

Level 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems (7189-02)

August 2018 Version 1.4



Qualification at a glance

Subject area	Refrigeration and air conditioning
City & Guilds number	7189
Age group approved	16+
Entry requirements	None
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 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems	464	510	7189-02	600/6036/0

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
1.4 August 2018	Additional information regarding permitted materials for 202 added	Assessment



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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 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 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems**, learners must achieve **51** 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
202	J/504/0745	Scientific Principles within RAC and HP Systems	10	2	82
203	R/504/0747	Apply scientific principles to practical vapour compression systems	8	2	68
204	Y/504/0748	Functions and features of RAC and HP systems	9	2	87
205	D/504/0749	Service and maintain RAC and HP systems	5	2	48
206	R/504/0750	Install and commission RAC and HP systems	5	2	47
207	Y/504/0751	Electrical systems for RAC and HP systems	5	2	48
209/509	D/502/0629	Handling fluorinated gases and ozone-depleting substances Category I Personnel	3	2	30
210	J/602/2482	Understand how to communicate with others within building services engineering	3	2	28

Total Qualification Time

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

Title and level	GLH	TQT
Level 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems	464	510



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 2 Diploma in Refrigeration, Air Conditioning and Heat Pump Systems (7189-02)** 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 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 Adviser may decide to refer the decision to the Portfolio/Group Portfolio Consultant for further consideration.

Candidate entry requirements

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

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.
202	Scientific principles within RAC and HP Systems	City & Guilds on-line multiple choice test The assessment covers the knowledge requirements of the unit and assesses all learning outcomes to verify coverage of the unit	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden
203	Apply scientific principles to practical vapour compression systems	City & Guilds on-line multiple choice test The assessment covers the knowledge requirements of the unit and assesses all learning outcomes to verify coverage of the unit	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden
204	Functions and features of RAC and HP systems	City & Guilds on-line multiple choice test The assessment covers the knowledge requirements of the unit and assesses all learning outcomes to verify coverage of the unit	Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden

205	Service and maintain 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>
206	Install and commission 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>
207	Electrical systems for 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>
209/509	Handling fluorinated gases and ozone-depleting substances Category I Personnel	<p>Practical Assignment (209) City & Guilds on-line multiple choice test (509)</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>
210	Understand how to communicate with others within building services engineering	<p>City & Guilds on-line multiple choice test</p> <p>The assessment covers the knowledge requirements of the unit and assesses all learning outcomes to verify coverage of the unit</p>	<p>Go to www.cityandguilds.com and navigate to the 7189 webpage. Password available on the Walled Garden</p>

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 202 Scientific principles within RAC and HP systems

Duration: 1 hour 30 mins

Other instructions: 300mm ruler, fine point pen/pencil/and A3 psychrometric chart must be provided by the centre for this test. The A3 psychrometric chart is available on the 7189 web page.

Unit	Outcome	Number of questions	%
202	01 Know the standard units of measurement used in the RAC sector	2	4
	02 Know fundamental thermodynamics	13	28
	03 Know the forms of heat as found in RAC systems	5	11
	4 Know the principles of pressure	4	9
	5 Understand the pressure temperature	6	13
	6 Understand the vapour compression cycle	4	9
	7 Able to understand the psychrometric processes in RAC systems	7	15
	8 Know the general properties of materials used in the RAC sector	4	11
	Total	45	100

Test: Unit 203 Apply scientific principles to practical vapour compression systems

Duration: 1 hour 30 mins

Unit	Outcome	Number of questions	%
203	01 Know the principles of operation of the vapour compression system	13	44
	02 Know characteristics of line and pipe systems used in RAC systems	4	13
	03 Know how properties of air are controlled	5	17
	04 Know the principles of operation of heat pumps	4	13
	05 Know the impact of operating conditions on system performance	4	13
Total		30	100

Test: Unit 204 Functions and features of RAC and HP systems

Duration: 50 mins

Unit	Outcome	Number of questions	%
204	01 Know the function of a range of RAC and HP system components	6	24
	02 Know the operating principles for a range of RAC and HP system applications	4	16
	03 Know the properties of refrigerants	4	16
	04 Know the properties of oils	4	16
	05 Know the operating principles of a range of system controls	4	16
	06 Know the operation of a range of test instruments used in the RAC industry	3	12
Total		25	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 questions	% of overall grade
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
04	04.01	Identify potential leakage points of refrigeration/air conditioning and heat pump	2	5

Test Section	Area	No. of questions	% of overall grade
	04.02 04.06	equipment	
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

Test: Unit 210 Understand how to communicate with others within building services engineering

Duration: 40 mins

Unit	Outcome	Number of questions	%
210	01 Know the members of the construction team and their role within the building services industry	5	25
	02 Know how to apply information sources in the building services industry	9	45
	03 Know how to communicate with others in the building services industry	6	30
	Total	20	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.

Range
<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>

Learning outcome
<p>The learner will:</p> <ol style="list-style-type: none"> 2. know how to handle hazardous situations.
Assessment criteria
<p>The learner can:</p> <ol style="list-style-type: none"> 2.1 identify common hazardous situations found on site 2.2 describe safe systems at work 2.3 identify the categories of safety signs 2.4 identify symbols for hazardous substances 2.5 list common hazardous substances used in the building services industry 2.6 list precautions to be taken when working with hazardous substances 2.7 identify the types of asbestos that may be encountered in the workplace 2.8 identify the actions to be taken if the presence of asbestos is suspected 2.9 describe the implications of being exposed to asbestos 2.10 state the application of different types of personal protective equipment 2.11 identify the procedures for manually handling heavy and bulky items 2.12 identify the actions that should be taken when an accident or emergency is discovered 2.13 state procedures for handling injuries sustained on-site 2.14 state the procedures for recording accidents and near misses at work.

<p>Range</p> <p>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.</p> <p>Safe systems at work Method statements, permit to work systems, risk assessments, safety signs and notices.</p> <p>Categories Mandatory, prohibition, information, warning.</p> <p>Symbols Toxic, harmful, corrosive, irritant, oxidising, extremely flammable.</p> <p>Hazardous substances Lead - solid and fume, solvents and lubricants, fluxes, jointing compounds, sealants, gases – LPG, oxy-acetylene and carbon dioxide, cleaning agents.</p> <p>Precautions PPE, ventilation, risk assessment, method statements, safe systems of work.</p> <p>Types of asbestos White asbestos (Chrysotile), brown or grey asbestos (Amosite), blue asbestos (Crocidolite), asbestos cement materials.</p> <p>Actions Stop working immediately, report to supervisor.</p> <p>Implications Long-term health implications (mesothelioma, asbestosis).</p> <p>Personal protective equipment Clothing protection including high visibility, Eye protection, Hand protection, Head protection, Foot protection, Hearing protection, Respiratory protection.</p> <p>Procedures for manually handling Single, two-person lift, mechanical lift.</p> <p>Actions Raising the alarm, contact emergency services, follow typical emergency evacuation procedures, inform supervisor.</p> <p>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.</p> <p>Procedures for recording accidents RIDDOR, the use of company accident books, details to be recorded.</p>

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 202

Scientific Principles within RAC and HP Systems

UAN:	J/504/0745
Level:	Level 2
Credit value:	10
GLH:	82
Aim:	This unit provides learners with the underpinning knowledge of scientific principles refrigeration, air conditioning and heat pumps systems. It is structured by first introducing the units of measurement followed by their application to the principles of vapour compression 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. know the standard units of measurement used in the RAC sector.
Assessment criteria
The learner can: 1.1 define the System International (SI) units of measurement.

Range
SI units of measurement Standard Metre (length) m., Kilogram (mass) kg., Second (time) s., Kelvin (temperature). Derived Area (m ²), Volume (m ³), Litres (L), Density (kg/m ³), Velocity (m/s), Acceleration (m/s ²), Pressure (Pascal).

Learning outcome
The learner will: 2. know fundamental thermodynamics.
Assessment criteria
The learner can: 2.1 describe the concept of temperature 2.2 describe temperature scales 2.3 define absolute zero 2.4 convert values between temperature scales 2.5 define the laws of thermodynamics 2.6 describe the concept of heat as energy in transition 2.7 describe how heat is transferred 2.8 state the unit of heat 2.9 state the unit used to describe the rate of heat transfer 2.10 describe how power is derived from energy and time values 2.11 define the units of power 2.12 calculate compressor input power.

Range
Temperature scales Celsius, Kelvin. Laws of thermodynamics First law, second law. Heat is transferred Conduction, convection, radiation. Calculate Mass flow rate x enthalpy change.

Learning outcome
The learner will: 3. know the forms of heat as found in RAC and HP systems.
Assessment criteria
The learner can: 3.1 describe latent heat processes 3.2 describe sensible heat processes 3.3 define specific heat capacity 3.4 define latent heat capacity 3.5 use formulae to calculate quantity of heat.

Range
<p>Latent heat processes Melting (Fusion), freezing, sublimation, condensation, evaporation, boiling.</p> <p>Sensible heat processes Super heating, sub-cooling, cooling, heating.</p> <p>Formulae $Q = mC\Delta t$, $Q = mL$.</p>

Learning outcome
The learner will: 4. know the principles of pressure.
Assessment criteria
The learner can: 4.1 define pressure 4.2 describe how units of pressure are derived 4.3 convert units of pressure 4.4 describe pressure scales .

Range
<p>Units of pressure Pascal, Bar, Millimetres of Hg.</p> <p>Pressure scales Atmospheric, absolute, vacuum, gauge.</p>

Learning outcome
The learner will: 5. understand the pressure temperature relationship.
Assessment criteria
The learner can: 5.1 describe the impact of changing pressures on saturation temperatures for a range of substances 5.2 describe two phase mixes 5.3 describe sensible heating processes in terms of superheat and sub-cooling 5.4 describe the ideal gas laws 5.5 describe Dalton's Law of partial pressures 5.6 calculate a variable using the Combined Gas Law.

Range
<p>Range of substances Water, refrigerants.</p> <p>Ideal gas laws Boyle's law, Charles' law, combined gas law.</p>

Learning outcome
The learner will: 6. understand the vapour compression cycle.
Assessment criteria
The learner can: 6.1 describe the vapour compression cycle 6.2 describe the pressure enthalpy chart 6.3 plot the vapour compression cycle using a pressure enthalpy chart 6.4 calculate using a pressure enthalpy chart a range of variables .

Range
Pressure enthalpy chart Pressure, temperature, constant quality, enthalpy, specific volume, latent, superheat and sub-cooled zones. Range of variables Work done, refrigeration effect, total heat rejected, Coefficient of Performance, mass flow rate, compression ratio.

Learning outcome
The learner will: 7. understand the psychrometric processes in RAC and HP systems.
Assessment criteria
The learner can: 7.1 describe the properties of air 7.2 define the relationship between specific volume and specific density 7.3 differentiate between wet and dry bulb temperatures 7.4 describe devices used for measuring wet and dry bulb temperatures 7.5 describe the psychrometric chart 7.6 plot a point on the psychrometric chart using any two given variables 7.7 define from a given point on the psychrometric chart the values of remaining variables.

Range
Properties of air Physical make-up, moisture content, temperature. Devices Sling psychrometer, hygrometer. Psychrometric chart Wet bulb temperature, dry bulb temperature, percentage saturation, moisture content, specific volume.

Learning outcome
The learner will: 8. know the general properties of materials used in the RAC and HP sector.
Assessment criteria
The learner can: 8.1 identify the properties of a range of materials 8.2 describe the common use of a range of materials .

Range
Range of materials Steels (common varieties), copper and cuprous based alloys, aluminium and its alloys, silver and its alloys, lead and its alloys, natural and synthetic rubbers, plastics including PTFE, heavy metals.
Properties Compatibility with oils and refrigerants, suitability for use in a food processing environment, thermal expansion & contraction, brittleness, elasticity, malleability, conductivity, ductility, corrosiveness.

Unit 203

Apply scientific principles to practical vapour compression systems

UAN:	R/504/0747
Level:	Level 2
Credit value:	8
GLH:	68
Aim:	This unit enables learners to apply scientific principles to practical refrigeration systems. The unit commences with the theory of vapour compression systems in a practical environment discussing the important components and their operation. At its completion learners will have studied from basic systems through to system performance evaluation.
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 the principles of operation of the vapour compression system.
Assessment criteria
The learner can: 1.1 describe the function of an evaporator as defined by the pressure enthalpy chart 1.2 distinguish on a typical DX evaporator the importance of the areas of latent and sensible heat using the pressure enthalpy chart as a reference 1.3 describe the function of a condenser as defined by the pressure enthalpy chart 1.4 distinguish on an air-cooled condenser the importance of the areas of latent and sensible heat using the pressure enthalpy chart as a reference 1.5 describe the function of a compressor as defined by the pressure enthalpy chart 1.6 describe the impact of superheat at the compressor inlet 1.7 describe the function of a metering device as defined by the pressure enthalpy chart

- | |
|---|
| 1.8 identify the condition of the refrigerant entering the metering device and its impact |
| 1.9 describe the impact of refrigerant states entering the metering device. |

Range

Refrigerant states

Sub-cooled liquid, saturated liquid, saturated mixture.

Learning outcome

The learner will:

- | |
|---|
| 2. know characteristics of line and pipe systems used in RAC systems. |
|---|

Assessment criteria

The learner can:

- | |
|---|
| 2.1 describe how pipe characteristics affect refrigerant and oil flow |
| 2.2 describe the impact of pressure drop on system performance |
| 2.3 describe the importance of pipe sizing for specific system conditions |
| 2.4 describe how oil can be returned to the compressor using refrigerant vapour velocity. |

Range

Pipe characteristics

Diameter, length, bends, fittings, orientation, equation of continuity.

System performance

Flash gas, oil return, velocity, saturation temperature.
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Specific system conditions

Refrigerants, operating temperatures, system design.
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Learning outcome

The learner will:

- | |
|---|
| 3. know how properties of air are controlled. |
|---|

Assessment criteria

The learner can:

- | |
|--|
| 3.1 describe how vapour compression systems control the properties of air using a psychrometric chart |
| 3.2 describe the range of air conditioning systems in common use |
| 3.3 describe ideal storage conditions for a range of products . |

Range

Vapour compression systems

Split system for a single room cooling application, fruit and vegetable chill store system.

Air conditioning systems

Comfort cooling/heating, close control, de-humidification specific.

Range of products

Unpackaged fresh fruit and vegetables, unpackaged meat, flowers.

Learning outcome

The learner will:

4. know the principles of operation of heat pumps.

Assessment criteria

The learner can:

- 4.1 describe the operation of a ground source heat pump using a pressure enthalpy chart
- 4.2 compare heat pump efficiency against **traditional heating methods**
- 4.3 describe the **range of heat pumps** available.

Range**Traditional heating methods**

Oil boiler, gas boiler, electric heating.

Range of heat pumps

Domestic & commercial ground source, air source, swimming pool heat reclaim, district heating systems.

Learning outcome

The learner will:

5. Know the impact of operating conditions on system performance

Assessment criteria

The learner can:

- 5.1 describe how system performance is affected when **environmental conditions** change using a pressure enthalpy chart
- 5.2 describe how system performance is affected by **common system faults** using a pressure enthalpy chart.

Range**Environmental conditions**

Higher than design ambient temperatures, lower than design ambient temperatures.

Common system faults

Blocked condenser, blocked evaporator, shortage of refrigerant, large load variations.

Unit 204

Functions and features of RAC and HP systems

UAN:	Y/504/0748
Level:	Level 2
Credit value:	9
GLH:	87
Aim:	The purpose of this unit is to provide learners with the knowledge of a range of RAC and HP systems and their components. Learners will be able to use their knowledge of material properties, systems and their components in order to relate to well-defined systems related problems.
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 the function of a range of RAC and HP system components.
Assessment criteria
The learner can: 1.1 describe the construction of system components used in the RAC and HP industry 1.2 describe the function of system components used in the RAC and HP industry 1.3 describe the operating principles of system components used in the RAC and HP industry.

Range
<p>System components compressors Reciprocating, rotary, scroll.</p> <p>Condensers Air, liquid cooled.</p> <p>Evaporators Forced draft, induced draft, natural convection, liquid cooling, direct expansion.</p> <p>Expansion devices Capillary, thermostatic expansion valves (internally and externally equalised), orifice plates and tubes, electronic expansion valves (stepper and pulse).</p> <p>Ancillary components Liquid and suction line driers, pressure relief valves, strainers, oil separators, sight glass, service valves.</p> <p>Storage vessels Suction line accumulator, high pressure receivers.</p> <p>Control valves Four way reversing, solenoid, evaporator, crankcase, differential pressure regulators, non return valves.</p> <p>Fans Axial, centrifugal.</p>

Learning outcome
The learner will:
2. know the operating principles for a range of RAC and HP system applications.
Assessment criteria
The learner can:
2.1 describe the operating principles of RAC and HP systems
2.2 describe how operating principles differ in a range of system applications .

Range
<p>Operating principles Temperature difference (TD), airflow, defrost methods, system controls.</p> <p>System applications Chill store, cold store, liquid chilling, heat pumps, air conditioning, dehumidifiers.</p>

Learning outcome
The learner will: 3. know the properties of refrigerants.
Assessment criteria
The learner can: 3.1 assess how well primary refrigerants meet ideal properties 3.2 assess how well secondary refrigerants meet ideal properties 3.3 select refrigerants for a range of applications 3.4 explain the differences between pure fluids, azeotropic and zeotropic refrigerants 3.5 explain how the refrigerant numbering system categorises the refrigerants .

Range
Primary refrigerant ideal properties Has an odour, non-flammable, non-explosive, non-toxic, miscible with oil, high latent heat value, low cost, easily leak detectable, manageable pressure range, suitable saturation temperatures, non-ozone depleting, non-global warming potential, high dielectric strength, high density, low specific volume. Primary refrigerants HFC, HCFC, HC, natural refrigerants. Secondary refrigerant ideal properties Low viscosity, non-toxic, non-flammable, non-explosive, high specific heat value, low cost, non-corrosive, low freezing point. Secondary refrigerants Water, propylene glycol, ethylene glycol. Range of applications Air conditioning, cold storage, chill storage, heat pumps, blast freezing.

Learning outcome
The learner will: 4. know the properties of oils.
Assessment criteria
The learner can: 4.1 describe the properties of an ideal oil 4.2 explain why oils must be matched with the system refrigerant 4.3 explain the differences between synthetic and mineral oils.

Range
Properties Low floc point, low pour point, low viscosity, high dielectric strength, low foaming tendency, high flashpoint, low hygroscopic effect, low acidity, low moisture content, low toxicity, high miscibility with refrigerant.

Learning outcome
The learner will: 5. know the operating principles of a range of system controls.
Assessment criteria
The learner can: 5.1 describe the operating principles of system controls 5.2 describe the operating principles for defrost systems .

Range
System controls Pressure controls, temperature controls (for cooling, for heating), time controls, sequence controllers, flow switches. System control operating principles High pressure, low pressure, dead band, differential, proportional. Defrost operating principles Initiation, termination, defrost sequence. Defrost systems Off cycle, electric, hot gas, saturated gas.

Learning outcome
The learner will: 6. know the operation of a range of test instruments used in the RAC industry.
Assessment criteria
The learner can: 6.1 identify the function of test instruments 6.2 describe how test instruments operate 6.3 describe how test instruments are used.

Range
Test instruments Pressure gauges, service manifolds, thermometers, anemometers, sling psychrometers, hydrometers, scales.

Unit 204 Functions and features of RAC and HP systems

Supporting information

Guidance

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

Unit 205

Service and maintain RAC and HP systems

UAN:	D/504/0749
Level:	Level 2
Credit value:	5
GLH:	48
Aim:	<p>The purpose of this unit is for learners to gain knowledge of the principles of servicing and maintaining RAC and HP systems and develop the skills needed to apply those principles. The skills developed will enable them to carry out service and maintenance tasks on a variety of systems.</p> <p>This unit refers to mechanical fault finding. Fault finding on electrical circuits is addressed in Service and Maintain RAC and HP systems</p>
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 service and maintenance principles for RAC and HP systems.
Assessment criteria
The learner can: 1.1 identify faults on RAC and HP system components 1.2 describe symptoms of component faults in RAC and HP systems 1.3 describe maintenance requirements for RAC and HP systems 1.4 identify effects of component failure on other RAC and HP system components 1.5 describe fault finding techniques used in RAC and HP systems 1.6 identify sources of information which aid service and maintenance of RAC and HP systems 1.7 identify information included in documentation when completing service and maintenance activities on RAC and HP systems.

Range
<p>RAC and HP system Small commercial.</p> <p>Components Compressors, condensers, evaporators, capillary line, thermostatic expansion valves (internally and externally equalised), orifice plates and tubes, electronic expansion valves (stepper and pulse), liquid and suction line driers, pressure relief valves, strainers, oil separators, service valves, suction line accumulator, liquid receivers, four way reversing, solenoid, evaporator, crankcase, differential pressure regulators, non return valves, axial fans, centrifugal fans.</p> <p>Maintenance Planned preventative maintenance.</p> <p>Requirements Cleaning, component replacement, leak testing, visual inspection.</p> <p>Fault finding techniques Six point, half split, algorithmic.</p> <p>Sources of information Previous service reports, operations manuals, customer, senses.</p> <p>Documentation Log books, job sheets, certificates, site logs, permits to work, maintenance sheets, parts requisition sheets.</p>

Learning outcome
<p>The learner will:</p> <ol style="list-style-type: none"> 2. know requirements of RAC and HP service and maintenance tools and equipment.
Assessment criteria
<p>The learner can:</p> <ol style="list-style-type: none"> 2.1 describe purpose of service and maintenance tools and equipment 2.2 describe maintenance requirements of tools and equipment 2.3 identify inspection requirements of service and maintenance tools 2.4 describe safe storage of tools and equipment.

Range
<p>Equipment Vacuum pump, recovery rig, recovery cylinders, scales, oil pump, leak indicators, flame brazing equipment, regulators.</p> <p>Tools Torque wrench, valve keys, flare block, hexagonal wrench, Torx wrench, tube cutters, reamer, tube expander, Schrader key, flare spanners, vernier calliper, inspection mirror, tube benders, tape measure.</p>

Learning outcome

The learner will: 3. be able to service and maintain RAC and HP system.
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Assessment criteria

The learner can: 3.1 identify faults on RAC and HP systems 3.2 prepare RAC and HP systems for service and maintenance 3.3 rectify RAC and HP systems faults 3.4 restore original state of RAC and HP systems following service and maintenance 3.5 assess fitness for purpose of tools and equipment 3.6 record service and maintenance activities.
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Range

Rectify Replace components, cleaning components, calibrate, adjust, align.
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Unit 206

Install and commission RAC and HP systems

UAN:	R/504/0750
Level:	Level 2
Credit value:	5
GLH:	47
Aim:	This unit aims to develop in learners the ability to apply a range of skills related to installation and commissioning of small commercial 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. be able to prepare for installation of RAC and HP systems.
Assessment criteria
The learner can: 1.1 collate information available prior to planning the installation activities 1.2 list resources required for installation activities 1.3 identify roles and responsibilities of persons involved 1.4 conduct risk assessment for installation activities 1.5 complete permit to work 1.6 identify variations to original planned work 1.7 identify safe storage for all resources prior to commencement of the installation 1.8 identify services required for the installation.

Range
<p>Information Regulatory documents, industry codes of practice, manufacturers' instructions, installation specifications.</p> <p>Resources Tools, equipment and materials, documentation.</p> <p>Persons involved Self, colleagues, supervisor, client, general public, health and safety officer.</p> <p>Complete Prior to installation, on completion.</p> <p>Services Electricity, water, drainage, ventilation, gas.</p>

Learning outcome
<p>The learner will:</p> <ol style="list-style-type: none"> 2. be able to install RAC and HP systems.
Assessment criteria
<p>The learner can:</p> <ol style="list-style-type: none"> 2.1 form pipework 2.2 position system components 2.3 assemble interconnecting pipework 2.4 fix pipework 2.5 use oxygen free nitrogen for purging during flame brazing operations 2.6 use protective measures when flame brazing temperature sensitive system components 2.7 apply insulation to pipework systems 2.8 fix cabling 2.9 terminate cabling 2.10 compare installed system with system drawings.

Range
<p>Form Braze (oxy -acetylene), flare, bend, swage, other mechanical joints.</p> <p>System components Condensing units, evaporators, condensate drains, valves, electrical cabling, drier, pressure switches, pumps, sight glass, vessels.</p> <p>Fix Vibration damping clamps, pipe saddles, blackboard clips, insulated clamps.</p> <p>Protective measures Wet rag, non-conductive foam, temporary removal of low melting point items.</p> <p>Temperature sensitive system components Thermostatic expansion valves, solenoid valves, vibration eliminators, schrader valves, pressure transducers.</p> <p>Apply Pre-insulated, cut and glue, continuous, mitred, insulated tape.</p> <p>Cabling Multi-core flex, steel wire armoured, single conductor, twin and earth, braided sheath cable, screened.</p> <p>Terminate Insulated crimps, non-insulated crimps.</p>

Learning outcome
The learner will: 3. be able to commission RAC and HP systems.
Assessment criteria
The learner can: 3.1 record commissioning activities .

Range
<p>Commissioning activities Visual checks, strength test, tight ness test, evacuation, charging, system running, measure (Superheat, Subcooling, Evaporator air on and off temperature, Running currents, Refrigerant type and quantity, condenser air on and off).</p>

Learning outcome
The learner will: 4. be able to handover RAC and HP systems.
Assessment criteria
The learner can: 4.1 demonstrate system operation 4.2 explain maintenance requirements for the system 4.3 document installation activities.

Range
System operation Heating, cooling, defrost, time clocks, auto/manual operation, system controls
Document Job sheet/card

Unit 207

Electrical systems for RAC and HP systems

UAN:	Y/504/0751
Level:	Level 2
Credit value:	5
GLH:	48
Aim:	<p>This unit applies knowledge and related practical skills required to undertake safe testing and fault finding on small RAC and HP systems under direction.</p> <p>This unit refers to fault finding on electrical circuits. Mechanical fault finding is addressed in Service and maintain RAC and HP systems</p>
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 the fundamental principles of electrical systems used in RAC and HP systems.
Assessment criteria
The learner can: 1.1 identify the fundamental principles of electricity 1.2 identify the fundamental principles of electrical circuits used INRAC & HP circuits 1.3 identify the fundamental working principles of electrical controls 1.4 identify the working principles of electrical components 1.5 identify the starting arrangements for single phase compressor motors.

Range
<p>Principles of electricity Ohms Law, direct current and alternating current, potential difference, resistance, capacitance, frequency, impedance, current, power, electrical shock potential and its consequences.</p> <p>Principles of circuits Single phase, earthing and bonding, series, parallel.</p> <p>Electrical controls Pressure switches, thermostats, flow switches, over current/over temperature (bimetal, PTC, NTC), relays (current, potential, solid state).</p> <p>Electrical components Single phase motors, coils, transformers, heaters, lights.</p> <p>Starting arrangements Resistance start induction run (RSIR), capacitor start induction run (CSIR), capacitor start and run (CSR).</p>

Learning outcome
The learner will:
2. know the requirements of electrical test instruments.
Assessment criteria
The learner can:
2.1 identify the test instruments used to measure electrical circuits
2.2 identify scales used to measure electrical circuits
2.3 state when it is appropriate to carry out an insulation resistance test using a megaohm meter
2.4 describe importance of Guidance Note GS38 for use of electrical test instruments.

Range
<p>Electrical circuits Continuity, short circuit, open circuit, insulation resistance, polarity, current, voltage, capacitance.</p>

Learning outcome
The learner will:
3. be able to test electrical circuits.
Assessment criteria
The learner can:
3.1 select testing instruments
3.2 check testing instruments are calibrated
3.3 use testing instruments on electrical circuits
3.4 record measurements.

Range
<p>Testing instruments Multimeter, ammeter, voltmeter, megaohm meter, capacitance tester.</p> <p>Electrical circuits Continuity, short circuit, open circuit, insulation resistance, polarity, current, voltage (a.c, d.c), capacitance.</p> <p>Use Use appropriate scales, operate safely.</p>

Learning outcome
<p>The learner will:</p> <p>4. be able to fault find in electrical circuits for RAC and HP systems.</p>
Assessment criteria
<p>The learner can:</p> <p>4.1 identify electrical faults on RAC and HP systems components</p> <p>4.2 replace faulty components</p> <p>4.3 record recommissioning activities.</p>

Range
<p>Components Motors, switches, heaters, relays, conductors, thermistors, transformers, coils.</p>

Unit 207 Electrical systems for RAC and HP systems

Supporting information

Guidance

If learners can use a multimeter that covers resistance, voltage and capacitance they do not need to use separate testing instruments

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 210

Understand how to communicate with others within building services engineering

UAN:	J/602/2482
Level:	Level 2
Credit value:	3
GLH:	28
Aim:	This knowledge unit provides learning in the development and continued maintenance of effective working relationships in the building services industry associated with work in dwellings, industrial and commercial premises and for private and contract type clients.

Learning outcome
The learner will: 1. know the members of the construction team and their role within the building services industry.
Assessment criteria
The learner can: 1.1 identify the key roles of the site management team: <ul style="list-style-type: none">• architect• project manager/clerk of works• structural engineer• surveyor• building services engineer• quantity surveyor• buyer• estimator• contracts manager• construction manager 1.2 identify the key roles of the individuals that report to the site management team: <ul style="list-style-type: none">• sub contractors• site supervisor• trade supervisor • trades:

- o bricklayer
- o joiner
- o plasterer
- o tiler
- o electrician
- o H&V fitter
- o gas fitter
- o decorator
- o groundworkers

1.3 identify the key roles of site visitors:

- building control inspector
- water inspector
- HSE inspector
- electrical services inspector.

Learning outcome

The learner will:

2. know how to apply information sources in the building services industry.

Assessment criteria

The learner can:

2.1 identify the types of statutory legislation and guidance information that applies to working in the industry:

- legislation:
 - o data protection
 - o equal opportunities
 - o health & safety
 - o employment
- regulations
- british standards
- codes of practice
- manufacturer guidance:
 - o installation instructions
 - o service & maintenance instructions
 - o user instructions

2.2 identify the purpose of information that is used in the workplace:

- job specifications
- plans/drawings
- work programmes
- delivery notes
- time sheets
- policy documentation – health & safety, environmental, customer service

2.3 identify the purpose of information given to customers:

- quotations
 - estimates
 - invoices/statements
 - statutory cancelation rights
 - handover information
- 2.4 state the importance of company policies and procedures that affect working relationships:
- company working policies/procedures:
 - behaviour
 - timekeeping
 - dress code
 - contract of employment
 - limits to personal authority:
 - apprentices
 - level 2 qualified staff
 - level 3 qualified staff
 - supervisor and management responsibilities.

Learning outcome
The learner will: 3. know how to communicate with others in the building services industry.
Assessment criteria
The learner can: 3.1 identify suitable communication methods for use in work situations: <ul style="list-style-type: none"> • oral communication • written communication: <ul style="list-style-type: none"> ○ e-mail ○ fax ○ letter
3.2 define methods of effective communication for people with: <ul style="list-style-type: none"> • physical disabilities • learning difficulties • language differences: <ul style="list-style-type: none"> ○ dialects ○ accents ○ foreign and second language issues
3.3 state the actions to take to deal with conflicts between: <ul style="list-style-type: none"> • customers and operatives • co-workers • supervisors and operatives
3.4 state the effects that poor communication may have on an organisation: <ul style="list-style-type: none"> • between operatives • between operatives and management • company to customer.



Appendix 1 Relationships to other qualifications

Links to other qualifications

This qualification has connections to the:

- Level 3 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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If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: feedbackandcomplaints@cityandguilds.com

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Licence to Practice (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

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