National Unit Specification: general information

UNIT Engineering Materials (SCQF level 5)

CODE F5W9 11

SUMMARY

This Unit may form part of a National Qualification Group Award or may be offered on a free-standing basis.

This Unit is designed to provide candidates with a basic knowledge and understanding of engineering materials. During delivery of the Unit candidates will learn to state the names of and applications of a range of engineering materials. They will also learn to describe common properties of engineering materials based on appropriate engineering workshop tests. Candidates will develop the knowledge and understanding to describe basic heat treatment processes as applied to engineering materials.

This Unit is suitable for candidates training to be fabrication and/or welding, manufacturing, mechanical or multi-disciplinary engineering craft persons or technicians but may also be delivered to candidates who are being introduced to engineering materials for the first time.

OUTCOMES

1 State the names and uses of common engineering materials.
2 Describe the properties of engineering materials.
3 Describe basic heat treatment processes and their applications as applied to engineering materials.

RECOMMENDED ENTRY

Entry to the Unit is at the discretion of the centre. While candidates do not require any previous knowledge of engineering materials some experience of working in an engineering environment would be advantage.

Administrative Information

Superclass: XA

Publication date: March 2009

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Engineering Materials (SCQF level 5)

CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

**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.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

The Unit provides opportunities for candidates to develop aspects of the following Core Skill:

- Problem Solving (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

UNIT Engineering Materials (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

State the names and uses of common engineering materials.

Performance Criteria

(a) State correctly the names of and uses of ferrous metals used in engineering.
(b) State correctly the names of and uses of non ferrous metals used in engineering.
(c) State correctly the names of and uses of non metallic materials used in engineering.

OUTCOME 2

Describe the properties of engineering materials.

Performance Criteria

(a) Identify correctly the properties of engineering materials using basic workshop tests.
(b) Describe correctly common properties of engineering materials.
(c) Describe correctly how common engineering processes change material and/or mechanical properties.

OUTCOME 3

Describe basic heat treatment processes and their applications as applied to engineering materials.

Performance Criteria

(a) Describe correctly a process for softening a metal.
(b) Describe correctly a process for hardening a metal.
(c) State correctly an engineering application for a softening process.
(d) State correctly an engineering application for a hardening process.

National Unit Specification: statement of standards (cont)

UNIT Engineering Materials (SCQF level 5)

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral and performance evidence supplemented with an assessor observation checklist(s) should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcomes 1, 2 and 3 may be assessed on an individual basis, as a combination of Outcomes or as a single, holistic assessment covering all three Outcomes. Assessment(s) must be conducted under supervised, closed-book conditions in which candidates may use reference materials provided by the centre but are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. Total assessment time for the three Outcomes must not exceed 2 hours.

With regard to Outcome 1:

- candidates must state the names of and an application of two ferrous metals from the following: low carbon steel, medium carbon steel, tool steel, cast iron or stainless steel
- candidates must state the names of and an application of three non-ferrous metals from the following: copper, brass, aluminium, lead, tin, zinc or bronze
- candidates must state the names of and an application of three non-metallic engineering materials from the following**:** rubber, thermosetting and thermoplastics, glass reinforced plastic and carbon fibre

With regard to Outcome 2:

- candidates must identify and describe four common material properties using basic workshop tests from the following list: malleability, ductility, toughness, hardness, work hardening, resistivity, conductivity or wear resistance
- candidates must describe how two common engineering processes change materials and/or mechanical properties. Engineering processes must be taken from the following: welding, cold working, hot working, machining, forging or any suitable alternative process

With regard to Outcome 3:

- heat treatment processes must be taken from the following: work hardening of aluminium alloys or copper; hardening of medium carbon steel; tempering of medium carbon steel; annealing of aluminium alloy or copper or any other suitable engineering heat treatment process

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

UNIT Engineering Materials (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

This Unit forms part of the National Qualification Group Awards in Fabrication and Welding Engineering, Maintenance Engineering and Manufacturing Engineering at SCQF level 5, but may also be offered on a free-standing basis.

This Unit provides an appropriate foundation of study for candidates wishing to proceed to the *Engineering Materials* SCQF level 6 Unit.

The aim of this Unit is to provide candidates with a basic knowledge and understanding of engineering materials. On successful completion of the Unit candidates will be able to state the names and applications of a range of engineering materials. They will also have learnt to describe common properties of engineering materials from appropriate engineering workshop tests. Candidates will have developed the knowledge and understanding to describe basic heat treatment processes and their applications as applied to engineering materials.

In Outcome 1 candidates should be introduced to a range of ferrous metals such as low carbon steel, medium carbon steel, tool steel, cast iron and basic stainless steels. The applications of these ferrous materials in car panels, cutting tools, vices and airframe fittings etc should be explained. Candidates should also be taught about a range of non ferrous metals such as copper, brass, aluminium, lead, tin, zinc and bronze and some of their common applications such as electrical wire, decorative work, aerospace uses, tank linings, plating and plain bearings. Candidates should also be introduced to non metallic materials used in engineering such as rubber, thermosetting and thermoplastics, glass reinforced plastic and carbon fibre and their uses such as sacrificial gears, shock absorption, marine, automotive and aerospace. With regard to all three categories of materials lecturers should explore with candidates the reasons behind the choice of particular materials for given applications so that the principles behind material selection can be reinforced.

In Outcome 2 the properties of engineering materials should be examined. Simple workshop tests should be used to identify as many of these properties as possible. Properties such as malleability, ductility, toughness, hardness, work hardening, resistivity, conductivity and wear resistance should be identified. Methods of identifying these properties may include magnetic, spark, visual, weight and colour checks and the use of basic mechanical tests (eg hardness by filing, and bending tests by hammering in a vice or repeated bending). The candidate should be made aware of how some engineering processes such as welding, cold working, hot working, machining, forging can change the properties of materials and the steps that can be taken to prevent or limit changes to material and/or mechanical properties.

In Outcome 3 simple heat treatment processes should be introduced. Such processes may include work hardening of aluminium alloys or copper, hardening of medium carbon steel or tempering of medium carbon steel or annealing of aluminium alloy or copper. It is recommended that candidates are taught to make comparisons of the properties of the materials pre and post-heat treatment.

National Unit Specification: support notes (cont)

UNIT Engineering Materials (SCQF level 5)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that the Unit is delivered in the same sequence the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. The Unit may be delivered by a combination of lectures, tutorial work, investigations using paper based and electronic sources and practical exercises. The Unit is best delivered by a mixture of classroom and engineering workshop teaching in which practical activities involving the inspection and testing of materials are used to enhance learning.

The materials chosen for this Unit should be such that candidates can carry out simple tests on them that can be readily reported on.

The Internet contains rich sources of information on the properties and applications of engineering materials and on engineering heat treatment processes.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Aspects of the Core Skill of *Problem Solving* will be developed and enhanced as candidates apply knowledge and understanding to carry out a workshop test in an engineering context.

They identify the differing properties and uses of common engineering materials and apply this information to basic heat treatment processes. Health and safety implications will be considered and observed throughout. Although candidates have to work independently assessor feedback could be useful to encourage reflective evaluation of approaches taken.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

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).*

Formative assessment exercises involving candidates in investigating and describing the applications and properties of a range of engineering materials and basic heat treatment process can play a particularly important role in building candidate knowledge, understanding and confidence of Unit content.

Outcome 1 may be assessed by candidates being presented with a range of materials, mounted on a board, and asked to complete a checklist in which they identify the materials and state one application of each material.

National Unit Specification: support notes (cont)

UNIT Engineering Materials (SCQF level 5)

Outcome 2 may be assessed by performing simple checks and tests on a number of materials to identify four common properties of these materials. Centres may use a suitable form to allow candidates to record their descriptions of the properties of the materials.

As part of this assessment candidates may also be asked to describe how common engineering processes change material and/or mechanical properties. Alternatively, this may be done as part of the assessment for Outcome 3.

Outcome 3 may be assessed by an assessment paper comprising a balance of short answers and restricted response questions in which candidates describe basic engineering heat treatment processes and state an application for both softening and hardening processes.

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**