National Unit specification: general information

Unit title: Building Services Engineering: Science (SCQF level 5)

Unit code: FT84 11

Superclass: TH

Publication date: September 2011

Source: Scottish Qualifications Authority

Version: 02

Summary

This is a mandatory Unit of the Skills for Work Building Services Engineering Award and is suitable for candidates with little or no previous engineering, technical or employment experience. Candidates will recognise the mechanical and electrical SI units commonly used within the building services engineering (BSE) sector and will carry out simple calculations to enhance that understanding. Candidates will also learn to recognise fundamental properties of materials as well as the fundamental principles of heat, mechanical and electrical applications to the BSE industry.

Outcomes

1 Explain standard SI Units and use them to carry out basic calculations.
2 Explain the properties and application of materials used in the BSE industry.
3 Explain and use principles of heat and mechanics.
4 Explain and use electrical principles and properties.

Recommended entry

Entry is at the discretion of the centre.

Credit points and level

1 National Unit credit at SCQF level 5: (6 SCQF credit points at SCQF level 5)

General information (cont)

Unit title: Building Services Engineering: Science (SCQF level 5)

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

- Using Number at SCQF level 5

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

National Unit specification: statement of standards

Unit title: Building Services Engineering: Science (SCQF level 5)

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 SQA.

Outcome 1

Explain standard SI units and use them to carry out basic calculations.

Performance Criteria

(a) Explain the standard SI units commonly used and how they apply in the BSE industry
(b) Carry out simple calculations using the standard SI units

Outcome 2

Explain the properties and application of materials used in the BSE industry.

Performance Criteria

(a) Explain the different types of materials used in the BSE industry.
(b) Explain the basic properties of materials used in the BSE industry.

Outcome 3

Explain and use principles of heat and mechanics.

Performance Criteria

(a) Explain the relationship between Celsius and Kelvin temperature scales.
(b) Identify the terminology associated with a change of state.
(c) Explain the processes by which heat transfer occurs.
(d) Explain the relationship between velocity, pressure and flow rate in systems.
(e) Explain the principles of basic mechanics.

Outcome 4

Explain and use electrical principles and properties.

Performance Criteria

(a) Explain the fundamentals of electron current flow.
(b) Carry out simple electrical calculations using the relevant SI units.

National Unit specification: statement of standards (cont)

Unit title: Building Services Engineering: Science (SCQF level 5)

Evidence Requirements for this Unit

Evidence is required to demonstrate that the candidate has achieved all Outcomes and Performance Criteria.

Written and/or oral evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria. The evidence should be produced in open book supervised and controlled conditions.

The evidence may be produced by one or more than one assessment covering all Outcomes.

Outcome 1: Written and/or oral evidence

Candidates must explain how the appropriate SI units appropriate to area (m^2), volume (m^3), litres (L), density (kg/m^3), and velocity (m/s), and carry out six simple calculations, one for each, to establish all of the following: area (m^2), volume (m^3), litres (L), density (kg/m^3), velocity (m/s), and relative density of common materials (to air and to water).

Candidates must accurately carry out three simple calculations to establish all of the following: quantity of heat energy required to raise the temperature of a substance, amount of power required to heat a substance.

Candidates must accurately carry out three simple calculations of pressure and flow rate including all of the following: pressure head, static pressure, dynamic pressure.

Outcome 2: Written and/or oral evidence

Candidates must be able to explain all of the following:

- The principal applications of solid materials used in the mechanical services industry, including: fireclays/ceramics, metals (pure metals, ferrous metals, alloys including solders), and plastics (thermo plastics, thermo-setting plastics).
- The detailed properties of solid materials for: conductivity (heat and electricity), ductility, hardness, malleability and strength (tensile and compressive).
- The implications of the breakdown of solid materials.
- The principal applications and basic properties of liquids used in the BSE sector for three of the following: anti-freeze/glycol mixes, fuel oils, lubricants/greases, refrigerant, water.
- Applications of gases used in the BSE sector from three of the following: air, carbon dioxide, LPG, natural gas, refrigerant gases.

National Unit specification: statement of standards (cont)

Unit title: Building Services Engineering: Science (SCQF level 5)

Outcome 3: Written and/or oral evidence

Candidates must be able to explain all of the following

- The relationship between Celsius and Kelvin temperature scales and the temperature measurement devices used.
- The terminology associated with a change of state including: boiling, condensing, evaporating, freezing, melting.
- The terms latent and sensible heat as they apply to liquids and gases.
- The main methods of heat transfer including: conduction in solids, convection in liquids and gases, radiation between two bodies.
- How units of energy and heat are related, including: energy — joules (J), power — watts (W), specific heat capacity (kJ/kg/°C).
- The processes by which heat transfer occurs including: conduction in solids, convection in liquids and gases, radiation between two bodies.
- The units of force and pressure including: acceleration (m/s^2) force due to gravity, flow rate (m^3/s), force — newton (N), pressure (pascals and N/m^2) — atmospheric pressure, principles of the siphon.
- The relationship between velocity, pressure and flow rate in systems including: effects of increasing/reducing pipe size on velocity and flow rate at constant pressure; effects of increasing/reducing pressure on velocity and flow rate.
- The reasons why pipework restricts the flow of liquids and gases including: changes of direction, bends and tees; constrictions such as valves; pipe reductions; pipe size.
- The principles behind simple machines including: mechanical advantage, velocity ratio (for two of the following: levers, wheel and axle, pulleys, screws).
- The principles of basic mechanics including: action and reaction, centre of gravity, equilibrium, theory of moments.

Outcome 4: Written and/or oral evidence

Candidates must be able to explain all of the following:

- The fundamentals of electricity including: AC/DC, material conductivity and resistance, measurement of electrical flow.
- The purpose and application of units of electrical measurement for use in the BSE sector including: current (amps), power (watts), resistance (ohms), voltage (volts).

Candidates must accurately carry out simple electrical calculations including: basic over-current protection device size; Ohm's law; power consumption of electrical circuits; voltage, current and resistance in series and parallel circuits.

National Unit specification: support notes

Unit title: Building Services Engineering: Science (SCQF level 5)

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 content and context of this Unit is at a basic, introductory level. The main purpose of the Unit is to make candidates aware of, and prepare for employment within, the BSE industry in any of the main occupational areas of plumbing, electrical, heating and ventilating, or refrigeration and air conditioning.

Outcome 1 covers the basic SI units likely to be encountered in the BSE industry. The candidate will be able to recognise these units and will develop an understanding of how they relate to each other through carrying out straightforward calculations.

Outcome 2 covers the three main types of materials used in the BSE industry. Candidates will be able to recognise these materials and to develop an understanding of how these materials can be used in buildings through understanding the basic mechanical and electrical properties.

Outcome 3 covers both heat and mechanics. The candidate will develop an understanding of temperature, temperature scales and how these can relate.

Outcome 4 covers fundamental electrical principles and properties. The candidate will develop an understanding of what electricity is by understanding the basic electrical flow model and then going on to recognise that there is more than one ‘type of electricity’. This understanding will be enhanced by carrying out some simple Ohm’s law calculations for series circuits.

Guidance on learning and teaching approaches for this Unit

Candidates should be given opportunities to work towards Outcomes in an integrated way whenever possible.

Practical activities should be teacher/lecturer-led in that all equipment, techniques and processes should be explained, demonstrated and thoroughly understood before (candidate) commencement. Demonstrations should be clear, logically sequenced and reflect current safe working practices to ensure candidate understanding.

An integrated approach to learning and teaching across the outcomes in this Unit, and relevant others, is suggested.

National Unit specification: support notes (cont)

Unit title: Building Services Engineering: Science (SCQF level 5)

Opportunities for developing Core Skills

Throughout this Unit there may be opportunities for candidates to develop the Core Skills of *Communication*, *Problem Solving* and *Numeracy* at SCQF level 4. If the candidate is set tasks this will allow them to develop the Core Skills of *Problem Solving* and *Communication*. Whilst completing the necessary calculations the Core Skill of *Numeracy* will be developed.

Guidance on approaches to assessment for this Unit

An integrated approach to assessment across the outcomes in this Unit is suggested. If this is being delivered as part of the National Progression Award the use of holistic assessment with other applicable Units is suggested. In addition, the project-based approach may be used to gather evidence of candidate achievement.

It is recommended that candidates are tested on their knowledge and understanding by explaining how the fundamental properties of materials, heat, mechanics and electrical properties affect each other. The candidate should also be able to carry out basic calculations and as they apply to the BSE industry in order to show how these effects can be measured. This could be done by using a questioning method such as restricted response/short answer questions, or by providing a specification or specifications for small tasks and asking the candidate to provide appropriate responses. This will ensure that candidates have the knowledge and understanding of the basic calculations as they apply to the BSE industry.

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communication technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**

History of changes to Unit

Version	Description of change	Date
02	Core Skills Using Number at SCQF level 5 embedded.	29/09/2011