National Unit Specification: general information

UNIT Land-based Engineering: Piston Engine Repair Skills (SCQF level 6)

CODE F919 12

SUMMARY

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

This is a practical Unit designed to provide candidates with the knowledge, understanding and skills to enable them to dismantle, condition assess, rebuild and test internal combustion engines used in land-based vehicles and equipment.

The Unit is suitable for candidates training to be service engineering technicians working on land-based vehicles and equipment.

OUTCOMES

1 Remove and replace engine assemblies.
2 Dismantle and clean engines and their ancillary systems.
3 Inspect components and compare with manufacturers' standard to determine serviceability.
4 Rebuild engine to manufacturer's specification.
5 Test reconditioned engine.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have some formal training and experience in lifting and handling and would have attained one of the following, or equivalent:

Land-based Engineering: Engine Technology at SCQF level 6
Numeracy at SCQF level 4

Administrative Information

Superclass: SK

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National Unit Specification: general information (cont)

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CREDIT VALUE

1 credit at SCQF level 6 (6 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

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

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

Remove and replace engine assemblies.

Performance Criteria

(a) Prepare vehicle/machine to remove engine in accordance with manufacturer's procedure.
(b) Remove engine in accordance with manufacturer's recommended procedures.

OUTCOME 2

Dismantle and clean engines and their ancillary systems.

Performance Criteria

(a) Remove ancillary components from engine in accordance with manufacturer's procedure.
(b) Dismantle engine following a logical sequence.
(c) Clean engine components and ancillary systems in compliance with current legislation.

OUTCOME 3

Inspect components and compare with manufacturer's standard to determine serviceability.

Performance Criteria

(a) Visually inspect and assess engine components and ancillary systems for serviceability in accordance with manufacturer's specification.
(b) Correctly determine engine components' serviceability in line with specified manufacturer's tolerances.
(c) Correctly identify unserviceable components.

OUTCOME 4

Rebuild engine to manufacturer's specification.

Performance Criteria

(a) Use workshop manual/manufacturer's data correctly.
(b) Reassemble components ensuring correct fit.
(c) Rebuild sub assemblies using correct torque settings.
(d) Check and set clearances accurately during assembly.

National Unit Specification: statement of standards (cont)

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OUTCOME 5

Test reconditioned engine.

Performance Criteria

(a) Correctly prepare engine for test.
(b) Start and operate engine to determine engine performance complies with manufacturer's specification.

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 is a practical assessment which is assessed in two parts: one designed to generate evidence of the candidate's ability to work in a safe manner preparing a vehicle/machine for the engine to be removed and the other generating evidence of the candidate removing the engine from a vehicle/machine using appropriate lifting and support equipment. Assessment must be carried out under supervised conditions. An observation checklist must be used to record whether candidates have satisfied all of the Performance Criteria in the Outcome or not.

Outcome 2

Outcome 2 is a practical exercise which is assessed in three parts: one which would generate evidence of the candidate's ability to work in a safe and methodical manner removing engine ancillary components, the second to generate evidence that the candidate demonstrates the ability to dismantle engines safely, identifying component orientation and storing dismantled parts in a systematic manner, the third to generate evidence of the candidate's ability to clean components correctly observing recognised health and safety procedures when using cleaning solution. Assessment must be carried out under supervised conditions; an observation checklist must be used to record whether the candidates have satisfied the criteria in parts one, two and three.

National Unit Specification: statement of standards (cont)

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Outcome 3

Outcome 3 is a practical exercise which is assessed in three parts: one relates to the candidate's ability to carry out a visual inspection of dismantled components to identify unusual wear characteristics, two requires the candidate to use precision measuring equipment correctly when measuring components and to compare measurements taken to standard data provided by the engine manufacturer, three requires the candidate to evaluate the data measured against the manufacturer's standard to identify when components are outwith recommended wear limits and unserviceable. Assessment must be carried out under supervised conditions using an observation checklist to record whether the candidates have satisfied the criteria in part one; a written report would be used to satisfy the criteria of parts two and three.

With regard to Outcome 3

- Candidates must measure the following main components
  - Crankshaft big end and main bearings
  - Cylinder bores
  - Pistons
  - Connecting rods
  - Cylinder head/s
  - Valves
  - Valve guides

Outcome 4

Outcome 4 must be assessed by a series of practical assessments designed to generate evidence of the candidate's ability to rebuild engines used in land-based vehicles and equipment.

Candidate evidence must be in the form of an observation checklist which would be completed by the assessor working in a closely supervised practical situation. Oral questioning may be used to verify the candidate's understanding of the task undertaken.

- Candidates must interpret and use manufacturer's workshop manual/data correctly.
- Candidates must reassemble components correctly ensuring correct orientation and fit.
- Candidates should build sub assemblies using the correct tightening techniques and recommended torque settings.
- Clearances should be checked and set according to manufacturers' recommendations

Outcome 5

Outcome 5 must be assessed in two parts: part one assesses the candidate's ability to prepare an engine for test running. This includes the installation of the engine in a land-based vehicle/machine or a purpose built test rig. Engine lubricants and coolants should be filled to manufacturers' recommended levels, a starter system should be installed and all work should be carried out in a safe manner complying with current health and safety recommendations: part two assesses the candidate's ability to start and operate the engine in accordance with manufacturers' operating instructions.

Assessment must be carried out under supervised conditions using an observation checklist to record whether candidates have satisfied all the Performance Criteria in the Outcome or not.

National Unit Specification: support notes

UNIT Land-based Engineering: Piston Engine Repair Skills (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 in Land-based 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 basic knowledge, understanding and skills to undertake the removal, dismantling, condition assessment, rebuild and testing of internal combustion engines found in land-based engineering. They will also develop skills in measurement, data interpretation and evaluation and report writing. Whilst it is preferable to rebuild an engine which has worn out or failed in service it should be recognised that the rebuild costs can be prohibitive for centres who do not have commercial support where new components are required.

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 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 Health Safety and the Environment Unit.

In **Outcome 1** candidates should learn how to remove engines from vehicles/machines used in land-based engineering. It is important to reinforce all the health and safety aspects to create a safe working environment. Particular emphasis should be placed on good housekeeping and the safe use of lifting equipment, a formal risk assessment could be considered prior to undertaking this task.
Where possible this task should be related to the engine to be rebuilt. Candidates will learn about safe working practices, how engines are mounted in vehicles/machines and how lifting equipment can be used.

In **Outcome 2** candidates learn about the function of ancillary components and how they can be removed safely without risk or damage. Once ancillary components have been removed the engine can be dismantled following a logical sequence checking component orientation, generally with the removal of eg rocker cover, valve operating components, cylinder head, engine sump, big end bearings, connecting rod and piston assemblies, crankshaft and valve timing drives and oil pump. Candidates would normally learn about the function of these components in a practical context, this would reinforce the work carried out in Land-based Engineering: Engine Technology (F918 12)
All components should be thoroughly cleaned using an appropriate cleaning solution, candidates must wear appropriate PPE and observe recognised health and safety procedures, all cleaned parts should be stored in a clean and safe environment until further use.

In **Outcome 3** candidates will carry out a visual inspection of components to identify any unusual wear characteristics before using precision measuring equipment to determine how much wear is on the engine components. Examples of measuring equipment could be: Micrometers, Vernier callipers, Bore gauges, Straight edge, Feeler gauges, Dial test indicators etc.

Measurement of main wearing components could be taken and compared with data available in manufacturers' workshop manuals. A comparative table could be drawn up to provide the candidate with a summary of measurements, this information will aid the candidate to evaluate whether a component is serviceable or outwith serviceable wear limits and therefore should be replaced. This information should be used to support any conclusion the candidate draws when they complete their report.

In **Outcome 4** candidates will reassemble the engines replacing components that are outwith manufacturers' recommended wear limits. All components must be clean with orientation checked at each stage. All work should be carried out in a clean environment with good housekeeping evident. Where applicable candidates should be encouraged to use workshop manuals/manufacturers' data supplemented by any notes they may have taken during disassembly. Components should be assembled into sub assemblies before being fitted to the engine. Where possible the use of an 'assembly quality checklist' by the assessor ensures that critical torque setting and operating clearances have been correctly adhered to. Candidates should be encouraged to reflect on the work carried out and although the work should be completed to commercial timescales the emphasis should always be on quality.

In **Outcome 5** the candidate will install the rebuilt engine into the land-based vehicle/machine and prepare the engine for test running. All the ancillary components should be refitted and lubricating oil and coolant filled to manufacturers' recommended levels. If it is not possible to refit the engine to the vehicle/machine the engine should be fitted to a purpose built test stand.

The engine should be started using the manufacturer's starting procedure and the engine should be run to ensure correct oil pressure and operating function.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Health Safety and Environmental

As all the Outcomes require candidates to practically service and repair equipment either on site or in the workshop situation, it is strongly recommended that candidates are inducted into current legislation, regulations and safe working procedures and practices before starting practical work.

It is recommended that the Unit is delivered in the same sequence as the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. The Unit is designed to be delivered as a practical exercise; it should be carried out in a workshop environment with access to a range of hand tools, lifting equipment and precision measuring instruments.

Manufacturers' standards should be observed at all times; workshop manuals and technical data can provide key information for the exercise and are a useful source of learning material for the candidates.

It is important to be disciplined when delivering this Unit. When candidates remove components they should be cleaned and stored in a logical fashion. Where possible components should be checked for manufacturers' marking; if no marking is evident components should be marked carefully avoiding

damage to wearing surfaces. Candidates should be encouraged to reflect on work completed and to take notes which will aid them in the re-assembly of the engine.

National Unit Specification: support notes (cont)

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OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill *Problem Solving* at SCQF level 5 may be developed in Outcomes 2 and 3 where there is a need to use factual and theoretical information to determine engine wear characteristics and likely causes. There is also a need to apply recognised procedures for the location of engine components to be re-used. Satisfactory application of the procedures will aid efficient engine reassembly.

Elements of the Core Skill *Working with Others* at SCQF level 4 may be developed in Outcomes 1, 2 and 4 where the candidate will work as part of a small team to remove the engine from a land-based vehicle, dismantle the engine, carry out wear assessment and rebuild the engine using new components as required. 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.

The Core Skill *Communication* at SCQF level 5 will be developed in Outcomes 1, 2, 3 and 4 where the candidate uses a wide range of oral and written communication skills in familiar and unfamiliar contexts. Although the candidate works as part of a team where effective verbal interaction with other team members can be observed, they will be required to demonstrate practical skills independently and may be questioned by the assessor. The candidate will be required to read and apply information gained from manufacturers' workshop manuals/data discs and as part of the assessment will be required to produce a detailed evaluative report.

Elements of *Numeracy* at SCQF level 5 may be developed in Outcome 3 where the candidate uses a range of numerical and graphical data to determine engine wear. The candidate will use precision measuring equipment to compare actual measurements against the manufacturer's standard, the difference calculated will determine component wear.

The Core Skill *ICT* at SCQF level 5 may be developed in Outcome 4 where the candidate may have to access information on manufacturers' databases or data discs.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Assessment of health and 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.

The Unit is a practical exercise based on commercial practice. Where possible the Outcome sequence should be followed with assessment carried out using observation checklists. The engine should run reliably on completion.

The reports required in Outcomes 2 and 3 could be combined into one report with supporting data, evaluation and conclusions evident.

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 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**