



Level 3 Heating and Ventilating Craftsperson Qualification (Industrial and Commercial) (6288-31)

(Version 1 October 2017)

Qualification Handbook

Qualification at a glance

Subject area	Heating and Ventilation
City & Guilds number	6288
Age group approved	16-19, 19+
Entry requirements	None
Assessment types	Multiple Choice; Assignment; Practical; Portfolio
Approvals	Automatic approval please refer to section 2 for more details.
Support materials	Assessment pack; Assignment/Assessment guide for candidates; Qualification handbook
Apprenticeship	On-programme qualification for the Building Services Engineering Craftsperson Standard
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 3 Heating and Ventilating Craftsperson Qualification (Industrial and Commercial)	538	900	6288-31	603/2488/0

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1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	Level 3 Heating and Ventilating Craftsperson Qualification (Industrial and Commercial) is for learners who want to work within new build construction sites and existing buildings on their own, proficiently and without supervision, in the most efficient and economical manner. They must adhere to safe working practices without endangering themselves or others.
What does the qualification cover?	This qualification covers the installation, testing, pre-commissioning, commissioning and decommissioning of large-scale engineering systems which are used for heating workplaces such as those found in industrial and commercial buildings like office blocks, factories, schools and hospitals. These engineering systems operate by moving temperature controlled water around the inside of buildings, providing heating and cooling, and utilise fossil fuels and sustainable energy systems. The qualification covers the detailed knowledge of the system's operating principles. In addition, it also covers the following: <ul style="list-style-type: none">• set, identify and establish the requirements of the job, whether from drawings or client's other instructions;• liaise and work with other trades, suppliers and clients, as appropriate;• solve problems within the scope of the work they carry out;• undertake work to comply with all relevant standards;• plan and monitor work programmes for installing, testing, pre-commissioning, commissioning and decommissioning systems;• contribute to adjusting the configuration of systems as they are installed.
What opportunities for progression are there?	Successful completion of the qualification will help you progress into a range of roles, including a Senior heating and ventilating engineer or a Heating and ventilation project leader or manager.
Who did we develop the qualification with?	This qualification has been developed in partnership with the trailblazer group responsible for the development of the Building services engineering Craftsperson apprenticeship standard.
Is it part of an apprenticeship framework or initiative?	This qualification is named on the Building Services Engineering Craftsperson Standard to support the delivery of the on-programme element of the apprenticeship.

Structure

Learners must successfully achieve the following assessments related to the below mandatory units to achieve this qualification.

Learners can also achieve 2 elective units (309, 310), however these will not contribute to the achievement of this qualification.

City & Guilds unit number	Unit title	GLH
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Mandatory

201	Understand health and safety requirements within the building services engineering industry	60
202	Understand how scientific principles are applied in heating and ventilation systems.	60
209	Installation of Industrial and Commercial Heating and Ventilation Systems within the workplace	96
301	Understand industrial and commercial complex hot water heating and chilled water systems	50
302	Water Supply (Water Fittings) Regulations and Water Byelaws in the UK	8
303	The installation, commissioning and safety aspects of hot water systems for domestic use in accordance with UK building regulations	10
304	Understand industrial and commercial complex hot water and cold water systems	80
305	Understand how to organise resources within building services engineering	24
306	Installation of complex industrial and commercial heating and ventilation systems in the workplace	40
307	Understand industrial and commercial fuel system regulations and installation requirements	70
308	Understand how to joint pipe work using Manual Metal Arc (MMA) and Tungsten Inert Gas (TIG) welding processes	40

Elective

309	Weld pipework using Tungsten Inert Gas (TIG) welding methods	200
310	Weld pipework using Manual Metal Arc (MMA) welding methods	200

When candidates achieve;

- unit 302 (assessment 302 or 311) they will be awarded the 3345-20 City & Guilds Level 3 Award in Water Supply (Water Fittings) Regulations and Water Byelaws in the UK
- unit 303 (assessment 303 or 312 plus 313) they will be awarded 3345-30 City & Guilds Level 3 Award in the Installation, Commissioning and Safety Aspects of Hot Water Systems for Domestic Use in Accordance With UK Building Regulations
- unit 307 (assessments 307 and 314) candidates will have met the requirements of ACS ICPN1 Limited Scope assessment and will be able to apply for Gas Safe registration.

Total Qualification Time

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.

TQT is comprised of the following two elements:

- 1) The number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and
- 2) an estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the Immediate Guidance or Supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training.

Title and level	GLH	TQT
Level 3 Heating and Ventilating Craftsperson Qualification (Industrial and Commercial)	538	900

2 Centre requirements

Approval

If your Centre is approved to offer the qualification Level 3 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation (6188-30) then you will be granted approval for the new Level 3 Heating and Ventilation Installer (Industrial and Commercial) automatically.

To offer these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the Centre Manual - Supporting Customer Excellence for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Resource requirements

Resources

It is acceptable for centres to use specially designated areas within a centre to teach practical skills and to assess the simulated practical assignments within the knowledge units. The equipment, systems and machinery must meet current industrial standards and be capable of being used under normal working conditions, and must fully meet the requirements set in each City & Guilds practical assessment pack.

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors **must**:

- be working towards or have achieved a relevant recognised assessor qualification such as a Level 3 Certificate in Assessing Vocational Achievement and continue to practice to that standard, or
- hold earlier qualifications (D32 or D33 or A1 or TQFE/TQSE) with CPD evidence to the most current standards.
- be occupationally competent; recognised within the industry as a heating and ventilating craftsperson holding a NVQ at level 3 or the SVQ equivalent, Gold Engineering Services SKILLcard or equivalents

Learner entry requirements

City & Guilds does not set entry requirements for these qualifications. However, centres must ensure that candidates have the potential and opportunity to gain the qualifications successfully.

Age restrictions

City & Guilds cannot accept any registrations for learners under 16 as these qualifications are not approved for learners under 16.

3 Delivering the qualification

Initial assessment and induction

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

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications
- the appropriate type and level of qualification.

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

Support materials

The following resources are available for these qualifications:

Description	How to access
Assessment pack	www.cityandguilds.com
Assignment/Assessment guide for candidates	www.cityandguilds.com

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems, including our own, Learning Assistant, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. Further details are available at: www.cityandguilds.com/eportfolios.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. Recording forms are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4 Assessment

Summary of assessment methods

Candidates must successfully complete

- onscreen e-volve tests for units 201, 202 and 208
- assignments for the units 301, 304, 305
- portfolios of evidence for units 209 and 306

Candidates must successfully achieve

- unit 302 by either an onscreen e-volve tests (302) or assignment (311)
- unit 303 by either an onscreen e-volve tests (303) or assignment (312) plus an assignment (313)
- unit 307 by achieving an onscreen e-volve tests (302) and assignment (314)

Candidates may chose to:

Complete assignments for the optional units 309 and 310.

Available assessments/assignments

City & Guilds has written the following assessments to use with this qualification:

- assignments
- onscreen multiple choice e-volve assessments
- logbooks to support the generation of a portfolio of evidence

City & Guilds have worked with Blue Flame Associates to produce a practical assessment for the unit 307/314 that meets the requirements of ACS ICPN1 Limited Scope allowing candidates to meet the requirements of the Gas Safe Register.

City & Guilds has written guidance for centres to write their own assessments/assignments.

Assessment Types

Unit	Title	Assessment method	Where to obtain assessment materials
201	Understand health and safety requirements within the building services engineering industry	On-screen multiple choice examination	<p>This assessment will be sat through the City & Guilds assessment platform e-volve.</p> <p>e-volve examinations can be scheduled and accessed through the Walled Garden.</p>
202	Understand how scientific principles are applied in heating and ventilation systems.	On-screen multiple choice examination	<p>This assessment will be sat through the City & Guilds assessment platform e-volve.</p> <p>e-volve examinations can be scheduled and accessed through the Walled Garden.</p>
209	Installation of Industrial and Commercial Heating and Ventilation Systems within the workplace	Portfolio of evidence	<p>City & Guilds have created a logbook to support centres and candidates in the production of a portfolio of evidence.</p> <p>This is available on the 6288 webpage of www.cityandguilds.com</p>
301	Understand industrial and commercial complex hot water heating and chilled water systems	Assignment	<p>A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com</p>
302/311	Water Supply (Water Fittings) Regulations and Water Byelaws in the UK	On-screen multiple choice examination/assignment	<p>This assessment can be sat through the City & Guilds assessment platform e-volve.</p> <p>e-volve examinations can be scheduled and accessed through the Walled Garden.</p> <p>Or alternatively candidates can complete an assignment A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com</p>

Unit	Title	Assessment method	Where to obtain assessment materials
303/312	The installation, commissioning and safety aspects of hot water systems for domestic use in accordance with UK building regulations	On-screen multiple choice examination/assignment	This assessment can be sat through the City & Guilds assessment platform e-volve. e-volve examinations can be scheduled and accessed through the Walled Garden. Or alternatively candidates can complete an assignment A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com
313	Hot water systems assignment	Practical assignment	A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com
304	Understand industrial and commercial complex hot water and cold water systems	Assignment	A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com
305	Understand how to organise resources within building services engineering	Assignment	A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com
306	Installation of complex industrial and commercial heating and ventilation systems in the workplace	Portfolio of evidence	City & Guilds have created a logbook to support centres and candidates in the production of a portfolio of evidence. This is available on the 6288 webpage of www.cityandguilds.com
307	Understand industrial and commercial fuel system regulations and installation requirements	On-screen multiple choice examination	This assessment will be sat through the City & Guilds assessment platform e-volve. e-volve examinations can be scheduled and accessed through the Walled Garden.
314	ACS ICPN1 limited scope assessment	Practical assignment	An assessment pack can be found on the 6288 webpage of www.cityandguilds.com

Unit	Title	Assessment method	Where to obtain assessment materials
308	Understand how to joint pipe work using Manual Metal Arc (MMA) and Tungsten Inert Gas (TIG) welding processes	On-screen multiple choice examination	This assessment will be sat through the City & Guilds assessment platform e-volve. e-volve examinations can be scheduled and accessed through the Walled Garden.

Elective Units			
309	Weld pipework using Tungsten Inert Gas (TIG) welding methods	Practical assignment	A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com
310	Weld pipework using Manual Metal Arc (MMA) welding methods	Practical assignment	A 6288-31 assessment pack can be found on the 6288 webpage of www.cityandguilds.com

Test Specifications

The way the knowledge is covered by each test is laid out in the table(s) below:

6288-201 Understand health and safety requirements within the building services engineering industry

Duration: 60 minutes			
Unit	Outcome	Number of questions	%
201	1 Understand current health and safety legislation relevant to Building Services Engineering activities	5	13
	2 Understand health and safety documentation used in the workplace	5	13
	3 Know the safe measures to ensure personal protection when working on site	4	10
	4 Understand how to respond to incidents within the workplace	3	8
	5 Know the how to work safely when using power tools	5	13
	6 Know how to work safely at height	5	13
	7 Understand how to work safely with flammable gasses and heat producing equipment	3	8
	8 Understand how to work safely with electricity during building services engineering operations	3	8
	9 Understand how to work safely in excavations and confined spaces	2	5
	10 Understand how to work safely with substances commonly used within the building services engineering industry	3	8
	11 Know how to work safely when carrying out manual handling activities	2	5
	Total	40	100

6288-202 Understand how scientific principles are applied in heating and ventilation systems.

Duration: 60 minutes			
Unit	Outcome	Number of questions	%
202	1 Know the Standard International (SI) units of measurement used in building services engineering	3	8
	2 Understand the properties of heat, energy and power	7	18
	3 Understand the principles and applications of force and pressure in building services engineering	6	15
	4 Understand the principles of expansion within building services engineering applications	3	8
	5 Know basic electrical principles	4	10
	6 Understand the principles of levers and moments	2	5
	7 Understand the properties and principles of water	8	20
	8 Know the principles of combustion and heating gases	3	8
	9 Understand the properties of materials used in the building service engineering industry	4	10
	Total	40	100

6288-302 Water Supply (Water Fittings) Regulations and Water Byelaws in the UK

Candidates are allowed to take **The Water Regulations Guide (Second Edition)** as reference into the exam

Duration: 90 minutes			
Unit	Outcome	Number of questions	%
302	1 Understand the requirements of the Water Supply (Water Fittings) Regulations and Water Byelaws	2	4
	2 Understand terminology used to confirm requirements of the water regulations	1	2
	3 Know the suitability of materials and substances in contact with water	2	4
	4 Understand the requirements for water fittings	7	14
	5 Know the design and installation requirements for a water supply system	9	18
	6 Know the requirements for the prevention of cross connection to unwholesome water	2	4
	7 Know the backflow prevention fluid categories	1	2
	8 Know the requirements for backflow prevention	1	2
	9 Understand the guidance clauses relating to backflow prevention	11	22
	10 Know the installation requirements for cold water services	1	2
	11 Know the installation requirements for hot water services	4	8
	12 Know the installation requirements for WC's, flushing devices and urinals approved for use	4	8
	13 Know the types of bath, sink, showers taps location and installation requirements	2	4
	14 Know the consumption limitations for washing machines, dishwashers and other appliances	1	2
	15 Know the requirements for water supplied for outside use.	2	4
Total		50	100

6288-303 The installation, commissioning and safety aspects of hot water systems for domestic use in accordance with UK building regulations

Candidates are allowed to take **The Water Regulations Guide (Second Edition)** as reference into the exam

Duration: 50 minutes			
Unit	Outcome	Number of questions	%
303	1 Understand the types and configurations of vented/unvented hot water systems including the design installation requirements	5	20
	2 Know the types and operation of specialist components used in hot water systems	4	16
	3 Understand the design requirements for hot water systems	5	20
	4 Know the installation and safety features of hot water systems and components	4	20
	5 Know the requirements for the installation of cold water components associated with hot water systems	2	8
	7 Know the commissioning requirements of hot water systems and components in accordance with design specifications	4	16
Total		24	100

6288-307 Understand industrial and commercial fuel system regulations and installation requirements

Duration: 60 minutes			
Unit	Outcome	Number of questions	%
307	01 Understand the types and uses of fuels within industrial and commercial building services engineering operations	4	10
	02 Understand the legislation and standards relevant to installing fuel systems	6	15
	03 Understand the requirements when installing natural gas pipework	12	30
	04 Understand the basic ventilation requirements for fuel burning appliances	4	10
	05 Understand the flueing systems for fuel burning appliances	2	5
	06 Understand the requirements of oil installations	6	15
	07 Understand the procedures for commissioning fuel supplies	4	10
	08 Understand the requirements for fault finding on fuel systems	2	5
	09 Be able to install natural gas pipework without connecting to a live supply	0	0
	Total	40	100

6288-308 Understand how to joint pipe work using Manual Metal Arc (MMA) and Tungsten Inert Gas (TIG) welding processes

Duration: 45 minutes			
Unit	Outcome	Number of questions	%
308	1 Understand how to work safely when carrying out welding activities in the workplace	7	23
	2 Understand the working principals of pipe welding within Industrial and Commercial Heating and Ventilation	13	23
	3 Understand how to prepare prior to carrying out any pipe welding activities	5	17
	4 Understand how to quality assure completed pipe welds	5	17
Total		30	100

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience, or qualifications which have already been achieved, to contribute to a new qualification.

For this qualification, RPL is allowed and is not sector specific.

5 Units

Availability of units

Some of the units can be found in a separate document.

Structure of the units

These units each have the following:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Learning outcomes, which are comprised of a number of assessment criteria

Centres must deliver the full breadth of the range. Specialist equipment or commodities may not be available to all centres, so centres should ensure that their delivery covers their use. This may be covered by a practical demonstration (e.g. video). For the practical assessments for this qualification, centres should ensure that there are sufficient resources to complete the task but are not required to use all the equipment or commodities in the range.

Unit 201

Understand health and safety requirements within the building services engineering industry

Unit level:	Level 2
GLH:	60
Unit aim:	Learners will understand how to work safely when carrying out their role onsite. They will have a knowledge of health and safety requirements that impact upon building services engineering operations.

Learning outcome

The learner will:

- 1 Understand current health and safety legislation relevant to Building Services Engineering activities

Assessment criteria

The learner can:

- 1.1 Identify materials relating to health and safety in heating and ventilation activities
- 1.2 State the purpose of key health and safety legislation and regulations relevant to building services engineering
- 1.3 State various individuals' responsibilities regarding health and safety in the workplace
- 1.4 Identify safety signage used within the workplace
- 1.5 Identify the role of the Health and Safety Executive within the construction industry

Range

- (AC1.1) **Materials:** statutory and non-statutory, acts of parliament, regulations, codes of practice, Health and Safety Executive guidance notes.
- (AC1.2) **Health and safety legislation and regulation:** Health and Safety at Work, The Electricity at Work, Control Of Substances Hazardous to Health (COSHH), Work at Height, Personal Protective Equipment (PPE) at Work, Lifting and Manual Handling, Provision and Use of Work Equipment, Control of Asbestos at Work, First Aid at Work, Confined Spaces, Reporting of Injuries, Diseases and Dangerous Occurrences.
- (AC1.3) **Individuals:** Employers, employees, contractors, visitors and public.
- (AC1.4) **Safety signs:** fire, emergency procedure, hazard, mandatory, prohibition, warning, first aid.

Learning outcome

The learner will:

- 2 Understand health and safety documentation used in the workplace

Assessment criteria

The learner can:

- 2.1 State the purpose of the risk assessment process
- 2.2 State site personnel's responsibilities regarding the risk assessment process when working on site
- 2.3 State appropriate actions to be taken if the level of risk is unacceptable
- 2.4 Describe how to complete risk assessment documentation
- 2.5 Describe how to complete accident reporting documentation
- 2.6 State the purpose of method statements

Learning outcome

The learner will:

- 3 Know the safe measures to ensure personal protection when working on site

Assessment criteria

The learner can:

- 3.1 Identify Personal Protective Equipment (PPE) for use within the building services engineering industry
- 3.2 Identify the appropriate Personal Protective Equipment (PPE) to be used in different situations in the workplace
- 3.3 State the appropriate quality checks prior to using Personal Protective Equipment (PPE)

Range

(AC3.1) **Personal Protective Equipment (PPE):** hard hat, eye protection, safety boots, gloves, flameproof overalls, ear protection, breathing apparatus, high visibility clothing.

Learning outcome

The learner will:

- 4 Understand how to respond to incidents within the workplace

Assessment criteria

The learner can:

- 4.1 Identify potential hazards on site prior to responding to incidents
- 4.2 State the actions to be taken when responding to an incident

4.3 State the procedures for dealing with minor injuries

Range

(AC4.1) **Hazards:** trips slips & falls, falling debris, fumes, electric shock, fire.

(AC4.2) **Actions:** assess, respond, make safe, raise the alarm, report.

(AC4.3) **Minor injuries:** cuts, burns, asphyxiation, fractures, electric shock.

Learning outcome

The learner will:

5 Know the how to work safely when using power tools

Assessment criteria

The learner can:

5.1 Identify types of power tools commonly used within building services engineering

5.2 State the safety checks to be carried out on power tools prior to use

5.3 State the procedure to follow when power tools fail safety checks

5.4 Identify common dangers relating to the use of power tools

5.5 State the correct operational procedures of power tools

5.6 State the training and competency required to operate power tools

Range

(AC5.1) **Power tools:** power drills, grinders, crimping tools, circular saws, pipe threading machines, reciprocating saw, transformers and leads.

(AC5.4) **Dangers:** frayed cables, trailing leads, damage to casing, hidden services, incorrect fuses, damaged/missing guards.

Learning outcome

The learner will:

6 Know how to work safely at height

Assessment criteria

The learner can:

6.1 Identify situations where work at height may be necessary

6.2 Identify types of access equipment

6.3 Describe safety checks to be carried out before the assembly and use of ladders and mobile towers

6.4 State the training and competency requirements for the assembly and use of access equipment

- 6.5 State procedures for assembly and use of ladders and mobile towers
 - 6.6 Identify types of fall arrest equipment
-

Range

- (AC6.2) **Access equipment:** step ladders, extension ladders, mobile towers, fixed scaffolds, boom lift, scissor lift.
 - (AC6.3) **Safety checks:** condition of equipment, proximity to live power, wind speed, loading, scaff-tags, ground condition and level, traffic.
 - (AC6.4) **Training & competency:** International Powered Access Federation (IPAF), Prefabricated Access Suppliers' & Manufacturers' Association (PASMA), risk assessment, permit to work.
 - (AC6.6) **Fall arrest equipment:** harness and lanyard, catch nets.
-

Learning outcome

The learner will:

- 7 Understand how to work safely with flammable gasses and heat producing equipment

Assessment criteria

The learner can:

- 7.1 Identify the types of fire classifications
 - 7.2 State the elements of the fire triangle
 - 7.3 Identify methods of fire prevention
 - 7.4 Identify compressed and flammable gasses used within the building services engineering sector
 - 7.5 State the procedures for storage and transportation of compressed and flammable gasses
 - 7.6 State the procedure for assembly and use of compressed and flammable gasses
 - 7.7 State the procedure for tackling small localised fires
 - 7.8 Identify types of heat producing equipment and how to check them for safety
-

Range

- (AC7.4) **Compressed and flammable gasses:** LPG gasses, acetylene, MAPP, nitrogen, argon, oxygen.
 - (AC7.6) **Procedure for assembly and use:** safety checks, purging lines, effect of acetylene decomposition, effect of flame on galvanised pipework.
 - (AC7.7) **Procedure for tackling small localised fires:** fire extinguishers, raising the alarm, method of operation.
 - (AC7.8) **Types:** Oxygen and acetylene equipment, propane and MAPP torches, welding, cutting, grinding, regulators, hoses, flashback arrestors, valves, blowpipes and cuttings heads.
-

Learning outcome

The learner will:

- 8 Understand how to work safely with electricity during building services engineering operations

Assessment criteria

The learner can:

- 8.1 Identify electrical supply sources for tools and equipment
- 8.2 Identify common electrical hazards in the workplace
- 8.3 Describe the safe isolation procedure
- 8.4 Identify electrical equipment required for the safe isolation procedure
- 8.5 Describe the use of temporary continuity bonding when working with pipework and components
- 8.6 Explain the purpose of equipotential bonding on exposed metallic conductors
- 8.7 State the responsibilities of site personnel regarding the safe use of electricity

Range

(AC8.1) **Supply sources:** battery power, 110v, 230v, AC, DC, generators, cable colours.

(AC8.4) **Electrical equipment:** Voltage meter, warning signs, padlock, clamp lock, GS 38 approved equipment, proving unit.

Learning outcome

The learner will:

- 9 Understand how to work safely in excavations and confined spaces

Assessment criteria

The learner can:

- 9.1 Define excavations and confined spaces
- 9.2 Identify situations where work in excavations and confined spaces may be required
- 9.3 Identify the hazards related to working in excavations and confined spaces
- 9.4 Describe how to minimise risk whilst working in excavations
- 9.5 Describe how to minimise risk whilst working in a confined space
- 9.6 State the competency requirements required for work to proceed within excavations and confined spaces

Range

(AC9.3) **Hazards:** collapse, falls, explosion, asphyxiation, proximity to services, flooding, vehicles, Explosion, asphyxiation, poor lighting, flooding.

- (AC9.4) **Minimise risk (excavations):** trench support, ladders and access, warning signs, barriers, vehicle stops, Personal Protective Equipment (PPE).
- (AC9.5) **Minimise risk (confined spaces):** ventilation, Personal Protective Equipment (PPE), lighting, breathing equipment, access equipment, safe system of work.
- (AC9.6) **Competency:** training courses, permits to work.
-

Learning outcome

The learner will:

- 10 Understand how to work safely with substances commonly used within the building services engineering industry

Assessment criteria

The learner can:

- 10.1 Identify the risks related to the use of common substances used in building services engineering
- 10.2 State information sources relevant to the safe use of common substances
- 10.3 State the safety precautions that must be followed specific to a range of common substances used in building services engineering
- 10.4 Describe the types of asbestos commonly found in buildings
- 10.5 State the reporting and recording procedures relevant to asbestos
- 10.6 State the potential health risks of asbestos inhalation
- 10.7 State the requirements for the removal and disposal of asbestos
-

Range

(AC10.1, **Common Substances:** flux, cutting oils, jointing compounds, chemical inhibitor, chlorine, AC10.3) glycol, solvents.

(AC10.2) **Information sources:** COSHH data sheets, manufacturers literature, HSE guidance notes, risk assessments, method statements, permit to work.

Learning outcome

The learner will:

- 11 Know how to work safely when carrying out manual handling activities

Assessment criteria

The learner can:

- 11.1 Define manual handling
- 11.2 Identify common hazards relating to the manual handling of heavy or bulky items
- 11.3 State the correct weight limitations for manual handling
- 11.4 Describe the correct procedures for the manual handling of heavy or bulky items
- 11.5 State the operating procedures of mechanical lifting aids
-

11.6 State the checks to be carried out on mechanical lifting aids before their use

Range

(AC11.5, **Lifting aids:** block and tackle, pallet truck, trolleys, jacks, hydraulic lifts.
AC11.6)

Unit 202

Understand how scientific principles are applied in heating and ventilation systems.

Unit level:	Level 2
GLH:	60
Unit aim:	Learners will understand the scientific principles that are essential to the operation of systems and practices within the building services engineering industry

Learning outcome

The learner will:

- 1 Know the Standard International (SI) units of measurement used in building services engineering

Assessment criteria

The learner can:

- 1.1 State the Standard International (SI) units
- 1.2 Define the purpose of Standard International (SI) derived units
- 1.3 Determine the application and use of the Standard International (SI) units

Range

(AC1.2) **Derived units:** area (m^2), volume (m^3), capacity (litres (L)), density (kg/m^3), velocity (m/s), acceleration (m/s^2), force (N), pressure (N/m^2), flow rate (m^3/s).

Learning outcome

The learner will:

- 2 Understand the properties of heat, energy and power

Assessment criteria

The learner can:

- 2.1 Identify the properties of heat
- 2.2 Describe the methods of heat transfer
- 2.3 Define specific heat capacity
- 2.4 State the factors relating to sensible and latent heat.
- 2.5 State the calorific values of various fuels

2.6 Calculate simple heat, energy and power scenarios

Range

(AC2.1) **Properties:** temperature scales, degrees Celsius, degrees Kelvin.

(AC2.2) **Heat transfer:** conduction, convection, radiation.

(AC2.3) **Specific heat capacity:**

Units:

- (kJ/kg/°C).

Materials:

- water, air, copper, lead, cast iron.

(AC2.4) **Sensible and latent heat:** changes in phase, latent heat of fusion, sensible heat of evaporation.

(AC2.5) **Fuels:** anthracite, coal tar, general purpose coal, diesel, gas oil, kerosene, petrol, wood, butane, propane, natural gas.

(AC2.6) **Energy:** Joules (J),

(AC2.6) **Power:** Watts (W).

(AC2.6) **Scenarios:** energy requirements, rate of heat transfer, heat requirements.

Learning outcome

The learner will:

- 3 Understand the principles and applications of force and pressure in building services engineering

Assessment criteria

The learner can:

- 3.1 State the units of measurement for force and pressure
 - 3.2 State principles of static head pressure and velocity pressure
 - 3.3 Explain the principles of siphonic action
 - 3.4 Determine the principles of the gas laws
 - 3.5 Calculate simple pressure scenarios
 - 3.6 Explain the relationship between flow and resistance.
-

Range

(AC3.4) **Gas laws:** Charles laws, Boyles law, general gas laws.

(AC3.6) **Resistance:**

Fittings:

- elbows, bends, tees, valves, reducers.

Pipe:

- copper, steel, plastic.
-

Learning outcome

The learner will:

- 4 Understand the principles of expansion within building services engineering applications

Assessment criteria

The learner can:

- 4.1 Explain the principles of expansion of materials
- 4.2 Explain the principles of expansion of substances
- 4.3 Calculate the expansion of materials and substances.

Range

(AC4.1) **Materials:** copper, cast iron, plastic, invar.

(AC4.2) **Substances:** water, gas.

Learning outcome

The learner will:

- 5 Know basic electrical principles

Assessment criteria

The learner can:

- 5.1 Define the units of measurement for electricity
- 5.2 State how currents are generated and distributed
- 5.3 Calculate basic electrical relationships
- 5.4 Describe the operation of types of protective devices and their ratings

Range

(AC5.1) **Generation:** power stations, photovoltaics, cells.

(AC5.4) **Protective devices:** Miniature Circuit Breaker (MCB), Residual Current Device (RCD), Cartridge.

Learning outcome

The learner will:

- 6 Understand the principles of levers and moments

Assessment criteria

The learner can:

- 6.1 Describe the principles of mechanical advantage
- 6.2 Calculate the effects of levers and moments

Range

(AC6.1) **Principles:** levers, moments, equilibrium, pulleys.

Learning outcome

The learner will:

- 7 Understand the properties and principles of water

Assessment criteria

The learner can:

- 7.1 Identify the different states of water
- 7.2 Describe the changing state of water in relation to temperature and pressure
- 7.3 Describe the rain water cycle
- 7.4 Explain how different factors can affect the properties of water
- 7.5 Describe the effects of hard and soft water on systems and components
- 7.6 Explain the concept of capillarity in liquids
- 7.7 Identify methods of water treatment
- 7.8 Describe the principles of the water table

Range

(AC7.1) **States of water:** solid, liquid, gas.

(AC7.2) **Temperature and pressure:** freezing, boiling points, maximum density.

(AC7.4) **Properties:** temporary and permanent hard, soft water.

(AC7.5) **Effects:** corrosion, lime-scale, reduced lifespan of material, performance of appliance.

(AC7.7) **Methods:** softeners, conditioners.

Learning outcome

The learner will:

- 8 Know the principles of combustion and heating gases

Assessment criteria

The learner can:

- 8.1 Describe the properties of gases used for heating purposes
- 8.2 Describe the requirements for combustion

8.3 State the application of gases for combustion

Range

(AC8.1) **Properties:** relative density, calorific value, air requirements.

(AC8.2) **Requirements:** fuel, oxygen, ignition, complete and incomplete combustion.

(AC8.3) **Gases:** Natural, Butane, Propane.

Learning outcome

The learner will:

9 Understand the properties of materials used in the building service engineering industry

Assessment criteria

The learner can:

9.1 Identify uses of different materials in heating and ventilation systems

9.2 Describe the properties of materials

9.3 Explain the causes of corrosion of materials used in heating and ventilations systems

9.4 Identify methods of corrosion prevention in heating and ventilations systems

Range

(AC9.1, **Materials:**

AC9.2) Metals:

- pure metals
- ferrous metals
- alloys.

Plastics:

- thermo-plastics
- thermo-setting plastics.

(AC9.2) **Properties:**

Strength:

- compressive and tensile, hardness, ductility, malleability, elasticity, conductivity, mass weight, relativity, density.

(AC9.3) **Causes:** electrolytic action, atmospheric corrosion.

(AC9.4) **Methods:** painted coatings, galvanised coatings, inhibitors, sacrificial anodes.

Unit 209

Installation of Industrial and Commercial Heating and Ventilation Systems within the workplace

Unit level:	Level 2
GLH:	96
Unit aim:	Learners will be able to demonstrate installation, testing and de-commissioning of BSE pipework systems, whilst working in accordance with regulations and guidance.

Learning outcome

The learner will:

- 1 Follow legislation for the installation of pipework systems

Assessment criteria

The learner can:

- 1.1 Use regulations and standards relevant to pipework systems

Range

(AC1.1) **Pipework systems:** chilled, cold, hot, heating.

(AC1.1) **Regulations and Standards:**

Chilled:

- The Water Supply (Water Fittings) Regulations, Conservation of Fuel and Power document L, TR/20 Installation and testing of pipework systems Part six - Chilled water, manufacturer's instructions.

Cold:

- The Water Supply (Water Fittings) Regulations and Scottish Water Byelaws, British Standards; BS EN 806, BS 6700, Water Regulation Advisory Scheme, Legionnaires' disease; L8.

Heating:

- The Building Regulations: Part L2 – Conservation of fuel and power, L2a other than new dwellings, L2b other than in existing dwellings, British Standards: BS EN 14511 Heat Pumps, BS EN 303-5 Heating Boilers, BS EN 15316-4-7 Heating Plant, BS EN 378 Refrigeration and Heat Pumps, BSRIA Guide to renewable technologies.

Hot:

- The Building Regulations; G3 Hot water supply and systems, L2A Conservation of fuel and power in new buildings other than dwellings, L2B Conservation of fuel and power in existing buildings other than dwellings, Part A Structure, Part B Fire Safety, Part C

Learning outcome

The learner will:

- 2 Install pipework systems

Assessment criteria

The learner can:

- 2.1 Assemble and install bracket systems
 - 2.2 Install pipework systems using a range of materials
 - 2.3 Install a range of components and valves within pipework systems
-

Range

- (AC2.1) **Brackets & Hangers:** malleable iron clips, rubber lined split band clips, roller and chair, U bolt, phenolic blocks, plastic clips, brass clips
- (AC2.1) **Materials:** brick, blockwork, concrete, wood and timber, plasterboard, metalwork
- (AC2.1) **Pipe support accessories:** channel strut, anti-vibration mounts, channel nuts, L brackets, power arms, wire hangers, beam clamps, lightweight channel systems
- (AC2.1) **Fixings and consumables:** Wall plugs, Anchor bolts, toggle bolts, wedge type anchors, concrete screws, cartridge fired fixings, chemical fixings, plasterboard fixings, screws, bolts, washers, nuts, rod
- (AC2.2) **Pipework systems:**
- Hot:
- vented systems, unvented systems, thermal storage, solar.
- Cold:
- direct, indirect, boosted, chilled; open vented, seal systems.
- Heating:
- low temperature, medium temperature, high temperature, steam, district heating, underfloor heating.
- Chilled.
- (AC2.2) **Materials:** copper, plastic, steel.
- (AC2.2) **Valves:** gate, lever, butterfly, drain cocks, pressure reducing, control, stop, servicing, backflow prevention device, float operating, blending, pressure relief, temperature relief, RPZ, motorised.
- (AC2.3) **Components:** thermostats, gauges, calorifiers, heat exchangers, hot water storage vessels, radiators, chillers, convector heaters (natural and assisted), panel heaters, ceiling coils, pumps/accelerators, expansion vessels, heat generating equipment, storage cisterns, break tanks, sectional, manifold, automatic air vent, dosing pot, air and dirt separator.
-

Learning outcome

The learner will:

- 3 Carry out soundness testing on industrial and commercial pipework systems

Assessment criteria

The learner can:

- 3.1 Confirm pipework systems and components are ready to receive soundness tests
- 3.2 Carry out soundness testing of pipework and components
- 3.3 Conduct quality assurance checks that would indicate successful testing
- 3.4 Demonstrate appropriate actions when inspection and testing reveals defects in pipework systems
- 3.5 Flush pipework systems
- 3.6 Charging pipework systems

Range

(AC3.1, **Pipework systems:** hot, cold, chilled, heating.
AC3.2)

(AC3.1, **Components:** heat emitters, pumps, bellows, valves, heat exchangers, terminal devices,
AC3.2) expansion vessels.

(AC3.2) **Soundness testing:** hydraulic, pneumatic.

(AC3.2) **Defects:** leaks, blockage, faulty component, incorrect installation.

Learning outcome

The learner will:

- 4 Carry out the decommissioning of industrial and commercial pipework systems

Assessment criteria

The learner can:

- 4.1 Confirm pipework systems and components are ready to be decommissioned
- 4.2 Safely dispose of system water
- 4.3 Carry out decommissioning of pipework systems and components
- 4.4 Demonstrate appropriate actions to take when normal emptying or shut off mechanisms for pipework systems that do not operate

Range

(AC4.1, **Pipework systems:** hot, cold, chilled, heating.
AC4.3)

(AC4.1, **Components:** heat emitters, pumps, bellows, valves, heat exchangers, terminal devices, AC4.3) expansion vessels.

Learning outcome

The learner will:

- 5 Communicate effectively when working on site

Assessment criteria

The learner can:

- 5.1 Demonstrate suitable communication methods when communicating with personnel within the workplace
 - 5.2 Use a range of site documentation to exchange information
 - 5.3 Maintain professionalism to promote company image
-

Range

(AC5.1) **Methods:** verbal, written.

(AC5.1) **Personnel:** site team, site management, site visitors.

(AC5.2) **Documentation:** job specifications, plans/drawings, work programmes, delivery notes, time sheets, variation order, material requisition, manufacturer instructions, site diary, quotations, estimates, invoices/statements, statutory cancellation rights, handover information.

Learning outcome

The learner will:

- 6 Be able to work safely whilst carrying out building services engineering activities in the workplace

Assessment criteria

The learner can:

- 6.1 Carry out the risk assessment of common building services engineering operations
 - 6.2 Follow risk assessments during building services engineering operations
 - 6.3 Produce a method statement for a simple building services engineering operation
 - 6.4 Use correct Personal Protective Equipment (PPE) within the workplace
 - 6.5 Check Personal Protective Equipment (PPE) is fit for purpose
 - 6.6 Perform safety checks on power tools
 - 6.7 Demonstrate safe operation of a range of power tools
 - 6.8 Use information sources when working with potentially hazardous substances
 - 6.9 Demonstrate the safe use of common substances used within the building services engineering industry
 - 6.10 Demonstrate the safe use of access equipment
-

Range

- (AC6.1, AC6.2, AC6.3) **Operations:** working with power tools, working at height, working with electricity, working with substances, working with heat producing equipment, working with compressed or flammable gasses, working in excavations and confined spaces.
- (AC6.4, AC6.5) **Personal Protective Equipment (PPE):** hard hat, eye protection, safety boots, gloves, flameproof overalls, ear protection, breathing apparatus, high visibility clothing.
- (AC6.6, AC6.7) **Power tools:** power drills, grinders, crimping tools, circular saws, screwing machines, reciprocating saw, transformers and leads.
- (AC6.8, AC6.9) **Substances:** flux, cutting oils, jointing compounds, chemical inhibitor, chlorine, glycol, solvents.
- (AC6.8) **Information sources:** COSHH data sheets, manufacturers literature, HSE guidance notes, risk assessments, method statements, permit to work.
- (AC6.10) **Access equipment:** step ladders, extension ladders, mobile towers, pop ups.

Unit 301

Understand industrial and commercial complex hot water heating and chilled water systems

Unit level:	Level 3
GLH:	50
Unit aim:	The aim of this unit is to gain an understanding of the installation and operating principals of industrial and commercial complex hot water and cold water systems. Learners will gain an understanding of how to size systems and components for both hot water and cold water systems.

Learning outcome

The learner will:

- 1 Understand the working principles of complex industrial and commercial hot water heating and chilled water systems

Assessment criteria

The learner can:

- 1.1 Identify the controls used on variable temperature circuits
- 1.2 Identify the controls used on constant temperature circuits
- 1.3 Describe the reasons for different pipework configurations
- 1.4 Explain why advanced controls are used on complex hot water heating and chilled water systems

Range

- (AC1.1) **Variable temperature:** balancing valves (manual and automatic), pumps, 3 way control valves, actuators, BMS, differential pressure control valves, 2 way valves.
- (AC1.2) **Constant flow:** balancing valves (manual and automatic), pumps, 3 way control valves, 4 way valve.
- (AC1.3) **Pipework configurations:** boiler room, low loss headers, shunt circuits, chiller connections
- (AC1.4) **Advanced controls:** programmers, thermostatic controls, motorized valves, zone valves, optimum start controllers and compensated circuits, BMS.

Learning outcome

The learner will:

- 2 Understand the various calculations needed when designing complex industrial and commercial hot water heating and chilled systems

Assessment criteria

The learner can:

- 2.1 Calculate heat loss requirements
- 2.2 State methods of calculating heat loss
- 2.3 Calculate pipe and component sizing

Range

(AC2.1) **Heat loss:** U values, air changes, building fabric, room volumes.

(AC2.2) **Methods:** mathematical calculation, fabric heat loss calculations, computer programme.

(AC2.3) **Pipe:** flow rates, velocity.

(AC2.3) **Component:** heat emitters, pumps, valves, commissioning valves.

Learning outcome

The learner will:

- 3 Understand the procedures for testing and commissioning industrial and commercial hot water heating and chilled water systems

Assessment criteria

The learner can:

- 3.1 Describe the procedure for carrying out soundness testing (K/C)
- 3.2 Describe the procedure for Flushing (K/C)
- 3.3 Describe the procedure for water treatment (K)
- 3.4 Explain how to carry out commissioning checks on industrial and commercial hot water heating and chilled water systems
- 3.5 Determine the types and operation of commissioning devices
- 3.6 Determine the equipment used to carry out the commissioning of hot water heating and chilled water systems

Range

(AC3.1) **Procedure for soundness testing:** metal and plastic pipes, hydraulic and pneumatic.

Learning outcome

The learner will:

- 4 Understand fault finding procedures for industrial and commercial hot water heating and chilled water systems

Assessment criteria

The learner can:

- 4.1 State the common faults on hot water heating and chilled systems
- 4.2 State the maintenance checks on hot water heating and chilled systems
- 4.3 State actions to take when faults are identified

Range

- (AC4.1) **Common faults:** leaks, incorrect installation, system pressure, noise and vibration, air locks, boiler failure, chiller failure, pump failure, control faults.
- (AC4.2) **Maintenance checks:** check installation is to current regulations, clean line strainer, pressure reducing pressure correct, expansion vessel pressure checked, discharge pipework free from blockage, no sign of discharge from safety devices, flow rates correct, thermostat set correctly, system operation, flow temperatures, pump rotation.

Learning outcome

The learner will:

- 5 Understand thermal comfort conditions within buildings

Assessment criteria

The learner can:

- 5.1 Describe comfort indices within a building
- 5.2 Identify the types of internal heat and external gains
- 5.3 Explain the impacts internal heat and external gains have on the building

Range

(AC5.2, **Internal heat:** lighting, equipment, occupancy
AC5.3)

(AC5.2, **External gains:** Solar irradiance
AC5.3)

Unit 302

Water Supply (Water Fittings) Regulations and Water Byelaws in the UK

UAN:	T/504/1602
Unit level:	Level 3
Credit value:	3
GLH:	8
Unit aim:	The aim of this unit is to provide candidates with the underpinning knowledge of the legal requirements for plumbing systems in the UK covered by Water Supply (Water Fittings) Regulations and Water Byelaws. The purpose of this unit is to enable learners to develop the underpinning knowledge and skills required. On achievement of this unit candidates may apply for approval status to one of the recognised Approved Contractor Schemes operating in the UK.
Endorsed by	This unit is endorsed by Summit Skills, the Sector Skills Council for the building services engineering (BSE) sector.

Learning outcome

The learner will:

- 1 Understand the requirements of the Water Supply (Water Fittings) Regulations and Water Byelaws

Assessment criteria

The learner can:

- 1.1 Explain the requirements of the Water Regulations/Byelaws (Part 1):
 - 1.1 a within the domestic environment
 - 1.1 b within the commercial, industrial environment
- 1.2 Explain the requirements of the Water Regulations/Byelaws (Part 2) in relation to:
 - 1.2 a the restriction on installation of water fittings
 - 1.2 b the requirements for water fittings
 - 1.2 c the notification requirements relating to any person who proposes to install a water fitting
 - 1.2 d approved contractors
- 1.3 Explain the requirements of the Water Regulations/Byelaws (Part 3) in relation to:
 - 1.3 a penalties for contravening the Water Regulations

- 1.3 b relaxation of the Water Regulations
 - 1.3 c dispute with a water undertaker
-

Learning outcome

The learner will:

- 2 Understand terminology used to confirm requirements of the water regulations

Assessment criteria

The learner can:

- 2.1 Explain the meanings of the key factors within the interpretations of the Water Regulations
 - 2.2 Identify the different types of water treatment apparatus available to dwellings
-

Range

(AC2.1) **Key Factors:** backflow, cistern, combined feed and expansion cistern, combined temperature and pressure relief, contamination, distributing pipe, expansion cistern/vessel, expansion valve, flushing cistern, overflow pipe, pressure relief valve, primary circuit, secondary circuit, secondary system, servicing valve, stopvalve, storage cistern, temperature relief valve, terminal fitting, vent pipe.

Learning outcome

The learner will:

- 3 Know the suitability of materials and substances in contact with water

Assessment criteria

The learner can:

- 3.1 Describe situations where materials or substances either alone or in combination are likely to cause contamination of water
 - 3.2 Identify suitable fittings for use above and below ground
 - 3.3 Identify suitable jointing materials and compounds
-

Range

(AC3.1) **Materials:** different classes of steel pipes, copper tubes and their connections above and below ground, unplasticised PVC, polyethylene pipes, stainless steel pipes.
(AC3.2) **Fittings:** stopvalves, drain off vales, servicing valves.

Learning outcome

The learner will:

- 4 Understand the requirements for water fittings
-

Assessment criteria

The learner can:

- 4.1 State the fitness for purpose of water fittings in relation to:
 - 4.1 a British Standards or equivalent
 - 4.1 b immunity and protection from galvanic action
 - 4.2 State the requirements for installed water fittings
 - 4.3 Describe the requirement for pressure testing
 - 4.3 a metallic pipework systems
 - 4.3 b plastic pipework systems
 - 4.4 Explain how surges within a pipework system can affect system performance
 - 4.5 State the connection requirements for the installation of a pump on a supply pipe
 - 4.6 State the connection requirements for the installation of a pumped shower
 - 4.7 State the installation requirements for pipes and operational fittings
 - 4.8 State the installation requirements for pipes entering a building
 - 4.9 State the installation requirements for underground pipework
 - 4.10 Explain the terms 'concealed fitting' and 'dezincification resistant material'
-

Range

- (AC4.2) **Requirements:** water tightness, prevention of ingress from contaminants, prevention from damage by freezing and other causes, prevention from deterioration by permeation, the supporting pipework, the fixings for water fittings.
- (AC4.4) **Affect system performance:** water hammer, relief valve discharge, pneumatic accumulators.
- (AC4.5) **Installation of a pump:** permissible pump output capacity, permitted siting of a pump.
- (AC4.6) **Installation of a pumped shower:** permissible pump output capacity, recommended siting of a pump.
- (AC4.7) **Requirements for pipes and operational fittings:** located in the cavity of a cavity wall, embedded in any wall or solid floor, located below a suspended floor, below a solid floor at ground level, location and accessibility to operational fittings.
- (AC4.8) **Requirements for pipes entering a building:** depth of pipework, insulation requirements, protection of pipework.
- (AC4.9) **Underground pipework:** pipes laid underground, pipes laid over an underground obstruction, pipes under an underground obstruction, pipes supplying water to a building below street level, pipes beneath a stream.
-

Learning outcome

The learner will:

- 5 Know the design and installation requirements for a water supply system

Assessment criteria

The learner can:

- 5.1 State factors to be taken into consideration in the design of a water supply system
-

- 5.2 Describe types of distribution system available within a dwelling
 - 5.3 Explain the methods of preventing the contamination of water fittings and the water contained within them when passing through contaminated environment
 - 5.4 State the distribution temperature of cold water
 - 5.5 State the installation requirements for Stopvalves to premises
 - 5.6 State the installation requirements for the provision, operation and location of servicing valves
 - 5.7 State the installation requirements for the provision of draining taps
 - 5.8 State the requirements with respect to dead legs and redundant fittings
 - 5.9 State the requirements for pressure testing different systems
 - 5.10 Explain the reason for the flushing of a system installation
 - 5.11 State when system disinfection is required
-

Range

- (AC5.1) **Factors:** total daily consumption, maximum and average flows required, availability of mains supply, mains pressure variance, water storage capacity where needed, transient or surge pressures, environmental issues surrounding area and supply.
 - (AC5.2) **Types of distribution system:** direct fed system, indirect fed system, combination of direct and indirect fed systems.
 - (AC5.5) **Premises:** individual property, location within premises supplied with water, block of flats supplied from a common supply pipe, block of flats with separate supply pipes to each flat
 - (AC5.6) **Servicing valves:** inlet to Float Operated Valve (FOV), outlet of storage cisterns, inlet to appliances, accessibility of servicing valves, methods of operation.
 - (AC5.7) **Installation requirements:** location, accessibility, types of draining taps.
 - (AC5.9) **Systems:** systems that do not include any plastic, systems that include plastic pipes.
-

Learning outcome

The learner will:

- 6 Know the requirements for the prevention of cross connection to unwholesome water

Assessment criteria

The learner can:

- 6.1 State the meaning of unwholesome water in relation to:
 - 6.1 a rainwater
 - 6.1 b recycled water
 - 6.1 c any fluid not supplied by a water undertaker
- 6.2 State the requirements for identifying an unwholesome water system so that it is readily distinguishable from a wholesome system in relation to:
 - 6.2 a colour coding for pipes and fittings
 - 6.2 b labelling for pipes and terminal fittings
- 6.3 Identify the correct arrangement for connecting a wholesome water supply to a re-use system

Learning outcome

The learner will:

- 7 Know the backflow prevention fluid categories

Assessment criteria

The learner can:

- 7.1 Define the five fluid categories
-

Learning outcome

The learner will:

- 8 Know the requirements for backflow prevention

Assessment criteria

The learner can:

- 8.1 State the requirements for the arrangements or devices to prevent the cross connection to unwholesome water
 - 8.2 Identify devices or arrangements used for backflow, back pressure and back siphonage prevention and their suitability
-

Learning outcome

The learner will:

- 9 Understand the guidance clauses relating to backflow prevention

Assessment criteria

The learner can:

- 9.1 Describe the requirements whereby water can flow back into a supply or distributing pipe
 - 9.2 Explain the terms 'upstream' and 'downstream'
 - 9.3 Identify the method of protection against the backflow of water into a supply or distributing pipe without the need for a mechanical backflow prevention device
 - 9.4 Describe installation requirements for a mechanical backflow protection device
 - 9.5 State the requirements for appliances supplied through or incorporating a pump
 - 9.6 State the requirements for the installation of a bidet or appliance using a hand held spray
 - 9.7 Explain the requirements for a water supply to a manually operated WC or urinal using a pressure flushing valve when supplied from a supply pipe or distributing pipe
 - 9.8 Explain the requirements for tap outlets in relation to:
 - 9.8 a single outlet taps
 - 9.8 b combination tap assembly outlets
 - 9.8 c fixed shower heads over basins, baths and bidets
-

- 9.9 Explain the requirements for a sink in a non domestic environment
 - 9.10 Identify the requirements for submerged inlets to baths and washbasins in:
 - 9.10 a a dwelling
 - 9.10 b a non-dwelling
 - 9.11 Identify the requirements for the installation of a drinking water fountain
 - 9.12 Identify the requirements for the installation of washing machines, washer-dryers and dishwashers in relation to:
 - 9.12 a a dwelling
 - 9.12 b a non-dwelling
 - 9.13 State the requirements for the installation of hose pipes for:
 - 9.13 a a house garden
 - 9.13 b commercial installations
 - 9.14 Explain when whole site and zone protection are required
 - 9.15 State the requirements for fire protection systems
 - 9.16 State the requirements when applied to miscellaneous commercial and industrial applications
-

Range

- (AC9.4) **Installation requirements:** accessibility of the mechanical backflow protection device, location within the premises, not to be buried in the ground, vented and verifiable, or devices with relief outlets not to be installed in chambers below ground or where liable to flooding, the installation of line strainers, the lowest point of discharge from the ground and termination with a Type AA air gap.
 - (AC9.6) **Installation of a bidet:** ascending spray type, over rim type, spray handset fittings used with bidets and WC's.
 - (AC9.15) **Fire protection systems:** direct fed sprinkler systems with no additives, direct fed sprinkler systems with additives, elevated storage cisterns with or without additives by gravity, elevated storage cisterns with pumped outlet with or without additives, dual feed cisterns with water from the water undertaker and from another source.
 - (AC9.16) **Miscellaneous commercial and industrial applications:** pumped supply to laboratory fittings, separation of wholesome water from supplementary sources, separation of wholesome water from water that has been used, water supply taken directly from a supply pipe to a ship, water supply taken by gravity from storage on a quayside, water supply pumped from storage on a quayside, water taken from a hose union tap on a quayside.
-

Learning outcome

The learner will:

- 10 Know the installation requirements for cold water services

Assessment criteria

The learner can:

- 10.1 Describe the installation requirements and methods of connection for water fittings:
 - 10.1 a float operated valves
 - 10.1 b inlets to cisterns
-

- 10.1 c outlets from cisterns
 - 10.1 d warning and overflow pipes
 - 10.1 e cold water storage cisterns
-

Learning outcome

The learner will:

- 11 Know the installation requirements for hot water services

Assessment criteria

The learner can:

- 11.1 Describe the installation requirements and methods of connection for water fittings
 - 11.2 State the requirements for discharge pipes from safety devices
 - 11.3 State the requirements for discharge pipes from expansion valves
 - 11.4 State the requirements for vent pipes from a primary circuit
 - 11.5 State the requirements for vent pipes from a secondary hot water storage system
-

Range

(AC11.1) **Water fittings:** directly heated unvented hot water systems, indirectly heated unvented hot water systems, independent water heaters, methods of accommodating expanded water in a hot water system, maximum temperature within a hot water system, hot water distribution temperatures, temperature of hot water at terminal fittings and surfaces of hot water pipes.

Learning outcome

The learner will:

- 12 Know the installation requirements for WC's, flushing devices and urinals approved for use

Assessment criteria

The learner can:

- 12.1 Identify the installation methods and requirements for the operation of WC pans
 - 12.2 Explain methods for flushing urinals
 - 12.3 Describe methods for filling a urinal cistern
 - 12.4 State the requirements for urinal cistern filling rates for:
 - 12.4 a a single urinal bowl
 - 12.4 b a urinal stall or slab serving two or more urinals
 - 12.5 State the requirements for the renewal of a WC cistern installed before 1 July 1999
-

Range

(AC12.1) **Installation methods and requirements:** single flush cisterns, dual flush cisterns, single flush siphonic outlet, dual flush siphonic outlet, drop and flap valve, dual flush cistern

capacities, operating instructions for dual flush cisterns, pressure flushing valves, cistern water line mark, requirements for warning pipes, internal overflows.

(AC12.2) **Methods to flush urinals:** manually operated cistern, automatically operated cistern, pressure flushing valves.

(AC12.3) **Methods to fill a urinal cistern:** manual infill, electronic sensor, pressure pad, time switch, frequency of flushing.

Learning outcome

The learner will:

13 Know the types of bath, sink, showers taps location and installation requirements

Assessment criteria

The learner can:

13.1 State the requirements for drinking water points in premises

13.2 State the requirements for drinking water supplies

13.3 State the requirements for waste outlets from appliances

Range

(AC13.2) **Drinking water supplies:** water supplied from a supply pipe, water supplied from a pumped supply pipe, water supplied from a storage cistern, water that has been softened used for drinking purposes.

Learning outcome

The learner will:

14 Know the consumption limitations for washing machines, dishwashers and other appliances

Assessment criteria

The learner can:

14.1 State the upper limits of water consumption for domestic:

14.1 a horizontal axis washing machines

14.1 b washer – driers

14.1 c dish washers

Learning outcome

The learner will:

15 Know the requirements for water supplied for outside use

Assessment criteria

The learner can:

- 15.1 State the installation requirements for animal drinking troughs or bowls in relation to:
 - 15.1 a methods of controlling the inflow to a trough or bowl
 - 15.1 b the siting of servicing valves
 - 15.1 c backflow protection
- 15.2 State the installation requirements for ponds, fountains and pools in relation to:
 - 15.2 a impervious liners and water tightness
 - 15.2 c temporary connections to ponds, pools and fountains

Unit 303

The installation, commissioning and safety aspects of hot water systems for domestic use in accordance with UK building regulations

UAN:	D/504/1545
Unit level:	Level 3
Credit value:	1
GLH:	10
Unit aim:	The purpose and aim of this unit is to enable learners to develop the underpinning knowledge and skills required prior to progressing to assessment of occupational competence. It will enable existing workers in the occupation to update their professional competence and extend their range of work. Where appropriate achievement will lead to the issue of a licence to practice.
Endorsed by	This unit is endorsed by Summit Skills, the Sector Skills Council for the building services engineering (BSE) sector.

Learning outcome

The learner will:

- 1 Understand the types and configurations of vented/unvented hot water systems including the design installation requirements

Assessment criteria

The learner can:

- 1.1 Explain types of domestic hot water supply systems:
 - 1.1 a centralised systems
 - 1.1 b unvented hot water systems
 - 1.1 c open vented hot water systems
 - 1.1 d localised systems
 - 1.1 e unvented point of use heaters
 - 1.1 f instantaneous heaters
- 1.2 Describe types of unvented/vented hot water systems:
 - 1.2 a indirect storage systems (include water jacketed tube heaters)
 - 1.2 b direct storage systems

- 1.2 c electrically heated
- 1.2 d gas or oil fired
- 1.2 e small point of use (under sink)
- 1.2 f bulk Storage heaters (combination tank)
- 1.2 g solar thermal hot water systems
- 1.2 h combination boilers
- 1.3 Identify hot water system pipework layout features including systems with secondary circulation:
 - 1.3 a direct and indirect vented and unvented
 - 1.3 b direct and indirect cylinders
 - 1.3 c solar thermal
 - 1.3 d thermal stores
 - 1.3 e combination boilers
 - 1.3 f secondary circulation
 - 1.3 g location of pump and type
 - 1.3 h automated timing devices
 - 1.3 i methods of balancing systems
- 1.4 State the recommended design temperatures within hot water systems:
 - 1.4 a hot water storage vessels
 - 1.4 b hot water delivery
 - 1.4 c secondary return
 - 1.4 d point of use
 - 1.4 e instantaneous heaters
 - 1.4 f storage system
 - 1.4 g fixed bath
 - 1.4 h basin
 - 1.4 i blending valve installations
- 1.5 Identify the layout requirements, location and safety features for unvented/vented hot water systems:
 - 1.5 a expansion and temperature relief pipework
 - 1.5 b vent pipes

Learning outcome

The learner will:

- 2 Know the types and operation of specialist components used in hot water systems

Assessment criteria

The learner can:

- 2.1 state methods of preventing stored water from exceeding 100o C
- 2.2 state the minimum number of independent safety devices required to prevent overheating in unvented hot water systems
- 2.3 state the expansion rate of water when converted to steam

- 2.4 explain the working principle of functional devices in unvented hot water systems:
 - 2.4 a line strainer
 - 2.4 b pressure reducing valve
 - 2.4 c check valves
 - 2.4 d expansion device (vessel or integral to cylinder)
 - 2.4 e tundish
 - 2.4 f composite valve
-

Learning outcome

The learner will:

- 3 Understand the design requirements for hot water systems

Assessment criteria

The learner can:

- 3.1 Identify factors affecting the selection of hot water systems for domestic use
 - 3.2 Explain how to minimise bacterial growth in hot water systems
 - 3.3 State the criteria for selecting hot water system and component types:
 - 3.3 a occupiers needs or usage (Max usage of water per person per day)
 - 3.3 b building layout and features
 - 3.3 c suitability of system
 - 3.3 d water efficiency
 - 3.3 e environmental impact
 - 3.3 f energy efficiency
 - 3.4 State which regulation applies to the installation of unvented hot water systems of more than 45KW and a capacity of 500 litres
 - 3.5 State which documents should be used when designing domestic hot water systems
-

Learning outcome

The learner will:

- 4 Know the installation and safety features of hot water systems and components

Assessment criteria

The learner can:

- 4.1 State the effects of unbalanced supply pressures in hot water systems
 - 4.2 State the take off point on a cold water supply to maintain a balanced hot and cold water supply
 - 4.3 State the additional safety components where multiple heat sources exist
 - 4.4 Identify the positioning and fixing requirements of components used in unvented hot water systems:
 - 4.4 a control thermostat
-

- 4.4 b overheat thermostat
 - 4.4 c temperature relief valve
 - 4.4 d line strainer
 - 4.4 e pressure reducing valve
 - 4.4 f check valves
 - 4.4 g expansion device
 - 4.4 h expansion relief valve
 - 4.4 i composite valves
 - 4.4 j tundish arrangements
 - 4.5 State the installation, fixing and sizing requirements for safety relief pipework:
 - 4.5 a discharge D1
 - 4.5 b discharge D2
 - 4.5 c tundish
 - 4.5 d multiple discharge pipe arrangements from safety devices
 - 4.5 e termination
-

Learning outcome

The learner will:

- 5 Know the requirements for the installation of cold water components associated with hot water systems

Assessment criteria

The learner can:

- 5.1 Describe the installation and siting requirements of cold water cisterns
 - 5.2 Describe the requirements for positioning a cold water pipe in relation to sources of heat
-

Learning outcome

The learner will:

- 6 Be able to diagnose faults in hot water systems and components

Assessment criteria

The learner can:

- 6.1 Carry out diagnosis of hot water systems installation and component faults:
 - 6.1 a thermostats
 - 6.1 b expansion and pressure vessels
 - 6.1 c temperature relief
 - 6.1 d expansion relief
 - 6.1 e discharge pipework
 - 6.2 Confirm the correct operation of system components and safety valves:
 - 6.2 a thermostats
-

- 6.2 b expansion and pressure vessels
 - 6.2 c temperature relief
 - 6.2 e expansion relief
 - 6.2 f discharge pipework
- 6.3 Confirm the actions required to rectify the diagnosed faults
-

Learning outcome

The learner will:

- 7 Know the commissioning requirements of hot water systems and components in accordance with design specifications

Assessment criteria

The learner can:

- 7.1 State the checks to be carried out during a visual inspection
 - 7.2 Describe the commissioning procedure for an unvented hot water system
 - 7.3 Describe the procedure for carrying out a soundness test on a hot water system:
 - 7.3 a metallic systems
 - 7.3 b plastic pipework systems
 - 7.4 Describe the flushing procedure after completion of a soundness test
-

Learning outcome

The learner will:

- 8 Be able to carry out the commissioning of hot water systems

Assessment criteria

The learner can:

- 8.1 Carry out the commissioning of a hot water system
-

Learning outcome

The learner will:

- 9 Be able to confirm that unvented hot water systems have been serviced in accordance with manufacturer's instructions

Assessment criteria

The learner can:

- 9.1 Demonstrate service procedures on an unvented hot water storage system
-

Unit 304

Understand industrial and commercial complex hot water and cold water systems

Unit level:	Level 3
GLH	80
Unit aim:	The aim of this unit is to gain an understanding of the installation and operating principals of industrial and commercial complex hot water and cold water systems. Learners will gain an understanding of how to size systems and components for both hot water and cold water systems.

Learning outcome

The learner will:

- 1 Understand the working principles of complex cold water systems

Assessment criteria

The learner can:

- 1.1 Describe types of cold water distribution systems used in building services engineering
- 1.2 Identify the advantages and disadvantages of different types of cold water distribution systems
- 1.3 Identify situations where certain cold water distribution systems would be appropriate
- 1.4 Explain when the installation of a cold water boosted system may be required
- 1.5 Describe the installation layouts of complex cold-water systems
- 1.6 State the purpose of components within complex cold water systems
- 1.7 State suitable applications for systems

Range

(AC1.1) **Distribution systems:** direct with hot water cylinder, direct with combination, indirect.

(AC1.4) **Boosted systems:** high rise, direct, in direct, drinking water.

(AC1.5) **Installation layouts:** subterranean, direct and indirect.

(AC1.5, AC1.6) **Complex cold water systems:** complex high rise, Rain water harvesting, Grey water harvesting.

(AC1.6) **Components:** RPZ, pumps, level switches, accumulator, drinking water header, rain water control units, storage cisterns, break tanks, delayed action valves.

Learning outcome

The learner will:

- 2 Understand how to calculate the size of pipework and components of domestic water services

Assessment criteria

The learner can:

- 2.1 Identify the factors to be taken into consideration when designing complex water systems
- 2.2 Calculate the size of water pipework for domestic water services
- 2.3 Calculate the requirements of water system components

Range

(AC2.1) **Factors:** daily consumption, maximum average flow rates required, availability of mains supply, variances and surges in pressure, environmental considerations.

(AC2.3) **Components:** pump, accumulator, cistern, calorifier.

Learning outcome

The learner will:

- 3 Understand fault finding procedures for commercial and industrial cold water systems

Assessment criteria

The learner can:

- 3.1 State common faults on cold water systems
- 3.2 State actions to take when faults are identified

Range

(AC3.2) **Common faults:** leaks, incorrect installation, cross connection, low pressure, noise and vibration, pump failure, poor flow, incorrect back flow prevention device.

Unit 305

Understand how to organise resources within building services engineering

Unit level:	Level 3
GLH	24
Unit aim:	Learners will understand how to organise resources for installation to ensure efficiency within the workplace.

Learning outcome

The learner will:

- 1 Know the responsibilities of relevant people in the building services industry

Assessment criteria

The learner can:

- 1.1 Define the types of client that are encountered when working
- 1.2 Identify the types of communication that may be required with clients throughout the progress of a job
- 1.3 Identify the types of communication that may be required with the site management team
- 1.4 Define the typical site responsibilities for operatives in the workplace
- 1.5 Describe the different methods of supervising individuals that can be used
- 1.6 Define the job responsibilities when supervising staff
- 1.7 Explain how to ensure the relevant people are aware of the work schedule and requirements
- 1.8 Explain the role of the building control officer

Range

- (AC1.1) **Types of Client:** private customer (direct communication, through customer representatives, managing agents), contracting customer, internal customer – within same company.
- (AC1.3) **Site Management Team:** Architect, Quantity Surveyor, Buyer/Estimator, Surveyor, Project Manager/Clerk of Works, Structural Engineer, Building Services Engineer, Contracts Manager, and Construction Manager.
- (AC1.4) **Operative Levels:** Apprentices/Trainees, Installer, Craftsperson, Supervision.
- (AC1.5) **Supervision Methods:** styles of supervision, methods of motivating staff.
- (AC1.6) **Responsibilities:** identifying the competence of subordinates to undertake work, Identifying when direct supervision or detailed direction is required, Specific health and safety issues (Responsibility for planning safe working for subordinates, How to adjust work schedules when health and safety problems delay works).

Learning outcome

The learner will:

- 2 Understand how to devise and implement a plan of work to meet the job schedule and the importance of keeping to schedule

Assessment criteria

The learner can:

- 2.1 Define the initial tendering process
- 2.2 Specify the types of work programmes used
- 2.3 State the process for planning work activities against job specifications
- 2.4 State the process for selecting the required resources against the job specification
- 2.5 Specify material delivery requirements against work programmes and the impact that the non-availability of materials may have on work progress
- 2.6 Describe the factors which affect working time allocation to work activities
- 2.7 Identify how to produce bar/progress work programmes
- 2.8 Explain how to calculate materials required
- 2.9 Explain how to identify the order in which tasks should be completed
- 2.10 Explain how to ensure waste is kept to a minimum
- 2.11 Describe information, systems and methods used by the Company to monitor progress
- 2.12 Explain the consequences of work not being completed on schedule
- 2.13 Explain the key factors that determine the effectiveness of the programme of work
- 2.14 Explain how to deal with variations to works
- 2.15 Explain the effect of retentions in the construction programme

Range

(AC2.2) **Types of work programmes:** private installation work, new-build installation contract work.

(AC2.4) **Types of resource:** materials, plant, vehicles, equipment.

(AC2.6, AC2.13) **Factors:** labour resources, planning work with other trades, material deliveries.

(AC2.14) **Variations:** prescribed by the work environment (communication to the client, agreement to extra time and costs), prescribed by the customer (agreement to extra time and costs).

Learning outcome

The learner will:

- 3 Understand the application and management of health safety and welfare in the workplace

Assessment criteria

The learner can:

- 3.1 Describe the role of the construction team regarding health and safety during the installation process

- 3.2 Describe the roles of health and safety organisations within the installation process
 - 3.3 Describe the impact of the construction design and management regulations on the construction process
 - 3.4 State the requirements for welfare facilities on the construction site
-

Range

(AC3.1) **Construction team:** client, main contractor, sub-contractor.

(AC3.2) **Organisations:** HSE, IOSH, RoSPA.

Unit 306

Installation of complex industrial and commercial heating and ventilation systems in the workplace

Unit level:	Level 3
GLH:	40
Unit aim:	Learners will be able to install, test, commission and de-commission complex Building Services Engineering pipework systems, whilst working in accordance with regulations and guidance.

Learning outcome

The learner will:

- 1 Install and test complex water systems and components

Assessment criteria

The learner can:

- 1.1 Select the appropriate equipment, components and accessories for installation in complex water systems
- 1.2 Determine the positioning and fixing of equipment, components and accessories inline with requirements
- 1.3 Measure and mark out locations for fitting and fixing the selected equipment, components and accessories
- 1.4 Prepare, fit, fix and connect the selected pipework and equipment, components and accessories using suitable jointing methods
- 1.5 Adjust safety and control features of the system
- 1.6 Carry out cleaning and flushing of the system
- 1.7 Confirm the integrity of the installed system using soundness testing
- 1.8 Correctly disposal of any waste materials

Range

- (AC1.1)
- **Cold:**
boosted, grey, rain water
 - **Hot:**
unvented cylinder (direct / indirect), secondary circulation
 - **Heating:**

Low, Medium, High temperature heating systems. Steam Systems, district heating, underfloor heating and constant/variable heating systems

- **Chilled**

(AC1.1, AC1.2, AC1.3, AC1.4) **Equipment, components and accessories:** fuel-fired boilers (gas; oil; solid fuel), hot water storage vessels, water heaters, pumps, heat emitters, heat exchangers, burners, flues, cisterns, refrigeration plant, air conditioning plant, calorifiers, valves, compressors, receivers, filters, pressure vessels, sprinkler heads, traps and strainers, measuring instruments, environmental technology equipment, prefabricated modules

(AC1.2) **Requirements:** the system's design, the working environment, manufacturer instructions

(AC1.4) **Pipework:** copper, plastics, carbon steel, stainless steel

(AC1.4) **Jointing Methods:** threaded, grooved, flanges, compression, adhesives

(AC1.7) **Soundness Testing:** pressure, system hygiene and charging, performance

Learning outcome

The learner will:

- 2 Commission complex water systems and components

Assessment criteria

The learner can:

- 2.1 Check to ensure that an installation has been fitted and connected as per system requirements
 - 2.2 Commission an installation, adjusting the controls to ensure the configuration, safety and effective performance of the system
-

Learning outcome

The learner will:

- 3 Decommission complex water systems and components

Assessment criteria

The learner can:

- 3.1 Decommission the system and its associated equipment, components and accessories
- 3.2 Ensure that the system cannot be accidentally reactivated or become dangerous
- 3.3 Complete relevant documentation in accordance with organisational procedures

Unit 307

Understand industrial and commercial fuel system regulations and installation requirements

Unit level:	Level 3
GLH:	70
Unit aim:	Learners will have a basis understanding of the requirements to install fuel systems and gas pipework up to a 150mm diameter and a maximum operating pressure of 16 bar in non-domestic premises without connecting to a live supply.

Learning outcome

The learner will:

- 1 Understand the types and uses of fuels within industrial and commercial building services engineering operations

Assessment criteria

The learner can:

- 1.1 List space heating appliances
- 1.2 List water heating appliances
- 1.3 Identify fuel fired equipment for use in manufacturing processes
- 1.4 Identify how fuels are used for power generation
- 1.5 State the types of fuels used in heat producing equipment
- 1.6 State the methods of storing solid and bio-mass fuels
- 1.7 State the considerations when sizing a fuel store

Range

(AC1.3) **Processes:** kilns, furnaces, incinerators.

(AC1.4) **Power generation:** gas turbine, coal fired.

(AC1.5) **Fuels - Gas:** natural gas, butane, propane.

(AC1.5) **Fuels - Oil:** Class C1 (Paraffin), Class C2 (Kerosene), Class D (Gas Oil), Class E (Light Fuel Oil), Class F (Medium Fuel Oil), Class G (Heavy Fuel Oil), Bio Liquids.

(AC1.5, AC1.6) **Fuels - Bio-mass:** pellets, wood chips, logs.

(AC1.5, AC1.6) **Fuels - Solid fuel:** bituminous, anthracite, lignite, sub bituminous, smokeless.

(AC1.5, AC1.6) **Methods of storing:** bunkers, silos, hoppers, underground, auger, suction.

(AC1.7) **Considerations:** fuel type, fuel usage, reliability of delivery, space, access for delivery vehicle.

Learning outcome

The learner will:

- 2 Understand the legislation and standards relevant to installing fuel systems

Assessment criteria

The learner can:

- 2.1 Identify relevant pieces of legislation and standards for installation of fuels
 - 2.2 Identify key registration bodies relevant to fuel systems
 - 2.3 State the purpose of registration bodies relevant to fuel systems
 - 2.4 State the competency and training requirements needed to install fuel systems
 - 2.5 Identify the professional bodies who represent the gas industry
-

Range

(AC2.1) **Legislations and standards:** Gas Safety Regulations, IGEM/UP/2, HSL56 Reg 24, OFTEC technical publications, Building Regulation (Part A, Part B Vol. 2, Part F, Part J, Part L2A and L2B, Part P), Institute of Gas Engineers and Managers Standards, British and European standards, Non Domestic Building Services Compliance Guide, Manufactures information, Control of Substances Hazardous to Health (COSHH), Dangerous Substances & Explosive Atmospheres Regulations (DSEAR), Pressure Systems Safety Regulations (PSSR), Pressure Equipment Directive (PED), Clean Air Act.

(AC2.2) **Registration bodies:** Gas Safe Register, OFTEC, HETAS.

Learning outcome

The learner will:

- 3 Understand the requirements when installing natural gas pipework

Assessment criteria

The learner can:

- 3.1 State the types of materials used for gas pipework
 - 3.2 Identify the different jointing methods used for gas pipework
 - 3.3 Describe the safety controls used on gas pipework
 - 3.4 State the requirements for supporting gas pipework
 - 3.5 State the requirements for sleeving gas pipework through walls
 - 3.6 State the requirements for installing gas pipework in ducts, voids and underground
 - 3.7 State the pressures used in gas systems
 - 3.8 Calculate the sizing of gas pipework, test and purge points
 - 3.9 Describe the methods of protecting and identifying gas pipework
 - 3.10 State the effects of vibration from appliances and equipment on gas pipework
-

- 3.11 State the correct method of installing equipotential cross bonding
 - 3.12 State the correct method of installing gas pipework in multi-story/multiple dwellings
 - 3.13 State the requirements of the Awareness of Hazardous area classification
-

Range

- (AC3.1) **Materials:** copper, steel, polyethylene (PE), corrugated stainless steel tube (CSST), flexible tubes.
 - (AC3.2) **Joining methods:** welding, flanges (welded & screwed), flange categories, union joints, screwed, semi-ridged couplings, compression fittings, CSST Fittings, electro fusion weld, capillary joints, press fit, swivel joints, quick release coupling, brazing, expansion joints.
 - (AC3.3) **Safety controls:** emergency controls, manual isolation valves, automatic isolation valves, automatic valve shut off times, meters, regulators, non-return valves, filters, solenoids, safety shut off valves, boosters, proving systems, low pressure cut-off valve, pressure/flow switch.
 - (AC3.6) **Ducts, voids:** definition of a duct, ventilation, other services, unventilated ducts and voids.
 - (AC3.6) **Underground:** precautions, distance from buildings, depth, protection, identification, entry and exit from buildings.
 - (AC3.7) **Pressures:** low, medium, intermediate, high.
 - (AC3.9) **Methods:** coatings, ducts, sleeves, colour coding, tape, labels, line diagrams.
 - (AC3.13) **Requirements :** minimum number of joints. Ventilation of pipework, access for inspection.
-

Learning outcome

The learner will:

- 4 Understand the basic ventilation requirements for fuel burning appliances

Assessment criteria

The learner can:

- 4.1 Explain the reasons for ventilation
 - 4.2 State the methods of providing ventilation
 - 4.3 Identify the signs of inadequate ventilation
-

Range

- (AC4.1) **Reason:** safe operation, complete combustion, cooling.
 - (AC4.2) **Methods:** natural ventilation, mechanical ventilation, ducted ventilation, high level, low level, grills, vents.
-

Learning outcome

The learner will:

- 5 Understand the flueing systems for fuel burning appliances
-

Assessment criteria

The learner can:

- 5.1 State the function of a flue
- 5.2 Describe the operation of a flue
- 5.3 Identify the different types of flues
- 5.4 State the classifications of flues
- 5.5 Identify the materials used in constructing flues
- 5.6 Identify the components in flue systems
- 5.7 State the general requirements for installing flues
- 5.8 State the procedure for carrying out a flue flow test

Range

- (AC5.3) **Types:** Individual, shared, natural draft, fan assisted, positive, negative, open, closed, room sealed, modular, fan dilution.
- (AC5.4) **Classification:** BS EN 1443, temperature, pressure, resistance to condensate, resistance to corrosion, soot – fire resistance.
- (AC5.5) **Materials:** twin wall flue pipe, single wall flue pipe, metal flue liner, concrete liner, flue blocks, high alumina cement pipes, kiln burnt/pumice pipes, salt glazed pipe, clay liners, stainless steel, plastics.
- (AC5.6) **Components:** Primary flue, secondary flue, down draft diverter, terminals, flue draft stabiliser, fans, pressure switches, flow switches, thermal insulation.
- (AC5.7) **Requirements:** suitability, size, length, route, termination, controls.

Learning outcome

The learner will:

- 6 Understand the requirements of oil installations

Assessment criteria

The learner can:

- 6.1 State the pipework layouts for oil installations
- 6.2 Identify the different jointing methods used for oil pipework
- 6.3 State the types of oil pipework materials
- 6.4 Identify the components used on oil pipework installations
- 6.5 State the requirements for oil tanks

Range

- (AC6.1) **Layouts:** single pipe system (bottom of oil storage tank above burner), two pipe system (bottom of oil storage tank below or level with burner), single pipe system (with dc-aeration device, bottom of oil storage tank below or level with burner) two pipe system (pipes connected through top of the tank).
- (AC6.2) **Jointing:** threaded, brazed, manipulative.
- (AC6.3) **Materials:** cooper, low carbon steel.

(AC6.4) **Components:** isolation valves, filters, de-aerators, fire valves, fusible links, steel tanks, plastic tanks, integrally banded tanks, underground tanks, fill pipe, extended fill pipe, vent pipe, drain valve, contents gauge, overflow alarms.

(AC6.5) **Requirements:** internal bunding, external bunding, siting, risk assessment, proximity to water source, proximity to drains, decommissioning.

Learning outcome

The learner will:

7 Understand the procedures for commissioning fuel supplies

Assessment criteria

The learner can:

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

7.2 Describe the procedures for testing and purging oil supplies

7.3 Describe the procedure for checking the operation of a fuel burning appliance

Learning outcome

The learner will:

8 Understand the requirements for fault finding on fuel systems

Assessment criteria

The learner can:

8.1 Identify common faults on fuel supplies

8.2 State how to repair common faults on fuel supplies

Range

(AC8.1, **Common Faults:** fuel leaks, no fuel flow, poor pressure, blocked filters, incorrectly set
AC8.2) pressure, tripped safety valves.

Learning outcome

The learner will:

9 Be able to install natural gas pipework without connecting to a live supply

Assessment criteria

The learner can:

9.1 Join pipework using the appropriate jointing methods and fittings

9.2 Connect an expansion device to pipework work that is fully supported

9.3 Join contrasting pieces of pipework with appropriate pressed joints and tools

9.4 Check jointing of pipework is gas tight

- 9.5 Install appropriate safety devices to pipework fittings
 - 9.6 Select and install correct isolation valves
 - 9.7 Carry out quality checks on pre-installed pipework jointing
-

Range

- (AC9.1) **Pipework:** corrugated stainless steel tube, steel, copper, PE.
- (AC9.1) **Jointing Methods:** jointing compounds, anaerobic sealants and tapes.
- (AC9.1) **Fittings:** taper threaded, flange, semi rigid compression couplings, capillary end feed.
- (AC9.5) **Safety devices:** bonding strap, permanent continuity bond.

Unit 308

Understand how to joint pipe work using Manual Metal Arc (MMA) and Tungsten Inert Gas (TIG) welding processes

Unit level:	Level 3
GLH:	40
Unit aim:	Learners will understand how to prepare and safely carry out pipe welding procedures using Tungsten Inert Gas (TIG) and Manual Metal Arc (MMA). Learners will understand the quality assurance processes of identifying and rectifying faults in completed pipe welds.

Learning outcome

The learner will:

- 1 Understand how to work safely when carrying out welding activities in the workplace

Assessment criteria

The learner can:

- 1.1 Identify current regulations and standards relevant to welding
- 1.2 Identify welding safe working practices
- 1.3 Describe common hazards associated with welding
- 1.4 Identify precautions to prevent fires and explosions
- 1.5 Identify relevant Personal Protective Equipment (PPE) for different situations when welding
- 1.6 State the requirements of setting up the area for pipe welding activities

Range

- (AC1.1) **Regulations and Standards:** Health and Safety legislation, Reporting of Injuries, Dangerous Diseases and Occurrences Regulation (RIDDOR), Electricity at Work (EAWR), TR5, Building Engineering Services Competence Assessment (BESCA), Provision and Use of Work Equipment Regulations (PUWER), Control of Substances Hazardous to Health (COSHH).
- (AC1.2) **Safe working practices:** work area, fire watch, method statements, hot work permits, risk assessments, Personal Protective Equipment (PPE).
- (AC1.3) **Hazards:** temperature, noise, fumes, gases, radiant heat, electricity, chemicals, fire.
- (AC1.5) **Situations:** the system's design, the conditions of the working environment, organisational procedures.
- (AC1.6) **Setting Up:** screens, barriers, noise control, trip hazards, Personal Protective Equipment (PPE), manual handling, hot work permit, storage of materials.

Learning outcome

The learner will:

- 2 Understand the working principals of pipe welding within Industrial and Commercial Heating and Ventilation

Assessment criteria

The learner can:

- 2.1 Describe the various working environments where pipe welding activities can take place
- 2.2 Identify the types of pipework and materials suitable for pipe welding
- 2.3 Describe different types of pipe welding
- 2.4 Describe different techniques and positions of pipe welding
- 2.5 Identify the advantages and limitations of different pipe welding techniques
- 2.6 Describe the use of different types of welding plant
- 2.7 Identify the advantages and limitations of different welding plants
- 2.8 Describe the applications for TIG welding equipment and consumables
- 2.9 Describe the applications for MMA welding equipment and consumables
- 2.10 Identify the safe storage procedures for welding consumables and equipment
- 2.11 Describe how to identify defects of consumables and fittings
- 2.12 Explain the changes to the mechanical properties of materials when being joined by welding
- 2.13 Explain the methods used to control and prevent stress and distortion to pipework during welding

Range

- (AC2.1) **Working environments:** commercial, industrial, agricultural/horticultural, leisure and entertainment, residential medical and care facilities, public services establishments (hospital/medical centre, school/college/university, museum/library, prisons, military bases, car parks, places of worship), pre 1919 traditional/historic buildings.
- (AC2.2) **Types of Pipework and Materials:** grades of low carbon steel, stainless steel, flanges, fitting and fixing accessories.
- (AC2.3) **Types of Welding:** Manual Metal Arc (MMA), oxy-acetylene, Tungsten Inert Gas (TIG).
- (AC2.4) **Techniques and Positions:** down hand, vertical up, horizontal vertical, overhead, set-on branch, fillet, multi-run welds, 1G, 2G, 5G, 6G.
- (AC2.6) **Plant:** AC and DC/polarity, arc welding sets, gas welding, generators, Rectifiers, Transformers, inverter.
- (AC2.8) **Equipment and Consumables (TIG):** TIG welding machine, welding torch, hoses (water or air), gas flow meter, gas source, tungsten, nozzle, collet, gas lenses, collet body, back cap, flange square.
- (AC2.9) **Equipment and Consumables (MMA):** electrode holders, cables, clamps, remote controllers, electrodes, flange square, chipping hammer, grinders, files.
- (AC2.13) **Stress and distortion:** longitudinal, bowing, angular, transverse, residual.

Learning outcome

The learner will:

- 3 Understand how to prepare prior to carrying out any pipe welding activities

Assessment criteria

The learner can:

- 3.1 Identify the key welding requirements of joint set up
- 3.2 Describe the techniques to cut, profile and bevel pipework
- 3.3 Describe how to interpret engineering drawings and welding specifications to locate pipework that needs to be welded
- 3.4 State the common symbols used on assembly drawings

Range

- (AC3.1) **Joint Set Up:** edge preparation (abrasive and mechanical), tacking procedure, root face, electrode selection, flame cutting, gaps.
- (AC3.2) **Techniques:** mechanical, abrasive, oxy-acetylene, plasma cutting.
- (AC3.4) **Symbols:** elementary symbols, supplementary symbols.

Learning outcome

The learner will:

- 4 Understand how to quality assure completed pipe welds

Assessment criteria

The learner can:

- 4.1 Describe the different methods of testing completed welded joints
- 4.2 Describe the quality control checks used to ensure compliance of welds
- 4.3 Describe common weld faults
- 4.4 Explain how to repair common weld faults

Range

- (AC4.2) **Quality Control Checks:** visual inspection, soundness testing (hydraulic and pneumatic), Destructive testing, non-destructive testing.
- (AC4.3, AC4.4) **Common weld faults:** slag inclusion, undercut, overlap, lack of fusion, cracks, lack of penetration, concave/convex profile, porosity.

Unit 309

Weld pipework using TIG welding methods

Unit level:	Level 3
GLH:	300
Unit aim:	In this unit learners will develop their practical skill in welding using the TIG process. They will learn how to work safely whilst preparing to connect pipework using TIG welding methods.

Learning outcome

The learner will:

- 1 Work safely when completing welding activities

Assessment criteria

The learner can:

- 1.1 Carry out a risk assessment prior to starting welding activities in accordance with the working environment
- 1.2 Ensure work area can be accessed safely by all personnel
- 1.3 Produce a method statement for the welding process in accordance with the working environment
- 1.4 Select the appropriate Personal Protective Equipment (PPE) to be worn

Range

(AC1.3) **Method statement:** material storage, availability of equipment, job instructions.

Learning outcome

The learner will:

- 2 Use correct preparation methods for pipe welding TIG

Assessment criteria

The learner can:

- 2.1 Select appropriate welding equipment, materials and associated tools to carry out welding
- 2.2 Ensure that the plans for welding the pipework are in accordance with the system design prior to starting work
- 2.3 Perform appropriate techniques to cut, profile and bevel pipework in preparation for welding

- 2.4 Prepare pipework including the pre-treatment, set-up, alignment and tacking for appropriate welds
-

Range

(AC2.1) **Materials:** TIG welding machine, welding torch, hoses (water or air), gas flow meter, gas source, tungsten, nozzle, collet, gas lenses, collet body, back cap, flange square.

Learning outcome

The learner will:

- 3 Connect pipework using industrial commercial welding techniques TIG

Assessment criteria

The learner can:

- 3.1 Weld pipework using suitable TIG welding techniques
 - 3.2 Weld a variety of different welded joints in various positions
 - 3.3 Perform visual inspections and appropriate tests of completed welds
 - 3.4 Carry out corrective action where required
 - 3.5 Fill out all relevant documentation and reports
 - 3.6 Correctly disposal of any waste materials
-

Range

- (AC3.2) **Welded joints:** butt welds, Horizontal vertical, flanges, weld on tees, weld on bends/elbows, branches, pipe headers.
- (AC3.2) **Various positions:** fixed and rotated, open and restricted access.
- (AC3.3) **Tests:** destructive (roof bend, macro-etching), non-destructive (hydraulic/pneumatic pressure, visual).
- (AC3.4) **Documentation:** test certificate, assessment documentation.

Unit 310

Weld pipework using MMA welding methods

Unit level:	Level 3
GLH:	300
Unit aim:	In this unit learners will develop their practical skill in welding using the MMA process. They will learn how to work safely whilst preparing to connect pipework using MMA welding methods.

Learning outcome

The learner will:

- 1 Work safely when completing welding activities

Assessment criteria

The learner can:

- 1.1 Carry out a risk assessment prior to starting welding activities in accordance with the working environment
- 1.2 Ensure work area can be accessed safely by all personnel
- 1.3 Produce a method statement for the welding process in accordance with the working environment
- 1.4 Select the appropriate Personal Protective Equipment (PPE) to be worn

Range

(AC1.3) **Method statement:** material storage, availability of equipment, job instructions.

Learning outcome

The learner will:

- 2 Use correct preparation methods for pipe welding MMA

Assessment criteria

The learner can:

- 2.1 Select appropriate welding equipment, materials and associated tools to carry out welding
- 2.2 Ensure that the plans for welding the pipework are in accordance with the system design prior to starting work

- 2.3 Perform appropriate techniques to cut, profile and bevel pipework in preparation for welding
 - 2.4 Prepare pipework including the pre-treatment, set-up, alignment and tacking for appropriate welds
-

Range

(AC2.1) **Equipment (MMA):** electrode holders, cables, clamps, remote controllers, electrodes, flange square, chipping hammer, grinders, files.

Learning outcome

The learner will:

- 3 Connect pipework using industrial commercial welding techniques MMA

Assessment criteria

The learner can:

- 3.1 Weld pipework using suitable MMA welding techniques
 - 3.2 Weld a variety of different welded joints in various positions
 - 3.3 Perform visual inspections and appropriate tests of completed welds
 - 3.4 Carry out corrective action where required
 - 3.5 Fill out all relevant documentation and reports
 - 3.6 Correctly disposal of any waste materials
-

Range

(AC3.2) **Welded joints:** butt welds, Horizontal vertical, flanges, weld on tees, weld on bends/elbows, branches, pipe headers.

(AC3.2) **Various positions:** fixed and rotated, open and restricted access.

(AC3.3) **Tests:** destructive (roof bend, macro-etching), non-destructive (hydraulic/pneumatic pressure, visual)

(AC3.5) **Documentation:** test certificate, assessment documentation.

Appendix 1 Relationships to other qualifications

Links to other qualifications

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications.

Literacy, language, numeracy and ICT skills development

This [these] qualification[s] can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales – see www.cityandguilds.com/esw

Appendix 2 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.

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues.

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
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

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

- **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.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification.

Specifically, the document includes sections on:

- The centre and qualification approval process and forms

- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Appendix 3 Useful contacts

UK learners General qualification information	E: learnersupport@cityandguilds.com
International learners General qualification information	E: intcg@cityandguilds.com
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	E: centresupport@cityandguilds.com
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	E: singlesubjects@cityandguilds.com
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	E: intops@cityandguilds.com
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e- assessment, Navigation, User/menu option, Problems	E: walledgarden@cityandguilds.com
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	E: business@cityandguilds.com
Publications Logbooks, Centre documents, Forms, Free literature	F: +44 (0)20 7294 2413

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City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

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