

Higher National Unit Specification

General information for centres

Unit title: Air Conditioning B

Unit code: DP0W 34

Unit purpose: This Unit is designed to further develop candidate understanding of the principles and applications of air conditioning and also to provide an additional opportunity to experience the process of air conditioning design for large complex industrial/commercial multi-zone buildings. The Unit will enable the candidate to interpret the air conditioning and ventilation requirements of a building, to develop practical air conditioning schemes for a range of environments and to evaluate the effectiveness of alternative schemes.

On completion of the Unit the candidate should be able to

- ◆ Determine energy requirements using data related to climate, building envelope, occupancy and use.
- ◆ Produce and evaluate a design for ventilation systems for comfort and safety control in complex commercial and industrial buildings including aspects of fire and smoke management.
- ◆ Design for large multi-zone air conditioning systems for a range of complex commercial/industrial buildings including the use of high pressure/velocity systems.
- ◆ Analyse and evaluate the operation and application of refrigeration systems within air conditioning applications.
- ◆ Design and evaluate pipe and ductwork distribution 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: This Unit is intended to build upon and to develop the knowledge and the work undertaken in Air Conditioning A.

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

Unit title: Air Conditioning B

Unit code: DP0W 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

Determine energy requirements using data related to climate, building envelope, occupancy and use.

Knowledge and/or skills

- ◆ Seasonal climatic variations
- ◆ Building/system operating characteristics
- ◆ Heat gain and loss data
- ◆ Future needs
- ◆ Loading

Evidence requirements

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

- ◆ identify appropriate design criteria
- ◆ interpret seasonal climatic variation and published meteorological data
- ◆ identify properties and usage characteristics of a building envelope
- ◆ evaluate thermal energy requirements for maintenance of design criteria

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 five** 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.

Higher National Unit specification: statement of standards (cont)

Unit title: Air Conditioning B

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 and 5 to form a single assessment paper.

Outcome 2

Produce and evaluate a design for ventilation systems for comfort and safety control in complex commercial and industrial buildings including aspects of fire and smoke management.

Knowledge and/or skills

- ◆ Ventilation requirements of buildings

Evidence requirements

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

- ◆ identify the factors affecting the need for ventilation
- ◆ apply the principles of design of natural ventilation systems for contaminant control
- ◆ apply the principles of design of mechanical ventilation systems for contaminant control
- ◆ evaluate the characteristics of ventilation systems for comfort, contaminant and smoke control

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, 3, 4 and 5 to form a single assessment paper.

Higher National Unit specification: statement of standards (cont)

Unit title: Air Conditioning B

Outcome 3

Design for large multi-zone air conditioning systems for a range of complex commercial/industrial buildings including the use of high pressure/velocity systems.

Knowledge and/or skills

- ◆ Air conditioning for complex applications
- ◆ Design characteristics and factors

Evidence requirements

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

- ◆ evaluate the characteristics of a range of complex systems
- ◆ calculate heating and cooling loads
- ◆ develop an appropriate system design
- ◆ evaluate the system/building performance

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, 4 and 5 to form a single assessment paper.

Outcome 4

Analyse and evaluate the operation and application of refrigeration systems within air conditioning applications.

Knowledge and/or skills

- ◆ Basic concepts of refrigeration systems
- ◆ Practical and operating characteristics of refrigeration plant and equipment
- ◆ Design characteristics of the plant including safety and control

Higher National Unit specification: statement of standards (cont)

Unit title: Air Conditioning B

Evidence requirements

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

- ◆ explain the basic concepts of refrigeration cycles.
- ◆ summarise the characteristics of plant and refrigeration equipment.
- ◆ determine plant-operating loads and understand control requirements for refrigeration systems.

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 and 5 to form a single assessment paper.

Outcome 5

Design and evaluate pipe and ductwork distribution systems.

Knowledge and/or skills

- ◆ Safety requirements for air flow systems
- ◆ Operating characteristics of air flow systems
- ◆ Design of air and liquid distribution systems

Evidence requirements

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

- ◆ identify safety requirements for air and liquid distribution systems.
- ◆ design airflow systems.
- ◆ evaluate static regain as a suitable method for duct design.
- ◆ design chilled water and refrigeration pipe work systems.

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.

Higher National Unit specification: statement of standards (cont)

Unit title: Air Conditioning B

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

| | |
|-----------------------------|--------------------|
| Unit code: | DP0X 34 |
| Unit title: | Air Conditioning B |
| Superclass category: | TH |
| Date of publication: | August 2005 |
| Version: | 01 |
| Source: | SQA |

© Scottish Qualifications Authority 2005

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Air Conditioning 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 has been written in order to allow the candidates to develop knowledge, understanding and skills in the following areas:

- ◆ determining energy requirements using data related to climate, building envelope, occupancy and use
- ◆ producing and evaluating a design for ventilation systems for comfort and safety control in complex commercial and industrial buildings including aspects of fire and smoke management
- ◆ designing for large multi-zone air conditioning systems for a range of complex commercial/industrial buildings including the use of high pressure/velocity systems
- ◆ analysing and evaluating the operation and application of refrigeration systems within air conditioning applications
- ◆ designing and evaluating pipe and ductwork distribution systems.

The unit has been developed as a specialist optional unit that appears within the framework for HVAC and Refrigeration HN qualification pathways and builds on the knowledge and work undertaken in Air Conditioning B.

This unit is to develop the candidate's further understanding of the principles and applications of air conditioning and also to provide an additional opportunity to experience the process of completing air conditioning designs for large complex industrial/commercial multi-zone applications. It will enable the candidate to interpret the air conditioning and ventilation requirements of a building, to develop practical air conditioning schemes for a range of environments and evaluate the effectiveness of alternative schemes.

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. Energy requirements (8 hours)

Seasonal Climatic Variations

Factors to be evaluated:

Temperature
Humidity
Wind
Solar radiation
Precipitation

Higher National Unit specification: support notes (cont)

Unit title: Air Conditioning B

Building/System Operating Characteristics

Factors to be considered:

- Building geometry
- Occupation times
- System criticality
- Climatic factors
- Zoning requirements

Heat Gain and Loss Data

Factors to be considered:

- Occupants
- Machinery
- Fabric
- Solar
- Infiltration/exfiltration

Future Needs

Allowance for future:

- Expansion
- Diversification
- Flexibility

Loading

Factors to be considered

- Heating loads
- Cooling loads

2 Ventilation systems for comfort and safety (6 hours)

Ventilation Requirements of Buildings

Factors to be considered:

- Natural ventilation
- Mechanical ventilation
- Comfort
- Contaminants
- Fire/smoke control

3 Large multi-zone air conditioning systems (10 hours)

Air Conditioning

Systems for complex applications:

- Commercial buildings
- Industrial buildings
- High velocity/high pressure
- Single duct
- Dual duct
- Constant volume
- Variable air volume
- Chilled beam and others.

Higher National Unit specification: support notes (cont)

Unit title: Air Conditioning B

Design Characteristics

Factors to be considered:

- Heat recovery
- Waste minimisation
- Filtration of contaminants
- Control system requirements
- Simulation of building/system performance

4 Operation and application of a refrigeration system (10 hours)

Basic Concepts

Refrigeration systems:

- Vapour compression
- Absorption system
- Other methods eg vortex tube

Practical and Operating Characteristics

Components to be considered:

- Refrigerants
- Compressors
- Condensers
- Evaporators
- Generators

Design Characteristics

Determination of:

- Plant loads
- Safety controls
- Operating controls

5 Distribution systems (6 hours)

Safety Requirements for Air flow Systems

Systems for:

- Fire
- Smoke exhaust

Operating Characteristics of Air flow Systems

System selection covering:

- Ducting design
- Fan characteristics and selection
- Air distribution in spaces

Design

Distribution systems for:

- Chilled water
- Refrigerants
- Secondary refrigerants e.g. brine, glycol etc.

Higher National Unit specification: support notes (cont)

Unit title: Air Conditioning B

Guidance on the delivery and assessment of this Unit

Opportunities for developing Core Skills

As this Unit is a specialist optional unit that expands and develops the knowledge and work covered in Air Conditioning A, it is recommended that it be delivered after this Unit.

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.

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

Unit title: Air Conditioning B

On completion of the Unit you should be able to:

- ◆ Determine energy requirements using data related to climate, building envelope, occupancy and use.
- ◆ Produce and evaluate a design for ventilation systems for comfort and safety control in complex commercial and industrial buildings including aspects of fire and smoke management.
- ◆ Design for large multi-zone air conditioning systems for a range of complex commercial/industrial buildings including the use of high pressure/velocity systems.
- ◆ Analyse and evaluate the operation and application of refrigeration systems within air conditioning applications.
- ◆ Design and evaluate pipe and ductwork distribution 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.