



National Unit Specification: general information

UNIT Land-based Engineering: Workshop Processes (SCQF level 6)

CODE F91C 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 provide candidates with knowledge and skills required in service engineering workshop environs. During delivery of the Unit, candidates will learn to interpret and extract basic information from simple engineering drawings and to complete planning documentation prior to performing basic engineering workshop skills. Candidates will select workshop tools and materials for a given purpose and develop the knowledge and skills to use the tools to produce components to given specifications and tolerances. Throughout the delivery of the Unit candidates will apply safe working practices as they produce and assemble components.

This Unit is suitable for candidates who are training to be service engineering technicians.

OUTCOMES

- 1 Interpret engineering information and plan an artefact.
- 2 Describe non-thermal fastening and joining methods for service engineering applications.
- 3 Describe tools and materials for service engineering applications.
- 4 Carry out marking out procedures to produce artefacts to given specifications.
- 5 Manufacture components and assemble an artefact to meet given specifications.

RECOMMENDED ENTRY

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

- ◆ Communication at SCQF level 4
- ◆ Numeracy at SCQF level 4

Administrative Information

Superclass: SK

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CREDIT VALUE

1 credit at SQA 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.

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

Numeracy	(SCQF level 5)
Communication	(SCQF level 5)
ICT	(SCQF level 5)
Working with Others	(SCQF level 4)
Problem Solving	(SCQF level 5)

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 engineering information and plan an artefact.

Performance Criteria

- (a) Identification of basic drawing conventions and abbreviations in terms of current British and European Norm (EN) Standards is correct.
- (b) Interpretation of information from given component drawings is correct and produced to a logical plan for the fabrication of an artefact.
- (c) Complete a simple planning document correctly for the manufacture of components.

OUTCOME 2

Describe non-thermal fastening and joining methods for service engineering applications.

Performance Criteria

- (a) Description of non-thermal fastening and joining methods is correct.
- (b) Selection of non-thermal fastening and joining methods is correct.
- (c) Description of the joining method for components using non-thermal fastening and joining methods is correct.

OUTCOME 3

Describe tools and materials for service engineering applications.

Performance Criteria

- (a) Description of materials used in service engineering and manufacture of artefacts is correct.
- (b) Description of material finishing is correct.
- (c) Selection of tools used in the manufacture of artefacts is correct.

OUTCOME 4

Carry out marking out procedures to produce artefacts to given specifications.

Performance Criteria

- (a) Preparation of materials for marking out procedures is correct
- (b) Selection and use of equipment to mark out work is accurate.
- (c) Marking out is checked to ensure conformation to the given engineering drawing specification is accurate.

National Unit Specification: statement of standards (cont)

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OUTCOME 5

Manufacture components and assemble an artefact to meet given specifications.

Performance Criteria

- (a) Selection and use of hand and power tools to manufacture components is correct.
- (b) Process of component manufacture is correct.
- (c) Component assembly using non-thermal fastening and joining procedures is correct.
- (d) Select and use measuring equipment correctly to verify that components conform to specifications.

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, 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.

Outcome 1

Outcome 1 must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome and Performance Criteria. Candidate evidence must be in the form of written and graphical and/or recorded oral evidence. Assessment 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. Total assessment time for Outcome 1 must not exceed 30 mins.

With regard to Outcome 1

- ◆ candidates must interpret the information on a drawing of an artefact with reference to BS EN ISO 7083:1995 (BS308-3.6:1995) standards
- ◆ candidates must identify six abbreviations for component symbols used in drawings
- ◆ candidates must complete correctly, planning documentation for the manufacturing process of a given component
- ◆ artefacts must comprise of a minimum of five components which must include at least one comprising of ms sheet metal up to 3mm, one of tube and one of non-ferrous metal
- ◆ artefacts must have four different fastening/joining methods in its construction

Outcome 2

Outcome 2 must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome and Performance Criteria. Candidate evidence must be in the form of written and/or recorded oral evidence. 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. Total assessment time for Outcome 2 must not exceed 30 mins.

With regard to Outcome 2

- ◆ candidates must identify the correct application for six threaded and six non threaded methods of fastening
- ◆ candidates must identify the correct application for four adhesives suitable for service engineering applications
- ◆ candidates must identify the correct application for four vibration resistant fastenings
- ◆ candidates must identify the correct applications for four joint seals
- ◆ candidates must describe correctly the service solutions for four given problems found in service engineering applications
- ◆ candidates must source and extract information on internal and external threads and drill speeds from charts and technical data sheets for a minimum of four given thread sizes

National Unit Specification: statement of standards (cont)

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Outcome 3

Outcome 3 must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome and Performance Criteria. Candidate evidence must be in the form of written and/or recorded oral evidence. 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.

Total assessment time for Outcome 3 must not exceed 30 mins.

With regard to Outcome 3

- ◆ candidates must identify correctly four ferrous and six non ferrous metals
- ◆ candidates must identify correctly two service engineering applications for four ferrous and six non ferrous metals
- ◆ candidates must describe correctly two finishing processes used in service engineering applications
- ◆ candidates must identify correctly the application of hand tools for cutting, bending, drilling threading and forming
- ◆ candidates must describe correctly the application of power hand tools for four given service engineering tasks
- ◆ candidates must identify correctly the application of bench/fixed power tool application for four given service engineering tasks

Centres may choose to integrate the assessments for Outcomes 4 and 5 so that there is a logical flow to assessment in terms of marking out and manufacture of components.

For Outcomes 4 and 5 each candidate will require to prepare, mark out, manufacture and assemble a minimum of five components from given engineering drawings to a general manufacturing tolerance of $\pm 0.25\text{mm}$. The artefact must comprise of a minimum of five components, which must include at least one comprising of ms sheet metal, one of tube and one of non-ferrous metal. The manufacture of each component and assembly of the components should be carried out during the delivery of the Unit each within an allotted time scale. The components should be prepared, marked out, manufactured and assembled under supervised conditions. Fasteners may be used in the assembly.

Outcome 4

Outcome 4 must be assessed by a single practical assessment designed to generate evidence of candidates' abilities to mark out a minimum of two components. Candidate evidence must be in the form of product and performance evidence. They must undertake assessment on their own and it must be conducted under supervised conditions. An observation checklist must be used to record evidence of whether candidates have satisfied all the Performance Criteria in the Outcome or not.

With regard to Outcome 4

- ◆ candidates must prepare the materials to be marked out
- ◆ candidates must mark out the dimensions on ms sheet, tube and non-ferrous metal materials.
- ◆ candidates must demonstrate economic use of materials in marking out
- ◆ candidates must complete a planning sheet correctly showing information for all components and the assembly of the artefact.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Workshop Processes (SCQF level 6)

Outcome 5

With regard to Outcome 5:

- ◆ for Outcome 5 each candidate will require to manufacture a minimum of five components from given engineering drawings. At least three of these components should form part of an assembly of an artefact.
- ◆ during manufacture of the components candidates must use, as a minimum, the following tools: files, hack saw, engineer's square, drills, pedestal drill, countersink, centre punch, ball peen hammer and set of taps and dies
- ◆ candidates must in the manufacture of the components, undertake the following engineering operations: cutting, guillotining, hot and cold bending, drilling, counter sinking, tapping, riveting,
- ◆ candidates must use the following measuring equipment: surface table, angle plate, radius gauges, vernier calliper, micrometer and a vernier protractor, to check a minimum of eight dimensions on the final assembly. These dimensions must be recorded on an appropriate inspection document

National Unit Specification: support notes

UNIT Land-based Engineering: Workshop Processes (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 Land-based Engineering at SCQF level 6, but may also be offered on a free standing basis. It can operate in conjunction with the SVQ Level 3 in Land-based Engineering Operations, providing candidates with the knowledge and understanding required to service and repair equipment appropriate to their area.

The overall aim of this Unit is to develop candidates' knowledge, understanding and skills of engineering workshop processes and hand skills. On successful completion of the Unit candidates will be able to interpret and extract basic information from simple engineering drawings and other sources in relation to performing service engineering workshop tasks. They will also have a knowledge of and be able to select materials, fastenings and fixings for given specifications. Candidates will also be able to mark out profiles for given specifications, complete planning documentation, and will have the knowledge and skills to select and use engineering tools to produce components and assemble an artefact to a given specification. They will also be able to use appropriate measuring equipment to verify component dimensions conform to given specifications. Candidates will also be able to apply current safe working practices while manufacturing components and assembling an artefact.

As Outcomes 4 and 5 require candidates to work practically in a workshop situation, it is strongly recommended that candidates are inducted into current legislation, regulations and safe working procedures and practices before starting practical work.

A safe system of work should be established in line with the Health, Safety and the Environment Unit guidelines while taking cognisance of the candidate's previous experience and abilities prior to the commencement of practical activities. The methods for disposal of waste materials produced during the servicing of land-based equipment should comply with current legislation and good practice. Health, safety and environmental issues associated with this Unit should be taught together with the subject topics and not separately in the Land-based Engineering: Health, Safety and the Environment Unit.

Outcome 1 requires candidates to interpret dimensional and tolerance information from simple engineering drawings.

Outcome 2 requires candidates to know, identify and select non-thermal methods of fastening and joining components, including bolts, rivets, adhesives, patent and threaded fasteners. They must identify different common thread types and their potential uses and extract information on internal and external threads and drill speeds from charts and technical data sheets. In examining four problems found in service engineering applications they should identify the problems related to fastenings and give potential solutions.

Outcome 3 allows candidates to know and identify common ferrous and non-ferrous metals and their potential uses in service engineering equipment, so that ultimately they can select suitable repair and restoration techniques in the field. Candidates must describe correctly two finishing processes used in service engineering applications: annealing, painting, plating, hardening, case hardening, tempering,

hard facing, and/or polishing. They should know the common applications of these finishing processes. Candidates are to identify tools, both hand and power, which can be used to manufacture and repair components

National Unit Specification: support notes

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Outcome 4 involves the candidates in preparing work piece materials correctly for marking out purposes and in selecting and using marking out equipment to produce and verify profiles.

During the delivery of this Outcome candidates should learn to use such marking out equipment as a scribe, ruler, surface gauge, angle plate, dividers, protractor and radius gauges.

Outcome 5 is intended to allow candidates to develop engineering hand skills pertinent to service engineering while producing a range of components. During the delivery of the Outcome candidates should learn to use such tools as files, hack saw, engineer's square, drills, reamers, pedestal drill, taps, dies, centre punch and ball pein hammer. As part of this Outcome candidates should also learn to select and use a range of measuring equipment such as surface table, vernier height gauge, angle plate, radius gauges, vernier calliper and vernier protractor.

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 should be delivered partly in the classroom and partly in a service engineering workshop environment suitably equipped with marking out tools, engineering tools and measuring equipment. Candidates should be provided with access to a range of basic engineering drawings so that they can develop their knowledge and skills in interpreting and extracting information from drawing. It is possible this Unit may assist the candidate with the skill of assembling manufactured units in the work place. Delivery of Unit practical content should be principally by lecturer demonstration followed by candidate practice.

HEALTH SAFETY AND ENVIRONMENTAL ISSUES

As Outcomes 4 and 5 require candidates to practically service and repair equipment either onsite or in a workshop situation, it is strongly recommended that candidates be inducted into current legislation, regulations and safe working procedures and practices before starting practical work.

A safe system of work should be established in line with the Health, Safety and the Environment Unit guidelines while taking cognisance of the candidate's previous experience and abilities prior to the commencement of practical activities. The storage and handling of materials and methods for disposal of waste materials produced during the servicing of land-based equipment should comply with current legislation and good practice. Health safety and environmental issues associated with this Unit **should be taught together with the subject topics and not separately** in the Land-based Engineering: Health Safety and the Environment Unit.

A large range of paper based and electronic resource materials exist on Health and Safety. Centres may wish to show candidates Health and Safety videos/DVDs to highlight, for example, the dangers of working in engineering workshops.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill *Communication* at SCQF level 5 may be developed in Outcomes 1, 2 and 3 where detailed and complex written and oral communications are required. In interpreting information provided from reference sources, apply it to techniques and communicating detailed written decisions on the use of fastenings, materials and tools.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Workshop Processes (SCQF level 6)

Elements of *Numeracy* at SCQF level 5 may be developed in Outcomes 1, 4 and 5 where various aspects of workshop techniques require numerical skills particularly carrying out calculations associated with planning and marking out. Using Graphical Information at SCQF level 5 may be developed in Outcomes 1, 4 and 5 where candidates are given graphical information to interpret and correct mark out in the production of an artefact. Candidates are required to check the accuracy of the final assembly.

The Core Skill *ICT* at SCQF level 5 may be developed in Outcomes 1, 2 and 3 where candidates may access and interpret information, research and select differing fastening and joining methods and tool types in the production of artefacts and engineering applications.

The Critical Thinking component of *Problem Solving* at SCQF level 5 may be developed in Outcome 1 while candidates are interpreting drawings and practically planning artefacts. The Planning and Organisation component of *Problem Solving* at SCQF level 5 may be developed as candidates undertake practical activities in Outcomes 1, 4 and 5 when candidates are developing engineering skills pertinent to service engineering while producing a range of components and artefacts. The Planning and Organising component will also be developed in Outcome 1 where a candidate is completing a planning document for the manufacture of an artefact. Candidates are required to Review and Evaluate the effectiveness of their work while verifying components conform to prescribed specifications in Outcomes 4 and 5.

Elements of *Working with Others* Core Skill at SCQF level 4 may be developed in Outcomes 4 and 5 while candidates complete marking out, manufacture and assembly of artefacts and work co-operatively with others. Further development at SCQF level 4 may be found in Outcomes 4 and 5 in practical situations where team working is required while sharing service engineering workshop space, tools and equipment. Although candidates have to demonstrate practical skills independently, formative activities could enhance the skills of working with others. Good practice in using and sharing service engineering workshop areas, tools and equipment could be discussed in terms of the nature and scope of team goals, roles and responsibilities. Candidates could be given constructive feedback to encourage review and evaluation of their approaches to practical work including their contribution to team working.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Formative assessment exercises involving candidates in interpreting information on engineering drawings, extracting thread and drill speed information from specialist sources and practising marking out and workshop hand skills to produce components and assemblies will play a particularly important role in building candidate knowledge, understanding, skills and confidence of Unit content. A single, holistic assessment paper of short restricted response questions may assess Unit knowledge in Outcomes 1, 2 and 3. Alternately individual parts of the assignment could be carried out at appropriate points during Unit delivery or Outcome 1 may be assessed by a separate assessment paper while Outcomes 2 and 3 may be assessed together using short restricted response questions.

National Unit Specification: support notes (cont)

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With regard to Outcome 1 any assessment questions should comprise of an appropriate engineering drawing(s), specialist documentation and a question paper comprising a balance of short answers/restricted response questions. More specifically each candidate could be provided with a series of detailed drawings with certain complex features highlighted. Each candidate could be required to identify the highlighted features. A specialised source(s) of information may be a detailed manufacturer's chart for uncommon tapping drill sizes for different threaded holes. Candidates would be required to complete an appropriate planning and inspection document associated with the artefact from Outcomes 4 and 5.

In the practical exercise used to assess Outcomes 4 and 5 it is recommended that the time taken to mark out, manufacture and assemble the components to meet the assessment requirements should not exceed 15 hours.

It is also recommended that any checklist(s) and inspection record(s) used as part of the assessment of Outcomes 4 and 5 should be cross-referenced to the following:

- ◆ the planning of the manufacture of the components and assembly
- ◆ the selection and use of the correct tools/equipment to produce particular components
- ◆ measurement and verification of component dimensions against specifications

so that the finished components and assembly can be assessed in terms of compliance with dimensions, tolerances and functionality.

HEALTH SAFETY AND ENVIRONMENTAL ISSUES

Assessment of health, safety and environmental issues within this Unit could be cross-matched and assessed in the associated Land-based Engineering: Health, Safety and the Environment 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 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)*.

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