National Unit Specification: general information

UNIT Material Removal Practice: Milling (SCQF level 5)

CODE F5WB 11

SUMMARY

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

This predominantly practical Unit is designed to provide candidates with the knowledge and skills to produce components on a manually operated milling machine(s). During Unit delivery candidates will develop knowledge and understanding to interpret current engineering standard drawings and tolerances, use process documentation, and learn about the properties of materials used during milling processes. They will also learn about milling machines and their related equipment and select and use cutting tools to manufacture components. An essential aspect of Unit delivery will be that candidates comply with current Health and Safety legislation and safe working practices when performing milling operations.

This Unit is suitable for candidates studying the subject for the first time. It is an appropriate Unit for candidates training to be manufacturing, mechanical or multi-disciplinary engineering fitters or technicians.

OUTCOMES

1 Interpret engineering information in relation to milling operations.
2 Use milling machine(s) to manufacture component(s) to given specifications.
3 Comply with current Health and Safety regulations and safe working practices.

RECOMMENDED ENTRY

Entry to the Unit is at the discretion of the centre. While candidates do not require any previous knowledge of milling some practical engineering craft experience would be an advantage.

Administrative Information

Superclass: XF

Publication date: March 2009

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

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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.

This Unit provides opportunities for candidates to develop aspects of the following Core Skills:

Problem Solving (SCQF level 5)

Numeracy (SCQF level 5)

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

National Unit Specification: statement of standards

UNIT Material Removal Practice: Milling (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

Interpret engineering information in relation to milling operations.

Performance Criteria

(a) Drawing conventions and abbreviations are identified correctly in terms of current British Standards.
(b) Detailed dimensioning, tolerances and surface finishes are interpreted correctly from a given component drawing.
(c) Technical information relating to the manufacture of given component(s) using milling operations is correctly sourced and extracted from appropriate documentation.

OUTCOME 2

Use milling machine(s) to manufacture component(s) to given specifications.

Performance Criteria

(a) Work-holding methods and tooling are used correctly to manufacture a component(s) by following a given planning document.
(b) Measuring equipment is used correctly to verify component(s) conform to given specification.
(c) State the difference between conventional and climb milling and state an advantage and disadvantage of each.

OUTCOME 3

Comply with current Health and Safety regulations and safe working practices.

Performance Criteria

(a) Use machine guards correctly during milling machine operations.
(b) Use appropriate Personal Protective Equipment correctly.
(c) Comply fully with safety requirements, good housekeeping and appropriate tool/equipment storage.
(d) Cooperate effectively with others in engineering workshops.

National Unit Specification: statement of standards (cont)

UNIT Material Removal Practice: Milling (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, product 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.

Candidate evidence may be gathered using a single, holistic assessment covering all three Outcomes. Alternatively, Outcome 1 may be assessed separately from Outcomes 2 and 3. The assessment of Outcomes 2 and 3 must be integrated together.

Outcome 1 (Written and/or Oral Recorded Evidence)

Outcome 1 must be assessed at a single assessment event lasting 30 minutes. Assessment 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.

With regard to Outcome 1:

- candidates must correctly identify four drawing conventions and abbreviations from a given selection
- candidates must be given a milling component drawing and asked to extract 4 pieces of information relating to dimensions, tolerances and surface finishes
- candidates must be given cutter information and asked to source and extract information on feeds and speeds from charts and technical data sheets for a minimum of two materials

Outcomes 2 and 3 (Product, Performance and Written and/or Oral Recorded Evidence)

For Outcome 2 each candidate will require to manufacture a component(s) from a given engineering drawing(s) which has as a minimum the following features: two parallel faces, two flat faces, two square faces and two open ended slots. The component(s) will be manufactured throughout the delivery of the Unit. The component(s) must be manufactured under supervised conditions.

Candidates will manufacture a milling component, or components, to the following tolerances:

- general engineering manufacturing tolerance of ±0.5mm
- one specified length within ±0.25mm
- flatness within 0.125mm per 25mm
- squareness within 0.125mm per 25mm
- surface finish of 3.2µm (microns)

The flatness, squareness and surface tolerances must be achieved on at least two occasions.

National Unit Specification: statement of standards (cont)

UNIT Material Removal Practice: Milling (SCQF level 5)

For Outcome 2 Performance Criteria (b) measuring equipment must include as a minimum the use of an external micrometer, a vernier calliper and surface texture comparison gauges. Evidence of candidates making and recording measurements should be recorded on an appropriate inspection record/checklist.

Outcome 2 Performance Criteria (c) will be evidenced by candidates providing oral and/or written answers relating to the difference between milling and climb milling and one advantage and one disadvantage of each.

For Outcome 3 an observation checklist must be used to record evidence that candidates have complied with the Performance Criteria in Outcome 3 while undertaking practical milling work.

National Unit Specification: support notes

UNIT Material Removal Practice: Milling (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 Certificate Group Award (NCGA) in Manufacturing Engineering at SCQF level 5, but may also be offered on a free-standing basis.

The aim of this Unit is to provide candidates with the knowledge and skills to produce components on a manually operated milling machine. On successful completion of the Unit candidates will be able to interpret engineering drawings relevant to milling operations and extract related information from other common sources such as manufacturers' data, charts and tables. Candidates will also be able to select, care for and use cutting tools to perform such operations as facing, forming internal slots and milling external features as well as obtaining correct cutting speeds and feeds for different cutter types. Candidates will also learn to apply appropriate Health and Safety procedures while using a milling machine(s).

This Unit provides a good foundation of study for those candidates who wish to proceed to the *Material Removal Practice: Milling* (SCQF level 6) Unit.

Outcome 1 involves candidates in interpreting information from engineering drawings such as dimensions, tolerances and surface finishes and extracting, for given cutters, information on feeds and speeds from charts and technical data sheets relating to the milling of different materials.

Outcome 2 provides candidates with an opportunity to develop milling machine knowledge and skills which include making decisions on machining processes and tool selection, and producing profiles and simple features with an emphasis on correct tool selection, feeds and speeds, machine capability and maintenance. Candidates will also use a range of measuring equipment, such as an external micrometer, vernier calliper and surface texture comparison gauges to verify component(s) conform to given specifications.

In Outcome 3 emphasis should be placed on candidates applying good Health and Safety practices and procedures such as the correct use of machine guards and Personal Protective Equipment and complying fully with safety requirements, good housekeeping and appropriate tool/equipment storage while undertaking milling operations.

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. Delivery of Unit content should be principally by lecturer demonstration followed by candidates practising the skills demonstrated.

It is recommended that the same components are used throughout the delivery and assessment of the Outcomes (ie from initial drawing stage to final manufacture of components). The components manufactured by candidates should, as far as possible, reflect their current or future areas of employment and their own personal interests.

The component(s) chosen must cover the machining features listed in Outcome 2. The delivery of Outcome 3 should be fully integrated with the delivery of all practical milling operations in the engineering workshop.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill of *Problem Solving*, that is, Critical Thinking, Planning and Organising, can be developed as candidates follow a planning document and carry out milling operations. They have to consider regulations and safety factors affecting approaches to a range of practical tasks. They then have to adhere to these, using selected methods and techniques to produce components on a manually operated milling machine. Group discussions of workshop safety issues could be particularly beneficial to candidates with no industrial experience. The nature and scope of team goals, roles and responsibilities could be explained and candidates given constructive feedback to encourage review and evaluation of their approaches to co-operative team working.

Numeracy skills will be naturally enhanced as the Unit is undertaken. Candidates have to interpret information accurately from a component drawing. They learn to use measuring equipment and work within accepted tolerances. Formative activities should be contextualised with a focus on the practical interpretation, use and application of number and graphics in engineering.

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)*.

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge, understanding and skills in interpreting and extracting engineering information on milling processes, in milling components and in applying Health and Safety procedures and practices in an engineering workshop.

Outcome 1 may be assessed by an assessment paper which includes appropriate drawing information, component drawing and information sources (charts and technical data sheets) related to speeds and feeds. The assessment paper may comprise of short answer and restricted response questions or objective questions (eg multi-choice questions) or a combination of both. The assessment paper may be suitable for on-line delivery.

National Unit Specification: support notes (cont)

UNIT Material Removal Practice: Milling (SCQF level 5)

Outcome 2 Performance Criterion (a) and Performance Criterion (b) should involve a practical exercise, or exercises, in which candidates manufacture a component or components which meets, at least, the minimum features stated under the Evidence Requirements for Outcome 2. Centres may choose to limit the time candidates have to complete the manufacture of components(s) to a maximum of 6 hours. Candidates should also measure and record component(s) measurements as outlined in the Evidence Requirements for Outcome 2.

Centres should use appropriate inspection records and observation checklists to record candidate evidence. The checklist(s) used should, where possible, cross reference particular component features with the following:

- tool/equipment selection
- checking and making milling machine adjustments
- machining operations (eg have these been satisfactorily performed to ensure the finished component (s) is within tolerance)
- the functionality of the component ('fit for purpose')
- safe working practices

Outcome 2 Performance Criterion (c) may be evidenced by the lecturer providing candidates with graphical information relating to milling and climb milling and asking orally each candidate on their own to answer questions relating to the requirement set out in the Performance Criterion. A checklist should be used to record evidence of the candidate's answer. Alternatively, this Performance Criterion may be evidenced by all candidates sitting an assessment paper (which includes graphical information on milling and climb milling) lasting 15 minutes and conducted under supervised, closed-book conditions.

Outcome 3 should be evidenced throughout the whole time candidates are manufacturing component(s) in an engineering workshop. An observation checklist(s) should be used to record candidate evidence.

For re-assessment purposes it is acceptable to re-designate a size(s) or feature(s) of the original component(s) rather than produce a completely new component.

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**