

## National Unit Specification: general information

**UNIT** Refrigeration Technology (SCQF level 6)

**CODE** F1AW 12

### COURSE

### SUMMARY

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

This Unit is designed to develop candidate knowledge and understanding of the principles of design, installation and operation of refrigeration plant and equipment, within the context of low rise non-complex commercial buildings. It will provide an opportunity to experience the breadth and diversity of the uses of refrigeration systems within the Building Services Engineering industry. It will enable the candidate to interpret manufacturers' data, to develop practical solutions for a range of applications and to select appropriate plant and equipment. The Unit will develop the candidates knowledge and understanding of current legislation covering the safe handling and environmental impact in relation to refrigerants used in the refrigeration industry.

### OUTCOMES

- 1 Describe the operating principles of vapour compression refrigeration systems including the properties and characteristics of their refrigerants.
- 2 Describe and explain the operation and characteristics of components in vapour compression refrigeration systems.
- 3 Select refrigeration plant and equipment for commercial cold storage rooms.
- 4 Describe and explain current legislation, safe handling procedures and the potential environmental impact in relation to refrigerants used in the refrigeration industry.

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#### Administrative Information

**Superclass:** XH

**Publication date:** February 2007

**Source:** Scottish Qualifications Authority

**Version:** 01

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

### **UNIT** Refrigeration Technology (SCQF level 6)

#### **RECOMMENDED ENTRY**

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

#### **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 Refrigeration 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.

#### **OUTCOME 1**

Describe the operating principles of vapour compression refrigeration systems including the properties and characteristics of their refrigerants.

##### **Performance Criteria**

- (a) Describe and explain the key operating principles of a vapour compression refrigeration cycle.
- (b) Describe the main properties and characteristics of refrigerants used in vapour compression refrigeration systems.

#### **OUTCOME 2**

Describe and explain the operation and characteristics of components in vapour compression refrigeration systems.

##### **Performance Criteria**

- (a) Identify and explain the basic functions of a compressor, condenser, expansion devices and evaporators in vapour compression refrigeration systems.
- (b) Describe and explain the key operational characteristics and applications of compressors, condenser, expansion devices and evaporators in vapour compression refrigeration systems.

#### **OUTCOME 3**

Select refrigeration plant and equipment for commercial cold storage rooms.

##### **Performance Criteria**

- (a) Calculate the appropriate cooling load for a refrigeration system and the plant items for commercial cold storage rooms.
- (b) Use manufacturers' data to select system plant and components for commercial cold storage rooms.
- (c) Accurately define and identify the refrigeration system balance point.

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

### **UNIT Refrigeration Technology (SCQF level 6)**

#### **OUTCOME 4**

Describe and explain current legislation, safe handling procedures and the potential environmental impact in relation to refrigerants used in the refrigeration industry.

#### **Performance Criteria**

- (a) Describe the key points of legislation and current procedures applicable to the refrigeration industry.
- (b) Explain the key potential impact modern refrigerants may pose on the environment.

#### **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.

In any assessment of Outcomes 1, 2, 3 and 4 **all** items of content must be assessed.

For Outcomes 1, 2, 3 and 4 written and/or 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 based on case study material. Candidates must not bring notes, textbooks or handouts to the assessment.

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 Refrigeration 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 is designed to develop the student's knowledge and understanding of the principles of design, installation and operation of refrigeration plant and equipment. It will provide an opportunity to experience the breadth and diversity of the uses of refrigeration and air conditioning within the built environment. It will enable students to interpret manufacturers' data, to develop practical solutions for a range of applications and to select appropriate plant and equipment. The Unit will develop the candidates knowledge and understanding of current legislation covering the safe handling and environmental impact in relation to refrigerants used in the refrigeration industry.

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.

When delivered as part of the National Certificate in Building Services Engineering (SCQF level 6) this Unit has links with the Air Conditioning and Ventilation Technology Unit (SCQF level 6).

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

Emphasis in the delivery of the Unit should be on familiarisation with terminology and basic concepts in the context of low rise domestic and small commercial building applications.

The use of case study material is particularly recommended for delivery of this Unit and might integrate with the following Units:

- ◆ *Air Conditioning and Ventilation Technology Unit (SCQF level 6)*
- ◆ *Heating and Plumbing Technology (SCQF level 6)*
- ◆ *Building Services Engineering Technology (SCQF level 5)*
- ◆ *Electrical and Electronic Technology (SCQF level 5)*

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

## National Unit Specification: support notes (cont)

### UNIT Refrigeration Technology (SCQF level 6)

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.

Formative work for the Unit could specifically include group discussion. Such an approach could be particularly beneficial to candidates with no industrial experience.

#### *Opportunities for developing Core Skills*

Accuracy in interpreting graphic information and the ability to calculate, apply and present complex data underpins delivery of the Unit. Numeracy involves a wide range of skills and requires a flexible approach to building services technology which should be encouraged and developed as candidates undertake the award. Integrative assignments and project work will link this Unit with related Units and foster skills development in a practical context. Individual and group discussion of case studies in formative work is particularly recommended to support the development of practical problem solving skills, and to provide a stimulus for creative thinking and a guide to best practice. As candidates develop practical solutions for a range of applications and select appropriate plant and equipment the emphasis should be on Numeracy as a tool to be used and applied efficiently and critically, with consideration of factors such as codes of practice, other applicable legislation and environment issues. Candidates could benefit from discussions with the assessor to reinforce analytical evaluations of proposed design solutions.

### GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

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

Candidates may be assessed on an Outcome by Outcome basis, combinations of Outcomes 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 based on case study material.

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

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

- ◆ *Air Conditioning and Ventilation Technology Unit (SCQF level 6)*
- ◆ *Heating and Plumbing Technology (SCQF level 6)*
- ◆ *Building Services Engineering Technology (SCQF level 5)*
- ◆ *Electrical and Electronic Technology (SCQF level 5)*

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.

## **National Unit Specification: support notes (cont)**

### **UNIT** Refrigeration Technology (SCQF level 6)

#### **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 Refrigeration 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 Describe the operating principles of vapour compression refrigeration systems including the properties and characteristics of their refrigerants (12 hours).

#### Vapour Compression Cycle

- ◆ Fundamentals:
  - Heat transfer
  - Sensible heat and latent heat
  - Saturation pressure and saturation temperature
  - Mollier diagram (introduction)
- ◆ Refrigeration Cycle:
  - Evaporator
  - Refrigerant
  - Compressor
  - Condenser
  - Expansion device

#### Refrigerant Condition

- ◆ Working fluid condition:
  - Evaporating liquid
  - Condensing vapour
  - High or low pressure liquid
  - High or low pressure vapour
  - Superheated vapour
  - Subcooled liquid

#### Refrigerants

- ◆ Refrigerant characteristics:
  - Desirable properties
  - Refrigerants traditional (historical)
  - Refrigerants today
  - Applications



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

#### UNIT Refrigeration Technology (SCQF level 6)

##### Typical Design Temperatures

- ◆ Applications and operational data:
  - Coil temperatures
  - Room temperatures
  - Storage conditions
  - Suction temperatures
  - Condensing temperatures
  - Discharge temperatures
  - Comfort conditions
  
- 2 Describe and explain the operation and characteristics of components in vapour compression refrigeration systems (14 hours).

##### Compressors

- ◆ Compressor operation and construction:
  - Hermetic, semi-hermetic and open types
  - Reciprocating
  - Rotary
  - Scroll
  - Lubrication
  - Capacity control

##### Condensers

- ◆ Classifications and construction:
  - Air cooled
  - Water cooled
    - Concentric tube
    - Shell and tube
    - Plate type
  - Evaporative
    - Forced air
    - Induced air

##### Expansion Devices

- ◆ Classification and characteristics:
  - Capillary tube
  - Automatic expansion valve (AEV)
  - Thermostatic expansion valve (TEV)
  - Low pressure float

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

#### UNIT Refrigeration Technology (SCQF level 6)

##### Evaporators and Liquid Chillers

- ◆ Design and construction:
  - Natural convection
  - Forced convection
  - Liquid chillers
    - Concentric tube
    - Shell and tube
    - Baudelot cooler
    - Plate type

##### Cooling Towers

- ◆ Design and construction:
  - Induced draught
  - Forced draught
  - Cross flow

3 Select refrigeration plant and equipment for commercial cold storage rooms (10 hours).

##### Heat load on refrigeration systems

- ◆ For commercial applications:
  - Through the structure
  - Lighting
  - Operatives
  - Plant and machinery
  - Air infiltration
  - Solar allowance
  - Product load
  - Heat of respiration

##### Run time allowance

- ◆ For commercial systems:
  - Off cycle defrost systems
  - Electric defrost
  - Total plant duty required

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

#### UNIT Refrigeration Technology (SCQF level 6)

##### Manufacturers Information and System Balance

- ◆ Catalogue information and plant characteristics:
  - Compressor information
  - Condenser data
  - Condensing set information
  - Evaporator data
  - Expansion valve selection
  - System balance point
  - Modifications to achieve a working System

##### Piping Layout for Refrigeration Plant

- ◆ Basic information:
  - Allow for oil return
  - Pump down cycle
  - Pipe sizing charts
  - Pipe jointing methods
  - Insulation
  - Pipe-work and plant leak/pressure testing
  - Pipe-work and plant dehydration methods
  - Codes of practice
- 4 Describe and explain current legislation, safe handling procedures and the potential environmental impact in relation to refrigerants used in the refrigeration industry (4 hours).

##### Commissioning

- ◆ Factors for operation:
  - Operating sequences
  - Commissioning codes
  - Refrigerant charging
  - Control settings
  - Commissioning sheets

##### Environmental Issues

- ◆ Statutory information:
  - Codes of practice
  - Health and Safety at Work
  - Environmental Protection Act
  - Control of Substances Hazardous to Health (COSHH)
  - British Standard Specification
  - Montreal Protocol

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

#### **UNIT Refrigeration Technology (SCQF level 6)**

- ◆ Operational factors:
  - Safe handling of refrigerants
  - Waste disposal information