

SQA Advanced Unit Specification

General information for centres

Unit title: Engineering Measurement

Unit code: HT7D 47

Unit purpose: This Unit has been designed to provide candidates with the knowledge, understanding and skills to interpret engineering drawings and specifications and to measure a wide range of features common to many engineering parts or products. The Unit also allows candidates to make use of basic geometry and graphs to determine that part or product parameters are within specification.

On completion of the Unit the candidate should be able to:

- 1 Determine the features to be measured and the sequence of measurements on a given product.
- 2 Use measurement devices to determine component geometry and other features of the component.
- 3 Select the instruments and methods for a range of measurements.
- 4 Review more specialist measuring equipment.

Credit points and level: 1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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 National 1 to Doctorates.*

Recommended prior knowledge and skills: It would be beneficial if candidates had general knowledge and skills in Engineering Drawing and in Manufacturing. This may be evidenced by the possession of the following SQA Advanced Units: Engineering Drawing, Plastic Component Manufacture and Metal Component Manufacture.

Core Skills: There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Assessment: Candidates must be assessed on their overall ability to determine what can be measured, how it may be measured and the appropriate measuring instruments to be used. Each measuring exercise must include an estimate for errors in measurement.

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Outcome 1 and Outcome 3 must be assessed by means of measurement assignments and the preparation of reports. To reduce assessment loading centres may combine the two assignments into one larger assignment.

Outcome 2 involves candidates in using a range of inspection instruments and completing a log sheet for each instrument.

Outcome 4 involves candidates in reporting on an inspection method or features which are more specialist and could involve some investigative work by the candidate.

There is scope for integration of assessment between this Unit and the units Engineering Skills and Manufacturing Engineering: Graded Unit 2 (Project).

SQA Advanced Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Determine the features to be measured and the sequence of measurements on a given product

Knowledge and/or skills

- ◆ drawings and datums
- ◆ tolerances
- ◆ specifications from standards
- ◆ measurement sequences and instructions

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific tasks. Each candidate must demonstrate that they can perform tasks based on a sample of the items shown above. In any assessment of the Outcome **three out of four** knowledge and/or skills items should be sampled. Candidates must provide a satisfactory response to all three items.

In order to ensure that candidates will not be able to foresee which items they will be assessed on, a different sample of three out of four knowledge and /or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all three items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ read engineering drawings and/or interpret drawing or product specifications
- ◆ determine what has to be measured and to what degree of accuracy
- ◆ prepare measurement instructions

Assessment must be in the form of a supplied drawing(s) and the physical product and the product specification. The candidate will be expected to number a minimum of eight features to be measured on the CAD drawing, in a logical sequence, based on data and specifications. In addition, the candidate must provide a brief report to describe the measurement instructions and details of any set-up requirements.

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While candidates are not required to prepare their report under controlled, supervised conditions, centres should make every reasonable effort to ensure that reports are the candidates' own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Reports, which should include the annotated drawing, should contain a minimum of 200 words. If they so desire, candidates should be permitted to use software packages to produce documentation for their report.

Features to be measured could include: diameter, length, pitch, roundness, flatness, radii, resistance, current, voltage, speed and force. Current or voltage values could represent force or torque or pressure.

The assessment for Outcome 1 could be integrated with that for Outcome 3.

Outcome 2

Use measurement devices to determine component geometry and other features of the component

Knowledge and/or skills

- ◆ measurement fundamentals
- ◆ instruments for measurement
- ◆ device classification
- ◆ sources of error in measurement
- ◆ standards and calibration

Evidence Requirements

Evidence for the knowledge and/or skills items in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific tasks. Each candidate will need to demonstrate that they can undertake tasks based on a sample of the items shown above. In any assessment of the Outcome **three out of five** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee which items they will be assessed on, a different sample of three out of five knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all three items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ use a wide range of measurement devices for geometric shape, basic electrical parameters and other features
- ◆ classify the instrument type
- ◆ determine sources of error and estimate measurement error
- ◆ state the setting and calibration methods

Assessment must take the form of a series of varied measurement exercises where candidates will undertake the measurement of a product to demonstrate that they can use measuring equipment and record measurements. It is left to the discretion of centres to decide the number of practical exercises

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but the total number of exercises must ensure the use of a minimum of 10 measuring devices. Centres must develop a checklist for all instruments used to verify actual usage.

On completion of measurements candidates must complete an instrument log which must include the following: feature types, range, errors in measurement, accuracy and comments on ease of use. Centres must ensure that candidates are provided with blank log book forms.

Sketching of instruments must be avoided. Any set-ups or additional equipment (clamps or stands) must be described or sketched.

Assessment guidelines

Centres should encourage candidates to make use of photographs or schematics in their logbook.

The emphasis in this Outcome is on competent usage of the instrument and the creation of a log that may be used in Outcome 3.

Outcome 3

Select the instruments and methods for a range of measurements

Knowledge and/or skills

- ◆ function, range, resolution and accuracy
- ◆ compliance with the specification
- ◆ cost of measurement

Evidence Requirements

All knowledge and/or skills items in this Outcome should be assessed. The evidence should be presented in response to an assignment in which candidates are provided with specifications of two physical components each with a minimum of six different features and are asked to:

- ◆ select appropriate instruments based on function, range, resolution, accuracy
- ◆ determine if components or products meet a specification
- ◆ give an indication of measurement cost (cost elements or values)

Candidates must be supplied with the products or components, the product or component drawings and the specifications. Candidate evidence must be presented in the form of a short written report with sketches or pictures where appropriate.

Candidates must be provided with details of the required report format that should include, as a minimum, the items listed under the bullet points in the Evidence Requirements. While candidates are not required to prepare their report under controlled, supervised conditions, centres should make every reasonable effort to ensure that reports are the candidates' own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

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Assessment guidelines

Instrument selection should suit product features, tolerances and data. Comparison with the specification is required simply to determine whether a product is within specification or not. Candidates should identify sources of error, and estimate levels of error, in measurement processes to provide additional confidence in the correctness of measurements made.

The cost element may include a description of the set-up procedure and a statement of time involved. Overall cost could be based on inspection time and the relative cost of instruments and transducers. Supplier catalogues and price lists may be used.

The use of different components or different specifications for the same components would encourage individual effort and reduce collusion.

The assessment of this Outcome could be integrated with that of Outcome 1 to reduce the number of assessments.

Outcome 4

Review more specialist measuring equipment

Knowledge and/or skills

- ◆ gears
- ◆ screw threads
- ◆ roundness
- ◆ surface texture
- ◆ force
- ◆ acceleration
- ◆ energy
- ◆ flatness
- ◆ CMM's (coordinate measuring machines)
- ◆ coating thickness

Evidence Requirements

Evidence for the knowledge and/or skills items in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific tasks. Each candidate will need to demonstrate that she/he can perform tasks based on a sample of the items shown above. In any assessment of the Outcome **four out of ten** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee which items they will be assessed on, a different sample of four out of ten knowledge and /or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all four items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ describe the principle of operation of the equipment
- ◆ state or explain the features that are being measured
- ◆ state any settings, or calculations, or programming that may be required
- ◆ state the advantages and limitations of the equipment

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Candidate evidence should be in the form of a report plus sketches/diagram/pictures. Candidates must be provided with details of the required report format that should include, as a minimum, the items listed under the bullet points in the Evidence Requirements. While candidates are not required to prepare their report under controlled, supervised conditions, centres should make every reasonable effort to ensure that reports are the candidates' own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Candidates may be told which items they will be assessed on and to minimise collusion each candidate in a group may be given an individual measuring exercise involving a different mix of the four out of ten knowledge and/or skills items.

Reports, which should include sketches/diagrams/pictures, should contain a minimum of 200 words per item of equipment.

Examples could include:

- ◆ check the flatness of a surface table using precision level
- ◆ assess surface texture using portable equipment and a surface texture machine
- ◆ determine out of roundness using at least three methods for interpretation
- ◆ check four features of a spur gear using appropriate equipment
- ◆ check four features of a threaded diameter using appropriate equipment

The emphasis in this Outcome is on “hands on” measurement and any schematics should be supplied and graphs or calculations should be spreadsheet assisted and supplied.

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Administrative Information

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Superclass category:	WD
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SQA Advanced Unit specification: support notes

Unit title: Engineering Measurement

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 designed to give candidates knowledge and understanding and develop confidence in reading drawings, interpreting specifications and selecting and using measuring instruments.

This is a practically based Unit and one of the key purposes of the Unit is to get candidates to use measuring equipment taking into account sources or errors. Measurements should be made whether the product or part is within specification or not. Candidates should be encouraged to develop confidence in making decisions as to whether a product or component is within specification or not as this is one of the key purposes of measurement.

Candidates should be encouraged to develop good measurement practices such as cleanliness and being methodical/logical.

In Outcome 1 candidates should be given plenty of practice in reading drawings and interpreting specifications.

In Outcome 2 every time a candidate learns how to use a new instrument the candidate should complete a log or table in order to record features and capabilities that have been found.

The list below provides recommendations (it is not intended to be exhaustive) of the items that should be recorded in the log:-

Instrument type	micrometer 0- 25mm
Serial no	mic0034
Application/ features it can measure directly	diameter, length, thickness
Application/ features it can measure indirectly	most dimensional
Range of values possible (verified by gauge blocks)	0.00mm to 25.00 mm
Resolution	0.01mm
Accuracy	0.02
Range or reading in your group	19.55 to 19.61
Reasons for variation	skill, training, errors in diameter, gross error, access
Comment on ease of use	requires practice and while it is read more easily with DRO it still depends on touch

Following Outcome 2 a more 'professional' table or checklist from an equipment supplier could be used in Outcome 3 which will add realism to the exercises undertaken in this Outcome.

Historically measurement units have been laboratory (Metrology) room based but modern measurement can take place anywhere so long as the possible sources of error are taken into account. In Outcome 4 the centre does not have to teach all of the knowledge and/or skills to the same depth of treatment as it may dilute the Unit.

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Guidance on the delivery and assessment of this Unit

The suggested delivery time for each Outcome is shown in brackets below.

- 1 Determine the features to be measured and the sequence of measurements on a given product (4 hours).
- 2 Use measurement devices to determine component geometry and other features of the component (20 hours).
- 3 Select the instruments and methods for a range of measurements (6 hours).
- 4 Review more specialist measuring equipment (10 hours).

At the start of delivering the Unit it would be a useful exercise to allow candidates to conduct measurements on the same component and discuss results in order to emphasise the inconsistencies that can occur when measurements are taken by different people.

It will be noted from the above that the time dedicated to each outcome is not equal reflecting the different content in each outcome. A heavy weighting during delivery should be given to the use of measuring equipment but only at a pace where candidates can see some relevance or application. A ‘whistle stop’ tour of every piece of measuring equipment is counter-productive.

Outcome 4 could involve (or incorporate) a visit to a local company to demonstrate specific measurement requirements. If the company products are available the candidate could suggest measuring methods before the visits and this could be reinforced or corrected during the visit.

It is strongly recommended that any lecturer delivering this Unit studies the Unit Assessment Exemplar to determine the standard of assessment expected by the unit writers.

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Open learning

This knowledge and understanding parts of this Unit could be delivered by distance learning, which may incorporate some degree of online support. Candidates would require to have substantial access to a workshop and inspection equipment to undertake and check measurements. With regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning* (SQA 2000).

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Engineering Measurement

This Unit has been designed to allow you to develop knowledge and skills in interpreting engineering specifications and in using a range of measuring instruments to make a variety of different measurements. The ability or skill to select and use a wide range of measurement devices and determine if a product is right or wrong is a high level skill. This Unit provides a good introduction to the development of this skill. The Unit will provide you with plenty of practice opportunities to develop this skill for it is only by practice that you will develop confidence in selecting the correct measuring instrument and in deciding if a product or component is within 'spec' or not.

During the teaching of this Unit you will not need to memorise the fine details of each instrument as you can access such details via supplier catalogues.

In this Unit you will learn good measurement practices such as cleanliness and working in a logical/methodical manner. These are important transferable skills which can be applied to most measurement applications.

Measurement is normally the first stage in an "informed decision making" process and will be applicable in topics such as sampling, receiving inspection and process capability studies.

The review of more advanced measuring equipment in this Unit is only included to provide you with an insight in to how advanced measurement techniques have become. Such knowledge may help you in the future to pick the correct measurement equipment or indeed correct measurement machine (which often cost large sums of money) to make measurements.

Assessment in this Unit will be by a combination of short written reports and the completion of a logbook.