National Unit Specification: general information

UNIT Engineering Dimensional Control (SCQF level 6)

CODE F5KB 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 enable candidates to carry out a range of measurements on engineering components. During delivery of the Unit, candidates will learn about common measurement systems, standards and units used in engineering. They will also learn to describe common sources of error that occur in engineering measurements and describe methods for the minimisation of such errors. Candidates will also develop the knowledge and skills to use appropriate measuring equipment to undertake linear, angular and internal measurements on components. They will also learn techniques for adjusting and setting measuring equipment prior to use.

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 knowledge and skills in dimensional control.

OUTCOMES

1 State common measurement systems, standards, terms and units used in engineering.
2 Describe and calculate common sources of engineering measurement error and their minimisation.
3 Select and use a range of measuring equipment to establish component dimensions against those shown on given engineering drawings.
4 Adjust and set measuring equipment prior to use and produce an inspection report.

Administrative Information

Superclass: XA

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National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

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

- the NQ Unit *Mathematics: Technician 1* (SCQF level 6)
- the NQ Unit *Engineering Dimensional Control* (SCQF level 5)
- appropriate industrial experience in the field of engineering measurement

CREDIT VALUE

1 credit at SCQF 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 Skill:

- Numeracy (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

State common measurement systems, standards, terms and units used in engineering.

Performance Criteria

(a) State correctly the measurement systems that are commonly used in engineering.
(b) State correctly standards that engineering organisations may work to in their engineering activities.
(c) State correctly the units of measurement that are commonly used for linear, angular and surface measurements.
(d) State correctly what is meant by the term traceability in the context of calibration.

OUTCOME 2

Describe and calculate common sources of engineering measurement error and their minimisation.

Performance Criteria

(a) Describe correctly types of error that commonly occur when carrying out engineering measurements.
(b) Describe correctly how common types of error can be minimised or removed.
(c) Calculate correctly the error in measurement due to thermal expansion.

OUTCOME 3

Select and use a range of measuring equipment to establish component dimensions against those shown on given engineering drawings.

Performance Criteria

(a) Extract linear and angular dimensions with tolerances correctly from engineering drawings.
(b) Select correct measuring and comparative instruments appropriate to the measurement tasks.
(c) Check correctly measuring instruments for calibration status.
(d) Use measuring and comparative instruments correctly to perform measurement tasks.
(e) Measure a taper correctly using precision equipment.
(f) Record measurements correctly on an inspection sheet and identify any non-conformance in measurements to drawing specifications.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Adjust and set measuring equipment prior to use and produce an inspection report.

Performance Criteria

(a) Use slip gauges correctly to check and adjust a 0–25mm micrometer.
(b) Use angle slip gauges correctly to check a Vernier protractor for accuracy.
(c) Use slip gauges to check a Vernier height gauge for accuracy.
(d) Produce a complete and accurate inspection report on the tests carried out in Performance Criteria (a) to (c).

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

Written and/or recorded oral and performance evidence supplemented by an assessor observation checklist should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcomes 1 and 2 (Written and/or Recorded Oral Evidence)

Outcomes 1 and 2 may be assessed on an individual basis or the assessment of the two Outcomes may be combined. The total time for assessment(s) of the two Outcomes must not exceed 1 hour and 15 minutes. Assessment(s) 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 identify both the metric and imperial systems of measurement
- candidates should state correctly four standards that engineering organisations may work to while carrying out their engineering activities

With regard to Outcome 2:

- candidates must describe the following sources of error:
  - effects of dirt, grease
  - calibration error
  - effects of heat
  - instrument damage
  - angular misalignment
  - cosine error
  - incorrect application of the instrument (excessive force)
  - incorrect reading of the instrument (eg parallax error)

- candidates should calculate error due to thermal expansion for two different problems

Outcomes 3 and 4 (Performance and Written and/or Recorded Oral Evidence)

Assessment of Outcomes 3 and 4 must be conducted under supervised, open-book conditions.

With regard to Outcome 3:

- candidates must check calibration records/documentation to ensure calibration of measuring equipment is within date
- candidates must make measurements on three separate components. The minimum number of measurements across the three components must be as follows:
  - fifteen linear, nine external diameters, three internal diameters and three angular measurements
  - candidates should be able to identify three different thread forms
- during assessment(s) candidates must use the following measuring and comparative instruments and any ancillary equipment: rule, vernier caliper, external micrometer, internal micrometer, depth micrometer, vernier protractor, vernier height gauge, Dial Test Indicators, slip gauges, thread gauges and go/no-go gauges
- candidates must perform measurements on either an internal or external taper using precision rollers/spheres or sine bar
- **all readings should be to an accuracy of one increment of the resolution of the measuring equipment used**
- **all measurements should be carried out using conventional measuring and comparative instruments**

The measurements shown above may be taken at appropriate times during the delivery of the Unit.

In regard to Outcome 4:

- the inspection report should be between 250 and 400 words in length

Observation checklists must be used to record evidence that candidates have undertaken all the measurement tasks in Outcomes 3 and 4 correctly or not.

National Unit Specification: support notes

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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.

This Unit is particularly suitable for those candidates who have successfully completed the Unit *Engineering Dimensional Control* at SCQF level 5.

The Unit may be delivered using the metric or imperial system or a combination of both systems.

The aim of this Unit is to provide candidates with the knowledge, understanding and skills to carry out a range of measurements on engineering components. On successful completion of the Unit, candidates will be able to state common measurement systems, standards, terms and units used in engineering. They will also be able to describe common sources of error that occur in engineering measurement and describe methods for the minimisation of such errors. Candidates will also be able to use appropriate measuring equipment to undertake linear, angular and internal measurements on components. They will also be able to apply techniques for adjusting and setting measuring equipment prior to use.

This Unit may prove very useful in supplementing and reinforcing knowledge, understanding and skills of dimensional control gained by candidates in other manufacturing Units already completed or being taken at the same time as the Unit (eg *Material Removal Principles: Milling* at SCQF level 6, *Material Removal Principles: Turning* at SCQF level 6, *Engineering Workshop Skills* at SCQF level 6 etc.)

It is recommended that about 4 hours of Unit delivery time is spent on Outcome 1 ensuring that candidates gain a sound knowledge and understanding of common engineering units and standards used in engineering environments. Another 4 hours may be spent delivering Outcome 2 where a strong focus should be placed on common sources of measurement error and how to minimise, or eliminate, the effects of these. It is recommended that about 24 hours of Unit delivery time is spent on Outcome 3 as this practically based Outcome is the main part of the Unit with a further 8 hours being set aside for Outcome 4 involving adjusting and setting measuring and gauging equipment ready for use.

National Unit Specification: support notes (cont)

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While making and recording measurements candidates are likely to use the following measuring instruments:

- rules, internal and external calipers
- micrometers (external, internal, and depth).
- vernier calipers, vernier height gauges and vernier protractors
- Dial Test Indicator
- angle, radius, ring, plug, thread, go/no-go and slip gauges
- comparators
- rollers/spheres and/or sin bars

Candidates may also use some of the following ancillary equipment while taking and recording measurements:

- surface plate
- angle plate
- vee blocks
- bench centres
- straight edge

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.

It is recommended that wherever possible candidates have access to workshop measuring equipment so that they can gain first hand experience of selecting and using such equipment. This may require that candidates have access to engineering workshop and/or laboratory facilities. Where centres have access to Co-ordinate Measuring Machines candidates should be encouraged to learn to use these as such Machines are commonly used for measurement purposes in industry.

Access to the Internet to carry out searches on such subjects as measuring equipment including their limitations with regard to measuring accuracy is highly recommended.

Further details regarding the delivery of the Outcomes are now presented:

Outcomes 1 and 2

It is recommended that both Outcomes are delivered by a combination of lectures and tutorial work. Candidates should have access to the Internet as there are a range of useful websites on such subjects as engineering units, standards, errors and methods for minimising such errors.

Alignment errors, parallax error, location of measured part, application of incorrect measuring pressure, temperature and arithmetic error can be reduced or eliminated by correct use of measuring equipment.

Outcomes 3 and 4

It is recommended that these Outcomes are delivered by a series of practical exercises. At the start of a practical exercise the lecturer could demonstrate which measuring equipment should be selected to take a measurement and how the measuring equipment should be used correctly when taking the measurement. Candidates may also be shown how to set and adjust their measuring equipment. Such an approach will allow the contents of Outcomes 3 and 4 to be integrated.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

As they undertake the Unit candidates perform a series of measurements before using and recording extracted dimensional information from engineering drawings. They interpret results, identifying and explaining any sources of error. *Numeracy* skills will be naturally enhanced, with the focus on practical interpretation and presentation. Formative activities in engineering contexts will encourage confidence through good practices including the correct use and care of measuring and associated ancillary equipment.

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).*

Formative assessment can play a particularly important role in helping candidates to develop their knowledge, understanding, skills and confidence in such areas as engineering Units, standards, sources of error and their minimisation, taking and recording engineering measurements and adjusting and setting measuring equipment.

Outcomes 1 and 2

Candidates may be given an assessment paper comprising a combination of short answer and restricted response questions or objective questions (eg multi-choice questions) or a combination of both.

Outcomes 3 and 4

Candidates may be given a series of practical exercises to complete and also be asked to produce an inspection report covering the requirements of Outcome 4.

National Unit Specification: support notes (cont)

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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**