National Unit Specification: general information

UNIT Industrial CNC Machining (SCQF level 5)

CODE F5D9 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 develop candidates' knowledge, understanding and skills in Computer Numerical Control (CNC) machining. During the delivery of the Unit candidates will learn to load materials into a CNC machine and set datums, load programmes from machine memory and run simulations and undertake basic operations on a CNC machine to produce various components. Candidates will also develop the knowledge and skills to inspect manufactured components to verify if they conform to given specifications. They will also learn to comply with all appropriate Health and Safety requirements while working in an engineering workshop.

This Unit is suitable for candidates training to be manufacturing, mechanical or multi-disciplinary engineering fitters or technicians.

OUTCOMES

1 Load material and set datums for given components.
2 Load programmes from machine memory and run simulation for given components.
3 Produce given components on industrial CNC machines.

RECOMMENDED ENTRY

While entry is at the discretion of the centre it would be beneficial if candidates had attained one of the following, or equivalent:

- NQ Unit in *Material Removal Practice: Turning* at SCQF level 5
- NQ Unit in *Material Removal Practice: Milling* at SCQF level 5
- appropriate industrial experience in the field of manufacturing engineering or machining

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Administrative Information

Superclass: XF

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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.

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

- Information Technology (SCQF level 5)
- Problem Solving (SCQF level 5)
- Working with Others (SCQF level 4)

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

National Unit Specification: statement of standards

UNIT Industrial CNC Machining (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

Load material and set datums for given components.

Performance Criteria

(a) Select the correct work holding devices for given components.
(b) Locate and securely clamp the material for given components.
(c) Set correctly component datums for given components.
(d) Operate correctly a CNC machine in Manual Data Input (MDI) mode.

OUTCOME 2

Load programmes from machine memory and run simulation for given components.

Performance Criteria

(a) Load correctly given component CNC programmes from machine memory.
(b) Use computer simulation correctly to verify CNC programmes.
(c) Identify and report correctly an error within a CNC programme.

OUTCOME 3

Produce given components on an industrial CNC machine.

Performance Criteria

(a) Operate correctly a CNC machine in run mode to produce metallic and non-metallic components.
(b) Inspect components to identify correctly if they conform to given specifications.
(c) Comply fully with all appropriate Health and Safety requirements.
(d) Cooperate effectively with others in engineering workshops.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

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

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.

All three Outcomes must be assessed holistically throughout the duration of the Unit based on the following requirements:

Each candidate will produce four components from given information under supervised conditions. Components may be rotational only, prismatic only or a combination of the two. The information given to candidates to manufacture each component should include the component drawing, the CNC part programme, the material the component is to be made from and tooling requirements. Candidates are not required to set tooling as this should be preset by the centre.

Two of the four components manufactured must be made from suitable metals while the other two must be produced from a suitable non-metallic material. Components may be manufactured from the following selection of materials: mild steel, aluminium alloy, brass, copper or polymers. Each component manufactured must have a minimum of three machined features which must be selected from: flat faces, slots, steps, bored holes, reamed holes, square faces, parallel faces, internal/external profiles, parallel diameters, stepped diameters, tapered diameters, chamfer, radii, undercut, external profiles and external threads.

One of the CNC part programmes must include one error which the candidate should identify through graphical simulation and report to the assessor. The assessor must modify the programme for the candidate to remove the error.

Work holding devices used on the CNC machine(s) must be selected from the following: a 3-jaw chuck, machine vice, clamping to machine table and angle plate.

When inspecting the components candidates must only measure lengths, diameters and depths.

Outcome 3 pc (c) and pc (d) should be assessed in terms of performance evidence while candidates are producing their four components and undertaking all other activities in the workshop. A checklist must be used to record evidence that candidates are complying with all appropriate Health and Safety requirements.

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 Industrial CNC Machining (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 has been developed for the National Qualification Group Award (NQGA) in Manufacturing Engineering at SCQF level 5, but may also be offered on a free standing basis.

The aim of the Unit is to provide candidates with the basic knowledge, understanding and skills to manufacture components on industrial CNC machines. During delivery of the Unit candidates may produce components on one or more of the following: CNC Milling Machine, CNC Lathe and/or CNC Machining Centre.

On successful completion of the Unit candidates should be able to safely and securely load components, set component datums, upload CNC programmes, run simulations to verify programmes and operate a CNC machine to manufacture components. Candidates will also be able to inspect manufactured components to verify if they conform to given specifications. Candidates will also have learnt to comply with all appropriate Health and Safety requirements while working in an engineering workshop.

Candidates successfully completing this Unit may proceed to one or both of the following SCQF level 6 Units: *Industrial CNC Machining* and *Industrial CNC Part Programming.*

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 through a combination of lectures, practical demonstrations and practical tasks allowing candidates to develop their knowledge, understanding and skills of CNC machining operations.

The Unit should be delivered in a practical workshop equipped with suitable industrial standard CNC Lathes, and/or CNC Milling Machine and/or CNC Machining Centres. All CNC machines should incorporate an appropriate industrial programming language and simulation software.

Where centres have restraints on equipment it may be necessary for candidates to undertake practical activities as a group. However, each candidate must demonstrate he/she has achieved the Outcomes and Performance Criteria requirements independently.

Candidates should be inducted into all relevant Health and Safety requirements and safe working practices before commencing any practical work. These requirements and safe working practices should be re-emphasised throughout the delivery of the Unit.

National Unit Specification: support notes (cont)

UNIT Industrial CNC Machining (SCQF level 5)

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

With regard to the Using Information Technology Core Skill at SCQF level 5 there may be a number of opportunities for candidates to develop this Core Skill. For example, candidates will have opportunities to develop their Information Technology skills while becoming familiar with industrial programming languages and simulation software and as they load programmes, identify errors and run simulations. Opportunities may also arise for candidates to access online information or instructions on current industrial CNC machining practices which may support the development of their Internet search skills. The teaching of security and consideration of other users as a routine matter may also provide opportunities to enhance Information Technology skills.

All aspects of the *Problem Solving* Core Skill at SCQF level 5, that is, Planning and Organising, Critical Thinking, and Reviewing and Evaluating may be developed as candidates progress through the Unit. For example, planning and organising is involved when candidates have to locate and clamp materials and correctly set component datum for rotational and prismatic components. Critical thinking is required when identifying and evaluating potential errors and problems prior to running CNC machines in run mode to produce metallic and non-metallic components. Review and evaluation may take place during component inspection where, for example, any non-conformance with a given specification has to be identified and evaluated in terms of the reasons why the non-conformance occurred. Individual discussions with the assessor to support reflective evaluation of efficient working practice may be particularly useful.

The *Working with Others* Core Skill at SCQF level 4 may be developed while candidates share common engineering workshop areas, tools and equipment, or when working on practical tasks as a group. This Core Skill may also be developed while candidates are involved in group discussions regarding, for example, the reasons why a particular component did not meet a given specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Formative assessment, in the form of practical exercises, should be used throughout Unit delivery to allow candidates to develop knowledge, understanding and skills in CNC machining operations.

Unit assessment may comprise four practical exercises. Each exercise may involve the manufacture of 1 component from given information supplied by the centre. In an industrial context there are normally time limits for manufacturing components. In assessing candidates centres may wish to replicate such industrial practices by placing a time constraint of 1 hour for the manufacture of individual components.

National Unit Specification: support notes (cont)

UNIT Industrial CNC Machining (SCQF level 5)

When assessing whether candidates have complied with Health and Safety requirements centres will want to take into account such factors as:

- the wearing of correct Personal Protective Equipment (PPE) while undertaking all CNC operations
- the correct use of machine guards
- compliance with all Health and Safety practices, procedures and instructions

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 communications 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)*.

CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

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. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.