

National Unit Specification: general information

UNIT	Materials – Effects of Force and Protection (Higher)
NUMBER	D156 12
COURSE	Fabrication and Welding Engineering (Higher)

SUMMARY

This unit focuses on understanding the effect produced in a material by the application of a force and the effect of heat treatment and mechanical working on the structure of materials.

OUTCOMES

- 1 Identify the effect produced in a material by force.
- 2 Explain the effect of heat treatment and mechanical working on the structure of a material.
- 3 Explain the principles and methods of material protection.

RECOMMENDED ENTRY

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

- Intermediate 2 Structures together with Standard Grade Mathematics at grade 3
- a minimum of Standard Grade Mathematics at grade 4 and Craft and Design, Graphic Communication or Technological Studies at grade 3
- equivalent National units
- Intermediate 2 Scottish Group Award in a related area

Administrative Information

Superclass:	XD
Publication date:	December 1999
Source:	Scottish Qualifications Authority
Version:	03

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National Unit Specification: general information (cont)

UNIT Materials – Effects of Force and Protection (Higher)

CREDIT VALUE

0.5 credit at Higher.

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Materials – Effects of Force and Protection (Higher)

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

Identify the effect produced in a material by force.

Performance criteria

- (a) The identification of the type of stress expected in a material for a given loading is correct.
- (b) The identification of typical load extension graphs for given materials is correct.

Note on range for the outcome

Materials: low carbon steel, cast iron, copper, brass, aluminium.

Loadings: tension, compression, shear.

Evidence requirements

Written evidence that the candidate can identify and describe the type of stress expected in the materials for the three given types of loading. Written evidence that the candidate can identify extension graphs for given materials.

Supplementary oral evidence resulting from questioning to ensure full coverage of the range.

OUTCOME 2

Explain the effect of heat treatment and mechanical working on the structure of a material.

Performance criteria

- (a) Identification of the effect of heating on the grain structure of iron is correct.
- (b) Explanation of the heat treatment processes available for steel is comprehensive, clear and accurate.
- (c) The interpretation applied to hardness test results is correct.
- (d) Explanation of the effect of hot working on steel is comprehensive, clear and accurate.
- (e) Explanation of the effect of cold working on steel is comprehensive, clear and accurate.

Note on range for the outcome

Heat treatment: annealing, normalising, hardening, tempering, surface hardening.

Hardness testing: 0.27% carbon steel, 0.7% carbon steel.

Hot working: deformation, recrystallisation.

Cold working: work hardening, annealing, stress relieving, recrystallisation, grain growth.

National Unit Specification: statement of standards (cont)

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Evidence requirements

Written evidence that the candidate can give an explanation of the heat treatment process for a specific task.

Written and/or oral evidence that the candidate can give an explanation of the effect of mechanical working for a specific task.

Supplementary oral evidence resulting from questioning to ensure full coverage of the range.

OUTCOME 3

Explain the principles and methods of material protection.

Performance criteria

- (a) Explanation of the principles and methods of protection for a given material is comprehensive, clear and accurate.
- (b) Description of methods of cleaning and surface preparation for a given material is correct.
- (c) Description of methods of polishing and finishing work for a given material is correct in terms of the end result required.

Note on range for the outcome

Materials: steel, copper, brass, aluminium.

Protection methods: alloying, metallic, oxide, cathode.

Cleaning methods: degreasing, blast, flame, acid pickling.

Polishing methods: mechanical, manual.

Evidence requirements

Written evidence that the candidate can give a description of the cleaning method for 2 materials and oral evidence for the remainder.

Written evidence that the candidate can give a description of the method of polishing and finishing for a specific material and written and/or oral evidence for the remainder.

Written and/or oral evidence is required of the candidate's ability to explain principles and methods of material protection.

National Unit Specification: support notes

UNIT Materials – Effects of Force and Protection (Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

It is recommended that you refer to the SQA Arrangements document for Higher Fabrication and Welding Engineering before delivering this unit.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

The deformation effect produced in a material with the application of external forces. The effects on the structure of a material after being subjected to some form of heat treatment and/or mechanical working. Protection from environmental elements.

Reinforcement of the properties and identification of materials. Simple calculations of compressive, tensile and shear stress. Structural change of iron using the iron carbon equilibrium diagram. The use of workshop tests to show the effects of the heat treatment processes on steel. The effects of hot and cold working on the grain structure of low carbon steel. The principles and methods of protecting materials from the effects of environmental attack. The methods of cleaning metals and preparing surfaces for the required protective finishes.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Information on learning and teaching is available in the Subject Guide, produced by the Higher Still Development Unit (HSDU) in partnership with the Scottish Further Education Unit (SFEU) and the Scottish Consultative Council on the Curriculum (SCCC). The Subject Guide is intended to support the information contained in the SQA Arrangements document for the Higher Fabrication and Welding Engineering. The SQA Arrangements document contains the standards against which candidates are assessed.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Examples of instruments of assessment which could be used are as follows.

Outcome 1

Written/graphics exercise to assess the candidate's ability to identify the type of stress expected in the materials for the loadings identified in the PCs.

Outcome 2

Assignment report to assess the candidate's ability to identify and explain a heat treatment process given a specific task and explain the effect of mechanical working for a specific task.

National Unit Specification: support notes (cont)

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Outcome 3

Written exercise to assess the candidate's ability to describe cleaning operations and methods of polishing and finishing artefacts for protection against environmental conditions. In general, the approach should be to develop candidates' insight into the external factors to be considered in the selection of a material for a particular task. The learning programme should be activity-based and candidate-centred.

Note: Carefully structured practical worksheets should support the delivery and assessment of the unit.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).