

Higher National Unit Specification

General information for centres

Unit title: Heating A

Unit code: DP15 34

Unit purpose: The purpose of this unit is to develop candidate understanding of the principles of design, installation, operation and commissioning of heating equipment and installations.

It will provide an opportunity to experience the process of completing heating designs in complex industrial and commercial applications.

It will enable candidates to interpret the heating requirements of a building, develop practical heating schemes for a range of environments and evaluate the effectiveness of alternative schemes.

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

- ◆ Evaluate the appropriate heating needs for commercial/industrial buildings
- ◆ Determine space heating loads and energy requirements for heating schemes
- ◆ Produce and evaluate designs for heating systems for commercial/industrial buildings
- ◆ Select appropriate heating plant and energy sources for space heating and hot water generation systems.

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: 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.

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.

General information for centres (cont)

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

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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

Evaluate the appropriate heating needs for commercial/industrial buildings

Knowledge and/or skills

- ◆ Specifications and Requirements

Evidence requirements

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

- ◆ establish client and building requirements for heating
- ◆ evaluate alternative strategies for providing space heating systems
- ◆ establish heating installation design parameters and standards
- ◆ produce design specification for heating installations.

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 2, 3, 4 to form a single assessment paper.

Higher National Unit specification: statement of standards (cont)

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Outcome 2

Determine space heating loads and energy requirements for heating schemes

Knowledge and/or skills

- ◆ Thermal Comfort
- ◆ Steady State Heat Transfer in Buildings
- ◆ Non-Steady State Heat Transfer in Buildings
- ◆ Total Heating Loads & Heating Plant Capacity

Evidence requirements

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

- ◆ explain the factors contributing to human thermal comfort and the use of comfort indices.
- ◆ determine heating loads for buildings requiring steady state, intermittent and highly intermittent heating when heated via a range of heat emitters.
- ◆ evaluate the reliability of proposed heating installations at maintaining the comfort of occupants.
- ◆ analyse heating loads for given buildings and compare with appropriate energy efficiency standards and targets.
- ◆ determine strategies for achieving a reduction in heating load for buildings and evaluate their effectiveness

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 **three out of four** 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 all three 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, 3, 4 to form a single assessment paper.

Outcome 3

Produce and evaluate designs for heating systems for commercial/industrial buildings.

Knowledge and/or skills

- ◆ Heat Emitters

Higher National Unit specification: statement of standards (cont)

Unit title: Heating A

- ◆ Design of Heating System:
- ◆ Commissioning and testing requirements for heating installations

Evidence requirements

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

- ◆ select and evaluate heating design strategies for commercial/industrial buildings
- ◆ produce heating design solutions and evaluate their suitability and commercial viability
- ◆ specify control systems and strategies for heating systems in commercial/industrial buildings
- ◆ determine pipework, heating plant and equipment sizes and duties and produce component specifications and schedules
- ◆ develop commissioning schedules for heating installations and boiler plants
- ◆ measure and record variables in heating systems.

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 all three 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, 4 to form a single assessment paper.

Outcome 4

Select appropriate heating plant and energy sources for space heating and hot water generation systems.

Knowledge and/or skills

- ◆ Fuels
- ◆ Chemistry of Combustion
- ◆ Products of Combustion.
- ◆ Firing Equipment
- ◆ Boilers and Hot Water Generators
- ◆ Boiler-room ventilation, draught and flue requirements.

Higher National Unit specification: statement of standards (cont)

Unit title: Heating A

Evidence requirements

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

- ◆ describe the physical, supply and combustion properties of common fuels
- ◆ interpret legislation applicable to the supply and combustion of fuels
- ◆ calculate air:fuel ratios for stoichiometric combustion and resulting flue gas compositions
- ◆ analyse products of combustion
- ◆ explain the construction, operation, control arrangements and commissioning requirements of commonly used commercial and industrial boilers, burners and hot water generators
- ◆ specify boiler installation and control arrangements for single and multiple boiler installations
- ◆ determine operating efficiencies for boiler plant and identify methods employed to improve boiler operating efficiencies
- ◆ relate the impact of legislation, standards and procedures on the design, installation and use of boilers, flues and firing equipment
- ◆ produce combustion air and flue/chimney design solutions for single and multiple commercial boiler installations.

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 **four out of six** 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 all four 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, to form a single assessment paper.

Administrative Information

Unit code:	DP15 34
Unit title:	Heating A
Superclass category:	TH
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Higher National Unit specification: support notes

Unit title: Heating A

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

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

This unit is intended to develop a candidate's previous understanding of heating systems and to introduce candidates to the design and application of complex heating systems in commercial and industrial buildings. The unit is intended for those candidates who are, or will be involved in the design and installation of systems in 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. Learning experiences should allow for integration of content from all elements in the unit. Analysis using 'rules of thumb' and software are to be encouraged providing that candidates understand the underlying 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 Heating needs (10 hours)

Specifications & Requirements: analysis and interpretation of client and building operational requirements, balance between clients needs, commercial constraints, health, safety and welfare arrangements, aesthetic and energy efficiency considerations. Statutory requirements, heating design standards and publications for commercial and industrial buildings. Inter-relationship between heating and other mechanical and electrical building services.

2 Space heating loads and energy requirements (10 hours)

Thermal Comfort: factors effecting thermal comfort, predicting thermal satisfaction. Effect of radiation on comfort, local discomfort and asymmetry.

Steady State Heat Transfer in Buildings: steady state energy transfer networks. Steady state heating loads to maintain comfort and space temperatures.

Non-Steady State Heat Transfer in Buildings: transient heat transfer factors and equations, the admittance method, response factor. Pre-heat periods, heating loads with intermittent and highly intermittent heating

Total Heating Loads & Heating Plant Capacity: factors contributing to heating plant capacity for buildings, assessment of total heat losses and heating plant output, effect of building construction and orientation on its thermal inertia and heating load. Compliance with energy efficiency targets and standards. Use of computer software to determine heating loads for rooms, zones and building.

Higher National Unit specification: support notes (cont)

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3 Heating systems for commercial/industrial buildings (10 hours)

Heat Emitters: selection criteria, and performance of various radiant, convection and mixed output heat emitters associated with commercial and industrial buildings including direct fired, electric steam/water under-floor heating, and heated ceilings, natural and forced convection emitters

Design of Heating Systems: for complex industrial and commercial buildings containing a wide variety of environments and requirements, eg hospitals, laboratories, industrial processes, retail premises, information centres etc. Layout, specification and control systems, integration of heating requirements with ventilation, air conditioning and other services installations. Accommodation and control of expansion (water and pipework). Support and suspension systems for plant and pipework. Sizing and selection of plant, expansion devices and pipework, use of manufacturer's data, sizing and selection software. Design implications on space, maintenance and commissioning requirements, capital and operating costs. Evaluation of proposed systems.

Commissioning and testing requirements for heating installations: application of current standards and procedures for the commissioning of water circulation heating systems. Instruments and procedures for the measurement of flow, temperature and pressure. Commissioning schedules and documentation

4 Heating plant and energy sources (10 hours)

Fuels: properties, characteristics, performance, health, safety and welfare implications, and environmental implications of commercially available solid, liquid and gaseous fuels. Legislation and standards applicable.

Chemistry of Combustion: principles of combustion, stoichiometric air fuel ratios, flue gases arising from stoichiometric combustion. Need for and effect of excess air.

Products of Combustion: instrumentation for flue gas analysis, determining air fuel ratios and combustion efficiency from flue gas analysis. Combustion quality.

Firing Equipment: construction, operation characteristics and features of various types of burners found in boiler and hot water generation plant associated with commercial heating installations. Control and safety monitoring systems for burners. Air/Fuel adjustment and burner commissioning requirements.

Boilers & Hot Water Generators: construction, operation characteristics and features of various types of commercial LPHW boiler and hot water generation plant. Application and control of single and multiple boiler installations. Fuel consumption and operational efficiency. Boiler testing and commissioning.

Boiler-room ventilation, draught and flue requirements: legislation and standards applicable to the provision of boiler plant ventilation. Principles and applications of natural and mechanical draught in boiler plant. Principles, construction, materials and applications of flue systems for single and multiple boiler installations. Legislation and standards applicable to the design and installation of flue systems for single and multiple boiler installations using various fuels.

Higher National Unit specification: support notes (cont)

Unit title: Heating A

Guidance on the delivery and assessment of this Unit

Opportunities for developing Core Skills

This unit may be linked with the *Air Conditioning A* and may well use the same buildings as the basis of any project work. It is anticipated that most candidates studying this unit will also be studying the *Thermofluids and Acoustic Criteria*. It is strongly recommended that this unit should be integrated with supporting outcomes in *Building Engineering Services Science* and *Thermofluids & Acoustic Criteria*.

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.

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 Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk

General information for candidates

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On completion of this unit you should be able to:

- ◆ Evaluate the appropriate heating needs for commercial/industrial buildings
- ◆ Determine space heating loads and energy requirements for heating schemes
- ◆ Produce and evaluate designs for heating systems for commercial/industrial buildings
- ◆ Select appropriate heating plant and energy sources for space heating and hot water generation systems.

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.