City & Guilds Level 2 Heating and Ventilating Installer Qualification (Industrial and Commercial) (6288-21)

Version 1.5 (March 2025)

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; Portfolio; Synoptic Assessment
Approvals	Automatic approval
Support materials	Assessment pack; Qualification handbook
Apprenticeship	This qualification is named on the Building Services Engineering Installer Standard to support the delivery of the on-programme element of the apprenticeship.
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
City & Guilds Level 2 Heating and Ventilating Installer Qualification (Industrial and Commercial)	768	914	6288-21	603/1590/8

Version and Date	Change Detail	Section
1.1 July 2017	Guided Learning Hours corrected	Qualification at a Glace Total Qualification Time
1.2 August 2017	Approval changed from Fast Track to Automatic	Centre Requirements
1.3 January 2018	Assessment types corrected to include the omitted assessment 308	Assessment
1.4 September 2018	Permitted materials added	Assessment
1.5 March 2025	Qualification title updated	Front cover, footer, Qualification at a Glance, TQT table
	Added statement around knowledge of legislative requirements for devolved nations	5 - Units

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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?	On completion of the Level 2 Heating and Ventilation Installer qualification, the learner will be in possession of the practical skills and knowledge to work on a range of specialised industrial and commercial installations. It is ideal for those starting out or wishing to progress their career in heating and ventilation, perhaps choosing to specialise in installing and maintaining industrial or commercial heating and ventilation systems.
What does the qualification cover?	The qualification covers the installation of heating and ventilation systems for industrial and commercial purposes. It covers the understanding of hot and cold water system installations, and the practical installation of the systems. It also covers the preparation and fabrication of heating and ventilation pipework systems, and an understanding of testing, charging and decommissioning of heating and ventilation pipework systems.
What opportunities for progression are there?	Successful completion of the qualification could help you progress into a range of roles including heating and ventilating engineer. It would also allow you to progress onto a level 3 qualification.
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 Installer apprenticeship standard.
Is it part of an apprenticeship framework or initiative?	This qualification is named on the Building Services Engineering Installer Standard to support the delivery of the on-programme element of the apprenticeship.

Structure

City & Guilds Level 2 Heating and Ventilating Installer Qualification (Industrial and Commercial)		
City & Guilds unit number	**Unit title**	**GLH**
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
203	Communicate with others within building services engineering	24
204	Understand industrial and commercial hot water systems installations	30
205	Understand industrial and commercial cold water systems installations	30
206	Understand industrial and commercial hot water heating systems installations	30
207	Understand industrial and commercial chilled water systems installations	30
208	Preparation and fabrication of heating and ventilation pipework systems	390
209	Installation of Industrial and Commercial Heating and Ventilation Systems within the workplace	96
210	Understanding testing, charging and decommissioning of heating and ventilation pipework systems	18

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
City & Guilds Level 2 Heating and Ventilating Installer Qualification (Industrial and Commercial)	768	914

2 Centre requirements

Approval

If your Centre is approved to offer the qualification Level 2 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation (6188-20) then you will automatically be approved to delivery the new Level 2 Heating and Ventilation Installer (Industrial and Commercial).

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 assignment guide.

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

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 one assignment for the units 203 and 208
- successfully complete onscreen E-volve tests for units 201 and 202
- successfully complete onscreen E-volve test that synoptically tests the contents of units 204, 205, 206, 207, 210
- have completed a portfolio of evidence for unit 209

Available assessments/assignments

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

- assignments, including different versions
- 3 onscreen multiple choice E-volve assessments
- a logbook to support the generation of a portfolio of evidence

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

City & Guilds has developed a template which tutors/assessors can use to write their own 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	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.
202	Understand how scientific principles are applied in heating and ventilation systems.	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.
203	Communicate with others within building services engineering	Assignment	This assignment can be found on the 6288 webpage of www.cityandguilds.com
208	Preparation and fabrication of heating and ventilation pipework systems	Assignment	This assignment can be found on the 6288 webpage of www.cityandguilds.com
209	Installation of industrial and commercial heating and ventilation systems within the workplace	Portfolio	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
501	Synoptic systems test	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.

Assessment strategy

Tables and content pertaining to the assessment strategy

Test Specifications

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

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

Permitted Materials: Closed book.

Grade scale: P/X

Estimated Passmark: 60%

Duration: 60 minutes		
Outcome	**Number of questions**	**%**
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**

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

Permitted Materials: Closed book, A Calculator is permitted.

Grade scale: P/X

Estimated Passmark: 60%

Duration: 60 minutes		
Outcome	**Number of questions**	**%**
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**

Test: 6288-501 Level 2 Synoptic Systems Test

Permitted Materials: Closed book, a calculator is permitted.

Grade scale: P/X

Estimated Passmark: 60%

Test: 6288-501	**Duration: 90 minutes**		
Unit	**Outcome**	**Number of questions**	**%**
204	1 Understand legislation, standards and guidance relating to the installation of hot water systems	4	7
204	2 Understand industrial and commercial hot water system layouts and working principles	4	7
204	3 Understand the system requirements for environmental technologies supplying hot water	3	5
204	4 Understand the requirements of basic control equipment in industrial and commercial hot water systems	3	5
205	1 Understand legislation, standards and guidance relating to the installation of cold water systems	4	7
205	2 Understand Industrial and commercial cold water system layouts and working principals	6	10
205	3 Understand the requirements for cold water supplies to commercial buildings.	3	5
206	1 Understand legislation, standards and guidance relating to the installation of industrial and commercial hot water heating systems	1	2
206	2 Understand different types of heat generating equipment	1	2
206	3 Understand industrial and commercial heating water system layouts and working principles	6	10
206	4 Understand the Environmental technology of industrial commercial hot water heating systems	3	5
206	5 Understand the types of heat emitters used in industrial and commercial hot water heating systems	3	5
207	1 Understand legislation, standards and guidance relating to the installation of chilled water systems	1	2
207	2 Understand different types of chillers	2	3

Test: 6288-501	Duration: 90 minutes		
207	3 Understand industrial and commercial chilled water system layouts and working principles	6	10
207	4 Understand the types of terminal devices used in industrial and commercial chilled water systems	1	2
207	5 Understand the principles of heat pump technology	3	5
210	1 Understand the procedures for carrying out a soundness test and charging an industrial and commercial pipework systems	3	5
210	2 Understand the decommissioning procedures for industrial and commercial pipework systems	3	5
	Total	**60**	**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.

Important note to centres: When delivering this qualification, it is necessary to ensure learners have knowledge of legislative requirements that considers each devolved nation of the United Kingdom.

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

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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

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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

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Range

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

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Range

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

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

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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, AC9.2) **Materials:**

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 203 Communicate with others within building services engineering

Unit level:	Level 2
GLH:	24
Unit aim:	This knowledge unit provides learning in the development and continued maintenance of effective working relationships in the building services industry, associated with work in industrial and commercial.

Learning outcome

The learner will:

1 Understand the roles and responsibilities of key members of the construction team within the building services engineering industry

Assessment criteria

The learner can:

1.1 Describe the key roles and responsibilities of every employee onsite

1.2 Describe the key roles and responsibilities of the site management team

1.3 Describe the key roles and responsibilities of the individuals that report to the site management team

1.4 Describe the key roles and responsibilities of site visitors

1.5 Identify the purpose of site meetings

Range

(AC1.1) **Employee:** promoting the image of the business, dress code, timekeeping, behaviours.

(AC1.2, AC1.3) **Site management team:** Architect, Project Manager/Clerk of Works, Structural Engineer, Surveyor, Building Services Engineer, Quantity Surveyor, Buyer, Estimator, Contracts Manager, Construction Manager, Client.

(AC1.3) **Direct reports to site management team:** sub-contractors, site supervisor, trade supervisor, trades (bricklayer, joiner, plasterer, tiler, electrician, heating and ventilation fitter, gas fitter, decorator, ground workers).

(AC1.4) **Site visitors:** Building Control Inspector, Water Inspector, HSE Inspector, Electrical Services Inspector, public, client.

(AC1.5) **Site meetings:** progress, deliveries, revisions, health and safety, access.

Learning outcome

The learner will:

2 Understand how different information sources are used in the building services engineering industry

Assessment criteria

The learner can:

2.1 State the purpose of information that is used in the workplace

2.2 State the purpose of information given to customers

Range

(AC2.1) **Workplace information:** job specifications, plans/drawings, work programmes, delivery notes, time sheets, company policy documentation – health & safety, environmental, customer service, variation order, material requisition, manufacturer instructions, site diary.

(AC2.2) **Customer Information:** quotations, estimates, invoices/statements, statutory cancellation rights, handover information.

Learning outcome

The learner will:

3 Understand how to communicate appropriately with others in the building services engineering industry

Assessment criteria

The learner can:

3.1 Identify key elements of data protection legislation within a construction environment

3.2 Identify the key elements of equal opportunities legislation within a construction environment

3.3 Identify suitable communication methods for use with a variety of people in work situations

3.4 State the benefits of good communication within the workplace

3.5 Explain the effect of poor communication within the workplace

3.6 State how conflict can be avoided in the workplace

3.7 State the actions to take when dealing with conflicts in the workplace

Range

(AC3.3) **People:** operatives, management, customers, suppliers, other trades.

(AC3.7) **Conflicts in the workplace:** customers and operatives, co-workers, supervisors and operatives.

Unit 204 Understand industrial and commercial hot water systems installations

Unit level:	Level 2
GLH:	30
Unit aim:	The aim of this unit is to gain an understanding of the installation and operating principals of industrial and commercial hot water systems.

Learning outcome

The learner will:

1 Understand legislation, standards and guidance relating to the installation of hot water systems

Assessment criteria

The learner can:

1.1 Identify current regulations and standards relevant to industrial and commercial hot water systems

1.2 State the storage and delivery temperatures of industrial and commercial hot water systems

1.3 Describe the methods to prevent scolding

1.4 State the methods for protection against contamination

1.5 Explain the reasons for the build-up of limescale in hot water systems

Range

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

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 Site Preparation
- Part E Sound
- Part P Electrical Safety

British Standards:

- BS EN 12897
- BS EN 806

The Water Supply (Water Fittings) Regulations, manufacturer's instructions, Non-Domestic Building Service Compliance Guide, Town and Country Planning

(AC1.3) **Methods of prevention:** risk assessment of the vulnerable, maximum bathing temperature Part G3, blending valves, thermostatic mixing valves, temperature stops, signage.

(AC1.4) **Methods of protection:** storage temperatures, dead legs, insulation, secondary circulation, trace heating, high temperature flushing, sacrificial anode.

(AC1.5) **Reasons:** water type, temperature, direct system, lack of treatment.

Learning outcome

The learner will:

2 Understand industrial and commercial hot water system layouts and working principles

Assessment criteria

The learner can:

2.1 Describe the working principals of hot water systems

2.2 Describe the installation requirements for industrial and commercial hot water systems

2.3 Describe methods to identify hot water pipework

2.4 State requirements for water treatment for hot water installation

2.5 Identify different types of hot water generators installed on industrial and commercial hot water systems

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Range

(AC2.1) **Hot water systems:** vented systems, indirect hot water, unvented systems, thermal storage, secondary circuits.

(AC2.2) **Installation requirements:** bracketry, insulation, bronze pumps.

(AC2.4) **Treatment:** equipment, flushing, procedures, types of treatment.

(AC2.5) **Hot water generators:** storage and non-storage calorifiers, heat exchangers, multi-point/single-point, direct fire storage heaters.

Learning outcome

The learner will:

3 Understand the system requirements for environmental technologies supplying hot water

Assessment criteria

The learner can:

3.1 State the system layouts and components of environmental technologies

3.2 Describe the benefits of using environmental technologies in industrial and commercial hot water systems

3.3 Identify the requirements for specialist fittings used in installation of environmental technologies

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Range

(AC3.1) **Environmental technologies:** solar thermal systems, solar Photovoltaic system, heat pump technology, condensing technology, biomass systems.

(AC3.2) **Benefits:** environmental, financial.

(AC3.3) **Requirements:** approved fittings, materials, jointing methods.

Learning outcome

The learner will:

4 Understand the requirements of basic control equipment in industrial and commercial hot water systems

Assessment criteria

The learner can:

4.1 Describe the operation of different types of control fittings

4.2 State the location of hot water thermostats

4.3 State the positions of blending valves

4.4 Identify specialist terminal fittings installed on commercial hot water systems

4.5 Explain the operating principals of basic control fittings within hot water systems

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Range

(AC4.1) **Types:** cylinder thermostats, overheat thermostats, pipe thermostats, motorised valves, time controls.

(AC4.2) **Location:** calorifiers, direct fired water heaters, pipework.

(AC4.3) **Positions:** baths, basins, minimum outlet length.

(AC4.4) **Terminal fittings:** infared taps, concussive taps, vented taps.

Unit 205 Understand industrial and commercial cold water systems installations

Unit level:	Level 2
GLH:	30
Unit aim:	The aim of this unit is to gain an understanding of the installation and operating principals of industrial and commercial cold water systems. Learners will have a basic understanding of the purpose of water regulations and the impact this has on them as a Heating and Ventilation Installer.

Learning outcome

The learner will:

1 Understand legislation, standards and guidance relating to the installation of cold water systems

Assessment criteria

The learner can:

1.1 Identify current regulations and standards relevant to cold water systems

1.2 State the purpose of the water regulations

1.3 Describe the fluid categories

1.4 Identify the health impacts of Legionnaires' disease

1.5 Identify the conditions which promotes the growth of legionella

1.6 Describe the practices for the prevention of legionella

1.7 Describe types of backflow prevention

Range

(AC1.1) **Regulation and standards:** The Water Supply (Water Fittings) Regulations and Scottish Water Byelaws, British Standards; BS EN 806, BS 6700, Water Regulation Advisory Scheme, Legionnaires' disease, L8.

(AC1.6) **Practices:** avoiding dead legs, cistern cross flow, insulation, temperature control, disinfection.

(AC1.7) **Backflow prevention:** mechanical and non-mechanical.

Learning outcome

The learner will:

2 Understand Industrial and commercial cold water system layouts and working principals

Assessment criteria

The learner can:

2.1 Describe the working principals of cold water systems

2.2 Describe methods to identify cold water pipework

2.3 Identify the position of valves and components within cold water systems

2.4 Describe the installation requirement for cold water storage cisterns

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Range

(AC2.1) **Cold water systems:** direct/indirect/boosted.

(AC2.3) **Valves and components:** stop valves, gate valves, servicing valves, check valves, float operating valves, RPZ, lever valves, butterfly valves, drain cocks, pressure reducing valves, blending valves, pumps, level switches, accumulator, drinking water header.

(AC2.4) **Cisterns:** storage cisterns, break tanks, sectional.

Learning outcome

The learner will:

3 Understand the requirements for cold water supplies to commercial buildings.

Assessment criteria

The learner can:

3.1 Identify the various sources of water supply

3.2 Describe the methods of water filtration/treatments

3.3 State the supply pipework entry requirements to buildings

3.4 Identify the types of suitable supply pipework materials

3.5 State the methods used to make connections to mains supply

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Range

(AC3.1) **Sources:** surface source, underground source, private source.

(AC3.2) **Water filtration/treatments:** Sand filters, ultraviolet, water softeners, osmosis.

(AC3.3) **Requirements:** depth, pressures, boundaries, protection, relation to other services.

(AC3.4) **Pipework materials:** PE, copper.

Unit 206 Understand industrial and commercial hot water heating systems installations

Unit level:	Level 2
GLH:	30
Unit aim:	The aim of this unit is to gain an understanding of the installation and operating principals of industrial and commercial hot water heating systems

Learning outcome

The learner will:

1 Understand legislation, standards and guidance relating to the installation of industrial and commercial hot water heating systems

Assessment criteria

The learner can:

1.1 Identify current regulations and standards relevant to hot water heating systems

Range

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

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.

Learning outcome

The learner will:

2 Understand different types of heat generating equipment

Assessment criteria

The learner can:

2.1 Describe different types of heat generating equipment

2.2 State the installation requirements for heat generating equipment

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Range

(AC2.1, AC2.2) **Types of heat generating equipment:** boilers, modular, high efficiency, cast iron sectional, steel shell, water tube, plate heat exchangers, non-storage calorifiers.

Learning outcome

The learner will:

3 Understand industrial and commercial heating water system layouts and working principles

Assessment criteria

The learner can:

3.1 Describe the working principals of hot water heating systems

3.2 State the working temperatures for industrial and commercial hot water heating systems circuits

3.3 Describe the installation requirements for industrial and commercial hot water heating systems

3.4 Describe methods to identify hot water heating pipework

3.5 State requirements for water treatment for hot water heating installations

3.6 Explain the positioning of valves and components within commercial hot water heating systems

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Range

(AC3.1, AC3.3) **Hot water heating systems:** low temperature, medium temperature, high temperature, steam, district heating, underfloor heating, constant temperature, variable temperature, open and sealed, 1 pipe, 2 pipe parallel, 2 pipe reversed return.

(AC3.5) **Treatment:** equipment, flushing, procedures, types of treatment.

(AC3.6) **Components:** hot water storage vessels, pumps/accelerators, expansion vessels, low loss headers, expansion bellows, expansion loops, dosing pots, air and dirt separators, pressurisation unit, feed and expansion cisterns, manifold.

(AC3.6) **Valves:** temperature and pressure relief, motorised, Gate, lockshield, DRV, NRV, test/metering station, 3 port diverting, 3 port mixing valve, 2 port valve, TRV, differential pressure control.

Learning outcome

The learner will:

4 Understand the Environmental technology of industrial commercial hot water heating systems

Assessment criteria

The learner can:

4.1 State the system layouts of environmental technologies relevant to hot water heating systems

4.2 Describe the benefits of using environmental technologies in Industrial and Commercial hot water heating systems

4.3 Describe how condensing technology is used to improve system efficiency

Range

(AC4.1) **Environmental technologies:** air to air heat pumps, air to water heat pumps, ground source heat pumps, biomass boilers, CHP.

(AC4.2) **Benefits:** less energy used, lower carbon emissions, financial savings, sustainable energy.

(AC4.3) **Condensing technology:** condensing boilers, heat transfer, sensible heat, latent heat.

Learning outcome

The learner will:

5 Understand the types of heat emitters used in industrial and commercial hot water heating systems

Assessment criteria

The learner can:

5.1 Identify types of heat emitters used within Industrial and Commercial hot water heating systems

5.2 Explain suitable applications for heat emitters

5.3 State the installation requirements for heat emitters within hot water heating systems

5.4 Describe the purpose of valves and components used to control heat emitters

Range

(AC5.1) **Types of heat emitters:** radiators, convector heaters (natural and assisted), panel heaters, ceiling coils, radiant heaters, LST radiators.

(AC5.2) **Applications:** types of occupants, location, building type, building use.

(AC5.3) **Installation requirements:** hanging, positioning, fixing, connection arrangements.

(AC5.4) **Components and valves:** lockshield valves, TRV, wheelhead, remote sensors, air vents, drain points.

Unit 207 Understand industrial and commercial chilled water systems installations

Unit level:	Level 2
GLH:	30
Unit aim:	The aim of this unit is to gain an understanding of the installation and operating principals of industrial and commercial chilled water systems.

Learning outcome

The learner will:

1 Understand legislation, standards and guidance relating to the installation of chilled water systems

Assessment criteria

The learner can:

1.1 Identify current regulations and standards relevant to chilled water systems

Range

(AC1.1) **Regulation and standards:** the Water Supply (Water Fittings) Regulations, Document L – Conversation of Fuel and Power, TR/20 Installation and testing of pipework systems Part six - Chilled water, manufacturer's instructions.

Learning outcome

The learner will:

2 Understand different types of chillers

Assessment criteria

The learner can:

2.1 Describe different types of chillers

2.2 Identify the connection requirements to chillers

2.3 Explain the vapour compression refrigeration cycle

2.4 Describe the components of the vapour compression refrigeration cycle

Range

(AC2.1) **Types of chillers:** air cooled, water cooled, absorption.

(AC2.4) **Components:** condenser, compressor, evaporator, expansion valve.

Learning outcome

The learner will:

3 Understand industrial and commercial chilled water system layouts and working principles

Assessment criteria

The learner can:

3.1 Describe the working principals of chilled water systems

3.2 State the working temperatures for industrial and commercial chilled water circuits

3.3 Describe the installation requirements for industrial and commercial chilled water systems

3.4 Describe methods to identify chilled water pipework

3.5 State requirements for water treatment for chilled water installations

Range

(AC3.1) **Chilled water systems:** air conditioning systems, chilled beams, fan coil units, heat rejection systems, water side, condenser side, condensation risk.

(AC3.2) **Circuits:** primary circuits, secondary circuits.

(AC3.3) **Installation requirements:** bracketry, vapour barrier, insulation.

(AC3.4) **Treatment:** equipment, flushing, procedures, types of treatment.

Learning outcome

The learner will:

4 Understand the types of terminal devices used in industrial and commercial chilled water systems

Assessment criteria

The learner can:

4.1 Describe types of terminal devices

4.2 State the requirements for connecting to various terminal devices

4.3 Explain the operating principals of basic control fittings within chilled water systems

Range

(AC4.1, AC4.2) **Devices:** fan coil units, chilled beams, chilled ceilings, air handling units.

(AC4.2) **Connection:** condensate, flexible, ridged.

(AC4.3) **Control fittings:** two port valves, three port valve, four port valves, commissioning valves.

Learning outcome

The learner will:

5 Understand the principles of heat pump technology

Assessment criteria

The learner can:

5.1 Identify types of heat pumps

5.2 Identify the advantages of different types of ground collectors

5.3 Describe the benefits of using heat pump technology

Range

(AC5.1) **Types:** air source, ground source, water source.

(AC5.2) **Ground collectors:** borehole, slinky, ground loop.

(AC5.3) **Benefits:** environmental, financial.

Unit 208 Preparation and fabrication of heating and ventilation pipework systems

Unit level:	Level 2
GLH:	390
Unit aim:	Upon completion of this unit learners will understand and carry out fabrication techniques on a variety of bracketry, fittings and pipework materials commonly used within the heating and ventilation industry. Learners will develop essential skills to enable them to plan and work efficiently, whilst considering environmental impacts.

Learning outcome

The learner will:

1 Understand how to carry out installation work using environmentally sound methods

Assessment criteria

The learner can:

1.1 State the procedures for the safe disposal of waste materials

1.2 Identify potential environmental impacts caused by building services engineering operations

1.3 Identify relevant environmental legislation that impact upon the building services engineering industry

1.4 Describe methods to reduce environmental impacts caused by building services engineering operations

Range

(AC1.1) **Waste materials:** copper, steel, plastics, building materials, reclaimed chemically treated water, asbestos.

(AC1.2) **Impacts:** noise, waste, water and land pollution, air quality.

(AC1.3) **Environmental legislation:** clean air, climate change, control of noise, control of substances hazardous to health, control of asbestos.

(AC1.4) **Methods:** working hours, waste segregation, company policy, permits to work, COSHH, ventilation of work areas, accurate measurements.

Learning outcome

The learner will:

2 Know the fixings, brackets and supports used within industrial and commercial pipework installation

Assessment criteria

The learner can:

2.1 Identify types of fixings and consumables for use with a range of materials

2.2 Identify types of brackets and hangers for use in industrial and commercial pipework installation

2.3 Identify pipe support accessories for use in industrial and commercial pipework installation

2.4 State the procedure for fixing heat emitters

Range

(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.

(AC2.1) **Materials:** brick, blockwork, concrete, wood and timber, plasterboard, metalwork.

(AC2.2) **Brackets & hangers:** malleable iron clips, rubber lined split band clips, roller and chair, U bolt, phenolic blocks, plastic clips, brass clips.

(AC2.3) **Pipe support accessories:** channel strut, anti-vibration mounts, channel nuts, L brackets, power arms, wire hangers, beam clamps, lightweight channel systems.

Learning outcome

The learner will:

3 Understand how to use hand and power-tools within industrial and commercial pipework

Assessment criteria

The learner can:

3.1 State the operation of common hand tools

3.2 State the operation of common power tools

3.3 Explain the use of different drill bits for a range of materials

3.4 Describe the maintenance checks and inspections required for hand and power tools

3.5 State the training requirements and prohibitions for persons operating and maintaining power tools

Range

(AC3.1) **Hand tools:** pipe wrench, hacksaw, pipe cutters, rod cutter, bending tools, hand stocks, chain tools, screwdrivers, files, Allen keys, pliers, chisels, flange bars, rivet guns, hammers, water level, boat level.

(AC3.2) **Power tools:** drills, reciprocating saw, pipe threading machine, grooving tools, crimping tools, grinding tools, chop saw.

(AC3.3) **Drill bits:** HSS, masonry, SDS, hole saws, auger.

(AC3.3) **Materials:** brick, blockwork, concrete, wood and timber, plasterboard, metalwork.

Learning outcome

The learner will:

4 Understand installation procedures for pipework systems within industrial and commercial pipework

Assessment criteria

The learner can:

4.1 Identify types and applications of fittings and jointing methods

4.2 Identify types and applications of pipework material

4.3 State the procedures used to bend and set a range of pipework materials

4.4 State the requirements for sleeving and fire stopping pipework

4.5 State the clipping and clearance distances for pipework systems

4.6 State methods to protect client's property during the installation procedure

4.7 Describe methods to improve installation efficiency

4.8 Identify approved standards relevant to fittings and materials

4.9 Identify the properties of types of pipework insulation

4.10 Describe how to make measurements for pipework installations

4.11 Describe the process used to check level of pipework installations

Range

(AC4.1) **Fittings and jointing methods:** malleable iron, screwed and socketed, carbon steel, crimped, collar, grooved, flanged, welded fittings, copper, end feed, internal solder ring, compression, brazing, brass, ABS, solvent weld, MDPE, fusion weld.

(AC4.2) **Material:** LCS (Heavy/medium), Carbon steel, stainless steel, galvanised steel, copper, plastics.

(AC4.3) **Procedures:** machine bending, spring bending, heat bending.

(AC4.7) **Methods (installation efficiency):** pre-fabrication, modular installation, housekeeping, storage.

(AC4.9) **Types:** mineral wool, foil backed, aluminium formed, cellular, foam.

(AC4.10) **Measurements:** face to face, face to centre, end to end, end to centre, centre to centre, X dimensions, thread lengths, thread engagement.

Learning outcome

The learner will:

5 Understand the application of valves and specialist fittings

Assessment criteria

The learner can:

5.1 Identify the approved British Standards for a range of valves and specialist fittings

5.2 Describe the operation of different types of valves and specialist fittings

5.3 State the installation requirements of valves and specialist fittings

5.4 Describe the operation of different types of pumps and circulators

Range

(AC5.1, AC5.2, AC5.3) **Valves:** gate, globe, lever, double regulating, stop tap, service, butterfly, Pressure reducing, pressure relief, temperature relief, thermostatic radiator, lock shield, differential pressure, drain, float operated, solenoid, two/three/four port.

(AC5.1, AC5.2, AC5.3) **Specialist fittings:** gauges, air vents, actuator, expansion vessel, expansion loop, expansion bellow, strainers, air dirt separators, commissioning points, sight glass, dosing pots.

(AC5.4) **Pumps and circulators:** centrifugal, belt driven, direct coupled, twin sets, multistage.

Learning outcome

The learner will:

6 Know the basic elements of a building

Assessment criteria

The learner can:

6.1 Identify building regulations relevant to the installation of industrial and commercial pipework systems and components

6.2 Identify the common elements of a building

6.3 Describe the common types of wall construction

Range

(AC6.2) **Elements:** sub-structure, foundations, super structure, vapour barrier, damp proof membranes.

(AC6.3) **Types:** block work, brick work, partition wall, cavity, cladding.

Learning outcome

The learner will:

7 Understand how to use drawings for the installation of pipework systems

Assessment criteria

The learner can:

7.1 Identify types of drawings used in building services engineering

7.2 Describe how scale is used within a drawing

7.3 Identify drawing symbols

7.4 Identify relevant information on installation drawings

7.5 Describe how to produce a 'take off' from drawings

Range

(AC7.1) **Types:** installation drawing, tender drawings, block plan drawings, schematic drawings, projection.

(AC7.4) **Information:** revision numbers, drawing numbers, pipe level indication, changes to heights, drawing titles, locations.

Learning outcome

The learner will:

8 Be able to work safely whilst carrying out pipework installations

Assessment criteria

The learner can:

8.1 Carry out the risk assessment of common building services engineering operations

8.2 Use information sources during building services engineering operations

8.3 Produce a method statement for a simple building services engineering operations

8.4 Use correct Personal Protective Equipment (PPE) whilst carrying out building services engineering operations

8.5 Check Personal Protective Equipment (PPE) is fit for purpose

8.6 Demonstrate correct safety checks of equipment used to carry out building services engineering operations

8.7 Demonstrate safe operation of equipment used within building services engineering operations

8.8 Demonstrate the safe erection of access equipment

8.9 Carry out the assembly of heat producing gas equipment

8.10 Select suitable electrical equipment for the safe isolation of electrical supplies

8.11 Demonstrate the safe isolation of electrical supplies

8.12 Demonstrate the use of temporary continuity bonding when altering fixed metallic pipework

8.13 Demonstrate safe manual handling techniques

8.14 Demonstrate safe working with common substances during building services engineering operations

Range

(AC8.1, AC8.2, AC8.3, AC8.4, AC8.6, AC8.7, AC8.14) **Building services engineering 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.

(AC8.2) **Information sources:** COSHH data sheets, manufacturers literature, HSE guidance notes, risk assessments, method statements, permit to work.

(AC8.4, AC8.5) **Personal Protective Equipment (PPE):** hard hat, eye protection, safety boots, gloves, flameproof overalls, ear protection, breathing apparatus, high visibility clothing.

(AC8.6, AC8.6) **Equipment:**

Power tools:

- power drills, grinders, crimping tools, circular saws, screwing machines, reciprocating saw, transformers and leads.

Access equipment:

- step ladders, extension ladders, mobile towers, pop ups.

Heat producing gas equipment:

- propane gas cylinder, hose, regulator, hand torch, acetylene cylinder, hose, regulator, flash back arrestor, hand torch.

Lifting aides:

- block and tackle, pump truck, trolleys, jacks, hydraulic lifts.

(AC8.8) **Access equipment:** step ladders, extension ladders, mobile towers, pop ups.

(AC8.9) **Heat producing gas equipment:** propane gas cylinder, hose, regulator, hand torch, acetylene cylinder, hose, regulator, flash back arrestor, hand torch.

(AC8.10) **Electrical equipment:** voltage meter, warning signs, padlock, clamp lock, GS 38 approved equipment, proving unit.

(AC8.14) **Common substances:** flux, cutting oils, jointing compounds, chemical inhibitor, chlorine, glycol, solvents.

Learning outcome

The learner will:

9 Demonstrate environmentally sound work practices in building services engineering

Assessment criteria

The learner can:

9.1 Demonstrate correct disposal of waste materials

9.2 Demonstrate methods to reduce negative environmental impacts during work

Range

(AC9.1) **Waste materials:** Copper, steel, plastics, building materials, reclaimed chemically treated water, asbestos and general building materials.

(AC9.2) **Methods:** considerate working hours, waste segregation, company policy, permits to work, COSHH, ventilation of work areas, efficient working practices.

Learning outcome

The learner will:

10 Use fixings, brackets and supports to install industrial and commercial pipework installations

Assessment criteria

The learner can:

10.1 Use a range of fixings to install pipework systems and components

10.2 Fix pipework systems and components to a range of building materials

10.3 Fabricate and install brackets and hangers to support pipework systems and components

10.4 Fabricate and install pipework support accessories to support pipework systems and components

Range

(AC10.1) **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.

(AC10.2) **Materials:** brick, blockwork, concrete, wood and timber, plasterboard, metalwork.

(AC10.3) **Brackets & hangers:** malleable iron clips, rubber lined split band clips, roller and chair, U bolt, phenolic blocks, plastic clips, brass clips.

(AC10.4) **Pipe support accessories:** channel strut, anti-vibration mounts, channel nuts, L brackets, power arms, wire hangers, beam clamps, lightweight channel systems.

Learning outcome

The learner will:

11 Demonstrate the safe use of hand and power tools within installation procedures

Assessment criteria

The learner can:

11.1 Select and use hand tools in a safe manner

11.2 Select and use power tools in a safe manner

11.3 Select and use a range of drills-bits on a range of materials

11.4 Carry out maintenance checks and inspections on power tools

11.5 Correctly store tools and equipment

Range

(AC11.1) **Hand tools:** pipe wrench, hacksaw, pipe cutters, rod cutter, bending tools, hand stocks, chain tools, screwdrivers, files, Allen keys, pliers, chisels, flange bars, rivet guns, hammers, water level, boat level.

(AC11.2) **Power tools:** drills, reciprocating saw, pipe threading machine, grooving tools, crimping tools, grinding tools, chop saw.

(AC11.3) **Drill bits:** HSS, masonry, SDS, hole saws, auger.

(AC11.3) **Materials:** brick, blockwork, concrete, wood and timber, plasterboard, metalwork.

Learning outcome

The learner will:

12 Carry out the fabrication and installation of industrial and commercial pipework

Assessment criteria

The learner can:

12.1 Fabricate pipework systems for installations

12.2 Demonstrate the use of a range of pipework materials

12.3 Demonstrate the use of a range of fittings and jointing methods

12.4 Carry out the bending and setting of pipework

12.5 Demonstrate the use of sleeves and fire stops in the installation of pipework

12.6 Demonstrate methods to improve efficiency during the installation process

12.7 Demonstrate methods to protect client's property

Range

(AC12.2) **Material:** LCS (Heavy/medium), Carbon steel, stainless steel, galvanised steel, copper, plastics.

(AC12.3) **Fitting and jointing:** malleable iron, screwed and socketed, carbon steel, crimped, collar, grooved, flanged, welded fittings, copper, end feed, internal solder ring, compression, brazing, brass, ABS, solvent weld, MDPE, fusion weld.

(AC12.6) **Methods for installation efficiency:** pre-fabrication, modular installation, housekeeping, storage.

Learning outcome

The learner will:

13 Carry out the installation of valves and specialist fittings within industrial and commercial installations

Assessment criteria

The learner can:

13.1 Install a range of valves

13.2 Install a range of specialist fittings

13.3 Install pumps and circulators

Range

(AC13.1) **Valves:** gate, globe, lever, double regulating, stop tap, service, butterfly, Pressure reducing, pressure relief, temperature relief, thermostatic radiator, lock shield, differential pressure, drain, float operated, solenoid, two/three/four port.

(AC13.2) **Specialist fittings:** gauges, air vents, actuator, expansion vessel, expansion loop, expansion bellow, strainers, air dirt separators, commissioning points, sight glass, dosing pots.

(AC13.3) **Pumps and circulators:** centrifugal, belt driven, direct coupled, twin sets, multistage.

Learning outcome

The learner will:

14 Be able to use drawings for the installation of industrial and commercial pipework systems

Assessment criteria

The learner can:

14.1 Follow drawings for the installation of pipework

14.2 Demonstrate the ability to produce drawings for the installation of pipework

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Range

(AC14.1) **Drawings:** installation drawing, tender drawings, block plan drawings, schematic drawings, projection.

Unit 209 Installation of industrial and commercial heating and ventilation systems within the workplace

Unit level:	Level 2
GLH:	96
Unit aim:	Leaners 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 Site

Preparation, Part E Sound, Part P Electrical Safety British Standards; BS EN 12897, BS EN 806,The Water Supply (Water Fittings) Regulations, manufacturer's instructions, Non-Domestic Building Service Compliance Guide, Town and Country Planning.

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

(AC3.1, AC3.2) **Components:** heat emitters, pumps, bellows, valves, heat exchangers, terminal devices, 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, AC4.3) **Pipework systems:** hot, cold, chilled, heating.

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

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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 210 Understanding testing, charging and decommissioning of heating and ventilation pipework systems

Unit level:	Level 2
GLH:	18
Unit aim:	Learners will understand the process and procedures for testing and charging of pipework systems. They will also understand the procedures to safely decommission pipework systems.

Learning outcome

The learner will:

1 Understand the procedures for carrying out a soundness test and charging an industrial and commercial pipework systems

Assessment criteria

The learner can:

1.1 Identify the requirements of pipework systems and components to confirm that they are ready to receive soundness tests

1.2 State the procedures for soundness testing of pipework and components

1.3 Identify the quality assurance checks that would indicate successful testing

1.4 State the actions that must be taken when inspection and testing reveals defects in pipework systems

1.5 Define procedures for flushing pipework systems

1.6 Define procedures for charging pipework systems

Range

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

(AC1.1) **Components:** heat emitters, pumps, bellows, valves, heat exchangers, terminal devices, expansion vessels.

(AC1.2) **Soundness testing procedures:** hydraulic, pneumatic.

(AC1.4) **Defects:** leaks, blockage, faulty component, incorrect installation.

Learning outcome

The learner will:

2 Understand the decommissioning procedures for industrial and commercial pipework systems

Assessment criteria

The learner can:

2.1 Identify the requirements of pipework systems and components to confirm that they are ready to be decommissioned

2.2 Identify the safe procedures for disposing of system water

2.3 State the procedures for decommissioning pipework systems and components

2.4 State the actions to take when normal emptying or shut off mechanisms for pipework systems do not operate

Range

(AC2.1) **Components:** heat emitters, pumps, bellows, valves, heat exchangers, terminal devices, expansion vessels.

(AC2.3) **Decomissioning procedures:** signage, isolation of supplies, venting.

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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