City & Guilds Level 3 Award in the Design, Installation, Commissioning and Maintenance of Air Source Heat Pump Systems (2924-34)

Qualification Handbook

Version 1.1 (September 2025)

Qualification at a glance

Subject area	Building services industry
City & Guilds number	2924
Age group approved	18+
Entry requirements	Please see guidance on page 10
Assessment	Online multiple-choice knowledge test Practical assignment
Grading	Pass/Fail
Approvals	Full approval required
Support materials	Sample assessments (SAMs) Qualification Handbook SmartScreen
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds qualification number	Regulatory reference number	GLH	TQT
City & Guilds Level 3 Award in the Design, Installation, Commissioning and Maintenance of Air Source Heat Pump Systems	2924-34	610/5356/9	32	48

Version and date	Change detail	Section
1.0 February 2025	Initial version	All
1.1 September 2025	Added reference numbers for National Occupancy Standards (page 5)	1
	Amended information on learner entry requirements (page 10)	3

Contents

Qualification at a glance 2

Contents 4

1 Introduction 5

2 Qualification structure 6

3 Centre requirements 8

4 Delivering the qualification 12

5 Assessment 13

6 Units 18

Unit 301/302 Design, installation, commissioning and maintenance of air source heat pump systems 19

Appendix 1 Sources of general information 31

1 Introduction

What is this qualification about?

Area	Description
Who is the qualification for?	This qualification is aimed at qualified and experienced heating and plumbing engineers who wish to understand the requirements of design, installation, commissioning and maintenance of air source heat pump systems (ASHPs), typically within a domestic or small-commercial setting. Learners must be at least 18 years old to take this course as part of their continuous professional development.
What does the qualification cover?	The purpose of this qualification is to cover the knowledge, understanding and skills required for the design, installation, commissioning and maintenance of ASHPs. It follows the MCS Technical Standards for air source pump systems and industry guidance. It covers a range of relevant outcomes including the operating principles of ASHPs, applicable regulatory considerations, as well as their design, installation, commissioning, handover and maintenance requirements. The qualification is also mapped to the relevant National Occupational Standards (NOSs) for the design, installation, commissioning, handover and maintenance of ASHPs (listed below): BSERAC08, BSERAC09, BSERAC10, BSERAC11
What opportunities for progression are there?	This qualification builds on an existing job role (that of a heating and plumbing engineer). Upon completion, this qualification will enable learners to progress within their current job role and specialise in the design, installation, commissioning and maintenance of ASHPs.
Who did we develop the qualification with?	MCS
Is it part of an apprenticeship framework or initiative?	No.

2 Qualification structure

Structure

To achieve the City & Guilds Level 3 Award in the Design, Installation, Commissioning and Maintenance of Air Source Heat Pump Systems, learners must achieve:

City & Guilds unit number	Unit title	GLH
Learners must achieve the following mandatory units.		
301	Design, installation, commissioning and maintenance of air source heat pump systems – online knowledge test	32
302	Design, installation, commissioning and maintenance of air source heat pump systems – practical assignment	

Eligibility for this qualification must be confirmed according to the learner entry requirements on page 10. Once eligibility is confirmed, proxy unit **2924-801** must be claimed to allow certification. Please see Walled Garden for details.

Total Qualification Time (TQT)

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

TQT comprises of the following two elements:

1) the number of hours that an awarding organisation has assigned to a qualification for guided learning
2) an estimate of the number of hours a learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by – but, unlike guided learning, not under the immediate guidance or supervision of – a lecturer, supervisor, tutor or other appropriate provider of education or training.

Title and level	GLH	TQT
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3 Centre requirements

Approval

Full approval

To offer this qualification/these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the document **Centre Approval Process: Quality Assurance Standards** 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

Centre staffing

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

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

Continuing professional development (CPD)

Centres are expected to support their staff in ensuring that their knowledge remains current of the occupational area and of best practice in delivery, mentoring, training, assessment and quality assurance, and that it takes account of any national or legislative developments.

Physical resources

Centres must be able to demonstrate that they have access to the equipment and technical resources required to deliver this qualification and its assessment.

Quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications. Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance. All external quality assurance processes reflect the minimum requirements for verified and moderated assessments, as detailed in the Centre Assessment Standards Scrutiny (CASS), section H2 of Ofqual's General Conditions. For more information on both CASS and City and Guilds Quality Assurance processes visit: the What is CASS? and Quality Assurance Standards documents on the City & Guilds website.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, internal quality assurers must:

- have appropriate teaching and vocational knowledge and expertise
- have experience in quality management/internal quality assurance
- hold or be working towards an appropriate teaching/training/assessing qualification
- be familiar with the occupation and technical content covered within the qualification.

External quality assurance for the qualification will be provided by City & Guilds EQA process. EQAs are appointed by City & Guilds to approve centres and to monitor the assessment and internal quality assurance carried out by centres. External quality assurance is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres.

The role of the EQA is to:

- provide advice and support to centre staff
- ensure the quality and consistency of assessments within and between centres by the use of systematic sampling
- provide feedback to centres and to City & Guilds.

Learner entry requirements

This course is intended for practicing heating and plumbing engineers. Eligibility for this qualification must be confirmed according to the learner entry requirements as outlined below.

Evidence that eligibility requirements have been met must be kept by the centre for 3 years and will be subject to external quality assurance processes.

Learners **must** hold one of the following qualifications before taking this qualification:

- N/SVQ Level 2/3 in Plumbing or equivalent earlier certification that provides evidence of competence

or

- N/SVQ Level 2/3 in Heating and Ventilating (Domestic Installation) or equivalent earlier certification that provides evidence of competence

or

- N/SVQ Level 2/3 in Oil-Fired Technical Services or equivalent earlier certification that provides evidence of competence

or

- N/SVQ Level 2/3 in Gas Installation and Maintenance or equivalent earlier certification that provides evidence of competence

or

- heating installers with minimum 3 years of experience installing wet central heating systems, evidenced either by manufacturer courses certification or Gas Safe Register, OFTEC, MCS or HETAS registration

In addition, if not included in the above certification in relation to:

- WRAS Water Regulations/Water Byelaws or equivalent
- Domestic Hot Water Storage Systems (G3)

For all learners, the qualifications above must have been achieved no more than 5 years prior to starting this qualification.

Initial assessment and induction

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

- if the learner 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 learner fully understands the requirements of the qualification, their responsibilities as a learner and the responsibilities of the centre. This information can be recorded on a learning contract.

Age restrictions

This qualification is approved for learners aged 18 or above.

Access to assessment and special consideration

City & Guilds has considered the design of this qualification and its assessments in order to best support accessibility and inclusion for all learners. We understand however that individuals have diverse learning needs and may require reasonable adjustments to fully participate. Reasonable adjustments, such as additional time or alternative formats, may be provided to accommodate learners with disabilities and support fair access to assessment.

Access arrangements are adjustments that allow candidates with disabilities, special educational needs, and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

The Equality Act 2010 requires City & Guilds to make reasonable adjustments where a disabled person would be at a substantial disadvantage in undertaking an assessment.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Please refer to the JCQ access arrangements and reasonable adjustments and Access arrangements - when and how applications need to be made to City & Guilds for more information. Both are available on the City & Guilds website: http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments

4 Delivering the qualification

Inclusion and diversity

City & Guilds is committed to improving inclusion and diversity within the way we work and how we deliver our purpose which is to help people and organisations develop the skills they need for growth.

More information and guidance to support centres in supporting inclusion and diversity through the delivery of City & Guilds qualifications can be found here:

Inclusion and diversity | City & Guilds (cityandguilds.com)

Sustainability

City & Guilds are committed to net zero. Our ambition is to reduce our carbon emissions by at least 50% before 2030, and develop environmentally responsible operations to achieve net zero by 2040 or sooner if we can. City & Guilds is committed to supporting qualifications that support our customers to consider sustainability and their environmental footprint.

More information and guidance to support centres in developing sustainable practices through the delivery of City & Guilds qualifications can be found here:

Our Pathway to Net Zero | City & Guilds (cityandguilds.com)

Support materials

The following resources are available for this qualification:

Description	How to access
Sample assessments	www.cityandguilds.com
Qualification handbook	www.cityandguilds.com
SmartScreen	www.smartscreen.co.uk

5 Assessment

Summary of assessment methods

For City & Guilds Level 3 Award in the Design, Installation, Commissioning and Maintenance of Air Source Heat Pump Systems, candidates must successfully complete:

Assessment unit	Assessment method	Description and conditions
301	Externally marked Multiple-choice exam	The multiple-choice assessment is externally set and externally marked and will be delivered online via e-volve. The exam is designed to assess the candidate's depth and breadth of understanding across content in the unit using one-mark multiple choice questions, and will be sat under supervised examination conditions. See JCQ requirements for details: **http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations** Sample assessment materials can be downloaded from the City & Guilds website. Live assessment will be delivered by the City & Guilds online platform e-volve.
302	Externally set Internally assessed Practical assignment	The practical assignment is externally set and internally marked with external verification. The assignment is designed to assess the candidate's depth and breadth of knowledge, skills and understanding from across content in the qualification, at the end of their period of learning, and will be completed under supervised, controlled assessment conditions. Assignment material will be available to download from the City & Guilds website, with the password obtained via Walled Garden.

Scheme of assessment overview

For City & Guilds Level 3 Award in the Design, Installation, Commissioning and Maintenance of Air Source Heat Pump Systems, candidates must successfully complete:

Candidates must complete ALL assessment components					
Assessment unit	**Method**	**Duration**	**Marks**	**Marking approach**	**Grading**
301 Design, installation, commissioning and maintenance of air source heat pump systems – online knowledge test	On demand Online multiple-choice test	60 minutes	30	Externally set and externally marked	Pass/fail
302 Design, installation, commissioning and maintenance of air source heat pump systems – practical assignment	On-demand Practical assignment	4 hours	N/A	Externally set, internally marked and externally verified	Pass/fail

Test specification for online knowledge test

The exam specifications outlined in the tables below highlight at a high level the way that the qualification content will be assessed within component **301**.

Test: 2924-301	Duration: 60 minutes		
Unit	**Outcome**	**Number of questions**	**Percentage %**
301	LO1: Understand the purpose and operational characteristics of air source heat pumps and their components	9	30%
301	LO2: Understand the industry standards, regulations and job information/documentation required for installing air source heat pumps	8	27%
301	LO3: Understand the preparatory and installation requirements of air source heat pumps	11	37%
301	LO5: Service and maintain an air source heat pump system	2	6%
	Total	30	100%

Permitted materials: None

Graded: Pass/Fail

Pass mark: the pass mark for this examination is set at approx. 21

These boundaries may be subject to slight variation to ensure fairness should any variations in the difficulty of the individual assessment versions be identified.

Assessment objectives for online knowledge test

The following assessment objectives are used within the **301** knowledge test assessment.

The weightings for how the assessment objectives are applied in the assessment are shown in the table below.

Assessment objective	Description	Weighting in Assessment
AO1a Demonstrate knowledge of the content	The ability to demonstrate basic recall of relevant knowledge in response to straightforward questioning.	15 marks - 50%
AO1b Demonstrate understanding of the content	The ability to demonstrate understanding of principles and concepts beyond recall of definitions.	12 marks - 40%
AO2 Apply knowledge and understanding of the content to different situations and contexts	Applying knowledge and understanding taking the understanding of generalities and applying them to specific situations.	3 marks - 10%

Unit 302 - Practical assignment

This qualification is based around the development of a toolkit of knowledge, understanding and skills that an individual needs in order to have the capability to work in a particular industry or occupational area. Individuals in all occupational areas are expected to be able to apply their knowledge, understanding and skills in decision making to solve problems and achieve given outcomes independently and confidently. This qualification requires candidates to draw together their learning from across the qualification to solve problems or achieve specific outcomes by explicitly assessing this through a practical assignment component (302).

In this externally set, internally marked and externally verified assessment, the focus is on bringing together, selecting and applying learning from across the qualification rather than demonstrating achievement against individual units. The candidate will be given appropriately levelled, substantial, occupationally relevant problem to solve or outcome to achieve. For example, this might be in the form of a briefing from a client, leaving the candidate with the scope to select and carry out the processes required to achieve the client's wishes, as they would in the workplace.

Permitted materials/resources for completion of the practical assignment will be given to candidates by centres.

The practical assignment will be graded as **Pass/fail**. Candidates must gain a Pass in all tasks within the assignment to achieve a pass overall for this component.

The practical assignment does **not** utilise assessment objectives. Each task has individual grade descriptors and indicative content to drive the assessment and measure outcomes.

Availability of assessments

Assessment materials for the practical assignment will be available on-demand via the City & Guilds website, with the password securely held on Walled Garden. Details regarding the publication of any new practical assignments will be communicated directly to centres.

All assessments that are on e-volve are on demand and can be booked by the provider when the candidate is ready to be entered for the assessment.

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification. RPL can be used to exempt learners from areas of learning previously achieved, but does not exempt them from assessment.

RPL is allowed for this qualification and is also sector-specific.

6 Units

Structure of the units

The units have the following:

- City & Guilds reference number
- title
- level
- guided learning hours (GLH)
- unit aim
- assessment type
- learning outcomes, which are comprised of a number of topics
- relationship to /occupational standards inc. reference.

Unit guidance for delivery

This qualification comprises a single **unit**. A unit describes what is expected of a competent person in particular aspects of their job.

The **unit** is divided into **learning outcomes** which describe in further detail the knowledge and skills that a candidate should possess.

Each **learning outcome** has a set of **topics** (knowledge or skills) that are simple and concise statements that indicates to a learner something specific they will be learning in relation to the learning outcome. It should provide clarity to a learner at a high level on what they should be expecting to learn or be able to do about a specific area of the learning outcome.

The **content** sections define the 'depth and breadth' to which the teaching/ learning must be delivered. It is the information in these sections that learners will be assessed on and must be covered for the learner to achieve the learning outcome.

Unit 301/302 Design, installation, commissioning and maintenance of air source heat pump systems

Unit level:	Level 3
Guided Learning Hours (GLH):	32
Assessment methods:	Online multiple-choice knowledge test Practical assignment

Learning outcomes

1. Understand the purpose and operational characteristics of air source heat pumps and their components
2. Understand the industry standards, regulations and job information/documentation required for installing air source heat pumps
3. Understand the preparatory and installation requirements of air source heat pumps
4. Commission and handover an air source heat pump system
5. Service and maintain an air source heat pump system

Learning outcome 1

Understand the purpose and operational characteristics of air source heat pumps and their components

Topics	Content elements
1.1 Air source heat pump systems	1.1.1 Types of air source heat pump, their characteristics and operating principles Types of air source heat pump and their characteristics a) Air to water monobloc heat pump b) Split refrigerant air to water heat pump c) Air to air heat pump d) Hot water heat pump e) Exhaust air heat pump Operating principles of air source heat pumps a) Systems i) Monovalent ii) Bivalent iii) Space heating iv) Buffer tanks v) Accumulators b) Heat sources i) Air ii) Supplementary energy sources (solar, wind, battery storage) c) Role of cylinders i) Open-vented ii) Unvented iii) Thermal store d) Role of refrigerants i) R32 ii) R290 e) Vapour compression refrigeration cycle
1.2 Factors that influence the selection of air source heat pumps	1.2.1 Advantages of air source heat pumps over natural gas boilers a) Greater energy performance b) Low maintenance c) Low running costs (if designed correctly) d) Compatibility with other green technologies e) No locally produced carbon emissions f) Incentives for installation (i.e. grants, manufacturer's discounts/schemes)

Topics	Content elements
	1.2.2 Factors which influence the design, selection and positioning of air source heat pump systems a) 'Fabric first' (suitability for property; systems, age, design) b) Seasonal Performance Factor (SCOP) (bivalent vs monovalent; functionality in winter) c) Annual Operating Hours d) Sound/noise e) Installation costs f) Capacity of electrical connections g) Aesthetics (location/positioning of the air source heat pump, including proximity to neighbouring properties) h) Sizing of the heat pump against heat load (Coefficient of Performance, COP) and the effects of over and undersizing i) 'System Efficiency' j) Certification/listing of heat pump equipment
1.3 Components of air source heat pump systems	1.3.1 Types and identification of air source heat pump components, their purpose and operating principles Components a) Evaporator fan coil b) Low pressure switch c) Compressors (scroll, piston) d) High pressure switch e) Condenser f) Dryer receiver g) Expansion valve and phial h) Refrigerant four-way valve/hot gas bypass
1.4 Accessories and equipment of air source heat pump systems	1.4.1 Types of air source heat pump accessories/equipment, their purpose and operating principles a) Weather compensators, their components and installation requirements i) In-built ii) External b) Time and temperature controls, their requirements and when they are used (as detailed in Building Regulations Part L (where relevant)) i) Room thermostats ii) Cylinder thermostats iii) Frost thermostats iv) Programmers v) Thermostatic radiator valves (TRVs) vi) Automatic bypass vii) Optimisers viii) Smart controls ix) Heat meters c) Buffer tanks/vessels i) Volumisers, multi-input/integrated

Topics	Content elements
	ii) Identification of pipe configurations from diagrams (2, 3, 4) iii) Importance/impact of sizing on selection/design

Learning outcome 2

Understand the industry standards, regulations and job information/documentation required for installing air source heat pumps

Topics	Content elements
2.1 Industry standards and regulations	2.1.1 Purpose and requirements of industry standards and regulations relevant to installing air source heat pumps a) Building Regulations (England and Wales) i) Part A - Structure ii) Part B - Fire safety iii) Part E – Resistance to sound iv) Part G – Sanitation, hot water safety and water efficiency v) Part L – Conservation of fuel and power vi) Part P – Electrical safety b) Local authority requirements/authorisations i) Planning approvals ii) Building control approvals iii) Permitted developments iv) Listed developments c) British Standards d) MCS Technical Standards e) Manufacturer's/installation instructions f) Water Regulations/byelaws g) Electrical standards/safety/wiring regulations
2.2 Job and system information/documentation	2.2.1 Types of job and system documentation required for installing air source heat pumps, their purpose and the information they contain a) Manufacturer's instructions, including: i) Heat output data ('bivalent points') b) Benchmark certificates c) Electrical component/wiring diagrams and documentation d) Electrical supply information i) Distribution Network Operator (DNO) and Distribution System Operator (DSO) notifications ii) ENA Database e) Safe systems of work i) Risk assessments ii) Method statements

Topics	Content elements
	2.2.2 Reasons for verifying job and system information/documentation is current/relevant and their impact a) Compliance with MCS requirements b) Compliance with regulations and local authorities c) Maintaining warranty d) Ensures correct commissioning procedure is followed e) Ensures current electrical regulations are met f) Ensures the heat pump can meet expected demands g) Health and safety 2.2.3 Sources of current job and system information/documentation for air source heat pumps and the information they provide a) Websites b) Local authorities c) Manufacturers d) Health and Safety Executive (HSE) e) Building Regulations f) Electrical/energy suppliers
2.3 System diagrams and drawings	2.3.1 Types of air source heat pump system diagrams/drawings, their uses and the information they provide a) Manufacturer's instructions drawings, diagrams, schematics i) Installation instructions ii) Service instructions iii) Fault finding information iv) User instructions b) Wiring/circuit diagrams (low voltage, mains voltage; ring and radial circuits, controller area network (CAN Bus)) c) Site plans d) Building plans/footprints e) Pipework schematics 2.3.2 Factors to consider when interpreting air source heat pump system diagrams/drawings a) Identification of British Standard symbols i) Pressure relief valve ii) Anti-freeze valve iii) Check valve iv) Motorised valve v) Service valve vi) Drain valve vii) Plug valve b) Accurate position of the components i) Impact on operation ii) Impact on safety

Topics	Content elements
	c) Clearances and their minimum requirements (Town and Country Planning, Permitted Development Rights)

Learning outcome 3

Understand the preparatory and installation requirements of air source heat pumps

Topics	Content elements
3.1 Preparatory work prior to installing air source heat pumps	3.1.1 Methods of determining suitable equipment, components and accessories for air source heat pumps and their purpose a) Site surveys b) Calculations i) Heat loss and fabric heat loss calculations for a property ii) Pipe sizing calculations and Mean Water Temperature (MWT) calculations iii) Pump duty calculations (flow temperature, flow rates, identifying pump settings/speeds from data) iv) Use of cylinder heat load data to identify additional power requirements v) External air temperature calculations vi) Hot water demand calculations vii) Use of heat pump output data to determine bivalent points, auxiliary heating or hybrid system requirements c) Sizing i) Buffer tank sizing requirements/rules ii) Expansion vessel sizing iii) Heat emitters including standard panel radiators, underfloor heating, fan-assisted convector heaters iv) Combined systems d) Selection of suitable equipment, components and accessories i) Selecting suitable type of heat pump and components (air to air vs air to water) ii) Air to air – require ducting and plenum (registers), impact on space/planning required iii) Air to water – require pipework (heat emitters) 3.1.2 Factors to consider when determining suitable equipment, components and accessories for air source heat pumps a) Impact of building layout in relation to where the heat pump is to be sited and operate at optimum efficiency (orientation; north/east/south/west, location, size of property, age of property, existing systems, existing services) b) Number of occupants in property c) Suitability of electrical supply

Topics	Content elements
	d) Characteristics of zoning/heating zones (S Plan, S Plan +, W Plan, Y Plan) and under-floor control pack installation requirements e) Suitability of hot water cylinder: heat exchanger, distribution temperatures, thermal insulation, prevention of bacterial growth, compliance with manufacturer's requirements f) Characteristics of ductwork design: plenums, ductwork registers, return air ducting g) Components and requirements for secondary hot water systems h) Base positioning/installation (space for adequate airflow and clearances) i) Heat recovery ventilation systems with and without heat pumps and their purpose j) 'System Efficiency' bands
3.2 Environmental considerations when installing air source heat pumps	3.2.1 Environmental impact of air source heat pumps and methods of mitigation a) Positioning (optimal) north vs south vs east vs west facing b) Noise i) Impact on neighbouring properties ii) Use of reflective surfaces iii) Identifying and applying 'impact of noise' calculations/Q factors from MCS-020 data iv) Determining the reduction in noise/attenuation for barriers within sight lines up to 25cm c) Fixing i) Impact on neighbouring properties ii) Wall mounting vs floor mounting iii) Use/function of anti-vibration mounts iv) Positioning and preparation of suitable base (concrete, slabs) d) Pressure relief blow off i) Impact of ethyl glycol (poisoning/contamination) ii) Use of discharge capture tanks/bunded tanks e) F-gases and refrigerants i) Poisoning through inhalation ii) Greenhouse gases iii) Impact on ozone layer iv) Properties and characteristics of refrigerants (flammability, poisoning through inhalation) v) Certification requirements for those working with F-gases/refrigerants (only worked on by industry certified operatives) vi) Category 1-4 F-Gas requirements

Topics	Content elements
3.3 Considerations when fitting, fixing and connecting air source heat pumps	3.3.1 Types of pipework, fitting and fixings for connecting air source heat pumps and their uses a) Pipework material types, their application and requirements for them to pass through building fabric i) Copper ii) Plastic/barrier pipe iii) Stainless steel iv) Low carbon steel v) Requirements: sleeved, clipped, sealed b) Identification and uses of fitting types i) Crimp/press fit ii) Soldered iii) Compression iv) Push fit c) Identification of fixing types for securing heat pump units, their characteristics, uses and safety/PPE requirements i) Wall plugs ii) Screws iii) Rawl/expanding bolts iv) Toggle bolts v) Resin fixings vi) Plaster board fixings 3.3.2 Factors to consider when fitting, fixing and connecting air source heat pumps and their requirements a) Manual handling procedure/requirements when transporting and fitting units (to prevent damage) b) Use of trace heating for external pipework c) Use of safe isolation procedures d) Connection methods to equipment (use of flexible connections) e) Termination of condensate drain connections i) Connections to trap ii) Connections to drain iii) Pipe sizes and insulation f) Insulation types/methods and requirements, to reduce: i) Thermal loss ii) Freezing iii) Materials: glass wool, mineral wool, open-cell foam, closed-cell foam g) Protection types/methods and requirements, to reduce: i) Corrosion ii) Damage from UV/sunlight iii) Damage from animals
3.4 Safe transport and disposal of waste materials	3.4.1 Methods of ensuring safe transport and disposal of air source heat pump units and waste materials a) Types of waste material – glycol, inhibitors b) Compliance to COSHH regulations c) Use of manufacturer’s data sheets

Topics	Content elements
	d) Correct manual handling procedure for large containers and minimum PPE requirements for filling glycol into systems e) Correct disposal procedures of units and waste materials f) Spillage procedures for hazardous substances (glycol, inhibitors)

Learning outcome 4

Commission and handover an air source heat pump system

Topics	Content elements
4.1 Commission the installation of an air source heat pump	4.1.1 Commission the installation of an air source heat pump a) Requirements i) Compliance with manufacturer's instructions ii) Compliance with MCS Technical Standard procedure iii) Safe working practices (adherence to pre-completed risk assessment, use of PPE) b) Procedure i) Visual checks ii) Checks and actions to confirm system compliance and readiness for commissioning iii) Perform safe isolation of electrical system iv) Checking the suitability of electrical supply circuit arrangements v) Flushing the system of installation debris vi) Filling and venting vii) Testing the operation of the system viii) Operational checks c) Use of tools/equipment i) Thermometers ii) Tools for removing and attaching components/fixings/pipework iii) Multimeters iv) Voltage testing equipment/proving unit v) Non-contact electrical test equipment vi) Lock off tools vii) Charging/flushing equipment d) Completion of relevant documentation to record commissioning activities
4.2 Handover an air source heat pump	4.2.1 Handover an air source heat pump system to a client a) Handover requires explanation/demonstration of: i) System controls ii) Typical operation iii) How to detect faults iv) Maintenance needs/procedures

Topics	Content elements
	v) Health, safety and environmental considerations vi) Contents and purpose of relevant documentation; manufacturer's instructions b) Communicating information to client of system diagrams/manuals c) Completion of relevant documentation to record hand over activities

Learning outcome 5

Service and maintain an air source heat pump system

Topics	Content elements
5.1 Service and maintain an air source heat pump	5.1.1 Perform routine service and maintenance of an air source heat pump a) Preparing a work bay/area for service/maintenance activities b) Visual inspection/checks for i) Leaks and dampness ii) Position of components iii) Discharge of condensate iv) Quality, condition and positioning of pipework insulation and installation v) Integrity of outer casing and electrical components vi) Safety labels vii) Security of fixing of system components viii) Fuse rating ix) Protection of system against freezing c) Identification of remedial faults in an air source heat pump and carrying out repairs i) Incorrect system pressure ii) Leaks to emitter circuit iii) Incorrect fuse size iv) Incorrect expansion vessel pressure d) Setting electrical controls and temperature sensors e) Checking of system water content/fluid levels f) Functional checks i) Safe operation (including pressure relief valve) ii) Efficient operation iii) Function of system (flow return temperatures) iv) Noise vibration levels v) Pressure levels g) Cleaning, adjustment and lubrication of system components and controls h) Leave system in working condition i) Completion of relevant documentation to record maintenance activities

Topics	Content elements
5.2 Common faults in air source heat pumps	5.2.1 General procedure to rectify faults in air source heat pump systems a) Diagnose b) Notify client c) Safe isolation d) De-commission e) Rectify (e.g. fix/replace components) f) Re-commission g) Handover 5.2.2 Causes and characteristics of common faults in an air source heat pump system Common faults a) Heat pump high pressure trip/alarm activated by a circuit malfunction b) Heat pump low pressure trip/alarm activated by a circuit malfunction c) Insufficient heat output d) Domestic hot water heat up is satisfactory but space heating is not operating e) Space heating is satisfactory but domestic hot water heat up is not satisfactory f) System noise and/or vibration g) Pressure relief valve (PRV) discharge

Suggested learning resources

Publications

- MCS MIS 3005-D Heat Pump: Design Standard
- MCS MIS 3005-I Heat Pump: Installation Standard
- MCS MGD 007 Heat Pump reference information and tools
- MCS 031 – MCS Heat Pump System Performance Estimate
- MCS Heat Pump Guide
- BS 7671:2018+A1:2020 Requirements for Electrical Installations (IET Wiring
- Regulations Eighteenth Edition). Available from British Standards Institution (BSI):
  www.bsi-global.com or The Institution of Engineering and Technology (IET):
  www.theiet.org/publications/
- Approved Document G3 “Hot Water Supply and Systems” (England and Wales)
- Hot Water Association Specification HWA 002:2020: Hot water storage vessels for Domestic Purposes for use with Heat Pumps
- BS EN 12831-1:2017 Heating systems in buildings
- CIBSE Domestic Heating Design Guide. A CIBSE publication
- “Design of low-temperature domestic heating systems – a guide for system designers and installers”, 2013, BRE Trust publication FB59, www.brebookshop.com
- EN 806-5:2012: Specifications for installations inside buildings conveying water for human consumption
- BS EN ISO 52016-1:2017 Energy Performance of buildings – energy needs for heating and cooling, internal temperatures and sensible and latent heat loads. Calculation procedures
- EN 8558:2015 Guide to the design, installation, testing and maintenance of services supplying water for domestic use and their curtilages.
- Complementary guidance to BS EN 806-5:2012
- Guide A: Environmental Design. A CIBSE publication
- HSE Approved code of practice (ACOP) L8 - The control of legionella bacteria in water systems approved code of practice and guidance

Appendix 1 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 **Centre document library** on **www.cityandguilds.com** or click on the links below:

Centre Handbook: Quality Assurance Standards

This document is for all approved centres and provides guidance to support their delivery of our qualifications. It includes information on:

- centre quality assurance criteria and monitoring activities
- administration and assessment systems
- centre-facing support teams at City & Guilds/ILM
- centre quality assurance roles and responsibilities.

The Centre Handbook should be used to ensure compliance with the terms and conditions of the centre contract.

Centre Assessment: Quality Assurance Standards

This document sets out the minimum common quality assurance requirements for our regulated and non-regulated qualifications that feature centre-assessed components. Specific guidance will also be included in relevant qualification handbooks and/or assessment documentation.

It incorporates our expectations for centre internal quality assurance and the external quality assurance methods we use to ensure that assessment standards are met and upheld. It also details the range of sanctions that may be put in place when centres do not comply with our requirements or actions that will be taken to align centre marking/assessment to required standards. Additionally, it provides detailed guidance on the secure and valid administration of centre assessments.

Access arrangements: When and how applications need to be made to City & Guilds 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 document library** also contains useful information on such things as:

- conducting examinations
- registering learners
- appeals and malpractice.

Useful contacts

Please visit the **Contact us** section of the City & Guilds website.

City & Guilds

For almost 150 years, we have worked with people, organisations and economies to help them identify and develop the skills they need to thrive. We understand the life-changing link between skills development, social mobility, prosperity and success. Everything we do is focused on developing and delivering high-quality training, qualifications, assessments and credentials that lead to jobs and meet the changing needs of industry.

We partner with our customers to deliver work-based learning programmes that build competency to support better prospects for people, organisations and wider society.
We create flexible learning pathways that support lifelong employability because we believe that people deserve the opportunity to (re)train and (re)learn again and again – gaining new skills at every stage of life, regardless of where they start.

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City & Guilds
Giltspur House
5–6 Giltspur Street
London
EC1A 9DE

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