SCOTTISH QUALIFICATIONS AUTHORITY

Higher National Unit Specification

General information for centres

Unit title: Engineering Skills

Unit code: DR1V 34

Unit purpose: On completion of this Unit the candidate should be able to select and use a range of workshop skills. It is aimed at those candidates who have no previous knowledge of manufacturing and mechanical workshop skills but who have a basic understanding of manufacturing and mechanical technologies.

On completion of the Unit the candidate should be able to:

1 Select equipment and appropriate safe working techniques for the manufacture of given components.
2 Manufacture and assemble components to a given specification using relevant machine tools and mechanical assembly skills.
3 Take measurements and evaluate results.

Credit points and level: 2 HN Credits at SCQF level 7: (16 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: Access to this Unit is at the discretion of the centre. However it would be beneficial if the candidate had a basic understanding of manufacturing and mechanical technologies.

Core skills: There may be opportunities to gather evidence towards the following listed Core Skill components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Critical Thinking	Higher
Reviewing and Evaluating	Higher

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The Assessment Support Pack (ASP) for this unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (http://www.sqa.org.uk/sqa/46233.html).

General information for centres (cont)

Assessment: The Unit should be assessed holistically. Candidates should be assessed on the production of artefacts that meet the knowledge and skills requirements of the Unit. The artefacts should cover the skills of centre lathe turning, milling and bench fitting as described in the Outcomes. Candidates should also produce and maintain a log book of their work throughout the Unit and evaluate their work by completing an inspection sheet for the artefact(s) produced. Relevant risk assessment and Health & Safety criteria should be assessed on an on-going basis.

Higher National Unit specification: statement of standards

Unit title: Engineering Skills

Unit code: DR1V 34

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

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

Select equipment and appropriate safe working techniques for the manufacture of given components

Knowledge and/or skills

- Equipment:
  - centre lathe
  - vertical milling machine
  - horizontal milling machine
  - universal milling machine
  - pillar drill
  - radial arm drill
  - shaper
  - surface grinder

- Tooling:
  - tool shapes
  - feeds and speeds
  - common reasons for tool failure (including drills)

- Hand tools:
  - benches and vices
  - files
  - hammers
  - hacksaws
  - centre punches
  - spanners
  - screwdrivers
  - safe condition of tools

- Risk assessment and Health & Safety requirements:
  - reasoning behind risk assessment
  - risk assessment for each task
  - responsibilities under HASWA or marine equivalent (both employer and employee)

- Process planning:
  - drawings
  - cutting lists
  - operation sheets
  - inspection sheets

- Workholding methods

Evidence requirements

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

- select appropriate machine tools, hand skills and processes
- plan and organise work to suit a given component

Evidence should be available in the candidate's log book demonstrating that he/she can:

- select appropriate equipment
- determine operating parameters
- determine risk assessment
- comply with Health & Safety requirements
- complete process planning sheets
- select appropriate workholding methods
- identify the main machine parts for a minimum of three items of equipment
- select appropriate tooling shapes, rake and clearance angles including drills
- select appropriate feeds and speeds for the selected tooling

Evidence for the knowledge/skills items in this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that he/she can produce log book entries for a specific artefact(s) with a minimum of **three out of eight** items of equipment selected. The remainder of the knowledge/skills elements must be covered in the context of the artefact(s) being produced.

Outcome 2

Manufacture and assemble components to a given specification using relevant machine tools and mechanical assembly skills

Knowledge and/or skills

- machining skills
- mechanical assembly skills
- integration of standard items

Higher National Unit specification: statement of standards (cont)

Unit title: Engineering Skills

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can manufacture and assemble an artefact(s) to given tolerances using a range of machine tools and mechanical assembly skills. Evidence for skills must be provided by producing artefacts fit for purpose and evidence for knowledge must be provided in the candidate's log book. Standard items should be used where appropriate. Tolerances should not be more than +/- 0.25mm.

Evidence must include as a minimum:

- Centre Lathe skills:
  - setting up
  - selection of speeds and feeds
  - using 3 jaw chuck work
  - turning between centres
  - turning operations:
    - facing off
    - facing to length
    - turning diameters to a shoulder
    - turning a diameter between centres
    - centre drilling
    - drilling holes
    - reaming holes
    - knurling
    - taper turning (using the compound slide)
    - producing internal and external threads using an appropriate method
    - parting off
- Milling:
  - using horizontal or vertical or universal milling machines:
    - mounting and use of appropriate cutters (a minimum of two from; face mill, slot drill, end mill, slab mill, side and face cutters, slitting saws, angle cutters)
  - selection of appropriate speeds and feeds
  - using appropriate safe workholding techniques

- Milling operations:
  - milling a block
  - facing to length on horizontal or vertical machines
  - milling to a shoulder
  - milling a slot

- Drilling machines:
  - carrying out drilling operations
  - using safe workholding techniques
  - selection of drill speeds

- Hand skills:
  - using hand tools
  - carrying out measuring and marking out procedures
  - using measuring and marking out equipment
  - using taps and dies
  - performing appropriate fitting assembly skills

- Integration of standard parts such as:
  - pins
  - set screws
  - dowels
  - springs
  - washers
  - allen bolts

Assessment guidelines

It is recommended that a practical exercise(s) be set to include all of the knowledge/skills criteria. Candidates may be interviewed to check their knowledge and understanding of the subject matter. Candidates may be given two attempts to manufacture a functional component and a third attempt if time permits.

Outcome 3

Take measurements and evaluate results

Knowledge and/or skills

- Inspection reports
- Measuring equipment:
  - vernier callipers
  - vernier height gauge
  - micrometer
  - protractors
  - depth gauges
  - go-no go gauges
  - surface texture blocks
  - thread gauges

Evidence requirements

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that they can produce log book entries for a specific artefact(s). The remainder of the knowledge/skills elements must be covered in the context of the artefact(s) being produced.

Copies of the inspection checklists should be included in the candidate's log book. The candidate should also evaluate the fitness for purpose of the artefact and include a report in the log book. Measuring and inspection equipment should include:

- completion of inspection checklists
- evaluation of fitness for purpose
- the use of **five out of eight** appropriate items of measuring equipment

Assessment guidelines

It is recommended that a range of measurement equipment be used to measure the artefact(s) produced by the practical exercise. Centres should make every reasonable effort to ensure the log book and inspection checklists are the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter.

Administrative Information

Unit code: DR1V 34

Unit title: Engineering Skills

Superclass category: XA

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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: Engineering Skills

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 80 hours.

Guidance on the content and context for this Unit

This Unit has been written to allow candidates to develop knowledge, understanding and skills in the following areas using appropriate centre equipment:

- selection of equipment and appropriate techniques
- machine tool and mechanical assembly skills
- measurement and evaluation of artefacts against standards

The candidate should be instructed in the use of a range of measuring equipment. The artefact(s) produced should be inspected to ensure compliance with drawings and tolerances. An evaluation should then be made of the fitness for purpose of the artefact. All inspection should be carried out by the candidate and checked by the assessor.

The content reflects the need for candidates to select appropriate equipment and techniques to manufacture an artefact safely and efficiently and also the ability to evaluate measurements against a given standard.

Guidance on the delivery and assessment of this Unit

This Unit should be delivered predominantly using practical exercises that will allow candidates to learn and develop safe and efficient machining and assembly skills using standard hand and machine tools. Allocated times are for guidance purposes only. It is anticipated that candidates will produce an artefact or artefacts that demonstrate their competence in the skillset described and will utilise the artefact(s) to demonstrate competence in measuring and evaluating against set standards. Evidence will be by the production of an artefact(s) and completion of a log book which shows knowledge and understanding of the processes, techniques and tools used in manufacture.

Outcome 1 (10 hours)

Select equipment and appropriate safe working techniques for the manufacture of given components.
Selection of tooling.

Any **three** from:

- Centre lathe
- Vertical milling machine
- Horizontal milling machine
- Universal milling machine
- Pillar drill

- Radial arm drill
- Shaper
- Surface grinder

Determination of operating parameters:

- Types of tooling
  - roughing
  - finishing
  - end mills
  - slot drills
  - twist drills
  - countersinks
  - counterbores
- Feeds and speeds
- Risk assessment and Health & Safety requirements:
  - reasoning behind risk assessment
  - risk assessment for each task
  - responsibilities under HASWA or marine equivalent (both employer and employee)

Process planning:

- Drawings
- Cutting lists
- Operation sheets
- Inspection sheets

Workholding methods. Any **two** from:

- Workholding on milling machines
- Workholding on drill tables
- Workholding on shapers

Identification of machine parts:

- Identification of main parts of:
  - centre lathe
  - milling machine
  - drill

Tooling shapes and rake and clearance angles:

- Roughing
- Finishing
- Rake angles. Any **two** from:
  - low carbon steel
  - brass
  - aluminium

Higher National Unit specification: support notes (cont)

Unit title: Engineering Skills

Outcome 2 (60 hours)

Manufacture and assemble components to a given specification using relevant machine tools and mechanical assembly skills.

- Centre Lathe skills:
  - setting up
  - speeds and feeds
  - 3 jaw chuck work
  - turning between centres
  - turning operations. Any **10** from :
    - facing off
    - facing to length
    - turning diameters to a shoulder
    - turning between centres
    - centre drilling
    - drilling holes
    - reaming holes
    - knurling
    - taper turning (using the compound slide)
    - tapping
    - screwcutting using stocks and dies
    - boring
    - parting off
- Milling (knowledge only):
  - horizontal, vertical and universal milling machines
  - cutters (face mill, slot drill, end mill, slab mill, side and face cutters, slitting saws, angle cutters)
  - mounting cutters on horizontal, vertical and universal mills
  - cutting speeds and feeds
  - workholding (setting vice parallel, clamping regular shapes in the vice, setting to datum face, setting work to marking out)
- Milling operations:
  - milling a block
  - facing to length on horizontal and vertical machines
  - milling to a shoulder
  - milling a slot
  - milling vees
- Hand Skills
- Drilling machines:
  - drilling operations (types of drills, drill sizes, basic drill geometry)
  - workholding techniques
  - using drilling machines
  - common reasons for drill failure

- Hand tools (knowledge only):
  - benches and vices
  - files
  - hammers
  - hacksaws
  - centre punches
  - spanners
  - screwdrivers
  - safe condition of tools
- Hand skills:
  - using any five of the hand tools mentioned above
  - measuring and marking out procedures
  - measuring and marking out equipment
  - using taps and dies
  - fitting assembly skills
- Integration of standard parts:
  - pins
  - set screws
  - dowels

It is anticipated that an artefact or artefacts will be manufactured from given drawings to cover a substantial amount of the skillset above.

Outcome 3 (10 hours)

Take measurements and evaluate results

The candidate should complete a given checklist for the artefact(s) produced and evaluate the measurements against the drawing or standard. The tolerances in the drawing and/or standard should be adhered to at all times.

Appropriate measuring equipment should be used to carry out the inspection, and the candidate should be well versed in the use and care of all equipment used. Equipment used should include the following:

- vernier callipers
- vernier height gauge
- micrometer
- protractors
- depth gauges
- go-no go gauges
- surface texture block

Centres should make every reasonable effort to ensure the log book and inspection checklists are the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter.

Higher National Unit specification: support notes (cont)

Unit title: Engineering Skills

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards the following listed Core Skill components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Critical Thinking	Higher
Reviewing and Evaluating	Higher

Open learning

Due to the high practical content of this Unit, it is unlikely that it will be offered through Open Learning.

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 on 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: Engineering Skills

This Unit has been designed to allow you to gain knowledge and skills in basic machining, mechanical assembly and measurement techniques. These skills may be employed in other parts of the course and are likely to prove especially useful either in employment or if you progress to higher education.

The first Outcome deals with the selection of equipment and techniques to allow you to gain the underpinning knowledge of basic machines and processes leading to the practical parts later in the Unit. This information should be recorded in your log book as a record of your progression through the various machine tools and techniques including process planning and Health & Safety requirements.

The second Outcome is predominantly practical in nature and you will be expected to manufacture an artefact or artefacts using the machine tools and hand skills from Outcome 1. You will be provided with a drawing and you will compose a cutting list and process planning sheet to explain how you manufactured the artefact(s). There will be an opportunity to practise using the machine tools and hand skills on non assessed projects before commencing the assessment pieces. All written work should be kept in your log book.

The third Outcome is intended to give you vocational experience in using measuring tools to evaluate an artefact(s) against the drawing or standard. You will be given an opportunity to use various types of measuring equipment and will then inspect your artefact(s) against the drawing or standard, taking note of what the measurement should be and what it actually is. You will choose the item of measuring equipment most suited to this task and will complete an inspection sheet provided. On completion of the inspection sheet, you will evaluate whether your artefact(s) meet(s) the drawing or standard requirements and explain the reason for any deviations and any problems which you encountered during manufacture or inspection.

In summary you will be expected to learn about the operation and safe use of various machine tools and hand skills, manufacture an artefact or artefacts, and then measure and evaluate your product against the drawing or standard, to prove conformance. Your skills in using measurement equipment will be checked by the assessor. The assessment comprises the artefact(s) and your log book where you kept all of the written work, Health & Safety requirements, measurements and evaluations.