National Unit Specification: general information

UNIT Industrial CNC Part Programming (SCQF level 6)

CODE F5HV 12

SUMMARY

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

This Unit is designed to allow candidates to develop their knowledge, understanding and skills in part programming of Industrial Computer Numerical Control (CNC) machines. During the delivery of the Unit candidates will learn to interpret and re-dimension component drawings to suit CNC procedures. They will also develop the knowledge and understanding to plan operational layouts from supplied component drawings. Candidates will also learn to create and verify manual CNC part programmes.

This Unit is suitable for candidates training to be manufacturing, mechanical or multi-disciplinary engineering technicians who wish to learn about CNC part programming. The Unit may also be used on a free standing basis as part of a programme of training in CNC part programming.

OUTCOMES

1 Interpret component drawings and re-dimension to suit CNC procedures.
2 Plan operational layouts from given component drawings.
3 Create and verify manual CNC part programmes from given component drawings.

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
- Standard Grade Technological Studies at credit level
- Appropriate Industrial Experience in the fields 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 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:

- Information Technology (SCQF level 6)
- Numeracy (SCQF level 6)
- Problem Solving (SCQF level 6)

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

National Unit Specification: statement of standards

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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 component drawings and re-dimension to suit CNC procedures.

Performance Criteria

(a) Extract correctly dimensions and tolerances from a component drawing.
(b) Re-dimension component drawings into programme instructions correctly using both absolute and incremental programming methods.
(c) Identify correctly conventional axis notation for industrial CNC machines.
(d) Identify G and M codes correctly for current industrial/international standards programming code.

OUTCOME 2

Plan operational layouts from given component drawings.

Performance Criteria

(a) Identify correctly tooling requirements for rotational and prismatic components.
(b) Calculate correctly feeds and speeds for selected tooling.
(c) Select correctly work holding devices for rotational and prismatic components.
(d) Specify correctly tool cutting movements in accordance with current practice.
(e) Complete correctly and logically planning layouts in accordance with established practice for rotational and prismatic components.

OUTCOME 3

Create and verify manual CNC part programmes from given component drawings.

Performance Criteria

(a) Specify correctly tool positioning instructions for given components.
(b) Select correctly the appropriate G and M codes from a given industrial programming language for given components.
(c) Optimise tooling movement by successfully using fixed cycles throughout part programmes.
(d) Generate successfully CNC part programmes from a given industrial programming language for given components.
(e) Verify successfully part programmes on a CNC machine tool or through graphical simulation.

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.

Written and/or recorded oral evidence should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcomes may be assessed by a single, holistic assessment covering all three Outcomes or assessed as a combination of Outcomes (eg Outcome 1 on its own and Outcomes 2 and 3 together).

Outcome 1 (Written and/or Recorded Oral Evidence)

Outcome 1 may be assessed as part of a holistic assessment or separately at a single assessment event lasting 30 minutes. Assessment must be conducted under supervised, closed-book conditions in which candidates are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment.

With regard to Outcome 1

- candidates will be given a component drawing and asked to identify three dimensions and two tolerances
- candidates will be given drawings of one rotational and one prismatic component and asked to convert two dimensions for each component into absolute and incremental coordinates
- candidates will be given two line sketches and asked to annotate appropriate axes
- candidates will be given four commands and asked to identify the appropriate G and M codes

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

Assessment of Outcomes 2 and 3 must involve each candidate in producing two CNC part programmes from given component drawings. One of the components must be a rotational component and the other prismatic. The CNC part programmes will be produced throughout the duration of the delivery of the Unit under supervised conditions. An operational planning sheet must be produced for each CNC part programme which must include details of the following items that will be used in CNC machining operations: CNC Machine, sequence of operations, tooling requirements, speed and feed data, work holding device, work piece material and programme codes.

The information provided to candidates in relation to each assessment must include the component drawing, the material, tooling data and available work holding devices.

Each component must have a minimum of four machined features 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 or external threads.

National Unit Specification: statement of standards (cont)

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Cutting tools must be selected from the following list: face mill, end mill, slot drill, centre drill, twist drill, reamer, roughing tool, finishing tool, parting-off tool or screw cutting tool.

Work holding devices used on CNC machines must be selected from a 3-jaw chuck, machine vice, clamping to machine table, angle plate, dividing head or rotary table.

National Unit Specification: support notes

UNIT Industrial CNC Part Programming (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 this Unit is to allow candidates to develop their knowledge, understanding and skills in part programming of Industrial CNC machines. During delivery of the Unit candidates may develop part programmes on one or more of the following: CNC Milling Machine, CNC Lathe and/or CNC Machining Centre.

On successful completion of this Unit candidates will be able to interpret and re-dimension component drawings to suit CNC procedures. They will also have the knowledge and understanding to plan operational layouts from supplied component drawings. Candidates will also have learnt to create and verify manual CNC part programmes.

In Outcome 1 candidates should learn to extract dimensions and tolerances from component drawings, re-dimension component drawings into programme instructions using both absolute and incremental programming methods, identify conventional axis notation for industrial CNC machines and identify G and M codes for a current industrial/international standards programming code.

In Outcome 2 candidates should learn to identify tooling requirements for rotational and prismatic components, calculate feeds and speeds for selected tooling, select work holding devices for rotational and prismatic components, specify tool cutting movements in accordance with current practice and complete operational planning layouts in accordance with established practice for rotational and prismatic components.

In Outcome 3 candidates should learn, for rotational and prismatic components, to specify tool positioning instructions, select appropriate G and M codes, optimise tooling movement by using fixed cycles throughout part programmes, produce CNC part programmes from a given industrial programming language and verify part programmes on a CNC machine tool or through graphical simulation.

Centres may choose to integrate the delivery of this Unit with the *Industrial CNC Machining* 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 part programming.

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Candidates should have access to either computers or CNC machines loaded with the appropriate industrial CNC programming language and simulation software while undertaking this Unit.

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

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Candidates will naturally develop practical technology skills as they re-dimension component drawings into programme instructions and produce and verify CNC part programmes from a given industrial programming language. Access to on line information on current industry applications could further support development of IT skills.

The relevance and significance of Numeracy concepts needs to be understood and applied as candidates undertake the Unit. They extract dimensions and tolerances from component drawings and calculate feeds and speeds for selected tooling. The ability to interpret and calculate graphic and numerical information accurately and efficiently will be enhanced by formative opportunities for practice in practical engineering contexts. All elements of the Core Skill of *Problem Solving*, that is, Critical Thinking, Planning, Organising, Reviewing and Evaluating, will be naturally developed as candidates apply this information to undertake a complex practical task. A range of factors, including safety, will need to be taken into account before CNC part programmes are produced and verified. After interpretation of the component drawing candidates have to plan operational layouts in accordance with established practice for rotational and prismatic components. Formative activities could make use of group discussion to support review and evaluation of working practice.

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 their knowledge, understanding, skills and confidence in CNC part programming.

Outcome 1 may be assessed by an assessment paper comprising drawings and sketches and a question paper consisting of a suitable balance of short answer or objective questions (eg multi-choice questions) or a combination of both.

Outcomes 2 and 3 may be assessed by two practical exercises. Centres may choose to limit the time candidates have to complete each practical exercise to 2 hours. Candidate evidence for Outcome 2 and 3 may be in the form of a portfolio containing operational planning documentation and CNC part programme codes for both the rotational and prismatic components. Candidates may manufacture the two components once their part-programmes have been successfully verified.

Centres should ensure that candidates comply with all appropriate Health and Safety requirements while manufacturing the components.

National Unit Specification: support notes (cont)

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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**