Where suspected malpractice is identified by a centre after the candidate has signed the declaration of authentication, the Head of Centre must submit full details of the case to City & Guilds at the earliest opportunity. Please refer to the form in the document *Managing cases of suspected malpractice in examinations and assessments*.

## Access arrangements and special consideration

Access arrangements are adjustments that allow candidates with disabilities, special educational 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 candidates will be able to access the requirements of the qualification.

Please refer to the *JCQ access arrangements and reasonable adjustments and Access arrangements - when and how applications need to be made to City & Guilds* for more information. Both are available on the City & Guilds website: <http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments>

### *Special consideration*

We can give special consideration to candidates who have had a temporary illness, injury or indisposition at the time of the examination. Where we do this, it is given after the examination.

Applications for either access arrangements or special consideration should be submitted to City & Guilds by the Examinations Officer at the centre. For more information please consult the current version of the JCQ document, *A guide to the special consideration process*. This document is available on the City & Guilds website: <http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments>

# Unit 211 Health and Safety and Industry Practices

<b>Unit level:</b>	Level 2
<b>GLH:</b>	60

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## What is this unit about?

The purpose of this unit is for learners to gain a knowledge and understanding of the practices and procedures employed to maintain safe working environments and to prepare learners for the real working environments found within the building services engineering sector, this will lead to an improvement in employability for successful candidates. Learners will be introduced to legislation, management systems and procedures used on construction sites in order to reduce risk and prevent hazardous situations occurring.

This unit also introduces learners to the practical skills needed when using tools, equipment and plant on site and also provides learners with an understanding of environmental legislation and industry practices to maximise protection of the environment. In addition, this unit gives an opportunity for learners to understand the structure of organisations and the roles of persons on a construction site and what they are responsible for.

Learners should consider the following questions as a starting point to this unit:

What laws affect the plumbing and heating industry?

Why is site safety management important?

Why is the safe use of heat producing equipment important?

Why is it important to know the hierarchy of construction sites?

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## Learning outcomes

In this unit, learners will be able to

- 1 Understand health and safety legislation in the plumbing and heating industry
- 2 Understand hazardous situations within the plumbing and heating industry
- 3 Use personal protection and respond to accidents
- 4 Understand procedures for electrical safety
- 5 Work with heat producing equipment
- 6 Use access equipment on a construction site
- 7 Understand how to work safely in excavations and confined spaces

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## Learning outcome

1 Understand health and safety legislation in the plumbing and heating industry

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### Topics

- 1.1 Guidance material and legislation in the plumbing and heating industry
- 1.2 Purpose of enforcing authorities
- 1.3 Roles and responsibilities of personnel

Although an in-depth knowledge is not expected of all legislation within the range, learners are expected to know what the particular legislation and documentation covers, how they are enforced, their responsibilities along with whether it is statutory or non-statutory:

#### Topic 1.1

Types of health and safety guidance material:

- Acts of Parliament
- Regulation
- Approved codes of practice
- HSE Guidance Notes

Types of legislation:

- The Health & Safety at Work Act
- The Electricity at Work Regulations,
- Control of Substances Hazardous to Health (COSHH) Regulations
- Working at Heights Regulations
- Personal Protective Equipment at Work Regulations (PPE)
- Lifting and Manual Handling Operations Regulations
- Provision and Use of Work Equipment Regulations
- Control of Asbestos at Work Regulations
- Health, Safety and Welfare Regulations
- Health and Safety (First Aid) Regulations
- Confined Spaces Regulations

#### Topic 1.2

Purpose of enforcing authorities and control measures:

- Health and safety executive
- Local authority
- Improvement notice
- Prohibition notice
- Powers of prosecution
- Providing advice and guidance

### Topic 1.3

Roles and responsibilities in relation to health and safety:

- Employers
- Employees
- Self employed
- Designers
- Main and sub-contractors
- Clients

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### Learning outcome

2 Understand hazardous situations within the plumbing and heating industry

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### Topics

- 2.1 Preventing potential site hazards
- 2.2 Types of hazardous substances
- 2.3 Dealing with asbestos in the workplace
- 2.4 Types of Environmental protection

### Depth

#### Topic 2.1

Types of site hazards:

- Trailing leads
- Slippery or uneven surfaces
- Presence of dust and fumes
- Handling and transporting equipment or materials,
- Contaminants and irritants
- Fire
- Working at heights
- Malfunctioning equipment
- Improper use and storage of tools and equipment
- Potential presence of asbestos

Methods to reduce risk of injury from hazards:

- Method statements
- Risk assessments
- Permits to work
- Safety signs

#### Topic 2.2

Types and characteristics of hazardous substances:

- Lead

- Solvents
- Lubricants
- Fluxes
- Jointing compounds
- Sealants
- Gases
- Petroleum/Diesel
- Cleaning agents

Classification of hazardous substances:

- Toxic
- Harmful
- Corrosive
- Irritant
- Oxidizing
- Flammable

### **Topic 2.3**

Types and effects of asbestos exposure and how this should be prevented:

- Chrysotile
- Amosite
- Crocidolite
- Asbestos cement materials
- Health issues

Asbestos based materials:

- Flue
- Soil
- Gutter and rainwater pipes
- Tanks and cisterns
- Artex
- Gaskets and seals

Dealing with Asbestos:

- Safe disposal
- Licensed removal
- Protection of the workforce and public
- Licensed and unlicensed tasks

### **Topic 2.4**

Types of waste management and disposal:

- Recycling
- Landfill
- Waste electrical and electronic equipment (WEEE)
- Waste carriers licensing
- Hazardous waste disposal



Different types of pollution found on a construction site and how they impact installation:

- Land contamination
- Air contamination
- Noise
- Light

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## Learning outcome

3 Use personal protection and respond to accidents

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### Topics

- 3.1 Use PPE for plumbing and heating work
- 3.2 Perform manual handling
- 3.3 First aid in the plumbing and heating industry
- 3.4 Dealing with accidents

#### Topic 3.1

Select types of personal protection equipment in relation to plumbing and heating work being carried out:

- Clothing
- Eye, hand, head, foot, hearing, respiratory and vibration protection.
- Harnesses

#### Topic 3.2

Perform manual handling:

- Manual lifting technique
- Mechanical aids
- Load assessment

#### Topic 3.3

The importance of first aid provisions in different working environments:

- Small occupied properties
- Construction sites
- Company first aid supply requirements

#### Topic 3.4

Dealing with accidents on a construction site:

- Raising alarm
- Emergency service contact methods
- Evacuation procedures
- Statutory requirements when reporting accidents/ near misses.
- Accident book usage and details recorded
- RIDDOR requirements

Dealing with minor injuries:

- Cuts
- Minor burns
- Objects in the eye
- Fume exposure

Dealing with major injuries and the scope of potential assistance:

- Bone fracture
- CPR method
- Electric shock
- Concussion
- Unconsciousness
- Recovery position.

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## Learning outcome

4 Understand procedures for electrical safety

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## Topics

- 4.1 Types of electrical supplies used on site
- 4.2 Types of electrical hazards and safety
- 4.3 Safe isolation procedure

### Topic 4.1

Supply voltages used on site:

- Battery powered
- 110 volt
- 230 volt

### Topic 4.2

Common electric dangers:

- Fixed and portable equipment requirements
- Signs of damage or worn electrical cables
- Trailing cables
- Proximity of cables to service pipework
- Buried/ hidden cables
- Inadequate overcurrent protection devices
- Shock – Temporary continuity bonding

Power tool safety:

- Visual inspection
- PAT test requirements
- RCD protection

### Topic 4.3

Safe isolation procedure and how this could be carried out on common electrical plumbing equipment:

- Immersion/water heaters
- Showers
- Central heating

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### Learning outcome

5 Work with heat producing equipment

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### Topics

- 5.1 Gases used in equipment
- 5.2 Fire safety principles
- 5.3 Assemble LPG equipment

### Topic 5.1

Types of gases commonly used in plumbing equipment

- Bottle colours
- Properties of gasses
  - \*Propane
  - \*Butane
  - \*Oxy-acetylene
  - \*Nitrogen
- Transport and storage

### Topic 5.2

Causes and prevention of fire and procedures to follow along with the use of safety equipment.

- Combustion (fire triangle)
- Types of fire extinguishers
- Use of extinguishers
- Evacuation procedures

### Topic 5.3

Carry out assembly and safety checks on heat producing equipment:

- Bottle location
- Correct colour selection
- Thread direction
- Assembly sequence
- Leak detection
- Safe purge
- Lighting / extinguishing
- Prevention of leakage
- Transportation

- Storage
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## Learning outcome

6 Use access equipment on a construction site

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### Topics

- 6.1 Types of access equipment
- 6.2 Use access equipment

#### Topic 6.1

Types and inspection requirements of access equipment commonly used:

- Steps
- Ladders
- Mobile scaffold towers
- Platforms
- Harnesses
- Roof ladders and crawling boards
- Fixed scaffolds and edge protection
- Mobile elevated work platforms including scissor lifts and cherry pickers

#### Topic 6.2

Use different types of access equipment including all necessary pre checks prior to use:

- Steps
  - Ladders
  - Mobile scaffold towers
  - Platforms
- 

## Learning outcome

7 Understand how to work safely in excavations and confined spaces

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### Topics

- 7.1 Working practices in excavations
- 7.2 Working practices in confined space

#### Topic 7.1

Safe working practices in excavations:

- Safe access and trench support system requirements
- Use of barriers and warning signs
- Vehicle proximity and stop blocks

#### Topic 7.2

Types of confined spaces:

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- Under floors
- Roof spaces
- Plant rooms
- Main service duct rooms

Dangers of working in confined spaces:

- Inadequate ventilation
- Inadequate lighting
- Flooding
- Obstruction of escape route

## Guidance for delivery

Whilst learners are not expected to have an in-depth knowledge of all legislation and guidance material, they are expected to know what the legislation and guidance material covers, who is responsible and whether the legislation is statutory or non-statutory. Knowledge of how regulations are created under an Act of Parliament then maintained by departments or organisations is also relevant as it assists learners understanding of where to look for updated regulations later in their careers as well as participate in public consultation exercises.

This unit should be delivered using a range of classroom and practical activities. Practical activities should include demonstrations and safe use of hazardous substances, access equipment, safe lifting technique, power tools and safe use of heat producing equipment. Learners are not expected to be able to erect tower scaffolding although this element is at the discretion of the centre and their policy regarding PASMA.

Learners are expected to be able to demonstrate the full electrical isolation procedure on common plumbing/ electrical equipment as well as having a full understanding of the reason for this procedure. Centres are expected to provide candidates with the opportunities and resources to practice this procedure.

Within this unit, learners will be introduced to the systems employed on sites to reduce risk. Whilst learners are not expected to develop the skills required to plan and prepare these systems, they will need to apply their understanding of the systems and relate them to situation and environments to keep themselves and others safe. Learners need to be prepared for the real working environment and so should be familiar with all site procedures, common hazards and routine safety management. This should further be promoted when undertaking all practical activities within this qualification.

Where protection of the environment is concerned, learners should be aware of the need to separate and process waste at source in order to reduce landfill and contamination. Having a good understanding of how all waste is dealt with promotes good practice, this also includes hazardous waste and its effects. Knowledge of pollution and contamination is important due to their environmental impacts, learners should explore reduction methods as these help to promote a good ethos and protect the environment. Centres should consider utilising the knowledge of experts in this field for guest speaking opportunities and also opportunities to visit waste processing facilities if appropriate.

As many of the activities in this qualification require learners to demonstrate safe working techniques and apply what they have learned within this unit across all the other units in the qualification, it is advised that this unit is the first learning outcome delivered in the curriculum.

Information contained within learning outcome one is less safety critical and is intended to provide learners with an understanding of organisations and site hierarchy. Knowing the roles of individuals and organisations improves the flow of information which in turn leads to safe and efficient working environments.

# Unit 212 Plumbing Processes

<b>Unit level</b>	Level 2
<b>GLH:</b>	30

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## What is this unit about?

The purpose of this unit is for learners to gain the knowledge and understanding of the equipment and the skills used in the plumbing and heating industry. This unit covers the basic equipment used for plumbing activities, the processes to be followed and gives an overview of the jointing and pipework systems used in the industry. This unit will give the learner basic information needed to plan a job and basic information to assist giving learners examples of good practice. Many systems and materials of pipework exist in the modern plumbing industry and this unit covers the more common methods giving an understanding of the suitable materials used and how to fabricate the systems in the correct way to ensure industry requirements.

Practical activities have been included in this unit to develop skills when working with pipework systems. These support and lead onto more complex systems contained in other system units.

Learners should consider the following questions as a starting point to this unit:

What tools are used in the plumbing industry?

What are the various types of building fabric found in domestic properties?

Why is correct fitting selection such an important activity?

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## Learning outcomes

In this unit, learners will be able to

- 1 Use tools in the plumbing and heating industry
- 2 Carry out site preparation techniques for plumbing and heating work
- 3 Use clips and brackets to support domestic plumbing and heating pipework components
- 4 Install domestic plumbing and heating pipework

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## Learning outcome

1 Use tools in the plumbing and heating industry

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## Topics

1.1 Use hand tools

1.2 Use power tools

### Topic 1.1

Function, safe use and maintenance of hand tools:

- Screwdrivers
- Hammers
- Chisels
- Grips
- Wrenches
- Spanners
- Spirit levels
- Manual pipe threaders
- Pipe cutters
- Hand saws
- Pliers
- Bending Tools

### Topic 1.2

Function and safe use of power tools:

- Power drills
- Drill bits
- Circular saws
- Jig saws
- Reciprocating saws
- Portable pipe threading machines
- Hydraulic machine benders
- Hydraulic crimping kits
- Portable pipe freezing kits
- Blow torch
- Fusion welding kits



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## Learning outcome

2 Carry out site preparation techniques for plumbing and heating work

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## Topics

2.1 Planning work for installation

2.2 Perform site preparation work for installation

### Topic 2.1

Methods for planning work:

- Job schedules
- Material list
- Storing tools and equipment

### Topic 2.2

Types of work environments:

- New site
- Refurbishment
- Industrial/commercial
- Domestic

Methods of protecting the building fabric from damage:

- Flame damage
- Packaging of components
- Notching timber joints
- Cover plates
- Checking for existing damage

Methods of protecting customer property:

- Walking boards
- Dust sheets
- Removal of personal property

Carry out preparation work:

- Holes in masonry surfaces
- Making good to masonry surfaces
- Lifting and replacing timber flooring materials
- Drilling holes – timber floor joists
- Cutting chases – wall and floor surfaces

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## Learning outcome

3 Use clips and brackets to support domestic plumbing and heating pipework components

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## Topics

3.1 Fixings used with pipework components

3.2 Install clips and brackets

### Topic 3.1

Types of fixing devices:

- Nails
- Screws
  - \*Slotted head
  - \*Phillips head
- Pozidrive
- Plastic plugs
- Heavy duty fixings
- Coach bolts
- Rawlbolts
- Cavity fixings
- Drive in fixings

### Topic 3.2

Install the following clips and brackets to plumbing and heating pipework

Steel

- Munsen rings
- School board brackets
- Rubber lined
- Threaded bar and base plate

Copper

- Saddles
- Nail on
- Plastic stand off types
- School board
- Munsen rings

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## Learning outcome

4 Install domestic plumbing and heating pipework

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### Topics

- 4.1 Installation methods for pipework
- 4.2 Pipework materials and sizes
- 4.3 Bend pipework work for installation
- 4.4 Join pipework for installation
- 4.5 Install pipework

#### Topic 4.1

Methods of installation:

- Prefabrication of pipework
- Installing pipework in-situ
- Use of sleeves
- Fire stopping to pipework

#### Topic 4.2

Pipework materials and sizes used in installation work:

- Copper
- R220 soft coils
- R250 half hard lengths
- R290 hard lengths
- Low Carbon steel (LCS)
- Light grade
- Medium grade
- Heavy grade
- Plastic pipework
- Polyethylene (MDPE)
- Polybutylene
- Plastic pipework (sanitary)
- PVC-u
- Polypropylene
- MUPVC
- ABS

Measure, mark and cut pipework materials:

- Copper pipework
- LCS pipework
- Plastic pipework

#### Topic 4.3

Types of copper machine bending:

- 90 degree bends

- Sets and offset bends
- Passover bends

Types of LCS hydraulic machine bending

- 90 degree bends
- Sets and offset bends
- Passover bends

Cabling technique for plastic pipework

#### **Topic 4.4**

Types of fittings:

- Couplers
- Elbows and bends
- Equal tees
- Reducing tees
- Reducers
- Tap connectors
- Flexible connectors
- Manifolds
- Specialist fittings such as tank connectors

Types of jointing methods for copper pipe:

- Solder ring and end feed
- Compression (type A and B)
- Push-fit
- Press-fit

Types of jointing methods for low carbon steel (LCS)

- Hand and machine threaded
- Compression or mechanical

Types of jointing methods for plastic pipe

- Push fit
- Compression
- Proprietary - copper and MDPE
- Ring seal
- Solvent weld

#### **Topic 4.5**

Install different types of pipework following the below process:

- Select
- Measure
- mark out

- Cut
- Joint
- Bend
- Fabricate
- fix and test pipework

Types of pipework to be installed

- Copper pipework
- LCS pipework
- Plastic pipework

## Guidance for delivery

This unit underpins a number of other units in the qualification and should be covered early in the course as its content is generic through all units. The unit is also best delivered in conjunction with workshop activity as many of the outcomes directly relate to practical activity.

Learning outcome one should involve the use of visual examples in the workshop accompanied by demonstrations on each piece of equipment. Learners can be asked to identify a range of tools on the bench giving uses, maintenance requirements and safety tips. This method of delivery could also be used in the classroom if required, however candidates will need to be able to use these tools safely and effectively. Other unit learning could be supported by directly relating this outcome to regulations of Health and Safety at Work and PUWER.

Learning outcome two can be delivered in the classroom or workshop but relating the topics to real world scenarios will help learners' understanding. Learners could develop a method statement on how they will complete a job could be an option for delivery once some knowledge and understanding has been gained.

Learning outcome three will need to be delivered in a workshop environment where candidates can develop the understanding of clips, brackets and fixings and their uses before being able to apply them to pipework.

In learning outcome four learners will need to joint pipework on most systems so practical delivery is essential. However ensuring the basic understanding of the suitability of material and basic jointing principles for differing tasks needs to be covered. The use of manufacturer's presentations, guest speakers or factory visits would increase the understanding and interest in these processes.

Generally linking the unit to industry practises and real experiences of the tutors is essential to contextualise the learning for students with little experience. Ongoing and constructive feedback and formative assessment should be built into the delivery method to direct and monitor the learning.

## Unit 213 Electrical and Scientific Principles

<b>Unit level:</b>	Level 2
<b>GLH:</b>	30

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### What is this unit about?

The purpose of this unit is to give learners the underpinning knowledge and understanding of plumbing design criteria and concepts. Learners will investigate properties of materials, liquids and gases, heat transfer and pressure and force and see how these impact on work within the plumbing and heating industry. The unit also covers the basic concepts of electricity and links them to the requirements a plumber will need to know whilst performing his duties. This includes electrical theory and safety critical processes such as safe isolation.

Learners should consider the following questions as a starting point to this unit:

What is heat?

How do I measure pressure?

What materials are most suitable for pipework?

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### Learning outcomes

In this unit, learners will be able to

- 1 Understand materials used in the plumbing industry
- 2 Understand properties of water, liquids and gases
- 3 Understand density, force, pressure, flowrate and basic mechanics
- 4 Understand heat and power in the plumbing and heating industry
- 5 Understand the principles of electricity within the plumbing and heating industry

## Scope of content

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### Learning outcome

- 1 Understand materials used in the plumbing industry
- 

### Topics

- 1.1 Material properties used in the plumbing industry
- 1.2 Uses of materials
- 1.3 Corrosion protection and degradation

#### Topic 1.1

Physical properties of materials:

- Tensile and compressive strength
- Hardness
- Ductility
- Malleability
- Conductivity

Classification of metals:

- Ferrous
- Non Ferrous
- Alloying of metals

Heat capacity and energy of materials:

- Water
- Metals

Thermal expansion of materials:

- Plastics
- Common metals
- Pipes
- Guttering

#### Topic 1.2

Types and uses of materials:

- Steel
- Iron
- Copper
- Lead
- Stainless steel
- Brass
- Solder



Types and uses of plastic thermos and thermosetting:

- UPVC
- ABS
- Poly propylene
- Polybutylene
- Polythene (classes)

Types and uses of ceramics:

- Fireclay
- Vitreous china

### **Topic 1.3**

Material corrosion or degradation:

- Atmospheric conditions
- Oxidisation
- Rusting
- Dezincification
- Electrolytic corrosion and principles
- Erosion
- Pitting /pinholing
- Plastic -
  - \*Thermal
  - \*UV/ light
  - \*Oxygen ingress,

Methods of corrosion protection:

- Galvanising/ plating
- Coatings
  - \*plastic
  - \*painting
  - \*Chrome
  - \*Anodising
  - \*Greasing/oil based compounds
- Corrosion inhibitors
- Sacrificial Anodes

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## Learning outcome

2 Understand properties of water, liquids and gases

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### Topics

- 2.1 Properties of Water
- 2.2 Properties of Liquids
- 2.3 Properties of Gases

#### Topic 2.1

Physical properties of 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

#### Topic 2.2

Properties of liquids:

- Water
- Refrigerant
- Anti-freeze/glycol mixes
- Fuel oils
- Lubricants/greases

#### Topic 2.3

Properties of gas:

- Air and steam
- LPG
- Natural gas
- Carbon dioxide
- Refrigerant gases

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## Learning outcome

3 Understand density, force, pressure, flowrate and basic mechanics

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### Topics

- 3.1 Types of SI units
- 3.2 Density of materials
- 3.3 Force pressure and flowrate
- 3.4 Mechanical principles

#### Topic 3.1

Units of measurement:

- Metre (length) m
- Kilogram (mass) kg
- Second (time) s
- Kelvin (temperature)
- Pascals
- Bar

Application and use of SI derived units:

- Area (m<sup>2</sup>)
- Volume (m<sup>3</sup>)
- Litres (L)
- Density (kg/m<sup>3</sup>)
- Velocity (m/s)

#### Topic 3.2

Density and relative density of the following:

- Solids
- Liquids
- Gases
- Formula/Calculations
- Common materials

#### Topic 3.3

Units of force and pressure:

- Acceleration (m/s<sup>2</sup>)
- Force due to gravity
- Force - Newton (N)
- Pressure (N/m<sup>2</sup>)
- Atmospheric pressure
- Flow rate (m<sup>3</sup>/s)

Pressure and flow units:

- Pressure

- Bar / millibar
- kPa
- Psi
- Metre head
- Flow rate
- m<sup>3</sup>/s
- l/s
- kg/s

Simple force and pressure calculations:

- Force calculations
- Pressure head
- Simple pressure calculations
- Static pressure

Relationship between velocity, pressure and flow rate:

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

Restrictions on the flow of liquid and gases:

- Changes of direction, bends and trees
- Pipe size
- Pipe reductions
- Roughness of material surface
- Constrictions such as valves

### **Topic 3.4**

Principles of basic mechanics:

- Theory of moments
- Action & reaction
- Centre of gravity
- Equilibrium
- Velocity and ratio
- Mechanical advantage

Principles of simple machines:

- Velocity ratio
- Levers
- Pulleys
- Archimedes Screws

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## Learning outcome

4 Understand heat and power in the plumbing and heating industry

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### Topics

- 4.1 Approaches to measuring temperature
- 4.2 States of matter and change
- 4.3 Types of heat transfer
- 4.4 Heat capacity and power

#### Topic 4.1

Temperature measurement:

- Celsius and Kelvin scales
- Units
- Devices

#### Topic 4.2

Changes of state:

- Melting
- Freezing
- Boiling
- Evaporating
- Condensing

Latent and sensible heat

#### Topic 4.3

Methods of heat transfer:

- Conduction
- Convection
- Radiation

#### Topic 4.4

Units of energy and heat:

- Joules
- KJ, KG, °C
- Watts

Relationship of energy and heat:

- Simple temperature calculations
- Quantity of heat energy required to raise the temperature of a substance
- The amount of power required to heat a substance
- Maximum density
- Specific heat capacity
- COLE

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## Learning outcome

5 Understand the principles of electricity within the plumbing and heating industry

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## Topics

5.1 Principles of electricity

5.2 Units and formula

5.3 Circuit protection and earthing

### Topic 5.1

Basic principles of electron flow theory:

- Measurement
- Conductivity and resistance
- Direct and alternating current

### Topic 5.2

Units of electrical measurement:

- Current
- Voltage
- Resistance
- Power

Basic electrical calculations:

- Ohms law
- Power consumption of electrical units
- Over-current protection device size
- Resistance in series and parallel circuits

### Topic 5.3

Electrical system protection components

- MCB
- RCD
- Cartridge fuse
- RCBO
- Rewirable fuse

Protective equipotential bonding

- Sizes
- Temporary continuity bonding

## **Guidance for delivery**

This unit is fundamental to the understanding of many concepts in plumbing. It can be delivered during the delivery of other units. However when delivered, the relevant concepts should be referenced by the tutor before applying the concepts to other units in plumbing systems to ensure good understanding. If delivered as a standalone unit it should be delivered near the beginning of the course to enable students to gain a deeper understanding of the science applications in plumbing whilst undertaking other more vocational based units.

It is highly recommended that the unit is delivered by referencing real situations in plumbing and explaining the links to the theory based element within this unit. For example discussing how a radiator emits heat or the energy needed to heat a cylinder.

The use of diverse methods of delivery is recommended to ensure all learners are engaged, the use of video clips, performing experiments in the classroom, using the workshop environment and possible use of the science specialist tutor could all add to the student experience. Some of the electrical principles can be supplemented by the use of multi-meters in the classroom or workshop environment as an interactive session. For example measuring resistance of certain plumbing components or wiring of a plug.

As this subject has application of theory around Maths, opportunities should be given to students to perform calculations at various levels to ensure understanding. This might need to be revisited to ensure students are able to perform the tasks. Self-study tasks or homework could support the learning in this unit.

## Unit 214 Cold Water

<b>Unit level:</b>	Level 2
<b>GLH:</b>	60

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### What is this unit about?

The purpose of this unit is for learners to develop the knowledge and understanding, together with the practical skills to install and maintain cold water systems and their components.

All properties need a supply of fresh, wholesome cold water as a basic requirement and as a domestic plumber you will be expected to pipe water from the main external stop valve to the point of use inside the property so the quality of water is not compromised and remains fit for human consumption.

The learner will familiarise themselves with basic requirements for piping domestic cold water systems, appliances and components with the primary objective of preserving water quality for the end user.

From a theory view point the learner will develop in depth knowledge regarding all aspects of domestic cold water systems. Development of practical skills will take the form of preparation, planning and positioning of various types of pipework to the installation, testing and commissioning of cold water systems and appliances. Natural progression for the learner from this point will be the ability to complete simple maintenance tasks in the form of planned preventative maintenance to unplanned emergency maintenance.

Learners should consider the following questions as a starting point to the unit:

Where does water come from?

How is water quality preserved?

Who is responsible for piping water to our properties?

What document offers guidance for cold water supplies?

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### Learning outcomes

In this unit, learners will be able to

- 1 Understand cold water supply to dwellings
- 2 Understand domestic cold water systems
- 3 Install cold water systems and components



## Scope of content

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### Learning outcome

- 1 Understand cold water supply to dwellings
- 

### Topics

- 1.1 Sources and properties of water
- 1.2 Types of supply into a property
- 1.3 Treatment and distribution of cold water

#### Topic 1.1

Sources and properties of water:

- Rainwater cycle
- Surface sources
- Underground sources

Fluid categories of water

- 1-5

Uses of cold water

- Wholesome water for domestic purposes - drinking, washing, food production.
- Recycled water/harvested water – WC flushing, water for outdoor use, clothes washing.

#### Topic 1.2

Types of water supply:

- Undertaker's main
- Private source
- Rainwater harvesting
- Recycled water

Requirement to provide wholesome water to prevent the following:

- Waste
- Undue consumption
- Misuse
- Contamination

#### Topic 1.3

Treatment methods of mains cold water:

- Sedimentation
- Filtration
- Sterilisation

Distribution methods of water supply :

- Gravity
- Pumped

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## Learning outcome

2 Understand domestic cold water systems

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## Topics

- 2.1 Sources of information relating to systems
- 2.2 Service pipework layout
- 2.3 Selecting cold water systems
- 2.4 Operating principles of backflow prevention devices

### Topic 2.1

Sources of information to be used when undertaking work on cold water systems:

- Statutory regulations
- Industry standards
- Manufacturer technical instructions

### Topic 2.2

Service layout of incoming supply:

- Connection methods to the main
- Communication pipe
- Service pipe
- Identification
- Materials used
- Stop valve location
- Main external stop valve and meter housing
- Depth of external service pipework
- Correct methods of entry of the service pipework to a property.

Suitable methods of connecting to supply pipework to internal installation:

- Medium density polyethylene (MDPE)
- Copper
- Lead

### Topic 2.3

Types and factors of selection of cold water systems and typical pipe sizes used:

- Direct system
- Indirect system

Advantages and disadvantages of cold water systems:

- Direct system
- Indirect system

Requirements for cold water storage cistern installation

- Typical cistern sizes for small dwellings
- Warning pipe (overflow) arrangements
- Inlet/ outlet position
- Position of float operated valve
- Position of cistern vent
- Position of open vent pipe connection
- Requirement for a rigid close fitting lid
- Service valve requirements
- Insect screens
- Insulation
- Support
- Drilling requirements
- Linking cold water storage cisterns
- Legionella control

#### **Topic 2.4**

Operating principles and uses for basic types of backflow prevention devices:

- Mechanical
- Non-mechanical

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## Learning outcome

3 Install cold water systems and components

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### Topics

- 3.1 Prepare for the installation of systems and components
- 3.2 Install and test systems and components
- 3.3 Replace defect components
- 3.4 Decommission systems and components

#### Topic 3.1

Carry out preparatory work required for installation:

- Drawings
- Positioning of components
- Marking out
- Materials list

Component layout and working principles of cold water system appliances and systems:

- Bath tap or shower mixer valve
- Wash hand basin
- Cylinder
- Combination boiler (JIG)
- Cold water storage cistern
- WC flushing cistern
- Stop valves
- Servicing valves
- Drain valves
- Float operated valves
- Pillar taps
- Bib taps
- Mixer taps
- Ceramic disc taps
- Outside taps
- Water softeners
- Water filters
- Water conditioners
- Water meters

Insulation requirements of system components:

- Frost protection
- Undue warming

Types of standard backflow prevention devices:

- Simple air gap arrangements (AUK2 and 3).
- Double and single check valves

Key contamination issues:

- Non-approved materials
- Backflow
- Back syphonage
- Cross connection

### **Topic 3.2**

Carry out installation pipework on cold water system appliances and components:

- Bath tap or shower mixer valve
- Wash hand basin
- Cylinder
- Combination boiler (JIG)
- Cold water storage cistern
- WC flushing cistern

Carry out tests prior to operation:

- Visual inspection
- Soundness test on metal and plastic pipework
- Pressure test
- Flow rate

### **Topic 3.3**

Types of information to be referred to when replacing components:

- Manufacturer's instructions
- Verbal instructions

Prepare work area:

- Tools and Materials
- Select suitable components
- Protective equipment

Carry out decommissioning, replacement and testing of components:

- Pump
- Tap
- F.O.V
- Valves

### **Topic 3.4**

Information to be provided before decommissioning to other users:

- Length of time appliances will not be available
- Alternative availability of welfare facilities.

Consider ways that can reduce periods when facilities are not available:

- Isolate sections at a time
- Isolate appropriate fuel supply
- Work outside operational times

Preventing the end user from using appliance or system:

- Temporary capping of pipework sections
- Use of warning notices and signs

Decommissioning process for the following:

- Permanent
- Temporary

## **Guidance for delivery**

This unit will begin by focusing on the origin, collection and treatment of water to the distribution and various usages of water within domestic properties. As always health and safety will be paramount but teaching should also highlight links with other units such as science and plumbing processes.

It is advised that knowledge from outcomes one and two should be delivered first in a classroom based environment using a variety of teaching methods. These may include but not be limited to group discussion, independent research/ projects, presentations, guest speakers from the cold water industry, interactive resources and a show and tell box. The learner will benefit from having a brief insight into theory aspects of cold water systems and component installation methods before undertaking practical activities.

For learning outcomes two, three and four it is expected that learners show an appreciation of sources of information with regard to practical installation i.e. British Standards, Building Regulations and manufacturer's instructions and water regulations (WRAS). Learners should focus on the effects of legislation and regulations and the outcomes these have on cold water system design, component placement and also the work methods used during the installation process.

Practical demonstrations in a controlled workshop environment will lead learners to investigate and develop the skills and methods required to install, commission, maintain and service cold water systems and components. Learners should be expected to investigate the processes of conception to completion of a working cold water system and appliances. Learners should also explore aspects of cold water system maintenance including planned preventative maintenance.

# Unit 215 Hot Water

<b>Unit level:</b>	Level 2
<b>GLH:</b>	60

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## What is this unit about?

Hot Water is an essential daily requirement with many uses from personal hygiene to washing clothes. Hot water is a prominent resource used to combat germs and bacteria, but it can also lead to unsafe situations if the temperature is not carefully controlled.

The purpose of this unit is to introduce the learner to the various sources of information which govern basic design and installation aspects of hot water systems. The learner will also be introduced to the diverse methods of supplying hot water within domestic properties. This will include numerous appliances used to generate hot water safely, so that the temperature can be controlled and delivered to the point of use at safe, usable limits.

The learner will explore key requirements of testing and decommissioning domestic hot water systems and this will lead to common hot water related faults that can develop and investigate ways of maintaining systems for optimum performance. Not only will the successful learner develop a sound understanding of the theory behind hot water systems but they will also develop an extensive practical skill set that will benefit them as they enter a work based environment.

Learners should consider the following questions as a starting point to the unit:

What is a safe hot water temperature?

What factors should be considered when selecting hot water systems?

What do the terms direct and indirect mean?

Why is maintenance such an important factor?

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## Learning outcomes

In this unit, learners will be able to

- 1 Understand hot water systems and their layouts
- 2 Install hot water systems and components



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## Learning outcome

1 Understand hot water systems and their layouts

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### Topics

- 1.1 Sources of information relating to work on hot water systems
- 1.2 Hot water systems and components
- 1.3 System safety and efficiency

#### Topic 1.1

Sources of information to be used when undertaking work on hot water systems:

- Statutory regulations
- Industry standards
- Manufacturer technical instructions

#### Topic 1.2

Basic factors that need to be considered when selecting hot water systems:

- Occupancy
- Type and size of building
- Available services
- Typical sizes

Types, layout and working principles of the following hot water systems and components:

Direct system

- direct cylinder (small hot water only boiler)
- Immersion heater, direct cylinder

Indirect system

- Single feed
- Double feed
- Combination
- Boiler, indirect cylinder
- Thermal store

Instantaneous hot water heaters

- Single point heaters
- Multipoint heaters
- Combination boilers

Showers

- Gravity mixer
- Mains fed/boosted mixer
- Electric instantaneous

#### Backflow prevention devices

- Simple air gaps
- Check valves

#### Working principles of components:

- Stop valves
- Fullway gate valves
- Servicing valves
- Drain valves
- Float operated valves
- Secondary pump
- Thermostatic mixing valves
- Terminal fittings
- Bib taps
- Pillar taps
- Mixer taps
- Ceramic disc taps
- Pillar taps
- Mixer taps
- Ceramic disc taps

### **Topic 1.3**

#### Types of temperature controls

- Thermostats
- Overheat thermostats
- Temperature relief valves
- Thermostatic mixing valve (Part G)

#### Outlet temperatures of appliances:

- Bath
- Shower
- Wash hand basin
- Thermostatic mixing valves (TMV)

#### Insulation requirements:

- Pipework
- Cylinder
- System
- Cisterns

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## Learning outcome

2 Install hot water systems and components

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### Topics

- 2.1 Prepare for the installation of systems and components
- 2.2 Decommission systems and components
- 2.3 Install and test systems and components
- 2.4 Replace defect components

#### Topic 2.1

Carry out preparatory work required for installations

- Drawings
- Positioning of components
- Marking out
- Materials list

#### Topic 2.2

Information to be provided before decommissioning to other users:

- Length of time appliances will not be available
- Alternative availability of welfare facilities.

Methods that reduce periods when facilities are not available:

- Isolate sections at a time
- Isolate appropriate fuel supply
- Work outside operational times

Methods to prevent end user from using appliance or system:

- Temporary capping of pipework sections
- Use of warning notices and signs

#### Topic 2.3

Carry out installation pipework on hot water system and appliances:

- Bath
- Wash hand basin
- Cylinder
- Combination boiler (JIG)
- Cistern
- Taps
- Showers

Carry out tests prior to operation:

- Visual inspection
- Soundness test on metal and plastic pipework
- Pressure test

- Flow rate

## **Topic 2.4**

Types of information to be referred to when replacing components:

- Manufacturer's instructions
- Verbal instructions

Prepare work area:

- Tools and Materials
- Select suitable components
- Protective equipment

Carry out decommission, replacement and testing of components

- Pump
- Tap
- F.O.V
- Valves

## **Guidance for delivery**

It is advised that learners have a basic understanding of Common Plumbing Processes, Scientific Principles and Cold Water systems as a prerequisite to studying this unit. This is due to the relation of knowledge and understanding of those units being applied throughout this hot water unit.

Health and Safety will be continually monitored throughout the unit in practical scenarios. Successful achievement of this unit will benefit the learner as they progress onto other units within the qualification, specifically Central Heating.

Learning outcome one should be delivered in a classroom based environment using a range of delivery techniques, such as group discussion, independent research projects and presentations. Guest speakers from manufacturers within the hot water sector may be invited in to encourage discussions and demonstrate their products. Learners should be introduced to sources of information that may be used when working on hot water systems and also basic factors to be considered when selecting hot water systems.

An awareness of design principles will benefit the learner but they will not be applying this understanding practically too any complex design principles. Learners will benefit from an insight into various system types and numerous ranged components used and positioning within the systems.

The learner will apply knowledge and understanding from outcome one and put this into practical context in learning outcome two. It is to be expected that learners will benefit from practical demonstrations in a workshop environment and develop the practical skill required to install, commission and maintain all installation pipework, components and appliances.

# Unit 216 Central Heating

<b>Unit level:</b>	Level 2
<b>GLH:</b>	60

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## What is this unit about?

The purpose of this unit is for learners to develop the knowledge and understanding, together with the practical skills needed to install, maintain, decommissioning and soundness test a basic range of wet central heating systems and their components in dwellings.

The learner will be introduced to legislation covering central heating systems and develop practical skills needed to correctly position components. Learners will install the necessary pipework and be able to understand the consequences of incorrect installation.

Learners should consider the following questions as a starting point to this unit:

What legislation covers central heating systems?

Why are central heating systems installed?

What are the benefits to the user?

Do all central heating systems use the same components?

How do we ensure the systems are running correctly?

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## Learning outcomes

In this unit, learners will be able to

- 1 Understand Central Heating Systems and their layout.
- 2 Install central heating systems and components
- 3 Understand the decommissioning requirements of central heating systems and their components

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## Learning outcome

- 1 Understand Central Heating Systems and their layout.
- 

### Topics

- 1.1 Sources of information
- 1.2 Operating principles of systems and components
- 1.3 System layouts
- 1.4 Filling and venting systems
- 1.5 Selection of fuels for heat producing appliances

#### Topic 1.1

Potential sources of information required when planning and undertaking work:

- Statutory regulations
- Industry standards
- Manufacturer technical instructions

#### Topic 1.2

Operating principles and layout of central heating systems and components:

- Types of system.
  - \*Water central heating
  - \*Warm air
  - \*Storage heaters
- Common heat emitters
  - \*Panel radiators
  - \*Column radiators
  - \*Low surface temperature radiators
  - \*Fan convectors
  - \*Plinth heaters
  - \*Towel warmers
- Heating components
  - \*Radiator valves – thermostatic and manual valves
  - \*Automatic air vents
  - \*Expansion vessel
  - \*Filling loop
  - \*Pressure gauge
  - \*Motorised valves – two port and three port mid position and diverter
  - \*Feed and expansion cisterns
  - \*Circulating pumps
  - \*Automatic bypass valves
  - \*Thermo-mechanical cylinder control valves
  - \*Anti-gravity valves
  - \*Drain valves

- \*Additives
- \*Low loss headers
- \*Buffers
- \*Pressure relief valves
- \*Expansion joints
- \*Corrosion filters

- Traditional, system and combination boilers:
  - \*Condensing
  - \*Combination
  - \*Freestanding
  - \*Wall mounted
  - \*Open flued
  - \*Room sealed (natural/fan assisted)

### Topic 1.3

Types of system layout and location of components:

- Pumped heating gravity hot water
- Fully pumped, 2 x two port valves (S plan)
- Fully pumped, 3 x two port valves (S plan+)
- Fully pumped, 3 port valve (mid position/diverting) (Y plan)
- One pipe
- Two pipe
- Manifold (micro and minibore)
- Underfloor

### Topic 1.4

Features to allow for appropriate filling and venting of systems:

- Open vented systems
  - \*Feed and expansion cistern position
  - \*Pump position
  - \*Cold feed and open vent pipe connection
  - \*Methods of releasing air from the system
- Sealed systems
  - \*Expansion vessel position
  - \*Pressure gauge, pressure relief valve and filling \*loop position
  - \*Pump position
  - \*Methods of releasing air from the system

### Topic 1.5

Types of fuels used for heat producing appliances:

- Oil
- Gas



- Solid Fuel

---

## Learning outcome

2 Install central heating systems and components

---

### Topics

- 2.1 Positioning and fixing requirements of pipework
- 2.2 Effects of expansion and contraction
- 2.3 Connecting to existing systems
- 2.4 Soundness test requirements for pipework
- 2.5 Install and test components
- 2.6 Replace defect components

#### Topic 2.1

Pipework installation requirements for various areas within the building fabric:

- In suspended timber floors
- In solid floors
- Embedded in walls
- In areas of the building subject to frost

#### Topic 2.2

How expansion and contraction is catered for within central heating components.

- Pipework expansion
- Expansion in open vented systems (cistern)
- Expansion in sealed systems (expansion vessel)

#### Topic 2.3

Types of connecting pipework and how they connect into existing systems and location of connection:

- One pipe
- Two pipe
- Manifold (micro and minibore)
- Underfloor

#### Topic 2.4

Soundness test procedure to follow for installation work:

- Visual inspection
- Notify
- Initial flush and fill
- Stabilisation
- Test to required pressure
- Check for leaks
- Check pressures after test period

- Complete documentation and notify as required

Types of pipework and test procedures to be covered:

- Metal
- Plastic

## **Topic 2.5**

Types of information to be referred to for installation work:

- Manufacturer instructions
- Specification drawings
- Verbal instructions

Prepare work area:

- Select tools and materials
- Prepare work area
- Identify and follow procedure in regards to safety requirements
- Notify relevant person
- Plan installation

Install a range of central heating components including all necessary pipework components and fixings for the following:

- Radiators
- Radiator valves
- Pump
- Combination boiler jig

Carry out tests to confirm connections:

- Visual inspection
- Soundness test

## **Topic 2.6**

Types of information to be referred to when replacing components:

- Manufacturer's instructions
- Verbal instructions

Preparation of work area:

- Select tools and materials
- Prepare work area
- Identify and follow procedure in regards to safety requirements
- Notify relevant person
- Plan installation

Carry out decommission, replacement and testing of different components

- Radiator
- Radiator valve
- Pump

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## Learning outcome

- 3 Understand the decommissioning requirements of central heating systems and their components
- 

## Topics

- 3.1 Decommissioning systems  
3.2 Preparing for decommissioning  
3.3 Decommissioning central heating systems

### Topic 3.1

Types of decommissioning methods

- Permanent
- Temporary

### Topic 3.2

Methods to prepare for decommissioning systems:

- Notify building users
- Make alternative sources of heat available
- Warning notices

### Topic 3.3

Procedures to follow when decommissioning systems:

- Isolation of services
- Warning notices and signs
- Temporary continuity bonding
- Drainage and disposal of systems contents and components
- Capping of pipework

## Guidance for delivery

It is important that the learners have a full understanding of the underpinning knowledge of each of the topics in the central heating unit. The subject content will be delivered in a classroom and workshop environments and it is important that learners have the opportunity to relate this knowledge and understanding to other units, which may have been studied when candidates are in actual workshop situations carrying out practical tasks.

This unit should be studied in conjunction with the other units from this qualification so that the learner does not see the technology in isolation to the other aspects studied. This is particularly relevant with the Science and Plumbing processes units. Integrated and applied study will enable a greater understanding of the science principles involved, the application of the technology outlined in this unit and improve learning.

Outcome one will require an understanding of the different types of technical information available when undertaking installation work. It is important that at this stage the learners will be able to identify the various components used in Central Heating systems and their position within the system. The subject of fuels used in Central Heating systems should consider the advantages and disadvantages of them and topics such as cost and storage should be a part of the discussion. The use of layout drawings is required.

Outcome two will require the learner to link study from the Plumbing processes and Electrical and Scientific Principles units in order to understand the implications of central heating installations and its working principles. It is important that learners apply the practical skills in the workshop and therefore must have access to a wide range of hand and power tools commonly used by the plumber. The subject of corrosion in systems and accommodation of expansion and contraction are specific areas which will require consideration. This area of study will be supported by practical activities designed to give the learners the hand skills required to carry out installation, inspection, testing and component replacement.

Outcome three highlights the need for understanding of the correct decommissioning of Central Heating systems, the safe disposal of waste materials and how to leave the system in a safe manner which will prevent it being accidentally re-charged or switched on.

Tutors are encouraged to utilise a wide range of techniques for delivery such as demonstration, videos/visual support, manufacturer's instructions and catalogues as well as textbooks and guides.

Work experience or employer visits from the building services industry will underpin and support candidates study within a training environment.

The examples used to demonstrate the range of technology should reflect current developments in the sector as well as the breadth of enterprises and businesses found within the industry. In particular the tutors should use local resources through visits to ensure that the range of technology is covered.

The use of the internet along with specialist central heating component websites should be an integrated learning tool along with the use of specifically designed E Learning packages from various sources.

# Unit 217 Sanitation and Drainage

<b>Unit level:</b>	Level 2
<b>GLH:</b>	60

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## What is this unit about?

The purpose of this unit is for learners to develop the knowledge and understanding, together with the practical skills to install and maintain gravity rainwater systems and sanitation appliances. Open sewers are a breeding ground for diseases that can cause serious illness and even death. Our drainage systems have developed to the extent that illness and death are rare occurrences. This unit will help develop the skills required to safely remove effluent and surface water from properties in accordance with this trend.

Learners will be introduced to variety of legislation, rainwater and drainage systems, appliances and procedures. Learners can apply this knowledge to reduce risk and prevent hazardous situations occurring during installation, commissioning and maintenance activities.

Learners should consider the following questions as a starting point to this unit:

What laws affect rainwater and drainage systems?

Why are correctly installed drainage systems important?

Why is trap seal loss such an issue?

Why are commissioning and maintenance such important activities?

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## Learning outcomes

In this unit, learners will be able to

- 1 Understand layouts of gravity rainwater systems
- 2 Install gravity rainwater systems
- 3 Understand service, maintenance requirements and commissioning of gravity rainwater systems
- 4 Understand sanitary appliances used in dwellings
- 5 Install sanitary appliances and connecting pipework systems
- 6 Understand service and maintenance requirements for sanitary appliances and connecting pipework systems

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## Learning outcome

- 1 Understand layouts of gravity rainwater systems
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## Topics

- 1.1 Systems and materials used in gravity rainwater systems
- 1.2 Gutter systems and components
- 1.3 Rainwater pipework and components
- 1.4 Jointing procedures for gutter and rainwater materials
- 1.5 Gutter bracket selection and fixing

### Topic 1.1

Purpose and principles of gravity rainwater systems:

- Collection of rainwater
- Delivery to a safe outlet
- Water ingress

Types of materials:

- PVCu
- Extruded Aluminium
- Cast Iron
- Copper

### Topic 1.2

Types of guttering systems:

- Half round
- Square
- Ogee
- High capacity

Types of guttering components:

- Running outlets
- Gutter angles
- Gutter unions
- Stop ends
- Specialist unions between different gutter materials

Factors that determine the type and size of guttering system:

- Rainfall intensity
- Roof area
- Running outlet position
- Gutter fall
- Changes of direction in the gutter run
- Customer preference

### Topic 1.3

Types of rainwater pipework:

- Round section
- Square section

Purpose of rainwater pipework components:

- Offsets
- Angles
- Branches
- Hopper heads
- Shoes
- Specialist connectors to the drainage system

### Topic 1.4

Joining procedures for gutter and rainwater materials:

- PVCu
- Extruded Aluminium
- Cast Iron
- Copper

### Topic 1.5

Factors affecting gutter bracket selection and fixings for buildings:

- Fascia boards
- Exposed rafters
- No fascia board or exposed rafters
- Gutter and rainwater material selection

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## Learning outcome

2 Install gravity rainwater systems

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## Topics

- 2.1 Sources of information for gravity rainwater systems
- 2.2 Preparation of the building fabric
- 2.3 Positioning and fixing of gutter system components
- 2.4 Pipework connections
- 2.5 Install and join PVC- u rainwater system components
- 2.6 Test rainwater systems

### Topic 2.1

Information to be followed when carrying out work:

- Statutory regulations

- Industry standards
- Manufacturer technical instructions
- Design considerations

### **Topic 2.2**

Preparatory work to be carried out on building fabric:

- Building wall surfaces
- Existing gravity rainwater system components
- Incomplete building works

### **Topic 2.3**

Positioning, fixing and expansion requirements of components:

- Gutter brackets – fascia, rafter and drive-in types
- Running outlets
- Gutter angles
- Gutter unions
- Stop ends
- Specialist unions between different gutter materials

### **Topic 2.4**

Pipework connections:

- Discharge to gully using a shoe
- Direct connection to drainage bend
- Direct connection to gulley
- Direct connection to a soak-away

### **Topic 2.5**

Install and joint PVCu rainwater system components:

- Running outlet
- Gutter angle
- Gutter union
- Stop ends
- Down pipe
- Brackets

### **Topic 2.6**

Carry out tests on gravity rainwater systems:

- Suitable operation
- Leakage

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## **Learning outcome**

- 3 Understand service, maintenance requirements and commissioning of gravity rainwater systems



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## Topics

- 3.1 Maintenance checks
- 3.2 Defects in systems
- 3.3 Pre-commissioning checks

### Topic 3.1

Visual inspection as part of routine checks

- Adequate support
- Leakage and damage
- Obstructions

### Topic 3.2

Correcting defects using appropriate equipment and PPE

- Leaks
- Blockages including contaminated waste
- Inadequate or broken support

### Topic 3.3

Types of checks to be carried out before commissioning:

- Check against installation requirements
- Bracketing and support
- Jointing
- Remedial work if required

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## Learning outcome

- 4 Understand sanitary appliances used in dwellings

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## Topics

- 4.1 Working principles of sanitary appliances
- 4.2 Features of sanitary pipework and layout
- 4.3 Ground floor systems and appliances
- 4.4 Types of traps and seal loss
- 4.5 Suitability of drainage systems
- 4.6 Condensate drain connections

### Topic 4.1

Types and working principles of appliances including:

- Conventional WCs (not macerators)
- Baths
- Bidets
- Wash hand basins

- Showers/cubicles
- Sinks (not waste disposal units)
- Urinals

Positioning and fixing of appliances:

- Conventional WCs (not macerators)
- Baths
- Bidets
- Wash hand basins
- Showers/cubicles
- Sinks (not waste disposal units)
- Urinals

## **Topic 4.2**

Types of sanitary pipework systems:

- Primary ventilated stack system
- Secondary ventilated stack system
- Ventilating branch discharge system

Layout features of discharge stacks:

- Soil stack sizes based on WC outlet size
- Waste stack sizes serving waste appliances only
- Use and types of bends
- Proximity of low level connections
- Layout features of branch discharge pipework:
- Unventilated and ventilated branch discharge pipework
- Maximum pipework lengths and gradients
- Sizes of branch discharge pipework for soil and waste appliances
- Ventilating branch discharge pipework
- Connecting multiple waste appliances to branch discharge pipework
- Connecting branch discharge pipework into the main stack

Layout features of stack ventilation:

- Proximity of vent outlet to openable windows
- Use of air admittance valves

## **Topic 4.3**

Layout features and connections for ground floor systems and appliances:

- Stub stack systems
- Waste appliance connections to gullies
- Waste appliance connections direct to drain
- WC connection direct to drain

## **Topic 4.4**

Types and uses of traps:

- P-trap
- S-trap
- Bottle trap
- Specialist traps

Factors that lead to trap seal loss that include:

- Incorrect installation
- Wavering out
- Induced siphonage
- Compression
- Self siphonage
- Capillarity
- Momentum
- Evaporation
- Leakage

#### **Topic 4.5**

Suitability of drainage systems to receive foul soil and waste water:

- Combined drainage systems
- Separate drainage systems
- Partially separate drainage systems

#### **Topic 4.6**

Suitable termination of condensate drain connections:

- Connections to trap
- Connections to drain
- Pipe sizes and insulation
- Gradient

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## Learning outcome

5 Install sanitary appliances and connecting pipework systems

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### Topics

- 5.1 Sources of information
- 5.2 Installation requirements of appliances and systems
- 5.3 Decommissioning process of appliances and systems
- 5.4 Install and test systems and appliances

#### Topic 5.1

Information to be referred to when carrying out work:

- Statutory regulations
- Industry standards
- Manufacturer technical instructions
- Design requirements
- Storage and protection of appliances

#### Topic 5.2

Preparatory work required for installation:

- Assembly of sanitary appliances
- Preparation of the building fabric

#### Topic 5.3

Information to be provided before decommissioning to other users:

- Length of time appliances will not be available
- Alternative availability of welfare facilities.

Methods that reduce periods when facilities are not available:

- Isolate sections at a time
- Work outside operational times

Methods to prevent end user from using appliance or system:

- Temporary capping of pipework sections
- Use of warning notices and signs

Decommissioning processes for the following:

- Permanent
- Temporary

## Topic 5.4

Carry out installation of primary ventilated stack systems and appliances:

- WC
- Bath
- Wash hand basin

Carry out tests prior to operation:

- Visual inspection
- Air test

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## Learning outcome

- 6 Understand service and maintenance requirements for sanitary appliances and connecting pipework systems

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## Topics

- 6.1 Maintenance checks  
6.2 Defects in systems  
6.3 Pre commissioning checks

## Topic 6.1

Visual inspection as part of routine checks

- Adequate support
- Leakage and damage
- Obstructions

## Topic 6.2

Correcting defects using appropriate equipment and PPE:

- Leaks
- Blockages including contaminated waste
- Inadequate or broken support

## Topic 6.3

Checks to be carried out before commissioning:

- Check against installation requirements
- Bracketing and support
- Jointing
- Remedial work if required

## **Guidance for delivery**

Learning outcome one and four should give learners the opportunity to develop a raised awareness of a variety of rainwater and drainage system types, correct component identification and positioning within the installation. The learner will also develop the ability to correctly identify and position a variety of sanitation appliances. Learners should have to opportunity to explore the outcomes of poor installation choices and techniques.

For learning outcomes two, three, five and six it is expected that learners show an appreciation of sources of information with regard to practical installation. Learners should focus on the effects of legislation and regulations and the outcomes these have on drainage system design, component placement and also the work methods used during the installation process.

Practical demonstrations in a controlled workshop environment will lead learners to investigate and develop the skills and methods required to install, commission, maintain and service drainage systems and appliances. Learners should be expected to investigate the processes required to develop a system from an installation to a working drainage system. Learners should explore trap seal loss and its prevention and the diverse nature of planned preventative maintenance.

## Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on [www.cityandguilds.com](http://www.cityandguilds.com).

### **City & Guilds Centre Manual**

This document provides guidance for organisations wishing to become City & Guilds approved centres, as well as information for approved centres delivering City & Guilds qualifications. It covers the centre and qualification approval process as well as providing guidance on delivery, assessment and quality assurance for approved centres.

It also details the City & Guilds requirements for ongoing centre and qualification approval, and provides examples of best practice for centres. Specifically, the document includes sections on:

- the centre and qualification approval process
- assessment, internal quality assurance and examination roles at the centre
- registration and certification of candidates
- non-compliance and malpractice
- complaints and appeals
- equal opportunities
- data protection
- management systems
- maintaining records
- internal quality assurance
- external quality assurance.

### **Our Quality Assurance Requirements**

This document explains the requirements for the delivery, assessment and awarding of our qualifications. All centres working with City & Guilds must adopt and implement these requirements across all of their qualification provision. Specifically, this document:

- specifies the quality assurance and control requirements that apply to all centres
- sets out the basis for securing high standards, for all our qualifications and/or assessments
- details the impact on centres of non-compliance

Our Quality Assurance Requirements document encompasses the relevant regulatory requirements of the following documents, which apply to centres working with City & Guilds:

- Ofqual's General Conditions of Recognition

The **centre homepage** section of the City & Guilds website also contains useful information on

- **Walled Garden**: how to register and certificate candidates on line
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

## Useful contacts



### UK learners

General qualification information

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**E: [learnersupport@cityandguilds.com](mailto:learnersupport@cityandguilds.com)**

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### International learners

General qualification information

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**E: [intcg@cityandguilds.com](mailto:intcg@cityandguilds.com)**

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### Centres

Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results

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**E: [centresupport@cityandguilds.com](mailto:centresupport@cityandguilds.com)**

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### Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

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**E: [singlesubjects@cityandguilds.com](mailto:singlesubjects@cityandguilds.com)**

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### International awards

Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports

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**E: [intops@cityandguilds.com](mailto:intops@cityandguilds.com)**

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### Walled Garden

Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems

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**E: [walledgarden@cityandguilds.com](mailto:walledgarden@cityandguilds.com)**

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### Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

T: +44 (0)121 503 8993

**E: [business@cityandguilds.com](mailto:business@cityandguilds.com)**

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## City & Guilds Group

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Licence to Practice (land-based qualifications) and Learning Assistant (an online e-portfolio).

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