

## Higher National Unit Specification

### General information for centres

**Unit title:** Heating B

**Unit code:** DP16 34

**Unit purpose:** The purpose of this unit is to further develop candidate skills in the design and application of large and complex heating installations and to gain experience of applying appropriate design procedures.

It will enable the candidate to analyse the space and process heating requirements of a building, develop practical heating systems for a range of applications and evaluate the effectiveness of alternative schemes.

On completion of the Unit the candidate should be able to:

- ◆ Produce and evaluate a design for steam and process heating systems for commercial/industrial buildings
- ◆ Produce and analyse a design for high temperature hot water space and process heating systems for commercial/industrial buildings
- ◆ Evaluate the use of group and district heating schemes
- ◆ Select and analyse the use of high temperature hot water and steam heating plant and primary energy sources for space/process heating and hot water generation
- ◆ Design and evaluate the use of electrical heating systems for commercial/industrial buildings.

**Credit points and level:** 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7\*)

*\*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.*

**Recommended prior knowledge and skills:** This unit is designed to extend candidates knowledge and skills from those developed in the Heating A unit.

It would be an advantage for candidates to have a basic understanding and knowledge of building services engineering science and technology.

Such understanding and knowledge may be evidenced by the possession of a National Certificate in Building Services Engineering or a related subject.

The unit includes all the basic principles necessary to allow candidates possessing other qualifications or experience to succeed in this unit.

## General information for centres (cont)

**Core skills:** There may be opportunities to gather evidence towards core skills in this Unit, although there is no automatic certification of core skills or core skills components.

**Context for delivery:** This unit was developed for the HNC in Building Services Engineering. If this Unit is delivered as part of another group award(s), it is recommended that it should be taught and assessed within the context of the group award(s) to which it contributes.

**Assessment:** It is possible to assess candidates either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. The assessment paper/s should be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be conducted under supervised, controlled conditions. A single assessment covering all outcomes should not exceed 2 hours in duration. It should be noted that candidates must achieve all the minimum evidence specified for each Outcome in order to pass this Unit.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

An exemplar instrument of assessment and marking guidelines has been produced to provide examples of evidence required to demonstrate achievement of the aims of this unit.

## Higher National Unit specification: statement of standards

**Unit title:** Heating B

**Unit code:** DP16 34

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

(If you think holistic assessment is the best assessment strategy for the Unit and you wish to state *Knowledge and/or Skills* and *Evidence requirements* for the Unit as a whole, please add the following statement here: ‘Please refer to *Knowledge and/or skills for the Unit* and *Evidence requirements for the Unit* after the Outcomes.’)

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

### Outcome 1

Produce and evaluate a design for steam and process heating systems for commercial/industrial buildings.

#### Knowledge and/or skills

- ◆ Properties and generation of steam
- ◆ Design of steam systems
- ◆ Design procedures

#### Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ determine heat content of boiler feed water, wet, dry and superheated steam
- ◆ determine the evaporation rate of steam at the generator and the mass flow rate of steam required at the heat exchanger
- ◆ explain the need for and use of the steam traps, relay points and pressure reducing valves
- ◆ analyse the potential for using flash steam recovery and integrating its use with the primary steam systems
- ◆ produce design solutions and evaluate their suitability for steam system applications including, flash steam recovery systems and condensate return systems
- ◆ determine the sizes and duties of steam and condensate pipework, plant and equipment, produce component specifications and schedules
- ◆ specify pressure and temperature control systems and strategies for steam appliances and equipment

## Higher National Unit specification: statement of standards (cont)

### Unit title: Heating B

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two out of three** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to both items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 2,3,4,5 to form a single assessment paper.

### Outcome 2

Produce and analyse a design for high temperature hot water space and process heating systems for commercial/industrial buildings.

### Knowledge and/or skills

- ◆ Application
- ◆ Pressurisation
- ◆ Design procedures

### Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ describe appropriate applications for high temperature hot water
- ◆ analyse the use of high temperature hot water as an alternative to steam and low temperature hot water systems
- ◆ analyse the application, operational methodology, characteristics, safety features of the various methods of pressurisation
- ◆ determine the safe operating temperature or pressure for different system configurations
- ◆ produce design solutions and evaluate their suitability for HPHW systems to provide space and process heating in commercial/industrial buildings
- ◆ determine the sizes and duties of HPHW plant and equipment, produce component specifications and schedules.

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two out of three** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to both items.

## Higher National Unit specification: statement of standards (cont)

### Unit title: Heating B

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

#### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,3,4,5 to form a single assessment paper.

### Outcome 3

Evaluate the use of group and district heating schemes

#### Knowledge and/or skills

- ◆ Feasibility
- ◆ Distribution
- ◆ Utilisation

#### Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ analyse the engineering, economic, environmental and social factors involved in the use of group/district heating schemes when compared with individual heating plants
- ◆ investigate the primary heat sources/fuels available for district heating
- ◆ identify the plant associated with district heating
- ◆ analyse the operating conditions, methodologies and design features of distribution pipe networks from central plant to consumers point of use
- ◆ compare the ways in which the consumer can be charged for the supply of heat energy.

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two out of three** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to both items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

#### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

## Higher National Unit specification: statement of standards (cont)

### Unit title: Heating B

The assessment for this outcome might be combined with that for Outcomes 1,2,4,5 to form a single assessment paper.

### Outcome 4

Select and analyse the use of high temperature hot water and steam heating plant and primary energy sources for space/process heating and hot water generation.

#### Knowledge and/or skills

- ◆ Heating plant, appliances and equipment

#### Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ analyse heating plant and appliances available for use with steam and high temperature hot water systems
- ◆ assess the efficiency of steam and high temperature hot water boiler plant and the methods used to reduce pollutants in the combustion process
- ◆ analyse plant annual energy consumption/CO<sub>2</sub> emission and overall system thermal efficiencies
- ◆ evaluate the use of steam superheaters
- ◆ identify the methods and purposes of feed water treatment for steam and high temperature hot water plant
- ◆ determine blowdown rates and requirements for steam boiler plant
- ◆ evaluate the use of reciprocating and centrifugal pumps for steam boiler feed.

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

#### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,2,3,5 to form a single assessment paper.

### Outcome 5

Design and evaluate the use of electrical heating systems for commercial/industrial buildings.

#### Knowledge and/or skills

- ◆ Electrical heating equipment:
- ◆ Energy requirements

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Heating B

- ◆ Pressurised electrothermal storage systems:

### Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ explain the operation and application of electrical heating systems
- ◆ specify the energy requirements for electrical storage heating systems
- ◆ describe the methods of temperature control of storage heaters
- ◆ determine the boiler plant size, power requirement, thermal storage volume and expansion volume for a pressurised system of electrothermal storage
- ◆ describe the operation and control of pressurised systems of electrothermal storage.

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two out of three** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to both items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1,2,3,4 to form a single assessment paper.

## **Administrative Information**

<b>Unit code:</b>	DP16 34
<b>Unit title:</b>	Heating B
<b>Superclass category:</b>	TH
<b>Date of publication:</b>	August 2005
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## Higher National Unit specification: support notes

### Unit title: Heating B

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

This unit is intended to build upon and to develop the knowledge and work undertaken in *Heating A*. The unit is intended for those candidates who are or will be involved in the design and installation of systems in large industrial or commercial buildings. Candidates undertaking this unit should, in addition to the requirements for design and selection of plant and systems be required to undertake critical evaluation of the effectiveness of those schemes, in particular with reference to energy consumption, CO<sub>2</sub> and NOX emissions and the concept of “just sufficient” in respect of system design. Analysis using “rules of thumb” and software are to be encouraged providing that candidates understand the underpinning principles.

Recommended time allocations to each outcome are given as guidance towards the depth of treatment which might be applied to each topic. This guidance has been used in the design of the assessment exemplar material provided with the unit.

#### 1 Steam and process heating systems (8 hours)

*Properties and generation of steam:* use of steam tables, heat content of pressurised water, wet, dry and superheated steam

*Design of Steam Systems:* layouts, plant arrangements, types, operation, use and requirements for steam traps, relay points, pressure reducing valves. Steam requirements at heat exchangers and steam generation rates. Design of steam space heating systems including buildings in which the prime purpose for steam generation may be for process work. Use of flash steam recovery, design of flash steam recovery systems. Use of steam for space heating directly at the heating appliances and indirectly via steam to water heat exchangers

*Design procedures:* systems design, plant and equipment sizing and selection

#### 2 High temperature hot water space and process heating systems (8 hours)

*Application:* feasibility of adopting high temperature hot water, comparison with the use of low temperature hot water and steam systems. Conversion from high temperature hot water to low temperature hot water

*Pressurisation:* methods of pressurisation, application, operational methodology and characteristics, safety features. Analysis of safe working temperatures/pressures for proposed systems. Anti-flash margins. Effect of pump location. Evaluation techniques

*Design procedures:* system design, installation and control arrangements for HTHW plant, pipework requirements. Expansion volumes, sizing and selection of plant including pressurisation plant and associated equipment, heat emitters

## Higher National Unit specification: support notes (cont)

**Unit title:** Heating B

### **3 Group and district heating schemes (8 hours)**

*Feasibility:* comparison with the use of individual plants, capital costs, running costs, thermal efficiency, CO<sub>2</sub> and NOX emissions. Alternative primary heat sources/fuels. Alternative plant, waste incineration, CHP schemes, geothermal sources. Social and economic effects for local authorities and consumers

*Distribution:* distribution methodologies, operating temperatures, design of distribution networks, distribution ducting. Plant for district heating schemes

*Utilisation:* provision of heating and hot water to and within consumer's premises. Consumer charging and energy metering

### **4 High temperature hot water and steam heating plant and primary energy sources (8 hours)**

*Heating plant, appliances and equipment:* requirements/configurations for saturated and superheated steam and high temperature hot water systems and applications. Steam superheaters. Thermal efficiency of steam and high temperature hot water boiler plant. Annual energy consumption and emissions, energy losses. Boiler feed-water treatment, blowdown rates, feed pumps

### **5 Electrical heating systems (8 hours)**

*Electrical heating equipment:* application and operation of the various types of electrical space heating equipment. Immersion heaters, electrode boilers, thermal storage, trace heating tape, quartz/luminous heaters, non-storage heaters, embedded resistance cables etc. Building constructional details for resistance cable installations

*Energy requirements:* Active Store, Daily Design Energy requirement and Charge Acceptance in storage heating

*Pressurised electrothermal storage systems:* plant size and power requirements. Methods of temperature control and time scheduling

## **Guidance on the delivery and assessment of this Unit**

This unit, or parts, could be studied in conjunction with Project unit/s and other related technology units.

It is recommended that evidence for learning outcomes is achieved through well-planned course work, assignments and projects. Assessment may be formative and summative and both may feature as part of the process. Although assessments must be focused on the individual achievement of each candidate, group work and role-play activities may contribute to the assessment. Integrative assignments and project work will help to link this unit with other related units.

The volume of evidence required for each assessment should take into account the overall number of assessments being contemplated within this unit and the design of the overall teaching programme.

In designing the assessment instrument/s, opportunities should be taken to generate appropriate evidence to contribute to the assessment of Core Skills units.

Appropriate attention must be given to health, safety and welfare arrangements and CDM Regulations throughout the delivery of this unit.

## **Higher National Unit specification: support notes (cont)**

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Where available, evidence from the workplace can also be incorporated to enhance the learning outcomes, provided that this evidence is appropriate and authenticated as the candidate's own work.

### **Open learning**

Given that appropriate materials exist this unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessment/s were conducted under controlled, supervised conditions.

### **Candidates with additional support needs**

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. 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. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements for Candidates with Additional Support Needs* ([www.sqa.org.uk](http://www.sqa.org.uk)).

## **General information for candidates**

### **Unit title:** Heating B

On completion of this unit a you should be able to:

- ◆ Produce and evaluate a design for steam and process heating systems for commercial/industrial buildings
- ◆ Produce and analyse a design for high temperature hot water space and process heating systems for commercial/industrial buildings
- ◆ Evaluate the use of group and district heating schemes
- ◆ Select and analyse the use of high temperature hot water and steam heating plant and primary energy sources for space/process heating and hot water generation
- ◆ Design and evaluate the use of electrical heating systems for commercial/industrial buildings.

Evidence that you can satisfy the knowledge and skill elements of this unit will be obtained by assessment in controlled, supervised conditions to which you will not be allowed to bring textbooks, handouts or notes to the assessment.