

City & Guilds Level 3 NVQ Diplomas in Heating and Ventilating (6188- 30/31/32)

Qualification handbook for centres

Level 3 NVQ Diploma in Heating and Ventilating
Industrial and Commercial Installation (6188-30)
600/1009/5

Level 3 NVQ Diploma in Heating and Ventilating
Ductwork Installation (6188-31) 600/1005/8

Level 3 NVQ Diploma in Planned and Reactive
Maintenance on Heating & Ventilating Systems (6188-
32) 600/1008/3

About City & Guilds

City & Guilds is the UK's leading provider of vocational qualifications, offering over 500 awards across a wide range of industries, and progressing from entry level to the highest levels of professional achievement. With over 8500 centres in 100 countries, City & Guilds is recognised by employers worldwide for providing qualifications that offer proof of the skills they need to get the job done.

City & Guilds Group

The City & Guilds Group includes City & Guilds, ILM (the Institute of Leadership & Management, which provides management qualifications, learning materials and membership services), City & Guilds NPTC (which offers land-based qualifications and membership services), City & Guilds HAB (the Hospitality Awarding Body), and City & Guilds Centre for Skills Development. City & Guilds also manages the Engineering Council Examinations on behalf of the Engineering Council.

Equal opportunities

City & Guilds fully supports the principle of equal opportunities and we are committed to satisfying this principle in all our activities and published material. A copy of our equal opportunities policy statement is available on our website.

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent.

However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching candidates working towards a City & Guilds qualification, or for internal administration purposes
- candidates may copy the material only for their own use when working towards a City & Guilds qualification

The *Standard Copying Conditions* (which can be found on our website) also apply.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

Publications

City & Guilds publications are available from our website or from our Publications Sales department, using the contact details shown below.

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

City & Guilds

1 Giltspur Street

London EC1A 9DD

T +44 (0)844 543 0000

F +44 (0)20 7294 2413

www.cityandguilds.com

centresupport@cityandguilds.com

City & Guilds City & Guilds Level 3 NVQ Diplomas in Heating and Ventilating (6188-30/31/32)

Qualification handbook for centres

Qualification level and title	City & Guilds qualification number	Qualification accreditation number	GLH	TQT
City & Guilds Level 3 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation	6188-30	600/1009/5	454	570
City & Guilds Level 3 NVQ Diploma in Heating and Ventilating Ductwork Installation*	6188-31	600/1005/8	Qualification no longer available	
City & Guilds Level 3 NVQ in Planned and Reactive Maintenance on Heating & Ventilating Systems	6188-32	600/1008/3	504	620

*Qualifications no longer available.

Version and date	Change detail	Section
2.1 October 2017	Added TQT and GLH details Deleted QCF	Qualification Structure Throughout
2.2 March 22	Checked TQT which was accurate and did not need changing, added C&G to front cover and changed address	Front and back covers

City & Guilds
Skills for a brighter future



www.cityandguilds.com

Contents

1	Introduction to the qualifications	6
1.1	Qualification structure	7
1.2	Opportunities for progression	12
1.3	Qualification support materials	12
2	Centre requirements	14
2.1	Resource requirements	14
2.2	Candidate entry requirements	17
3	Course design and delivery	18
3.1	Initial assessment and induction	18
3.2	Recommended delivery strategies	18
4	Assessment	19
4.1	Summary of assessment methods	19
4.2	Assignments	22
4.3	Evidence requirements	22
4.4	Test specifications	24
4.5	Recording forms	24
4.6	Recognition of prior learning (RPL)	24
5	Units	25
Unit 301	Understand how to organise resources within BSE	28
Unit 302	Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components	33
Unit 303	Understand industrial and commercial cold water system installation and pre-commissioning techniques	51
Unit 304	Understand industrial and commercial hot water system installation and pre-commissioning techniques	63
Unit 305	Understand industrial and commercial heating system installation and pre-commissioning techniques	75
Unit 306	Understand industrial and commercial chilled water system installation and pre-commissioning techniques	86
Unit 307	Understand the principles and requirements of industrial and commercial fuel systems	100
Unit 308	Install heating and ventilation industrial and commercial systems	119
Unit 309	Understand industrial and commercial heating and ventilating maintenance techniques	130
Unit 310	Maintain industrial and commercial heating and ventilating systems	135
Unit 311	Understand industrial and commercial oxy-acetylene pipe jointing	141
Unit 312	Perform industrial and commercial oxy-acetylene pipe jointing	146
Unit 313	Understand industrial and commercial manual metal arc pipe jointing techniques	149

Unit 314	Perform industrial and commercial manual metal arc pipe jointing	154
Unit 315	Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques	157
Unit 316	Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques	168
Unit 317	Understand industrial and commercial air handling unit installation and pre-commissioning techniques	179
Unit 318	Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques	190
Unit 319	Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques	200
Unit 320	Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques	210
Unit 321	Install and pre-commission industrial and commercial ductwork systems	220
Unit 322	Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques	228
Unit 323	Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques	246
Unit 324	Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques	262
Unit 325	Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques	280
Unit 326	Maintain and diagnose faults on heating and ventilating industrial and commercial systems	298
Relationship to other qualifications		319
Appendix 1	Sources of general information	320

City & Guilds
Skills for a brighter future



www.cityandguilds.com



1 Introduction to the qualifications

This document contains the information (please consult the Walled Garden/Online Catalogue for last dates) that centres need to offer the following qualifications:

Qualification title and level	City & Guilds qualification number	Qualification accreditation number
Level 3 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation	6188-30	600/1009/5
Level 3 NVQ Diploma in Heating & Ventilating - Ductwork Installation	6188-31	600/1005/8
Level 3 NVQ Diploma in Planned and Reactive Maintenance on Heating and Ventilating Systems	6188-32	600/1008/3

These qualifications meet the needs of learners in England, Wales and Northern Ireland who want to work as a heating and ventilation engineer installing, industrial and commercial pipe-work and or ductwork systems or planned and reactive maintaining of these systems, equipment and components in buildings, structures and the environment within the Building Services industry.

These qualifications also contribute to the knowledge, understanding, and practical skills regarding Heating and Ventilating Ductwork and Industrial and Commercial Installation as well as Planned and Reactive Maintenance Systems.

Once candidates have learnt the required skills and knowledge, they will demonstrate their occupational competence in the workplace within this qualification.

They replace the following City & Guilds qualifications:

- 6088-06 Level 3 NVQ in Heating and Ventilating (Industrial and Commercial) 100/3376/2
- 6088-08 Level 3 NVQ in Heating and Ventilating (Ductwork Installation) 100/3376/2 ,
- 6128-06 Level 3 Certificate in Heating and Ventilating (Complex Industrial and Commercial Systems Installation) 100/3514/X
- 6128-08 Level 3 Certificate in Heating and Ventilating (Complex Ductwork Systems Installation) 100/3514/X

1.1 Qualification structure

To achieve the **Level 3 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation (6188-30)**, learners must achieve 50 credits from the eight mandatory units plus a minimum of 7 credits from the optional units in the table shown below

City & Guilds unit number	Unit accreditation number	Unit title	Mandatory/ optional for full qualification	Credit value	GLH	Unit type
Unit 301	R/602/2498	Understand how to organise resources within BSE	Mandatory	3	26	Knowledge
Unit 302	R/502/9151	Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components	Mandatory	12	102	Combination
Unit 303	R/602/4851	Understand industrial and commercial cold water system installation and pre-commissioning techniques	Mandatory	5	42	Knowledge
Unit 304	Y/602/4852	Understand industrial and commercial hot water system installation and pre-commissioning techniques	Mandatory	5	42	Knowledge
Unit 305	K/602/4855	Understand industrial and commercial heating system installation and pre-commissioning techniques	Mandatory	5	42	Knowledge
Unit 306	A/602/4858	Understand industrial and commercial chilled water system installation and pre-commissioning techniques	Mandatory	5	42	Knowledge

Unit 307	F/602/4862	Understand the principles and requirements of industrial and commercial fuel systems	Mandatory	12	112	Knowledge
Unit 308	Y/602/4897	Install H&V industrial and commercial systems	Mandatory	3	4	Performance
Unit 309	H/602/4871	Understand industrial and commercial H&V maintenance techniques	Optional	5	38	Knowledge
Unit 310	Y/502/8194	Maintain industrial and commercial H&V systems	Optional	2	4	Performance
Unit 311	D/602/4884	Understand industrial and commercial oxy-acetylene pipe jointing	Optional	5	38	Knowledge
Unit 312	K/602/4905	Perform industrial and commercial oxy-acetylene pipe jointing	Optional	2	4	Performance
Unit 313	K/602/4886	Understand industrial and commercial manual metal arc pipe jointing techniques	Optional	5	38	Knowledge
Unit 314	T/602/4907	Perform industrial and commercial manual metal arc pipe jointing	Optional	2	4	Performance

To achieve the **Level 3 NVQ Diploma in Heating and Ventilating Ductwork Installation (6188-31)**, learners must achieve 39 credits from the eight mandatory units in the table shown below.

City & Guilds unit number	Unit accreditation number	Unit title	Mandatory/ optional for full qualification	Credit value	GLH	Unit type
Unit 301	R/602/2498	Understand how to organise resources within BSE	Mandatory	3	26	Knowledge
Unit 315	F/602/4909	Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques	Mandatory	8	65	Knowledge
Unit 316	A/602/4911	Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques	Mandatory	8	65	Knowledge
Unit 317	D/602/4920	Understand industrial and commercial air handling unit installation and pre-commissioning techniques	Mandatory	4	28	Knowledge
Unit 318	K/502/8202	Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques	Mandatory	4	28	Knowledge
Unit 319	M/502/8203	Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques	Mandatory	4	28	Knowledge

Unit 320	R/502/8226	Understand industrial and commercial local exhaust ventilation system installation and pre-commissioning techniques	Mandatory	4	28	Knowledge
Unit 321	H/502/8229	Install and pre-commission industrial and commercial ductwork systems	Mandatory	4	4	Performance

To achieve the **Level 3 NVQ Diploma in Planned and Reactive Maintenance on Heating and Ventilating Systems (6188-32)**, learners must achieve 62 credits from the eight mandatory units in the table shown below.

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value	GLH	Unit type
R/602/2498	Unit 301	Understand how to organise resources within BSE	Mandatory	3	26	Knowledge
R/502/9151	Unit 302	Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components	Mandatory	12	102	Combination
F/602/4862	Unit 307	Understand the principles and requirements of industrial and commercial fuel systems	Mandatory	12	112	Knowledge
D/502/8231	Unit 322	Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques	Mandatory	8	65	Knowledge
F/502/8190	Unit 323	Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques	Mandatory	8	65	Knowledge
J/502/8191	Unit 324	Understand industrial and commercial ventilation system maintenance and fault diagnosis techniques	Mandatory	7	61	Knowledge

L/502/8192	Unit 325	Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques	Mandatory	7	61	Knowledge
R/502/8193	Unit 326	Maintain and diagnose faults on H&V industrial and commercial systems	Mandatory	5	12	Performance

1.2 Opportunities for progression

On completion of this qualification candidates may progress into employment or to the following City & Guilds qualifications:

- 6189-41 Level 3 NVQ Diploma in Domestic Heating
- 6189-42 Level 3 NVQ Diploma in Domestic Heating (Gas Fired Warm Air Appliances)
- 6189-43 Level 3 NVQ Diploma in Domestic Heating (Gas Fired Water and Central Heating Appliances)
- 6189-31 Level 3 NVQ Diploma in Domestic Plumbing and Heating
- 6189-32 Level 3 NVQ Diploma in Domestic Plumbing and Heating (Gas Fired Warm Air Appliances)
- 6189-33 Level 3 NVQ Diploma in Domestic Plumbing and Heating (Gas Fired Water and Central Heating Appliances)
- 4467 Level 4 Higher Level Qualification in Building Services Engineering
- ILM Level 2 Award and Certificate in Team Leading
- ILM Level 2 NVQ in Team Leading
- ILM Qualifications in Effective Team Member Skills
- ILM Level 3 Award in Effective Management
- ILM Level 3 Certificate in Management
- ILM Level Qualifications in First Line Management

1.3 Qualification support materials

City & Guilds also provides the following publications and resources specifically for this qualification:

Description

Assessment pack

How to access

www.cityandguilds.com

Total Qualification Time

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

Title and level	GLH	TQT
Level 3 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation	454	570
Level 3 NVQ Diploma in Planned and Reactive Maintenance on Heating and Ventilating Systems	504	620

2 Centre requirements

This section outlines the approval processes for Centres to offer this qualification and any resources that Centres will need in place to offer the qualifications including qualification-specific requirements for Centre staff.

Centres already offering City & Guilds qualifications in this subject area

Centres that are currently approved for the following qualifications:

- 6088-06 Level 3 NVQ in Heating and Ventilating (Industrial and Commercial) 100/3376/2
- 6088-08 Level 3 NVQ in Heating and Ventilating (Ductwork Installation) 100/3376/2
- 6128-06 Level 3 Certificate in Heating and Ventilating (Complex Industrial and Commercial Systems Installation) 100/3514/X
- 6128-08 Level 3 Certificate in Heating and Ventilating (Complex Ductwork Systems Installation) 100/3514/X

are eligible for automatic approval for the new 6188-30 Level 3 NVQ Diploma in Heating and Ventilating Industrial and Commercial Installation 600/1009/5 and the 6188-31 Level 3 NVQ Diploma in Heating and Ventilating Ductwork Installation 600/1005/8.

Centres wishing to offer the new 6188-32 Level 3 NVQ Diploma in Planned Reactive Maintenance on Heating and Ventilating Systems 600/1008/3 must use the standard Qualification Approval Process (refer to *Providing City & Guilds qualifications – a guide to centre and qualification approval* in Appendix 2). This also applies to new centres wishing to offer any of these qualifications.

City & Guilds reserves the right to insist on full qualification approval if there have been quality issues within a centre or if there have been substantial staff changes at the centre.

2.1 Resource requirements

Physical resources and site agreements

It is acceptable for centres to use specially designated areas within a centre to teach practical skills and to assess the simulated practical assignments within the knowledge units. The equipment, systems and machinery must meet current industrial standards and be capable of being used under normal working conditions, and must fully meet the requirements set in each City & Guilds practical assignment guide.

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. This knowledge must be at least to the same level as the training being delivered
- hold appropriate qualifications as detailed in this handbook.
- have recent relevant experience in the specific area they will be assessing

- have credible experience of providing training.

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

The following information is taken from the 'Summit Skills Consolidated Assessment Strategy for Units and Qualifications of 'Occupational Competence' in the Qualifications and Credit Framework (England, Northern Ireland and Wales@ for the Building Services Engineering Sector January 2010 v2.1 (amended April 2010)', which governs the assessment of competence based qualifications in the Building Services Engineering sector.

Assessors

Assessors **must**:

- be working towards or have achieved A1 or A2 Standards and continue to practice to those standards, or
- have achieved D32 or D33 or TQFE/TQSE and possess CPD evidence of practicing to A1 or A2 Standards, or
- have other suitable "equivalent assessor qualifications" endorsed by SummitSkills, which apply the principles of the A1/A2 Standards.

Occupational Competence

Assessors must have verifiable relevant industry experience and current knowledge of industry working practices and techniques relevant to the occupational working area. This verifiable evidence must be **at or above the level being assessed** and include one or more of the following:

- A relevant qualification (*NVQs/SVQs at the appropriate level or their equivalents*)
- Registration with the appropriate industry registration body at the relevant occupational level and grade

For particular units/qualifications the verifiable evidence may need to be above the level of the unit/qualification being assessed. Where applicable this requirement will be detailed in the 'Additional Information' pertaining to specific units/qualifications.

Assessment of competence-based units/qualifications for electrotechnical and mechanical services occupations will require assessors to have the relevant qualification that certifies their competence in key technical areas pertinent to the completion of the unit/qualification.

This occupational competence must include up-to-date knowledge of each industry (for which the assessment is taking place), its settings, legislative and regulatory requirements, codes of practice and guidance.

NOTE: Assessors and verifiers who have relevant qualifications pre-NVQ and post-NVQ which are not competence-based must provide verifiable evidence that they are occupationally competent. This evidence must demonstrate that the assessor/verifier has up-to-date knowledge of the industry/occupation (for which the assessment is taking place), its settings, legislative and regulatory requirements, codes of practice and guidance.

Assessor Continuing Professional Development

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed via continuing professional development (CPD) via the assessment centres and quality assured by City & Guilds.

It is the responsibility of each assessor to identify and make use of opportunities for CPD, such as industry conferences, access to trade journals, and SSC and Professional Body/Trade Association events, at least on an annual basis to enhance and upgrade their professional development and technical knowledge. It is imperative that records are kept of all such CPD opportunities/occasions and that they provide evidence of cascading such technical knowledge and industry intelligence to all relevant colleagues.

Internal Verifiers (IV)

IV Role and Responsibilities

SummitSkills considers the main focus of IVs to be the quality assurance of assessment procedures. The IV is also required to have a minimum of occupational experience evidenced by having a Building Services Engineering sector related qualification or proven sector competence/experience plus access to relevant “occupational expertise” to enable them to conduct their role as internal verifier appropriately. This evidence and access to ‘occupational expertise’ is quality assured by City & Guilds.

Internal verifiers must:

Be working towards or have achieved the V1 Standard and continue to practice to that standard; or have achieved D34 and possess CPD evidence of practicing to the V1 Standard and demonstrate an understanding of the assessment process.

IV Continuing Professional Development

The occupational experience of IVs must be updated on a regular basis and be periodically reconfirmed via continuing professional development (CPD) via the assessment centres and quality assured by City & Guilds.

It is the responsibility of each IV to identify and make use of opportunities for CPD, such as industry conferences, access to trade journals, and SSC and Professional Body/Trade Association events, at least on an annual basis to enhance and upgrade their professional development and technical knowledge. It is imperative that records are kept of all such CPD opportunities/occasions.

Expert Witnesses

Where ‘**Expert Witnesses**’ are used in the assessment process identified above they must be sector competent individuals who can attest to the learner's performance in the workplace.

Expert witnesses will need to demonstrate:

- they have relevant current knowledge of industry working practices and techniques
- that they have no conflict of interest in the outcome of their evidence.

It is not necessary for expert witnesses to hold an assessor qualification, as a qualified assessor must assess the performance evidence provided by an expert witness

Evidence presented by expert witnesses must meet the tests of validity, reliability, authenticity and sufficiency

2.2 Candidate entry requirements

Candidates should not be entered for a qualification of the same type, content and level as that of a qualification they already hold.

There are no formal entry requirements for candidates undertaking this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully

As part of the assessment for this qualification, candidates must have, or have the potential to obtain access to a real work setting where they can demonstrate practical occupational competence to the requirements of the units, consistently over time.

Age restrictions

This qualification is not approved for use by candidates under the age of 16, and City & Guilds cannot accept any registrations for candidates in this age group.

Other legal considerations

All legal requirements related to the subject matter must be met by candidates and centres.

3 Course design and delivery

3.1 Initial assessment and induction

Centres will need to make an initial assessment of each candidate prior to the start of their programme to ensure they are entered for an appropriate type and level of qualification.

The initial assessment should identify any:

- Specific training needs the candidate has, and the support and guidance they may require when working towards their qualification. This is sometimes referred to as diagnostic testing.
- Units the candidate has already completed, or credit they have accumulated which is relevant to the qualification they are about to begin.

City & Guilds recommends that centres provide an induction programme to ensure the candidate fully understands the requirements of the qualification they will work towards, their responsibilities as a candidate, and the responsibilities of the centre. It may be helpful to record the information on a learning contract.

City & Guilds are providing optional practice tests for the online assessments within this qualification. These may aid centres and candidates in determining the learners readiness to undertake the online assessment

3.2 Recommended delivery strategies

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their candidates
- satisfies the requirements of the qualification.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualification. This might include the following:

- literacy, language and/or numeracy
- personal learning and thinking
- personal and social development
- employability.

Where applicable, this could involve enabling the candidate to access relevant qualifications covering these skills.

4 Assessment

4.1 Summary of assessment methods

City & Guilds provides the following assessments:

- Online, on-demand testing using multiple choice questions
- Assignments (practical and written) available from the 6188 webpage (passwords for approved centres available via City & Guilds Walled Garden 6188 page).
- Short-answer questions available from the 6188 webpage (passwords for approved centres available via City & Guilds Walled Garden 6188 page).

Unit No.	Title	Assessment Method	Where to obtain assessment materials
Unit 301	Understand how to organise resources within BSE	City & Guilds on-line multiple choice test	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 302	Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components	Externally set multiple choice paper, locally marked and externally verified. Externally set assignment, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 303	Understand industrial and commercial cold water system installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 304	Understand industrial and commercial hot water system installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 305	Understand industrial and commercial heating system installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 306	Understand industrial and commercial chilled water system installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 307	Understand the principles and requirements of industrial and commercial fuel systems	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden

Unit No.	Title	Assessment Method	Where to obtain assessment materials
Unit 308	Install H&V industrial and commercial systems	This unit will be assessed via observation and the development of a portfolio in a work based environment and will be assessed to the assessment criteria set out in the unit.	Candidates and centres may decide to use a paper-based or electronic method of recording evidence. Recording forms are available on the City & Guilds website.
Unit 309	Understand industrial and commercial H&V maintenance techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 310	Maintain industrial and commercial H&V systems	This unit will be assessed via observation and the development of a portfolio in a work based environment and will be assessed to the assessment criteria set out in the unit.	Candidates and centres may decide to use a paper-based or electronic method of recording evidence. Recording forms are available on the City & Guilds website.
Unit 311	Understand industrial and commercial oxy-acetylene pipe jointing	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 312	Perform industrial and commercial oxy-acetylene pipe jointing	This unit will be assessed via observation and the development of a portfolio in a work based environment and will be assessed to the assessment criteria set out in the unit.	Candidates and centres may decide to use a paper-based or electronic method of recording evidence. Recording forms are available on the City & Guilds website.
Unit 313	Understand industrial and commercial manual metal arc pipe jointing techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 314	Perform industrial and commercial manual metal arc pipe jointing	This unit will be assessed via observation and the development of a portfolio in a work based environment and will be assessed to the assessment criteria set out in the unit.	Candidates and centres may decide to use a paper-based or electronic method of recording evidence. Recording forms are available on the City & Guilds website.

Unit No.	Title	Assessment Method	Where to obtain assessment materials
Unit 315	Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 316	Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 317	Understand industrial and commercial air handling unit installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified	Go to www.cityandguilds.com . Password available on Walled Garden.
Unit 318	Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 319	Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 320	Understand industrial and commercial local exhaust ventilation system installation and pre-commissioning techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 321	Install and pre-commission industrial commercial ductwork systems	This unit will be assessed via observation and the development of a portfolio in a work based environment and will be assessed to the assessment criteria set out in the unit.	Candidates and centres may decide to use a paper-based or electronic method of recording evidence. Recording forms are available on the City & Guilds website
Unit 322	Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 323	Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden

Unit No.	Title	Assessment Method	Where to obtain assessment materials
Unit 324	Understand industrial and commercial ventilation system maintenance and fault diagnosis techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 325	Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques	Externally set multiple choice paper, locally marked and externally verified.	Go to www.cityandguilds.com . Password available on Walled Garden
Unit 326	Maintain and diagnose faults on H&V industrial and commercial systems	This unit will be assessed via observation and the development of a portfolio in a work based environment and will be assessed to the assessment criteria set out in the unit.	Candidates and centres may decide to use a paper-based or electronic method of recording evidence. Recording forms are available on the City & Guilds website.

Time constraints

The following time constraints must be applied to the assessment of this qualification:

- Candidates must be assessed within the lifespan of the qualification.
- All assessments must take no longer than the stated time limit to complete, where maximum time limits apply. Centre staff should guide candidates to ensure excessive evidence gathering is avoided. Centres finding that assignments are taking longer, should contact the external verifier for guidance.
- All assignments must be completed and assessed within the candidate's period of registration. Centres should advise candidates of any internal timescales for the completion and marking of individual assignments.

4.2 Assignments

All assignments are available on the 6188 section of **www.cityandguilds.com** dedicated to this qualification. The password to access these materials are available to approved centres on the Walled Garden. Assessment materials **must** only be accessed by centre staff formally appointed to securely handle assessments.

4.3 Evidence requirements

The evidence requirements and City & Guilds assessment strategy for this qualifications has been designed within the confines of SummitSkills 'Consolidated Assessment Strategy for Units and Qualifications of 'Occupational Competence' in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector' (April 2010 v2.1a (06.10.)

There are three types of units within this qualification:

- Knowledge units that give the learner the opportunity to demonstrate their knowledge and understanding of identified topics and subject areas. There are some formal practical assessments within these units. In addition SummitSkills expect for some units candidates knowledge to be consolidated by the use of "Practical Support

Learning” activity in simulated conditions. The ‘notes for guidance’ section in each unit will detail where this is expected.

- Performance units that give the learner the opportunity to demonstrate they have the practical skills that are in keeping with the relevant National Occupational Standards for identified activities.
- Combination units consist of practical activities/assignments in simulated conditions. Identified knowledge is assessed in accordance with projects/assignments, external written assessments/tests and professional discussion.

For the **performance units** the majority of evidence must be generated from a real working environment. This is an environment in which real work activities take place under real working conditions in keeping with real commercial situations

Simulation can take place in those rare circumstances where the opportunities to collect naturally occurring evidence are limited or absent and the learner lacks evidence for completion of the unit. However, this scenario is anticipated to be rare in relation to the qualifications and the units to which this strategy applies given the inherent flexibility of the evidence-gathering process. Where simulation does take place it must be in a realistic working environment.

A simulated environment in which simulated activities take place must replicate a real working environment. The criteria for which must be to supply fit-for-purpose tools, equipment, full-size components, realistic deadlines and other commercial requirements.

Simulation **must take** place for industry identified key-safety critical aspects of the qualification as listed in and their relevant associated units. A key-safety critical aspect is defined by SummitSkills as ‘any ‘technical’ activity with the potential to harm/damage personnel/property if carried out incorrectly’. The activities that will be undertaken demonstrating competence in these areas are contained within each industries ‘Assessment of Occupational Competence’ arrangement and this must **not** be undertaken before the learner has demonstrated sufficient technical expertise, knowledge, skill and maturity.

‘Knowledge’ units must be undertaken in line with the City & Guilds assessment strategy for each unit as detailed in this handbook.

The environment, in which the evidence and the quantity of evidence for **Performance Units** must be assessed, i.e. sourced from the real working environment or simulated conditions will be detailed in the ‘Additional Requirements’ for each Performance Unit. This could be applicable to all the Learning Outcomes in the unit or particular Learning Outcomes.

Evidence that is sourced from the real working environment for **Performance Units** must be naturally occurring and can be generated by;

- Direct observation of performance in the workplace by a qualified assessor and/or testimony from an expert witness subject to the activity being assessed. **This will be the primary source of evidence.**
- Candidate’s reflective account of performance.
- Work plans and work based products eg diagrams, drawings, specifications, customer testimony, authorised & authenticated photographs / images and audiovisual records of work completed.
- Evidence from prior achievements that demonstrably match the requirements of the Performance Unit.
- Witness testimony.

Meeting the assessment requirements of **Performance Units** will need initial discussions and assessment planning between the learner and Assessor, as an essential activity to identify opportunities to assess real working environment evidence, gaps that need to be filled or opportunities to recognise the prior achievement of the learner.

Competence must be demonstrated **consistently over a period of time and on more than one occasion**. Unless specifically stated otherwise within the unit, there is no stipulation what that period of time might be as this is a decision for the Assessor. Based on their own professional judgement Assessors must be capable of identifying when competence has been demonstrated by the learner.

4.4 Test specifications

The test specification for these units is available on the City & Guilds website. Please go to **www.cityandguilds.com** and navigate to the 6188 webpage.

4.5 Recording forms

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several EPortfolio systems. Further details are available at: **www.cityandguilds.com/eportfolios**.

Although it is expected that new centres will use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used.

4.6 Recognition of prior learning (RPL)

Recognition of Prior Learning (RPL) recognises the contribution a person's previous experience could contribute to a qualification. RPL is allowed and is sector specific.

There is no automatic RPL for candidates who have completed the 6128 Level 3 Certificate in Heating and Ventilating technical certificate to enable them automatic exemption from taking the knowledge units of the 6188-30, 31 and 32 pathways of this qualification.

With regards to the performance units of this qualification there are opportunities to recognise candidate's RPL from the 6088 Level 3 NVQ in Heating and Ventilating qualifications. There are however no automatic exemption against units successfully attained in the 6088 Heating and Ventilating qualification against the new 6188 qualification. Centres will have to undertake a manual mapping exercise comparing the units to identify opportunities for recognised performance evidence gained by the candidate in the 6088 qualifications.

5 Units

Availability of units

The learning outcomes and assessment criteria are also viewable on the Register of Regulated Qualifications www.register.ofqual.gov.uk

Structure of units

The units in this qualification are written in a standard format and comprise the following:

- City & Guilds reference number
- unit title
- unit level
- unit credit value
- unit accreditation number
- guided learning hours
- learning outcomes
- assessment criteria

Summary of units

City & Guilds unit number	Title	Ref number	Credits
Unit 301	Understand how to organise resources within BSE	R/602/2498	3
Unit 302	Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components	R/502/9151	12
Unit 303	Understand industrial and commercial cold water system installation and pre-commissioning techniques	R/602/4851	5
Unit 304	Understand industrial and commercial hot water system installation and pre-commissioning techniques	Y/602/4852	5
Unit 305	Understand industrial and commercial heating system installation and pre-commissioning techniques	K/602/4855	5
Unit 306	Understand industrial and commercial chilled water system installation and pre-commissioning techniques	A/602/4858	5
Unit 307	Understand the principles and requirements of industrial and commercial fuel systems	F/602/4862	12
Unit 308	Install H&V industrial and commercial systems	Y/602/4897	3
Unit 309	Understand industrial and commercial H&V maintenance techniques	H/602/4871	5
Unit 310	Maintain industrial and commercial H&V systems	Y/502/8194	2
Unit 311	Understand industrial and commercial oxy-acetylene pipe jointing	D/602/4884	5
Unit 312	Perform industrial and commercial oxy-acetylene pipe jointing	K/602/4905	2
Unit 313	Understand industrial and commercial manual metal arc pipe jointing techniques	K/602/4886	5
Unit 314	Perform industrial and commercial manual metal arc pipe jointing	T/602/4907	2
Unit 315	Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques	F/602/4909	8
Unit 316	Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques	A/602/4911	8
Unit 317	Understand industrial and commercial air handling unit installation and pre-commissioning techniques	D/602/4920	4
Unit 318	Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques	K/502/8202	4
Unit 319	Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques	M/502/8203	4

Unit 320	Understand industrial and commercial local exhaust ventilation system installation and pre-commissioning techniques	R/502/8226	4
Unit 321	Install and pre-commission industrial and commercial ductwork systems	H/502/8229	4
Unit 322	Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques	D/502/8231	8
Unit 323	Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques	F/502/8190	8
Unit 324	Understand industrial and commercial ventilation system maintenance and fault diagnosis techniques	J/502/8191	7
Unit 325	Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques	L/502/8192	7
Unit 326	Maintain and diagnose faults on H&V industrial and commercial systems	R/502/8193	5

Level: 3

Credit value: 3

UAN number: R/602/2498

Learning outcomes

There are **four** learning outcomes to this unit. The learner will

1. Know the responsibilities of relevant people in the building services industry
2. Know how to oversee building services work
3. Know how to produce risk assessments and method statements for the building services industry
4. Know how to plan work programmes for work tasks in the building services industry

Guided learning hours

It is recommended that **26** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 301 Understand how to organise resources within BSE

Outcome 1 Know the responsibilities of relevant people in the building services industry

Assessment criteria

The learner can:

- 1.1 define the types of client that are encountered when working:
 - private customer
 - direct communication
 - through customer representatives - managing agents
 - contracting customer
 - internal customer – within same company
- 1.2 specify the types of communication that may be required with clients throughout the progress of a job
- 1.3 specify the types of communication that may be required with the site management team:
 - architect
 - quantity surveyor
 - buyer/estimator
 - surveyor
 - project manager/clerk of works
 - structural engineer
 - building services engineer
 - contracts manager
 - construction manager
- 1.4 define the typical site responsibilities for craft operatives in the workplace:
 - apprentices/trainees
 - level 2 craft level qualified staff
 - limited self responsibility
 - level 3 craft level qualified staff
 - supervision of self and other staff members
- 1.5 specify the different methods of supervising individuals that can be used:
 - styles of supervision
 - methods of motivating staff
- 1.6 define the job responsibilities when supervising staff:
 - identifying the competence of subordinates to undertake work
 - identifying when direct supervision or detailed direction is required
 - specific health and safety issues
 - responsibility for planning safe working for subordinates
 - how to adjust work schedules when health and safety problems delay works.

Unit 301

Understand how to organise resources within BSE

Outcome 2

Know how to oversee building services work

Assessment criteria

The learner can

- 2.1 specify how to deal with variations to works:
 - prescribed by the work environment
 - communication to the client
 - agreement to extra time and costs
 - prescribed by the customer
 - agreement to extra time and costs
- 2.2 clarify how to undertake ongoing monitoring of the work progress against the work programme to ensure:
 - safety
 - cost effectiveness
 - quality
- 2.3 clarify how to deal with problems that arise with deficiencies in work performance that could affect:
 - safety
 - cost effectiveness
 - quality.

Unit 301

Understand how to organise resources within BSE

Outcome 3

Know how to produce risk assessments and method statements for the building services industry

Assessment criteria

The learner can:

- 3.1 define the levels of risk presented by work situations
- 3.2 define the hazards presented by work situations
- 3.3 specify the methods used to carry out a risk assessment for a task:
 - methods of assessing risk
 - risk calculation formula
- 3.4 identify how to produce a methods statement for areas of work and safety risk:
 - information to be provided in a method statement
 - presentation of a method statement.

Unit 301

Understand how to organise resources within BSE

Outcome 4

Know how to plan work programmes for work tasks in the building services industry

Assessment criteria

The learner can:

- 4.1 specify the types of work programme that would be used for:
 - private installation work
 - private service/maintenance work
 - new-build installation contract work
 - service/maintenance contract work
- 4.2 state the process for planning work activities against job specifications, the scope, purpose and requirements of the work:
 - identification of work responsibilities
 - external factors that affect timeframe
- 4.3 state the process for selecting the required resources against the job specification:
 - materials
 - plant
 - vehicles
 - equipment
- 4.4 specify material delivery requirements against work programmes and the impact that the non-availability of materials may have on work progress:
 - work in private properties
 - work on new-build housing
 - work on commercial contracts
 - avoiding loss of materials on site (theft)
- 4.5 define the factors which affect working time allocation to work activities:
 - labour resources
 - planning work with other trades
 - material deliveries
- 4.6 identify how to produce simple work programmes:
 - simple bar (progress) chart.

Unit 302

Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components

Level: 3

Credit value: 12

UAN number: R/502/9151

Learning outcomes

There are **thirteen** learning outcomes to this unit. The learner will

1. Know the electrical standards that apply to the mechanical services industry
2. Know the fundamental principles of electricity supply to buildings
3. Know the layout features of electrical circuits in buildings
4. Understand the electrical industry safe isolation procedure
5. Be able to carry out the electrical industry safe isolation procedure
6. Know the preparation techniques for the electrical connection of mechanical services components
7. Be able to demonstrate preparation, installation and connection techniques for the connection of electrically operated mechanical services components
8. Understand the installation and connection requirements of electrically operated mechanical services components
9. Be able to install and connect electrically operated mechanical services components
10. Know the inspection and testing requirements of electrically operated mechanical services components
11. Be able to inspect and test electrically operated mechanical services components
12. Know the procedures for safely diagnosing and rectifying faults in electrically operated mechanical services components
13. Be able to safely diagnose and rectify faults in electrically operated mechanical services components

Guided learning hours

It is recommended that **102** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 1 Know the electrical standards that apply to the mechanical services industry

Assessment criteria

The learner can:

- 1.1 state the statutory and non statutory regulations legislation and guidance information that applies to electrical supply and control of industrial and commercial mechanical services systems and their components, including those for:
 - health and safety
 - construction specific requirements
 - mechanical services
 - professional body guidance
 - codes of practice
 - industry standards
 - manufacturers' installation and service/maintenance instructions
 - manufacturer technical/user instructions
- 1.2 identify the range of information that would be detailed on minor works certificate for an installation of an electrical system or component
- 1.3 specify the procedure for notifying works carried out to the relevant authority.

Unit 302 Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components

Outcome 2 Know the fundamental principles of electricity supply to buildings

Assessment criteria

The learner can:

- 2.1 specify the methods by which electricity is generated:
 - basic power station operation
 - principles of generation
 - types of supply:
 - single phase
 - three phase and neutral
- 2.2 specify the methods by which generated electricity is distributed to non dwellings and commercial properties:
 - basic operation and features of the national grid and local distribution systems:
 - sub-stations
 - supply transformers
 - local distribution of three – and single phase supplies to premises
- 2.3 state the purpose of electrical components at entry of the property:
 - metering
 - distribution board
 - main earth terminal
 - protective devices.

Unit 302 Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components

Outcome 3 Know the layout features of electrical circuits in buildings

Assessment criteria

The learner can:

- 3.1 define the operating principles of electrical circuit protection devices:
 - miniature circuit breakers
 - residual current devices including RCBO's
 - fuses:
 - re-wireable
 - cartridge
 - high breaking capacity
- 3.2 define the system layout features for electrical circuits in non dwellings and commercial properties:
 - ring main circuit
 - radial circuit
 - fixed equipment supplies:
 - spurs and fused outlets
- 3.3 state the types, applications and limitations of cables, flexible-cords and conductors used for installation of electrical equipment and components in mechanical services systems
- 3.4 clarify the difference between Class 1 and Class 2 electrical equipment
- 3.5 define the function of electrically operated components used in mechanical services systems:
 - flame rectification devices
 - flame suppression devices
 - solenoid valves
 - thermistors
 - thermocouples
 - micro switches
 - relays
 - printed circuited boards
 - pressure switches
 - pumps
 - fans
 - leak detection

control components:

- thermostats
- programmers/timers
- electrically operated control valves (actuators)
- sensors
- wiring centres

switches:

- rocker plate (with/without CPC – single and double pole)
- pull cord
- pressure operated
- DP lockable isolators

3.6 define the operating principles of electrical circuit protection devices:

- miniature circuit breakers
- residual current devices including RCBO's
- fuses:
 - re-wireable
 - cartridge
 - high breaking capacity

3.7 clarify the need for, and requirements of, earthing systems:

- main earthing systems:
 - TT systems
 - TN – S system
 - TN – C – S system
- protective equipotential bonding
- high risk zones in buildings
- supplementary earthing (bonding)
- temporary continuity bonding

3.8 identify the warning notices to be applied.

Unit 302 Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components

Outcome 4 Understand the electrical industry safe isolation procedure

Assessment criteria

The learner can:

- 4.1 identify the test equipment required to prove that circuits to be worked on are dead:
 - approved voltage indicating device
 - proving unit
- 4.2 specify the electrical industry regulatory procedure for the safe isolation of electrical circuits:
 - select the approved voltage indicating device and test on a known supply
 - locate and identify the isolation point for the equipment to be worked on
 - isolate the supply and prevent re-energisation
 - verify that the equipment is dead
 - fit warning labels
 - re-check the approved voltage indicating on a known supply for correct function
- 4.3 clarify the methods of ensuring that circuits cannot be re-activated while work is taking place on them:
 - use of locking devices
 - device retention (fuse removal).

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 5 Be able to carry out the electrical industry safe isolation procedure

Assessment criteria

The learner can:

- 5.1 check to ensure that test equipment is safe to be used
- 5.2 carry out the safe isolation procedure to industry standards.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 6 Know the preparation techniques for the electrical connection of mechanical services components

Assessment criteria

The learner can:

- 6.1 identify the cable, materials and fittings required to complete work on electrical systems
- 6.2 identify the hand and power tools required to complete work on electrical systems
- 6.3 identify relevant personal protective equipment for the installation, termination, connection and disconnection of electrical equipment and components.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 7 Be able to demonstrate preparation, installation and connection techniques for the connection of electrically operated mechanical services components

Assessment criteria

The learner can:

- 7.1 check the safety of the work location in order for the work to safely proceed:
 - safe access and exit
 - immediate work location eg tripping hazards
 - appropriate risk assessments/method statements are followed
- 7.2 wear Personal Protective Equipment (PPE) relevant to installation, decommissioning, service or maintenance tasks being carried out.

Unit 302 Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components

Outcome 8 Understand the installation and connection requirements of electrically operated mechanical services components

Assessment criteria

The learner can:

- 8.1 define the method used to identify that existing electrical supplies and circuits are suitable for the proposed installation of electrical equipment used in industrial and commercial mechanical services systems
- 8.2 specify the methodology for determining that a fuse or miniature circuit-breaker is compatible to and electrically operated mechanical services component
- 8.3 specify the wiring requirements for protecting cables installed in the building fabric and structure and terminating enclosures:
 - conduit
 - trunking
 - junction boxes
 - switch/socket boxes:
 - countersunk
 - pattresses
 - surface mounted
 - wiring centres
- 8.4 define the types of cable termination and connection of cables, cords and conductors:
 - screw terminals
 - pillar terminals
 - claw and washer terminals
 - crimping
 - strip connectors
- 8.5 specify the method of installation and wiring termination for fixed electrical equipment:
 - from control panels:
 - heating system wiring centres
 - fan motors
 - pumps
 - heat pumps
 - solar collection systems
 - pressurisation units
 - boilers
 - motorised valve actuators
 - thermostatic control devices and sensors
 - solenoid valves

- fire protection controls

- from existing appliance supply point:
 - heating system wiring centres
 - fan motors
 - pumps
 - heat pumps
 - solar collection systems
 - pressurisation units
 - boilers
 - motorised valve actuators
 - thermostatic control devices and sensors
 - solenoid valves
 - fire protection controls.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 9 **Be able to install and connect electrically operated mechanical services components**

Assessment criteria

The learner can:

- 9.1 carry out the electrical wiring of a mechanical control system from an existing supply outlet:
- mechanical engineering services systems incorporating all necessary control components
 - positioning and fixing all necessary enclosures, switches and circuit protection devices
 - correct routing, installation and termination of appropriate cables and conductors to control system components
 - correct earthing provision for all components and exposed metallic parts of the system
- 9.2 apply temporary continuity bonding to metallic pipework prior to making pipework connections.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 10 Know the inspection and testing requirements of electrically operated mechanical services components

Assessment criteria

The learner can:

- 10.1 specify the requirements of a visual inspection of completed electrical installation work for mechanical services systems prior to electrical inspection and testing
- 10.2 define the equipment used for electrical testing of mechanical services components and its calibration requirements
- 10.3 identify the importance of carrying out tests on dead circuits wherever possible
- 10.4 state the purpose of the electrical testing procedures for new and existing circuits:
 - polarity
 - earth continuity
 - insulation resistance
 - earth fault loop impedance
 - residual current device
- 10.5 clarify the requirements for carrying out functional testing of electrical components
- 10.6 clarify the procedure for final handover of electrical circuits that supply electrically operated industrial and commercial mechanical services components:
 - installation completion of certification
 - demonstration to the user.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 11 **Be able to inspect and test electrically operated mechanical services components**

Assessment criteria

The learner can:

11.1 carry out the inspection and testing of the completed wiring system for electrically operated mechanical services components:

- visual inspection
- selection and use of appropriate test equipment
- appropriate circuit testing:
 - polarity
 - earth continuity
 - insulation resistance
- functional testing
- completion of a minor works certificate

11.2 carry out the inspection and testing of existing electrical circuit for electrically operated mechanical services components following the replacement of electrical conductors and/or components.

Unit 302 Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components

Outcome 12 Know the procedures for safely diagnosing and rectifying faults in electrically operated mechanical services components

Assessment criteria

The learner can:

- 12.1 state the methods of obtaining details of system faults from end users
- 12.2 identify and use manufacturer instructions and industry standards to establish the diagnostic requirements of electrical system components
- 12.3 identify the electrical test equipment used to undertake fault diagnostics
- 12.4 identify the situations in which dead testing of components can be carried out
- 12.5 identify the situations in which live testing of components may be necessary and the safety procedures required
- 12.6 define how to perform a range of routine checks and diagnostics on electrical system components as part of a fault finding process. Checking for correct operation of:
 - appliance components:
 - flame certification devices
 - flame suppression devices
 - solenoid valves
 - thermistors
 - thermocouples
 - micro switches
 - relays
 - pressure switches
 - printed circuit boards
 - pumps
 - fans
 - leak detection
 - control components:
 - thermostats
 - programmers/timers
 - electrically operated control valves
 - wiring centres
 - switches:
 - rocker plate (with/without CPC) – single and double pole
 - pull cord
 - pressure operated
 - DP lockable isolators
- 12.7 state the methods of correcting deficiencies in electrical components:
 - inadequate earthing provision

- defective cable positioning (aged cables/proximity to other services)
- failed electrical components
- incorrect polarity
- provision of inadequate circuit protection devices.

Unit 302 **Understand and carry out electrical work on industrial and commercial heating and ventilating systems and components**

Outcome 13 Be able to safely diagnose and rectify faults in electrically operated mechanical services components

Assessment criteria

The learner can:

- 13.1 safely isolate electrical systems or components to prevent them being brought into operation before the work has been fully completed
- 13.2 carry out diagnostic checks to electrical circuits:
 - inadequate earthing provision
 - defective cable routing
 - defective termination
 - incorrect polarity
 - provision of inadequate circuit protection devices
- 13.3 carry out diagnostic tests to locate faults in electrical components and carry out repair work:
 - heating components replacement
 - water components replacement
 - control components
 - thermostats
 - programmers/timers
 - motorised valve actuators
 - sensors.

Unit 303

Understand industrial and commercial cold water system installation and pre-commissioning techniques

Level: 3

Credit value: 5

UAN number: R/602/4851

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial cold water systems
2. Understand the legislative and organisational procedures related to all industrial and commercial cold water systems work activities
3. Understand how to complete preparation work for industrial and commercial cold water system installation activities
4. Understand the procedures for identifying industrial and commercial cold water systems, equipment and components
5. Understand how to install industrial and commercial cold water systems
6. Understand procedures for soundness testing of industrial and commercial cold water systems
7. Understand procedures for decommissioning industrial and commercial cold water systems
8. Understand procedures for commissioning industrial and commercial cold water systems
9. Understand procedures for identifying faults on industrial and commercial cold water systems

Guided learning hours

It is recommended that **42** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial cold water systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles of boosted high rise cold water systems including:
 - connections from mains to premises
 - cold water storage cisterns
 - factors to determine system selection
 - key regulations relevant to installation
- 1.2 define the operating principles of different appliance types that are connected to cold water systems, including:
 - sanitary appliances
 - industrial and commercial appliances
 - appliances specific to industrial and commercial premises
 - compliance with building and water regulations
- 1.3 specify the working principles of all cold water system components in boosted and high rise systems
- 1.4 determine pipe sizing requirements in relation to demand units for cold water systems, including:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
- 1.5 confirm the cold water system layout requirements for boosted and high rise systems including:
 - cisterns
 - terminal fittings
 - valves
 - industry specifications and regulations
- 1.6 justify the positioning of selected components in cold water systems.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial cold water systems work activities7

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as they relate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning of cold water systems
- 2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning of cold water systems
- 2.3 specify the actions that should be taken to liaise with other persons during the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning of cold water systems
- 2.4 state appropriate persons whom it may be necessary to advise before a cold water system is isolated in order to undertake work
- 2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components
- 2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 3 Understand how to complete preparation work for industrial and commercial cold water system installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - de-commission
 - identify faults on cold water systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection of pipework materials and fittings required to complete work on cold water systems and check them for damage.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial cold water systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific cold water installation requirements
- 4.2 interpret and apply appropriate sources of information when determining cold water installation requirements including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides / good practice guides
 - specifications
- 4.3 evaluate possible proposals to determine how well they meet:
 - site structures and features
 - industry requirements
- 4.4 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.5 demonstrate methods for determining the size and specification of components to be used within cold water systems including:
 - storage (indirect)
 - storage (direct)
 - boosted
 - high rise building systems.

Unit 303 **Understand industrial and commercial cold water system installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial cold water systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of cold water systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides / good practice guides
 - specifications.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 6 Understand procedures for soundness testing of industrial and commercial cold water systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of cold water systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides / good practice guides
 - specifications
- 6.2 identify the requirements of boosted and high rise building cold water systems to confirm that they are ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 6.3 specify procedures for flushing and charging a boosted or high rise building cold water system
- 6.4 justify that input services adequately meet the cold water system requirements for boosted and high rise building cold water systems
- 6.5 state the procedure for carrying out a soundness test on boosted and high rise building cold water systems
- 6.6 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 303 **Understand industrial and commercial cold water system installation and pre-commissioning techniques**

Outcome 7 Understand procedures for decommissioning industrial and commercial cold water systems

Assessment criteria

The learner can:

- 7.1 confirm that the status of the systems will permit safe decommissioning
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning cold water system components and pipework, including requirements for earth bonding complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal emptying or shut off mechanisms for cold water systems do not operate.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 8 Understand procedures for commissioning industrial and commercial cold water systems

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of cold water systems including:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
- 8.2 specify the procedures for establishing correct mechanical, electrical and control performance for the following:
 - systems:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - components:
 - storage cisterns
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - gate valves
 - pressure booster sets
 - break cisterns
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
- 8.3 evaluate the procedures for commissioning cold water systems and components in accordance with project specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 303 Understand industrial and commercial cold water system installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial cold water systems

Assessment criteria

The learner can:

- 9.1 interpret and apply information on performance of cold water system components from sources of information including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - manufacturers' specifications
- 9.2 interpret information on cold water system components faults from:
 - advice from users
 - visual inspections or tests
 - diagnostic tests
- 9.3 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.4 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.5 describe the work actions and sequences for diagnosing faults in systems and components
- 9.6 demonstrate how to isolate systems and components including:
 - systems:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - components:
 - storage cisterns
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - gate valves
 - pressure booster sets
 - break cisterns
 - RPZ valves
 - servicing valves

- drain taps
 - shower mixer valves
 - blending valves
- 9.7 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.8 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients
- 9.9 specify the procedures for identifying component faults in cold water systems including:
- systems:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - components:
 - storage cisterns
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - gate valves
 - pressure booster sets
 - break cisterns
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
- 9.10 evaluate the effects of common component faults upon overall cold water system performance, for systems which include:
- storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems.

Unit 304

Understand industrial and commercial hot water system installation and pre-commissioning techniques

Level: 3

Credit value: 5

UAN number: Y/602/4852

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial hot water systems
2. Understand the legislative and organisational procedures related to all industrial and commercial hot water systems work activities
3. Understand how to complete preparation work for industrial and commercial hot water system installation activities
4. Understand the procedures for identifying industrial and commercial hot water systems, equipment and components
5. Understand how to install industrial and commercial hot water systems
6. Understand procedures for soundness testing industrial and commercial hot water systems
7. Understand procedures for decommissioning industrial and commercial hot water systems
8. Understand procedures for commissioning industrial and commercial hot water systems
9. Understand procedures for identifying faults on industrial and commercial hot water systems

Guided learning hours

It is recommended that **42** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 304 Understand industrial and commercial hot water system installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial hot water systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles of hot water systems including:
 - indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - factors to determine system selection
 - key regulations relevant to the installation
- 1.2 define the operating principles of different appliance types that are connected to hot water systems, including:
 - sanitary appliances
 - hospital appliances
 - appliances specific to industrial and commercial premises
 - compliance with building and water regulations
- 1.3 specify the working principles of all hot water system components including:
 - indirect systems
 - unvented systems
 - secondary circulation systems
 - instantaneous (plate heat exchanger) systems
- 1.4 determine pipe sizing requirements in relation to demand units for hot water systems, including:
 - indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- 1.5 confirm the hot water system layout requirements for all hot water systems including:
 - indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- 1.6 justify the positioning of selected components in hot water systems.

Unit 304 Understand industrial and commercial hot water system installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial hot water systems work activities

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as they relate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof hot water systems
- 2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof hot water systems
- 2.3 specify the actions that should be taken to liaise with other persons during the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof hot water systems
- 2.4 state the appropriate persons whom it may be necessary to advise before a hot water system is isolated in order to undertake work
- 2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components
- 2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 304 **Understand industrial and commercial hot water system installation and pre-commissioning techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial hot water system installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - de-commission
 - identify faults on hot water systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection of pipework materials and fittings required to complete work on hot water systems and check them for damage.

Unit 304 Understand industrial and commercial hot water system installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial hot water systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings and plans and the work location to determine specific hot water installation requirements
- 4.2 interpret and apply appropriate sources of information when determining hot water installation requirements:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
- 4.3 evaluate possible proposals to determine how well they meet:
 - site structures and features
 - industry requirements
- 4.4 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.5 demonstrate methods for determining the size and specification of components to be used within hot water systems including:
 - indirect systems
 - unvented systems
 - secondary circulation systems
 - instantaneous (plate heat exchanger).

Unit 304 **Understand industrial and commercial hot water system installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial hot water systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of hot water systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 304 Understand industrial and commercial hot water system installation and pre-commissioning techniques

Outcome 6 Understand procedures for soundness testing industrial and commercial hot water systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of hot water systems:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of hot water systems to confirm that they are ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 6.3 specify procedures for flushing and charging all hot water systems
- 6.4 justify that input services adequately meet hot water service system requirements
- 6.5 state the procedures for carrying out a soundness test on all hot water systems
- 6.6 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 304 Understand industrial and commercial hot water system installation and pre-commissioning techniques

Outcome 7 Understand procedures for decommissioning industrial and commercial hot water systems

Assessment criteria

The learner can:

- 7.1 confirm that the status of the system will permit safe decommissioning
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning hot water system components and pipework, including requirements for earth bonding complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal emptying or shut off mechanisms for hot water service systems do not operate.

Unit 304 **Understand industrial and commercial hot water system installation and pre-commissioning techniques**

Outcome 8 Understand procedures for commissioning industrial and commercial hot water systems

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of hot water systems including:
- indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- 8.2 describe the procedures for establishing correct mechanical, electrical and control performance for the following:
- systems:
 - indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - components:
 - cold water storage cistern – secondary system
 - feed and expansion cistern – primary system
 - hot water storage vessels, including high temperature to low temperature calorifiers
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - gate valves
 - servicing valves
 - drain taps
 - pressure reducing valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - line strainers
 - temperature and pressure relief valves
 - expansion vessel
- 8.3 evaluate the procedures for commissioning hot water systems and components in accordance with project specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required

- 8.5 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 304 Understand industrial and commercial hot water system installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial hot water systems

Assessment criteria

The learner can:

- 9.1 interpret information on the performance of hot water system components from sources of information including:
- statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - manufacturer's specifications
- 9.2 interpret information on hot water system component faults from:
- advice from users
 - visual inspections or tests
 - diagnostic tests
- 9.3 explain how fault diagnosis activities can cause potential disruption for other persons, including:
- customers
 - other site workers
 - site visitors
- 9.4 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.5 describe the work actions and sequences for diagnosing faults in systems and components
- 9.6 demonstrate how to isolate systems and components including:
- systems:
 - indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - components:
 - cold water storage cistern – secondary system
 - feed and expansion cistern – primary system
 - hot water storage vessels, including high temperature to low temperature calorifiers
 - electric and gas water heaters

- appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - gate valves
 - servicing valves
 - drain taps
 - pressure reducing valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - line strainers
 - temperature and pressure relief valves
 - expansion vessel
- 9.7 describe the work action and sequences for rectifying faults in systems or components which will ensure minimum disruption to customers/clients
- 9.8 specify the procedures to identify common faults in hot water systems including:
- systems:
 - indirect
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - components:
 - cold water storage cistern – secondary system
 - feed and expansion cistern – primary system
 - hot water storage vessels, including high temperature to low temperature calorifiers
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - gate valves
 - servicing valves
 - drain taps
 - pressure reducing valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - line strainers
 - temperature and pressure relief valves
 - expansion vessel
- 9.9 evaluate the effects of common component faults upon overall hot water system performance, for systems which include:
- indirect
 - unvented

- secondary circulation
- instantaneous (plate heat exchanger).

Unit 305

Understand industrial and commercial heating system installation and pre-commissioning techniques

Level: 3

Credit value: 5

UAN number: K/602/4855

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial hot water heating systems
2. Understand the legislative and organisational procedures related to all industrial and commercial hot water heating systems work activities
3. Understand how to complete preparation work for industrial and commercial hot water heating system installation activities
4. Understand the procedures for identifying industrial and commercial hot water heating systems, equipment and components
5. Understand how to install industrial and commercial hot water heating systems
6. Understand procedures for soundness testing of industrial and commercial hot water heating systems
7. Understand procedures for decommissioning industrial and commercial hot water heating systems
8. Understand procedures for commissioning industrial and commercial hot water heating systems
9. Understand procedures for identifying faults on industrial and commercial hot water heating systems

Guided learning hours

It is recommended that **42** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 305

Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 1

Understand the working principles and layouts of industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles of hot water heating systems including:
 - low temperature hot water
 - medium temperature hot water
 - high temperature hot water
 - factors to determine system selection
 - key regulations relevant to the installation
- 1.2 define the operating principles of different appliance types that are connected to hot water heating systems, including:
 - boilers, fired by solid fuel, gas or oil including:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - compliance with building and water regulations
- 1.3 specify the working principles of all hot water heating components including:
 - low temperature hot water systems
 - medium temperature hot water systems
 - high temperature hot water systems
- 1.4 determine pipe sizing requirements in relationship to loading in hot water heating systems including:
 - low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating
- 1.5 confirm the hot water heating system layout requirements for hot water heating systems including:
 - low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating
- 1.6 justify the positioning of selected components in hot water heating systems.

Unit 305 Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial hot water heating systems work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of hot water heating systems

2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of hot water heating systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of hot water heating systems

2.4 state appropriate persons whom it may be necessary to advise before a hot water heating system is isolated in order to undertake work

2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 305 Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 3 Understand how to complete preparation work for industrial and commercial hot water heating system installation activities

Assessment criteria

The learner can:

- 3.5 describe the visual inspections and tests required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faults on hot water heating systems
- 3.6 evaluate the work location to determine planning requirements
- 3.7 justify the selection of pipework materials and fittings required to complete work on hot water heating systems and check them for damage.

Unit 305 Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial hot water heating systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific heating installation requirements
- 4.2 interpret and apply appropriate sources of information when determining hot water heating installation requirements including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate possible proposals to determine how well they meet:
 - site structures and features
 - industry requirements
- 4.4 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.5 demonstrate methods for determining the size and specification of components to be used within hot water heating systems including:
 - low temperature hot water
 - medium temperature hot water
 - high temperature hot water.

Unit 305 Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 5 Understand how to install industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of hot water heating systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications

Unit 305 Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 6 Understand procedures for soundness testing of industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of hot water heating systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements hot water heating systems to confirm that they are ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 6.3 specify procedures for flushing and charging all hot water heating systems
- 6.4 justify that input services adequately meet hot water heating system requirements
- 6.5 state the procedure for carrying out a soundness test on all types of hot water heating systems
- 6.6 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 305 **Understand industrial and commercial heating system installation and pre-commissioning techniques**

Outcome 7 **Understand procedures for decommissioning industrial and commercial hot water heating systems**

Assessment criteria

The learner can:

- 7.1 confirm that the status of the system will permit safe decommissioning
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify work sequences for decommissioning hot water heating system components and pipework, including requirements for earth bonding complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal emptying or shut off mechanisms for hot water heating systems do not operate.

Unit 305

Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 8

Understand procedures for commissioning industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of hot water heating systems including:
 - low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating
- 8.2 specify the procedures for establishing correct mechanical, electrical and control performance for the following:
 - systems:
 - low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating
 - appliances:
 - boilers, fired by solid fuel, gas or oil
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 8.3 evaluate the procedures for commissioning hot water heating systems and components in accordance with project specification
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required

- 8.5 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 305 Understand industrial and commercial heating system installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 9.1 interpret and apply information on the performance of hot water heating system components from sources of information including:
- statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - manufacturer's specifications
- 9.2 interpret information on hot water heating system component faults from:
- advice from users
 - visual inspections or tests
 - diagnostic tests
- 9.3 explain how fault diagnosis activities can cause potential disruption for other persons, including:
- customers
 - other site workers
 - site visitors
- 9.4 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.5 describe the work actions and sequences for diagnosing faults in systems and components
- 9.6 demonstrate how to isolate systems and components including:
- systems:
 - low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating
 - appliances:
 - boilers, fired by solid fuel, gas or oil
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - components:

- hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 9.7 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.8 describe the work actions and sequences for rectifying faults in systems or components which will ensure minimum disruption to customers/clients
- 9.9 specify the procedure for identifying component faults in hot water heating systems including:
- systems:
 - low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating
 - appliances:
 - boilers, fired by solid fuel, gas or oil
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 9.10 evaluate the effects of common component faults upon overall hot water heating system performance, for systems which include:
- low temperature hot water heating
 - medium temperature hot water heating
 - high temperature hot water heating.

Unit 306

Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Level: 3

Credit value: 5

UAN number: A/602/4858

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles of industrial and commercial chilled water systems
2. Understand the legislative and organisational procedures related to all industrial and commercial chilled water systems work activities
3. Understand how to complete preparation work for industrial and commercial chilled water systems installation activities
4. Understand the procedures for identifying industrial and commercial chilled water systems, equipment and components
5. Understand how to install industrial and commercial chilled water systems
6. Understand the procedures for soundness testing of industrial and commercial chilled water systems
7. Understand procedures for decommissioning industrial and commercial chilled water systems
8. Understand procedures for commissioning industrial and commercial chilled water systems
9. Understand procedures for identifying faults on industrial and commercial chilled water systems

Guided learning hours

It is recommended that **42** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 1 Understand the working principles of industrial and commercial chilled water systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles of chilled water systems including:
 - air conditioning systems
 - chilled beams
 - fan coil systems
 - air handling units
 - heat rejection systems
 - factors to determine system selection
 - key regulations relevant to the installation
- 1.2 define the operating principles of different appliance types that are connected to chilled water, including:
 - refrigeration plant
 - FCU
 - A/C plant
 - cooling towers
 - air handling units
 - heat exchangers
 - chilled beams
- 1.3 specify the working principles of all chilled water system components including:
 - air conditioning systems
 - chilled beams
 - fan coil systems
 - air handling units
 - heat rejection systems
- 1.4 determine the pipe sizing requirements in relation to duty load for chilled water systems including:
 - air conditioning systems
 - chilled beams
 - fan coil units
 - air handling units
 - heat rejection systems
- 1.5 confirm the chilled water system layout for all cooling applications:
 - air conditioning systems
 - air handling systems
 - chilled beam systems
 - industry specifications and regulations

1.6 justify the positioning of selected components in chilled water systems.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial chilled water systems work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of chilled water systems

2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of chilled water systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of chilled water systems

2.4 state appropriate persons whom it may be necessary to advise before a chilled water system is isolated in order to undertake work

2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 3 Understand how to complete preparation work for industrial and commercial chilled water systems installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faults on chilled water systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection of pipework materials and fittings required to complete work on chilled water systems and check them for damage.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial chilled water systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings and plans and the work location to determine specific chilled water installation requirements
- 4.2 interpret and apply appropriate sources of information when determining chilled water installation requirements, including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate possible proposals to determine how well they meet:
 - site structures and features
 - industry requirements
- 4.4 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.5 demonstrate methods for determining the size and specification of components to be used within chilled water systems including:
 - air conditioning systems
 - chilled beams
 - fan coil systems
 - air handling units
 - heat rejection systems.

Unit 306 **Understand industrial and commercial chilled water system installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial chilled water systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of chilled water systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 6 Understand the procedures for soundness testing of industrial and commercial chilled water systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of chilled water systems from:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of chilled water systems to confirm that they are ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 6.3 specify procedures for flushing and charging a chilled water system
- 6.4 justify that input services adequately meet the chilled water system requirements for all cooling systems
- 6.5 state the procedure for carrying out a soundness test on chilled water systems
- 6.6 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 306 **Understand industrial and commercial chilled water system installation and pre-commissioning techniques**

Outcome 7 Understand procedures for decommissioning industrial and commercial chilled water systems

Assessment criteria

The learner can:

- 7.1 confirm that the status of the system will permit safe decommissioning
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning chilled water system components and pipework, including requirements for earth bonding complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal emptying or shut off mechanisms for chilled water systems do not operate.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 8 Understand procedures for commissioning industrial and commercial chilled water systems

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of chilled water systems including:
- air conditioning systems
 - chilled beams
 - fan coil units
 - air handling units
 - heat rejection systems
- 8.2 specify the procedures for establishing correct mechanical, electrical and control performance for the following:
- systems:
 - air conditioning systems
 - chilled beams
 - fan coil units
 - air handling units
 - heat rejection systems
 - appliances:
 - refrigeration plant
 - FCU
 - A/C plant
 - cooling towers
 - air handling units
 - heat exchangers
 - chilled beams
 - components:
 - isolation valves
 - three & four port valves
 - temperature & humidity stats
 - calorifiers
 - actuators
 - RPZ valves
- 8.3 evaluate the procedures for commissioning chilled water systems and components in accordance with project specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required

- 8.5 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 306 Understand industrial and commercial chilled water system installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial chilled water systems

Assessment criteria

The learner can:

- 9.1 interpret and apply information on the performance of chilled water system components from sources of information including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - manufacturer's specifications
- 9.2 interpret information on chilled water system component faults from:
 - advice from users
 - visual inspections or tests
 - diagnostic tests
- 9.3 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.4 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.5 describe the work actions and sequences for diagnosing faults in systems and components
- 9.6 demonstrate how to isolate systems and components including:
 - systems:
 - air conditioning systems
 - chilled beams
 - fan coil units
 - air handling units
 - heat rejection systems
 - components:
 - isolation valves
 - three & four port valves
 - temperature & humidity stats
 - calorifiers
 - actuators
 - RPZ valves
- 9.7 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance

- 9.8 describe the work actions and sequences for rectifying faults in systems or components which will ensure minimum disruption to customers/clients

9.9 specify the procedures for identifying component faults in chilled water systems including:

- systems:
 - air conditioning systems
 - chilled beams
 - fan coil units
 - air handling units
 - heat rejection systems
- appliances:
 - refrigeration plant
 - FCU
 - A/C plant
 - cooling towers
 - air handling units
 - heat exchangers
 - chilled beams
- components:
 - isolation valves
 - three & four port valves
 - temperature & humidity stats
 - calorifiers
 - actuators
 - RPZ valves

9.10 explain the effects of common component faults upon overall chilled water system performance, for systems which include:

- air conditioning systems
- chilled beams
- fan coil units
- air handling units
- heat rejection systems.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Level: 3

Credit value: 12

UAN number: F/602/4862

Learning outcomes

There are **fourteen** learning outcomes to this unit. The learner will

1. Understand the appropriate items of legislation which apply to fuel supply systems in industrial and commercial situations
2. Understand the differences between the types of solid fuel and the factors affecting fuel selection
3. Understand the basic operating principles of solid fuel appliances
4. Understand the factors which affect the selection of solid fuel appliances
5. Understand the combustion process and the principles of safe combustion of solid fuels
6. Understand the types of oil storage tank, associated fittings and installation requirements
7. Understand the installation requirements of oil supply pipelines to industrial and commercial locations
8. Understand the combustion process and the types of burners used in oil fired appliances
9. Understand the basic operating principles of natural gas fired appliances
10. Understand the combustion process and the principles of safe combustion for natural gas fired appliances
11. Understand the ventilation requirements of fuel supply systems
12. Understand the types of chimneys and flue arrangements used with different fuel supply systems
13. Understand the types of chimneys and flue arrangements used with different fuel supply systems
14. Understand how to identify and respond to unsafe situations relating to fuel burning appliances or flue systems

Guided learning hours

It is recommended that **112** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

:

Unit 307 Understand the principles and requirements of industrial and commercial fuel systems

Outcome 1 Understand the appropriate items of legislation which apply to fuel supply systems in industrial and commercial situations

Assessment criteria

The learner can:

- 1.1 define the types of statutory legislation and guidance information that applies to the installation, maintenance and servicing of industrial and commercial fuel supply systems:
 - building regulations
 - industry standards
 - manufacturer installation and service/maintenance instructions
 - The Clean Air Act
- 1.2 identify the recommended responsibilities of key personnel relating to the installation, maintenance and servicing of fuel supply systems and equipment:
 - business registration and competence
 - personnel registration and competence
 - consumers:
 - industrial
 - commercial
 - multi dwelling building users (private householders and tenants)
- 1.3 identify the legislative requirements related to the prevention of pollution from fuel supply systems
- 1.4 analyse and interpret the requirements of specific safety legislation as it applies to industrial and commercial:
 - oil supply systems
 - gas supply systems (Natural Gas and LPG)
 - solid fuel supply systems (mineral fuels and wood)
- 1.5 state the range of information that would be contained within a commissioning record for the following industrial and commercial:
 - oil supply systems
 - gas supply systems (Natural Gas and LPG)
 - solid fuel supply systems (mineral fuels and wood)
- 1.6 identify the procedure for notifying works carried out to the relevant building control body:
 - notification to the building control body
 - self certification via a Competent Person's Scheme.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 2

Understand the differences between the types of solid fuel and the factors affecting fuel selection

Assessment criteria

The learner can:

- 2.1 identify the types of solid mineral fuels burnt in solid fuel appliances, including:
 - pulverised/milled dust
 - chipped coal
- 2.2 identify the types of wood burnt in industrial and commercial solid fuel appliances, including:
 - wood pellets
- 2.3 define the term 'sustainable sources' related to the production and burning of wood in solid fuel appliances
- 2.4 define the factors which affect the selection of solid fuels:
 - client preference
 - appliance type
 - fuel storage requirements
 - environmental considerations
 - smoke control legislation.

Unit 307 **Understand the principles and requirements of industrial and commercial fuel systems**

Outcome 3 Understand the basic operating principles of solid fuel appliances

Assessment criteria

The learner can:

3.1 state the operating principles of solid fuel independent boilers:

- batch fed appliances (log boilers)
- gravity fed appliances
- automatic feed type eg pellet burners.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 4

Understand the factors which affect the selection of solid fuel appliances

Assessment criteria

The learner can:

- 4.1 specify the minimum solid fuel appliance efficiency requirements laid down by statutory legislation
- 4.2 clarify the impact of smoke control legislation on the selection of solid fuel appliances:
 - appliance fuel types restricted in smoke control areas
 - use of exempted appliances
- 4.3 specify the fuel storage requirements of solid fuel appliances burning solid mineral fuels
- 4.4 specify the fuel storage requirements for solid fuel appliances which utilise wood pellets.

Unit 307 Understand the principles and requirements of industrial and commercial fuel systems

Outcome 5 Understand the combustion process and the principles of safe combustion of solid fuels

Assessment criteria

The learner can:

- 5.1 define the terms related to solid fuel composition:
 - calorific value
 - moisture content
 - volatile content
- 5.2 identify the combustion process as it applies to solid fuels used in industrial and commercial buildings:
 - the combustion equation
 - air requirements for combustion including excess air
 - optimum combustion temperature
 - impact of fuel size on the combustion process
 - main constituents of complete combustion
 - soot production as a by-product of the combustion process
- 5.3 specify the main causes of incomplete combustion with solid fuels:
 - inadequate air supply
 - incorrect fuel
 - inadequate flue/ chimney performance
- 5.4 identify the production of Carbon Monoxide as a possible by-product of incomplete combustion
- 5.5 identify the potential effects of Carbon Monoxide when incomplete combustion takes place:
 - effects of exposure to Carbon Monoxide on the human body
 - symptoms of CO poisoning
 - advice to give to a person who describes symptoms of being affected by products of combustion
- 5.6 specify the measures necessary to ensure that exposure to Carbon Monoxide does not take place:
 - primary measures – correct appliance installation and maintenance
 - secondary measures – use of Carbon Monoxide detectors
 - types of CO detectors available and standards of manufacture
 - the positioning requirements for Carbon Monoxide detectors
 - causes of activation of CO detectors & indicators
- 5.7 clarify the use of CO analysers in measuring CO concentrations in ambient air:
 - test procedure for measuring CO in ambient air
 - response required based on CO in ambient air levels (action levels).

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 6

Understand the types of oil storage tank, associated fittings and installation requirements

Assessment criteria

The learner can:

6.1 state the main features of the following types of oil storage tank:

- steel
- polyethylene
- single skin
- integrally bundled

6.2 define the purpose of the following oil tank fittings

- fill pipe
- extended fill pipe
- vent pipe
- drain valve
- isolating valve
- contents gauge:
 - sight glass
 - hydrostatic pressure operated
 - float operated
 - electronic gauges with remote readout
- overfill alarms and prevention devices:
 - electronic
 - mechanical

6.3 specify the installation requirements of oil tank fittings, including:

- fill pipe
- extended fill pipe:
 - above ground extended fill line
 - extended fill line installation in a building
 - underground extended fill line
- vent pipe
- drain valve
- isolating valve
- contents gauge
- overfill alarms and prevention devices

6.4 define the points to be analysed when undertaking a risk assessment to determine whether secondary containment to an oil storage tank is required:

- tank capacity
- tank proximity to controlled water sources
- tank proximity to spillage running into open drain or loose fitting inspection chamber cover

- tank proximity to borehole or spring
 - tank siting on hard ground providing run-off to controlled water source
 - tank vent pipe not visible from the fill point
 - tank serving more than one building
- 6.5 specify the types of secondary containment (use of bunds/catch pits) that can be provided to oil storage tank
- 6.6 specify the main features when constructing a bund to act as secondary containment to an oil storage tank:
- bund holding capacity
 - bund base
 - bund walls
 - bund surface sealant materials
 - pipework projection through bund via puddle flange.

Unit 307 Understand the principles and requirements of industrial and commercial fuel systems

Outcome 7 Understand the installation requirements of oil supply pipelines to industrial and commercial locations

Assessment criteria

The learner can:

- 7.1 identify the layout features of oil supply pipeline systems
- 7.2 define the function of oil supply pipeline components:
 - service/isolation valves
 - oil filters
 - de-aerators – internal and external
 - oil lifters
 - fire valves
 - anti-siphon valves
 - pressure reducing valves
- 7.3 clarify the pipework materials and jointing processes suitable for oil supply lines:
 - R220 copper - manipulative (Type B) flared fittings
 - low carbon steel – screw thread joints using petroleum resisting compound and welded joints
- 7.4 specify the support and fixing requirements for oil supply pipework:
 - requirements for sleeving
 - external and internal surface mounted installation pipework – copper and low carbon steel
 - pipework protection against corrosion – externally mounted
- 7.5 specify the installation requirements of underground oil supply lines:
 - proximity to other services
 - pipework protection against corrosion
 - use of pipework ducts
 - minimum trench depth
 - trench preparation
 - use of warning tape
 - access to underground joints
 - use of a pipe in pipe system (sleeving)
 - production of records
- 7.6 specify the installation requirements of oil filters:
 - oil filter positioning:
 - storage tank
 - oil fired appliances
 - oil filter clearance requirements for maintenance

- 7.7 specify the installation requirements of de-aerator devices:
- types of oil fired appliance used with de-aerator devices
 - external de-aerator
 - internal de-aerator
- 7.8 specify the installation requirements of oil supply line components
- 7.9 state the types of fire valves considered suitable for use in industrial & commercial applications
- 7.10 clarify the positioning requirements of fire valves fitted to oil supply pipelines:
- standard external valve position to internal appliance
 - internal valve position to existing internal appliance
 - position for external boiler
 - dead weight with fusible link
 - remote sensing phial and capillary tube
- 7.11 clarify the earth bonding requirements of oil supply pipework systems and components.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 8

Understand the combustion process and the types of burners used in oil fired appliances

Assessment criteria

The learner can:

- 8.1 identify the uses of heating oils to supply oil fired appliances in dwellings:
 - Class D – kerosene
 - Class E - fuel oils
- 8.2 define the key properties of heating oils:
 - viscosity
 - density
 - flash point temperature
 - sulphur content
 - ash content
 - water content
 - sediment content
 - carbon residue
 - char value
 - smoke point
 - cold filter plugging point
 - calorific value – gross and net
 - mean specific heat capacity
 - minimum storage temperature
 - atomisation temperature
- 8.3 identify the combustion process with heating oils used in industrial and commercial buildings:
 - the combustion equation
 - air requirements for combustion
 - main constituents of complete combustion
 - main constituents of incomplete combustion:
 - Carbon Monoxide
 - soot deposits
- 8.4 identify the potential effects of carbon monoxide when incomplete combustion takes place:
 - effects of exposure to Carbon Monoxide on the human body
 - symptoms of CO poisoning
 - advice to give to a person who describes symptoms of being affected by products of combustion
- 8.5 specify the measures necessary to ensure that exposure to carbon monoxide does not take place:
 - primary measures – correct appliance installation and maintenance
 - secondary measures – use of Carbon Monoxide detectors
 - types of CO detectors available and standards of manufacture
 - the positioning requirements for Carbon Monoxide detectors

- causes of activation of CO detectors and indicators
- 8.6 define the layout features and basic operating principles of burners to oil fired appliances:
- pressure jet burners
 - vaporising burners.

Unit 307 Understand the principles and requirements of industrial and commercial fuel systems

Outcome 9 Understand the basic operating principles of natural gas fired appliances

Assessment criteria

The learner can:

9.1 state the operating principles of natural gas heating appliances:

- boilers
 - cast iron sectional
 - steel shell
 - modular
 - condensing
- water heaters
 - multi point storage – direct fired unvented
 - multi heater storage
 - instantaneous
- heaters
 - radiant heaters
 - unit air heaters
 - forced draught heaters

9.2 state the operating principles of natural gas cooking appliances:

- ovens
- hotplates
- ranges
- fryers.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 10

Understand the combustion process and the principles of safe combustion for natural gas fired appliances

Assessment criteria

The learner can:

10.1 define the following as they relate to natural gas combustion:

- calorific value
- ignition sources
- specific gravity
- Wobbe number
- flammability limits
- combustion air

10.2 identify the characteristics of combustion for natural gas fuelled appliances, including:

- the main constituents of complete and incomplete combustion
- causes of incomplete combustion at the:
 - burner
 - combustion space
 - heat exchanger
 - symptoms of CO poisoning

10.3 identify different types of Carbon Monoxide detectors and combustion gas analysers appropriate for use with natural gas installations.

Unit 307 Understand the principles and requirements of industrial and commercial fuel systems

Outcome 11 Understand the ventilation requirements of fuel supply systems

Assessment criteria

The learner can:

- 11.1 calculate the ventilation requirements for open flued:
 - solid fuel appliances
 - oil appliances
 - natural gas appliances
- 11.2 calculate the ventilation requirements for oil and natural gas appliances located in compartments and boiler houses:
 - open flued – natural draught combustion
 - forced draught burners
- 11.3 identify the types of grilles and vents available for ventilation:
 - types of grilles and vents
 - sizing of grilles and vents
- 11.4 calculate the free area of unmarked grilles and vents
- 11.5 specify the acceptable locations for ventilation to appliances:
 - restrictions to ventilator/grille locations
 - installation of vents through walls (including cavity walls)
 - ventilation paths via other rooms
 - siting of ventilation
 - walls
 - ducts
- 11.6 clarify the effect that other heat producing appliances and extractor fans have on the requirement for ventilation of natural gas, oil and solid fuel appliances, including:
 - other fuel type appliances and flue systems
 - passive stack ventilation.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 12

Understand the types of chimneys and flue arrangements used with different fuel supply systems

Assessment criteria

The learner can:

12.1 state the function of an open flue/ chimney system:

- clearing the products of combustion
- inducing combustion air into the solid fuel appliance

12.2 identify the working principles of open flue systems including the effect that height has on flue performance

12.3 state how oil fired appliances are classified according to the type of chimney or flue used:

- open flued
 - natural draught
 - forced (fanned) draught

12.4 identify the working principles of flue systems serving oil fired appliances:

- open flued chimneys
- mechanical systems:
 - supply
 - extract
 - balanced

12.5 state the effects that the flue gas temperature from oil fired appliances has on the selection of suitable materials for the open flue/chimney construction:

- appliances with a flue gas temperature above 250°C

12.6 identify the working principles of flue systems serving natural gas fired appliances:

- open flues:
 - natural draught
 - fan assisted
- shared open flues (natural draught)
- balanced flue - natural draught
- room sealed - fanned draught
- balanced compartments for open flues
- shared room sealed flue systems (se duct, u duct)
- fan diluted flues
- modular flues

12.7 state the types and general layout features of chimney and flue construction:

- rigid chimney types
 - brick / masonry
 - pre-cast flue blocks
 - metallic (single & double wall flues)
- flexible metallic liner installation – types and suitability

12.8 specify the requirements for new and existing chimney/flue installations:

- minimum cross-sectional area of new chimney installations to serve appliances
- insulation requirements for flues/ chimneys
- restrictions placed on (bends) changes of direction in the chimney/ flue system
- types of flue liners – during construction (salt glazed, clay etc):
 - poured/pumped concrete flue liners
 - pre-cast flue blocks
 - flexible flue liners
 - flue system jointing methods
- restrictions on the use of poured concrete liners
- pre-cast flue design:
 - minimum cross sectional area of new flue blocks
 - minimum requirement of vertical flue blocks before off sets
 - jointing material for pre-cast flue blocks
 - minimum flue size diameter for connecting pre-cast transfer blocks to termination point
 - effects of temperature on installation requirements for pre-cast flues
- flexible flue liners
 - sealing & support requirements for flexible flue liners in chimneys
 - flexible liner components
 - termination of flue liners
- metallic rigid flue/ chimney systems
 - support requirements
 - jointing methods
 - use external to the building.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 13

Understand the types of chimneys and flue arrangements used with different fuel supply systems

Assessment criteria

The learner can:

13.1 define the design requirements of flues used with fuel burning appliances:

- requirements of designer, builder, provider or installer when installing chimneys
- chimney system design:
 - distance requirements when passing through combustible material
 - fire-stopping requirements when passing through compartments
 - methods of preventing contact of combustible materials with metallic internal flue pipes eg in cupboards, roof spaces
 - special requirements for chimneys passing adjacent to combustible material
 - proximity of single skin flue pipes to combustible materials
- temperature effects and condensation problems caused by flue pipe runs
- requirements for access to appliances and chimneys/flue systems for cleaning purposes
- open flued chimney system:
 - parts of an open flue chimney system
- room-sealed chimney system:
 - parts of a room sealed flue chimney system

13.2 specify the requirements for the termination of flue systems serving different fuel burning appliances:

- solid fuel:
 - low level open flue appliance termination (pellet burners)
 - open flue terminal positions on roof surfaces
 - open flue terminal positions on easily ignited roof surfaces
 - methods of dealing with down-draught on steeply pitched roofs
 - types of chimney pots and approved cowls for use with solid fuel flue systems
- oil:
 - room sealed flue positions - including the restrictions on fuel type for flue outlets discharging below 2m from ground level
 - condensing appliances
 - terminal guard requirements
 - open flue terminal positions
 - methods of dealing with down-draught on steeply pitched roofs
- natural gas:
 - room sealed flue positions
 - terminal guard requirements
 - heat shields for balanced flue terminals
 - condensing appliances
 - open flue terminal positions

13.3 identify the working principles of flue draught stabilisers and their uses with open flued appliances

13.4 specify the requirements for installing chimney fans to open flues/chimney systems:

- requirements prior to installing fans in flues
- additional safety requirements when fans are installed in flues.

Unit 307

Understand the principles and requirements of industrial and commercial fuel systems

Outcome 14

Understand how to identify and respond to unsafe situations relating to fuel burning appliances or flue systems

Assessment criteria

The learner can:

14.1 clarify the types of unsafe situation that may be found with appliances and supply system installations:

- types of immediate risk – safety and environmental:
 - actions to take
 - 'do not use' notices and labels
 - warning notice forms
- types of potential risk – safety and environmental:
 - actions to take
 - use of warning notices
- substandard installation
- RIDDOR reportable

14.2 identify the use of general notices and warning labels to avoid the occurrence of unsafe situations

14.3 define the purpose of the following documents and how they are designed to help avoid the occurrence of unsafe situations:

- gas fired installation and commissioning certificates
- gas fired service certificates
- oil fired installation commissioning certificates
- oil fired service certificates
- solid fuel commissioning certificates
- solid fuel service certificates.

Unit 308

Install heating and ventilation industrial and commercial systems

Level: 3

Credit value: 3

UAN number: Y/602/4897

Learning outcomes

There are **six** learning outcomes to this unit. The learner will

1. Be able to complete preparation work for industrial and commercial cold water, hot water, heating and chilled water systems installation activities
2. Be able to identify industrial and commercial cold water, hot water, heating and chilled water systems, equipment and components
3. Be able to install industrial and commercial cold water, hot water, heating and chilled water systems
4. Be able to complete soundness tests on industrial and commercial cold water, hot water, heating and chilled water systems
5. Be able to complete commissioning of industrial and commercial cold water, hot water, heating and chilled water systems
6. Be able to complete fault identification on industrial and commercial cold water, hot water, heating and chilled water systems

Guided learning hours

It is recommended that **4** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 308

Install heating and ventilation industrial and commercial systems

Outcome 1

Be able to complete preparation work for industrial and commercial cold water, hot water, heating and chilled water systems installation activities

Assessment criteria

The learner can:

- 1.1 assess the work location and report factors that will impact on the work to one of the following:
 - line manager
 - main contractor
 - consultant
- 1.2 confirm that job information and documentation for cold water, hot water, heating and chilled water system installation is available and appropriate including:
systems:
 - cold water: one of the following:
 - boosted
 - high rise building systems
 - hot water: one of the following:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - heating: both of the following:
 - low temperature hot water heating
 - medium temperature hot water heating
 - chilled water two of the following:
 - air conditioning systems
 - heat rejection systems
 - chilled beams
 - fan coil units and air handling units
 - job information and documentation
 - statutory regulations/ codes of practice
 - industry standards
 - industry guides/good practice guides/ verbal instructions
- 1.3 use job information and documentation to ensure that the following is fit for purpose:
 - equipment
 - tools
 - labour resources
- 1.4 confirm the points in the work process where liaison with other persons will be required from one of the following:
 - contractor/consultant
 - other site workers

- site visitors
 - supervisor or line manager
- 1.5 demonstrate that job information on key aspects of the work has been issued to relevant people including user instructions or manufacturer's instructions
- 1.6 demonstrate that authorisation has been obtained from the relevant person(s) prior to commencement of the work, from one of the following:
- contractor/consultant
 - other site workers
 - site visitors
 - supervisor or line manager
- 1.7 identify any pre work damage or defects to existing equipment or building features, record and report it to one of the following:
- contractor/consultant
 - other site workers
 - site visitors
 - supervisor or line manager
- 1.8 demonstrate that suitable personal protective equipment has been worn throughout the duration of work preparation activities
- 1.9 verify that the materials needed to complete the job are free from damage and take appropriate action should any defects be found:
from materials used for cold water, hot water, heating and chilled water systems installation activities including all of the following:
- copper pipe
 - plastic
 - stainless steel
 - steel flues
 - low carbon steel
- 1.10 complete preparatory work for the installation of cold water, hot water, heating and chilled water systems to include:
- use of material and equipment requisites where appropriate
 - confirmation that the selection of material, equipment and components are compatible to the installation
 - confirmation that the work location is ready for installation activities
 - confirmation of secure site storage for tools, equipment, materials and components
 - confirmation of suitable access equipment
 - confirmation of suitable lifting equipment where required
 - completion of risk assessments
 - completion of method statements.

Unit 308

Install heating and ventilation industrial and commercial systems

Outcome 2

Be able to identify industrial and commercial cold water, hot water, heating and chilled water systems, equipment and components

Assessment criteria

The learner can:

- 2.1 verify that site drawings, plans and the work location is in accordance with the specific installation requirements for cold water, hot water, heating and chilled water systems
- 2.2 confirm that the proposed job specification for cold water, hot water, heating and chilled water system installation complies with:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 2.3 confirm that relevant persons have been notified and agreement achieved on any changes required to the job specification prior to commencement of the work from one of the following:
 - contractor/consultant
 - supervisor or line manager.

Unit 308

Install heating and ventilation industrial and commercial systems

Outcome 3

Be able to install industrial and commercial cold water, hot water, heating and chilled water systems

Assessment criteria

The learner can:

- 3.1 verify that job information applicable to the installation process is available and conforms to:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 3.2 verify that materials, tools, equipment and resources necessary for the installation of cold water, hot water, heating and chilled water systems are:
 - available as required
 - safely and securely stored
 - meet industry requirements
 - fit for intended purpose
- 3.3 position and fix control components for one of the following systems:
 - cold water
 - hot water
 - hot water heating
 - chilled
- 3.4 inspect and confirm that all aspects of the installation process conform with industry requirements, including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - verbal instructions
 - manufacturers instructions
- 3.5 verify that methods of working ensures that any damage to customer/client property and building features is avoided during work activities
- 3.6 report problems which may affect the progress of the installation, to the line manager or contractor/consultant, including:
 - compliance with specification
 - resource issues.

Unit 308

Install heating and ventilation industrial and commercial systems

Outcome 4

Be able to complete soundness tests on industrial and commercial cold water, hot water, heating and chilled water systems

Assessment criteria

The learner can:

- 4.1 confirm through visual inspections that the following systems conform with industry requirements:
 - cold water (one of the following):
 - boosted
 - high rise building systems
 - hot water (one of the following):
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - heating (two of the following):
 - low temperature hot water heating
 - medium temperature hot water heating
 - chilled water (two of the following):
 - air conditioning systems
 - heat rejection systems
 - chilled beams
 - fan coil units and air handling units
- 4.2 confirm that the cold water, hot water, heating and chilled water system is ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 4.3 verify that procedures for:
 - cleaning
 - flushing
 - charging systems have been carried out in accordance with industry requirements
- 4.4 confirm procedures for establishing that input services to the system components are suited to the intended purpose for two of the following:
 - water company mains
 - mains fed, direct, or indirect
 - gas
 - oil

- 4.5 verify that a soundness test to one of the following systems conforms with appropriate industry standards, guides and good practice guides:
- cold water
 - hot water
 - heating
 - chilled water
- 4.6 implement pre-commissioning tests and checks in accordance with appropriate industry requirements, including:
- statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - verbal instructions
- 4.7 implement checks to confirm:
- system cleanliness
 - use of additives where appropriate
 - system is charged
 - un-commissioned systems and components cannot be activated.

Unit 308

Install heating and ventilation industrial and commercial systems

Outcome 5

Be able to complete commissioning of industrial and commercial cold water, hot water, heating and chilled water systems

Assessment criteria

The learner can:

5.1 verify the availability of the relevant industry specifications and guidelines on the performance of cold water, hot water, heating and chilled water system systems including:
systems:

- cold water: one of the following:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
- hot water: one of the following:
 - open vented
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- heating: two of the following:
 - low temperature hot water heating
 - medium temperature hot water heating
- chilled water two of the following:
 - air conditioning systems
 - heat rejection systems
 - chilled beams
 - fan coil units and air handling units

5.2 confirm that liaison has taken place during the commissioning process in order to minimise disturbance to work routines including liaison with one of the following:

- contractors
- other site workers
- site visitors
- supervisor/line manager

5.3 conduct mechanical and control performance checks and adjustments in accordance with industry specifications for the following:

- hot and cold water system components including all of the following:
 - cold water storage cistern
 - pressure booster sets
 - hot water storage vessels, including high temperature to low temperature calorifiers

- appliance control valve or tap, terminal fittings
- and a minimum of any two from the following:
 - electric and gas water heaters
 - stop valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - expansion vessels
 - RPZ valves
 - feed and expansion cistern (primary system)

heating system:

- appliances:
 - modular
 - sectional
 - high efficiency
 - biomass
- components (all of the following):
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of heating systems
 - time control of heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels

chilled water system:

- appliances (two from the following):
 - refrigeration plant
 - FCU
 - A/C plant
 - cooling towers
 - air handling units
 - heat exchangers
 - chilled beams
- components (two from the following):
 - isolation valves
 - three and four port valves
 - temperature & humidity stats
 - calorifiers
 - actuators
 - RPZ valves

5.4 confirm that appropriate system information is available to the line manager.

Unit 308

Install heating and ventilation industrial and commercial systems

Outcome 6

Be able to complete fault identification on industrial and commercial cold water, hot water, heating and chilled water systems

Assessment criteria

The learner can:

- 6.1 obtain specific information on cold water, hot water, heating and chilled water system component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 6.2 confirm that the relevant persons have been advised that fault diagnosis and rectification activities can cause potential disruption, including one of the following:
 - customers
 - other site workers
 - site visitors
- 6.3 implement procedures for diagnosing faults in system components in accordance with industry specifications including:
 - hot and cold water, a minimum of any two from the following:
 - electric and gas water heaters
 - stop valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - expansion vessels
 - RPZ valves
 - feed and expansion cistern (primary system)
 - heating, all of the following:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of heating systems
 - time control of heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels

- chilled water, (two from the following):
 - isolation valves
 - three and four port valves
 - temperature & humidity stats
 - calorifiers
 - actuators
 - RPZ valves
- 6.4 confirm that procedures for reporting diagnosed faults in systems and components have been carried out in accordance with industry specifications.

Unit 309

Understand industrial and commercial heating and ventilating maintenance techniques

Level: 3

Credit value: 5

UAN number: H/602/4871

Learning outcomes

There are **two** learning outcomes to this unit. The learner will

1. Understand the legislative and organisational procedures for maintaining industrial and commercial heating and ventilation systems, equipment and components
2. Understand the maintenance requirements for industrial and commercial heating and ventilation systems, equipment and components

Guided learning hours

It is recommended that **38** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 309 Understand industrial and commercial heating and ventilating maintenance techniques

Outcome 1 Understand the legislative and organisational procedures for maintaining industrial and commercial H&V systems, equipment and components

Assessment criteria

The learner can:

- 1.1 state the appropriate sources of health and safety information when maintaining have systems
- 1.2 state the documentation appropriate to the routine maintenance of heating and ventilation systems:
 - statutory regulations
 - codes of practice
 - industry specifications
 - manufacturer’s instruction
 - organisational procedures
- 1.3 state appropriate persons whom it may be necessary to advise before heating and ventilation systems are isolated in order to undertake maintenance work
- 1.4 state the actions that should be taken to liaise with other persons upon completion of work procedures with regard to:
 - safe system shutdown
 - labelling of components.

Unit 309

Understand industrial and commercial heating and ventilating maintenance techniques

Outcome 2

Understand the maintenance requirements for industrial and commercial H&V systems, equipment and components

Assessment criteria

The learner can:

- 2.1 state the routine maintenance procedures required to restore or maintain system performance in accordance with industry specifications, for the following systems:
 - cold water:
 - storage (indirect)
 - non-storage (direct)
 - hot water:
 - open vented
 - indirect
 - storage
 - unvented
 - secondary circulation
 - instantaneous
 - heating:
 - low temperature hot water
 - medium temperature hot water
 - air:
 - air conditioning systems
 - heat rejection systems
 - tempered air ventilation systems
- 2.2 define the relative operating principles of gas, oil and solid fuel boilers
- 2.3 define the relative operating principles of chiller units, air handling units and air conditioning units
- 2.4 define the specific tests required to complete the routine maintenance of systems including:
 - hydrostatic pressure
 - dynamic tests
 - heat input
- 2.5 state the function and maintenance requirements of the following components in relation to hot and cold water systems:
 - storage cisterns
 - F and E cisterns
 - hot water storage vessels including high to low temperature calorifiers
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves

- single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
 - circulating pumps (bronze)
 - booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 2.6 state the requirements and characteristics of hot and cold water systems in terms of:
- safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion, erosion and acidity
 - methods of locating defects caused by corrosion, erosion and acidity
 - colour coding for identification of pipework
- 2.7 state the purpose, function and maintenance requirements of the following components in relation to heating systems:
- hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of heating systems
 - time control of heating systems
 - energy management systems
 - storage calorifiers
 - non-storage calorifiers
 - feed and expansion cisterns
 - pressurisation units
 - mechanical controls
 - dousing pots
 - drain taps
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
 - industry specifications and regulations
- 2.8 state the requirements and characteristics of heating systems in terms of:
- safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion, erosion and acidity
 - methods of locating defects caused by corrosion, erosion and acidity
 - colour coding for identification of pipework

- 2.9 state the purpose, function and maintenance requirements of the following components in relation to air systems:
- isolation valves
 - three and four port valves
 - temperature and humidity stats
 - registers and grilles
 - actuators
 - RPZ valves
 - pumps
 - fans
 - filters
 - air washer
 - humidifier
 - attenuators
 - dampers
 - heat exchangers
 - condensers
 - industry specifications and regulations
- 2.10 state the requirements and characteristics of air systems in terms of:
- safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion, erosion and acidity
 - methods of locating defects caused by corrosion, erosion and acidity
 - colour coding for identification of pipework
- 2.11 state the requirements for completing records or reports for system maintenance activities
- 2.12 state the actions to take should a system or component fail to operate to specification requirements.

Unit 310

Maintain industrial and commercial heating and ventilating systems

Level: 3

Credit value: 2

UAN number: Y/502/8194

Learning outcomes

There are **two** learning outcomes to this unit. The learner will

1. Be able to complete preparation work for industrial and commercial heating and ventilation system maintenance activities
2. Be able to maintain industrial and commercial heating and ventilation systems, equipment and components

Guided learning hours

It is recommended that **4** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 310

Maintain industrial and commercial heating and ventilating systems

Outcome 1

Be able to complete preparation work for industrial and commercial H&V system maintenance activities

Assessment criteria

The learner can:

- 1.1 check the work location and report factors that will impact on the work to the supervisor or line manager
- 1.2 source appropriate job information and documentation for heating and ventilation system service and maintenance requirements including any two from the following:
systems:
 - cold water:
 - storage (indirect)
 - non storage (direct)
 - hot water:
 - open vented
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - heating:
 - low temperature hot water
 - medium temperature hot water
 - air:
 - air conditioning systems
 - heat rejection systems
 - tempered air ventilation systems
 - job information and documentation:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - verbal instructions
- 1.3 use job information and documentation to ensure that the following is fit for purpose:
 - equipment
 - tools
- 1.4 identify the points in the work process where liaison with other persons may be necessary:
 - other site workers
 - site visitors
 - supervisor or line manager
- 1.5 demonstrate that job information on key aspects of the work has been issued to relevant people including user instructions or manufacturer's instructions

- 1.6 demonstrate that authorisation has been obtained from the relevant person(s) prior to commencement of the work, from one of the following:
 - other site workers
 - site visitors
 - supervisor or line manager
- 1.7 note any pre-work damage or defects to existing equipment or building features should it exist, and report to the job supervisor or your line manager.
- 1.8 demonstrate that suitable personal protective equipment has been worn throughout the duration of work preparation activities
- 1.9 check that the resources needed to complete the job are free from damage and take appropriate action should any defects be found
- 1.10 complete preparatory work for the maintenance of heating and ventilation systems, to include:
 - use of material and equipment requisites where appropriate
 - confirmation that the selection of material, equipment and components are compatible to the installation
 - confirmation that the work location is ready for service and maintenance activities
 - confirmation of secure site storage for tools, equipment, materials and components
 - confirmation of suitable access equipment
 - confirmation of suitable lifting equipment where required.

Unit 310

Maintain industrial and commercial heating and ventilating systems

Outcome 2

Be able to maintain industrial and commercial H&V systems, equipment and components

Assessment criteria

The learner can:

- 2.1 check that the relevant information is available in order to carry out maintenance work
- 2.2 check that materials, tools and equipment are available for the specified maintenance activity
- 2.3 demonstrate that liaison has taken place with the supervisor or line manager at the key points within the routine maintenance activities to minimise disruption to work routines
- 2.4 perform work activities for routine maintenance that complies with industry specifications and manufacturer's instructions, for hot and cold water system and components including:

one of the following:

- cold water storage cistern
- pressure booster sets
- hot water storage vessels
- appliance control valve or tap, terminal fittings

and a minimum of any two from the following:

- electric and gas water heaters
- stop valves
- shower mixing valves
- blending valves
- mixing valves
- circulating pumps (bronze)
- expansion vessels
- RPZ valves

- 2.5 perform work activities for routine maintenance that ensure the continued effective operation of the hot and cold water systems and components identified in:

one of the following:

- cold water storage cistern
- pressure booster sets
- hot water storage vessels
- appliance control valve or tap, terminal fittings

and a minimum of any two from the following:

- electric and gas water heaters
- stop valves
- shower mixing valves
- blending valves
- mixing valves
- circulating pumps (bronze)
- expansion vessels
- RPZ valves

2.6 perform work activities for routine maintenance that complies with industry specifications and manufacturer's instructions, for hot water heating systems and components including:

one from the following:

- low temperature hot water
- medium temperature hot water

and a minimum of three from the following:

- hot water storage vessels
- radiators
- convector heaters, natural and assisted
- panel heaters
- ceiling coils
- thermostatic control of heating systems
- time control of heating systems
- energy management systems
- storage calorifiers
- non-storage calorifiers
- feed and expansion cisterns
- pressurisation units
- mechanical controls
- dosing pots
- drain taps
- motorised valves
- pumps/accelerators
- temperature and pressure relief valves
- expansion vessels

2.7 perform work activities for routine maintenance that ensure the continued effective operation of the hot water heating systems and components identified in:

one from the following:

- low temperature hot water
- medium temperature hot water

and a minimum of three from the following:

- hot water storage vessels
- radiators
- convector heaters, natural and assisted
- panel heaters
- ceiling coils
- thermostatic control of heating systems
- time control of heating systems
- energy management systems
- storage calorifiers
- non-storage calorifiers
- feed and expansion cisterns
- pressurisation units
- mechanical controls
- dosing pots
- drain taps
- motorised valves
- pumps/accelerators

- temperature and pressure relief valves
 - expansion vessels
- 2.8 perform work activities for routine maintenance that comply with industry specifications and manufacturer's instructions for air systems and components, including:
- one from the following:
- air conditioning systems
 - tempered air ventilation systems
- and a minimum of three from the following:
- isolation valves
 - three & four port valves
 - temperature & humidity stats
 - registers and grilles
 - actuators
 - RPZ valves
 - pumps
 - fans
 - filters
 - air washer
 - humidifier
 - attenuators
 - dampers
 - heat exchangers
 - condensers
 - industry specifications and regulations
- 2.9 perform work activities for routine maintenance that ensure the continued effective operation of the air systems and components identified in:
- one from the following:
- air conditioning systems
 - tempered air ventilation systems
- and a minimum of three from the following:
- isolation valves
 - three & four port valves
 - temperature & humidity stats
 - registers and grilles
 - actuators
 - RPZ valves
 - pumps
 - fans
 - filters
 - air washer
 - humidifier
 - attenuators
 - dampers
 - heat exchangers
 - condensers
 - industry specifications and regulations
- 2.10 confirm that maintenance records have been completed accurately and checked by the supervisor or line manager.

Unit 311

Understand industrial and commercial oxy-acetylene pipe jointing

Level: 3

Credit value: 5

UAN number: D/602/4884

Learning outcomes

There are **four** learning outcomes to this unit. The learner will

1. Understand the working principles of industrial and commercial compressed gas welding processes
2. Understand the legislative and organisational procedures related to all industrial and commercial compressed gas welding processes
3. Understand how to complete preparation work for compressed gas welding activities
4. Understand how to connect pipework by compressed gas welding

Guided learning hours

It is recommended that **38** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 311

Understand industrial and commercial oxy-acetylene pipe jointing

Outcome 1

Understand the working principles of industrial and commercial compressed gas welding processes

Assessment criteria

The learner can:

1.1 specify the working principles of all the following items of compressed gas welding equipment:

- compressed gas cylinders
- two stage regulators
- blowback arresters
- non-return valves
- high pressure welding torches
- welding nozzles
- flame cutting nozzles
- high pressure hoses.

Unit 311

Understand industrial and commercial oxy-acetylene pipe jointing

Outcome 2

Understand the legislative and organisational procedures related to all industrial and commercial compressed gas welding processes

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as it relates to:
 - compressed gases
 - welding equipment
 - autogeneous processes
 - materials handling
- 2.2 interpret and apply regulations, codes of practice, industry recommendations, and welding specifications appropriate to:
 - compressed gases
 - welding equipment
 - autogeneous processes
- 2.3 state the appropriate persons whom it may be necessary to advise before undertaking welding processes (including compressed gas cutting activities)
- 2.4 define the actions that should be taken upon completion of welding processes (including compressed gas cutting activities) in terms of:
 - quality control
 - documentation procedures
- 2.5 explain how to prevent the inadvertent operation of welding equipment after completion of work operations.

Unit 311

Understand industrial and commercial oxy-acetylene pipe jointing

Outcome 3

Understand how to complete preparation work for compressed gas welding activities

Assessment criteria

The learner can:

- 3.1 explain how to complete a risk assessment in the work location
- 3.2 specify the preparation requirements for:
 - joining pipework by welding (cutting pipe to size, preparing pipe ends)
 - testing welded pipework sections
 - commissioning welded pipework sections
 - decommissioning welded pipework sections
 - identifying faults on welded pipework sections
- 3.3 explain how to complete a method statement for welding processes
- 3.4 state the safety requirements of the work location in terms of:
 - safe access and egress
 - immediate work location eg tripping hazards
 - hazards related to the welding process
- 3.5 identify the Personal Protective Equipment (PPE) appropriate to the work activity being carried out
- 3.6 justify the selection of pipework materials and fittings required to complete work on welded pipework system installations and check them for defects
- 3.7 justify the selection of welding tools and equipment required to carry out welding processes and compressed gas cutting activities
- 3.8 define the procedures for maintaining welding tools and equipment.

Unit 311

Understand industrial and commercial oxy-acetylene pipe jointing

Outcome 4

Understand how to connect pipework by compressed gas welding

Assessment criteria

The learner can:

- 4.1 interpret engineering drawings and welding specifications prior to carrying out welding procedures
- 4.2 identify appropriate cutting and grinding methods to ensure pipe ends are properly prepared prior to welding
- 4.3 state the procedures for safely using cutting and grinding equipment to achieve correct pipe end/weld preparation
- 4.4 define the oxy-acetylene gas welding processes in terms of:
 - compressed gases
 - welding equipment
 - autogeneous processes
- 4.5 evaluate the relative merits of:
 - compressed gas welding processes
 - compressed gas welding equipment
 - consumables
- 4.6 define the operating principles of different component types that are connected to compressed gas cylinders, including:
 - plant
 - equipment
 - control devices
- 4.7 describe the basic principles for inspecting, testing and maintaining gas welding equipment
- 4.8 define the procedures for:
 - checking welds for compliance
 - testing for defects in products and assets.

Unit 312

Perform industrial and commercial oxy-acetylene pipe jointing

Level: 3

Credit value: 2

UAN number: K/602/4905

Learning outcomes

There are **two** learning outcomes to this unit. The learner will

1. Be able to complete preparation work for industrial and commercial compressed gas welding activities
2. Be able to connect pipework by industrial and commercial compressed gas welding

Guided learning hours

It is recommended that **4** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 312 Perform industrial and commercial oxy-acetylene pipe jointing

Outcome 1 Be able to complete preparation work for industrial and commercial compressed gas welding activities

Assessment criteria

The learner can:

- 1.1 carry out a risk assessment for welding processes in the work location
- 1.2 carry out a method statement for welding processes in the work location including requirements for:
 - storage of materials and finished products
 - availability of service supplies
 - informing appropriate people at key stages in the welding process
 - reporting problems
 - joining procedures
 - job instructions
- 1.3 select Personal Protective Equipment (PPE) appropriate to the work activity being carried out
- 1.4 select and confirm that pipe and materials are appropriate for the specific welding processes
- 1.5 select and confirm that equipment is appropriate and properly prepared for the specific
- 1.6 welding/cutting/ grinding processes to be completed
- 1.7 select and prepare compressed gas cutting equipment and grinding equipment for the
- 1.8 preparation of pipework materials for welding
- 1.9 use cutting and grinding equipment safely and correctly to prepare pipework materials for
- 1.10 welding in accordance with provided welding specifications
- 1.11 confirm that preparations have been completed in line with organisational procedures.

Unit 312 Perform industrial and commercial oxy-acetylene pipe jointing

Outcome 2 Be able to connect pipework by industrial and commercial compressed gas welding

Assessment criteria

The learner can:

- 2.1 confirm that checks have been completed to establish:
 - joint preparation
 - welding equipment
 - consumablescomply with specifications and are fit for purpose
- 2.2 select and use tools and inspection equipment to carry out compressed gas welding of pipework and confirm they are fit for purpose
- 2.3 weld pipework materials to conform with job specifications on all of the following:
 - LCS pipe
 - pipe headers
 - weld-on bends and elbows
 - weld-on tees
 - weld-on flanges
 - weld-on valves
 - butt welds
 - branch weldsweld pipe and fitting by the following joint methods:
 - vertical horizontal butt (all positions)
 - horizontal vertical butt
 - fillet
- 2.4 confirm that welding equipment has been safely isolated after welding activities
- 2.5 conduct industry approved checks and tests on completed work to confirm:
 - compliance with specification
 - any defects
 - any corrective action
- 2.6 verify that waste materials and temporary attachments have been dealt with in line with approved procedures
- 2.7 demonstrate approved methodologies for dealing with and reporting problems:
 - within scope of control
 - outside scope of control
- 2.8 complete relevant documentation including weld test reports.

Unit 313

Understand industrial and commercial manual metal arc pipe jointing techniques

Level: 3

Credit value: 5

UAN number: K/602/4886

Learning outcomes

There are **four** learning outcomes to this unit. The learner will

1. Understand the working principles of industrial and commercial manual metal arc welding processes
2. Understand the legislative and organisational procedures related to all industrial and commercial manual metal arc welding processes
3. Understand how to complete preparation work for manual metal arc welding activities
4. Understand how to connect pipework by manual metal arc welding

Guided learning hours

It is recommended that **38** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 313

Understand industrial and commercial manual metal arc pipe jointing techniques

Outcome 1

Understand the working principles of industrial and commercial manual metal arc welding processes

Assessment criteria

The learner can:

1.1 specify the working principles of all the following items of manual metal arc welding equipment:

- arc welding sets (AC/DC)
- remote controllers
- generators
- rectifiers
- transformers
- welding tongs
- cables
- return clamp
- consumables.

Unit 313

Understand industrial and commercial manual metal arc pipe jointing techniques

Outcome 2

Understand the legislative and organisational procedures related to all industrial and commercial manual metal arc welding processes

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as it relates to:
 - arc welding sets (AC/DC)
 - welding equipment
 - autogeneous processes
 - materials handling
- 2.2 interpret and apply regulations, codes of practice, industry recommendations, and welding specifications appropriate to:
 - arc welding sets (AC/DC)
 - welding equipment
 - autogeneous processes
- 2.3 state appropriate persons whom it may be necessary to advise before undertaking welding processes
- 2.4 define the actions that should be taken upon completion of welding processes in terms of:
 - quality control
 - documentation procedures
- 2.5 explain how to prevent the inadvertent operation of welding equipment after completion of work operations.

Unit 313

Understand industrial and commercial manual metal arc pipe jointing techniques

Outcome 3

Understand how to complete preparation work for manual metal arc welding activities

Assessment criteria

The learner can:

- 3.1 explain how to complete a risk assessment in the work location
- 3.2 specify the preparation requirements to:
 - join pipework by welding (cutting pipe to size, preparing pipe ends)
 - test welded pipework sections
 - commission welded pipework sections
 - decommission welded pipework sections
 - identify faults on welded pipework sections
- 3.3 explain how to complete a method statement for welding processes
- 3.4 state the safety requirements of the work location in terms of:
 - safe access and egress
 - immediate work location eg tripping hazards
 - hazards related to the welding process
- 3.5 identify the personal protective equipment appropriate to the work activity being carried out
- 3.6 justify the selection of pipework materials and fittings required to complete work on welded pipework system installations and check them for defects
- 3.7 justify the selection of welding tools and equipment required to carry out welding processes
- 3.8 define the procedures for maintaining welding tools and equipment.

Unit 313

Understand industrial and commercial manual metal arc pipe jointing techniques

Outcome 4

Understand how to connect pipework by manual metal arc welding

Assessment criteria

The learner can:

- 4.1 interpret engineering drawings and welding specifications prior to carrying out welding procedures
- 4.2 identify appropriate cutting and grinding methods to ensure pipe ends are properly prepared prior to welding
- 4.3 state the procedures for safely using cutting and grinding equipment to achieve correct pipe-end/weld preparation
- 4.4 define the manual metal arc welding processes in terms of:
 - arc welding sets (AC/DC)
 - welding equipment
 - autogeneous processes
 - flame cutting processes
- 4.5 evaluate the relative merits of:
 - manual metal arc welding processes
 - manual metal arc welding equipment
 - consumables
- 4.6 define the operating principles of different component types that are connected to arc welding sets (AC/DC), including:
 - plant
 - equipment
 - control devices
- 4.7 describe the basic principles for inspecting, testing and maintaining manual metal arc welding equipment
- 4.8 define the procedures for:
 - checking welds for compliance
 - testing for defects in products and assets.

Unit 314

Perform industrial and commercial manual metal arc pipe jointing

Level: 3

Credit value: 2

UAN number: T/602/4907

Learning outcomes

There are **two** learning outcomes to this unit. The learner will

1. Be able to complete preparation work for industrial and commercial manual metal arc welding activities
2. Be able to connect pipework by industrial and commercial manual metal arc welding

Guided learning hours

It is recommended that **4** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 314 Perform industrial and commercial manual metal arc pipe jointing

Outcome 1 Be able to complete preparation work for industrial and commercial manual metal arc welding activities

Assessment criteria

The learner can:

- 1.1 carry out a risk assessment for welding processes in the work location
- 1.2 carry out a method statement for welding processes in the work location including requirements for:
 - storage of materials and finished products
 - availability of service supplies
 - informing appropriate people at key stages in the welding process
 - reporting problems
 - joining procedures
 - job instructions
- 1.3 select personal protective equipment appropriate to the work activity being carried out
- 1.4 select and confirm that pipe and materials are appropriate for the specific welding processes
- 1.5 select and confirm that equipment is appropriate and properly prepared for the specific welding/cutting/ grinding processes to be completed
- 1.6 select and prepare cutting and grinding equipment correctly for the preparation of pipework materials for welding
- 1.7 use cutting and grinding equipment safely and correctly to prepare pipework materials for welding in accordance with provided welding specifications.

Unit 314 Perform industrial and commercial manual metal arc pipe jointing

Outcome 2 Be able to connect pipework by industrial and commercial manual metal arc welding

Assessment criteria

The learner can:

- 2.1 confirm that checks have been completed to establish:
- joint preparation
 - welding equipment
 - consumables
- comply with specifications and are fit for purpose
- 2.2 select and use tools and inspection equipment to carry out manual metal arc welding of pipework and confirm they are fit for purpose
- 2.3 weld pipework materials to conform with job specifications on all of the following:
- LCS pipe
 - pipe headers
 - weld-on bends and elbows
 - weld-on tees
 - weld-on flanges
 - weld-on valves
 - butt welds
 - branch welds
- weld pipe and fitting by the following joint methods:
- vertical horizontal butt (all positions)
 - horizontal vertical butt
 - fillet
- 2.4 confirm that welding equipment has been safely isolated after welding activities
- 2.5 conduct industry approved checks and tests on completed work to confirm:
- compliance with specification
 - any defects
 - any corrective action
- 2.6 verify that waste materials and temporary attachments have been dealt with in line with approved procedures
- 2.7 demonstrate approved methodologies for dealing with and reporting problems:
- within scope of control
 - outside scope of control
- 2.8 complete relevant documentation including weld test reports.

Unit 315

Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques

Level: 3

Credit value: 8

UAN number: F/602/4909

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial rectangular ductwork systems
2. Understand the legislative and organisational procedures related to all industrial and commercial rectangular ductwork systems work activities
3. Understand how to complete preparation work for industrial and commercial rectangular ductwork installation activities
4. Understand the procedures for identifying industrial and commercial rectangular ductwork systems, equipment and components
5. Understand how to install industrial and commercial rectangular ductwork systems
6. Understand procedures for the soundness testing of industrial and commercial rectangular ductwork systems
7. Understand procedures for decommissioning industrial and commercial rectangular ductwork systems
8. Understand procedures for commissioning industrial and commercial rectangular ductwork systems
9. Understand procedures for identifying faults on industrial and commercial rectangular ductwork systems

Guided learning hours

It is recommended that **65** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 315 Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial rectangular ductwork systems

Assessment criteria

The learner can:

- 1.1 specify the working principles for all of the following rectangular ductwork systems:
 - supply
 - extract
 - re-circulation
 - kitchen extract
 - low, medium and high pressure/velocity air
- 1.2 specify the working principles of the following components within a rectangular ductwork system:
 - small air handling units
 - fans, axial and centrifugal
 - attenuator
 - heater / filter / cooler batteries
 - fan coil units
 - variable air volume units
 - regulating/ motorised dampers
 - fire dampers
 - kitchen hoods and grease filters
 - plenum boxes
 - access doors
 - terminal units/grilles/diffusers
- 1.3 explain the procedures that should be followed where the installation requirements do not meet the design specification
- 1.4 interpret the ductwork system layout requirements for systems and components in accordance with industry specifications and regulations including:
 - systems:
 - supply
 - extract
 - re-circulation
 - kitchen extract
 - low, medium and high pressure/velocity air
 - components:
 - rectangular ductwork components including flexible ducts
 - air handling units
 - fans, axial and centrifugal

- attenuator
- heater / filter / cooler batteries
- fan coil units
- variable air volume units
- regulating/ motorised dampers
- fire dampers
- kitchen hoods and grease filters
- plenum boxes
- access doors
- terminal units/grilles/diffusers

1.5 justify the positioning of selected components in rectangular ductwork systems.

Unit 315 Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial rectangular ductwork systems work activities

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as they relate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof rectangular ductwork systems
- 2.2 interpret and apply codes of practice and industry recommendations appropriate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof rectangular ductwork systems
- 2.3 specify the actions that should be taken to liaise with other persons during the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof rectangular ductwork systems
- 2.4 state appropriate persons whom it may be necessary to advise before a rectangular ductwork system is isolated in order to undertake work
- 2.5 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 315 **Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial rectangular ductwork installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faultson rectangular ductwork systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 calculate from drawings and specifications the materials and fittings required to complete work on rectangular ductwork systems.

Unit 315 **Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques**

Outcome 4 Understand the procedures for identifying industrial and commercial rectangular ductwork systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific rectangular ductwork installation requirements
- 4.2 interpret and apply appropriate sources of information when determining rectangular ductwork installation requirements including:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate the installation requirements against drawings and specifications to determine compatibility
- 4.4 summarise the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to rectangular ductwork systems.

Unit 315 Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques

Outcome 5 Understand how to install industrial and commercial rectangular ductwork systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of rectangular ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 315 **Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques**

Outcome 6 Understand procedures for the soundness testing of industrial and commercial rectangular ductwork systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of rectangular ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of rectangular ductwork systems to confirm that they are ready to receive soundness tests to cover:
 - ductwork
 - appliances
 - components
- 6.3 interpret test records to confirm compliance with specifications
- 6.4 state the actions that must be taken when testing reveals leakage from rectangular ductwork systems.

Unit 315 **Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques**

Outcome 7 Understand procedures for decommissioning industrial and commercial rectangular ductwork systems

Assessment criteria

The learner can:

- 7.1 explain the conditions that determine the safe decommissioning of a rectangular ductwork system
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning rectangular ductwork system components and ductwork, complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal shut off mechanisms for rectangular ductwork systems do not operate.

Unit 315 Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques

Outcome 8 Understand procedures for commissioning industrial and commercial rectangular ductwork systems

Assessment criteria

The learner can:

- 8.1 interpret and apply industry specifications and guidelines on the performance of rectangular ductwork systems including:
 - supply
 - extract
 - re-circulation
 - kitchen extract
 - low, medium and high pressure/velocity air
- 8.2 specify the procedures for establishing correct mechanical and control performance for the following:
 - small air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - fan coil units
 - variable air volume units
 - regulating/ motorised dampers
 - fire dampers
- 8.3 explain the procedures for commissioning rectangular ductwork systems and components in accordance with industry specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 315 Understand industrial and commercial rectangular ductwork installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial rectangular ductwork systems

Assessment criteria

The learner can:

- 9.1 interpret information on rectangular ductwork system component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 9.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.3 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 describe the work actions and sequences for diagnosing faults in system components in accordance with industry specifications including:
 - air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 9.5 demonstrate how to isolate components including:
 - air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 9.6 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.7 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients:
 - air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers.

Unit 316

Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Level: 3

Credit value: 8

UAN number: A/602/4911

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial circular or flat oval ductwork systems
2. Understand the legislative and organisational procedures related to all industrial and commercial circular or flat oval ductwork systems work activities
3. Understand how to complete preparation work for industrial and commercial circular or flat oval installation activities
4. Understand the procedures for identifying industrial and commercial circular or flat oval ductwork systems, equipment and components
5. Understand how to install industrial and commercial circular or flat oval ductwork systems
6. Understand procedures for the soundness testing of industrial and commercial circular or flat oval ductwork systems
7. Understand procedures for decommissioning industrial and commercial circular or flat oval ductwork systems
8. Understand procedures for commissioning industrial and commercial circular or flat oval ductwork systems
9. Understand procedures for identifying faults on industrial and commercial circular or flat oval ductwork systems

Guided learning hours

It is recommended that **65** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 316 Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 1.1 specify the working principles for all of the following circular or flat oval ductwork systems:
 - supply
 - extract
 - re-circulation
 - kitchen extract
 - low, medium and high pressure/velocity air
- 1.2 specify the working principles of the following components within a circular or flat oval ductwork system:
 - small air handling units
 - fans, axial and centrifugal
 - attenuator
 - heater / filter / cooler batteries
 - fan coil units
 - variable air volume units
 - regulating/ motorised dampers
 - fire dampers
 - kitchen hoods and grease filters
 - plenum boxes
 - access doors
 - terminal units/grilles/diffusers
- 1.3 evaluate the options where the installation requirements are not compatible with the design specification
- 1.4 interpret the ductwork system layout requirements for systems and components including:
 - systems:
 - supply
 - extract
 - re-circulation
 - kitchen extract
 - low, medium and high pressure/velocity air
 - components:
 - circular or flat oval ductwork components including flexible ducts
 - air handling units
 - fans, axial and centrifugal
 - attenuator

- heater / filter / cooler batteries
- fan coil units
- variable air volume units
- regulating/ motorised dampers
- fire dampers
- kitchen hoods and grease filters
- plenum boxes
- access doors
- terminal units/grilles/diffusers

in accordance with industry specifications and regulations

1.5 justify the positioning of selected components in circular or flat oval ductwork systems.

Unit 316 Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial circular or flat oval ductwork systems work activities

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as they relate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof circular or flat oval ductwork systems
- 2.2 interpret and apply codes of practice and industry recommendations appropriate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof circular or flat oval ductwork systems
- 2.3 state the appropriate persons whom it may be necessary to advise before a circular or flat oval ductwork system is isolated in order to undertake work
- 2.4 define the actions that should be taken to liaise with other persons during the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof circular or flat oval ductwork systems
- 2.5 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 316 **Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial circular or flat oval installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faultson circular or flat oval ductwork systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 calculate from drawings and specifications the materials and fittings required to complete work on circular or flat oval ductwork systems.

Unit 316 Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial circular or flat oval ductwork systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific circular or flat oval ductwork installation requirements
- 4.2 interpret and apply appropriate sources of information when determining circular or flat oval ductwork installation requirements including:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate the installation requirements against drawings and specifications to determine compatibility
- 4.4 summarise the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to circular or flat oval ductwork systems.

Unit 316 **Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of circular or flat oval ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 316 Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Outcome 6 Understand procedures for the soundness testing of industrial and commercial circular or flat oval ductwork systems

Assessment criteria

the learner can:

- 6.1 interpret and apply information for the soundness testing of circular or flat oval ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of circular or flat oval ductwork systems to confirm that they are ready to receive soundness tests to cover:
 - ductwork
 - appliances
 - components
- 6.3 interpret test records to confirm compliance with specifications
- 6.4 state the actions that must be taken when testing reveals leakage from circular or flat oval ductwork systems.

Unit 316 **Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques**

Outcome 7 Understand procedures for decommissioning industrial and commercial circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 7.1 explain the conditions that determine the safe decommissioning of a circular or flat oval ductwork system
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning circular or flat oval ductwork systems and components, complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal shut off mechanisms for circular or flat oval ductwork systems do not operate.

Unit 316 Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Outcome 8 Understand procedures for commissioning industrial and commercial circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 8.1 interpret and apply industry specifications and guidelines on the performance of circular or flat oval ductwork systems including:
 - supply
 - extract
 - re-circulation
 - kitchen extract
 - low, medium and high pressure/velocity air
- 8.2 specify the procedures for establishing correct mechanical and control performance for the following:
 - small air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - fan coil units
 - variable air volume units
 - regulating/ motorised dampers
 - fire dampers
- 8.3 explain the procedures for commissioning circular or flat oval ductwork systems and components in accordance with industry specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 316 Understand industrial and commercial circular and flat oval ductwork installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 9.1 interpret information on circular or flat oval ductwork system component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 9.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.3 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 describe the work actions and sequences for diagnosing faults in system components in accordance with industry specifications including:
 - air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 9.5 demonstrate how to isolate components including:
 - air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 9.6 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.7 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients:
 - air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Level: 3

Credit value: 4

UAN number: D/602/4920

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial air handling units
2. Understand the legislative and organisational procedures related to all industrial and commercial air handling unit work activities
3. Understand how to complete preparation work for industrial and commercial air handling unit installation activities
4. Understand the procedures for identifying industrial and commercial air handling unit equipment and components
5. Understand how to install industrial and commercial air handling units
6. Understand procedures for the testing of industrial and commercial air handling units
7. Understand procedures for decommissioning industrial and commercial air handling units
8. Understand procedures for commissioning industrial and commercial air handling units
9. Understand procedures for identifying faults on industrial and commercial air handling units

Guided learning hours

It is recommended that **28** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 1

Understand the working principles and layouts of industrial and commercial air handling units

Assessment criteria

The learner can:

1.1 specify the operating and working principles for all of the following air handling units:

- high and low velocity
- constant and variable volume systems:
 - primary (fresh air) air plant for fan-coil, induction and room heat pump systems
 - supply and extract air plant for single-duct, dual-duct and multi-zone systems
 - special filtration for operating theatres, museums or clean rooms
 - energy/ heat recovery for industrial application, and for very quiet applications such as concert halls
- units that may be accommodated in plant rooms or external to the building served, typically a roof location

including:

- factors to determine unit/system selection
- key regulations relevant to the installation

1.2 define the operating principles of different appliance types that are connected to air handling units, including:

- manufacturer's units
- compliance with industry specifications and manufacturer's instructions

1.3 specify the working principles of the following air handling unit components:

- mechanical, moving and non-moving parts
- electrical
- motors
- pumps
- humidifiers
- filters

1.4 calculate the duct sizing requirements for air handling units, including:

- high and low velocity
- constant and variable volume systems:
 - primary (fresh air) air plant for fan-coil, induction and room heat pump systems
 - supply and extract air plant for single-duct, dual-duct and multi-zone systems
 - special filtration for operating theatres, museums or clean rooms
 - energy/ heat recovery for industrial application, and for very quiet applications such as concert halls
- units that may be accommodated in plant rooms or external to the building served, typically a roof location

1.5 confirm the air handling system layout requirements for:

systems:

- high and low velocity systems
- constant and variable volume systems:
 - primary (fresh air) air plant for fan-coil, induction and room heat pump systems
 - supply and extract air plant for single-duct, dual-duct and multi-zone systems
 - special filtration for operating theatres, museums or clean rooms
 - energy/ heat recovery for industrial application, and for very quiet applications such as concert halls
- units that may be accommodated in plant rooms or external to the building served, typically a roof location

and components:

- mechanical, moving and non-moving parts
- electrical
- motors
- pumps
- humidifiers
- filters

in accordance with industry specifications and regulations

1.6 justify the positioning of selected components in air handling units.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 2

Understand the legislative and organisational procedures related to all industrial and commercial air handling unit work activities

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as they relate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof air handling units
- 2.2 interpret and apply codes of practice, and industry recommendations appropriate to the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof air handling units
- 2.3 specify the actions that should be taken to liaise with other persons during the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof air handling units
- 2.4 state appropriate persons whom it may be necessary to advise before an air handling unit is isolated in order to undertake work
- 2.5 define the actions that should be taken to liaise with other persons during the:
 - installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioningof air handling units
- 2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 3

Understand how to complete preparation work for industrial and commercial air handling unit installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faults on air handling units
- 3.2 evaluate the work location to determine planning requirements
- 3.3 calculate from drawings and specifications the materials fittings and components required to complete work on air handling units.

Unit 317 Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial air handling unit equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific air handling unit installation requirements
- 4.2 interpret and apply appropriate sources of information when determining air handling installation requirements including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate the installation requirements against drawings and specifications to determine compatibility
- 4.4 summarise the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to air handling units.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 5

Understand how to install industrial and commercial air handling units

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of air handling units from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 6

Understand procedures for the testing of industrial and commercial air handling units

Assessment criteria

the learner can:

- 6.1 interpret and apply information for the testing of air handling units from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of air handling units to confirm that they are ready to receive tests to cover:
 - motors
 - pumps
 - humidifiers
 - filters
- 6.3 state the procedure testing air handling units/unit components including:
 - motors
 - pumps
 - humidifiers
 - filters
- 6.4 specify the procedures for cleaning and charging an air handling unit
- 6.5 interpret test records to confirm compliance with specifications.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 7

Understand procedures for decommissioning industrial and commercial air handling units

Assessment criteria

The learner can:

- 7.1 confirm that the status of the system will permit safe decommissioning of the air handling unit
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning air handling units and components complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal shut off mechanisms for air handling units do not operate.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 8

Understand procedures for commissioning industrial and commercial air handling units

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of air handling units including:
 - high and low velocity systems
 - constant and variable volume systems:
 - units that may be accommodated in plant rooms or external to the building served, typically a roof location.
- 8.2 specify the procedures for establishing correct mechanical and control performance for the following:
 - systems:
 - high and low velocity
 - constant and variable volume systems:
 - primary (fresh air) air plant for fan-coil, induction and room heat pump systems
 - supply and extract air plant for single-duct, dual-duct and multi-zone systems
 - special filtration for operating theatres, museums or clean rooms
 - energy/ heat recovery for industrial application, and for very quiet applications such as concert halls
 - units that may be accommodated in plant rooms or external to the building served, typically a roof location.
 - components:
 - mechanical, moving and non-moving parts
 - electrical
 - motors
 - pumps
 - humidifiers
 - filters
- 8.3 explain the procedures for commissioning systems and components in accordance with industry specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 317

Understand industrial and commercial air handling unit installation and pre-commissioning techniques

Outcome 9

Understand procedures for identifying faults on industrial and commercial air handling units

Assessment criteria

The learner can:

- 9.1 interpret information on air handling units and component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 9.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.3 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 describe the work actions and sequences for diagnosing faults in systems and components in accordance with industry specifications
- 9.5 demonstrate how to isolate systems and components including:
 - systems:
 - high and low velocity
 - constant and variable volume systems:
 - primary (fresh air) air plant for fan-coil, induction and room heat pump systems
 - supply and extract air plant for single-duct, dual-duct and multi-zone systems
 - special filtration for operating theatres, museums or clean rooms
 - energy/ heat recovery for industrial application, and for very quiet applications such as concert halls
 - units that may be accommodated in plant rooms or external to the building served, typically a roof location.
 - components:
 - mechanical, moving and non-moving parts
 - electrical
 - motors
 - pumps
 - humidifiers
 - filters
- 9.6 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.7 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients
- 9.8 specify the procedures for identifying component faults in air handling units
- 9.9 evaluate the effects of common component faults upon overall air handling unit performance.

Unit 318

Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques

Level: 3

Credit value: 4

UAN number: K/502/8202

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial plastic ductwork systems
2. Understand the legislative and organisational procedures related to all industrial and commercial plastic ductwork systems work activities
3. Understand how to complete preparation work for industrial and commercial plastic ductwork installation activities
4. Understand the procedures for identifying industrial and commercial plastic systems, equipment and components
5. Understand how to install industrial and commercial plastic ductwork systems
6. Understand procedures for the soundness testing of industrial and commercial plastic ductwork systems
7. Understand procedures for decommissioning industrial and commercial plastic ductwork systems
8. Understand procedures for commissioning industrial and commercial plastic ductwork systems
9. Understand procedures for identifying faults on industrial and commercial plastic ductwork systems

Guided learning hours

It is recommended that **28** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 318 Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial plastic ductwork systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles for all of the following plastic ductwork systems:
 - supply
 - extract
 - low, medium and high pressure/velocity air
- 1.2 specify the working principles of the following plastic ductwork components:
 - flexible ducts
 - air handling units
 - fans, axial and centrifugal
 - attenuator
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
 - plenum boxes
 - access doors
 - terminal units/grilles/diffusers
- 1.3 evaluate the options where the installation requirements are not compatible with the design specification
- 1.4 interpret the ductwork system layout requirements for systems and components including:
 - systems:
 - supply
 - extract
 - low, medium and high pressure/velocity air
 - components:
 - flexible ducts
 - air handling units
 - fans, axial and centrifugal
 - attenuator
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
 - plenum boxes
 - access doors
 - terminal units/grilles/diffusers

in accordance with industry specifications and regulations
- 1.5 justify the positioning of selected components in plastic ductwork systems.

Unit 318 Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial plastic ductwork systems work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of plastic ductwork systems

2.2 interpret and apply codes of practice, and industry recommendations appropriate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of plastic ductwork systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of plastic ductwork systems

2.4 state appropriate persons whom it may be necessary to advise before a plastic ductwork system is isolated in order to undertake work

2.5 define the actions that should be taken to liaise with other persons during the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of plastic ductwork systems

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 318 **Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial plastic ductwork installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faultson plastic ductwork systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 calculate, from drawings and specifications, the materials and fittings required to complete work on plastic ductwork systems.

Unit 318 **Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques**

Outcome 4 Understand the procedures for identifying industrial and commercial plastic systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific plastic ductwork installation requirements
- 4.2 interpret and apply appropriate sources of information when determining plastic ductwork installation requirements including:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate the installation requirements against drawings and specifications to determine compatibility
- 4.4 summarise the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to plastic ductwork systems.

Unit 318 **Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial plastic ductwork systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of plastic ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 318 **Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques**

Outcome 6 Understand procedures for the soundness testing of industrial and commercial plastic ductwork systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of plastic ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of plastic ductwork systems to confirm that they are ready to receive soundness tests to cover:
 - ductwork
 - appliances
 - components
- 6.3 interpret test records to confirm compliance with specifications
- 6.4 state the actions that must be taken when testing reveals leakage from plastic ductwork systems.

Unit 318 Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques

Outcome 7 Understand procedures for decommissioning industrial and commercial plastic ductwork systems

Assessment criteria

The learner can:

- 7.1 explain the conditions that determine the safe decommissioning of a plastic ductwork system
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning plastic ductwork system components and ductwork, including requirements complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal shut off mechanisms for plastic ductwork systems do not operate.

Unit 318 Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques

Outcome 8 Understand procedures for commissioning industrial and commercial plastic ductwork systems

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of plastic ductwork systems including:
 - supply
 - extract
 - low, medium and high pressure/velocity air
- 8.2 specify the procedures for establishing correct mechanical and control performance for the following:
 - small air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - fan coil units
 - variable air volume units
 - regulating/ motorised dampers
 - fire dampers
- 8.3 evaluate the procedures for commissioning plastic ductwork systems and components in accordance with project specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 318 Understand industrial and commercial plastic ductwork installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial plastic ductwork systems

Assessment criteria

The learner can:

- 9.1 interpret information on plastic ductwork system component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 9.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.3 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 describe the work actions and sequences for diagnosing faults in system components in accordance with industry specifications including:
 - small air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 9.5 demonstrate how to isolate components including:
 - small air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 9.6 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.7 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients:
 - small air handling units
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers.

Unit 319

Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Level: 3

Credit value: 4

UAN number: M/502/8203

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial fire rated ductwork systems
2. Understand the legislative and organisational procedures related to all industrial and commercial fire rated ductwork systems work activities
3. Understand how to complete preparation work for industrial and commercial fire rated ductwork installation activities
4. Understand the procedures for identifying industrial and commercial fire rated ductwork equipment and components
5. Understand how to install industrial and commercial fire rated ductwork systems
6. Understand procedures for the soundness testing of industrial and commercial fire rated ductwork systems
7. Understand procedures for decommissioning industrial and commercial fire rated ductwork systems
8. Understand procedures for commissioning industrial and commercial fire rated ductwork systems
9. Understand procedures for identifying faults on industrial and commercial fire rated ductwork systems

Guided learning hours

It is recommended that **28** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 319 Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial fire rated ductwork systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles for supply and extract fire rated ductwork systems in:
 - car parks
 - stair wells
 - other fire protected areas
- 1.2 specify the working principles of the following fire rated ductwork components:
 - flexible ducts
 - air handling units
 - fans, axial and centrifugal
 - attenuator
 - regulating/ motorised dampers
 - fire dampers
 - access doors
 - terminal units/grilles/diffusers
- 1.3 evaluate the options where the installation requirements are not compatible with the design specification
- 1.4 interpret the ductwork system layout requirements for systems and components including:
systems:
 - supply
 - extractcomponents:
 - flexible ducts
 - air handling units
 - fans, axial and centrifugal
 - attenuator
 - regulating/ motorised dampers
 - fire dampers
 - access doors
 - terminal units/grilles/diffusersin accordance with industry specifications and regulations
- 1.5 justify the positioning of selected components in fire rated ductwork systems.

Unit 319 Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial fire rated ductwork systems work activities

Assessment criteria

The learner can:

- 2.1 interpret and apply appropriate sources of health and safety information as they relate to the:
- installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning
- of fire rated ductwork systems
- 2.2 interpret and apply codes of practice, and industry recommendations appropriate to the:
- installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning
- of fire rated ductwork systems
- 2.3 specify the actions that should be taken to liaise with other persons during the:
- installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning
- of fire rated ductwork systems
- 2.4 state appropriate persons whom it may be necessary to advise before a fire rated ductwork system is isolated in order to undertake work
- 2.5 define the actions that should be taken to liaise with other persons during the:
- installation
 - testing
 - commissioning
 - fault diagnosis
 - decommissioning
- of fire rated ductwork systems
- 2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 319 **Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial fire rated ductwork installation activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections required in the work location to determine preparation requirements to:
 - install
 - test
 - commission
 - decommission
 - identify faultson fire rated ductwork systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 calculate from drawings and specifications the materials and fittings required to complete work on fire rated ductwork systems.

Unit 319 Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Outcome 4 Understand the procedures for identifying industrial and commercial fire rated ductwork equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific fire rated ductwork installation requirements
- 4.2 interpret and apply appropriate sources of information when determining fire rated ductwork installation requirements including:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate the installation requirements against drawings and specifications to determine compatibility
- 4.4 summarise the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to fire rated ductwork systems.

Unit 319 **Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial fire rated ductwork systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of fire rated ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 319 **Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques**

Outcome 6 Understand procedures for the soundness testing of industrial and commercial fire rated ductwork systems

Assessment criteria

The learner can:

- 6.1 interpret and apply information for the soundness testing of fire rated ductwork systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of fire rated ductwork systems to confirm that they are ready to receive soundness tests to cover:
 - ductwork
 - appliances
 - components
- 6.3 interpret test records to confirm compliance with specifications
- 6.4 state the actions that must be taken when testing reveals leakage from fire rated ductwork systems.

Unit 319 Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Outcome 7 Understand procedures for decommissioning industrial and commercial fire rated ductwork systems

Assessment criteria

The learner can:

- 7.1 confirm that the status of the system will permit safe decommissioning of a fire rated ductwork system
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning fire rated ductwork system components and ductwork, including requirements complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 7.5 define the action to take when normal shut off mechanisms for fire rated ductwork systems do not operate.

Unit 319 Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Outcome 8 Understand procedures for commissioning industrial and commercial fire rated ductwork systems

Assessment criteria

The learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of fire rated ductwork systems including:
 - supply
 - extract
- 8.2 specify the procedures for establishing correct mechanical and control performance for the following:
 - small air handling units
 - fans, axial and centrifugal
 - regulating/ motorised dampers
 - fire dampers
- 8.3 evaluate the procedures for commissioning fire rated ductwork systems and components in accordance with project specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 319 Understand industrial and commercial fire rated ductwork installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial fire rated ductwork systems

Assessment criteria

The learner can:

- 9.1 interpret information on fire rated ductwork system component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 9.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.3 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 describe the work actions and sequences for diagnosing faults in system components in accordance with industry specifications including:
 - small air handling units
 - fans, axial and centrifugal
 - regulating/ motorised dampers
 - fire dampers
- 9.5 demonstrate how to isolate components including:
 - small air handling units
 - fans, axial and centrifugal
 - regulating/ motorised dampers
 - fire dampers
- 9.6 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.7 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients:
 - small air handling units
 - fans, axial and centrifugal
 - regulating/ motorised dampers
 - fire dampers.

Unit 320

Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques

Level: 3

Credit value: 4

UAN number: M/502/8203

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial local exhaust ventilation systems
2. Understand the legislative and organisational procedures related to all industrial and commercial local exhaust ventilation work activities
3. Understand how to complete preparation work for industrial and commercial local exhaust ventilation system installation activities
4. Understand the procedures for identifying industrial and commercial local exhaust ventilation systems equipment and components
5. Understand how to install industrial and commercial local exhaust ventilation systems
6. Understand procedures for the testing of industrial and commercial local exhaust ventilation systems
7. Understand procedures for decommissioning industrial and commercial local exhaust ventilation systems
8. Understand procedures for commissioning industrial and commercial local exhaust ventilation systems
9. Understand procedures for identifying faults on industrial and commercial local exhaust ventilation systems

Guided learning hours

It is recommended that **28** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 320 Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial local exhaust ventilation systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles for ductwork systems serving fume and dust extraction applications
- 1.2 specify the working principles of the following local exhaust ventilation system components:
 - rectangular and circular ductwork components including flexible ducts
 - manufacturer's units
 - laboratory fume cupboards
 - ventilated hoods, enclosures and work stations
 - storage cabinets
- 1.3 evaluate the options where the installation requirements are not compatible with the design specification
- 1.4 interpret the ductwork layout requirements for systems serving fume and dust extraction applications including the following components:
 - rectangular ductwork components including flexible ducts
 - air handling units
 - fans, axial and centrifugal
 - attenuator
 - filters
 - variable air volume units
 - regulating/ motorised/ blast gate dampers
 - fire dampers
 - plenum boxes
 - access doors
 - grillesin accordance with industry specifications and regulations
- 1.5 justify the positioning of selected components in local exhaust ventilation systems.

Unit 320 Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial local exhaust ventilation work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of local exhaust ventilation systems

2.2 interpret and apply codes of practice, and industry recommendations appropriate to the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of local exhaust ventilation systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of local exhaust ventilation systems

2.4 state appropriate persons whom it may be necessary to advise before a local exhaust ventilation system is isolated in order to undertake work

2.5 define the actions that should be taken to liaise with other persons during the:

- installation
- testing
- commissioning
- fault diagnosis
- decommissioning

of local exhaust ventilation systems

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 320 **Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial local exhaust ventilation system installation activities

Assessment criteria

The learner can:

3.1 describe the visual inspections required in the work location to determine preparation requirements to:

- install
- test
- commission
- decommission
- identify faults

on local exhaust ventilation systems

3.2 evaluate the work location to determine planning requirements

3.3 calculate, from drawings and specifications, the materials, fittings and components required to complete work on local exhaust ventilation systems.

Unit 320 **Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques**

Outcome 4 Understand the procedures for identifying industrial and commercial local exhaust ventilation systems equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate site drawings, plans and the work location to determine specific extraction unit installation requirements
- 4.2 interpret and apply appropriate sources of information when determining extraction installation requirements including:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate the installation requirements against drawings and specifications to determine compatibility
- 4.4 summarise the range of environmentally friendly materials, products, procedures and energy efficiency devices applicable to local exhaust ventilation systems.

Unit 320 **Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques**

Outcome 5 Understand how to install industrial and commercial local exhaust ventilation systems

Assessment criteria

The learner can:

- 5.1 specify methodologies to measure and record site details for installation purposes
- 5.2 interpret and apply information for the installation of local exhaust ventilation systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 320 **Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques**

Outcome 6 Understand procedures for the testing of industrial and commercial local exhaust ventilation systems

Assessment criteria

the learner can:

- 6.1 interpret and apply information for the testing of local exhaust ventilation systems from:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 6.2 identify the requirements of local exhaust ventilation systems to confirm that they are ready to receive tests to cover:
 - fans
 - appliances
 - components
- 6.3 interpret test records to confirm compliance with specifications.

Unit 320 **Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques**

Outcome 7 Understand procedures for decommissioning industrial and commercial local exhaust ventilation systems

Assessment criteria

The learner can:

- 7.1 confirm that the status of the system will permit safe decommissioning of a local exhaust ventilation system
- 7.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 7.3 clarify that work sequences for decommissioning local exhaust ventilation systems and components complies with method statements
- 7.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems including contaminated components
- 7.5 define the action to take when normal shut off mechanisms for local exhaust ventilation systems do not operate.

Unit 320 **Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques**

Outcome 8 Understand procedures for commissioning industrial and commercial local exhaust ventilation systems

Assessment criteria

the learner can:

- 8.1 interpret and apply appropriate sources of information on the performance of local exhaust ventilation systems including ductwork systems serving fume and dust extraction applications
- 8.2 specify the procedures for establishing correct mechanical and control performance for ductwork systems serving fume and dust extraction applications, including the following components:
 - rectangular and circular ductwork components including flexible ducts
 - manufacturer's units
 - laboratory fume cupboards
 - ventilated hoods, enclosures and work stations
 - storage cabinets
- 8.3 explain the procedures for commissioning systems and components in accordance with industry specifications
- 8.4 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 8.5 state the information that would be required to complete commissioning documentation
- 8.6 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 320 Understand industrial and commercial local exhaust ventilation systems installation and pre-commissioning techniques

Outcome 9 Understand procedures for identifying faults on industrial and commercial local exhaust ventilation systems

Assessment criteria

The learner can:

- 9.1 interpret information on local exhaust ventilation system and component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 9.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:
 - customers
 - other site workers
 - site visitors
- 9.3 clarify the points in the fault diagnosis process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 describe the work actions and sequences for diagnosing faults in systems and components in accordance with industry specifications including:
 - rectangular and circular or flat oval ductwork components including flexible ducts
 - manufacturer's units
 - laboratory fume cupboards
 - ventilated hoods, enclosures and work stations
 - storage cabinets
- 9.5 demonstrate how to isolate components including:
 - rectangular and circular or flat oval ductwork components including flexible ducts
 - manufacturer's units
 - laboratory fume cupboards
 - ventilated hoods, enclosures and work stations
 - storage cabinets
- 9.6 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 9.7 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients:
 - rectangular and circular or flat oval ductwork components including flexible ducts
 - manufacturer's units
 - laboratory fume cupboards
 - ventilated hoods, enclosures and work stations
 - storage cabinets.

Unit 321

Install and pre-commission industrial and commercial ductwork systems

Level: 3

Credit value: 4

UAN number: H/502/8229

Learning outcomes

There are **six** learning outcomes to this unit. The learner will

1. Be able to complete preparation work for industrial and commercial rectangular, circular or flat oval ductwork systems
2. Be able to identify industrial and commercial rectangular, circular or flat oval ductwork systems, equipment and components
3. Be able to install industrial and commercial rectangular, circular or flat oval ductwork systems
4. Be able to complete soundness tests on industrial and commercial rectangular, circular or flat oval ductwork systems
5. Be able to complete commissioning of industrial and commercial rectangular, circular or flat oval ductwork systems
6. Be able to complete fault identification on industrial and commercial rectangular, circular or flat oval ductwork systems, equipment and components

Guided learning hours

It is recommended that **4** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 321 **Install and pre-commission industrial and commercial ductwork systems**

Outcome 1 Be able to complete preparation work for industrial and commercial rectangular, circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 1.1 assess the work location and report factors that will impact on the work to other persons from one of the following:
 - line manager
 - clients/customer
- 1.2 confirm that job information and documentation for the installation of the following rectangular, circular or flat oval ductwork systems is available and appropriate, including one from:
 - supply
 - extract
 - kitchen extractas well as:
 - medium and high pressure/velocity air systems
 - job information and documentation including:
 - regulations
 - industry standards
 - industry guides/good practice guides
- 1.3 select and use job information and documentation to ensure that the following is fit for purpose:
 - equipment
 - tools
- 1.4 confirm the points in the work process where liaison with other persons will be required for one from:
 - customers/clients
 - line manager
- 1.5 confirm that job information on key aspects of the work has been issued to relevant people including user instructions or manufacturer's instructions
- 1.6 demonstrate that authorisation has been obtained from the relevant person(s) prior to commencement of the work, from at least one of the following:
 - customers/clients
 - line manager
- 1.7 identify any pre work damage or defects to existing equipment or building features should it exist, and report to the line manager
- 1.8 demonstrate that suitable personal protective equipment has been worn throughout the duration of work preparation activities

1.9 verify that the materials needed to complete the job are free from damage and report any defects to a line manager:

From materials for rectangular, circular and flat oval ductwork which include and any one from:

- stainless steel
- galvanised steel
- aluminium

1.10 complete preparatory work for the installation of rectangular, circular or flat oval ductwork systems to include:

- completion of risk assessments
- completion of method statements.

Unit 321 **Install and pre-commission industrial and commercial ductwork systems**

Outcome 2 Be able to identify industrial and commercial rectangular, circular or flat oval ductwork systems, equipment and components

Assessment criteria

The learner can:

- 2.1 verify that site drawings, plans and the work location is in accordance with the specific installation requirements for rectangular, circular or flat oval ductwork systems
- 2.2 confirm that job specification for proposed rectangular, circular or flat oval ductwork installation complies with:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications.

Unit 321

Install and pre-commission industrial and commercial ductwork systems

Outcome 3

Be able to install industrial and commercial rectangular, circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 3.1 verify that job information appropriate to the installation process is available and conforms with industry specifications
- 3.2 verify that materials, tools and equipment necessary for the installation of rectangular, circular or flat oval ductwork systems are:
 - available as required
 - safely and securely stored
 - meet industry requirements
 - fit for intended purpose
- 3.3 inspect and confirm that all aspects of the installation process conforms with industry requirements, including:
 - codes of practice
 - industry standards
 - industry guides/good practice guides
- 3.4 verify that methods of working ensures that any damage to customer/client property and building features is avoided during work activities
- 3.5 report problems which may affect the progress of the installation to one of the following:
 - customers/clients
 - line manager.

Unit 321 **Install and pre-commission industrial and commercial ductwork systems**

Outcome 4 Be able to complete soundness tests on industrial and commercial rectangular, circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 4.1 confirm through visual inspections that rectangular, circular or flat oval supply systems conform with industry specifications
- 4.2 confirm that the ductwork system is ready to receive soundness tests
- 4.3 verify that a soundness test to a rectangular, circular or flat oval supply conforms with industry standards, guides and good practice guides:
- 4.4 complete and evaluate test sheet documentation in accordance with appropriate industry specifications/guides
- 4.5 report any system defects to one of the following:
 - customers/clients
 - line manager
- 4.6 implement checks to confirm:
 - system cleanliness
 - un-commissioned systems and components cannot be activated.

Unit 321

Install and pre-commission industrial and commercial ductwork systems

Outcome 5

Be able to complete commissioning of industrial and commercial rectangular, circular or flat oval ductwork systems

Assessment criteria

The learner can:

- 5.1 verify the availability of the relevant industry specifications and guidelines on the performance of rectangular, circular or flat oval ductwork systems including one from:
 - supply
 - extract
 - kitchen extractas well as:
 - medium and high pressure/velocity air
- 5.2 confirm that liaison has taken place during the commissioning process in order to minimise disturbance to work routines including liaison with one of the following:
 - customers/clients
 - other site workers
 - line manager
- 5.3 conduct mechanical and control performance checks and adjustments in accordance with industry specifications for the following:
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
- 5.4 confirm that appropriate system information is available to the line manager or the end user.

Unit 321

Install and pre-commission industrial and commercial ductwork systems

Outcome 6

Be able to complete fault identification on industrial and commercial rectangular, circular or flat oval ductwork systems, equipment and components

Assessment criteria

The learner can:

1. obtain specific information on rectangular, circular or flat oval ductwork system component faults from:
 - verbal confirmation
 - visual inspections
 - mechanical tests
2. confirm that the relevant persons have been advised of fault diagnosis and rectification activities that can cause potential disruption, including one of the following:
 - customers/clients
 - other site workers
 - line manager
3. implement procedures for diagnosing faults in system components in accordance with industry specifications including:
 - fans, axial and centrifugal
 - heater / filter / cooler batteries
 - regulating/ motorised dampers
 - fire dampers
4. confirm that procedures for reporting diagnosed faults in systems and components have been carried out in accordance with industry specifications.

Unit 322

Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Level: 3

Credit value: 8

UAN number: D/502/8231

Learning outcomes

There are **eleven** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial hot and cold water systems
2. Understand the legislative and organisational procedures related to all industrial and commercial hot and cold water systems work activities
3. Understand how to complete preparation work for industrial and commercial hot and cold water system maintenance activities
4. Understand the procedures for identifying industrial and commercial hot and cold water systems, equipment and components
5. Understand the service requirements for industrial and commercial hot and cold water systems, equipment and components
6. Understand the maintenance requirements for industrial and commercial hot and cold water systems, equipment and components
7. Understand procedures for soundness testing of industrial and commercial hot and cold water systems
8. Understand procedures for decommissioning industrial and commercial hot and cold water systems
9. Understand procedures for commissioning industrial and commercial hot cold water systems
10. Understand procedures for identifying faults on industrial and commercial hot and cold water systems
11. Understand procedures for rectifying faults on industrial and commercial hot and cold water systems

Guided learning hours

It is recommended that **65** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial hot and cold water systems

Assessment criteria

The learner can:

1.1 specify the operating and working principles of hot and cold water systems including:

- cold water:
 - storage (indirect)
 - non-storage (direct)
 - boosted
 - high rise building systems
- hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)

and including (relevant to hot or cold water applications):

- connections from mains to premises
- pipe sizes for all installation pipework
- cold water storage cistern capacities
- connection to cold water services
- hot water storage vessel capacities
- factors to determine system selection
- key regulations relevant to the installation

1.2 define the operating principles of different appliance types that are connected to hot and cold water systems, including:

- sanitary appliances
- industrial and commercial appliances
- appliances specific to industrial and commercial premises
- compliance with building and water regulations

1.3 specify the working principles of all hot and cold water system components including:

- storage cisterns
- F and E cisterns
- hot water storage vessels including high to low temperature calorifiers
- electric and gas water heaters
- appliance control valve or tap, terminal fittings
- stop valves
- float operated valves

- single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
 - circulating pumps (bronze)
 - booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 1.4 determine pipe sizing requirements in relation to demand units for hot and cold water systems, including:
- cold water:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- 1.5 confirm the layout requirements for hot and cold water systems and components including:
- cold water:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- 1.6 justify the positioning of selected components in hot and cold water systems.

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial hot and cold water systems work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of hot and cold water systems

2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of hot and cold water systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of hot and cold water systems

2.4 state appropriate persons whom it may be necessary to advise before a hot or cold water system is isolated in order to undertake work

2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 322 **Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial hot and cold water system maintenance activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
- maintain
 - test
 - commission
 - diagnose faults
 - rectify faults
 - de-commission
- hot and cold water systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection materials and fittings required to complete work on hot and cold water systems and check them for damage.

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 4 Understand the procedures for identifying industrial and commercial hot and cold water systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate specifications and the work location to determine specific hot and cold water maintenance requirements
- 4.2 evaluate possible maintenance proposals to determine how well they meet industry requirements
- 4.3 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.4 demonstrate methods for determining the capacity and specification of components to be used within hot and cold water systems including:
 - cold water
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger).

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 5 Understand the service requirements for industrial and commercial hot and cold water systems, equipment and components

Assessment criteria

The learner can:

- 5.1 define the information relevant to the routine and non-routine maintenance of hot and cold water systems
- 5.2 propose a method statement for planning routine and non-routine maintenance work to include:
 - provision for minimising disruption to system operation
 - confirmation that materials, tools and equipment will be available as required
 - confirmation that maintenance activities comply with industry requirements
- 5.3 identify the key points within the routine and non-routine maintenance activities where liaison is required to minimise disruption to work routines including one from:
 - customer/clients
 - other site workers
 - line manager
- 5.4 identify the routine and non-routine maintenance procedures that comply with industry specifications and manufacturer's instructions, including:
 - cold water systems:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - components:
 - storage cisterns
 - F and E cisterns
 - hot water storage vessels
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - pressure reducing valves

- gate valves
- RPZ valves
- servicing valves
- drain taps
- shower mixer valves
- blending valves
- circulating pumps (bronze)
- booster pumps
- line strainer
- temperature and pressure relief valve
- expansion vessels

5.5 define the work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of the systems for the following components:

- storage cisterns
- F and E cisterns
- hot water storage vessels
- electric and gas water heaters
- appliance control valve or tap, terminal fittings
- stop valves
- float operated valves
- single and double check valves
- pressure reducing valves
- gate valves
- RPZ valves
- servicing valves
- drain taps
- shower mixer valves
- blending valves
- circulating pumps (bronze)
- booster pumps
- line strainer
- temperature and pressure relief valve
- expansion vessels

5.6 identify methods of ensuring that maintenance records have been completed accurately

5.7 propose what action to take when a system or component does not meet the performance specification.

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 6 Understand the maintenance requirements for industrial and commercial hot and cold water systems, equipment and components

Assessment criteria

The learner can:

6.1 identify the routine and non-routine maintenance procedures required to restore or maintain system performance in accordance with industry specifications, for the following systems:

- cold water:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
- hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)

6.2 define the specific tests required to complete the maintenance of systems including:

- hydrostatic pressure tests
- dynamic tests
- heat input
- efficiency

6.3 define the relative operating principles of gas, oil and solid fuel boilers

6.4 state the purpose and function of the following components in relation to hot and cold water systems:

- storage cisterns
- F and E cisterns
- hot water storage vessels
- electric and gas water heaters
- appliance control valve or tap, terminal fittings
- stop valves
- float operated valves
- single and double check valves
- pressure reducing valves
- gate valves
- RPZ valves
- servicing valves
- drain taps
- shower mixer valves
- blending valves
- circulating pumps (bronze)
- booster pumps

- line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 6.5 state the requirements for hot and cold water systems in terms of:
- safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion, erosion and acidity
 - methods of locating defects caused by corrosion, erosion and acidity
 - colour coding for identification of pipework
- 6.6 state the requirements for completing records or reports for system maintenance activities
- 6.7 state the actions to take should a system or component fail to operate to specification.

Unit 322 **Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques**

Outcome 7 Understand procedures for soundness testing of industrial and commercial hot and cold water systems

Assessment criteria

The learner can:

- 7.1 identify the requirements for hot and cold water systems to confirm that they are ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 7.2 specify procedures for flushing and charging:
 - a boosted or high rise building cold water system, and
 - an unvented hot water system
- 7.3 justify that input services adequately meet the hot and cold water system requirements
- 7.4 state the procedure for carrying out a soundness test on all hot and cold water systems
- 7.5 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 322 **Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques**

Outcome 8 Understand procedures for decommissioning industrial and commercial hot and cold water systems

Assessment criteria

The learner can:

- 8.1 confirm that the status of the system will permit safe decommissioning
- 8.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 8.3 clarify that work sequences for decommissioning hot and cold water system components and pipework, including requirements for earth bonding, complies with method statements
- 8.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 8.5 define the action to take when normal emptying or shut off mechanisms for hot and cold water systems do not operate.

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 9 Understand procedures for commissioning industrial and commercial hot cold water systems

Assessment criteria

The learner can:

9.1 specify the procedures for establishing correct mechanical control performance for the following:

- cold water systems:
 - boosted
 - high rise building systems
- hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- components:
 - storage cisterns
 - F and E cisterns
 - hot water storage vessels
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
 - circulating pumps (bronze)
 - booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels

9.2 evaluate the procedures for commissioning hot and cold water systems and components in accordance with maintenance specifications

9.3 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required

- 9.4 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components.
- 9.5 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 10 Understand procedures for identifying faults on industrial and commercial hot and cold water systems

Assessment criteria

The learner can:

10.1 interpret information on hot and cold water system component faults from:

- advice from users
- visual inspections or tests
- diagnostic tests

10.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:

- customers
- other site workers
- site visitors

10.3 describe the work actions and sequences for diagnosing faults in systems and components

10.4 demonstrate how to isolate systems and components including:

- cold water:
 - storage (indirect)
 - non-storage (direct)
 - boosted
 - high rise building systems
- hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- components:
 - storage cisterns
 - F and E cisterns
 - hot water storage vessels
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves

- blending valves
 - circulating pumps (bronze)
 - booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 10.5 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 10.6 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients
- 10.7 specify the procedures for identifying component faults in hot and cold water systems including:
- cold water:
 - storage (indirect)
 - non-storage (direct)
 - boosted
 - high rise building systems
 - hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - components:
 - storage cisterns
 - F and E cisterns
 - hot water storage vessels
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
 - circulating pumps (bronze)
 - booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 10.8 evaluate the effects of common component faults upon overall hot and cold water system performance, for systems which include:
- cold water:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems

- hot water:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger).

Unit 322 Understand industrial and commercial hot and cold water system maintenance and fault diagnosis techniques

Outcome 11 Understand procedures for rectifying faults on industrial and commercial hot and cold water systems

Assessment criteria

The learner can:

- 11.1 propose a method statement for rectifying faults on hot and cold water systems including:
- recommended industry work procedures
 - minimising risks to individuals and the environment
 - liaison with customer
 - use of documentation
 - methods of emptying systems
- 11.2 identify the procedures for isolating mains supplies to components in accordance with industry recommendations for:
- gas
 - oil
 - water services
- 11.3 evaluate technical performance of replacement components against manufacturer or industry specifications
- 11.4 define the procedures for carrying out the replacement of faulty components in accordance with industry specifications including:
- methods of installing and fixing replacement components
 - implications of incorrect fixing
- 11.5 identify methods of ensuring that overall system performance is not affected following rectification work.

Unit 323

Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Level: 3

Credit value: 8

UAN number: F/502/8190

Learning outcomes

There are **eleven** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial hot water heating systems
2. Understand the legislative and organisational procedures related to all industrial and commercial hot water heating system work activities
3. Understand how to complete preparation work for industrial and commercial hot water heating system maintenance activities
4. Understand the procedures for identifying industrial and commercial hot water heating systems, equipment and components
5. Understand the service requirements for industrial and commercial hot water heating systems, equipment and components
6. Understand the maintenance requirements for industrial and commercial hot water heating systems, equipment and components
7. Understand procedures for soundness testing of industrial and commercial hot water heating systems
8. Understand procedures for decommissioning industrial and commercial hot water heating systems
9. Understand procedures for commissioning industrial and commercial hot water heating systems
10. Understand procedures for identifying faults on industrial and commercial hot water heating systems
11. Understand procedures for rectifying faults on industrial and commercial hot water heating systems

Guided learning hours

It is recommended that **65** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles of hot water heating systems including:
 - low temperature hot water heating
 - medium temperature hot water heating
 - factors to determine system selection
 - key regulations relevant to the installation
- 1.2 define the operating principles of different appliance types that are connected to hot water heating systems, including:
 - boilers, fired by solid fuel, gas or oil including:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - compliance with building and water regulations
- 1.3 specify the working principles of all hot water heating system components including:
 - low temperature hot water heating
 - medium temperature hot water heating
- 1.4 identify the pipe sizing requirements in relation to heat demand for hot water heating systems, including:
 - low temperature hot water heating
 - medium temperature hot water heating
- 1.5 confirm the layout requirements for hot water heating systems and components including:
 - low temperature hot water heating
 - medium temperature hot water heating
- 1.6 justify the positioning of selected components in hot water heating systems.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial hot water heating system work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of hot water heating systems

2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of hot water heating systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of hot water heating systems

2.4 state appropriate persons whom it may be necessary to advise before a hot water heating system is isolated in order to undertake work

2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components

2.6 explain how to isolate the installation in order to prevent the inadvertent operation of the installed system during work activities.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 3 Understand how to complete preparation work for industrial and commercial hot water heating system maintenance activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
- maintain
 - test
 - commission
 - diagnose faults
 - rectify faults
 - de-commission
- hot water heating systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection of materials and fittings required to complete work on hot water heating systems and check them for damage.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 4 Understand the procedures for identifying industrial and commercial hot water heating systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate specifications and the work location to determine specific hot water heating maintenance requirements
- 4.2 evaluate possible maintenance proposals to determine how well they meet industry requirements
- 4.3 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.4 demonstrate methods for determining the capacity and specification of components to be used within hot water heating systems including:
 - low temperature hot water heating
 - medium temperature hot water heating.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 5 Understand the service requirements for industrial and commercial hot water heating systems, equipment and components

Assessment criteria

The learner can:

- 5.1 define the information relevant to the routine and non-routine maintenance of hot water heating systems
- 5.2 propose a method statement for planning routine and non-routine maintenance work to include:
 - provision for minimising disruption to system operation
 - confirmation that materials, tools and equipment will be available as required
 - confirmation that maintenance activities comply with industry requirements
- 5.3 identify the key points within the routine and non-routine maintenance activities where liaison is required to minimise disruption to work routines including one from:
 - customer/clients
 - other site workers
 - line manager
- 5.4 identify the routine and non-routine maintenance procedures that comply with industry specifications and manufacturer's instructions, including:
 - systems:
 - low temperature hot water
 - medium temperature hot water
 - key regulations relevant to the installation
 - boilers, fired by solid fuel, gas or oil including:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - compliance with building and water regulations
 - components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves

- pumps or accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 5.5 define the work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of the systems for the following components:
- hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 5.6 identify methods of ensuring that maintenance records have been completed accurately
- 5.7 propose what action to take when a system or component does not meet the performance specification.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 6 Understand the maintenance requirements for industrial and commercial hot water heating systems, equipment and components

Assessment criteria

The learner can:

- 6.1 identify the routine and non-routine maintenance procedures required to restore or maintain system performance in accordance with industry specifications, for the following systems:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - compliance with building and water regulations
- 6.2 define the specific tests required to complete the routine maintenance of systems including:
 - hydrostatic pressure tests
 - dynamic tests
 - heat input
 - efficiency
- 6.3 define the relative operating principles of gas, oil and solid fuel boilers
- 6.4 state the purpose and function of the following components in relation to hot water heating systems:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 6.5 state the requirements for hot water heating systems in terms of:
 - safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion, erosion and acidity
 - methods of locating defects caused by corrosion, erosion and acidity
 - colour coding for identification of pipework

- 6.6 state the requirements for completing records or reports for system maintenance activities
- 6.7 state the actions to take should a system or component fail to operate to specification.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 7 Understand procedures for soundness testing of industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 7.1 identify the requirements of hot water heating systems to confirm that they are ready to receive soundness tests to cover:
 - pipework
 - appliances
 - components
- 7.2 specify procedures for flushing and charging all hot water heating systems
- 7.3 justify that input services adequately meet hot water heating system requirements
- 7.4 state the procedure for carrying out a soundness test on all types of hot water heating systems
- 7.5 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 8 Understand procedures for decommissioning industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 8.1 confirm that the status of the system will permit safe decommissioning
- 8.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 8.3 clarify that work sequences for decommissioning hot water heating system components and pipework, including requirements that earth bonding complies with method statements
- 8.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 8.5 define the action to take when normal emptying or shut off mechanisms for hot water heating systems do not operate.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 9 Understand procedures for commissioning industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 9.1 specify the procedures for establishing correct mechanical control performance for the following:
- systems:
 - low temperature hot water heating
 - medium temperature hot water heating
 - appliances – boilers, fired by solid fuel, gas or oil:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 9.2 evaluate the procedures for commissioning hot water heating systems and components in accordance with maintenance specification
- 9.3 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 9.5 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 10 Understand procedures for identifying faults on industrial and commercial hot water heating systems

Assessment criteria

The learner can:

10.1 interpret information on hot water heating system component faults from:

- advice from users
- visual inspections or tests
- diagnostic tests

10.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:

- customers
- other site workers
- site visitors

10.3 describe the work actions and sequences for diagnosing faults in systems and components

10.4 demonstrate how to isolate systems and components including:

- systems:
 - low temperature hot water heating
 - medium temperature hot water heating
- appliances – boilers, fired by solid fuel, gas or oil:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
- components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels

10.5 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance

10.6 describe the work actions and sequences for rectifying faults in systems or components which will ensure minimum disruption to customers/clients

10.7 specify the procedure for identifying component faults in hot water heating systems including:

- systems:
 - low temperature hot water heating
 - medium temperature hot water heating
- appliances – boilers, fired by solid fuel, gas or oil:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
- components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels

10.8 evaluate the effects of common component faults upon overall hot water heating system performance, for systems which include:

- low temperature hot water heating
- medium temperature hot water heating.

Unit 323 Understand industrial and commercial hot water heating system maintenance and fault diagnosis techniques

Outcome 11 Understand procedures for rectifying faults on industrial and commercial hot water heating systems

Assessment criteria

The learner can:

- 11.1 propose a method statement for rectifying faults on hot water heating systems including:
 - recommended industry work procedures
 - minimising risks to individuals and the environment
 - liaison with customer
 - use of documentation
 - methods of emptying systems
- 11.2 identify the procedures for isolating mains supplies to components in accordance with industry recommendations for:
 - gas
 - oil
 - water services
- 11.3 evaluate technical performance of replacement components against manufacturer or industry specifications
- 11.4 define the procedures for carrying out the replacement of faulty components in accordance with industry specifications including:
 - methods of installing and fixing replacement components
 - implications of incorrect fixing
- 11.5 identify methods of ensuring that overall system performance is not affected following rectification work.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Level: 3

Credit value: 7

UAN number: J/502/8191

Learning outcomes

There are **eleven** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial ventilation systems
2. Understand the legislative and organisational procedures related to all industrial and commercial ventilation systems work activities
3. Understand how to complete preparation work for industrial and commercial ventilation system maintenance activities
4. Understand the procedures for identifying industrial and commercial ventilation systems, equipment and components
5. Understand the service requirements for industrial and commercial ventilation systems, equipment and components
6. Understand the maintenance requirements for industrial and commercial ventilation systems, equipment and components
7. Understand procedures for soundness testing of industrial and commercial ventilation systems
8. Understand procedures for decommissioning industrial and commercial ventilation systems
9. Understand procedures for commissioning industrial and commercial ventilation systems
10. Understand procedures for identifying faults on industrial and commercial ventilation systems
11. Understand procedures for rectifying faults on industrial and commercial ventilation systems

Guided learning hours

It is recommended that **61** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 324 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial ventilation systems

Assessment criteria

The learner can:

- 1.1 specify the operating and working principles of ventilation systems including:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - key regulations relevant to the installationand including (relevant to ventilation system applications):
 - connections to and from ductwork
 - connections to appliances and components
 - factors to determine system selection
 - key regulations relevant to the installation
- 1.2 define the operating principles of different component types that are connected to ventilation systems, including:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
- 1.3 specify the working principles of all ventilation system components including:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies

- air to water heat exchangers
- air to gas heat exchangers
- air to refrigerant heat exchangers

1.4 confirm the layout requirements for ventilation systems and components including:

- systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
- components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers

1.5 justify the positioning of selected components in ventilation systems.

Unit 324 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial ventilation systems work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of ventilation systems

2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of ventilation systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of ventilation systems

2.4 state appropriate persons whom it may be necessary to advise before a ventilation system is isolated in order to undertake work

2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 324 **Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques**

Outcome 3 Understand how to complete preparation work for industrial and commercial ventilation system maintenance activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
- maintain
 - test
 - commission
 - diagnose faults
 - rectify faults
 - de-commission
- ventilation systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection of materials and fittings required to complete work on ventilation systems and check them for damage.

Unit 324 **Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques**

Outcome 4 Understand the procedures for identifying industrial and commercial ventilation systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate specifications and the work location to determine specific ventilation maintenance requirements
- 4.2 evaluate possible maintenance proposals to determine how well they meet industry requirements
- 4.3 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.4 demonstrate methods for determining the capacity and specification of components to be used in ventilation systems including:
 - tempered warm air supply
 - supply
 - extract
 - balanced.

Unit 324 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 5 Understand the service requirements for industrial and commercial ventilation systems, equipment and components

Assessment criteria

The learner can:

- 5.1 define the information relevant to the routine and non-routine maintenance of ventilation systems
- 5.2 propose a method statement for planning routine and non-routine maintenance work to include:
 - provision for minimising disruption to system operation
 - confirmation that materials, tools and equipment will be available as required
 - confirmation that maintenance activities comply with industry requirements
 - provision for system cleaning
- 5.3 identify the key points within the routine and non-routine maintenance activities where liaison is required to minimise disruption to work routines including one from:
 - customer/clients
 - other site workers
 - line manager
- 5.4 identify the routine and non-routine maintenance procedures that comply with industry specifications and manufacturer's instructions, including:
 - systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers

- air to refrigerant heat exchangers

- 5.5 define the work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of the systems for the following components:
- filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers
- 5.6 identify methods of ensuring that maintenance records have been completed accurately
- 5.7 propose what action to take when a system or component does not meet the performance specification.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 6

Understand the maintenance requirements for industrial and commercial ventilation systems, equipment and components

Assessment criteria

The learner can:

- 6.1 identify the routine and non-routine maintenance procedures required to restore or maintain system performance in accordance with industry specifications, for the following systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
- 6.2 define the specific tests required to complete the routine maintenance of systems including:
 - air tightness
 - dynamic
 - efficiency
- 6.3 state the purpose and function of the following components in relation to ventilation systems:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers
- 6.4 state the requirements for ventilation systems in terms of:
 - safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion and erosion
 - methods of locating defects caused by corrosion and erosion
 - colour coding for identification of ductwork
 - system cleaning
- 6.5 state the requirements for completing records or reports for system maintenance activities

6.6 state the actions to take should a system or component fail to operate to specification.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 7

Understand procedures for soundness testing of industrial and commercial ventilation systems

Assessment criteria

The learner can:

- 7.1 identify the requirements for ventilation systems to confirm that they are ready to receive soundness tests to cover:
 - ductwork
 - appliances
 - components
- 7.2 state the procedure for carrying out a soundness test on all ventilation systems
- 7.3 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 8

Understand procedures for decommissioning industrial and commercial ventilation systems

Assessment criteria

The learner can:

- 8.1 confirm that the status of the system will permit safe decommissioning
- 8.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 8.3 clarify that work sequences for decommissioning ventilation system components and ductwork, including requirements that earth bonding complies with method statements
- 8.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 8.5 define the action to take when normal shut off mechanisms for ventilation systems do not operate.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 9

Understand procedures for commissioning industrial and commercial ventilation systems

Assessment criteria

The learner can:

- 9.1 specify the procedures for establishing correct mechanical control performance for the following:
 - systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers
- 9.2 evaluate the procedures for commissioning ventilation systems and components in accordance with commissioning specifications
- 9.3 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required
- 9.4 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 9.5 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 10

Understand procedures for identifying faults on industrial and commercial ventilation systems

Assessment criteria

The learner can:

10.1 interpret information on ventilation system component faults from:

- advice from users
- visual inspections or tests
- diagnostic tests

10.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:

- customers
- other site workers
- site visitors

10.3 describe the work actions and sequences for diagnosing faults in systems and components

10.4 demonstrate how to isolate systems and components including:

- systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
- components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers

10.5 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance

10.6 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients

10.7 specify the procedures for identifying component faults in ventilation systems including:

- systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
- components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers

10.8 evaluate the effects of common component faults upon overall ventilation system performance, for systems which include:

- tempered warm air supply
- supply
- extract
- balanced.

Unit 324

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 11

Understand procedures for rectifying faults on industrial and commercial ventilation systems

Assessment criteria

The learner can:

- 11.1 propose a method statement for rectifying faults on ventilation systems including:
 - recommended industry work procedures
 - minimising risks to individual and the environment
 - liaison with customer
 - use of documentation
 - methods of emptying systems
- 11.2 evaluate technical performance of replacement components against manufacturer or industry specifications
- 11.3 define the procedures for carrying out the replacement of faulty components in accordance with industry specifications including:
 - methods of installing and fixing replacement components
 - implications of incorrect fixing
- 11.4 identify methods of ensuring that overall system performance is not affected following rectification work.

Unit 325

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Level: 3

Credit value: 7

UAN number: L/502/8192

Learning outcomes

There are **eleven** learning outcomes to this unit. The learner will

1. Understand the working principles and layouts of industrial and commercial air conditioning systems
2. Understand the legislative and organisational procedures related to all industrial and commercial air conditioning systems work activities
3. Understand how to complete preparation work for industrial and commercial air conditioning system maintenance activities
4. Understand the procedures for identifying industrial and commercial air conditioning systems, equipment and components
5. Understand the service requirements for industrial and commercial air conditioning systems, equipment and components
6. Understand the maintenance requirements for industrial and commercial air conditioning systems, equipment and components
7. Understand procedures for soundness testing of industrial and commercial air conditioning systems
8. Understand procedures for decommissioning industrial and commercial hot and cold water systems
9. Understand procedures for commissioning industrial and commercial air conditioning systems
10. Understand procedures for identifying faults on industrial and commercial air conditioning systems
11. Understand procedures for rectifying faults on industrial and commercial air conditioning systems

Guided learning hours

It is recommended that **61** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 325 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 1 Understand the working principles and layouts of industrial and commercial air conditioning systems

Assessment criteria

The learner can:

1.1 specify the operating and working principles of all air, air-water and refrigerant air conditioning systems including:

- central plant
- dual duct
- single duct
- variable air volume
- constant air volume
- split
- variable refrigerant flow
- chilled ceilings or passive chilled beams and displacement ventilation
- water loop heat pumps
- active chilled beam
- fan coil units

and including :

- connections to and from ductwork
- connections to appliances and components
- factors to determine system selection
- key regulations relevant to the installation

1.2 define the operating principles of different component types that are connected to air conditioning systems, including:

- filters
- fans
- humidifiers
- heater batteries
- cooling batteries
- air inlet grilles
- grilles
- dampers
- attenuators
- automatic controls
- time control for air conditioning systems
- energy management systems
- motorised dampers
- condensers
- cooling towers

- refrigeration units
- chillers

1.3 specify the working principles of all air conditioning system components including:

- filters
- fans
- humidifiers
- heater batteries
- cooling batteries
- air inlet grilles
- grilles
- dampers
- attenuators
- automatic controls
- time control for air conditioning systems
- energy management systems
- motorised dampers
- condensers
- cooling towers
- refrigeration units
- chillers

1.4 confirm the layout requirements for all air, air-water and refrigerant air conditioning systems including:

- central plant
- dual duct
- single duct
- variable air volume
- constant air volume
- split
- variable refrigerant flow
- chilled ceilings or passive chilled beams and displacement ventilation
- water loop heat pumps
- active chilled beam
- fan coil units

1.5 justify the positioning of selected components in air conditioning systems.

Unit 325 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 2 Understand the legislative and organisational procedures related to all industrial and commercial air conditioning systems work activities

Assessment criteria

The learner can:

2.1 interpret and apply appropriate sources of health and safety information as they relate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of air conditioning systems

2.2 interpret and apply regulations, codes of practice, and industry recommendations appropriate to the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of air conditioning systems

2.3 specify the actions that should be taken to liaise with other persons during the:

- maintenance
- testing
- commissioning
- fault diagnosis
- fault rectification
- decommissioning

of air conditioning systems

2.4 state appropriate persons whom it may be necessary to advise before an air conditioning system is isolated in order to undertake work

2.5 define the actions that should be taken upon completion of work procedures with regard to safe system shutdown and labelling of components

2.6 explain how to prevent the inadvertent operation of the installed system during work activities.

Unit 325

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 3

Understand how to complete preparation work for industrial and commercial air conditioning system maintenance activities

Assessment criteria

The learner can:

- 3.1 describe the visual inspections and tests required in the work location to determine preparation requirements to:
 - maintain
 - test
 - commission
 - diagnose faults
 - rectify faults
 - decommission air conditioning systems
- 3.2 evaluate the work location to determine planning requirements
- 3.3 justify the selection of materials and fittings required to complete work on air conditioning systems and check them for damage.

Unit 325 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 4 Understand the procedures for identifying industrial and commercial air conditioning systems, equipment and components

Assessment criteria

The learner can:

- 4.1 evaluate specifications and the work location to determine specific air conditioning maintenance requirements
- 4.2 interpret and apply appropriate sources of information when determining air conditioning installation requirements including:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 4.3 evaluate possible maintenance proposals to determine how well they meet industry requirements
- 4.4 critically compare the range of environmentally friendly materials, products, procedures and energy efficiency devices and make recommendations for their use
- 4.5 demonstrate methods for determining the capacity and specification of components to be used with all air, air-water and refrigerant air conditioning systems including:
 - central plant
 - dual duct
 - single duct
 - variable air volume
 - constant air volume
 - split
 - variable refrigerant flow
 - chilled ceilings or passive chilled beams and displacement ventilation
 - water loop heat pumps
 - active chilled beam
 - fan coil units.

Unit 325 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 5 Understand the service requirements for industrial and commercial air conditioning systems, equipment and components

Assessment criteria

The learner can:

- 5.1 define the information relevant to the routine and non-routine maintenance of air conditioning systems
- 5.2 propose a method statement for planning routine and non-routine maintenance work to include:
 - provision for minimising disruption to system operation
 - confirmation that materials, tools and equipment will be available as required
 - confirmation that maintenance activities comply with industry requirements
 - cleaning requirements
- 5.3 identify the key points within the routine and non-routine maintenance activities where liaison is required to minimise disruption to work routines including one from:
 - customer/clients
 - other site workers
 - line manager
- 5.4 identify the routine and non-routine maintenance procedures that comply with industry specifications and manufacturer's instructions for all air, air-water and refrigerant air conditioning systems including:
 - central plant
 - dual duct
 - single duct
 - variable air volume
 - constant air volume
 - split
 - variable refrigerant flow
 - chilled ceilings or passive chilled beams and displacement ventilation
 - water loop heat pumps
 - active chilled beam
 - fan coil unitscomponents:
 - filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles

- grilles
 - dampers
 - attenuators
 - automatic controls
 - time control for air conditioning systems
 - energy management systems
 - motorised dampers
 - condensers
 - cooling towers
 - refrigeration units
 - chillers
- 5.5 define the work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of all air, air-water and refrigerant air conditioning systems for the following components:
- filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles
 - grilles
 - dampers
 - attenuators
 - automatic controls
 - time control for air conditioning systems
 - energy management systems
 - motorised dampers
 - condensers
 - cooling towers
 - refrigeration units
 - chillers
- 5.6 identify methods of ensuring that maintenance records have been completed accurately
- 5.7 propose what action to take when a system or component does not meet the performance specification.

Unit 325 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 6 Understand the maintenance requirements for industrial and commercial air conditioning systems, equipment and components

Assessment criteria

The learner can:

- 6.1 identify the routine and non-routine maintenance procedures required to restore or maintain system performance in accordance with industry specifications, for all air, air-water and refrigerant air conditioning systems including:
 - central plant
 - dual duct
 - single duct
 - variable air volume
 - constant air volume
 - split
 - variable refrigerant flow
 - chilled ceilings or passive chilled beams and displacement ventilation
 - water loop heat pumps
 - active chilled beam
 - fan coil units
- 6.2 define the specific tests required to complete the routine maintenance of systems including:
 - air tightness
 - dynamic tests
 - efficiency
- 6.3 state the purpose and function of the following components in relation to air conditioning systems:
 - filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles
 - grilles
 - dampers
 - attenuators
 - automatic controls
 - time control for air conditioning systems
 - energy management systems
 - motorised dampers
 - condensers

- cooling towers
 - refrigeration units
 - chillers
- 6.4 state the requirements for air conditioning systems in terms of:
- safe operating pressures and temperatures
 - lubricants and cleansing agents
 - causes of corrosion and erosion
 - methods of locating defects caused by corrosion and erosion
 - colour coding for identification of ductwork
 - system cleaning
- 6.5 state the requirements for completing records or reports for system maintenance activities
- 6.6 state the actions to take should a system or component fail to operate to specification.

Unit 325

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 7

Understand procedures for soundness testing of industrial and commercial air conditioning systems

Assessment criteria

The learner can:

- 7.1 identify the requirements for air conditioning systems to confirm that they are ready to receive soundness tests to cover:
 - ductwork
 - appliances
 - components
- 7.2 state the procedure for carrying out a soundness test on all air conditioning systems
- 7.3 state the information that would be required to complete pre-commissioning documentation in order to ensure the safe pre-commissioning of systems and components.

Unit 325 Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 8 Understand procedures for decommissioning industrial and commercial hot and cold water systems

Assessment criteria

The learner can:

- 8.1 confirm that the status of the system will permit safe decommissioning
- 8.2 explain why completion of decommissioning activities can have implications for other persons, including:
 - clients/customers
 - other site workers
 - site visitors
- 8.3 clarify that work sequences for decommissioning air conditioning system components and pipework, including requirements for earth bonding complies with method statements
- 8.4 state the information that would be required to complete decommissioning documentation in order to ensure the safe decommissioning of systems and components
- 8.5 define the action to take when normal emptying or shut off mechanisms for air conditioning systems do not operate.

Unit 325

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 9

Understand procedures for commissioning industrial and commercial air conditioning systems

Assessment criteria

The learner can:

9.1 specify the procedures for establishing correct mechanical control performance for all air, air-water and refrigerant air conditioning systems including:

- central plant
- dual duct
- single duct
- variable air volume
- constant air volume
- split
- variable refrigerant flow
- chilled ceilings or passive chilled beams and displacement ventilation
- water loop heat pumps
- active chilled beam
- fan coil units

components:

- filters
- fans
- humidifiers
- heater batteries
- cooling batteries
- air inlet grilles
- grilles
- dampers
- attenuators
- automatic controls
- time control for air conditioning systems
- energy management systems
- motorised dampers
- condensers
- cooling towers
- refrigeration units
- chillers

9.2 evaluate the procedures for commissioning air conditioning systems and components in accordance with commissioning specifications

9.3 clarify the points in the commissioning process where co-operation and liaison with other trades and clients/customers may be required

- 9.4 state the information that would be required to complete commissioning documentation in order to ensure the safe commissioning of systems and components
- 9.5 demonstrate the actions to take when components being commissioned do not meet performance requirements.

Unit 325

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 10

Understand procedures for identifying faults on industrial and commercial air conditioning systems

Assessment criteria

The learner can:

10.1 interpret information on air conditioning system component faults from:

- advice from users
- visual inspections or tests
- diagnostic tests

10.2 explain how fault diagnosis activities can cause potential disruption for other persons, including:

- customers
- other site workers
- site visitors

10.3 describe the work actions and sequences for diagnosing faults in systems and components

10.4 demonstrate how to isolate systems and components for all air, air-water and refrigerant air conditioning systems including:

- central plant
- dual duct
- single duct
- variable air volume
- constant air volume
- split
- variable refrigerant flow
- chilled ceilings or passive chilled beams and displacement ventilation
- water loop heat pumps
- active chilled beam
- fan coil units

components:

- filters
- fans
- humidifiers
- heater batteries
- cooling batteries
- air inlet grilles
- grilles
- dampers
- attenuators
- automatic controls
- time control for air conditioning systems
- energy management systems

- motorised dampers
 - condensers
 - cooling towers
 - refrigeration units
 - chillers
- 10.5 specify the procedures for reporting diagnosed faults in systems and components in accordance with industry guidance
- 10.6 describe the work actions and sequences for rectifying faults in systems and components which will ensure minimum disruption to customers/clients
- 10.7 specify the procedures for identifying component faults in all air, air-water and refrigerant air conditioning systems including:
- central plant
 - dual duct
 - single duct
 - variable air volume
 - constant air volume
 - split
 - variable refrigerant flow
 - chilled ceilings or passive chilled beams and displacement ventilation
 - water loop heat pumps
 - active chilled beam
 - fan coil units
- components:
- filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles
 - grilles
 - dampers
 - attenuators
 - automatic controls
 - time control for air conditioning systems
 - energy management systems
 - motorised dampers
 - condensers
 - cooling towers
 - refrigeration units
 - chillers
- 10.8 evaluate the effects of common component faults upon overall air conditioning system performance, for all air, air-water and refrigerant air conditioning systems including:
- central plant
 - dual duct
 - single duct
 - variable air volume
 - constant air volume
 - split

- variable refrigerant flow
- chilled ceilings or passive chilled beams and displacement ventilation
- water loop heat pumps
- active chilled beam
- fan coil units

Unit 325

Understand industrial and commercial air conditioning system maintenance and fault diagnosis techniques

Outcome 11

Understand procedures for rectifying faults on industrial and commercial air conditioning systems

Assessment criteria

The learner can:

- 11.1 propose a method statement for rectifying faults on air conditioning systems including:
 - recommended industry work procedures
 - minimising risks to individual and the environment
 - liaison with customer
 - use of documentation
- 11.2 evaluate the technical performance of replacement components against manufacturer or industry specifications
- 11.3 define the procedures for carrying out the replacement of faulty components in accordance with industry specifications including:
 - methods of installing and fixing replacement components
 - implications of incorrect fixing
- 11.4 identify methods of ensuring that overall system performance is not affected following rectification work.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Level: 3

Credit value: 5

UAN number: R/502/8193

Learning outcomes

There are **seven** learning outcomes to this unit. The learner will

1. Be able to complete preparation work for industrial and commercial heating and ventilation systems service and maintenance activities
2. Be able to identify industrial and commercial heating and ventilation systems, equipment and components
3. Be able to service industrial and commercial heating and ventilation systems, equipment and components
4. Be able to complete soundness tests on industrial and commercial heating and ventilation systems
5. Be able to complete commissioning of industrial and commercial heating and ventilation systems
6. Be able to complete fault identification on industrial and commercial heating and ventilation systems
7. Be able to rectify faults on industrial and commercial heating and ventilation systems

Guided learning hours

It is recommended that **12** guided learning hours should be allocated for this unit, although patterns of delivery are likely to vary.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 1

Be able to complete preparation work for industrial and commercial H&V systems service and maintenance activities

Assessment criteria

The learner can:

- 1.1 assess the work location and report factors that will impact on the work to one of the following:
 - supervisor/line manager
 - customer/clients
- 1.2 confirm that job information and documentation for hot and cold water systems service and maintenance is available and appropriate including:
 - cold water systems, one of the following:
 - boosted
 - high rise building systems
 - hot water systems, one of the following:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - heating, one of the following:
 - low temperature hot water
 - medium temperature hot water
 - ventilation, one of the following:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - air conditioning systems, one of the following:
 - all air
 - air - water
 - refrigerant – air
 - job information and documentation:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - verbal instructions
- 1.3 use job information and documentation to ensure that the following are fit for purpose:
 - equipment
 - tools
 - labour resources

- 1.4 confirm the points in the work process where liaison with other persons will be required from one of the following:
 - customer/client
 - other site worker
 - supervisor/line manager
- 1.5 demonstrate that job information on key aspects of the work has been issued to relevant people including user instructions or manufacturer's instructions
- 1.6 demonstrate that authorisation has been obtained from the relevant person(s) prior to commencement of the work, from one of the following:
 - contractor/consultant
 - other site workers
 - site visitors
 - supervisor or line manager
- 1.7 identify any pre work damage or defects to existing equipment or building features, record and report it to one of the following:
 - customer/client
 - other site workers
 - supervisor or line manager
- 1.8 demonstrate that suitable personal protective equipment has been worn throughout the duration of work preparation activities
- 1.9 verify that the resources needed to complete the job are free from damage and take appropriate action should any defects be found:
- 1.10 complete preparatory work for the service and maintenance of H&V systems, to include:
 - use of material and equipment requisites where appropriate
 - confirmation that the selection of material, equipment and components are compatible to the installation
 - confirmation that the work location is ready for service and maintenance activities
 - confirmation of secure site storage for tools, equipment, materials and components
 - confirmation of suitable access equipment
 - confirmation of suitable lifting equipment where required
 - completion of risk assessments
 - completion of method statements.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 2

Be able to identify industrial and commercial H&V systems, equipment and components

Assessment criteria

The learner can:

- 2.1 verify that documentation and the work location is in accordance with the specific service and maintenance requirements for heating and ventilation systems
- 2.2 confirm that the job specification for heating and ventilation systems comply with:
 - statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - specifications
- 2.3 confirm that relevant persons have been notified and agreement achieved on any changes required to the job specification prior to commencement of the work from one of the following:
 - customer/client
 - supervisor/line manager.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 3

Be able to service industrial and commercial H&V systems, equipment and components

Assessment criteria

the learner can:

- 3.1 verify that maintenance schedule activities are compatible with the system components
- 3.2 implement a method statement for planning routine and non-routine maintenance work to include:
 - provision for minimising disruption to system operation
 - confirmation that materials, tools and equipment will be available as required
 - confirmation that maintenance activities comply with industry requirements
- 3.3 verify that liaison has taken place at the key points within the routine and non-routine maintenance activities to minimise disruption to work routines including one from:
 - customer/clients
 - other site workers
 - supervisor/line manager
- 3.4 implement work procedures for routine and non-routine maintenance activities that comply with industry specifications and manufacturer's instructions, for the following including:
systems:
 - cold water: one of the following:
 - boosted
 - high rise building systems
 - hot water: one of the following:
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
components, for at least 10 of the following:
 - storage cisterns
 - hot water storage vessels
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
 - circulating pumps (bronze)

- booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 3.5 implement work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of the following hot and cold water system components:
- components, at least 10 of the following:
 - storage cisterns
 - hot water storage vessels including high to low temperature calorifiers
 - electric and gas water heaters
 - appliance control valve or tap, terminal fittings
 - stop valves
 - float operated valves
 - single and double check valves
 - pressure reducing valves
 - gate valves
 - RPZ valves
 - servicing valves
 - drain taps
 - shower mixer valves
 - blending valves
 - circulating pumps (bronze)
 - booster pumps
 - line strainer
 - temperature and pressure relief valve
 - expansion vessels
- 3.6 implement work procedures for routine and non-routine maintenance activities that comply with industry specifications and manufacturer's instructions, for the following heating:
- systems:
 - low temperature hot water
 - medium temperature hot water
 - key regulations relevant to the installation
 - boilers, fired by solid fuel, gas or oil including one from:
 - high efficiency
 - modular
 - cast iron sectional
 - steel shell
 - copper or steel water tube
 - compliance with building and water regulations
 - components, six from:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems

- motorised valves
- pumps/accelerators
- temperature and pressure relief valves
- expansion vessels

- 3.7 implement work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of at least six of the following heating components:
- hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 3.8 implement work procedures for routine and non-routine maintenance activities that comply with industry specifications and manufacturer's instructions, for the following ventilation:
- systems:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers
- 3.9 implement work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of at least six of the following ventilation components:
- filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units

- canopies
- air to water heat exchangers
- air to gas heat exchangers
- air to refrigerant heat exchangers

3.10 implement work procedures for routine and non-routine maintenance activities that comply with industry specifications and manufacturer's instructions for air conditioning:

- systems:
 - all air
 - air-water
 - refrigerant air conditioning
- components:
 - filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles
 - grilles
 - dampers
 - attenuators
 - automatic controls
 - time control for air conditioning systems
 - energy management systems
 - motorised dampers
 - condensers
 - cooling towers
 - refrigeration units
 - chillers

3.11 implement work procedures for routine and non-routine maintenance activities that ensure the continued effective operation of at least six of the following air conditioning components:

- filters
- fans
- humidifiers
- heater batteries
- cooling batteries
- air inlet grilles
- grilles
- dampers
- attenuators
- automatic controls
- time control for air conditioning systems
- energy management systems
- motorised dampers
- condensers
- cooling towers
- refrigeration units
- chillers

3.12 confirm that maintenance records have been completed accurately.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 4

Be able to complete soundness tests on industrial and commercial H&V systems

Assessment criteria

The learner can:

- 4.1 confirm through visual inspections that the following systems conform with industry requirements:
- cold water (one of the following):
 - boosted
 - high rise building systems
 - hot water (one of the following)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - heating: one of the following:
 - low temperature hot water
 - medium temperature hot water
 - ventilation: one of the following:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - air conditioning systems: one of the following:
 - all air
 - air – water
 - refrigerant - air
- 4.2 confirm the heating and ventilation system is ready to receive soundness tests to cover:
- pipework
 - ductwork
 - appliances
 - components
- 4.3 verify that procedures for:
- cleaning
 - flushing
 - charging
- systems have been carried out in accordance with industry requirements
- 4.4 confirm procedures for establishing that input services to the system components are suited to the intended purpose for two of the following:
- water company mains
 - mains fed, direct, or indirect
 - gas

- oil

- 4.5 verify that a soundness test for two of the following systems conforms with appropriate industry standards, guides and good practice guides:
- cold water
 - hot water
 - heating
 - ventilation
 - air conditioning
- 4.6 implement pre-commissioning tests and checks in accordance with appropriate industry requirements, including:
- statutory regulations
 - codes of practice
 - industry standards
 - industry guides/good practice guides
 - verbal instructions
- 4.7 implement checks to confirm:
- system cleanliness
 - system is charged
 - un-commissioned systems and components cannot be activated.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 5

Be able to complete commissioning of industrial and commercial H&V systems

Assessment criteria

The learner can:

5.1 verify the availability of the relevant industry specifications and guidelines on the performance of heating and ventilation systems including:

- cold water: one of the following:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
- hot water: one of the following:
 - open vented
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
- heating: one of the following:
 - low temperature hot water
 - medium temperature hot water
- ventilation: one of the following:
 - tempered warm air supply
 - supply
 - extract
 - balanced
- air conditioning systems: one of the following:
 - all air
 - air - water
 - refrigerant - air

5.2 confirm that liaison has taken place during the commissioning process in order to minimise disturbance to work routines including liaison with one of the following:

- customer/client
- other site workers
- site visitors
- line manager

5.3 conduct mechanical and control performance checks and adjustments in accordance with industry specifications for the following:

- hot and cold water system components (all of the following):
 - cold water storage cistern
 - pressure booster sets

- hot water storage vessels
- appliance control valve or tap, terminal fittings

- and a minimum of any two from the following:
 - electric and gas water heaters
 - stop valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - expansion vessels
- 5.4 conduct mechanical and control performance checks and adjustments in accordance with industry specifications for six of the following heating system components
- hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 5.5 conduct mechanical and control performance checks and adjustments in accordance with industry specifications for six of the following ventilation system components:
- filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers
- 5.6 conduct mechanical and control performance checks and adjustments in accordance with industry specifications for six of the following air conditioning system components:
- filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles
 - grilles
 - dampers

- attenuators
- automatic controls
- time control for air conditioning systems
- energy management systems
- motorised dampers
- condensers
- cooling towers
- refrigeration units
- chillers

5.7 confirm that appropriate system information is available to the line manager.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 6

Be able to complete fault identification on industrial and commercial H&V systems

Assessment criteria

The learner can:

- 6.1 obtain specific information on heating and ventilation system component faults from:
 - system users
 - visual inspections
 - diagnostic tests
- 6.2 confirm that the relevant persons have been advised that fault diagnosis and rectification activities can cause potential disruption, including one of the following:
 - customers/clients
 - other site workers
 - supervisor/line manager
- 6.3 implement procedures for diagnosing faults in system components in accordance with industry specifications including:
 - any two from the following hot and cold water components:
 - electric and gas water heaters
 - stop valves
 - shower mixing valves
 - blending valves
 - mixing valves
 - circulating pumps (bronze)
 - expansion vessels
 - RPZ valves
 - feed and expansion cistern (primary system)
 - any three from the following heating components:
 - hot water storage vessels
 - radiators
 - convector heaters, natural and assisted
 - panel heaters
 - ceiling coils
 - thermostatic control of hot water heating systems
 - time control of hot water heating systems
 - energy management systems
 - motorised valves
 - pumps/ accelerators
 - temperature and pressure relief valves
 - expansion vessels
- 6.4 implement procedures for diagnosing faults in system components in accordance with industry specifications including:

- any three from the following ventilating components:
 - filters
 - fans
 - air inlet grilles
 - dampers
 - attenuators
 - automatic controls
 - time control ventilating systems
 - energy management systems
 - motorised dampers
 - air handling units
 - canopies
 - air to water heat exchangers
 - air to gas heat exchangers
 - air to refrigerant heat exchangers
- any three from the following air conditioning:
 - filters
 - fans
 - humidifiers
 - heater batteries
 - cooling batteries
 - air inlet grilles
 - grilles
 - dampers
 - attenuators
 - automatic controls
 - time control for air conditioning systems
 - energy management systems
 - motorised dampers
 - condensers
 - cooling towers
 - refrigeration units
 - chillers

6.5 confirm that procedures for reporting diagnosed faults in systems and components have been carried out in accordance with industry specifications.

Unit 326

Maintain and diagnose faults on heating and ventilating industrial and commercial systems

Outcome 7

Be able to rectify faults on industrial and commercial H&V systems

Assessment criteria

The learner can:

- 7.1 implement procedures for rectifying systems performance that:
 - minimise risk to individuals
 - minimise down time
- 7.2 implement procedures for rectifying systems performance in accordance with the requirements of one of the following:
 - customers/clients
 - other site workers
 - line manager
- 7.3 demonstrate that systems or partial systems have been isolated prior to commencing of rectification work in accordance with industry requirements
- 7.4 implement procedures for rectifying faults on systems including:
 - cold water, one of the following:
 - storage (indirect)
 - non storage (direct)
 - boosted
 - high rise building systems
 - hot water, one of the following:
 - open vented
 - storage (indirect)
 - unvented
 - secondary circulation
 - instantaneous (plate heat exchanger)
 - heating, one of the following:
 - low temperature hot water
 - medium temperature hot water
 - ventilation, one of the following:
 - tempered warm air supply
 - supply
 - extract
 - balanced
 - air conditioning systems, one of the following:
 - all air
 - air – water
 - refrigerant - air
- 7.5 demonstrate that actions taken to rectify system performance can be maintained

7.6 confirm that the relevant system documentation has been completed accurately and forwarded to the line manager.

Relationship to other qualifications

Links to other qualifications and frameworks

This qualification will be contained within the SummitSkills Apprenticeship framework. Please visit SummitSkills website www.summitskills.org.uk for more details.

Literacy, language, numeracy and ICT skills development

This qualification includes opportunities to develop and practise many of the skills and techniques required for success in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales.

There might also be opportunities to develop skills and/or portfolio evidence if candidates are completing any Key Skills alongside this qualification.

Any Key Skills evidence will need to be separately assessed and must meet the relevant standard.

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 **Centres and Training Providers homepage** on www.cityandguilds.com.

Providing City & Guilds qualifications – a guide to centre and qualification approval contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve ‘approved centre’ status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Ensuring quality contains updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document contains information on:

- Management systems
- Maintaining records
- Assessment
- Internal verification and quality assurance
- External verification.

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***
Find out how to register and certificate candidates on line
- ***Events***
Contains dates and information on the latest Centre events
- ***Online assessment***
Contains information on how to register for GOLLA assessments.

The **centre homepage** section of the City & Guilds website also contains useful information such on such things as:

- **Walled Garden**
Find out how to register and certificate candidates on line
- **Events**
Contains dates and information on the latest Centre events
- **Online assessment**
Contains information on how to register for GOLA assessments.

City & Guilds
Skills for a brighter future
www.cityandguilds.com



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, Registrations/enrolment, Certificates, 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, GOLLA, 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_unit@cityandguilds.com

Publications

Logbooks, Centre documents, Forms, Free literature

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

If you have a complaint, or any suggestions for improvement about any of the services that City & Guilds provides, email: feedbackandcomplaints@cityandguilds.com

Published by City & Guilds
5-6 Giltspur Street
London
EC1A 9DE
T +44 (0)844 543 0000
F +44 (0)20 7294 2413
www.cityandguilds.com

City & Guilds is a registered charity
established to promote education and
training

