Levels 2 and 3 Certificate in Heating and Ventilating (6128)

Qualification handbook

www.cityandguilds.com
November 2008
Version 2.0

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, NPTC which offers land-based qualifications and membership services, and HAB (the Hospitality Awarding Body). 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 the City & Guilds website.

Copyright

Publications
City & Guilds publications are available on the City & Guilds website or from our Customer Relations department at the address below or by telephoning +44 (0)20 7294 2850 or faxing +44 (0)20 7294 2405.

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)20 7294 2800
F +44 (0)20 7294 2400
www.cityandguilds.com
centresupport@cityandguilds.com

Levels 2 & 3 Certificate in **Heating & Ventilating**

www.cityandguilds.com
November 2008
Version 2.0

Contents

		Page
1. General information		6
1.1 General structure		6
1.2 Assessment and quality assurance		6
1.3 Course design		7
1.4 Health and safety		7
1.5 Centre and scheme approval		7
1.6 Registration and Certification		8
1.7 Verification of assessments		8
1.8 External verification		8
1.9 Career progression routes		9
2. Guidance notes on assessment		**10**
2.1 Introduction		10
2.2 Assessment		10
2.2.1 Assessment of core units		10
2.2.2 Assessment of optional units		10
2.3 What is provided by City and Guilds?		10
2.4 Guidance for marking		10
2.4.1 Conduct and supervision of multiple-choice assessments		10
2.4.2 Pass marks		11
2.4.3 Security of assessment material		11
2.4.4 Responsibility for security		12
3. The Award		**13**
3.1 Award details		13
3.2 Test specifications		14
3.3 Relationship to ESTTL/SummitSkills standards		19
3.4 Key Skills signposting		20
4. Assessment Components – Levels 2 & 3		**23**
101	Mechanical Engineering Services Sector-Core studies	25
201/202	Domestic Installation	34
203/204	Industrial and Commercial Installation	41
205/206	Maintenance of system components	47
207/208	Ductwork	54
301/302	Domestic Installation	62
303/304	Industrial and Commercial Installation	72
305/306	Rectification of systems	85
307/308	Ductwork	92

(This page is intentionally blank)

1. General information

This Award has been designed by City & Guilds in conjunction with the Industry Sector Skills Council SummitSkills to support government initiatives towards the National Qualifications Framework. It can contribute towards the knowledge and understanding required for the related NVQ while not requiring or proving evidence of occupational competence.

This award is aimed at candidates who

- are following Foundation & Advanced Modern Apprenticeship programmes
- require evidence towards the underpinning knowledge of the NVQ
- do not have immediate access to an NVQ
- wish for career progression within the Heating & Ventilating industry
- wish to develop the skills learnt from Heating & Ventilating Level 2 to progress

This award is designed to contribute towards the knowledge and understanding for the NVQs in Heating & Ventilating Levels 2 & 3 (City & Guilds 6088)

1.1 General structure

The award is made up of units expressed in a standard format. Each unit is preceded by details of the

- structure of the unit
- aims and general coverage of the unit
- relationship of the unit to the appropriate NVQ/ National Occupational Standards
- outcomes
- assessment methods.

1.2 Assessment and quality assurance

National standards and rigorous quality assurance are maintained by the use of

- City & Guilds set and marked written tests

Quality assurance includes initial centre approval, scheme approval, the centre's own procedures for monitoring quality and City & Guilds' ongoing monitoring by an External Verifier. Details of City & Guilds' criteria and procedures, including roles of centre staff and External Verifiers can be found in '*Providing City & Guilds Qualifications – a guide to centre and scheme approval'*.

Assessment components are graded (Pass). A pass is the achievement level required for the knowledge and understanding in a specific NVQ unit as specified on page 22.

For candidates with particular requirements, centres should refer to City & Guilds policy document '*Access to assessment, candidates with particular requirements.'*

External verifiers act on behalf of City & Guilds to ensure that national standards are maintained. Full details of their role can be found in '*Providing City & Guilds' Qualifications - a guide to centre and scheme approval'.*

1.3 Course Design

Teacher/assessors should familiarise themselves with the structure and content of the award before designing an appropriate course; in particular they are advised to consider the knowledge and understanding requirements of the relevant NVQ.

City & Guilds does not itself provide courses of instruction, training, programmes of learning or specify entry requirements.

As long as the requirements for the award are met, teachers/assessors may design courses of study in any way that they feel best meets the needs and capabilities of the candidates. Centres should combine and plan 6128 programmes with candidate's site work (practical performance) requirements as linked to the NVQ scheme 6088. Scheme 6128 programmes should therefore show a direct and relevant link to programmes leading to scheme 6088 NVQs in Heating and Ventilating.

It is recommended that centres cover the following in the delivery of the course, where appropriate

- Key Skills (such as Communication, Application of Number, Information technology, Working with others, Improving own learning and performance, Problem solving)
- Health and safety considerations, in particular the need to impress to candidates that they must preserve the health and safety of others as well as themselves
- Environmental education
- European dimensions.

It is recommended that the following hours should be allocated for each Heating & Ventilating discipline:

Ductwork	Level 2	540
Ductwork	Level 3	250
H&V Installation (ind/comm)	Level 2	540
H&V Installation (ind/comm)	Level 3	420
H&V Installation (domestic)	Level 2	540
H&V Installation (domestic)	Level 3	495
Maintenance of system components	-	580
Rectification of systems	-	350

NVQ Units not covered with the Level 3 Heating & Ventilating technical certificate are 11, 12, 13, 14, 15 and 16. This underpinning knowledge must be covered within an NVQ context and assessment programmes.

1.4 Health and safety

The requirement to follow safe working practices is an integral part of all City & Guilds qualifications and assessments, and it is the responsibility of centres to ensure that all relevant health and safety requirements are in place before candidates start practical assessments.
Should a candidate fail to follow health and safety practice and procedures during an assessment (eg practical assignment) the test must be stopped and the candidate advised of the reasons why. The candidate should be informed that they have failed the assessment. Candidates may retake the assessment at a later date, no less than seven days after the failure.

1.5 City & Guilds Centre and Scheme approval

Centres wishing to offer City & Guilds qualifications must gain approval.

New centres must apply for centre and scheme approval.

Existing City & Guilds centres will need to get specific scheme 6128 approval to run this Award. Centres should refer to Assessor & Internal Verifier requirements in scheme 6088 handbook.

Full details of the process for both centre and scheme approval are given in '*Providing City & Guilds qualifications - a guide to centre and scheme approval'* which is available from City & Guilds' regional offices and the City & Guilds web site http://www.cityandguilds.com

1.6 Registration and Certification

- Candidates must be registered at the beginning of their course. Centres should submit registrations using Form S (Registration), under scheme no 6128 see page 20 for full details.

- When assessments have been successfully completed, candidate results should be submitted on Form S (Results submission). Centres should note that results must NOT be submitted to City & Guilds until the external verifier is satisfied that the required standard has been attained.

City & Guilds reserves the right to suspend an approved centre, or withdraw its approval from an approved centre to conduct a particular City & Guilds scheme or particular City & Guilds schemes. This might be for reasons of debt, malpractice or for any reason that maybe detrimental to the maintenance of authentic, reliable and valid qualifications or that may prejudice the name of City & Guilds.

- Full details on all the above procedures, together with dates and times of written tests will be found in the *Directory of Vocational Awards* published annually by City & Guilds. This information also appears on City & Guilds Web site http://www.cityandguilds.com
- Heating & Ventilating assessments are also detailed within this document, please read carefully.

1.7 Verification of assessments

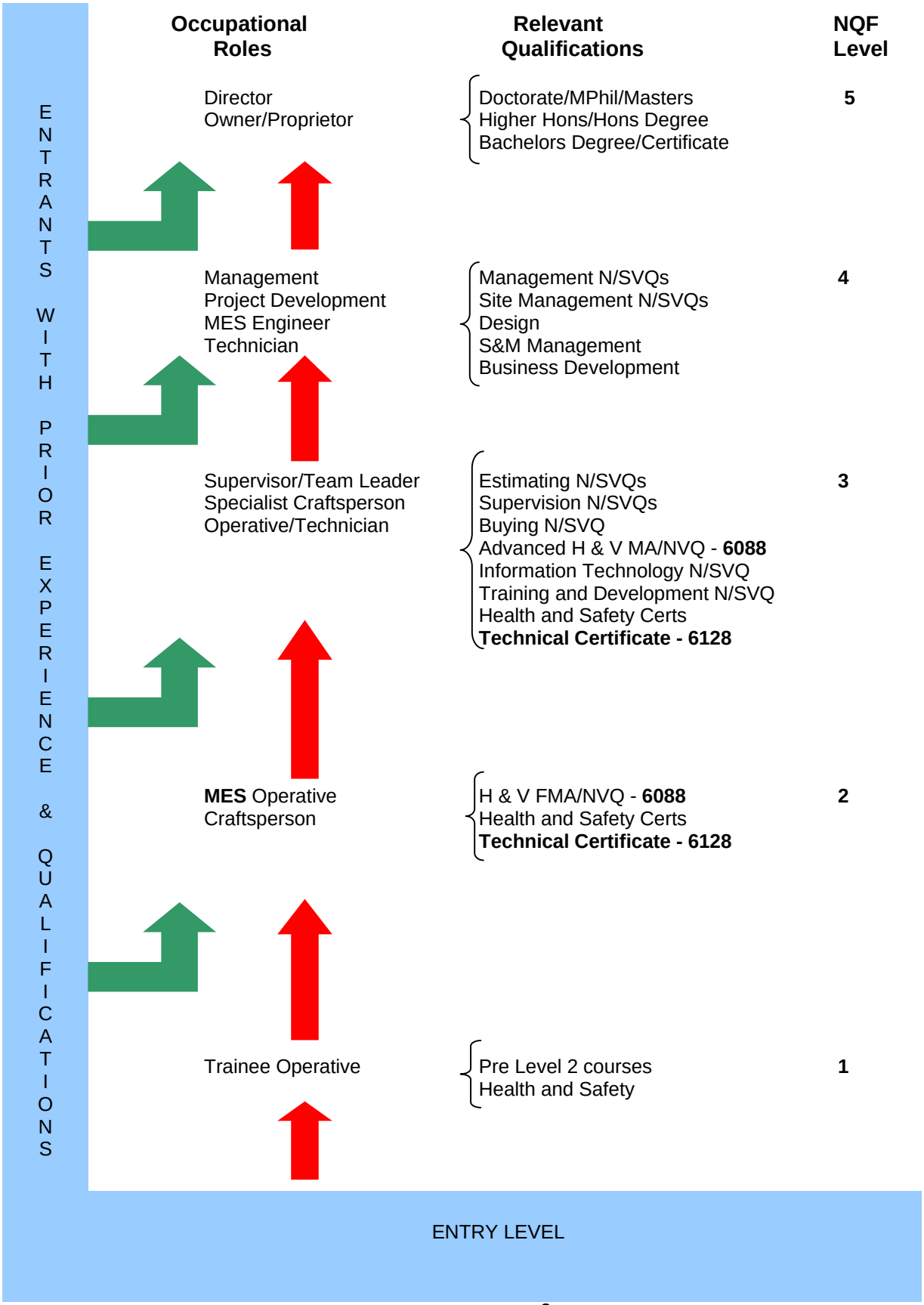
Although this Award does not imply occupational competence, it has a very close relationship with NVQ programmes. It is for this reason that, when the **6128 Technical Knowledge Tests** are used, it is important that reference is made to NVQ assessment methodology. Assessors/tutors will need to be familiar with the occupational standards for Heating & Ventilating NVQs Scheme 6088, because a similar system of internal verification is used. This means that the work of assessors involved in the qualification must be monitored by an Internal Verifier/scheme co-ordinator, to ensure that they are applying the standards consistently throughout assessment activities.

1.8 External verification

An External Verifier will make an annual visit to the centre and their role includes the following:

- ensuring that internal verifiers are undertaking their duties satisfactorily
- monitoring internal quality assurance systems and sampling assessment activities, methods and records
- **acting as a source of advice and support**
- promoting best practice
- providing prompt, accurate and constructive feedback to all relevant parties on the operation of centres' assessment systems.

1.9 Heating & Ventilating Sector Progression Routes



2. Guidance notes on assessment

2.1 Introduction

The City & Guilds Level 2 & 3 Certificate in Heating & Ventilating is designed to provide opportunities for candidates to gain accreditation for their individual level of understanding of the underpinning knowledge relevant to the appropriate related NVQ units within scheme 6088. See page 22.

For the certificate: eg Level 2 or 3 Certificate in Heating & Ventilating candidates will be required to achieve those components listed in the Qualification Structure on page 22.

2.2 Assessment

In order to gain the full certificate candidates MUST complete

ONE on-demand multiple-choice GOLA assessment for the core unit, externally set and marked.

2.2.1 Assessment of Core units

The core unit will be assessed by externally set multiple choice question papers.
This test will be available via City & Guilds from December 2004.

Each test will comprise of multiple choice items in accordance with the test specifications provided.

2.2.2 Assessment of qualification-specific units

The additional qualification-specific units are assessed by externally set, centre administered multiple choice question papers.

These tests are available via City & Guilds upon completion of the CD application form.

Each test will comprise of multiple choice items in accordance with the test specifications provided.

2.3 What is provided by City & Guilds

City & Guilds will provide on-demand multiple-choice GOLA assessments for testing the core unit.

The qualification-specific units tests will be provided to a designated centre person responsible for security of the optional papers, to centres (at cost) that have approval for scheme 6128.

2.4 Guidance for marking

2.4.1 Conduct and supervision of multiple-choice assessments

Centres must ensure the following

1. All multiple-choice assessments (option unit technical knowledge tests) are ‘closed book’ assessments, and candidates will not be allowed access to any reference material during the course of an assessment. Any information charts in rooms or workshops where knowledge assessments take place, should be removed or covered if they would give help to candidates taking the assessments.

2. Centres must provide levels of supervision that are commensurate with ensuring that the candidate works unaided for the duration of the assessment. The assessment supervision may be by a non-technical person working under the direction of the centre assessor, who must ensure that the assessment supervisor is fully conversant with all requirements for the conduct of the assessment.

   Where a candidate's score on an assessment indicates that the assessment needs to be followed up by oral questioning, this shall be carried out after the assessor has considered the assessment results. Oral questioning of candidates shall only be undertaken by the assessor. (see below)

3. Candidates will not be permitted to remove question papers from the location in which the assessment is taking place, or to retain question papers.

4. Where, in the opinion of the assessor, the candidate engages in any conduct during an assessment that is deemed to have given him, or her an unfair advantage, the candidate will be required to retake a paper.

2.4.2 Pass marks

The core unit is set and marked by City & Guilds via GOLA.

Centrally set and locally marked papers will be marked by Centres using a mark sheet, which will be provided by the Awarding Body for each paper.

After marking, the following procedures should be adopted

1. The basic pass mark for all centrally set and locally marked papers is 80 % - where a candidate scores 80 % or more for a particular paper, he or she will be deemed to have passed the paper.

2. Where a candidate scores between 70 to 79 % the assessor may use oral questions, covering those question topics that the candidate has not answered correctly. If the candidate satisfies the assessor that that he or she does know the subject matter covered by the oral questioning, the assessor will record the oral questions asked, and the candidate's responses, and award the candidate a 'pass' in that paper. Centres must retain evidence of oral questioning of candidates for checking by the External Verifier.

3. If a candidate scores 69% or less on a paper, he or she will take a 'resit'

4. Retakes – a minimum period of 10 days shall elapse between candidate retakes of multiple-choice papers in any given subject area.

The assessor will retain all answer sheets and multiple-choice papers. These shall be retained by the centre, in secure storage for a minimum of 3 years.

2.4.3 Security of Assessment material

Centres must provide secure and lockable storage for

- **Centrally set and locally marked multiple-choice question papers** (provided on scheme 6128 CD-Rom)

- All questions papers
- All marking templates
- All marked papers

2.4.4 Responsibility for security

The centre assessor shall be responsible for ensuring the security of all assessment materials. He or she may nominate a named person to take charge of the assessment materials, to be responsible for day to day security, and to record the issue and return of assessment material to storage after use. In addition to the nominated person the centre assessor shall be the only person within the centre with access to the secure storage for assessment material.

Assessment material will be provided to Centres on computer disc (CD) and it will be the responsibility of the nominated person (or the centre assessor) to download the material, and arrange to provide copies as required.

The Centres storage provisions for assessment materials, methods of recording issue and return will be examined by External Verifiers on centre approval visits, and failure to comply with the security requirements will have serious consequences for the Centres ongoing approval as an assessment centre.

3. The Award

3.1 Award Details

For the award of a certificate, candidates must successfully complete the assessments for Units 101 and one optional unit applicable to the pathway route that the candidate is registered for at each level 2 and 3)

Core unit		**Assessment components required**	
101	Mechanical Engineering Services Core Studies	All 6128 complexes	Questions – on-line (GOLA)multiple choice Externally set and marked
Units – Level 2 and 3			
201/202	Domestic Installation	6128-01	Questions – multiple choice Externally set and centre marked
203/204	Industrial & Commercial Installation	6128-02	Questions – multiple choice Externally set and centre marked
205/206	Maintenance of System Components	6128-03	Questions – multiple choice Externally set and centre marked
207/208	Ductwork	6128-04	Questions – multiple choice Externally set and centre marked
301/302	Domestic Installation	6128-05	Questions – multiple choice Externally set and centre marked
303/304	Industrial & Commercial Installation	6128-06	Questions – multiple choice Externally set and centre marked
305/306	Rectification of Systems	6128-07	Questions – multiple choice Externally set and centre marked
307/308	Ductwork	6128-08	Questions – multiple choice Externally set and centre marked
309/310	Welding	6128-06	Questions – multiple choice Externally set and centre marked

3.2 Test Specifications

Core Unit for Level 2 and 3

The knowledge requirements will be assessed by multiple choice tests

Subject **Heating & Ventilation Level 2 & 3**

Paper No. 6128-all complexes

Paper title Mechanical Engineering Services Core Studies

Duration 60 minutes **No of items - 30**

Outcome	Topic / objective	No of items	%
01	Describe the MES sector the main bodies and organisations within the sector and the basic safety and communication issues that apply	3	11
02	Identify the physical forces that have an impact on the MES sector	6	22
03	Interpret drawings, specifications, data and describe the use of IT in the sector	3	11
04	Describe the tools and the work processes used in the MES sector	6	20
05	Calculate and quantify from drawings and mark and set out	4	11
06	Understand building construction methods and the materials used in the MES sector	8	25
	Totals	**30**	**100**

Note 1: This note applies to all the test specifications:
The figures given for the number of questions set (against each outcome) may change (small adjustments) and are provided to Centres for guidance only.

Note 2: Each Test Specification provided will have two assessment papers of 30 questions each.

Certificate in Heating & Ventilating – Level 2 Test Specifications

Optional Units-Level 2

Subject **Heating & Ventilation Level 2**

Paper No. 6128-01

Paper title Domestic Installation

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify, plan and prepare the installation	10	20
02	Install systems components and pipework	25	50
03	Test, pre-commission and de-commission systems	25	30
	Totals	**60**	**100**

Subject **Heating & Ventilation Level 2**

Paper No. 6128-02

Paper title Industrial and Commercial

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify commonly used services and components	5	10
02	Plan the installation process using available data	10	20
03	Install components, plant and services	25	40
04	Test and commission the system to specified requirements	20	30
	Totals	**60**	**100**

Certificate in Heating & Ventilating – Level 2 Test Specifications

Subject **Heating & Ventilating Level 2**

Paper No. 6128-03

Paper title Maintenance of System Components

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify and establish customer requirements and prepare the work location for routine maintenance	10	20
02	Correctly de-activate and re-activate and test systems and test outcomes	30	40
03	Diagnose fault and routinely maintain system components	20	30
	Totals	**60**	**100**

Subject **Heating & Ventilation Level 2**

Paper No. 6018-04

Paper title Ductwork

No of items **30**

Outcome	Topic / objective	No of items	%
01	Identify ductwork systems and plant units	11	43
02	Use available data and resources to prepare and carry out installation	2	6
03	Install ductwork systems and plant units	7	21
04	Pressure test the ductwork system components	6	18
05	Pre-commission ductwork systems and plant units and carry out check to show conformance to specification	3	9
06	De-commission and remove ductwork systems and plant units	1	3
	Totals	**30**	**100**

Optional Units-Level 3

Subject **Heating & Ventilation Level 3**

Paper No. 6128-05

Paper title Domestic Installation

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify, plan and prepare the installation	10	20
02	Install system components and pipework	30	45
03	Test, pre-commission and de-commission systems	20	35
	Totals	**60**	**100**

Subject **Heating & Ventilation Level 3**

Paper No. 6128-06

Paper title Industrial and Commercial Installation

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify the planning and preparation requirements prior to commencement of system installation	20	36
02	Understand the layout of systems and the function of the system components	30	50
03	Identify the need for and processes involved in commissioning and de-commissioning	10	14
	Totals	**60**	**100**

Certificate in Heating & Ventilating – Level 3 Test Specifications

Subject **Heating & Ventilation Level 3**

Paper No. 6128-07

Paper title Rectification of systems

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify and establish customer requirements and prepare the work location to rectify/modify systems and components	10	20
02	Correctly de-commission and re-commission systems and test outcomes	30	45
03	Diagnose and rectify system failure and modify systems	20	35
	Totals	**60**	**100**

Subject **Heating & Ventilation Level 3**

Paper No. 6128-08

Paper title Ductwork

No of items **60**

Outcome	Topic / objective	No of items	%
01	Identify ductwork systems and plant units	5	10
02	Use available data and resources to prepare for and carry out installation	5	15
03	Install ductwork systems and plant units	20	30
04	Commission ductwork systems and plant units and carry out checks to show conformance to specification	20	25
05	De-commission and remove ductwork systems and plant units	10	20
	Totals	**60**	**100**

3.3 Relationship to ESTLL/SUMMITSKILLS standards

Unit Number/Title Scheme 6128	Related H & V Unit(s) NVQS Scheme 6088
Core unit - Level 2 and 3	
MES core Studies	001, 002, 003
Optional units - Level 2	
Domestic Installation	004, 005
Industrial and Commercial Installation	004, 005
Maintenance of System Components	017, 018, 019
Ductwork	004, 005
Optional units - Level 3	
Domestic Installation	006, 007, 008 and [012, 014] or [015, 016]
Industrial and Commercial Installation	006, 007, 008 and [009, 010] or [011] or [015, 016]
Maintenance of System Components	020, 021, 022
Ductwork	006, 007, 008 and[013] or [015, 016]

The following units underpinning knowledge must be covered through the 6088 NVQ:

011, 012, 013, 014, 015 & 016 NVQ units underpinning knowledge are not covered within scheme 6128.

3.4 Key/Core Skills Signposting

Achievement of a Key and Core Skill qualification is based upon the provision of evidence by a candidate who shows that he or she has carried out certain required activities. The following table indicates where there are opportunities for candidates to provide evidence which will enable them to achieve Key or Core Skills in such units. The identification of such opportunities is called 'signposting'. As a result, if the student has met the indicated vocational requirement of the unit, the relevant aspect of a Key or Core Skill may also be achieved.

Some of the Key or Core skills units may be achieved as a complete unit due to the diversity of skills required by the vocational unit.

Key skills mapping has been completed for the relevant NVQ units as identified in the table highlighting the relationship between the NVQ (6088) and the Technical Certificate (6128) and the link with the Certificate Units (see Page 16). Please refer to this to apply the key skills to this qualification.

Key for Key Skill Units

N/SVQ Unit – Guide to Units

C- Communication
WO – Working with others
PS – Problem solving
LP – Improving own learning and performance
AN - Application of Number
IT – Information Technology

Guide to Level Framework:

There are units at 5 levels, level 5 being the highest. For instance, levels 1 and 2 deal with straightforward subjects, levels 3 and above deal with more complex issues.

Units	Key Skills					
	C	N	IT	PS	LP	WO
1. Maintain the Safe Working Environment for HVACR Work Activities • Industrial and Commercial • Domestic • Ductwork	1.1 1.2 1.3			1.1 1.2 1.3	1.1 1.2 1.3	1.1 1.2 1.3
2. Maintain Effective Working Relationships • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2		1.1		1.1 1.2 1.3	2.1 2.2 2.3
3. Contribute to the Improvement of Business Products and Services for HVACR Work Activities • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2 2.3	1.1 1.2 1.3		1.1 1.2 1.3	1.1 1.2 1.3	2.1 2.2 2.3
4. Install Heating and Ventilating Systems and Components • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	2.1 2.2 2.3
5. Pre-commission and Decommission Heating and Ventilating Systems • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	2.1 2.2 2.3
6. Plan Heating and Ventilating Work Activities • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2	2.1 2.2		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
7. Install Complex Heating and Ventilating Systems and Components • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
8. Commission and Decommission Heating and Ventilating Systems • Industrial and Commercial • Domestic • Ductwork	2.1a 2.1b 2.2 1.3	2.1 2.2		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
9. Prepare Resources for Welding Activities • Industrial and Commercial	2.1a 2.1b 2.2 1.3	1.1 1.2		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
10. Install Pipework by Welding • Industrial and Commercial	2.1a 2.1b 2.2	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3

	Key Skills					
Units	C	N	IT	PS	LP	WO
11. General Service and Maintenance of Industrial and Commercial Systems and Components	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
12. General Service and Maintenance of Domestic Systems and Components	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
13. General Service and Maintenance of Ductwork Systems and Components	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
14. Apply Domestic System Design Principles	2.1a 2.1b 2.2 2.3	2.1 2.2	1.2	2.1 2.2 2.3	1.1 1.2 1.3	
15. Design Heating and Ventilating Systems	2.1a 2.1b 2.2 2.3	2.1 2.2	1.2	2.1 2.2 2.3	1.1 1.2 1.3	
16. Specify Programmes for Working on Heating and Ventilating Systems	2.1a	2.1 2.2 2.3		2.1 2.2 2.3	1.1 1.2 1.3	
17. Plan and Prepare for Routine Maintenance	2.1a 2.1b 2.2	1.1 1.2		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
18. Deactivate, Reactivate and Test Systems for Operation	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	2.1 2.2 2.3
19. Service and Maintain Systems and Components	2.1a 2.1b 2.2	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
20. Plan to Rectify/Modify Systems to Meet Customers Requirements	2.1a 2.1b 2.2 1.3	2.1 2.2		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
21. Decommission, Re-commission Systems	2.1a 2.1b 2.2 1.3	2.1 2.2		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3
22. Rectify System Failure and Modify Systems	2.1a 2.1b 2.2 1.3	1.1 1.2 1.3		2.1 2.2 2.3	1.1 1.2 1.3	3.1 3.2 3.3

4. Qualification structure and the Units

Included is a copy of the qualification structure, followed by a complete set of the Units

Level 2 & 3 Certificate in Heating and Ventilating 6128

This vocational award reflects the knowledge and understanding required for City & Guilds NVQ in Heating and Ventilating scheme 6088

Core Unit
G101 Mechanical Engineering Services Sector-Core Studies (MC)

Units–Level 2
#201 Domestic Systems Installation-written-(MC)-paper 1
#202 Domestic Systems Installation-written-(MC)-paper 2
#203 Industrial and Commercial Systems Installation-written-(MC)-Paper 1
#204 Industrial and Commercial Systems Installation-written-(MC)-Paper 2
#205 Maintenance of system components-written-(MC)-Paper 1
#206 Maintenance of system components-written (MC)-Paper 2
#207 Ductwork Systems Installation-written-(MC)-Paper 1
#208 Ductwork Systems Installation-written-(MC)-Paper 2

Units–Level 3
#301 Complex Domestic Systems Installation-written-(MC)-paper 1
#302 Complex Domestic Systems Installation-written-(MC)-paper 2
#303 Complex Industrial and Commercial Systems Installation-written-(MC)-Paper 1
#304 Complex Industrial and Commercial Systems Installation-written-(MC)-Paper 2
#305 Rectification of systems-written-(MC)-Paper 1
#306 Rectification of systems-written-(MC)-Paper 2
#307 Complex Ductwork Systems Installation-written-(MC)-Paper 1
#308 Complex Ductwork Systems Installation-written-(MC)-Paper 2

Additional assessment component to be used with 304/305:
001 Welding-Preparation & Application (#309 and 310)
G=On-demand GOLA examination-multiple choice-externally set and marked
#=Technical Knowledge tests-externally set, centre delivered and marked

	Level 2 Certificate in Heating and Ventilating
Complex 01	**Domestic Systems Installation**
Certificate	Core: 101 Optional: 201 & 202
Complex 02	**Industrial and Commercial System Installation**
Certificate	Core: 001 Optional: 203 & 204
Complex 03	**Maintenance of system components**
Certificate	Core: 101 Optional: 205 & 206
Complex 04	**Ductwork Systems Installation**
Certificate	Core: 101 Optional: 207 & 208
	Level 3 Certificate in Heating and Ventilating
Complex 05	**Complex Domestic Systems Installation**
Certificate	Core: 101 Optional: 301 & 302
Complex 06	**Complex Industrial and Commercial Systems Installation**
Certificate	Core: 101 Optional: 303 & 304 & 001 (309 or 310)
Complex 07	**Rectification of Systems**
Certificate	Core: 101 Optional: 305 & 306
Complex 08	**Complex Ductwork Systems Installation**
Certificate	Core: 101 Optional: 307 & 308

Unit 101 Mechanical Engineering Services Sector-Core Studies

Rationale

This core unit is concerned with the knowledge required to operate effectively within the MES Sector. It describes the structure of the sector and the organisations involved in the sector. It also covers basic safety and communications so that people are aware of the issues that allow them to work safely and communicate effectively within the MES sector.

The unit covers 6 performance outcomes. The candidate will be able to:

1. Describe the MES sector, the main bodies and organisations within the sector and the basic safety and communication issues that apply
2. Identify the physical forces that have an impact on the MES sector
3. Interpret drawings, specifications, data and describe the use of IT in the sector
4. Describe the tools and the work processes used in the MES sector
5. Calculate and quantify from drawings and mark and set out
6. Understand building construction methods and the materials used in the MES sector

Connection with other awards

This unit is derived from ESTTL's Training Specifications, in particular Foundation Training Module 2. This unit is common across Heating and Ventilating and Refrigeration and Air Conditioning NVQs and is a precursor to the following NVQs for the sector

1. H&V Installation (Industrial and Commercial)
2. H&V Installation (Domestic)
3. H&V Installation (Ductwork)
4. H&V Maintenance of System Components
5. RAC Small Commercial Refrigeration and Air Conditioning Systems (Installation)
6. RAC Small Commercial Refrigeration and Air Conditioning Systems (Service and Maintenance)

Assessment

The unit outcomes will be assessed via a GOLA-based on-line multiple choice paper. The structured assessment paper will cover the 6 outcomes specified. The paper will be externally set and externally marked.

Core Unit Unit 101: The MES Sector

Outcome 101. 1: Describe the MES sector, the main bodies and organisations within the sector and the basic safety and communication issues that apply

Underpinning Knowledge
The candidate will be able to:

1. Describe the structure of the MES industry
2. List the main services/trades within the MES industry as
   a. Industrial and Commercial
   b. Domestic
   c. Ductwork
   d. Service and Maintenance
   e. Refrigeration and Air Conditioning
   f. Electrical
   g. Plumbing
3. List the parties that are responsible for agreements within the MES sector and be able to describe the function of
   a. The negotiating bodies
   b. Employers organisations
   c. Trades Unions
4. Describe the career paths and progression routes within the MES sector and the education and training opportunities available
5. List the main building trades and describe their function in construction projects
6. List the main acts and regulations governing health and safety in the workplace
7. Describe the protective clothing applicable to various work processes and the accident prevention methods that ensure a safe working environment
8. List the different types of access equipment used within the MES sector and describe the safe usage, the limitations that apply and the potential hazards
9. List the potential hazards associated with hand and power tools and the safe measures to adopt when using them
10. Describe the causes of fire and the methods to adopt when tackling different categories of fire using the correct equipment
11. Describe how to set up and use safely the heating and cutting equipment found in the MES sector
12. State the correct procedures for locating and isolating services before starting to cut and drill and list the services
13. Describe the structural considerations that apply when cutting into floors, walls and ceilings and state the potential consequences of ignoring these considerations
14. List the general rules that apply to safe work practices and define the consequences of an untidy work location/poor housekeeping and state the potential risk of injury or damage to health arising from these situations
15. Describe the value of good communications and personal presentation as they apply to the workforce, employers and the industry
16. Describe the value of sketches as an aid to information and communications
17. Complete time sheets, expenses forms accurately ensuring that all the necessary information is included and that the calculations are correct
18. List the important aspects of oral communication both face to face and via communication devices

Core Unit Unit 101: The MES Sector

Outcome 101. 2: Identify the physical forces that have an impact on the MES sector

Underpinning Knowledge
The candidate will be able to:

1. State the main points relating to the basic physical quantities as they relate to the MES sector, describe the main principles and apply relevant calculations
2. State the principles and theories relevant to pressure and explain
   a. Pressure
   b. Pressure exerted by liquids
   c. Pressure and gas
3. Recognise the main points relating to pressure, describe the main principles and apply relevant calculations
4. Describe the main principles associated with heat, apply the relevant calculations and relate the following to applications in the MES sector
   a. Heat as energy
   b. Change of state – melting and solidifying
   c. Change of state – evaporation and condensation
   d. Heat transfer
5. Describe the main principles associated with thermal movement, apply the relevant calculations and relate the following to applications in the MES sector
   a. Temperature
   b. Thermal movement of solids
6. Apply the relevant calculations and explain the thermal movements of
   a. Liquids
   b. Gases
7. Apply relevant energy calculations, describe the main principles and relate the following to applications within the MES sector
   a. Work
   b. Power
8. Describe the main points in the construction of tools, the materials technology used and apply calculations relating to the principles of the lever
9. Describe the main points of chemistry as they apply to the MES sector, apply the relevant calculations and relate to their application as follows
   a. Laboratory and industrial safety
   b. Measurement
   c. Structure of materials
   d. Gases and combustion
10. Describe the main points relating to materials used in the MES sector, apply the relevant calculations and relate the following to their application in the MES sector
    a. Ferrous metals
    b. Non-ferrous metals
11. Describe the main points relating to force, apply relevant calculations, state the main principles involved and relate the following to their application within the MES sector
    a. Effects of force
    b. Movements
    c. Conditions of equilibrium
    d. Centre of gravity
    e. Friction
12. State the basic principles of electricity and describe how they can be applied to domestic circuits
13. Describe the potential hazards of working with or near electrical supply systems and the safe practices and precautions to apply
14. Identify the main items of electrical supply systems to buildings and to temporary supplies on construction sites and describe the function of the identified items
15. State the advantages of using reduced voltage supplies on site and the correct method of using step down transformers

16. State the colour code for electrical cables and flexible cords and use it to identify the line, earth and neutral and describe how to wire up a 2 and 3 core cable so that the correct wires are connected to the correct terminal
17. Describe how to
    a. Assess fuse ratings for various domestic appliances
    b. Locate, repair and replace a circuit fuse which has failed
    c. Locate, check and replace a defective cartridge fuse that has failed
    d. Locate and reset miniature circuit breakers and residual current devices using safe methods
18. Describe the checks to be made on electrical equipment prior to use
19. State the correct procedure for isolating someone from the live source and the procedure for dealing with a person suffering the effects of electrical shock

Core Unit Unit 101: The MES Sector

Outcome 101. 3: Interpret drawings, specifications, data and describe the use of IT in the sector

Underpinning Knowledge
The candidate will be able to:

1. Describe the use of drawings as an aid to installation and service and maintenance activities
2. Describe how specifications are used within the MES sector
3. Describe how Technical Standards are used to communicate information in a common format and name the various methods that are used in the MES sector
4. Interpret the various forms of Technical Drawings as used within the MES sector
5. Identify the various standard symbols used to identify mechanical and electrical components
6. Construct a basic operation sheet or a plan from a simple drawing in a logical and structured sequence
7. Identify from drawings, specification and data sheets the various components featured
8. Identify and interpret manufacturers instructions in order to extract specific information
9. Identify the use of colour coding within the MES sector and use to identify
    a. Electrical components and wiring
    b. Content of pipes and vessels
    c. Gas cylinders
10. List the main uses of IT within the MES sector
11. Describe the implications of IT
    a. Within the MES sector
    b. Outside of the working environment
12. Compare and contrast the use of computers and IT against previous information systems used in the MES sector and list the benefits and disadvantages
13. List the main items of hardware within a computer system and describe their function
14. Identify the main mathematical operations of calculators

Core Unit Unit 101: The MES Sector

Outcome 101. 4: Describe the tools and the work processes used in the MES sector

Underpinning Knowledge
The candidate will be able to:

1. Identify the tools commonly used within the MES sector and be able to distinguish between hand and power tools
2. Describe the correct and safe use of the tools found in the MES sector
3. State the maintenance requirements of these tools and explain why tool maintenance is required
4. State the correct storage environment for tools and why this is necessary
5. List the specialist tools required for the different disciplines
    a. Industrial and commercial installation
    b. Domestic installation ductwork installation
    c. Service and maintenance
    d. Refrigeration and air conditioning
6. List the main methods of cutting used in the MES sector by
    a. manual processes
    b. power tool processes
7. State the factors that must be considered when cutting out in various types of material, the reason why damage must be minimised and explain how to finish off the work correctly
8. List the techniques and methods for the various cutting out operations and match the operation to the appropriate techniques
9. Describe the tools and equipment required for each of the cutting out techniques and methods
10. Describe the work required before and after cutting out in order to prevent problems occurring later
11. Describe how to carry out the work efficiently
12. Describe how to lubricate and clean cutting equipment correctly and why routine care and maintenance of cutting equipment is necessary
13. State the purpose of drilling and list the main methods used in the MES sector for manual and power tools
14. Identify and select the appropriate drilling equipment and match it to the correct drill bit for various applications and materials as follows
    a. Wood
    b. Masonry
    c. Metal
15. Identify the various types of file and the types of material they would be used on and describe their safe use
16. Identify the types of nails and screws used in the MES sector and match to particular applications
17. List the considerations that apply when using these fixings in different materials
18. List and identify the tools and equipment used for fixing to different types of surface and materials and know the relationship between
    a. Drill, screw and fixing sizes
    b. Fixing strength and supporting weight
19. List the different methods and principles of jointing used in the MES sector and describe the jointing by
    a. Mechanical methods
    b. Application of heat methods
    c. Solvent methods
20. State the advantages and disadvantages of jointing by each method
21. Describe simple techniques and methods for jointing
    a. Pipe
    b. Duct
    c. Sheet

22. List the tools, equipment and materials for different jointing operations for particular conditions
23. Explain why the inspection of jointing equipment is important before and after use and describe the action to take if the results of the inspection are unsatisfactory
24. State the effects on materials caused by particular jointing methods and describe the problems that can occur if these effects are not taking into consideration
25. Describe how these unwanted effects can be eliminated or minimised by ensuring
    a. Correct heat
    b. Correct tightening
    c. Correct use of solvents
    d. Correct use of jointing materials
26. Describe the necessary work that needs to take place before and after jointing by any of the methods and techniques available to the MES sector and explain why this improves efficiency
27. Describe how to maintain and care for the various types of jointing equipment
28. State the purpose of bending and folding machines and describe their application to
    a. Pipe
    b. Sheet material
29. List the cold and hot working methods for bending and folding materials
30. State the advantages and disadvantages and describe the techniques used for folding and bending materials for the following
    a. Cold bending of pipe or bar
    b. Hot bending of bar
    c. Folding low carbon steel sheet
31. List the tools and equipment required for each bending or folding method/technique by the following
    a. Manual
    b. Mechanical
    c. Hydraulic
32. Describe why the safety and working condition inspection of bending and folding equipment is required and the action to take when the condition of the equipment is unsatisfactory
33. State the effect that bending and folding has on materials and what impact it will have when used in the workplace
34. List the advantages and disadvantages of bending and folding as opposed to cutting and jointing relative to
    a. Cost
    b. Time
    c. Convenience
    d. Constraints (space, location, construction etc)
35. Describe the routine care and maintenance requirements for bending and folding equipment with regard to
    a. Cleaning
    b. Lubrication
    c. Storage

Core Unit Unit 101: The MES Sector

Outcome 101. 5: Calculate and quantify from drawings and mark and set out

Underpinning Knowledge
The candidate will be able to:

1. Read and interpret simple plans and drawing to quantify material requirements
2. Explain the purpose of drawings and carry out calculations related to the drawing
3. Read and interpret drawings and relate to measurements taken to the work that is required
4. Use measuring and calculating methods correctly to determine
   a. Areas
   b. Volumes
   c. Quantities
5. Identify and describe the range of equipment used for the accurate setting out and marking off of a job and explain how to use the equipment correctly
6. Describe how to correctly mark and set out within tolerances the following
   a. Centre lines
   b. Angles
   c. Centres for drilling and tapping
   d. Parallel lines
   e. Squares
   f. Rectangles
   g. Circles
7. Describe the methods of marking off the positions of components in various situations and explain how to obtain the detail from working drawings
8. Explain the purpose of marking out, including how to avoid faults and minimise inaccuracies and list the benefits of doing so

Core Unit Unit 101: The MES Sector

Outcome 101. 6: Understand building construction methods and the materials used in the MES sector

Underpinning Knowledge
The candidate will be able to:

1. State the main functions of the components which make up a simple building
2. List the internal construction parts of a simple building and the factors and functions that are applicable
3. List the principal services required of a simple building and the implication for the construction
4. List the safe and correct methods for removing and replacing constructional elements
5. List and describe the correct procedures for undertaking basic building tasks in relation to MES activities
6. Identify typical MES fittings and pipework materials and list the general characteristics of
   a. Low carbon steel pipe
   b. Galvanised steel pipe
   c. Stainless steel pipe
   d. Copper tube
   e. Plastic pipe
   f. lead pipe
   g. cast iron
7. Describe the use by the MES sector of the following materials
   a. Galvanised steel
   b. Low carbon steel
   c. Copper
   d. Aluminium
   e. Lead
   f. Zinc
8. List the main building materials which may be encountered when working in the MES sector and describe the general characteristic of each identified material
9. Describe the safety requirements that apply when dealing with thermal insulation materials
10. List the materials used for insulation and cladding and describe how these materials are used
11. List the typical applications for insulation
12. State the dangers associated with asbestos and describe the actions required when asbestos is encountered
13. Identify the various materials used in the manufacture of ductwork

Unit 201/202: Domestic Systems Installation -Level 2

Rationale

This unit is concerned the with knowledge and understanding of Heating, Hot and Cold Water Services, above ground Waste and Sanitary pipework systems and Fuel supply systems as are commonly used in Domestic premises
The unit deals with appropriate use of resources and procedure required to achieve an efficient installation, testing and commissioning operation

The unit covers

1. system types and their main components
2. planning and preparing the installation
3. installation processes and methods
4. selection and use of appropriate tools and equipment
5. testing, commissioning and decommissioning systems
6. finishing and checking the system as per the specification

The unit covers THREE learning outcomes. The candidate will know how to:
1. identify, plan and prepare the installation
2. install system components and pipework
3. test, pre-commission and de-commission systems

Connection with other awards

This unit is linked to Mechanical Engineering Services, Heating and Ventilating (Domestic) Occupational Standards and

Unit 4. Install Heating and Ventilating Systems and Components
Unit 5. Pre-commission and De-commission Heating and Ventilating Systems

Assessment

The outcomes from this unit will be assessed by two multiple choice question paper/s covering the three outcomes

Paper 1 – 201
Paper 2 - 202

The underpinning knowledge requirements are listed for each outcome in the following pages

Outcome 201/202. 1: Identify, Plan and Prepare the Installation

Underpinning knowledge
The candidate will be able to:

1. name the different types of dwellings as being
    a. bungalows
    b. single and multi-storey flats/apartments
    c. detached and semi detached houses
    d. terraced houses

2. state the types of services/system to be installed in dwellings as being
    a. cold water service
        i. mains
        ii. indirect
    b. hot water service
        i. direct
        ii. indirect
        iii. unvented
    c. hot water heating
    d. warm air (ducted) heating
    e. waste and sanitary (above ground) pipework
    f. fuel
        i. gas
        ii. oil
        iii. solid

3. name components from drawings, specifications and other data as listed below
    a. installation drawings
    b. client bills of quantity and specifications
    c. manufacturers manuals and instructions
    d. other data sheets

4. interpret installation drawings for the purpose of
    a. determining material requirements
    b. identifying tools and equipment for
        i. lifting
        ii. manoeuvring
        iii. positioning
        iv. jointing
        v. supporting
    c. ensuring that the correct electrical supplies are available
    d. checking that all foundations and plinths are in the correct locations
    e. checking that all wall structures are suitable for hanging components
    f. producing a sequence of operations for the installation
    g. ensuring that all components are correctly located

5. state the colour identification coding for
    a. pipe work systems
    b. electrical wiring
    c. gas cylinders

6. identify from specifications and manufacturers manuals
    a. correct installation methods of components
    b. the structural elements of the building prior to installation
        i. for the purpose of fixing components
        ii. for the purpose of commissioning the installation
    c. the type and condition of input services
    d. the type of tests required

Outcome 201/202. 2:Install Systems, Components & Pipework

Underpinning Job Knowledge
The candidate will be able to:

1. state the type of service/system to be installed as being
    a. heating
        i. open vented/sealed
        ii. single/two pipe
        iii. small bore/mini-bore/micro bore
        iv. ducted warm air
    b. hot water
        i. open vented/unvented
        ii. direct/indirect
    c. cold water
        i. storage/non-storage
    d. fuel
        i. gas
        ii. oil
        iii. solid

2. name, state the function, the relative position and the inter relationship of, the various components used in the systems identified in 1a, b & c, above
    a. boilers
        i. freestanding/wall mounted/inset fire side
        ii. conventional/balanced/fan flued
        iii. system/combi/condensing
        iv. gas/electric, vented/un-vented water heaters
        v. gas/oil/solid fuel
    b. circulating pumps
    c. heat emitters
        i. radiators
        ii. natural & mechanical convectors
        iii. skirting heaters
        iv. embedded and radiant panel heating
    d. pipes, tubes and fittings
        i. copper tubes and fittings
        ii. plastic tubes and fittings
        iii. LCS tubes and malleable fittings
    e. cylinders, cisterns and tanks
        i. direct/indirect/self priming cylinders
        ii. plastic/galvanised cisterns
        iii. DHW storage/feed & expansion cisterns
        iv. direct/indirect combination tanks
        vi. plastic/steel oil fuel tanks
        vii. pressurisation vessels and units

f. valves and system components
    i. thermostatic (TRV) radiator valve
    ii. wheel/lock shield radiator valve
    iii. isolating/regulating valves
    iv. pressure relief (PRV) valve
    v. fill loop/double check valve
    vi. CWS stop valve
    vii. drain valve
    viii. two/three port motorised valve
    ix. float operated valve
    x. strainer
    xi. non return valve
    xii. ball valve
g. thermostats
    i. boiler stat
    ii. boiler high limit stat
    iii. room stat
    iv. frost stat
    v. cylinder stat

3. state the requirements for the marking out, positioning and fixing of the components as listed in 2a - g above

4. name, select appropriate fixing devices to be used when installing/fixing the components as listed in 2a - g above

5. state the requirements for the positioning of brackets for pipework, as recommended in BS 6880

6. describe the installation methods and techniques when using copper, steel and plastic tubes and fittings in the systems listed in 1a - d above
    a. selecting and completing appropriate jointing methods
    b. methods and techniques of bending/manipulation
    c. selecting and using appropriate tools
    d. selecting and using appropriate bracketing devices
        i. pipe rings/clips
        ii. screw to wood/build in brackets
        iii. fabricated/'uni-strut' bracketing systems

7. state the basic requirements of the Building, Gas, Oil and Solid Fuel regulations for flues
    a. types of flue for gas, oil and solid fuel
    b. construction of flues for gas, oil and solid fuel
    c. location and safe termination of gas, oil and solid fuel flues

8. state the basic requirements of the Building, Gas, Oil and Solid Fuel regulations for the storage and installation of
    a. fuel oil tanks and pipework
    b. gas pipework
    c. solid fuel stores

9. state the basic requirements for the connection of input services to the system as for
    a. electricity (v/v 17th edition IEE regulations)
    b. gas/oil
    c. water (v/v water byelaws)
    d. above ground drainage

10. state the good practices to be observed when working in a customers property in regard to
    a. site and property access
    b. storage of tools and equipment
    c. protection of furnishings and fittings
    d. safe and effective working practices
    i. occupied/unoccupied premises

Outcome 201/202. 3: Test, Pre-Commission and De-Commission systems

Underpinning knowledge
The candidate will be able to:

1. state the testing procedures required for systems (listed under outcome 2.1 a-d above) as being
    a. system readiness to undergo testing
    b. system suitability for a water test to take place
    c. system suitability for air/nitrogen test

2. identify the
    a. equipment required to carry out
    b. relevant test specification
    c. test pressures required by the relevant specification, to ensure soundness/tightness of the installation

3. state the
    a. necessary records of testing required by the
        i. client/customer
        ii. customers agent/landlord
        iii. employees company
    b. procedures/records required in cases of test failure

4. state the sequence of requirements for system cleansing/filling/charging as being
    a. flushing including use of cleansing agents
    b. checking the effectiveness of the flushing process
    c. addition of charging agents/inhibitors
    d. filling/venting
    e. testing for soundness/tightness

5. state the requirements for the
    a. pre-commissioning checks for systems (listed under outcome 2.1 a-d above)
    b. commissioning of
        i. systems as listed under outcome 2.1 a-d
        ii. components as listed under outcome 2.2 a-g
    c. identifying data required commissioning activities in b. i & ii

6. state the requirements for the de-commissioning of systems as being
    a. establishing current system/component performance prior to de-commissioning
    b. reporting/liaison procedures prior to suspending operation of the system
    c. safe and effective disposal of system contents
    d. measures to prevent systems being brought into operation by
        i. safe and effective isolation of system and its components
        ii. use of safety/warning notices

Unit 203/204: Industrial and Commercial Systems Installation-Level 2

Rationale

This unit is concerned with the installation techniques of systems commonly used in industrial and commercial premises. These include hot water heating, hot water services, cold water services, fire protection, chilled and condensed water services and industrial heating appliances. The unit deals with use of appropriate resources and procedures required to achieve an efficient installation test and commissioning operation.

The unit covers
1. system layouts and their main components
2. data and resources used for planning the installation process
3. the installation process
4. the tools and equipment required for the installation process
5. test and commissioning procedures to confirm compliance with the specification it will also reinforce the need to follow safe working practices

The unit covers FOUR performance outcomes. The candidate will know how to:
1. identify commonly used services and components
2. using available data plan the installation process
3. install components, plant and services
4. test and commission the system to specified requirements

Connection with other awards

This unit is linked to the MES Heating and Ventilating occupational Standards

Unit 4 Install Heating and Ventilating System and Components
Unit 5 Pre-commission and Decommission Heating and Ventilating Systems

Assessment

The underpinning knowledge requirements are listed for each outcome

Paper 1 – 203
Paper 2 - 204

These will be assessed by a multiple choice question paper/s covering the FOUR outcomes.

Outcome 203/204. 1: Identify commonly used services and components

Underpinning knowledge
The candidate will be able to:

1. Identify various types of services and the working principles including working temperatures, safety devices, system layout, methods of filling and draining to the requirement of the Water Regulations, Building Regulations and BS 6880 of the following systems

    a. heating
        i. low temperature hot water heating
        ii. sealed heating systems
        iii. medium pressure hot water heating
    b. hot water
        i. open vented system
        ii. indirect
        iii. unvented
    c. cold water
        i. storage
        ii. nonstorage
    d chilled water
        i. cooling water
        ii. chilled water

2. Recognise types of components and their purpose contained in system identified in section 1a,b,c,d

    a. the design, storage requirements location and working principles of the following types of cylinder, calorifier cistern and heat exchanger
        i. indirect storage cylinder
        ii. high temperature to low temperature calorifiers
        iii. feed and expansion cisterns
        iv. storage cisterns
        v. plate heat ex changers
    b. the size location installation requirements and working principles of the following types of heat emitters
        i. radiators
        ii. convector heaters natural and assisted
        iii. unit heaters water and gas
        iv. underfloor heating
        v. ceiling coils
    c identify the location, purpose and working principles of the following valves also the relevant drawing symbol
        i. non return
        ii. isolating
        iii. regulating
        iv. two and three port motorised valves
        v. float operated
        vi. drain
        vii. ballvalves
        viii. anti vac
        ix. butterfly
        x strainers
        xi. relief valves

d. identify the types, correct location and purpose of the following pumps as BS 6880 part 2 also the problems created by incorrect location
    i. circulating
    ii. feed
    iii. sump
    iv. Pressurization equipment
e. identify the types of construction location and working principles of the following boilers
    i. cast iron
    ii. steel
    iii. package
    iv. modular
    v. condensing
f. recognise the requirements of the Building Gas and Oil regulation for flues
    i. types of flue required for gas oil and solid fuel
    ii. construction of flues suitable for gas oil and solid fuel
    iii. location of flues and there safe termination
g. recognise the requirements of the Building, Gas, and Oil regulations applying to storage and installation
    i. storage requirements for oil
    ii. pipework installation requirements for oil
    iii. pipework installation requirements for gas
    iv. test specification for both oil and gas installations

3. describe the input services necessary prior to and during the installation required for services contained in section 1.1 a b c d

a. electricity
   voltage depending on rating of installation equipment and components
b. gas
   type and pressure depending on installation components
c. water
   pressure for testing and for installation requirements

Outcome 203/204. 2: Use available data to plan the installation process

Underpinning knowledge
The candidates will be able to:

1. Identify components from drawings symbols to BS specifications and data suitable for systems identified in 1.1 abcd these to include valves, fittings and installation requirements from the following sources of information.
   a. installation drawings
   b. manufacturers manuals
   c. data sheet etc

2. Interpret drawings for installation of systems contained in 1.1abcd
   a. determine material requirements for economic and efficient installation programme
   b. identify tool and equipment requirements for
      i. lifting
      ii. manoeuvring
      iii. positioning
      iv. jointing
      v. supporting
   c. insure that the correct electrical voltage supplies are available for there intend purpose
   d. check that all foundations and plinths are in the correct locations and suitable for the equipment they will have to support
   e. produce a sequence of operations for installation of systems contained in section 1.1 abcd
   f. ensure that all components of systems contained in section 1.1 abcd are correctly located to ensure efficient and economical operation of the installation

3. Identify colour identification coding to British Standard 5422
   a. wiring
   b. pipework
   c. gas cylinders

4. From specifications and manufactures manuals applying to systems in 1.1 abcd
   a. identify correct installation methods for pipework and components
   b. identify the type of tests required water and air
   c. the structural requirements necessary prior to installation foundations plinth

Outcome 203/204. 3: Install components, plant and services

Underpinning knowledge
The candidates will be able to:

1. Indicate the position of cuts, bends, joints and fixings from installation drawings

2. Position various components on walls ceilings and floors from working drawings

3. Position brackets for pipework as recommended in BS 6880
   a. installation techniques for systems identified in section 1.1 abcd containing copper steel and plastic pipework
      i. types of jointing methods used
      ii. select suitable joint
      iii. list methods of bending
      iv. describe techniques associated with the various bending methods
      v. identify tools and their purpose
      vi. identify and describe bracketing systems munsen ring, pipe rings, school board clips, uni-strut systems etc
      vii. select suitable fixings screws, plugs, rawbolts, drill anchors, toggle bolts etc
   b. installation sequence for systems identified in section 1.1 abcd and containing steel, copper and plastic pipework
      i. list stages of installation assembly
      ii. identify relevant tools and equipment

4. Select correct fixing technique for various structures brick block concrete plasterboard timber etc
   a. recognise the most economical method of working
   b. position components brackets and pipework to the correct dimensions
   c. position adequate number of isolation, control and threeway valves in correct locations
   d. cut bend and fix pipework
   e. install using economical practices
   f. installation meets the requirements of the relevant standards
   g. identify two methods of allowing thermal expansion of pipework to take place
   h. describe two the types of anti vibration equipment units and pad and there position
   i. identify the pipework supports and fixings required for various materials
   j. identify types of pipe joint used on different types of materials
   k. identify pipe joints suitable for different systems

Outcome 203/204. 4: Test and pre-commission systems identify and rectify faults checked against the specification

Underpinning knowledge
The candidate will be able to:

1. a. testing procedures for systems identified in section 1.1 abcd
    i. check system is suitable to undertake testing
    ii. for a water test to take place
    iii. for air test
    iv. identify the equipment necessary to carry out test on systems in section 1.1 abcd
    v. identify the relevant test specification
    vi. identify test pressures required by a specification to ensure sound construction of the system
   b test records
    i. list the necessary records of testing required by the client
    ii. procedure in the event of test failure
    iii. list records required at handover required by a client or those identified in BS 6880
   c. methods of cleaning systems
    i. prepare system for cleansing after testing
    ii. describe methods of flushing
    iii. identify the cleansing agents to be used acid and abrasive
    iv. identify necessary checks to ensure flushing has been successful
   d. commission systems
    i. describe the required pre-commissioning checks
    ii. identify the data required to undertake commissioning
   e. de-commission systems
    i. identify the importance of confirming the function and the outcomes of suspending the operation of the system
    ii. recognise the need to liaise with others whose procedures or routines may be affected by the suspension of the system operation
    iii. recognise the precautions to ensure that de-commissioned systems do not prove safety hazards and the necessary measures to prevent systems being brought into operation including the correct safety and warning notices

Unit 205/206: Maintenance of System Components-Level 2

Rationale

This unit is concerned with the routine maintenance of building services systems and specifically with the maintenance of the components within those systems. The unit deals with the justification and use of appropriate resources and procedures required to achieve the efficient running of systems and systems components by routine maintenance operations.

This unit covers:
1. The planning of resources and manpower to carry out activities
2. The preparation of the work location to carry out routine maintenance
3. The preparation of the work location to carry out testing
4. The activities necessary to de-activate and re-activate systems
5. The procedures to carry out service and maintenance
6. Diagnostic procedures to identify and rectify faults on components
7. The selection of appropriate tools and equipment

This unit is relevant to candidates who are working towards a qualification in MES Service and Maintenance.

This unit covers THREE learning outcomes. The candidate will be able to:
1. Identify and establish customer requirements and prepare the work location for routine maintenance.
2. Correctly de-activate and re-activate systems and test outcomes.
3. Diagnose faults and routinely maintain system components.

This unit combines and extends the knowledge and understanding required for units:
17. Plan and prepare for routine maintenance
18. De-activate, re-activate and test system for operation
19. Services and maintain system components of the NVQ MES 6088 Maintenance of System Components and should be read and used in conjunction with Training Specification Part 1.

Assessment
The outcome of this unit will be assessed using evidence from the underpinning knowledge requirements as listed for each outcome. These will be assessed by two multiple-choice question papers covering the three learning outcomes.

Paper 1 – 205
Paper 2 – 206

Outcome 205/206. 1: Identify and establish customer requirements and prepare the work location for routine maintenance

Underpinning Knowledge
The candidate will be able to:

1. State the different types of job information encountered as
   a. maintenance specifications and recommendations
   b. drawings
   c. statutory regulations and recommendations
      A. Health & Safety at Work Act
      B. COSHH Regulations
      C. Electricity at Work Regulations
      D. Gas Safety (Installation & Use) Regulations
      E. British Standards
      F. Codes of Practice
   d. instructions – verbal and written
   e. maintenance procedures

2. Identify and know the purpose of MES systems in terms of how they function for the following systems
   a. hot water heating
      A. LTHW systems
      B. MTHW systems
      C. HTHW systems
   b. ventilating
      A. supply
      B. extract
      C. balanced
   c. air conditioning
      A. Chilled Water systems
      B. Central Plant systems
      C. Induction systems
      D. Dual Duct systems
      E. Cassette Units
   d. water supply
      A. Cold/Boosted systems
      B. Hot Unvented/Vented systems
   e. fuel
   f. electrics/controls
   g. input services

3. Identify and know the purpose of system components
   a. boilers
   b. pumps
   c. fans
   d. air handling plant
   e. heat emitters/exchangers
   f. pressurisation units
   g. pipework systems
   h. electrics/controls

4. Describe the types and use of tools and equipment
    a. hand and power tools
    b. access equipment
    c. personal protective equipment
    d. Safety equipment

5. Identify and know the purpose of materials
    a. cleaning agents
    b. lubricating oils and grease
    c. pipework materials
        A. low Carbon Steel
        B. copper
        C. plastic
    d. jointing methods and materials
    e. Insulating materials

6. Knows the individual requirements for building structures relating to
    a. domestic premises
    b. commercial premises
    c. industrial premises
    d. occupied/unoccupied premises
    e. building fabric, fixtures and finishes
    f. building regulations (Building Standards for Scotland)

7. Identifies customer job requirements
    a. routine maintenance
    b. timing
    c. accessibility
    d. system performance
    e. legal requirements

8. Identify and describe access and safety provisions
    a. fire fighting equipment
    b. first aid
    c. accident prevention methods
    d. ladders
    e. scaffolding
    f. mechanical access equipment
    g. emergency Services

Outcome 205/206. 2: Correctly de-activate and re-activate systems and test outcomes

Underpinning Knowledge
The candidate will be able to:

1. State the correct method of communicating and relating information to
   a. customers
   b. contractors
   c. co-contractors
   d. general public
   e. liaison with other persons
   f. line managers

2. State the method of de-activating and re-activating systems as
   a. heating
   b. ventilation
   c. air conditioning
   d. water
   e. fuel
   f. electrics/controls
   g. input services

3. Identify and know the purpose of system components
   a. boilers
   b. pumps
   c. fans
   d. air handling plant
   e. heat emitters/exchangers
   f. pressurisation units
   g. pipework systems
   h. electrics/controls

4. States the industry requirements for routine maintenance
   a. statutory regulations and recommendations
      A. Gas Safety (Installation & Use) Regulations
      B. Electricity at Work Regulations
      C. 17th Edition IEE Regulations
   b. safety legislation governing activities in the workplace
      A. Health & Safety at Work Act
      B. COSHH Regulations
   c. work sequences
   d. safe systems shutdown
   e. labelling systems and components
   f. co-ordination with the work of others
   g. de-activating and re-activating techniques for routine maintenance of systems or components
   h. company procedures
   i. records and information

4. knows the methods for testing and checking the components of systems
    a. circulation
    b. airflow
    c. discharge
    d. pressure (liquid/gas)
    e. combustion efficiency
    f. electrical

Outcome205/206. 3: Diagnose faults and routinely maintain system components

Underpinning Knowledge
The candidate will be able to:

1. State the industry requirements for routine service and maintenance
   a. statutory regulations, recommendations and system documentation. (Reference Outcome 1.1; c A to E)
   b. sequences for maintenance activities
   c. co-ordination with other trades
   d. maintenance methods for
      I. cleaning
      II. lubricating
      III. adjusting
      IV. testing
      V. electrical/mechanical
      VI. repairing

2. Knows the method of routine maintenance of systems including
   a. heating
      A. LTHW systems
      B. MTHW systems
      C. HTHW systems
   b. ventilating
      A. supply
      B. extract
      C. balanced
   c. air conditioning
      A. chilled water systems
      B. central plant systems
      C. induction systems
      D. dual duct systems
      E. cassette units
   d. water
      A. cold/boosted systems
      B. hot unvented/vented systems
   e. fuel
   f. electrics/controls

3. identify and know the purpose of system components
   a. boilers
   b. pumps
   c. fans
   d. air handling plant
   e. heat emitters/exchangers
   f. pressurisation units
   g. pipework systems

4. knows the purpose of maintaining records
   a. legislative records
   b. schedules
   c. company records
   d. maintenance documents

5. identify faults as being mechanical or electrical
    a. visual inspection
    b. unusual/unacceptable noise
    c. indication of hot, cold, vibration by touch
    d. faults determined by odour
    e. use and interpretation of instrument
    f. information

6. state the precautionary actions taken when maintaining components
    a. System isolation and labelling
    b. Minimising risk
    c. Maintaining safe environments

Unit 207/208: Ductwork Systems Installation-Level 2

Rationale

This unit is concerned with the installation, testing, commissioning, de-commissioning and removal of ductwork systems, plant and equipment. The unit deals with the justification and use of appropriate resources and procedures required to achieve an efficient installation, commissioning and de-commissioning operation.

This unit covers:

The candidate will know how to:

1. Operating principles of ductwork systems, plant units and components.
2. The component parts of these systems and plant units.
3. The use of manufactures information/data for planning, scheduling and conducting installation operations.
4. The selection of appropriate tools and equipment.
5. The techniques and procedures involved in the installation process.
6. Installing components and testing systems to meet specified requirements.
7. Checks and pre - commissioning requirements to confirm satisfactory operation of the systems.
8. Checks, de-commissioning and removal requirement.

This unit is relevant to candidates who are installing ventilation and air conditioning systems.

Outcome

This unit covers SIX learning outcomes. The candidate will be able to:

1. Identify ductwork systems and plant units.
2. Use available data and resources to prepare for and carry out installation.
3. Install ductwork systems and plant units.
4. Pressure test the ductwork system components.
5. Pre - commission ductwork systems and plant units and carry out checks to show conformance to specification.
6. De-commission and remove ductwork systems and plant units.

Connection with other awards

This unit combines and extends the knowledge and understanding required for NVQ Units:

4. Install heating and ventilating system components.
5. Pre-commission and de-commission heating and ventilating systems.

Of the NVQ Heating and Ventilating installating-6088

Training specification modules.

Ductwork	Knowledge (L2) Duct K1
Ancillaries	Knowledge (L2) Duct K2
Organising	Knowledge (L2) Duct K3
People	Knowledge (L2) Duct K4
Quality	Knowledge (L2) Duct K5
Environment	Knowledge (L2) Duct K6

HVCA. Ductwork Installer Training Scheme. Modules 1 to 12, 14, 16 and17.

Assessment

The outcome for this unit will be assessed using evidence from the underpinning knowledge requirements as listed for each outcome 1-6. These will be assessed by multiple choice papers covering the six learning outcomes.

Paper 1 – 207
Paper 2 - 208

Outcome 207/208. 1: Identify ductwork systems and plant units

Underpinning knowledge
The candidate will be able to:

1. identify the factors affecting warm and cool air transferred through the ductwork and system

2. identify the factors affecting noise in ductwork systems

3. state the meaning of the terms
   a) thermal
   b) acoustic

4. state the purpose of ductwork systems
   a) supply systems
   b) extract systems
   c) re-circulation systems
   d) low pressure systems
   e) medium pressure systems
   f) high pressure systems

5. state the purpose of ductwork system components
   a) ductwork components
   b) air handling units
   c) fans, Axial and Centrifugal
   d) attenuator
   e) heater / Filter / Cooler batteries
   f) fan coil units
   g) variable air volume units
   h) regulating / motorised dampers
   i) fire dampers
   j) kitchen hoods and grease filters

6. describe the methods of bolting down or supporting
   a) air handling units
   b) axial flow fans
   c) fan coil and Variable air volume units

7. describe the working principles of ductwork systems
   a) fan coil system
   b) variable air volume system
   c) kitchen extract system
   d) ventilation systems

8. state the types of controls used on
   a) fire dampers
   b) regulating dampers

9. identify components requiring maintenance
   a) ductwork
   b) plant units

10. state the types of input service to
    a) ductwork
    b) plant units
    c) equipment

Outcome 207/208. 2: Use available data and resources to prepare for and carry out installation

Underpinning knowledge
The candidate will be able to:

1. describe how to obtain drawings and information from company files

2. state the methods of informing other trades of proposed activities to avoid unnecessary disruption

3. identify position and types of components in a ductwork system

4. identify specified installation requirements in ductwork specification DW 144

5. identify specific ductwork requirements within a planned scheme of work

6. describe the storage requirements for tools, materials, components for security and safety (long and short term)

7. state the range of tools and equipment required for the installation to enable
   a) lifting requirements
   b) manoeuvre
   c) joining ductwork components
   d) supporting and securing components
   e) cutting
   f) sealing

8. describe the types and methods of using tools for specialised tasks (in addition to standard tools and equipment)
   a) tirfors
   b) hoists (Genie)
   c) low voltage and battery operated
      i) hammer drills
      ii) grinders
      iii) jigsaws

9. list the types of equipment used for
   a) joining rectangular ducts
   b) joining circular/oval ducts
   c) cutting for access and fitting (access doors and branches)
   d) fixing supports

10. state the procedures and equipment needed for
    a) access
       i) trestles
       ii) towers and scissor lifts
       iii) fixed scaffolding
    b) material and component handling
    c) protection of vulnerable plant and components
    d) waste disposal

11. state the need for keeping copies of orders, schedules, requisitions, drawings and records of variations in the allocated places

12. state why it is necessary to forward records and documentation to appropriate persons

Outcome 207/208. 3: Install ductwork systems and plant units.

Underpinning knowledge
The candidate will be able to:

1. state how to obtain a permit to work, or take other approved procedures for working in restricted areas

2. state the specified requirements from DW 144 for
   a) types of support and maximum spacing requirements
      i) rectangular ductwork
      ii) circular ductwork
      iii) flat Oval ductwork
      iv) vertical ductwork
      vi) vapour seal to supports

3. state the specified types of cross joints and joining requirements from DW 144 for
   a) rectangular ductwork
   b) circular ductwork
   c) flat Oval ductwork

4. describe the procedures for making all types of cross joints for
   a) rectangular ducts
   b) circular ducts
   c) flat Oval ducts

5. describe how to install
   a) ductwork components
   b) brackets / supports
   c) air handling units
   d) axial flow fans
   e) centrifugal fans
   f) attenuators
   g) fan coil and variable air volume units
   h) induct plant units. (Heater / cooler / filter batteries)
   i) regulating and fire dampers
   j) hoods
   k) grilles and diffusers
   L) flexible connections
   m) flexible ducts
   n) plenum boxes
   o) access doors

6. name the types of fixings appropriate to building construction methods to support system components to
   a) hollow rib type
   b) hollow pot
   c) pre-cast beams and planks
   d) in-situ concrete
   e) brickwork
   f) steel trusses, purlins and joists
   g) timber joists

7. state the access door requirements for
    a) fire dampers
    b) regulating dampers
    c) induct plant and equipment
    d) duct cleaning requirements

8. state the specification (DW TM 2) requirements relating to the level of cleanliness of ductwork systems

9. state the procedures for isolating the working area using
    a) tapped barriers
    b) warning signs

10. state the need for providing equipment to deal with
    a) waste materials
    b) fire
    c) personal injury

11. name the correct tools and equipment required to carry out the installation operation

12. state the precautions needed to avoid damage to
    a) installed ductwork
    b) vertical ductwork
    c) air handling units
    d) fans
    e) heater / Cooler / Filter batteries
    f) fire dampers
    g) regulating dampers
    h) controls

13. state the need for protection of components from contamination and damage by
    a) cleaning using specified methods
    b) careful handling and manoeuvring
    c) storage of plant units / equipment by appropriate methods or in suitable containers
    d) covering or use of pallets for ductwork

14. describe how to make support hangers and brackets

15. describe the procedures for making
    a) rectangular, circular slip joints
    b) rectangular, circular. flat oval flange joints (all types)

16. state the correct procedures and specification requirements for installing
    a) fire ductwork
    b) special fixing material requirements
    c) support spacing

Outcome 207/208. 4: Pressure test the ductwork system components

Underpinning Knowledge
The candidate will be able to:

1. state the system operating test pressure for
   a) supply system ductwork
   b) extract system ductwork

2. state the duct pressure class for
   a) low pressure ductwork
   b) medium pressure ductwork
   c) high pressure ductwork

3. state the air leakage limits for
   a) low pressure ductwork
   b) medium pressure ductwork
   c) high pressure ductwork

4. identify the maximum air leakage rates for
   a) low pressure ductwork
   b) medium pressure ductwork
   c) high pressure ductwork

5. state the affect air leakage has on a ductwork system and the plant units at the inlet and outlet of the system

6. describe the method of working out the surface area of ductwork under test

7. explain how to set up for system test, fitting of temporary seals and test rig connection to the system
8. state the need to confirm the recommended inlet position of the test rig on the system under test

9. describe leak fault finding methods when the system exceeds the maximum leakage rate
   a) noise
   b) feel
   c) soap bubble
   d) smoke pellet (by agreement with the customer only)

10. describe how to deal with leaks located in the system under test

11. explain the need to remove temporary seals on completion of test

Outcome 207/208. 5: Pre - Commission ductwork systems and plant units and carry out checks to show conformance to specification.

Underpinning knowledge
The candidate will be able to:

1. name who needs to be informed when fire dampers are ready for drop testing

2. state the essential points to be checked when inspecting and checking components and induct plant units
   a) supports and brackets
   b) access requirements
   c) fire and smoke dampers
   d) damage, internal and external
   e) vapour seals

3. state the need to confirm the open position of all regulating and fire dampers

4. state the procedures for checking internal cleanliness of systems

5. describe the methods for checking ductwork for
   a) leaks
   b) un-removed temporary seals
   c) access locations

6. state the essential points to be examined when checking plant units
   a) condition of filters
   b) faulty flexible connections (holes)
   c) damage to heater / cooler / filter batteries
   d) the correct direction and alignment of Axial flow fans
   e) condition of anti vibration mountings
   f) loose holding down bolts

7. explain the need to confirm direction and orientation of fans and plant units

8. state the information and documentation required when completing a report following completed installation
   a) drawings
   b) manufacturers information
   c) snagging lists
   d) authority drop test reports

Outcome 207/208. 6: De-commission and remove systems

Underpinning knowledge
The candidate will be able to:

1. state how to obtain a permit to work, or take other approved procedures when removing large components at high level

2. state the need to confirm the isolation of all plant units
   a) electricity
   b) water

3. state the procedures for isolating the working area using
   a) barriers
   b) warning signs
   c) coloured tape

4. state the need for providing equipment to deal with
   a) personal injury
   b) spillage and contamination
   c) fire
   d) hazardous materials

5. name the tools and equipment required to carry out the removal and disposal of ductwork components and plant units

6. describe the sequence of dismantling a ductwork system
   a) at high level
   b) at low level

7. describe how to dismantle and remove
   a) large air handling units
   b) centrifugal fans
   c) attenuators / silencers

8. describe how to safely dispose of
   a) lagging materials
   b) ductwork

9. state the need to confirm the components for re-use, storage or disposal. c) Plant units / equipment

10. state the information required when completing a report on completion

Unit 301/302: Complex Domestic Systems Installation-Level 3

Rationale
This unit is concerned the with knowledge and understanding of Heating, Hot and Cold Water
Services, above ground Waste and Sanitary pipework systems and Fuel supply systems as are commonly used in Domestic premises / installations.

The unit deals with appropriate use of resources and procedures required to achieve an efficient installation, testing and commissioning operation

The unit covers
1. planning and preparing the installation
2. system types and their main components
3. installation processes and methods
4. selection and use of appropriate tools and equipment
5. testing, commissioning and decommissioning systems
6. finishing and checking the system as per the specification

The unit covers THREE learning outcomes. The candidate will know how to;
1. identify, plan and prepare the installation
2. install system components and pipework
3. test, pre-commission and de-commission systems

Connection with other awards
This unit is linked to;
Mechanical Engineering Services, Heating and Ventilating (Domestic) Occupational Standards and the following units of the 6088 scheme NVQ in Heating and Ventilating (Domestic) Level 3

Mandatory Units
Unit 6. Plan Heating and Ventilating Work Activities
Unit 7. Install Complex Heating and Ventilating Systems and Components
Unit 8. Commission and Decommission Heating and Ventilating Systems

Optional Units (Domestic Service and Maintenance)
Unit 12. General Service and Maintenance of Domestic Systems and Components
Unit 14. Apply Domestic System Design Principles

Optional Units (Domestic Designing and Programming Systems)
Unit 15. Design Heating and Ventilating Systems
Unit 16. Specify Programmes for Working on Heating and Ventilating Systems

Assessment

The outcomes from this unit will be assessed by two multiple choice question papers covering the three outcomes.

Paper 1 - 301
Paper 2 - 302

The underpinning knowledge requirements are listed for each outcome

Outcome 301/302.1. Identify, Plan and Prepare the Installation

Underpinning knowledge
The candidate will be able to:

1. identify the different types of dwellings as being;
   a. bungalows
   b. single and multi-storey flats / apartments
   c. detached and semi detached houses
   d. terraced houses

2. describe the main structural elements, the materials used and the construction methods of domestic dwellings listed in 1. a - d
   a. structural elements
      i. foundations / substructure
      ii. superstructure / walls / framing
      iii. weatherings / roofs
   b. construction methods
      i. foundations - raft / strip / pile
      ii. walls - load / non-load bearing
      iii. timber / steel frame
      iv. weatherings / claddings / roofs
   c. materials
      i. brick / block / concrete
      ii. timber / steel framing
      iii. cement / plaster
      iv. plasterboard / tiles
      v. synthetic weatherings

3. identify the types of services / system to be installed in dwellings as being:
   a. Cold Water Service
      i. Mains
      ii. Indirect
   b. Hot Water Service
      i. Direct
      ii. Indirect
      iii. Unvented
   c. Hot Water Heating
   d. Warm Air (Ducted) Heating
   e. Waste and Sanitary (above ground) pipework
   f. Fuel
      i. Gas
      ii. Oil
      iii. Solid

4. identify components from drawings, specifications and other data as listed below:
   a. installation drawings
   b. client bills of quantity and specifications
   c. manufacturers manuals and instructions
   d. other data sheets

5. identify and select, from specifications and manufactures brochures, suitable fixing and mounting devices, for the components identified in 1.4 a - d above, to include:
   a. screws / plugs / rawl bolts / drill anchors / toggle bolts
   b. pipe rings / saddle clips
   c. LCS - flat / angle / channel
   d. uni-strut and other proprietry mounting systems

6. interpret installation drawings for the purpose of:
   a. determining material requirements sufficient to complete the installation v/v
      i. listing / ordering, components and materials
      ii. organising safe storage of same, to avoid loss or damage
      iii. maintaining supply / advice / delivery records and documents
      iv. control procedures in the event of incorrect or defective supplies
   b. identifying tools and equipment for:
      i. lifting
      ii. manoeuvring
      iii. positioning
      iv. jointing
      v. supporting
   c. maintaining tools and equipment in safe and efficient working operation
   d. ensuring that the correct electrical supplies are available
   e. checking that all foundations and plinths are in the correct locations
   f. checking that all wall structures are suitable for hanging components
   g. producing a sequence of operations for the installation
   h. ensuring that all components are correctly located

7. identify and interpret the relevant documents and regulations referring to the installation of heating systems into domestic dwellings / properties:
   a. British Standards
   b. HASAWA / Construction HSaW regulations / COSHH
   c. Building regulations / Local planning & development
   d. gas / oil / solid fuel / regulations
   e. water / electricity regulations
   f. manual lifting and handling regulations

8. state the colour identification coding for:
   a. pipe work systems
   b. electrical wiring
   c. gas cylinders

9. identify from specifications, manufacturers manuals and written / verbal instructions:
   a. correct installation methods of components
   b. the structural elements of the building prior to installation
      i. for the purpose of fixing components
      ii. for the purpose of commissioning the installation
   c. the type and condition of input services
   d. the type of tests required

10. state need to and, reasons for, developing sound customer / client relationships by:
   a. applying appropriate measures to protect customers property during installation for:
      i. building fabric/ decor
      ii. contents / furnishings / fixings
      iii. cost / efficiency
      iv. promoting company image via personal presentation and actions
   b. reporting any pre / post installation damage to appropriate person v/v:
      i. customer / client
      ii. supervisor / line manager / employer
      iii. co-worker / contractor
   c. maintaining customer care via
      i. monitoring customer satisfaction at regular intervals
      ii. recording and acting upon deficiencies
      iii. recording and acting upon complaints

11. describe the function of the following members of the construction team:
    a. client / architect / surveyor / clerk of works
    b. main / sub contractor /
    c. building services / design engineer
    d. supervisor / tradesman / apprentice / trainee

12. explain the principles of sound working relationships and improved communications with co-workers, line managers and other contractors in pursuit of:
    a. improved efficiency
    b. better organisation
    c. prevention of unnecessary disruption
    d. greater degree of safety

13. explain the methods available and the advantages of using clear and precise:
    a. verbal and written communication
    b. telephone / fax / pager / e-mail communications

14. describe methods / factors and action in event of alterations in work programming:
    a. block programming / bar chart / critical path analysis
    b. identification of requested / required variations to programme
    c. need for variation order(s)
    d. person(s) to report to

15. describe possible factors that may affect work programmes / schedules:
    a. availability of labour
    b. availability of materials
    c. weather conditions
    d. industrial action
    e. costing / inflation
    f. other trades / contractors / sub contractors

16. identify and interpret appropriate documents relating to responsibilities for, and factors to be observed, prior / during / after work activity:
    a. personal protective equipment (PPE)
        i. overalls / boots / gloves
        ii. hard hat / goggles/ ear defenders
    b. tools and equipment - correct use and training
    c. working at heights
        i. ladders - angle / height / securing of / extension
        ii. scaffolding - mobile / fixed / toe boards / hand rails / stability of
    d. working in confined space
        i. trenches & ducts - side walls / surrounding areas
        ii. tanks - fumes / lack of oxygen / fire
        iii. supervision / safety personnel / emergency escape procedures
    e. fire fighting equipment and action
    f. first aid - where to access and action to take
    g. accident prevention - induction and training

17. describe the input services necessary prior to, and during the installation as being:
    a. electricity - voltage dependant on rating of equipment and components
    b. gas - type and pressure dependent on components and installation
    c. water - sufficient pressure for installation requirements and testing

18. explain how, input services (identified in 15 above), can be confirmed as suitable
    a. electricity
        i. data badges on appliances
        ii. compatibility of plugs and sockets
        iii. identification of competent installer
    b. gas
        i. data badges on appliances
        ii. manufacturers installation and servicing documents
        iii. tightness testing
        iv. pipe / meter sizing check
    c. water
        i. visual check / pressure testing installation
        ii. water flow rate

19. identify course of action to be taken, if and when input services are not suitable, by
    a. reporting to relevant persons
    b. describing how input services should be isolated

Outcome 301/302. 2. Install Systems, Components & Pipework

Underpinning Knowledge
The candidate will be able to:

1. identify and describe the working principles of the type of service / system to be installed as being:
   a. heating
      i. open vented / sealed
      ii. single / two pipe
      iii. small bore / mini-bore / micro bore
      iv. ducted warm air
   b. hot water
      i. open vented / unvented
      ii. direct / indirect
   c. cold water
      i. mains / indirect
      ii. storage / non-storage
   d. fuel
      i. gas
      ii. oil
      iii. solid

2. identify and describe heating system selection criteria / requirements (as listed in 1.a. i - iv above) in terms of:
   a. occupancy comfort conditions
   b. building fabric protection
   c. thermal insulation properties
   d. selection / sizing / positioning of heat emitters,
   e. water / air temperatures
   f. components / fittings / materials
   g. identification codings

3. identify and describe hot and cold water system selection criteria / requirements (as listed in 1.b & c. i - ii above) in terms of:
   a. occupancy / usage / flow rates
   b. storage quantities and temperatures
   c. hygiene / bacteria control
   d. components / fittings / materials
   e. identification codings

4. describe fuel systems selection criteria / requirements (as listed in 1.d. i - iii above) in terms of:
   a. availability / supply / usage
   b. storage / pipeline requirements
   c. controls / pumps / boosters
   d. safe handling and storage
   e. components / fittings / materials
   f. identification codings

5. identify, state the function and working principles, the relative position and the inter-relationship of, the various components used in the systems identified in 1a - d, above
   a. boilers
      i. freestanding / wall mounted / inset fire side
      ii. conventional / balanced / fan flued
      iii. system / combi / condensing
      iv. gas / electric, vented / un-vented water heaters

v. gas / oil / solid fuel

b. circulating pumps

c. heat emitters
   i. radiators
   ii. natural & mechanical convectors
   iii. skirting heaters
   iv. embedded and radiant panel heating

d. pipes, tubes and fittings
   i. copper tubes and fittings
   ii. plastic tubes and fittings
   iii. LCS tubes and malleable fittings

e. cylinders, cisterns and tanks
   i. direct / indirect / self priming cylinders
   ii. plastic / galvanised cisterns
   iii. DHW storage / feed & expansion cisterns
   iv. direct / indirect combination tanks
   vi. plastic / steel oil fuel tanks
   vii. pressurisation vessels and units

f. valves and system components
   i. thermostatic (TRV) radiator valve
   ii. wheel / lock shield radiator valve
   iii. isolating / regulating valves
   iv. pressure relief (PRV) valve
   v. fill loop / double check valve
   iv. CWS stop valve
   iiv drain valve
   iiiv two / three port motorised valve
   ix. float operated valve
   x. strainer
   xi. non return valve
   xii. ball valve

g. thermostats
   i. boiler stat
   ii. boiler high limit stat
   iii. room stat
   iv. frost stat
   v. cylinder stat

6. interpret system drawings and describe the installation sequence of systems (listed in 1. a - d above) as for:
   a. drawings / symbols / conventions
   b. job specifications / bills of quantities
   c. ordering / delivery / receipt of materials, components and equipment
   d. positioning / fixing, brackets / supports
   e. positioning / fixing, pipework / components
   f. testing / commissioning installation

7. describe procedure and method for 'breaking' into / connecting to existing systems v/v:
   a. authorisation
   b. isolation / decommissioning
   c. testing / commissioning

8. identify and relate the requirements for the marking out, positioning and fixing of the components as listed in 2a - g above

9. identify and select appropriate fixing devices to be used when installing / fixing the components as listed in 2a - g above

10. state the requirements for the positioning of brackets for pipework, as recommended in BS 6880

11. describe the installation methods and techniques when using copper, steel and plastic tubes and fittings in the systems listed in 1a - d above
    a. selecting and completing appropriate jointing methods
    b. methods and techniques of bending / manipulation
    c. selecting and using appropriate tools
    d. selecting and using appropriate bracketing devices
        i. pipe rings / clips
        ii. screw to wood / build in brackets
        iii. fabricated / 'uni-strut' bracketing systems

12. identify and describe the requirements of the Building, Gas, Oil and Solid Fuel regulations for flues
    a. types of flue for gas, oil and solid fuel
    b. construction of flues for gas, oil and solid fuel
    c. location and safe termination of gas, oil and solid fuel flues

13. identify and describe the requirements of the Building, Gas, Oil and Solid Fuel regulations for the storage and installation of:
    a. Fuel oil tanks and pipework
    b. Gas pipework
    c. Solid Fuel stores

14. identify and describe the requirements for the connection of input services to the system as for:
    a. electricity (v/v 17th edition IEE regulations)
    b. gas / oil
    c. water (v/v water byelaws)
    d. above ground drainage

15. identify and describe the good practices to be observed when working in a customers property in regard to:
    a. site and property access
    b. storage of tools and equipment
    c. protection of furnishings and fittings
    d. safe and effective working practices:
        i. occupied / unoccupied premises

16. describe factors of best practice, via discussion / negotiation, with other trades / client / client representatives, ensuring work continuity throughout the installation sequence.

Outcome 301/302. 3. Test, Pre-Commission and De-Commission systems

Underpinning knowledge
The candidate will be able to:

1. identify and describe the content of, documents required prior to commencement of commissioning / testing and state where the documents can be accessed:
   a. documentation
      i. commissioning specification
      ii. manufacturers specification / installation instructions
      iii. installation specification
      iv. test records / certificates
   b. access
      i. client / client representative
      ii. HMSO (British Standards) / library
      iii. company office / manufacturer

2. describe the pre-commissioning procedures / checks required for, systems, components and materials (listed under 2.1a-d, 2.5a-g & 2.11a-d), using:
   a. installation drawings / job specification
   b. statutory recommendations / standards compliance
   c. industry procedures / manufacturers documentation
   d. visual / mechanical inspection
   c. input services data / specifications

3. identify and describe the testing procedures / checks required for, systems, components and materials (listed under 2.1 a-d, 2.5a-g & 2.11a-d), above) as being system:
   a. readiness to undergo testing
   b. visually checked
   c. suitability for a water test to take place
   d. suitability for air / nitrogen test
   e. mechanical / dynamic testing

4. identify and describe the operation of / requirement contained by the:
   a. equipment required to carry out
   b. relevant test specification
   c. test pressures required by the relevant specification, to ensure soundness / tightness of the installation

5. identify and describe the procedures for and maintenance of:
   a. necessary records / certificates of testing required by the:
      i. client / customer
      ii. customers agent / landlord
      iii. employees company
      iv. system handover
   b. procedures / records required in cases of test failure

6. identify and describe the sequence of requirements for system cleansing / filling / charging as being:
   a. flushing including use of cleansing agents
   b. checking the effectiveness of the flushing process
   c. addition of charging agents / inhibitors
   d. filling / venting
   e. testing for soundness / tightness

7. identify and describe the requirements for the
   a. pre-commissioning checks for systems (listed under outcome 2.1 a-d above)
   b. commissioning of:
      i. systems as listed under outcome 2.1 a-d
      ii. components as listed under outcome 2.5 a-g
   c. identifying data required commissioning activities in b. i & ii
   d. reporting to responsible persons following system fault or failure
      i. line manager
      ii. manufacturers of components
      iii. client / client representative

8. identify and describe the requirements for the de-commissioning of systems as being:
   a. establishing current system / component performance prior to de-commissioning
   b. reporting / liaison procedures prior to suspending operation of the system v/v
      i. line manager
      ii. client / client representative
   c. safe and effective draining and disposal of system contents
      i. water containing contaminants
      ii. gas purging
      iii. oil
   d. measures to prevent systems being brought into operation by:
      i. safe and effective isolation of system and its components
      ii. use of safety / warning notices

Unit 303/304: Complex Industrial and Commercial Systems Installation

Rationale

This document is concerned with the underpinning knowledge required for the Installation of Industrial Heating, Hot/Cold/ Chilled water Services and Fuel Systems.
The areas covered within this specification are

1. Identifying and using the documents associated with, and relevant to, the planning and installation of a systems
2. The planning and organising of tools materials, plant and labour to ensure efficient installation procedures
3. Identification of common building types and materials
4. The installation procedure/sequence for system components
5. The testing/commissioning procedures and documentation
6. Decommissioning procedures and documentation.

The unit covers THREE performance outcomes. The candidate will know how to:

1. Identify the Planning and Preparation requirements prior to commencement of system installation
2. Understand the layout of systems and the function of the system components
3. Identify the need for, and the processes involved in - commissioning and de-commissioning

Connection with other awards

This unit is linked to Mechanical Engineering Services, Heating and Ventilating (Industrial and Commercial Installation) NVQ scheme 6088 units and should be used in conjunction with H/V Training Specification 1

Unit 6 Plan heating an ventilating work activities
Unit 7 Install complex heating and ventilating systems and components
Unit 8 Commission and decommission heating and ventilating systems
Unit 9 Prepare resources for welding activities
Unit 10 Install pipework by welding
Unit 11 General service and maintenance of Industrial & Commercial systems and components
Unit 15 Design heating and ventilating systems
Unit 16 Specify programmes for working on heating and ventilating systems

Assessment

The outcomes from this unit will be assessed by two multiple choice question papers covering the three outcomes

Paper 1 – 303
Paper 2 - 304

The underpinning knowledge requirements are listed for each outcome

Outcome 303/304. 1 Identify the planning and preparation requirements prior to the commencement of system installation.

Underpinning knowledge
The candidate will be able to:

1. Identify, within the workplace

    a. Structural components
    b. Methods of construction
    c. Materials used in construction
    d. Input services

2. State methods of supporting installation components

    a. Fixings
    b. Brackets

3. Identify appropriate documents associated with the installation of industrial systems

    a. Safety

        i. Health and safety at Work Act
        ii. Electricity at Work regulations
        iii. Gas regulations
        iv. COSHH regulations
        v. Construction regulations

    b. Installation

        i. Drawings
        ii. Job specification
        iii. Manufacturers instructions
        iv. Company procedures
        v. British Standards
        vi. Building regulations
        vii. Test certificates
        viii. Job programmes / bar charts

4. Identify the workplace is suitable for work to proceed for the following systems:

    a. Heating
        i. LPHW heating
        ii. MPHW heating
        iii. HPHW heating
        iv. Steam systems

    b. Water systems
        i. Indirect cold water
        ii. Direct cold water
        iii. Indirect hot water
        iv. Direct hot water
        v. Unvented hot water

c. Ducted systems
    i. Warm air heating
    ii. Air conditioning
    iii. Ventilation

d. Fuel
    i. Gas
    ii. Oil

5. Identify and quantify resources

a. materials and components
b. equipment
c. labour and support

6. State methods of communication within the workplace

a. written
    i. notes
    ii. messages
    iii. sketches

b. Oral
    i. Verbal instructions
    ii. Telephone

c. Electronic
    i. e-mail
    ii. Fax

Outcome 303/304. 2 Understand the layout of systems and the function of system components.

Underpinning knowledge
The candidate will be able to:

1. State the working principles of the following systems

    a. Heating
        i. LPHW heating
        ii. MPHW heating
        iii. HPHW heating Mains cold water
        iv. Steam systems

    b. Water systems
        i. Indirect cold water
        ii. Direct cold water
        iii. Indirect hot water
        iv. Direct hot water
        v. Unvented hot water

    c. Ducted systems
        i. Warm air heating
        ii. Air conditioning
        iii. Ventilation

    d. Fuel
        i. Gas
        ii. Oil

2. Identify the system components and their function

    a. heating

        i. pipework/fittings
        ii. storage/expansion/pressurisation vessels
        iii. boilers
        iv. controls
        v. pumps
        vi. heat exchangers

    b. Water systems

        i. Pipework/fittings
        ii. Storage vessels
        iii. Heat exchangers
        iv. Controls
        v. Pumps
        vi. Draw-off points

c. Ductwork systems

i. Ductwork/grilles
ii. Fans
iii. Heat exchangers
iv. Humidifiers/de-humidifiers
v. Filters
vi. Controls

3. Describe methods of joining and connecting components for systems

a. heating

i. LPHW
ii. MPHW
iii. HPHW
iv. Steam

b. water

i. potable
ii. non-potable

c. ductwork

i. low pressure system (rectangular)
ii. high pressure system (round)

4. States the information which can be accessed from the following documents

a. drawings
b. job specifications
c. manufacturers literature/instructions
d. British Standards
e. Guide books

Outcome 303/304. 3 Identify the need for, and the process of commissioning and de-commissioning

Underpinning knowledge
Candidates will be able to:

1. describes methods of filling and testing the following systems

   a. Heating
      i. LPHW heating
      ii. MPHW heating
      iii. HPHW heating Mains cold water
      iv. Steam systems

   b. Water systems
      i. Indirect cold water
      ii. Direct cold water
      iii. Indirect hot water
      iv. Direct hot water
      v. Unvented hot water

   c. Ducted systems
      i. Warm air heating
      ii. Air conditioning
      iii. Ventilation
      iv.

   d. Fuel
      i. Gas
      ii. Oil

2. Identifies the commissioning procedures for system components

   a. heating

      i. pipework/fittings
      ii. storage/expansion/pressurisation vessels
      iii. boilers
      iv. controls
      v. pumps
      vi. heat exchangers

   b. Water systems

      i. Pipework/fittings
      ii. Storage vessels
      iii. Heat exchangers
      iv. Controls
      v. Pumps
      vi. Draw-off points

c. Ductwork systems

i. Ductwork/grilles
ii. Fans
iii. Heat exchangers
iv. Humidifiers/de-humidifiers
v. Filters
vi. Controls

Unit Component Assessment Number 001: Level 3 Welding (linked to unit assessments 303/304)

Rationale
This unit covers the underpinning knowledge for welding processes and standards required by operatives in the heating and Ventilation industry, and supplement the mandatory unit 'Level 3 Heating and Ventilating Installation'. The welding processes referred to include both oxy-acetylene and manual metal arc and cover 'all positional welding' techniques.
The unit ranges from the preparation stages of the process through to the assembly and fault finding/ testing and of the finished product.

Outcomes
There are three outcomes to this unit. The candidate will know how able to:

1. Understand the need for planning and preparation of the work area and equipment
2. Identify welding techniques and processes
3. Identify testing procedures and techniques

Connection with other awards
This unit is linked to Mechanical Engineering Services, Heating and Ventilating (Industrial and Commercial Installation) Occupational Standards and should be used in conjunction with H/V Training Specification 1

Unit 9. Prepare resources for welding activities
Unit 10. Install gas pipework by welding

Assessment
The outcomes from this unit will be assessed by one multiple choice question paper covering the three outcomes

Paper 1 - 001

The underpinning knowledge requirements are listed for each outcome

Outcome 001. 1 State the need for planning and preparation of the work area and equipment

The candidate will be able to:

1. State the planning and preparation requirements for the welding processes of positional and rotated techniques on mild steel pipes.

    a. oxy-acetylene techniques

        i. down hand
        ii. vertical
        iii. horizontal vertical
        iv. overhead
        v. set-on branch

    b. manual metal arc processes

        i. down hand
        ii. vertical
        iii. horizontal vertical
        iv. overhead
        v. set-on branch

2. Identify the features of work locations

    a. input services
    b. structural materials
    c. storage requirements for welding equipment

3. Identify the relevant documents associated with welding processes in work locations

    a. Safety

        i. Health and Safety act
        ii. Electricity at Work regulations
        iii. Gas regulations
        iv. COSHH regulations
        v. Construction regulations

    b. Installation by welding

        i. Drawings
        ii. Job specification
        iii. Manufacturers instruction
        iv. Company procedures
        v. British standards
        vi. Building regulations
        vii. Test certificates
        viii. Codes of Practice

4. Identify and quantify welding resources

   a. materials and resources
   b. equipment
   c. labour and support

5. States factors involved to ensure continuity of work

   a. working with others
   b. availability of resources
   c. formal work programmes
   d. customers

6. Identify methods of maintaining a safe working environment

   a. first aid equipment
   b. PPE
   c. Risk assessment
   d. Lifting /handling/access/tools and equipment
   e. Ventilation
   f. Fire fighting equipment
   g. Work planning

Outcome 001. 2 Identify welding techniques and processes

The candidate will be able to:

1. States the welding techniques and factors associated with thermal joining of mild steel pipework and fittings in the rotated and fixed positions.

    a. Oxy-acetylene

        i. Assembling equipment
        ii. Setting pressures
        iii. Selection appropriate consumables
        iv. Pipe end preparation
        v. Set up/tacking
        vi. Flame type
        vii. Nozzle and rod angles
        viii. Root /side wall penetration
        ix. Reinforcement
        x. Heat affected zone
        xi. Crystal structure
        xii. Grain growth
        xiii. Safety of equipment and personnel

    b. Manual metal arc

        i. Assembling equipment
        ii. Setting amps/volts
        iii. Electrode selection
        iv. Rod angles
        v. Root/side wall penetration
        vi. Reinforcement
        vii. Heat affected zone
        viii. Crystal structure
        ix. Grain growth
        x. Safety of equipment and personnel

2. Identify faults of welded product

    a. Oxy-acetylene

        i. Lack of root/side wall penetration
        ii. Lack of reinforcement
        iii. Irregular surface finish
        iv. Undercut
        v. porosity

    b. manual metal arc

        i. Lack of root/side wall penetration
        ii. Lack of reinforcement
        iii. irregular surface finish
        iv. Undercut
        v. Porosity
        vi. Inclusions

3. Identifies methods to rectify faults in completed welded product

    a. Oxy-acetylene
    b. Manual metal arc

4. States the function of welding components

    a. oxy-acetylene

        i. cylinders
        ii. gauges
        iii. safety devices
        iv. hoses
        v. mixing chamber
        vi. nozzles
        vii. rods
        viii. safety equipment

    b. manual metal arc

        i. transformers
        ii. rectifiers
        iii. generators
        iv. welding cables
        v. electrode holder
        vi. electrodes
        vii. safety equipment

Outcome 001. 3 *Identify testing procedures and techniques*

The candidate will be able to:

1. State the standards required for pipe welding in the H/V industry

    a. Industry standards
    b. British standards

2. Describe methods of testing completed welds

    a. Destructive

        i. root bend
        ii. face bend
        iii. visual
        iv. macro-etching

    b. Non-destructive

        i. hydraulic/pneumatic pressure
        ii. ultra-sonic
        iii. x-ray

3. Identify equipment required for carrying out weld testing

    a. destructive
    b. non-destructive

4. Identify the relevant documents associated with weld testing in the workplace

    a. British standards
    b. Industry standards
    c. Job specification

Unit 305/306: Rectification of Systems-Level 3

Rationale

This unit is concerned with the diagnosis, rectification and modification of faults in building services systems and specifically the replacement of component within those systems and providing solutions to upgrade or modify. The unit deals with the justification and use of appropriate resources and procedures required to achieve the efficient running of systems and systems components to provide optimum performance.

This unit covers:

1. The identification and establishment of faults within systems and components
2. The planning and preparation of resources to meet customer requirements
3. The production of programmes for rectification and modification to take place
4. The activities necessary to de-commission and re-commission systems
5. The diagnostic procedures necessary to ascertain the causation of faults
6. The preparation of work locations in readiness for rectification and modification to take place
7. The rectification and modification of systems/components to meet requirements

This unit is relevant to candidates who are working towards a qualification in MES Rectification of Systems.

Outcome

This unit covers THREE learning outcomes. The candidate will know how to:

1. Identify and establish customer requirements and prepare the work location to rectify/modify systems and components.
2. Correctly de-commission and re-commission systems and test outcomes.
3. Diagnose and rectify system failure and modify systems.

This unit combines and extends the knowledge and understanding required for units:

20 Plan to rectify/modify systems
21 De-commission and re-commission systems
22 Rectify system failure and modify systems of the NVQ MES 6088 Rectification of Systems and should be read and used in conjunction with Training Specification Part 1.

Assessment

The outcome of this unit will be assessed using evidence from the underpinning knowledge requirements are listed for each outcome. These will be assessed by two multiple-choice question papers covering the three outcomes.

Paper 1 – 305
Paper 2 – 306

Outcome 305/306. 1 Identify and establish customer requirements and prepare the work location to rectify/modify systems and components

Underpinning Knowledge
The candidate will be able to:

1. state the requirement for rectification/modification of systems as
   a. heating
      A. LTHW systems
      B. MTHW systems
      C. HTHW systems
   b. ventilating
      A. supply
      B. extract
      C. balanced
   c. air conditioning
      A. chilled water systems
      B. central plant systems
      C. induction systems
      D. dual duct systems
      E. cassette units
   d. water
      A. cold/boosted systems
      B. hot unvented/vented systems
   e. fuel
   f. electrics/controls

2. identify system faults by
   a. symptoms
   b. fault location techniques

3. identify the features and structures of work locations
   a. the intended use of structures
   b. methods of construction and materials used
   c. rectification/modification requirements
   d. availability of input services

4. state the industry requirements
   a. current statutory regulations and recommendations
      A. Health & Safety at Work Act
      B. COSHH Regulations
      C. Electricity at Work Regulations
      D. Gas Safety (Installation & Use) Regulations
      E. 17th Edition IEE Wiring Regulations
      F. British Standards
      G. Codes of Practice
   b. Specifications
   c. Company procedures
   d. Codes of practice

5. describes the methods of presenting information and reaching agreement
   a. oral
   b. written
   c. visual
   d. the use of Information and Communication Technology
   e. standard Company issues

6. identify and establish resources
    a. labour requirements
    b. materials and availability
    c. equipment and availability

7. establishes and agrees programmes
    a. customer
    b. different types of customers
    c. other workers
    d. access to work location
    e. availability of personnel
    f. programmes of work
    g. standard form of contract
    h. industry documentation
    i. safety legislation
        A. Health & Safety at Work Act

Outcome 305/306. 2 Correctly de-commission and re-commission systems and test outcomes

Underpinning Knowledge
The candidate will be able to:

1. identify and know the purpose of systems in terms of function, including
   a. heating
      A. LTHW systems
      B. MTHW systems
      C. HTHW systems
   b. ventilating
      A. Supply
      B. Extract
      C. Balanced
   c. air conditioning
      A. Chilled Water systems
      B. Central Plant systems
      C. Induction systems
      D. Dual Duct systems
      E. Cassette Units
   d. water
      A. Cold/Boosted systems
      B. Hot Unvented/Vented systems
   e. fuel
   f. electrics/controls

2. identify and know the purpose of system components
   a. boilers
   b. pumps (centrifugal/induction)
   c. fans (centrifugal/axial)
   d. air handling plants
   e. heat emitters/exchangers
   f. pressurisation units
   g. pipework systems (or parts thereof)
   h. electrics/controls (actuators/sensors)

3. state the industry requirements for the de-commissioning/re-commissioning systems
   a. current statutory regulations and recommendations
      A. Health & Safety at Work Act
      B. Gas Safety (Installation & Use) Regulations
      C. 17th Edition IEE Wiring Regulations
      D. British Standards
   b. safety legislation in the workplace
      A. Electricity at Work Regulations
      B. COSHH Regulations
   c. work sequences
   d. co-ordination with the work of others
   e. de-commissioning techniques for systems/components
   f. re-commissioning techniques for systems/components
   g. company procedures
   h. manufacturer's recommendations

4. describe the procedures for carrying out tests to establish
    a. pressure
    b. temperature
    c. humidity
    d. leakage
    e. voltage
    f. resistance
    g. loop impedance
    h. amperage
    i. rotational speed/direction
    j. polarity
    k. safe isolation
    l. continuity and insulation

5. states how to access and use information
    a. maintenance specifications
    b. installation specifications
    c. maintenance schedules
    d. manufacturer’s information
    e. statutory regulations and recommendations

Outcome 305/306. 3 Diagnose and rectify system failure and modify systems

Underpinning Knowledge:
The candidate will be able to:

1. identify faults in systems and components as
   a. mechanical
   b. electrical
   c. electronic (substitution and sub-assembly)

2. describe the diagnostic procedures for identifying faults
   a. statutory regulations, recommendations and system documentation
   b. visual inspection
   c. unusual/unacceptable noise
   d. indication of hot, cold, vibration by touch
   e. faults determined by odour
   f. use and interpretation of instrument information
   g. testing of systems and components
   h. performance testing
   i. maintenance practices and procedures
   j. co-ordination with other trades/customers

3. describe systems in place to maintain the safe working environment
   a. personal protective equipment
   b. fire fighting equipment
   c. first aid
   d. accident prevention methods
   e. tools and equipment
   f. risk assessment
   g. permit to work
   h. access equipment
   i. substances
   j. hand tools power tools

4. identify appropriate solutions for rectifying and modifying systems
   a. re-routing of pipework
   b. re-location of individual components
   c. substitution components
   d. rectify component faults

5. identify and know the purpose of systems in terms of function
   a) heating
      A. LTHW systems
      B. MTHW systems
      C. HTHW systems
   b) ventilating
      A. supply
      B. extract
      C. balanced
   c) air conditioning
      A. chilled Water systems
      B. central Plant systems
      C. induction systems
      D. dual Duct systems
      E. cassette Units
   d) water
   e) fuel

f) electrics/controls

6. identify and know the purpose of system components
   a. boilers
   b. pumps (centrifugal/induction)
   c. fans (centrifugal/axial)
   d. air handling plants
   e. heat emitters/exchangers
   f. pressurisation units
   g. pipework systems (or parts thereof)
   h. electrics/controls (actuators/sensors)

7. correctly identify supply services
   a. water
   b. gas
   c. electricity
   d. oil
   e. drainage
   f. solid fuel

Unit 307/308: Complex Ductwork Systems-Level 3

Rationale

This unit is concerned with the installation, testing, commissioning, de-commissioning and removal of ductwork systems, plant and equipment. The unit deals with the justification and use of appropriate resources and procedures required to achieve an efficient installation, commissioning and de-commissioning operation.

This unit covers:
The candidate will know how to:

1. Operating principles of ductwork systems, plant units and components.
2. The component parts of these systems and plant units.
3. The use of manufactures information/data for planning, scheduling and conducting installation operations.
4. The selection of appropriate tools and equipment.
5. The techniques and procedures involved in the installation process.
6. Installing components and testing systems to meet specified requirements.
7. The checks and commissioning requirements to confirm satisfactory operation of the systems.
8. The checks, de-commissioning and removal requirement.

This unit is relevant to candidates who are installing ventilation and air conditioning systems.

Outcome

This unit covers FIVE learning outcomes. The candidate will be able to:

1. Identify ductwork systems and plant units.
2. Use available data and resources to prepare for and carry out installation.
3. Install ductwork systems and plant units.
4. Commission ductwork systems and plant units and carry out checks to show conformance to specification.
5. De-commission and remove ductwork systems and plant units.

Connection with other awards

This unit combines and extends the knowledge and understanding required for NVQ Units **:**

6. Plan heating and ventilating work activities.
7. Install complex heating and ventilating systems and components.
8. Commission and De-commission heating and ventilating systems.

Of the NVQ Heating and ventilating Installation Level scheme 6088

Training Specification modules.	Ductwork	Knowledge (L3) K1
	Ancillaries	Knowledge (L3) K2
	Organising	Knowledge (L3) K3
	People	Knowledge (L3) K4
	Quality	Knowledge (L3) K5
	Environment	Knowledge (L3) K6

HVCA. Ductwork Installers Training Scheme. Modules. 1 to 14, 16 and17.

Assessment

The outcome for these units will be assessed using multiple choice question papers covering the outcomes 1 to 5.

Paper 1 – 307
Paper 2 – 308

Outcome 307/308. 1 Identify ductwork systems and plant units

Underpinning knowledge
The candidate will be able to:

1. explain the principles and factors affecting warm and cool air transferred through the ductwork system

2. explain the factors and why they generate noise in ductwork systems

3. explain why ductwork design has to take into consideration the following
   a) thermal
   b) acoustic

4. explain the function of ductwork systems
   a) supply systems
   b) extract systems
   c) re-circulation systems
   d) low pressure systems
   e) medium pressure systems
   f) high pressure systems

5. explain the function of system components
   a) air handling units
   b) fans, Axial and Centrifugal
   c) attenuator
   d) heater / Filter / Cooler batteries
   e) fan coil units
   f) variable air volume units
   g) regulating / motorised dampers
   h) fire dampers
   i) kitchen hoods and grease filters

6. explain how to fit drives and tension V belts on centrifugal fans

7. explain the function and working principles of ductwork systems
   a) fan coil system
   b) variable air volume system
   c) kitchen extract system

8. explain the control methods used on
   a) fire dampers
   b) regulating dampers

9. explain the maintenance requirements of
   a) ductwork
   b) plant units
   c) induct equipment

10. explain the input service requirements to
    a) ductwork
    b) plant units
    c) induct equipment

Outcome 307/308. 2: Use available data and resources to prepare for and carry out installation.

Underpinning knowledge
The candidate will be able to:

1. explain how to obtain specifications and information to ensure compliance with design requirements

2. explain the methods and action required to inform other trades of proposed activities to avoid unnecessary disruption

3. explain the specific installation requirements in ductwork specification DW 144

4. explain how to monitor progress against a programme of work

5. explain how to agree revisions / modifications to
   a) work programmes
   b) construction programmes
   c) ductwork systems and components

6. identify specific ductwork requirements within a construction programme

7. state the tool and equipment identification methods (use of catalogue numbers and codes) and the procedures for obtaining spare parts

8. explain how to arrange the storage requirements for tools, materials, components for security and safety (long and short term)

9. explain the use of tools and equipment required for the installation to enable
   a) lifting requirements
   b) manoeuvre
   c) joining ductwork components
   d) supporting and securing components
   e) cutting
   f) sealing

10. explain the types and use of equipment for installing and
    a) joining rectangular ducts
    b) joining circular ducts
    c) cutting for access and fitting (access doors and branches)

11. explain the procedures for obtaining equipment needed for
    a) access
       i) trestles
       ii) towers and scissor lifts
       iii) fixed scaffolding
    b) material and component handling
    c) protection of vulnerable plant and components
    d) waste disposal

12. explain the reasons for producing copies of orders, schedules, requisitions, drawings and records of variations in the allocated places

13. explain who requires records and documentation of installation work being carried out

Outcome 307/308. 3 Install ductwork systems and plant units

Underpinning knowledge
The candidate will be able to:

1. explain how to organise with appropriate people a permit to work, or take other approved procedures for working in restricted areas

2. explain the specification and operational features of the system to be installed
   a) special consideration as prescribed in the specification and layout drawings
   b) access consideration to induct plant units and equipment
   c) types of fixings appropriate to building construction methods and system components
   d) how the system may interact or affect other systems or services
   e) the specification requirements relating to the level of cleanliness of the systems

3. explain the reasons and who needs to be informed when isolating the working area using
   a) tapped barriers
   b) warning signs

4. explain who provides equipment to deal with
   a) waste materials
   b) fire
   c) personal injury

5. explain and justify the use of tools and equipment required to carry out the installation operation

6. explain why precautions are needed to avoid damage to
   a) installed ductwork
   b) vertical ductwork
   c) air handling units
   d) fans
   e) heater / Cooler / Filter batteries
   f) fire dampers
   g) regulating dampers
   h) controls

7. explain the protection methods to components from contamination and damage by
   a) cleaning using specified methods
   b) careful handling and manoeuvring
   c) storage of plant units / equipment by appropriate methods or in suitable containers
   d) covering or use of pallets for ductwork

8. explain specific installation requirements when installing
    a) ductwork components
    b) brackets / supports
    c) air handling units
    d) axial flow fans
    e) centrifugal fans
    f) attenuators
    g) fan coil and variable air volume units
    h) induct plant units. (Heater / cooler / filter batteries and regulating dampers)
    i) fire dampers
    j) hoods
    m) flexible ducts
    n) vertical ducts
    o) fire ductwork
    p) roof units

9. explain why the correct tools and equipment are required when installing ductwork systems and plant

10. explain the fire ductwork requirements
    a) the need for Fire ductwork, rather than fire dampers
    b) area of a building normally to be protected
    c) types of material used in construction and supporting
    d) the authority responsible for inspection

Outcome 307/308. 4 Commission ductwork systems and plant units and carry out checks to show conformance to specification

Underpinning knowledge
The candidate will be able to:

1. explain how to organise drop tests to fire dampers with the appropriate authority

2. explain the essential points and why inspection and checking components is required
   a) supports and brackets
   b) access requirements
   c) fire and smoke dampers
   d) damage, internal and external
   e) vapour seals

3. explain why all dampers are required to be left in the open position

4. explain the requirements of internal cleanliness of systems

5. explain the need and methods of checking ductwork for
   a) leaks
   b) un-removed temporary seals
   c) access locations

6. explain the checks required to plant units
   a) condition of filters
   b) faulty flexible connections (holes)
   c) damage to heater / cooler / filter batteries
   d) the correct direction and alignment of Axial flow fans
   e) condition of anti vibration mountings
   f) loose holding down bolts

7. explain the need to confirm direction and orientation of fans and plant units

8. explain the need to confirm pre – commissioning checks have been carried out

9. explain the need to confirm electrical power and control systems are safe for loading through the correct authority

10. state the procedures for bringing a small system into operation

11. state the information required when completing a report following completed installation

12. state the information required to be used in O and M manuals to confirm a satisfactory installation

Outcome 307/308. 5 De-commission and remove systems

Underpinning knowledge
The candidate will be able to:

1. explain how to organise a permit to work, or take other approved procedures when removing large components at high level

2. explain how to and confirm the isolation of all plant units
   a) electricity
   b) water

3. explain the reasons and who needs to be informed for isolating the working area using
   a) barriers
   b) warning signs
   c) coloured tape

4. explain why there is a need for providing equipment to deal with
   a) personal injury
   b) spillage and contamination
   c) fire
   d) hazardous materials

5. explain and justify the use of tools and equipment required to carry out the removal and disposal of ductwork components and plant units

6. explain the sequence and why it is important to follow when dismantling a ductwork system
   a) at high level
   b) at low level

7. explain what checks may be required and who needs to be informed when removing
   a) large air handling units
   b) centrifugal fans
   c) attenuators / silencers

8. explain why materials and components need to be safely disposed of
   a) lagging materials
   b) ductwork
   c) plant units / equipment

9. explain why it is important to confirm with appropriate people the components for re-use, storage or disposal

10. explain why a report is required and who requires copies following completion of an installation