

## National Unit Specification: general information

**UNIT** Heating and Plumbing Technology (SCQF level 6)

**CODE** F1AT 12

### SUMMARY

This Unit will be suitable for candidates who have limited or no experience of Heating and Plumbing Technology within a Building Services Engineering environment.

It is designed to enable the candidate to develop a basic understanding and application of the factors affecting the design of heating systems and domestic hot and cold water supplies in the context of low rise domestic and commercial buildings using relevant industry guidelines and manufacturer's reference data.

### OUTCOMES

- 1 Identify and describe factors affecting the design of heating systems in domestic and low rise commercial buildings.
- 2 Identify and calculate heating requirements and design conditions for domestic and low rise commercial buildings.
- 3 Determine heating system distribution pipe sizes, pump sizes, plant and associated equipment loads for building heating systems for domestic and low rise commercial buildings.
- 4 Identify compare, and calculate hot and cold water distribution systems for domestic and low rise commercial buildings.

### RECOMMENDED ENTRY

Entry is at the discretion of the centre.

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#### Administrative Information

**Superclass:** XH

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## **National Unit Specification: general information (cont)**

**UNIT** Heating and Plumbing Technology (SCQF level 6)

### **CREDIT VALUE**

1 credit at Higher (6 SCQF credit points at SCQF level 6\*)

*\*SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

6 credit points, indicates a notional Unit design length of 40 hours of contact and 20 hours of self-directed learning.

### **CORE SKILLS**

There is no automatic certification of Core Skills or Core Skill components in this Unit.

The Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- ◆ Numeracy (SCQF level 6)
- ◆ Problem Solving (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

## **National Unit Specification: statement of standards**

### **UNIT Heating and Plumbing Technology (SCQF level 6)**

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority. The appendix forms a part of this statement of standards.

#### **OUTCOME 1**

Identify and describe factors affecting the design of heating systems in domestic and low rise commercial buildings.

##### **Performance Criteria**

- (a) Identify and describe the key characteristics of conduction, convection and radiation modes of heat transfer.
- (b) Describe the main heat transfer and performance characteristics of heat emitters.
- (c) Describe the key characteristics and appropriate application of boiler plant and equipment.
- (d) Describe the key characteristics of Low Pressure Hot Water Heating systems.

#### **OUTCOME 2**

Identify and calculate heating requirements and design conditions for domestic and low rise commercial buildings.

##### **Performance Criteria**

- (a) Identify appropriate heating requirements for domestic and low rise commercial buildings.
- (b) Select realistic design conditions using industry guidelines.
- (c) Calculate building heat losses using industry guidelines for domestic and low rise commercial buildings.
- (d) Calculate heating equipment loads using industry guidelines for domestic and low rise commercial buildings.

#### **OUTCOME 3**

Determine heating system distribution pipe sizes, pump sizes, plant and associated equipment loads for building heating systems for domestic and low rise commercial buildings.

##### **Performance Criteria**

- (a) Identify appropriate pipework distribution circuits for heating systems using relevant industry guidelines.
- (b) Determine pump operating duty and select suitable pump/s for heating systems using relevant manufacturer's reference data.
- (c) Select appropriate heat emitters for heating systems using relevant manufacturer's reference data.
- (d) Determine duty of boiler/s and select appropriate installation arrangement/s using relevant industry guidelines.

## **National Unit Specification: statement of standards (cont)**

### **UNIT Heating and Plumbing Technology (SCQF level 6)**

#### **OUTCOME 4**

Identify compare, and calculate hot and cold water distribution systems for domestic and low rise commercial buildings.

#### **Performance Criteria**

- (a) Identify and calculate appropriate hot and cold water distribution system requirements.
- (b) Compare possible alternative means of hot water generation.
- (c) Calculate appropriate hot and cold water pipe sizes for domestic and low rise commercial buildings using relevant industry guidelines.

#### **EVIDENCE REQUIREMENTS FOR THIS UNIT**

The Appendix to this Unit details the mandatory content for each Outcome.

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

For Outcomes 1 and 2 written and/or recorded oral evidence must be produced in controlled, supervised, closed-book conditions. In this Unit an appropriate instrument of assessment could be a question paper consisting of a balance of multiple choice, short answer, restricted response and structured questions. Candidates must not bring notes, textbooks or handouts to the assessment.

For Outcomes 3 and 4, product evidence which will include a preliminary set of low pressure hot water heating and domestic hot water pipe sizing calculations for a domestic and /or low rise commercial building, including a selection of plant and equipment which demonstrates that the candidate has achieved to the standard specified in the Outcome and Performance Criteria. This evidence could be assessed using an assignment. The assessment will be carried out under supervised conditions.

Assessments must be manageable and practicable for centres and candidates and a single assessment covering all Outcomes should not exceed 2 hours in duration.

## **National Unit Specification: support notes**

### **UNIT Heating and Plumbing Technology (SCQF level 6)**

This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

#### **GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT**

The Appendix to this Unit details the mandatory content for each Outcome.

This Unit is an optional Unit within the National Certificate in Building Services Engineering (SCQF level 6).

This Unit aims to provide the candidate with an introduction to elementary understanding and application of the factors affecting the design of heating systems and domestic hot and cold water supplies including the selection of appropriate plant and equipment and pipe sizing. The Unit considers these requirements in the context of low rise domestic and commercial buildings and accepted practice.

Candidates may also undertake specific technology optional Units that will broaden the content of this Unit and also provide an option for specialization.

When delivered as part of the National Certificate in Building Services Engineering (SCQF level 6) this Unit has links with the Building Services Technology (SCQF level 6) mandatory Unit. The Unit has links with the Thermofluids (SCQF level 6) optional Unit and might be delivered in parallel with that Unit.

Health and Safety and Sustainability are integral and key to the Building Services Engineering industry therefore throughout the Unit emphasis will be placed where appropriate on the application of Health & Safety and Sustainability. Safe working practises should be looked at in accordance with current safety codes of practise and regulations. Sustainability should include reference to criteria affecting sustainability, impact of not implementing sustainability on the environment and the legislation promoting sustainability.

#### **GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT**

The use of relevant industry guidance documents and manufacturer's reference data appropriate to low rise non-complex domestic or commercial buildings is particularly recommended.

The learning environment for this Unit will be mainly classroom based however where possible opportunities to enhance learning may include workshop and industrial visits.

Suggested teaching and learning methods for this Unit could include: the use of visual aids, ICT, group lectures and discussion, practical demonstrations, question and answer sessions, directed study, industrial/site visits.

Emphasis in the delivery of the Unit should be on familiarisation with terminology and basic concepts.

## National Unit Specification: support notes

### UNIT Heating and Plumbing Technology (SCQF level 6)

Where the Unit is taken as part of the National Certificate in Building Services Engineering (SCQF level 6), there will be opportunities to integrate learning and assessments for this Unit with the following Units:

- ◆ *Building Services Engineering Science* (SCQF level 6)
- ◆ *Building Services Engineering Technology* (SCQF level 5)
- ◆ *Air Conditioning and Ventilation Technology* (SCQF level 6)
- ◆ *Refrigeration Technology* (SCQF level 6)

and might be delivered and assessed in conjunction with these Units.

The use of case study material is particularly recommended for learning and assessment in this Unit.

#### *Opportunities for developing Core Skills*

Accuracy in interpreting graphic information and the ability to calculate, apply and present complex data is an aspect of best practice and is contained within this Unit. Numeracy involves a wide range of skills and underpins a flexible approach to building services technology which should be encouraged and developed as candidates undertake the Unit. It is recommended that evidence is achieved through well-planned course work, assignments and projects. Integrative assignments and project work will help to link this Unit with other related Units. Individual and group discussion with assessor support could develop problem solving skills. Analytical discussion of case studies could provide a stimulus to creative thinking and a guide to best practice. The emphasis should be on Numeracy as a tool to be used and applied efficiently and critically, with consideration of factors such as sustainability, the effect and impact on the environment of not implementing sustainability and the legislation promoting sustainability.

### **GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT**

To be read in conjunction with the **Evidence Requirements**.

For Outcomes 1 and 2 candidates may be assessed on an Outcome by Outcome basis, or by a single, holistic assessment. In this Unit an appropriate instrument of assessment could be a question paper consisting of a balance of short answer, restricted response and structured questions.

For Outcomes 3 and 4, product evidence which will include a preliminary set of low pressure hot water heating and domestic hot water pipe sizing calculations for a domestic and /or low rise commercial building, including a selection of plant and equipment which demonstrates that the candidate has achieved to the standard specified in the Outcome and Performance Criteria. This evidence could be assessed using an assignment.

Preparation for assessment should include formative work with opportunities for constructive feedback. Well planned assignments and project work will also be useful preparation.

## National Unit Specification: support notes

### UNIT Heating and Plumbing Technology (SCQF level 6)

Where the Unit is taken as part of the National Certificate in Building Services Engineering, there may be opportunities to integrate the assessments for this Unit with other appropriate Units. For example:

- ◆ *Building Services Engineering Science* (SCQF level 6)
- ◆ *Building Services Engineering Technology* (SCQF level 5)
- ◆ *Air Conditioning and Ventilation Technology* (SCQF level 6)
- ◆ *Refrigeration Technology* (SCQF level 6)

Planning should allow time for re-assessment. Given that assessment for this Unit must be conducted in controlled conditions, centres should ensure that a different assessment is given for re-assessment purposes and that similar controlled conditions apply.

#### Open learning

Where appropriate materials and facilities are available, this Unit could be delivered by distance learning which might include some degree of on-line support. Centres must ensure that for all modes of delivery the same assessment conditions, standards and quality assurance procedures apply to all candidates.

#### CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* ([www.sqa.org.uk](http://www.sqa.org.uk)).

### National Unit Specification: statement of standards

#### UNIT Heating and Plumbing Technology (SCQF level 6)

##### APPENDIX: CONTENT AND CONTEXT FOR THIS UNIT

This appendix is within the statement of standards, ie the mandatory requirements of the Unit.

Recommended time allocations to each Outcome are given as guidance towards the depth of treatment which might be applied to each topic and are inclusive of time for teaching and assessment. This guidance has been used in the design of Assessment Support Pack material provided with the Unit.

- 1 Identify and describe factors affecting the design of heating systems in domestic and low rise commercial buildings (10 hours).

##### Heating Requirements

- ◆ The need for heating.
- ◆ Identifying client's and users' requirements.

##### Design Conditions

- ◆ Defining comfort.
- ◆ Use of thermal indices.
- ◆ Internal & external design temperatures, Infiltration rates for domestic, commercial & industrial applications, factors affecting infiltration and natural ventilation rates, the effect of building exposure.

##### Determination of heating loads

- ◆ Calculating the thermal transmittance of composite building elements using thermal conductivities and resistivities of materials, resistances etc.
- ◆ Selecting practical U-values from tables and manufacturers' data..
- ◆ Recognising current building regulations minimum U-values.

##### Heat Losses

- ◆ Calculation of heat loss for domestic and simple commercial/industrial applications using manual calculation and software.
- ◆ Impact on use of thermal indices & type of heat emitters on the heating load.
- ◆ The use and validity of 'rules of thumb'.

- 2 Identify and calculate heating requirements and design conditions for domestic and low rise commercial buildings (10 hours).

##### Methods of heat transfer

Introduction to Conduction, Convection & Radiation.

##### Heat Emitters

Characteristics, operational features, installation requirements and application of heat emitters in domestic, commercial & industrial environments, methods of controlling heat output from heat emitters, criteria for selection.



### National Unit Specification: statement of standards (cont)

#### UNIT Heating and Plumbing Technology (SCQF level 6)

##### Boiler Plant

- ◆ Boiler types and characteristics, operational features, installation requirements, flue arrangements, methods of fuel firing for domestic, commercial & industrial applications.
- ◆ Pipework, pump and control arrangement for single and multiple boiler configurations.
- ◆ Combustion ventilation and fuel requirements.

##### Low Pressure Hot Water Heating System Design

- ◆ Recognised pipework systems and arrangements. Integrating pipework system layout design to best fit building.
- ◆ Criteria for zoning installations.
- ◆ Application of simple zone controls; Designated Variable & Constant temperature circuits.
- ◆ Application of circulating pumps for LPHW Heating, inter-relationship of cold feed, vent pipe and pumps.
- ◆ Open and closed systems, provision and methods of accommodating expansion.
- ◆ Provision for:
  - Valves for isolation and/or regulation.
  - Removing air from system and draining system.

- 3 Determine heating system distribution pipe sizes, pump sizes, plant and associated equipment loads for building heating systems for domestic and low rise commercial buildings (10 hours).

##### Pipework circuits

- ◆ Determining mass flow rates, selection of pipe sizes, velocity limits, pressure drop, pipework emission and temperature distribution in one & two pipe circuits.
- ◆ Identifying and calculating the total resistance of the Index circuit, methods of hydraulic system balancing.

##### Pumps

Determining pump duty requirements, selection of pumps from manufacturer' data and their operational and installation characteristics.

##### Heat Emitters

Selection of heat emitters from manufacturers data, variation of emitter output with operational and installation characteristics, hydraulic resistance, heat emitter specifications and schedules.

##### Boilers

Total boiler load and optimum number of boilers or modules, selection of boiler from manufacturers' data, hydraulic resistance and maintaining minimum flow rates.

### National Unit Specification: statement of standards (cont)

#### UNIT Heating and Plumbing Technology (SCQF level 6)

- 4 Identify compare, and calculate hot and cold water distribution systems for domestic and low rise commercial buildings (10 hours).

##### **Hot and cold water distribution systems**

- ◆ Direct and Indirect cold water distribution layouts. Cold & hot water storage requirements and legislation.
- ◆ Hot water distribution layouts.

##### **Hot water generation**

Single point instantaneous type, instantaneous multi point type, direct & indirect cylinders, vented & unvented hot water cylinders, plate heat exchangers with and without buffer vessels.

##### **Hot and cold water pipe sizes**

Use of loading Units, determination of flow rates, pressure loss and pipe size using published charts and graphical data.

##### **Materials**

- ◆ Suitability of materials for use in potable, hot & cold water distribution systems.
- ◆ Legislation. Copper tube, capillary and compression fittings, Polyethylene and other plastic pipe and fittings, fusion welding.

##### **Potable Water**

- ◆ Service pipes, communication pipe & supply pipes. Methods of entry to building, Metering, Classification of water, Water authority's responsibilities.