



## National Unit Specification: general information

**UNIT** Industrial CNC Machining (SCQF level 6)

**CODE** F5HT 12

### SUMMARY

This Unit may form part of a National Qualification Group Award or may 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 delivery of the Unit candidates will learn to load materials into a CNC machine and set datums, load programmes from machine memory, fault find on programmes and make corrections and run simulations, set tool offsets and run programmes 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 technicians. It is also suitable for craftspersons who wish to develop more advanced skills in industrial CNC machining.

### OUTCOMES

- 1 Load material and set component datums for given components.
- 2 Load programmes from machine memory, fault find programmes and run simulation for given components.
- 3 Set tool offsets and run programmes on an industrial CNC machine to produce given components.

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#### Administrative Information

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## National Unit Specification: general information (cont)

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### RECOMMENDED ENTRY

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

- ◆ the NQ Unit *Industrial CNC Machining* at SCQF level 5
- ◆ the NQ Unit *Material Removal Principles: Turning* at SCQF level 6
- ◆ the NQ Unit *Material Removal Principles: Milling* at SCQF level 6
- ◆ appropriate Industrial Experience in the field of manufacturing engineering or machining

### CREDIT VALUE

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

*\*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 6)
- ◆ Numeracy (SCQF level 6)
- ◆ Information Technology (SCQF level 6)

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

## **National Unit Specification: statement of standards**

### **UNIT Industrial CNC Machining (SCQF level 6)**

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 component 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, fault find programmes and run simulation for given components.

##### **Performance Criteria**

- (a) Load correctly given component CNC programmes from machine memory.
- (b) Identify correctly errors and edit and save changes to CNC programmes.
- (c) Use correctly computer simulation to verify CNC programmes.

#### **OUTCOME 3**

Set tool offsets and run programmes on an industrial CNC machine to produce given components.

##### **Performance Criteria**

- (a) Set up tooling, enter tool data and set tool offsets correctly on a CNC machine.
- (b) Operate a CNC machine in run mode to produce metallic and non-metallic components.
- (c) Inspect components to identify correctly any non-conformance to the given specification.
- (d) Comply fully with all appropriate Health and Safety requirements.
- (e) Cooperate effectively with others in engineering workshops.

## **National Unit Specification: statement of standards (cont)**

### **UNIT Industrial CNC Machining (SCQF level 6)**

#### **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. The components may be rotational only, prismatic only or a combination of the two. The information given to candidates must include the component drawings, the CNC part programmes, the materials and tooling requirements.

The four components must comprise two metallic and two non-metallic components. The components may be made from the following selection of materials: mild steel, aluminium alloy, brass, copper, plastic or nylon. Each component must have a minimum of four machined features which should be selected from the following: 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.

Two of the CNC part programmes must include errors, which the candidate is required to detect before altering and saving the programmes.

Candidates are required to set-up tooling, input tooling data and set tool offsets for a minimum of four cutting tools. The cutting tools required will be selected from: face mill, end mill, slot drill, centre drill, twist drill, reamer, roughing tool, finishing tool, parting-off tool and screw cutting tool.

The work holding devices used on a CNC machine(s) must be selected from a 3-jaw chuck, machine vice, clamping to machine table, angle plate, dividing head and rotary table.

When inspecting components lengths, diameters, depths, radii, tapers and thread pitch should be measured using appropriate measuring equipment.

Outcome 3 Performance Criteria (d) and (e) 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 6)**

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 Award (NQGA) in Manufacturing Engineering at SCQF level 6, but may also be offered on a free standing basis.

The aim of the Unit is to provide candidates with the 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 will be able, from given information, to load raw material in a CNC machine and set component datums, upload CNC programmes, fault find on programmes and make corrections to programmes, run simulations, set tool offsets and run programmes to manufacture rotational and prismatic components. Candidates will also be able to inspect manufactured components to verify if they conform to given specifications. They will also have learnt to comply with all appropriate Health and Safety requirements while working in an engineering workshop.

This Unit is particularly suitable for those candidates who have successfully completed the Unit *Industrial CNC Machining* (SCQF level 5).

Centres may choose to integrate the delivery of this Unit with the *Industrial CNC Part Programming* SCQF level 6 Unit.

#### **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 short lectures, practical demonstrations and practical tasks allowing candidates to develop their knowledge, understanding and skills in CNC machining operations.

The Unit should be delivered in a practical workshop equipped with at least one CNC lathe and/or one CNC milling machine and/or a CNC Machining Centre. All CNC machines should incorporate the appropriate industrial programming language and simulation software.

## National Unit Specification: support notes (cont)

### UNIT Industrial CNC Machining (SCQF level 6)

It may be necessary, where candidates have little or no knowledge of part-programming, to teach sufficient coding techniques to allow candidates to diagnose simple CNC programme faults.

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.

### OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

All elements of the Core Skill of *Problem Solving*, that is, Planning and Organising, Critical Thinking, and Reviewing and Evaluating, can be naturally developed as candidates apply theory to a complex practical task. A range of information on factors relevant to production will need to be investigated before candidates operate industrial CNC milling machines and lathes to produce components. After interpretation of the component drawing, material and tooling requirements will be considered carefully before safe and appropriate methods and techniques are selected. Evaluation of achievement will be ongoing as candidates set tool offsets and run programmes to produce components on industrial CNC machines. The ability to find faults and correct programme errors to solve problems will be assessed. Component inspection to identify any non-conformance to the given specification will encourage critical evaluation of process and product. Although candidates have to independently demonstrate skills, group discussion may be useful at various stages of formative activities to reflect on working practices. Individual discussions with the assessor to review activities could identify strengths and suggest ideas for improvement in efficiency for the future.

The ability to calculate and consider the implications of data which may be presented numerically and graphically will underpin the competencies developed in the Unit. Candidates have to focus on practical analysis and calculation to determine production needs. Practical exercises to support development of skills in the interpretation and calculation and presentation of data could be undertaken as part of formative work and integrated with other work across the award, with an emphasis on Numeracy as a tool to be used and applied efficiently and critically in working contexts. The provision of appropriate reference materials in numeric and graphic format would assist this process. Candidates will also develop practical technology skills in using CNC Milling machines and CNC lathes. As they load programmes, they will carry out basic fault finding and correction, modifying as necessary and saving changes. Accurate tooling data must be selected and input. Security, safety and consideration for other users as machines are operated should be routine. There may be occasions when access to online information on current industry applications could further support development of knowledge and understanding of Industrial CNC machining.

## **National Unit Specification: support notes (cont)**

### **UNIT Industrial CNC Machining (SCQF level 6)**

#### **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 one 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.

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 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)*.

#### **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](http://www.sqa.org.uk/assessmentarrangements)**