

Level 3 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems (7189-03)

September Version 1.3



Qualification at a glance

Subject area	Refrigeration and air conditioning
City & Guilds number	7189
Age group approved	16+
Entry requirements	Level 2
Assessment	By assignment/online multiple choice
Fast track	Available
Support materials	Qualification handbook Assessment Task Manual
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds number	Accreditation number
Level 3 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems	518	580	7189-03	600/5988/6

Version and date	Change detail	Section
1.2 March 2014	Test specification for 209/509 added	4. Assessment
1.3 September 2017	Added TQT and GLH details Deleted QCF	Qualification at a Glance, Structure Appendix



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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?	For candidates who want to work as refrigeration/air conditioning engineers in the building services engineering sector.
What does the qualification cover?	It allows candidates to learn, develop and practise the skills required for employment and/or career progression in the refrigeration, air conditioning and heat pumps sector.
What opportunities for progression are there?	Once learners have completed this qualification they can progress onto a wide variety of other qualifications. For further information please visit the City & Guilds website at www.cityandguilds.com .

Structure

To achieve the **Level 3 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems**, learners must achieve **58** credits from the mandatory units.

City & Guilds unit number	Unit accreditation number	Unit title	Credit value	Credit level	GLH
201/501	T/503/9669	Health and safety in building services engineering	3	2	26
209/509	D/502/0629	Handling fluorinated gases and ozone-depleting substances Category I Personnel	3	2	30
301	D/504/0752	Applying scientific principles to practical RAC and HP systems	13	3	116
302	K/504/1192	Complex RAC and HP systems	8	3	69
303	K/504/0754	Commissioning and troubleshooting Complex RAC and HP systems	8	3	71
304	T/504/0756	Work planning and organisation for RAC and HP systems	4	3	30
305	A/504/0757	Electrical power and control for RAC and HP systems	17	3	156
308	K/504/0253	Career awareness in building services engineering	2	3	20

Total Qualification Time

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

Title and level	GLH	TQT
Level 3 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems	518	580



2 Centre requirements

Approval

Centres already offering City & Guilds qualifications

If your Centre is approved to offer the following qualifications:

- **Certificate in Small Commercial Refrigeration and Air Conditioning Systems (6127)**
- **NVQ in Refrigeration and Air Conditioning Systems (6087)**
- **NVQ Diplomas in Refrigeration/Air Conditioning (6187)**

you can apply for the new **Level 3 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems (7189-03)** approval using the **fast track approval form**, available from the City & Guilds website.

Centres should use the fast track form if:

- there have been no changes to the way the qualifications are delivered, and
- they meet all of the approval criteria in the fast track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After 12 months, the Centre will have to go through the standard Qualification Approval Process. The centre is responsible for checking that fast track approval is still current at the time of application.

Centres NOT already offering City & Guilds qualifications

To offer this qualification, 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 qualification[s] before designing a course programme.

Resource requirements

Physical resources and site agreements

Centres can use specially designated areas within a centre to develop practical skills and to assess the simulated practical assignments. The equipment, systems and machinery must meet industrial standards and be capable of being used under normal working conditions.

Human Resources

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

- be technically competent in the area(s) for which they are delivering training and/or have experience of providing training
- hold appropriate qualifications detailed in this handbook
- have recent relevant experience in the specific area they are assessing
- be able to demonstrate occupational competence in the areas of the Building Services Engineering (BSE) for which they are delivering training and/or assessment. This competence must be at a level equal to, or above, the level of training being delivered and must include current knowledge and skills of each industry (for which the assessment is taking place), its techniques, settings, legislative and regulatory requirements, codes of practice and guidance
- have credible experience of providing training and/or assessment.

Centre staff may undertake more than one role, eg tutor and assessor or internal quality assurer, but must never verify their own assessments.

Assessors must;

- hold, or be working towards TAQA (A1/A2 – D32/33 updated) standards and continue to practice to these standards and possess CPD evidence of personally maintaining these standards, or
- have other suitable equivalent assessor qualifications endorsed by the Sector Skills Council and/or the Awarding Organisation.

Assessor Occupational Competence

For the purposes of this qualification, occupational competence will be deemed to have been demonstrated by the verifiable evidence of **one, preferably more**, of the following:

- **a relevant sector** qualification equal to or at a level above the training and/or assessment being delivered. Where earlier forerunner qualifications are held eg City & Guilds Craft or Advanced Craft Certificated, the assessor must demonstrate through CPD evidence a thorough knowledge of the qualification standards that they meet the required criteria
- **an up-to-date CPD record including relevant CPD qualifications.** Assessors must either be able to demonstrate that they are registered and up-to-date with their registration with an appropriate approved industry registration body or have one or more relevant occupational qualifications to demonstrate that they can be regarded as occupationally competent in terms of assessing or verifying the qualification and the unit contained
- **a verifiable CV** of industry experience and current knowledge of industry practice and techniques relevant to the occupational area in which they assess. This verifiable evidence must be **at or above the level being assessed**
- a thorough **knowledge and understanding** of the qualification standards and requirements

Assessor continuing professional development (CPD)

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed via CPD evidence and quality assured by City & Guilds.

It is the responsibility of the assessor to make use of opportunities for CPD such as industry conferences and events, access to trade publications and journals, SSC and professional/Trade Association events, at least on an annual basis to enhance and upgrade their professional development and technical knowledge.

It is imperative that evidence records of these CPD opportunities/occasions are maintained and retained in a verifiable CPD record.

Guidance note

Where questions arise about the occupational competence/qualification of an individual/trainer/assessor, these should be referred to the centre's Qualifications Adviser for a decision. The Qualification Advisor may decide to refer the decision to the Portfolio/Group Portfolio Consultant for further consideration.

Candidate entry requirements

Candidates should already hold the **Level 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems** or equivalent in order to complete the qualification satisfactorily.

Without evidence of formal qualifications, candidates must demonstrate adequate prior knowledge and experience to ensure they have the potential to gain the qualification.

Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as this qualification is not approved for under 16s.

Accreditation of prior learning (APL)

Guidance on APL between this qualification and the 6187 qualification will be available on the website by the start of November 2012.



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 qualification
- any units they have already completed, or credit they have accumulated which is relevant to the qualification
- 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, 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 this qualification:

Description	How to access
Level 2 Assessment Task Manual	City & Guilds website



4 Assessment

Assessment of the qualification

Unit Number	Unit Title	Assessment method	Where to obtain assessment materials
201/501	Health and safety in building services engineering	Practical Assignment (201) City & Guilds on-line multiple choice test (501) The assessment covers the knowledge and practical requirements of the unit and assesses all learning outcomes to verify coverage of the unit. Externally set assignment, locally marked and externally verified	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.
209/509	Handling fluorinated gases and ozone-depleting substances Category I Personnel	Practical Assignment City & Guilds on-line multiple choice test The assessment covers the knowledge and practical requirements of the unit and assesses all learning outcomes to verify coverage of the unit. Externally set assignment, locally marked and externally verified	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.

301	Applying scientific principles to practical RAC and HP systems	<p>Practical assignment</p> <p>The assessment covers the knowledge and practical requirements of the unit and assesses all learning outcomes to verify coverage of the unit.</p> <p>Externally set assignment, locally marked and externally verified.</p>	<p>Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.</p>
302	Complex RAC and HP systems	<p>Assignment</p> <p>The assessment covers the requirements of the unit and assesses all learning outcomes to verify coverage of the unit.</p> <p>Externally set assignment, locally marked and externally verified.</p>	<p>Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.</p>
303	Commissioning and troubleshooting Complex RAC and HP systems	<p>Assignment</p> <p>The assessment covers the requirements of the unit and assesses all learning outcomes to verify coverage of the unit.</p> <p>Externally set assignment, locally marked and externally verified.</p>	<p>Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.</p>
304	Work planning and organisation for RAC and HP systems	<p>Assignment</p> <p>The assessment covers the requirements of the unit and assesses all learning outcomes to verify coverage of the unit.</p> <p>Externally set assignment, locally marked and externally verified.</p>	<p>Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.</p>

305	Electrical power and control for RAC and HP systems	Assignment The assessment covers the requirements of the unit and assesses all learning outcomes to verify coverage of the unit. Externally set assignment, locally marked and externally verified.	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.
308	Career awareness in building services engineering	Assignment The assessment covers the requirements of the unit and assesses all learning outcomes to verify coverage of the unit. Externally set assignment, locally marked and externally verified.	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden.

Test Specifications

Test: Unit 501 Health and safety in building services engineering

Duration: 1 hour 15 mins

Unit	Outcome	Number of questions	%
	01 Know health and safety legislation	4	10
	02 Know how to handle hazardous situations	14	33
	03 Know electrical safety requirements when working in the building services industry	7	17
	04 Know the safety requirements for working with gases and heat producing equipment	8	19
	05 Know the safety requirements for using access equipment in the building services industry	4	9
	06 Know the safety requirements for working safely in excavations and confined spaces in the building services industry	5	12
	Total	42	100

Test: Unit 209/509 Health and safety in building services engineering

Duration: 1 hour and 20 minutes (80 minutes)

Test Section	Area	No. of Q's	%	
01	01.01	Identify standard units of temperature, pressure, mass, density, and enthalpy	13	32.5
	01.02	Describe basic theory of basic vapour compressions cycle, including key terms, and use of basic pH diagram		
	01.02	Describe the function of the four major components/processes (compressor, condenser, expansion device, evaporator)		
	01.02	Identify condition/state of refrigerant (ie superheated vapour/2 phase mix/subcooled liquid) by use of refrigerant comparator or service gauge		
	01.02	Determine reasonable operating conditions (sat. temperatures) for a condenser and evaporator, for a range of applications		
	01.02	Describe features of zeotropic blends		
	04.01	Understand the function of and role/importance of monitoring system performance for indications that leakage has occurred from: <ul style="list-style-type: none"> a. valves – service, pressure relief b. thermostats/pressure controls c. liquid line, receiver sight glasses and indicators d. defrost controls e. overloads f. service gauge manifold and thermometer g. oil control and separator systems h. high pressure receivers i. low pressure accumulators 		
02	02.01	Describe climate change and the Kyoto Protocol	6	15
	02.02			
	02.03	Understand direct and indirect Global Warming Potential (GWP) of the common HFC and HC refrigerants		
	02.04	Understand importance of energy efficiency on greenhouse gas emissions to the atmosphere		
	02.05	Describe the basic requirements of Regulation (EC) No. 842/2006 and other relevant regulations		
03	02.06	Describe the equipment records/commissioning data requirements to be recorded in such records	2	5

Test Section	Area		No. of Q's	%
04	04.01 04.02 04.06	Identify potential leakage points of refrigeration/air conditioning and heat pump equipment	2	5
05	04.03	State requirements and procedures for handling, storage, transportation and disposal of contaminated refrigerant and oil	2	5
06	04.04 04.06	Describe the function of a compressor and the risks of refrigerant leakage or release associated with it	2	5
	04.05	Identify the state/condition of a compressor that could lead to refrigerant release		
07	04.04 04.06	Describe the function of a condenser and the risks of refrigerant leakage or release associated with it	2	5
	04.05	Identify the state/condition of a condenser that could lead to refrigerant release		
08	04.04 04.06	Describe the function of an evaporator and the risks of refrigerant leakage or release associated with it	2	5
	04.05	Identify the state/condition of a evaporator that could lead to refrigerant release		
09	04.04 04.06	Describe the function of a thermostatic expansion valve and a capillary tube restrictor, and the risk of refrigerant release associated with them	2	5
	04.05	Identify the state/condition of a thermostatic expansion valve and capillary tube restrictor that could lead to refrigerant release		
10	03.01 03.02	Demonstrate knowledge of the potential of HCFC refrigerants to deplete ozone, and the effect of chlorine on ozone depletion. Identify the ODP of various HCFC refrigerants in use	2	5
	03.03 03.04	Describe the basic requirements of Regulation (EC) 2037/2000 and the impact of the Montreal Protocol		
11	05.02	Describe the hazards associated with refrigerant release, including a cold burns b asphyxiation c thermal decomposition d CNS effect e cardiac sensitisation	5	12.5
	05.03	Describe the hazards associated with flame brazing		
	05.01	Describe the hazards associated with pressure testing with nitrogen		
		Total	40	100



5 Units

Availability of units

The following units can also be obtained from The Register of Regulated Qualifications: <http://register.ofqual.gov.uk/Unit>

Structure of units

These units each have the following:

- City & Guilds reference number
- unit accreditation number
- title
- level
- credit value
- unit aim
- health and safety requirements
- learning outcomes which are comprised of a number of assessment criteria
- notes for guidance, where applicable.

Unit 201/501 Health and safety in building services engineering

UAN:	T/503/9669
Level:	Level 2
Credit value:	3
GLH:	26
Aim:	This combination unit provides learners with the essential health & safety knowledge and skills to demonstrate best practice in a business services engineering environment or sector. The unit provides learners with an awareness of relevant legislation and should underpin all business services engineering activities learners take part in.
Health and safety:	Health and safety behaviour learned in this mandatory unit should be displayed in all arenas.

Learning outcome
The learner will: 1. know health and safety legislation.
Assessment criteria
The learner can: 1.1 state the aims of health and safety legislation 1.2 identify the responsibilities of individuals under health and safety legislation 1.3 identify statutory and non-statutory health and safety materials 1.4 identify the different roles of Health and Safety Executive in enforcing health and safety legislation.

<p>Range</p> <p>Health and safety legislation The Health & Safety at Work Act, The Electricity at Work Regulations, Control of Substances Hazardous to Health (COSHH) Regulations, Working at Heights Regulations, Personal Protective Equipment at Work Regulations (PPE), Lifting and Manual Handling Operations Regulations, Provision and Use of Work Equipment Regulations, Control of Asbestos at Work Regulations, Health, Safety and Welfare Regulations, Health and Safety (First Aid) Regulations, Confined Spaces Regulations.</p> <p>Individuals Employers, employees and contractors, visitors to site.</p> <p>Health and safety materials Acts of Parliament, regulations, approved codes of practice, HSE Guidance notes.</p> <p>Roles Improvement notice, prohibition notice, powers of prosecution, providing advice and guidance.</p>
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<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to handle hazardous situations.</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 identify common hazardous situations found on site</p> <p>2.2 describe safe systems at work</p> <p>2.3 identify the categories of safety signs</p> <p>2.4 identify symbols for hazardous substances</p> <p>2.5 list common hazardous substances used in the building services industry</p> <p>2.6 list precautions to be taken when working with hazardous substances</p> <p>2.7 identify the types of asbestos that may be encountered in the workplace</p> <p>2.8 identify the actions to be taken if the presence of asbestos is suspected</p> <p>2.9 describe the implications of being exposed to asbestos</p> <p>2.10 state the application of different types of personal protective equipment</p> <p>2.11 identify the procedures for manually handling heavy and bulky items</p> <p>2.12 identify the actions that should be taken when an accident or emergency is discovered</p> <p>2.13 state procedures for handling injuries sustained on-site</p> <p>2.14 state the procedures for recording accidents and near misses at work.</p>

Range**Hazardous situations**

Trailing leads, slippery or uneven surfaces, presence of dust and fumes, handling and transporting equipment or materials, contaminants and irritants, fire, working at heights, malfunctioning equipment, improper use and storage of tools and equipment, potential presence of asbestos.

Safe systems at work

Method statements, permit to work systems, risk assessments, safety signs and notices.

Categories

Mandatory, prohibition, information, warning.

Symbols

Toxic, harmful, corrosive, irritant, oxidising, extremely flammable.

Hazardous substances

Lead - solid and fume, solvents and lubricants, fluxes, jointing compounds, sealants, gases – LPG, oxy-acetylene and carbon dioxide, cleaning agents.

Precautions

PPE, ventilation, risk assessment, method statements, safe systems of work.

Types of asbestos

White asbestos (Chrysotile), brown or grey asbestos (Amosite), blue asbestos (Crocidolite), asbestos cement materials.

Actions

Stop working immediately, report to supervisor.

Implications

Long-term health implications (mesothelioma, asbestosis).

Personal protective equipment

Clothing protection including high visibility, Eye protection, Hand protection, Head protection, Foot protection, Hearing protection, Respiratory protection.

Procedures for manually handling

Single, two-person lift, mechanical lift.

Actions

Raising the alarm, contact emergency services, follow typical emergency evacuation procedures, inform supervisor.

Procedures for handling injuries

Make self safe, make area safe, administer first aid where appropriate, contact emergency services, contact nominated first aid person, contact supervisor.

Procedures for recording accidents

RIDDOR, the use of company accident books, details to be recorded.

Learning outcome
The learner will: 3. know electrical safety requirements when working in the building services industry.
Assessment criteria
The learner can: 3.1 identify the common electrical dangers to be aware of on site 3.2 list different sources of electrical supply for tools and equipment 3.3 describe reasons for using reduced low voltage electrical supplies for tool and equipment on site 3.4 identify how to conduct a visual inspection of portable electrical equipment for safe condition before use 3.5 state actions to take when portable electrical equipment fails visual inspection 3.6 outline the Safe Isolation Procedure 3.7 state the procedures for dealing with electric shocks.

Range
Electrical dangers Faulty electrical equipment, damaged electrical equipment, exposed conductors, damaged insulation, worn electrical cables and cords, trailing cables, proximity of cables, buried/hidden cables.
Sources Battery powered supplies, 110 volt supplies, 230 volt supplies, generating sets.
Reasons Increased likelihood for damage to equipment, operative in better contact with earth, protect from electric shock, reduces trailing leads.
Visual inspection Checking for a valid PAT test, Inspection for general condition.
Actions Remove from use, report to supervisor.
Procedures Removal from supply, CPR method, contact emergency services, report to supervisors, treatment of minor burns.

Learning outcome

The learner will:

4. know the safety requirements for working with gases and heat producing equipment.

Assessment criteria

The learner can:

- 4.1 identify different **types of gases** used on site
- 4.2 describe how bottled gases and equipment should be safely transported and stored
- 4.3 describe how to conduct a **visual inspection** on heat producing equipment for safe condition
- 4.4 describe how **combustion** takes place
- 4.5 state the **dangers** of working with heat producing equipment
- 4.6 state the **procedures** to follow on discovery of fires on site
- 4.7 identify different **classifications of fires**
- 4.8 identify types of **fire extinguisher** for different classifications of fires.

Range**Types of gases**

Propane, butane, oxy-acetylene, nitrogen.

Visual inspection

Inspection for general condition.

Combustion

Three elements of the fire triangle.

Dangers

Fires, burns, fumes, equipment damage, explosions.

Procedures

Raise the alarm, follow safety evacuation procedures, fight fire if trained to do so.

Classifications of fires

Class A, B, C, D, electrical fires.

Fire extinguisher

Carbon dioxide, water, powder, foam.

Learning outcome
The learner will: 5. know the safety requirements for using access equipment in the building services industry.
Assessment criteria
The learner can: 5.1 identify different types of access equipment 5.2 select suitable equipment for carrying out work at heights based on the work being carried out 5.3 describe the safety checks to be carried out on access equipment 5.4 describe safe erection methods for access equipment .

Range
Types of access equipment Step ladders, ladders, roof ladders and crawling boards, mobile tower scaffolds, podiums fixed scaffolds and edge protection, mobile elevated work platforms including scissor lifts and cherry pickers, telescopic ladders.
Work being carried out Duration at work, action points for heights.
Safety checks Visual, tagging, fit for purpose, secure level ground.
Access equipment Step ladders, ladders, roof ladders, mobile tower scaffolds, podiums, telescopic ladders.

Learning outcome
The learner will: 6. know the safety requirements for working safely in excavations and confined spaces in the building services industry.
Assessment criteria
The learner can: 6.1 identify the situations in which it may be necessary to work in excavations 6.2 describe how excavations should be prepared for safe working 6.3 state precautions to be taken to make excavations safe 6.4 identify areas where working in confined space may be a consideration 6.5 state safety considerations when working in confined spaces.

Range
<p>Prepared Safe access into the excavation, trench support systems.</p> <p>Precautions Use of warning signs, use of barriers, vehicle proximity to excavation edges.</p> <p>Confined space Drainage systems, Plant rooms, Main service duct-rooms, In tanks, cylinders, boilers or cisterns, Under suspended timber floors, In roof spaces.</p> <p>Safety considerations Ventilation, lighting, PPE, evacuation procedures, medical conditions, lone working.</p>

Learning outcome
<p>The learner will:</p> <p>7. be able to apply safe working practice.</p>
Assessment criteria
<p>The learner can:</p> <p>7.1 perform manual handling techniques</p> <p>7.2 manually handle loads using mechanical lifting aids</p> <p>7.3 demonstrate the safe method of assembly of access equipment</p> <p>7.4 use access equipment safely.</p>

Range
<p>Manual handling Single, two-person lift.</p> <p>Access equipment Step ladders, ladders, mobile tower scaffolds.</p>

Unit 201/501 Health and safety in building services engineering

Supporting information

Guidance

Electrical equipment

Includes power tools, lights etc

Safe Isolation Procedure

Recommend referring to JIB Safe Isolation Procedure

On Site

Where reference to 'on site' is made in this unit, the intention is that this covers building sites and domestic sites.

It is recommended that assessors cover employee rights in relation to Health & Safety.

This First Aid element of this unit is not intended to replicate a full First Aid course but to give learners the underpinning knowledge to understand the types of injuries they may come across in a work place.

Unit 209/509 Handling fluorinated gases and ozone-depleting substances category I personnel

UAN:	D/502/0629
Level:	Level 2
Credit value:	3
GLH:	30
Aim:	Through this unit learners will gain knowledge of the theory and thermodynamics of vapour compression cycles and refrigerants. They will learn to identify causes and effects of global warming. Learners will develop skills to fabricate and examine pipework and pressure testing, taking account of health and safety considerations.
Health and safety	Health and safety behaviour learned in mandatory unit 201/501 should be displayed in all arenas.

Learning outcome
The learner will: 1. identify basic systems, terms, principles, units and how these relate to theory and thermodynamics of vapour compression cycles and refrigerants.
Assessment criteria
The learner can: 1.1 identify the standard units relating to category I systems 1.2 identify the terms and principles of basic theory/thermodynamics that relate to category I systems.

Learning outcome
The learner will: 2. identify the causes and effects of global warming and climate change.
Assessment criteria
The learner can: 2.1 identify the stated causes of climate change 2.2 identify how the Kyoto Protocol aims to reduce the effect of effects of greenhouse gas emissions 2.3 identify direct and indirect global warming potential (GWP) of the common hydrofluorocarbon (HFC) and hydrocarbon (HC) refrigerants 2.4 identify the importance of energy efficiency on greenhouse gas emissions to atmosphere 2.5 identify the basic requirements of Regulation (EC) No 842/2006 and other relevant regulations 2.6 identify the equipment records/commissioning data requirements of Regulation (EC) No 842/2006 and all appropriate regulations and standards.

Learning outcome
The learner will: 3. identify causes and effects of ozone depletion.
Assessment criteria
The learner can: 3.1 identify ozone depletion potential (ODP) of hydrochlorofluorocarbon (HCFC) refrigerants 3.2 identify the effect of chlorine on ozone depletion 3.3 identify the basic requirements of Regulation (EC) 2037/2000 3.4 identify the aims and impact of the Montreal Protocol.

Learning outcome
The learner will: 4. identify stationary refrigerant, air conditioning and heat-pump system components, functions and leakage risk.
Assessment criteria
The learner can: 4.1 identify the function of and the role/importance of monitoring system performance for indications that leakage has occurred from equipment (control and line components) relating to category I systems 4.2 identify potential leakage points of refrigeration/air conditioning and heat pump equipment 4.3 identify the requirements and procedures for handling, storage, transportation and disposal of contaminated refrigerant and oil 4.4 identify the function of stationary refrigeration, air conditioning and heat-pump system equipment (major components) 4.5 identify how the state/condition of equipment (major components) can lead to refrigerant release 4.6 identify the risks of refrigerant release associated with equipment (major, control and line components).

Learning outcome
The learner will: 5. identify the hazards and safe working practices for the installation, commissioning and handling of refrigerants.
Assessment criteria
The learner can: 5.1 identify the hazards and safe working practices associated with flame brazing 5.2 identify the hazards and safe working practices associated with nitrogen pressure testing 5.3 identify the hazards and safe working practices associated with refrigerant release.

Learning outcome
The learner will: 6. fabricate and examine pipework.
Assessment criteria
The learner can: 6.1 fabricate pipework test piece by completing brazed and mechanical joints to industry standards 6.2 install pipework test piece to testing station 6.3 visually examine pipework on testing station for signs of leakage 6.4 remove fabricated test piece from the system and inspect for penetration by a cut and peel test, upon completion of refrigerant recovery.

Learning outcome
The learner will: 7. undertake pressure testing, evacuation and record completion.
Assessment criteria
The learner can: 7.1 determine appropriate test pressures to BS EN378 standards 7.2 conduct strength tests to BS EN378 standards 7.3 undertake leak / tightness pressure tests to BS EN378 standards 7.4 evacuate the system to below 2 Torr/2000 microns/m bar/270 Pa 7.5 complete pressure testing and evacuation records.

Learning outcome
The learner will: 8. undertake refrigerant charging, leak checking and record keeping.
Assessment criteria
The learner can: 8.1 charge zeotropic blend into a system 8.2 record the weight of refrigerant charged (3 kg or more) 8.3 run a charged system 8.4 identify state of refrigerant in cylinder prior to charging 8.5 identify state of refrigerant in system while running 8.6 visually inspect the system for leaks 8.7 use equipment to accurately determine that the charge is correct 8.8 undertake an indirect leakage check 8.9 use an electronic leak detector to carry out a direct leak check to EU commission standard leak checking requirements 8.10 complete a leak check record 8.11 connect and disconnect gauges to/from running system with minimal refrigerant loss (by reducing gauge pressure to safe minimum) using a valve.

Learning outcome
The learner will: 9. undertake recovery of refrigerant and oil and prepare for disposal.
Assessment criteria
The learner can: 9.1 recover refrigerant from system into recovery cylinder 9.2 record weight of refrigerant recovered 9.3 drain oil out of a compressor to meet health & safety requirements.

Unit 301

Applying scientific principles to practical RAC and HP systems

UAN:	D/504/0752
Level:	Level 3
Credit value:	13
GLH:	116
Aim:	This unit allows learners to explore fundamental sciences to develop their understanding of how they relate to RAC and HP systems. There is particular emphasis on system design and efficiency and the use of both Ph and psychrometric charts as data sources. The unit concludes with theoretical calculations being applied to a range of practical system an engineer is likely to encounter.
Health and safety	Health and safety behaviour learned in mandatory unit 201/501 should be displayed in all arenas.

Learning outcome
The learner will: 1. understand RAC and HP system design.
Assessment criteria
The learner can: 1.1 identify heat load constituents in RAC and HP applications 1.2 identify heat load data from external information sources 1.3 calculate heat loads found in RAC and HP applications 1.4 design RAC and HP systems for calculated load.

Range
<p>Heat load constituents Building fabric, solar, air changes, infiltration, respiration, occupancy, product load, lighting, machinery, equipment, ventilation, temperature, humidity, activity.</p> <p>Applications cooling/heating single room occupancy, cooling / heating multi room/ multi occupancy, small commercial premises utilising ground source heat pump (ground coil, bore hole), fruit & vegetable chilling application, blast freezing application, cold storage application.</p> <p>Design Air conditioning, heat pump, commercial refrigeration, industrial refrigeration.</p>

Learning outcome
The learner will: 2. understand RAC and HP systems efficiencies.
Assessment criteria
The learner can: 2.1 plot on a pressure enthalpy chart the cooling cycle for refrigeration and air conditioning systems 2.2 manipulate pressure enthalpy chart data for system problem solving 2.3 compare system efficiencies at identical operating conditions 2.4 evaluate methods for improving system efficiencies 2.5 explain differences between plotted theoretical and practical systems.

Range
<p>Refrigeration and air conditioning systems Single stage system including cascade using a range of refrigerants including zeotropes, heat pump system using air, ground and water as a source of raw heat.</p> <p>Problem solving CoP (cooling and heating), work done, capacities for given mass flows, refrigerant quality, mass flows for given capacities, volume flows, density, temperatures, pressures.</p> <p>System efficiencies Single stage, two stage.</p> <p>Operating conditions Saturated suction -40C, condensing temperatures +40C, operating on ammonia.</p> <p>Methods Heat recovery, sub-cooling, super heat control, pressure ratio control, capacity control, reduce temperature difference, insulation.</p>

Learning outcome
The learner will: 3. understand relationship between psychrometric properties and plant design.
Assessment criteria
The learner can: 3.1 explain the effects of RAC and HP processes on the properties of air 3.2 manipulate psychrometric data for system problem solving 3.3 optimise plant design using psychrometric data.

Range
RAC and HP processes Sensible cooling, latent cooling, sensible heating, latent heating, air mixing.
Problem solving Mixed air, off coil conditions, apparatus dew point, coil contact factor, sensible heat ratio, room ratio line, supply air temperature, duct sizing (equal pressure drop method).
plant design Pre-heater, after heater, coil surface temperature.

Learning outcome
The learner will: 4. understand requirements for RAC and HP systems equipment.
Assessment criteria
The learner can: 4.1 select refrigerants for RAC and HP systems 4.2 select equipment for RAC and HP systems 4.3 balance equipment for RAC and HP systems 4.4 solve power calculations for RAC and HP systems 4.5 evaluate the Total Environmental Warming Impact (TEWI) for RAC and HP systems .

Range
Select refrigerants Application, performance, cost, environmental impact.
Select Match heat load calculations to data from different sources (catalogue, web based data, selection software).
Systems Cold store, blast freezer, chill store.

Unit 301 Applying scientific principles to practical RAC and HP systems

Supporting information

Evidence requirements

Calculations should be completed manually (with calculator) and can be checked using commercially available software

Guidance

1.2 Information sources could be any of the following: DOSSAT, ASHRAE, CIBSE, insulation and equipment manufacturers. Learners can be introduced to Smartphone applications but these should not be used in any assessment activities

UAN:	K/504/1192
Level:	Level 3
Credit value:	8
GLH:	69
Aim:	The purpose of this unit is to provide learners with the understanding of complex RAC and HP system components and their interrelationship for a range of applications. Learners will understand the construction and design of a range of system types operating on common refrigerants.
Health and safety	Health and safety behaviour learned in mandatory unit 201/501 should be displayed in all arenas.

Learning outcome
The learner will: 1. understand selection requirements for a range of complex RAC and HP system components.
Assessment criteria
The learner can: 1.1 select materials suitable for use with a range of refrigerants 1.2 select suitable components for a range of RAC and HP systems 1.3 compare performance for specified components using three refrigerants as a benchmark.

Range
Materials Ferrous metals, non-ferrous metals, oils, seal and gasket material.
Systems Direct expansion, flooded, pump overfeed, coldstore, chillstore, water chiller, VRF/VRV air conditioning, ground and air source heat pump, cascade, compound, transcritical, absorption.
Components Compressors, condensers, evaporators, expansion devices, intercoolers, surge drums.
Range of refrigerants R134a, R690, R717, R744.

Learning outcome

The learner will:

2. understand system design for complex RAC and HP systems.

Assessment criteria

The learner can:

- 2.1 select system layout for a range of RAC and HP **applications**
- 2.2 identify **pipework requirements** for a range of RAC and HP applications
- 2.3 select suitable **secondary refrigerants** for a range of applications
- 2.4 explain system **requirements** for systems using secondary refrigerants.

Range**Applications**

Direct expansion, flooded, pump overfeed, coldstore, chillstore, water chiller, VRF/VRV air conditioning, ducts, registers, diffusers, ground and air source heat pumps, cascade, compound, transcritical.

Pipework requirements

Oil return, pressure drop, suction risers, oil trapping, insulation, fixings, orientation, jointing methods, fittings.

Secondary refrigerants

Propylene and ethylene glycols, metallic salts in solution, water, alcohols, trade solutions.

Requirements

Mixing tanks, concentrators, reverse return piping, pumps, flow control valves, temperature, materials suitability for application.

Learning outcome
The learner will: 3. understand how systems are controlled in complex RAC and HP systems.
Assessment criteria
The learner can: 3.1 explain system control strategies for complex systems 3.2 assess suitability of control systems for different complex systems 3.3 compare defrost methods for complex systems 3.4 select system controls for a range of complex systems .

Range
Control systems BMS, EMS, Scada, local.
Defrost methods Electric, reverse cycle, water/brine spray, passive.
Complex systems Direct expansion, flooded, pump overfeed, coldstore, chillstore, water chiller, VRF/VRV air conditioning, dampers, AHUs, ground and air source heat pump.
System controls Electro-mechanical, solid state, pneumatic.

Unit 302 Complex RAC and HP systems

Supporting information

Guidance

Information can be found in any of the following: Dossat, Ashrae, manufacturers publications and the internet. Learners can be introduced to Smartphone applications but these should not be accessed for any assessment activities.

Unit 303

Commissioning and troubleshooting complex RAC and HP systems

UAN:	K/504/0754
Level:	Level 3
Credit value:	8
GLH:	71
Aim:	This unit will give the learner the understanding and practical skills to carry out commissioning and troubleshooting activities on complex RAC and HP systems. The commissioning activities are based on new operational systems, already charged with refrigerant. Troubleshooting activities are based on systems that have already been commissioned and are in operation.
Health and safety	Health and safety behaviour learned in mandatory unit 201/501 should be displayed in all arenas.

Learning outcome
The learner will: 1. understand requirements for commissioning complex RAC and HP systems.
Assessment criteria
The learner can: 1.1 identify key commissioning requirements for a range of systems 1.2 select equipment required for commissioning a range of systems 1.3 explain deviances between actual and design conditions on a range of systems 1.4 identify commissioning data required to meet industry standard .

Range [include where required, otherwise delete]
Range of systems DX multi evaporator, flooded and pump overfeed, compound, cascade and trans critical, VRV/VRF (2 and 3 pipe) air conditioning, heat pump systems, secondary cooling circuits.
Industry standard EN378, best practice, manufacturers requirements.

Learning outcome
The learner will: 2. be able to commission complex RAC and HP systems.
Assessment criteria
The learner can: 2.1 record commissioning data to industry standard 2.2 evaluate system performance from commissioning data 2.3 adjust systems to give required efficiency.

Range
Commissioning data Superheat, subcooling, coil delta T, pipework pressure drop, airflow, air distribution, air on and off temperatures, oil pressure, system pressures, running amperage's, Relative humidity, secondary flow rates.

Learning outcome
The learner will: 3. be able to troubleshoot complex RAC and HP systems.
Assessment criteria
The learner can: 3.1 identify system faults using a range of information 3.2 rectify faults in complex systems 3.3 document troubleshooting activities.

Range
Range of information Commissioning data, manufacturers manuals, system data, other information (internet customers, colleagues).
Faults Control valves, solid state controls, air sensors, air volume, flow switches, pumps and flow controls.

Unit 303 Commissioning and troubleshooting complex RAC and HP systems

Supporting information

Evidence requirements

Adjustments and troubleshooting to be made on a small complex multi-evaporator (3) system, a multi-outlet (4) duct system or a simulated three emitter water circulation system

Unit 304

Work planning and organisation for RAC and HP systems

UAN:	T/504/0756
Level:	Level 3
Credit value:	4
GLH:	30
Aim:	This unit has been designed to give students a broad understanding of organisations and work planning techniques. It is case study based using real companies so knowledge gained will be relevant and offer knowledge and understanding applicable to future employment.
Health and safety	Health and safety behaviour learned in mandatory unit 201/501 should be displayed in all arenas.

Learning outcome
The learner will: 1. know how different organisations are structured.
Assessment criteria
The learner can: 1.1 describe how organisations are structured 1.2 describe the main business function of the organisation 1.3 illustrate the task orientated reporting structure 1.4 state the organisational goals 1.5 describe how individuals contribute to the organisational goals .

Range
Structured Private limited company, public limited company, partnership, sole trader.
Main business function Servicing, manufacturing, commissioning, installation, design.
Organisational goals Mission statement, strategic objectives.

Learning outcome

The learner will:

2. understand work planning processes.

Assessment criteria

The learner can:

- 2.1 explain how competent planning contributes to **organisational goals**
- 2.2 explain how **resource** management affects efficiency
- 2.3 use **planning tools** to meet **organisational requirements**
- 2.4 explain how projects can **deviate** from plans
- 2.5 explain when a **work delay** should be compensated
- 2.6 describe the importance of **contracts**.

Range**Organisational goals**

Profit, growth, liquidity, corporate social responsibility.

Resource

Manpower, machinery / equipment, subcontractors, suppliers, clients.

Planning tools

Simple time / task, Gantt chart, Ishikawa (fish bone), critical path analysis, risk analysis, SWOT.

Organisational requirements

Contractual obligations, client expectations, profit margins, reputation, performance.

Deviate

Manpower, deliveries, subcontractors, faults, priority changes.

Work delay

Deliveries, subcontractors, equipment faults, client induced, services.

Contracts

Liquidated damages, variations, rise and fall, verbal and written.

Unit 304

Work planning and organisation for RAC and HP systems

Supporting information

Evidence requirements

This unit is assignment based using a case study of a UK based organisation. The organisation should be one that provides a contracting, service or maintenance function, ideally in the RAC and HP sector.

Guidance

This unit of work should be taught using a UK based organisation as a case study(s).

A theoretical approach to organisations and planning should lead the candidate into a case study of an organisation that is ideally contracting, service and or maintenance based. At least one organisation should be explored in some depth with an end goal of the candidate having a good knowledge of organisations, their human resources, structure and purpose.

Unit 305

Electrical power and control for RAC and HP systems

UAN:	A/504/0757
Level:	Level 3
Credit value:	17
GLH:	156
Aim:	This unit develops in learners the understanding of three phase electrical circuits and their control. Learners will apply their understanding by developing skills required to construct electrical circuits appropriate to RAC and HP systems.
Health and safety	Health and safety behaviour learned in mandatory unit 201/501 should be displayed in all arenas.

Learning outcome
The learner will: 1. understand the fundamental principles of three phase supply used in RAC and HP systems.
Assessment criteria
The learner can: 1.1 explain the fundamental principles of three phase supply 1.2 explain how three phase supply is protected .

Range
Principles of three phase supply a.c, frequency, phase angle, current, voltage, transforming potential, live and neutrals, power, power factor.
Protected MCB, fuse, cartridge fuse, thermal overload, isolator, phase failure, phase rotation.

Learning outcome
The learner will: 2. understand the principles of three phase electric motors.
Assessment criteria
The learner can: 2.1 explain the principles of three phase motors 2.2 explain starting arrangements for three phase motors 2.3 explain the protection arrangements for three phase motor starting arrangements 2.4 explain monitoring arrangements of electric motors.

Range
Principles of three phase motors Rotation, frequency, magnetic field, winding connections, Star, Delta, part-wind.
Starting arrangements Direct Online (Star, Delta) Star-Delta, part-wind, soft start, inverters.
Monitoring arrangements Current transformers, phase rotation, ammeters, tachometer, power.

Learning outcome
The learner will: 3. understand control circuitry.
Assessment criteria
The learner can: 3.1 explain relationship between power and control circuits 3.2 explain purpose of control circuits 3.3 explain control of three phase circuits using a range of voltages 3.4 explain control circuit protection methods 3.5 explain methods for fault finding in different voltage control circuits.

Range
Purpose Demand led, protection led.
Voltages 415, 240, below 50 (ac and dc).
Protection methods Fuse, MCB, thermal.
Methods Six point, half split, algorithmic, substitution.

Learning outcome

The learner will:

4. be able to construct electric circuits.

Assessment criteria

The learner can:

- 4.1 design **electrical circuits**
- 4.2 fix **components**
- 4.3 connect **components**
- 4.4 visually inspect **electrical circuits**
- 4.5 test **electrical circuits**
- 4.6 energise **electrical circuits**
- 4.7 measure **circuit parameters.**

Range**Electrical circuits**

Control circuit, power circuit (415V), Star-Delta.

Components

Isolator, circuit breaker, fuse, contactors, overloads, electric motor (suitable for Star-Delta and DOL), timers, relays, thermostat, pressure switch, emergency stop, mechanical interlocks.

Circuit parameters

Power and control circuit current and voltages, Star-Delta and Direct Online starting.

Unit 305 Electrical power and control for RAC and HP systems

Supporting information

Evidence requirements

LO4 control circuit, must be one 240V circuit and one low voltage circuit;
motor starting to be undertaken in Star-Delta and DOL

UAN:	K/504/0253
Level:	Level 3
Credit value:	2
GLH:	20
Aim:	<p>This unit will introduce learners to the concept of planning for own career development and setting goals to help realise plans. Learners will investigate the different crafts that make up Building Services Engineering.</p> <p>Learners are required to compile documents to support career plans including Curriculum Vitae and personal statements.</p> <p>The unit is designed to demonstrate to learners that there are many optional career pathways including becoming highly skilled in own craft or exploring supervisory responsibilities.</p>

Learning outcome
The learner will:
1. understand how to plan for careers in building services engineering.
Assessment criteria
The learner can:
1.1 identify resources to support career planning
1.2 describe elements of career planning
1.3 describe documents to support career development
1.4 explain the principles of goal setting
1.5 describe how to set goals
1.6 define the different roles in building services engineering
1.7 explain opportunities for progression within building services engineering
1.8 describe types of employment.

<p>Range</p>
<p>Resources Internet, publications, professional bodies/organisations, educational support and guidance, independent research, mentors, networking, job descriptions, role models, job centres, recruitment agencies, awarding organisations.</p> <p>Elements Goal setting, qualifications, Curriculum Vitae (CV), person specification, aspirations, work experience, SWOT analysis.</p> <p>Documents Curriculum Vitae (CV), personal statement, portfolio, cover letter, references, business plans.</p> <p>Principles SMART targets, SWOT analysis.</p> <p>Goals Short, medium, long.</p> <p>Roles Installation electrician, heating and ventilation service and maintenance engineer, plumber, heating and ventilation engineer, refrigeration engineer, maintenance electrician, ductwork installer, air-condition engineer.</p> <p>Opportunities for progression Supervisor, manager, business owner, highly skilled in craft, sideways moves to different crafts, assessor/trainer, designer, surveyor, estimator, apprenticeship, engineer, director.</p> <p>Types Contract work, private, consultancy, sub-contractor, casual labour.</p>

<p>Learning outcome</p> <p>The learner will:</p> <p>2. understand the requirements to become a qualified operative in building services engineering.</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 describe specific requirements for career choices in building services engineering</p> <p>2.2 identify the areas in building services which run competent person schemes</p> <p>2.3 define the term competent person scheme (CPS)</p> <p>2.4 identify the renewal requirements for being part of competent person schemes</p> <p>2.5 describe the consequences of not being part of the competent person scheme when working in building services engineering.</p>

Range
Specific requirements Qualifications, experience, competency, legal.
Areas Gas, hot water, cold water, electrical, air conditioning, solid fuel, environmental technologies, oil.
Term competent person scheme (CPS) To enable self-certification of own work carried out.
Consequences Fines, imprisonment, loss of license to practice, injury.



Appendix 1 Relationships to other qualifications

Links to other qualifications

This qualification has connections to the:

- Level 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems (7189)
- Level 2 Diploma in Heating and Ventilating (7188)
- Level 3 Diploma in Heating and Ventilating (7188)
- Level 2 Diploma in Plumbing Studies (6035)
- Level 3 Diploma in Plumbing Studies (6035)
- Level 2 NVQ in Plumbing and Heating (6189)
- Level 3 NVQ in Plumbing and Heating (6189)
- Level 3 NVQ in Electrotechnical Services (2357)
- Level 2 NVQ in Heating and Ventilating (6188)
- Level 3 NVQ in Heating and Ventilating (6188)
- Level 2 NVQ in Refrigeration and Air Conditioning (6187)
- Level 3 NVQ in Refrigeration and Air Conditioning (6187)
- Level 2 Diploma in Electrical Installations (Buildings and Structures) (2365)
- Level 3 Diploma in Electrical Installations (Buildings and Structures) (2365).

Literacy, language, numeracy and ICT skills development

This qualification 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:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- 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 such 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.

Useful contacts

UK learners General qualification information	T: +44 (0)844 543 0033 E: learnersupport@cityandguilds.com
International learners General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: intcg@cityandguilds.com
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 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	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: singlesubjects@cityandguilds.com
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: intops@cityandguilds.com
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: walledgarden@cityandguilds.com
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: business@cityandguilds.com
Publications Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

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