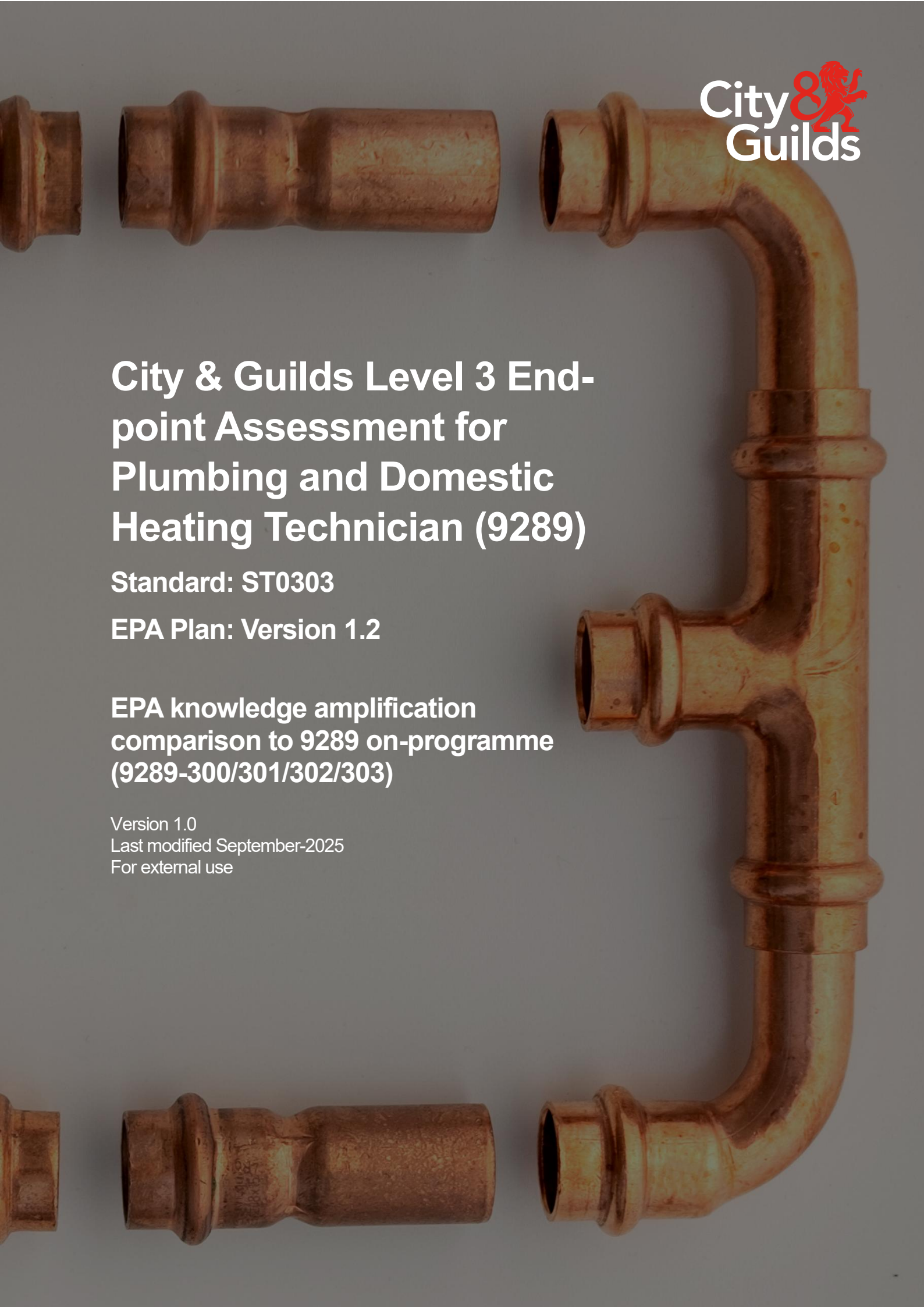

City & Guilds Level 3 End-point Assessment for Plumbing and Domestic Heating Technician (9289)

Standard: ST0303

EPA Plan: Version 1.2

EPA knowledge amplification comparison to 9289 on-programme (9289-300/301/302/303)

Version 1.0
Last modified September-2025
For external use

Version	Summary of changes	Section
1.0 September 2025	Document created	

End-point Assessment Knowledge Test Amplification – comparison to on-programme qualification (9289)

The amplified content for each Learning Outcome (LO) and Assessment Criteria (AC) in the End-point Assessment (EPA) will either:

- align to the City & Guilds Level 3 Diploma in Plumbing and Domestic Heating (9289-01/91/02/92/03/93) on-programme qualification **or**
- have additional or altered amplification to the assessment criteria in the on-programme qualification.

Providers and employers must ensure that the apprentice is familiar with the amplification content for the EPA as part of their preparation for the knowledge test.

The tables below show where the End-point Assessment ST0303 v1.2 knowledge test amplification of LO and AC is similar to the content of City & Guilds Level 3 Diploma in Plumbing & Domestic Heating v1.1 on-programme qualification (9289-01/91/02/92/03/93).

Amplification for 9289 EPA Domestic Air Source Heat Pump and Solar Thermal Systems Technician will be released in 2026.

Paper 1 (9289-300)		**9289-01/91/02/92/03/93**
Learning outcome	Assessment criteria	Unit and Learning Outcome
1. Know and apply health and safety legislation that applies to the building services industry.	1.1 Identify health & safety legislation in protecting the workforce and members of the public.	301 Health and safety systems LO1
	1.2 Identify responsibilities of members of the construction team.	
	1.3 Identify the legal status of health and safety guidance materials.	
	1.4 Identify the role of enforcing authorities.	
	1.5 Identify the control measures of inspectors.	
2. Understand hazardous situations working in the building services industry.	2.1 Identify types of site hazards that may be encountered while at work or by members of the public.	301 Health and safety systems LO2
	2.2 Identify strategies used to prevent accidents during work activities.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	2.3 Identify how the hazards of some substances and mixtures can be identified from the labels and packaging.	
	2.4 Identify how to deal with commonly encountered substances including disposal where applicable.	
	2.5 Identify common building materials and services components that may contain asbestos	
	2.6 Identify types of asbestos that may be encountered in the workplace.	
	2.7 Identify procedures that must be used to safely work with asbestos cement based materials.	
4. Understand how to respond to accidents.	4.1 Identify requirements for first aid provision in the workplace.	301 Health and safety systems LO4
	4.2 Identify actions that should be taken when an accident or emergency is discovered.	
	4.3 Identify procedures for dealing with minor injuries.	
	4.4 Identify procedures for dealing with major injuries.	
	4.5 Identify recording procedures for accidents and near misses at work.	
6. Understand how to work safely with heat producing equipment.	6.1 Identify various types of gases used in pipe jointing processes.	301 Health and safety systems LO6
	6.2 Identify how bottled gases and equipment should be safely transported and stored.	
	6.3 Identify various types of heat producing equipment and how to check them for safety.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	6.4 Identify how gas heating equipment is safely assembled and used.	
	6.5 Identify the three elements of the fire triangle and how combustion takes place.	
	6.6 Identify the dangers of working with heat producing equipment and how to prevent fires occurring.	
	6.7 Identify the method for fighting small, localised fires that can occur in the workplace in order to aid escape.	
7. Understand and safely use access equipment.	7.1 Identify situations where it may be necessary to work at height.	301 Health and safety systems LO7
	7.2 Identify how to select appropriate access equipment to permit work at heights.	
8. Understand working safely in excavations and confined spaces.	8.1 Identify situations where it may be necessary to work in excavations and confined spaces.	301 Health and safety systems LO8
	8.2 Identify safe working in excavations and confined spaces.	
	8.3 Identify dangers associated with excavations and confined spaces.	
	8.4 Identify safety measures when working in excavations and confined spaces	
10. Know types of plumbing and domestic heating system pipework and their jointing principles.	10.1 Identify pipework materials and sizes used in dwellings.	Unit 302 Common installation processes and techniques LO2
	10.2 Identify fitting types used in dwellings.	
	10.3 Identify methods of jointing pipework.	
	10.4 Identify methods of bending pipework.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
12. Understand and use clips and brackets to support plumbing and domestic heating pipework and components.	12.2 Identify types of fixing devices.	Unit 302 Common installation processes and techniques LO4
	12.3 Identify clip and bracket types.	
14. Understand units of measurement used in the plumbing and domestic heating systems industry.	14.1 Identify internationally recognised (SI) units of measurement.	Unit 303 Scientific principles LO1
	14.2 Identify the application and use of SI derived units.	
	14.3 Identify the use of conversion tables for non-SI units.	
15. Understand properties of materials.	15.1 Identify relative densities of common materials.	Unit 303 Scientific principles LO2
	15.2 Identify properties and applications of solid materials.	
	15.3 Identify why solid materials breakdown.	
	15.4 Identify methods of preventing corrosion.	
	15.5 Identify applications of liquids and gases.	
	15.6 Identify basic properties of liquids.	
	15.7 Identify basic properties of gases.	
16. Understand the relationship between energy, heat and power.	16.1 Identify the relationship between the Celsius and Kelvin temperature scales.	Unit 303 Scientific principles LO3
	16.2 Identify the principles associated with a change of state.	
	16.3 Identify the terms latent and sensible heat as they apply to liquids and gases.	
	16.4 Identify methods of heat transfer.	
	16.5 Identify how units of energy and heat are related and derived.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	16.6 Carry out heat, energy and power calculations.	
17. Understand principles of force and pressure and their application in the plumbing and domestic heating systems industry.	17.1 Identify the units of force and pressure derived from SI units.	Unit 303 Scientific principles LO4
	17.2 Identify pressure and flow rate units of measurements.	
	17.3 Identify the application of pressure and flow rate measurements.	
	17.4 Carry out simple force and pressure calculations.	
	17.5 Identify the relationship between velocity, pressure and flow rate in systems.	
	17.6 Identify how restrictions in the pipework effects the flow of liquids and gases.	
	17.7 Identify the principles of a siphon.	
18. Understand mechanical principles in the plumbing and domestic heating systems industry.	18.1 Identify principles of simple machines.	Unit 303 Scientific principles LO5
	18.2 Identify principles of basic mechanics.	
19. Understand principles of electricity in the plumbing and domestic heating systems industry.	19.1 Identify basic principles of electron flow theory.	Unit 303 Scientific principles LO6
	19.2 Identify the purpose and application of simple units of electrical measurement.	
	19.3 Carry out simple electrical calculations.	
	19.4 Identify the requirements for earthing of electrical circuits.	
	19.5 The testing and commissioning requirements applicable to electrical control systems and components.	
	20.1 Identify the different types of non-renewable energy.	Unit 314 Environmental technology systems

Paper 1 (9289-300)		9289-01/91/02/92/03/93
20. Know the sources of renewable and non-renewable energy.	20.2 Identify the different types of renewable energy.	LO1 LO4
	20.3 Identify the effects of using renewable and non-renewable energy sources.	
21. Know current energy efficiency advice and guidance.	21.1 Identify the benefits of energy efficient products, services and equipment.	Unit 314 Environmental technology systems LO4
	21.2 Identify the key factors of the Building Regulations and Guidance that apply to energy efficiency.	
22. Know the role of the construction team within the plumbing and domestic heating systems industry.	22.1 Identify key roles of the site management team.	Unit 304 Planning and supervision LO1
	22.2 Identify key roles of the site operatives.	
	22.3 Identify common site visitors.	
24. Know how to communicate with others.	24.1 Identify methods for effective communication with individual's needs.	Unit 304 Planning and supervision LO3
	24.2 Identify suitable communication methods.	
	24.3 Identify appropriate actions to deal with conflicting parties.	
	24.4 Identify the effects of poor communication with individuals.	
25. Understand responsibilities of relevant people in the building services industry.	25.1 Identify different types of client.	Unit 304 Planning and supervision LO4
	25.2 Identify what may be communicated to the client through the progress of a job.	
	25.3 Identify duties and methods for supervising staff.	
26. Understand and produce work programme for tasks in the plumbing and domestic heating systems industry.	26.1 Identify types of projects.	Unit 304 Planning and supervision LO6
	26.3 Identify the impact when materials are not delivered on time against the work programme.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	26.4 Identify factors which affect working time allocation to work activities.	
28. Understand cold water supply to dwellings.	28.1 Identify the key stages in the rainwater cycle.	Unit 305 Cold water treatment and routing LO1
	28.2 Identify the various sources of water and the typical properties of water from those sources.	
	28.3 Identify the types of water supply to dwellings and how these are regulated.	
	28.4 Identify the different types of water and uses of water in dwellings.	
	28.5 Identify the mains water treatment processes and typical mains water distribution system from treatment works to property.	
	28.6 Identify the private supply water treatment processes.	
	28.7 Identify water treatment processes and typical supply pipework and storage systems utilising harvested rainwater and recycled greywater.	
	28.8 Identify water service to the property and isolation points.	
	28.9 Identify the requirements to provide water whilst preventing waste, undue consumption, misuse or contamination.	
29. Understand and recognise the layouts of plumbing and domestic heating systems.	29.1 Identify types and layout features of cold water systems in dwellings.	Unit 306 Plumbing and domestic central heating system layouts LO1
	29.2 Identify the types and layout features of hot water systems in dwellings.	
	29.3 Identify the types and layout features of domestic central heating systems.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	29.4 Identify the types and layout features of sanitary pipework systems.	
	29.5 Identify the types and layout features of rainwater systems: pipe (RWP) and gutter.	
30. Understand and install cold water systems.	30.1 Identify fluid categories of water and uses of water supplied to dwellings.	Unit 307 Plumbing and domestic central heating systems LO1
	30.2 Identify the advantages and disadvantages of cold water systems.	
	30.4 Identify working principles of cold water systems, positioning fixing, connection and operation of components.	
	30.5 Identify layout and installation requirements for protected plastic storage cisterns.	
	30.6 Identify insulation requirements, system frost protection and prevention of undue warming of cold water systems.	
	30.9 Identify backflow risk and required methods of prevention.	
31. Understand and install hot water systems.	31.1 Identify advantages and disadvantages of hot water systems.	Unit 307 Plumbing and domestic central heating systems LO2
	31.2 Identify types and typical pipe sizes used in hot water systems within dwellings.	
	31.3 Identify working principles of hot water systems, positioning fixing, connection and operation of components.	
	31.4 Identify insulation requirements and system frost protection.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	31.6 Identify expansion and contraction in hot water systems and negative effects.	
	31.8 Identify secondary circulation and how trace heating can be used.	
	31.10 Identify backflow risk and required methods of prevention.	
32. Understand and install domestic central heating systems.	32.1 Identify advantages and disadvantages of types and layout features of heating systems.	Unit 307 Plumbing and domestic central heating systems LO3
	32.3 Identify working principles of types of central heating systems, positioning fixing, connection and operation of components.	
	32.4 Identify the importance of pump positioning.	
	32.5 Identify operating principles for system control.	
	32.6 Identify zoning and control requirements of central heating systems in accordance with statutory legislation.	
	32.7 Identify insulation requirements and system frost protection.	
	32.9 Identify expansion and contraction in central heating systems and negative effects.	
	32.11 Identify procedures for filling and venting system types.	
	32.12 Identify the operating principles of heat-producing appliances.	
33. Install sanitary appliances and pipework systems.	33.1 Identify advantages and disadvantages of sanitary appliances pipework systems.	Unit 307 Plumbing and domestic central heating systems

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	33.3 Identify working principles of sanitary appliances pipework systems and layouts and the positioning, fixing, connection and operation of components.	LO4
	33.5 Identify expansion and contraction in sanitary appliances pipework systems and negative effects.	
	33.7 Identify different types of sanitary appliances and components used in dwellings.	
	33.8 Identify factors that lead to trap seal loss in sanitary pipework systems.	
	33.9 Identify the suitability of below ground drainage systems to receive waste water.	
	33.10 Identify the installation features of sanitary facilities and equipment in dwellings for the disabled including wet rooms.	
	33.12 Identify working principles of greywater recycling systems.	
34. Understand and install rainwater systems.	34.1 Identify advantages and disadvantages of rainwater systems: pipe (RWP) and gutter.	Unit 307 Plumbing and domestic central heating systems LO5
	34.2 Identify typical sizes and materials used in rainwater systems: pipe (RWP) and gutter.	
	34.4 Identify expansion and contraction in rainwater systems and negative effects.	
	34.5 Identify factors affecting gutter bracket selection and fixing for buildings.	
36. Understand and perform a soundness test and	36.1 Identify information sources required to complete testing and commissioning.	Unit 309 Test plumbing and domestic central heating systems

Paper 1 (9289-300)		9289-01/91/02/92/03/93
commission cold water systems and components.	36.2 Identify how to fill and vent cold water systems.	LO1
	36.5 Identify the flushing requirements including the use of system additives for new and existing cold water systems.	
37. Understand and perform a soundness test and commission hot water systems and components.	37.1 Identify information sources required to complete testing and commissioning.	Unit 309 Test plumbing and domestic central heating systems LO2
	37.2 Identify how to fill and vent hot water systems.	
	37.5 Identify the flushing requirements including the use of system additives for new and existing hot water systems.	
38. Understand and perform a soundness test and commission central heating systems and components.	38.1 Identify information sources required to complete testing and commissioning.	Unit 309 Test plumbing and domestic central heating systems LO3
	38.2 Identify how to fill and vent central heating systems.	
	38.5 Identify the flushing requirements including the use of system additives for new and existing central heating systems.	
40. Understand and perform a soundness test and commission rainwater systems and components.	40.1 Identify information sources required to complete testing and commissioning.	Unit 309 Test plumbing and domestic central heating systems LO5
46. Understand and carry out service and maintenance on cold water systems.	46.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 312 Service and maintenance on plumbing and domestic central heating systems LO1
	46.3 Identify types of information to be provided on a maintenance record for cold water systems.	
	46.4 Identify requirements for legionella and bacterial growth control measures.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
47. Understand and carry out service and maintenance of hot water systems.	47.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 312 Service and maintenance on plumbing and domestic central heating systems LO2
	47.3 Identify types of information to be provided on a maintenance record for hot water systems.	
	47.4 Identify requirements for legionella and bacterial growth control measures.	
48. Understand and carry out service and maintenance on central heating systems.	48.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 312 Service and maintenance on plumbing and domestic central heating systems LO3
	48.3 Identify types of information to be provided on a maintenance record for central heating systems.	
49. Understand and carry out service and maintenance on sanitary appliances and pipework systems.	49.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 312 Service and maintenance on plumbing and domestic central heating systems LO4
	49.3 Identify types of information to be provided on a maintenance record for sanitary appliances and pipework systems.	
56. Know the basic operating principles of micro-renewable energy technologies.	56.1 Identify the basic operating principles of heat producing micro-renewable energy technologies.	Unit 314 Environmental technology systems LO2
	56.2 Identify the basic operating principles of heat-led microcombined heat and power.	
57. Understand requirements to install micro-renewable energy systems to existing systems.	57.1 Identify the suitability of building location and features when installing micro-renewable energy systems.	Unit 314 Environmental technology systems LO3

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	57.2 Identify statutory regulations affecting installation of microrenewable energy systems	
	57.3 Identify what would be typically classified as 'permitted development' under town and country planning regulations in relation to the deployment of technologies.	
	57.4 Identify which parts of the regulations apply in relation to the installation of environmental technologies.	
	57.5 Identify typical advantages and disadvantages associated with environmental technologies.	
58. Understand factors affecting fuel selection.	58.1 Identify the types of fuels used in appliances.	Unit 315 Domestic fuel systems LO1
	58.2 Identify the factors which affect the selection of fuels.	
	58.3 Identify sources of information for fuel supply installation.	
	58.4 Identify the regulatory type bodies which govern the installation of various fuel types.	
	58.5 Identify the storage requirements for fuels.	
	58.6 Identify factors which could affect storage requirements for fuels.	
59. Know combustion processes of fuel supplied systems.	59.1 Identify the combustion process.	Unit 315 Domestic fuel systems LO2
	59.2 Identify the main constituents of complete and incomplete combustion.	
	59.3 Identify causes of incomplete combustion.	
	59.4 Identify signs of incomplete combustion.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	59.5 Identify the symptoms of CO poisoning.	
	59.6 Identify the purpose of CO detectors.	
	59.7 Identify the requirements for ventilation.	
	59.8 Identify the different types of ventilation.	
	59.9 Identify installation practices for ventilation.	
60. Know principles of chimney/flue systems.	60.1 Identify the operating principles of chimney/flue systems.	Unit 315 Domestic fuel systems LO3
	60.2 Identify types of chimney/flue systems.	
	60.3 Identify the components within chimney/flue systems.	
	60.4 Identify the effects of layout on chimney/flue systems.	
	60.5 Identify the layout and features of chimney and flue construction.	
	60.6 Identify termination requirements for chimney/flue systems from relevant documents.	
	60.7 Identify basic inspection and testing procedures for chimney/flue systems.	
61. Understand and perform pre-installation activity prior to undertaking electrical work on plumbing and domestic heating systems.	61.1 Identify the limitations of your responsibility when carrying out work on electrical supplies and/or circuits for the control of plumbing and domestic heating systems.	Unit 316 Electrical work and the control of plumbing and domestic central heating systems LO1
	61.2 Identify the applications, advantages and limitations of electrical supplies.	

Paper 1 (9289-300)		9289-01/91/02/92/03/93
	61.3 Identify the applications, advantages and limitations of different electrical equipment, cables/wiring and components in relation to the working environment.	
	61.4 Identify the appropriate industry standards and regulations relevant to carrying out work on electrical supplies and/or circuits for the control of plumbing and domestic heating systems.	
	61.5 Identify how to verify that job information and documentation is current and relevant and that the plant, instruments, access equipment and tools are fit for purpose.	
62. Apply industry standard safe isolation procedures.	62.1 Identify the correct means of electrical isolation prior to commencing work.	Unit 316 Electrical work and the control of plumbing and domestic central heating systems LO2

Paper 2a (9289-301)		9289-02/92
Learning outcome	Assessment criteria	Unit and Learning Outcome
1. Know what an air source heat pump is, the principle of the vapour compression system and system components.	1.1 Identify key components of the vapour compression refrigeration cycle: • compressor • evaporator • expansion valve • condenser • refrigerant.	Unit 324 Air source heat pump systems LO2
	1.2 Identify how the vapour compression refrigerant circuit within a heat pump unit operates.	
2. Know the different operational characteristics of each type of heat pump unit and system arrangement.	2.1 Identify the different types of Air Source heat pump: • monoblock, fixed speed, inverter driven • split • air to air.	Unit 324 Air source heat pump systems LO1 LO2
	2.2 Identify the requirements of the current fluorinated greenhouse gases regulations in relation to: • the competence of personnel installing heat pumps where the refrigerant circuit has been assembled and tested by the product manufacturer • the competence of personnel installing and charging split air source heat pumps where the refrigerant circuit is to be assembled and tested in the location where the heat pump is to be installed and operated • the competence of personnel undertaking leakage checking on heat pump refrigerant circuits • the competence of personnel undertaking servicing of a split air source heat pumps • the competence of personnel undertaking recovery of fluorinated greenhouse gases from heat pump refrigerant circuits	

Paper 2a (9289-301)		9289-02/92
	• flammability of certain refrigerants.	
3. Know the fundamental principles of heat pump efficiency and design selection that are common for heat pumps.	3.1 Identify the meaning of the term 'Coefficient of Performance'.	Unit 324 Air source heat pump systems LO2 LO3
	3.2 Identify the relationship between Coefficient of Performance and the: • heat pump input temperature • heat pump emitter temperature.	
	3.3 Identify the effect that ambient temperature can have on: • coefficient of performance • heat pump output.	
	3.4 Identify the meaning of the term 'Seasonal Coefficient of Performance'.	
	3.5 Identify the factors that can affect the Seasonal Coefficient of Performance.	
	3.6 Identify the purpose and content of a products ErP label and product Fiche.	
	3.7 Identify the meaning of the term 'System Efficiency'.	
	3.8 Identify the factors that can affect the 'System Efficiency'.	
	3.9 Identify why achieving minimum heat loss from the building is particularly important when designing a heat pump system.	
	3.10 Identify the effect that oversizing of a heat pump has on: • system performance/efficiency • heat pump operation.	
	3.11 Identify the effect that under-sizing of a heat pump has on: • system performance/efficiency • heat pump operation.	
	3.12 Identify the meaning of the terms: • monovalent system • bivalent system • hybrid system.	

Paper 2a (9289-301)		9289-02/92
	3.14 Identify the meaning of the term ‘bivalent points’ in relation to heat pump output charts.	
	3.15 Identify how ‘bivalent points’ are used to determine auxiliary heat requirements.	
	3.16 Identify how heat pump output capacity is affected by: • heat pump input temperature • heat pump output temperature.	
	3.17 Identify the typical mean water temperature recommended when designing a hydraulic emitter circuit that incorporates: • standard panel radiators. • underfloor heating • fan assisted convector heaters • fan coils.	
	3.18 Identify the typical annual operating hours for a heat pump that is being used for: • heating only • heating and domestic hot water.	
	3.19 Identify how heat pump annual operating hours may vary in relation to the: • type of building • geographical location of the installation.	
5. Know the fundamental principles of domestic hot water cylinder selection and system design that are common for heat pumps.	5.1 Identify the different type of heat pump hot water cylinders: • heat pump, hot water packaged unit • coiled indirect cylinder • tank in tank cylinder • thermal store • solar cylinder.	Unit 324 Air source heat pump systems LO2 LO3
	5.2 Identify volume of hot water cylinder required for the building.	
	5.3 Identify output required from heat pump to heat the hot water cylinder.	
	5.4 Identify correct selection of hot water cylinder for the heat pump.	

Paper 2a (9289-301)		9289-02/92
	5.5 Identify correct zone valve selection for heat pump and hot water cylinder.	
	5.6 Identify requirements for secondary hot water circulation.	
	5.7 Identify safe system design in relation to regulations for: • legionella protection • hot water temperature protection and prevention of scalding.	
6. Know the fundamental principles of hydraulic system design that are common for heat pumps.	6.1 Identify the installation requirements where flow and return pipework passes through the external building fabric in relation to: • provision for movement • prevention of water ingress.	Unit 324 Air source heat pump systems LO4
	6.2 Identify the suitability of the following types of hydraulic heating system emitter for heat pump systems: • standard panel radiators • underfloor heating • fan assisted convector heaters • fan coils • combined systems (radiators, underfloor heating) • multiple zones.	
	6.3 Identify the installation requirements for the connection to the following types of hydraulic heating system emitter: • standard panel radiators • underfloor heating • fan assisted convector heaters • fan coils • combined systems (radiators, underfloor heating) • multiple zones.	
	6.4 Identify heat pump hydraulic flow rate requirements and circulation pump selection.	
	6.5 Identify heat pump pipe size requirements in relation to designed flow temperature.	

Paper 2a (9289-301)		9289-02/92
	6.6 Identify the correct pipe size requirements in relation to designed flow temperature.	
	6.7 Identify why a buffer vessel maybe required in the system design.	
	6.8 Identify if a buffer vessel is required in the system design and is correctly sized.	
	6.9 Identify correct piping alternatives for buffer vessels in the system design.	
	6.10 Identify the installation requirements for suitable insulation of external pipework in relation to: • thermal loss • protection against freezing • UV protection • animal protection.	
7. Know the fundamental principles of heat pump controls.	7.1 Identify the common control systems for heat pump units in relation to: • weather compensation • indoor and outdoor sensors • heat curves • scheduling • optimisation • accessories • internet connections and Apps.	Unit 324 Air source heat pump systems LO2

Paper 2a (9289-301)		9289-02/92
8. Know the preparatory work required for heat pump installation work.	8.1 Identify the common requirements of pre-installation checks for heat pump unit installations connected to hydraulic emitters circuits in relation to: • authorisation for the work to proceed • the availability and collation of all relevant information • verification of the suitability of the hydraulic emitter circuit for connection to the heat pump unit • verification that the heat output capacity of the heat pump unit is matched to the required proportional contribution of the total building heat load • verification that the buffer tank sizing is correct • the availability of appropriate access to all required work areas • the availability and condition of a suitable electrical input service • verify the correct fuse rating for heat pump • adequate provision for the siting of key internal system components • the suitability of the building structure in relation to the proposed installation • DNO notification • building regulation and assignment of rights.	Unit 324 Air source heat pump systems LO3 LO4
9. Know the preparatory work required for the installation of an air source heat pump.	9.4 Identify the requirements for moving and handling air source heat pumps units to avoid damage and personal injury. 9.5 Identify the options to deal with the condensate produced from normal and defrost cycle operation of an air source heat pump.	Unit 324 Air source heat pump systems LO1 LO2 LO4

Paper 2a (9289-301)		9289-02/92
	9.6 Identify suitable electrical supply in relation to: • District Network Operator (DNO) connection • isolation switches • fuse rating.	
10. Know the requirements to install and test air source heat pump systems (non-refrigerant circuits).	10.1 Identify the requirements for moving and handling heat pump units to avoid damage to the unit.	Unit 324 Air source heat pump systems LO4
	10.2 Identify the requirements to avoid undue noise and/or vibration transmission from the heat pump unit to the building structure during the operation of the heat pump.	
	10.3 Identify the requirements where brine circuit pipework passes through the external building fabric in relation to: • provision for movement • protection against freezing • prevention of water ingress.	
	10.4 Identify the charging and flushing requirements for hydraulic system in relation to: • correct filling and venting • purging of air and installation debris • addition of antifreeze protection and suitable cleansers and or inhibitors • checking for leaks • check filters for debris.	
	10.5 Identify what equipment is needed for system charging and flushing.	
	10.6 Identify the hydraulic test requirements.	
11. Understand the requirements to commission air source heat pump system installations (non-refrigerant circuits).	11.1 Identify the conditions that are required to implement commissioning activities for heat pump systems.	Unit 324 Air source heat pump systems LO4

Paper 2b (9289-302)		9289-02/92
Learning outcome	Assessment criteria	Unit and Learning Outcome
1. Know the health and safety risks and safe systems of work associated with solar thermal system installation work.	1.1 Identify which aspects of solar thermal system installation work pose risk of: • electrocution/electric shock • burns • toxic poisoning • injury through flash to steam of system heat transfer fluid • a fall from height • personal injury though component / equipment handling.	Unit 325 Solar thermal hot water systems LO1
	1.2 Identify safe systems of work for solar thermal system installation work in relation to prevention of: • electrocution/electric shock • burns • toxic poisoning • injury through flash to steam of system heat transfer fluid • a fall from height • personal injury though component/equipment handling.	
2. Know the requirements of relevant regulations/standards relating to practical installation, testing, and commissioning activities for solar thermal system installation work.	2.1 Interpret building regulation/building standards guidance documentation as relevant to solar thermal system installation work to identify the requirements in relation to: • maintaining the structural integrity of the building • maintaining the fire-resistant integrity of the building • the prevention of moisture ingress (building water tightness) • notification of work requirements • control of temperature in primary and secondary circuits including primary circuits connected to unvented hot water storage systems • energy conservation	Unit 325 Solar thermal hot water systems LO1 LO2

Paper 2b (9289-302)		9289-02/92
	• testing and commissioning requirements • compliance certification.	
	2.2 Interpret industry recognised water regulation/byelaw guidance documentation as relevant to solar thermal system installation work to identify the requirements in relation to: • prevention of contamination of the wholesome water supply • energy conservation • safe operation • testing and commissioning requirements.	
3. Know the types and layouts of solar thermal system.	3.1 Identify the following solar thermal system types: • fully filled (active) • drain back (active) • passive (thermos-siphon).	Unit 325 Solar thermal hot water systems LO3
	3.2 Identify the following solar thermal system storage vessel types and collector circuit arrangements: • direct (fully filled) DHW storage cylinder only • indirect, sealed collector circuit, DHW storage cylinder only (solar primary coil only) • indirect, sealed collector circuit, DHW storage cylinder only (dual coil) • indirect, sealed collector circuit, pre-heat cylinder and DHW storage cylinder • indirect, sealed collector circuit, thermal store.	
5. Know the types and key operating principles of solar collectors.	5.1 Identify the following types of solar collector: • unglazed collector • flat plate glazed collector • roof integrated glazed collector • evacuated tube collector – direct flow • evacuated tube collector – heat pipe.	Unit 325 Solar thermal hot water systems LO3

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	5.2 Identify the key operating principles for: • flat plate collectors • evacuated tube collector – direct flow • evacuated tube collector – heat pipe.	
	5.3 Identify the effect that the temperature difference between the solar primary circuit/collector temperature and the ambient temperature has on the relative efficiency of the following types of solar collector: • unglazed collector • flat plate glazed collector • evacuated tube collector.	
6. Know the information requirements to enable system component selection and sizing.	6.3 Identify the information requirements in relation to: • building occupancy • required hot water usage pattern.	Unit 325 Solar thermal hot water systems LO2
7. Know the fundamental techniques used to select, size and position components for solar thermal systems.	7.2 Identify how to determine typical domestic hot water system collector area requirements in relation to: • building occupancy • proposed angle of collector installation • proposed orientation of collector installation • shading that may affect collector performance.	Unit 325 Solar thermal hot water systems LO2
	7.3 Identify the annual irradiation yield as a % of optimum in relation to: • collector orientation • collector angle • proposed orientation of collector installation • shading that may affect collector performance.	
	7.4 State typical recommended solar primary circuit circulation rates.	

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	7.5 Identify solar primary circuit pipe size requirements in relation to: • primary circuit circulation rates • collector area • primary circuit pipework length.	
	7.6 Identify total solar primary circuit water content volume.	
	7.7 Identify total solar primary circuit expansion vessel size requirements in relation to: • primary circuit water content volume • collector height above cylinder.	
	7.8 Identify typical sizing requirements for drain back vessels in relation to: • net collector area • total volume of the system.	
	7.9 Identify solar primary circuit dynamic pressure drop and circulating pump size requirements for: • fully filled systems • drain back systems.	
8. Know how the performance of solar hot water systems is measured.	8.1 Identify the meaning of the term ‘solar fraction’.	Unit 325 Solar thermal hot water systems LO2
	8.2 Identify factors that affect the solar fraction.	
9. Know the preparatory work required for solar thermal system installation work.	9.1 Identify the requirements in relation to: • authorisation for the work to proceed • the availability of appropriate access to all required work areas.	Unit 325 Solar thermal hot water systems LO3

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	9.2 Identify the requirements of pre-installation checks in relation to: • the suitability of the proposed location and position of the solar collector(s) for optimum collection capacity • the suitability of the building structure and the building fabric in relation to the installation of system components • verification that the generation capacity of the proposed solar hot water system installation is appropriate to the hot water system energy load and usage • the inspection of existing hot water/heating system installations • water quality • the availability of a suitable electrical input service • the proposed siting of key internal system components.	
10. Know the requirements for connecting solar thermal system collector circuits to combination boiler domestic hot water circuits.	10.1 Identify the suitability of combination boilers to receive preheated water.	Unit 325 Solar thermal hot water systems LO2
	10.2 Identify the pipework layout and components required for connecting a solar thermal system to a combination boiler to include the: • arrangements for prevention of backflow • arrangements for ensuring that the combination boiler cold inlet supply water is provided at an appropriate temperature • arrangements for allowing stored hot water to be used directly from the store when the temperature of the stored water is appropriate.	

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11. Know the requirements for installing solar collector arrays.	11.1 Identify the positioning and fixing requirements and where appropriate the weathering requirements for the following solar collector types: • flat plate, surface mounted, inclined roof with single lap roof covering • flat plate, surface mounted, inclined roof with double lap roof covering • flat plate, integrated, inclined single lap roof covering • flat plate, integrated, inclined double lap roof covering • evacuated tube, inclined single lap roof covering • evacuated tube, inclined double lap roof covering • frame mounted, inclined (roof, wall or ground) • frame mounted, horizontal (roof or ground).	Unit 325 Solar thermal hot water systems LO2 LO3
	11.2 Identify the pipework layout, component requirements and component positioning requirements for the following system types and collector array connection arrangements: • fully filled system, collector array connected in series • fully filled system, collector array connected in parallel • fully filled system, collector array connected with east/west split • drain back system, single collector array.	
	11.3 Identify the requirements to achieve durable weather-tightness of buildings where collector array connection pipework passes through the building fabric.	
	11.4 Identify when specialist equipment is required in relation to preventing irradiation reaching collector absorbers during installation.	

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12. Know the requirements for installing for solar thermal system pipework.	12.2 Identify the requirements for pipework supports in relation to: • suitable materials • spacing of pipework supports.	Unit 325 Solar thermal hot water systems LO2 LO3
	12.3 Identify suitable pipework jointing methods in relation to: • system operating temperatures • system operating pressures • system chemicals.	
	12.4 Identify the requirements for pipework insulation for solar thermal system installation work in relation to: • system operating temperatures • system efficiency and performance • potential exposure of the insulation to ultra-violet rays/light • potential exposure of the insulation to adverse weather • the sections of installations that must be insulated • the sections of installations that must not be insulated • resistance to vermin attack.	
	12.5 Identify the requirements for installing pressure relief valve discharge pipework in relation to: • routing of pipework • termination of pipework.	

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13. Know the requirements to test and commission solar thermal system installations.	13.1 Identify the requirements to prepare for testing and commissioning in relation to: • compliance with the system design and specification • compliance with system/component manufacturer requirements • suitability of electrical supply circuit arrangements • flushing the system of installation debris • selection of suitable heat transfer fluid • filling and venting the hydraulic circuits • checking system water quality • protection against freezing • provision of system labelling.	Unit 325 Solar thermal hot water systems LO4
	13.2 Identify what specialist equipment is required in relation to: • the introduction and checking of system freeze protection fluids • setting system pressure • checking the corrosion protection of the system.	
	13.3 Identify the testing requirements for hydraulic circuits within solar thermal system installations in relation to: • hydraulic test pressure • hydraulic test duration.	

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Learning outcome	Assessment criteria	Unit and Learning Outcome
1. Understand health and safety risks and legislation associated with common processes for fabricating installing and testing non-domestic plumbing systems.	1.1 Identify which aspects of installation work pose health and safety risks.	Unit 327 Common processes and techniques in non-domestic plumbing systems LO1
	1.2 Identify safe systems of work for installation work.	
	1.3 Identify legislation relevant to installation, testing and commissioning.	
3. Know types of non-domestic plumbing systems pipework and their jointing principles.	3.1 Identify pipework materials and sizes used in non-domestic plumbing systems.	Unit 327 Common processes and techniques in non-domestic plumbing systems LO3
	3.2 Identify fitting types used in non-domestic plumbing systems.	
	3.3 Identify methods of jointing pipework used in non-domestic plumbing systems.	
	3.4 Identify methods of bending pipework used in non-domestic plumbing systems.	
4. Understand site preparation techniques for non-domestic plumbing systems work.	4.1 Identify work methods for preparing and protecting the building for installation work.	Unit 327 Common processes and techniques in non-domestic plumbing systems LO4
	4.2 Identify the pre-existing damage checks to the building fabric or customer property before the work commences.	
	4.3 Identify the methods of safe storing of tools and equipment.	
	4.4 Identify sources of information for carrying out preparatory work.	
7. Understand cold water supply to non-domestic premises.	7.1 Identify the typical mains water distribution system from treatment works to non-domestic premises.	Unit 328 Cold water supply to non-domestic premises LO1
	7.2 Identify the types of water supply to non-domestic premises and how these are regulated.	

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	7.3 Identify the different types of water and uses of water in non-domestic premises.	AC7.1 and AC7.4 are not covered for non-domestic premises.
	7.4 Identify the private supply water treatment processes and typical pipework systems from source to properties.	
	7.5 Identify water service to the premises and isolation points.	
	7.6 Identify the requirements to provide water whilst preventing waste, undue consumption, misuse or contamination.	
8. Understand and recognise the layouts of non-domestic plumbing systems.	8.1 Identify types and layout features of cold water systems in non-domestic and multi-storey premises.	Unit 329 Installation of non-domestic plumbing systems LO1
	8.2 Identify the types and layout features of hot water systems non-domestic premises.	
	8.3 Identify the types and layout features of sanitary pipework systems in non-domestic and multi-storey premises.	
	8.4 Identify the types and layout features of rainwater systems: pipe (RWP) and gutter in non-domestic premises.	
9. Install cold water systems in non-domestic and multi-storey premises.	9.1 Identify fluid categories of water and uses of water supplied to non-domestic premises.	Unit 329 Installation of non-domestic plumbing systems LO2 Unit 332 Fault diagnosis and rectification on non-domestic plumbing systems LO1
	9.2 Identify the advantages and disadvantages of cold water systems applicable to non-domestic and multistorey premises.	
	9.3 Identify the working principles of cold water systems applicable to non-domestic and multi-storey premises.	

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	9.4 Identify layout and installation requirements for protected cold water storage cisterns ≤ 1000 litres capacity.	
	9.5 Identify insulation requirements, system frost protection and prevention of undue warming of cold water systems.	
	9.8 Identify backflow risk and required methods of prevention.	
	9.10 Identify fault finding, diagnosis and rectification procedures applicable to plumbing (above 28mm) and non-domestic plumbing systems and appliances.	
10. Install hot water systems in non-domestic premises.	10.1 Identify advantages and disadvantages of hot water systems applicable to non-domestic premises.	Unit 329 Installation of non-domestic plumbing systems LO3
	10.2 Identify types and typical pipe sizes used in hot water systems within non-domestic premises.	
	10.3 Identify working principles of hot water systems, positioning fixing, connection and operation of components.	
	10.4 Identify expansion and contraction in hot water systems and negative effects.	
	10.5 Identify secondary circulation and how trace heating can be used.	
	10.7 Identify backflow risk and required methods of prevention.	
11. Install sanitary appliances and pipework systems in non-domestic and multi storey premises.	11.1 Identify advantages and disadvantages of sanitary appliance pipework systems applicable to non-domestic and multi-storey premises.	Unit 329 Installation of non-domestic plumbing systems LO4

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	11.2 Identify types and typical pipe sizes and maximum and minimum permitted distances used in sanitary appliance pipework within non-domestic and multi-storey premises.	Unit 332 Fault diagnosis and rectification on non-domestic plumbing systems LO3
	11.3 Identify working principles of sanitary appliances pipework systems, positioning fixing, connection and operation of components applicable to non-domestic and multi-storey premises.	
	11.5 Identify expansion and contraction in sanitary appliances pipework systems applicable to non-domestic and multi-storey premises and its negative effects.	
	11.7 Identify different types of sanitary appliances and components used in non-domestic and healthcare premises.	
	11.8 Identify the suitability of below ground drainage systems to receive waste water from non-domestic and health care premises.	
	11.9 Identify the installation features of sanitary facilities and equipment for the disabled in buildings other than dwellings.	
	11.11 Identify fault finding, diagnosis and rectification procedures applicable to plumbing (above 28mm) and non-domestic plumbing systems and appliances.	
12. Install rainwater systems in non-domestic premises.	12.1 Identify advantages and disadvantages of rainwater systems applicable to non-domestic premises.	Unit 329 Installation of non-domestic plumbing systems LO5

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	12.2 Identify typical sizes and materials used in rainwater systems: pipe (RWP) and gutter applicable to non-domestic premises.	
	12.3 Identify working principles of rainwater systems, (positioning fixing, connection and operation of components) applicable to non-domestic premises.	
	12.5 Identify expansion and contraction in rainwater systems applicable to non-domestic premises and its negative effects.	
15. Perform a soundness test and commission cold water systems and components in non-domestic and multi-storey premises.	15.2 Identify how to fill and vent cold water systems in non-domestic and multi-storey premises	Unit 331 Test and commission non-domestic plumbing systems LO1
	15.4 Identify the flushing requirements including the use of system additives for new and existing cold water systems in non-domestic and multi-storey premises.	
16. Perform a soundness test and commission hot water systems and components in non-domestic premises.	16.2 Identify how to fill and vent hot water systems in non-domestic premises.	Unit 331 Test and commission non-domestic plumbing systems LO2
	16.5 Identify the flushing requirements including the use of system additives for new and existing hot water systems in non-domestic premises.	
17. Perform a soundness test and commission sanitary appliances, pipework systems and components in non-domestic and multi-storey premises.	17.3 Identify a soundness test to industry requirements on sanitary appliances pipework systems and components in non-domestic and multi-storey premises.	Unit 331 Test and commission non-domestic plumbing systems LO3
23. Carry out service and maintenance on cold water systems in non-domestic and multi-storey premises.	23.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 332 Fault diagnosis and rectification on non-domestic plumbing systems LO1

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	23.2 Identify routine checks required on cold water system components and pipework as part of a periodic maintenance programme.	Unit 333 Service and maintenance of non-domestic plumbing systems LO1
	23.4 Identify requirements for legionella and bacterial growth control measures.	
	23.8 Identify fault finding, diagnosis and rectification procedures applicable to plumbing (above 28mm) and non-domestic plumbing systems and appliances.	
24. Carry out service and maintenance on hot water systems in non-domestic premises.	24.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 332 Fault diagnosis and rectification on non-domestic plumbing systems LO2
	24.4 Identify requirements for legionella and bacterial growth control measures.	Unit 333 Service and maintenance of non-domestic plumbing systems LO2
	24.6 Identify fault finding, diagnosis and rectification procedures applicable to plumbing (above 28mm) and non-domestic plumbing systems and appliances.	
25. Carry out service and maintenance on sanitary appliances and pipework systems in non-domestic and multi-storey premises.	25.1 Identify how to use manufacturer instructions and job maintenance schedules to establish the periodic servicing requirements of system components.	Unit 332 Fault diagnosis and rectification on non-domestic plumbing systems LO3
	25.2 Identify routine checks required on sanitary appliances and pipework systems as part of a periodic maintenance programme.	Unit 333 Service and maintenance of non-domestic plumbing systems LO3
	25.3 Identify types of information to be provided on a maintenance record for sanitary appliances and pipework systems.	

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	25.7 Identify fault finding, diagnosis and rectification procedures applicable to plumbing (above 28mm) and non-domestic plumbing systems and appliances.	