



National Unit Specification: general information

UNIT Engineering: Prime Movers (SCQF level 5)

CODE F5K4 11

SUMMARY

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

The largely practical Unit is designed to allow candidates to develop basic knowledge, understanding and skills of prime movers. During delivery of the Unit candidates will learn to identify the main parts and describe the sequence of operation of a range of prime movers. Candidates will also develop the knowledge and skills to dismantle prime movers, assess and report on the serviceability of the main component parts and reassemble prime movers. They will also learn how to carry out pre-start checks on prime movers and operate and adjust the performance of prime movers to meet given load conditions. Candidates will also learn to comply with current legislation, safety regulations and safe working procedures and practices while working on prime movers.

This Unit is suitable for candidates training to be maintenance or multi-disciplinary engineering crafts persons.

OUTCOMES

- 1 Identify component parts and describe the sequence of operation of prime movers.
- 2 Overhaul a given prime mover.
- 3 Carry out pre-start checks and operate a given prime mover.

RECOMMENDED ENTRY

While entry is at the discretion of the centre some knowledge and experience of working in a practical engineering environment would be an advantage.

Administrative Information

Superclass: XK

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CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

**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 candidates to develop aspects of the following Core Skills:

- ◆ Communication (SCQF level 5)
- ◆ Problem Solving (SCQF level 5)
- ◆ Working with Others (SCQF level 4)

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

Identify component parts and describe the sequence of operation of prime movers.

Performance Criteria

- 1 Identify correctly the main component parts of an internal combustion (IC) engine.
- 2 Describe correctly the sequence of operation of an IC engine.
- 3 Identify correctly the main component parts of an electric motor.
- 4 Describe correctly the principles of operation of an electric motor.

OUTCOME 2

Overhaul a given prime mover.

Performance Criteria

- (a) Select and use correctly tools appropriate to systematic dismantling, repair and re-assembly of a prime mover in accordance with the manufacturer's manual/procedures.
- (b) Dismantle correctly a prime mover in a logical sequence and in accordance with the manufacturer's manual/procedures.
- (c) Assess and report correctly the condition of the prime mover component parts and replace any faulty component parts.
- (d) Reassemble the prime mover in a logical sequence and in accordance with the manufacturer's manual/procedures.
- (e) Comply fully with safety procedures and practices, good housekeeping and appropriate tool/equipment storage while undertaking all practical tasks.

OUTCOME 3

Carry out pre-start checks and operate a given prime mover.

Performance Criteria

- (a) Use a pre-start checklist to ensure that required actions are sequenced correctly.
- (b) Carry out all pre-start checks in accordance with the manufacturer's operating instructions.
- (c) Operate the prime mover in accordance with the manufacturer's operating instructions.
- (d) Adjust prime mover parameters to obtain performance to suit the demands of a connected load and in accordance with the manufacturer's operating instructions.
- (e) Comply fully with safety procedures and practices, good housekeeping and appropriate tool/equipment storage while undertaking pre-start checks and operating a given prime mover.

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 and performance evidence supplemented with an assessor observation checklist should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcomes 1, 2 and 3 may be assessed on an individual basis, or as a combination of Outcomes (eg Outcome 1 on its own and Outcomes 2 and 3 together) or as a single, holistic assessment. Which ever approach is taken, assessment of the Outcomes must take place at suitable points in the delivery of the Unit. Assessment of Outcome 1 must last no more than 1 hour and 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. Assessment of Outcomes 2 and 3 must be conducted under supervised, open-book conditions.

With regard to Outcome 1

- ◆ candidates must identify six component parts of an IC engine
- ◆ the IC engine must be a four stroke engine and use either spark ignition (SI) or compression ignition (CI)
- ◆ candidates must identify five component parts of a dc motor or a three phase induction motor
- ◆ the electric motor must be either a dc motor or a three phase induction motor

With regard to Outcomes 2 and 3

- ◆ during the delivery of Outcomes 2 and 3 candidates must at all times:
 - comply fully with current legislation, regulations and procedures regarding Health and Safety
 - wear correct PPE appropriate to the working environment and
 - behave correctly in a manner appropriate to the working environment

With regard to Outcome 2

- ◆ the prime mover being overhauled may be either a SI or CI engine.
- ◆ candidates must have access to a short block in dry condition (ideally, the short block should be disconnected from all ancillaries and securely mounted on an engine frame/trolley).
- ◆ candidates must have access to relevant manufacturer's data/handbook, tools and equipment while overhauling the prime mover.
- ◆ candidates must assess the condition of the following parts of the engine:
 - cylinder block — bores
 - pistons — piston crown, skirt, piston rings and gudgeon pins
 - con-rods — small end bearing, big end bearing, shells, caps and bolts
 - crankshaft — main bearing shells, main and journal bearings

National Unit Specification: statement of standards (cont)

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- ◆ an assessor checklist must be developed to record evidence as to whether a candidate has satisfied the Outcome and Performance Criteria or not. Candidate evidence may also be gathered using video clips or digital images.

With regard to Outcome 3

- ◆ the prime mover being operated may be either a SI or CI engine.
- ◆ the prime mover may be in situ and part of a system, or, on a test bench with diagnostic equipment.
- ◆ an assessor checklist must be developed to record evidence as to whether a candidate has satisfied the Outcome and Performance Criteria or not. Candidate evidence may also be gathered using video clips or digital images.

National Unit Specification: support notes

UNIT Engineering: Prime Movers (SCQF level 5)

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 Qualifications Group Award in Maintenance Engineering at SCQF level 5, 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 of prime movers. On successful completion of the Unit candidates will have learnt to identify the main parts and the sequence of operation of a range of prime movers. Candidates will also have developed the knowledge and skills to dismantle prime movers, assess and report on the serviceability of the main component parts and reassemble prime movers. They will also be able to carry out pre-start checks on prime movers and operate and adjust the performance of prime movers to meet given load conditions. Candidates will also have learnt to comply with current legislation, safety regulations and safe working procedures and practices while working on prime movers.

In Outcome 1 candidates should be introduced to the main constructional features and sequence of operation of a range of prime movers. Lecturers may decide to classify prime movers under reciprocating or rotating types.

The range of prime movers candidates examine may be drawn from the following list:

- ◆ four stroke cycle CI and SI internal combustion engines
- ◆ two stroke cycle SI engine
- ◆ dual fuel engines,
- ◆ rotary engines
- ◆ gas turbines
- ◆ steam turbines
- ◆ water turbines
- ◆ wind turbines
- ◆ dc electric motors
- ◆ three phase induction motors

The choice of prime movers studied should satisfy assessment requirements, vocational and local industry needs and candidate interest. To stimulate candidate interest further, developing technologies such as hydrogen fuel cell technology and hybrid systems may also be included in their studies.

In Outcome 2 candidates should have the opportunity to underpin the knowledge and understanding they developed in Outcome 1 by overhauling a range of prime movers to see the way the technology is realised in practice. Overhauling should include disassembling prime movers, assessing and reporting on the condition of prime mover component parts and replacing faulty components and reassembling prime movers.

National Unit Specification: support notes (cont)

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In Outcome 3 candidates should be allowed to gain practical experience of operating prime movers by carrying out pre-start checks, operating the prime mover and making adjustments to prime mover parameters to achieve satisfactory operating conditions for given connected loads and as prescribed by the manufacturer.

During the delivery of Outcomes 2 and 3 candidates should be made aware of current legislation, regulations and safe working procedures and practices when working on prime movers. Compliance with safety regulations, safe working practices and procedures, the wearing of appropriate PPE, appropriate behaviour in workshops and working environments are paramount for the successful completion of this Unit and must be observed at **all** times.

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. In delivering Outcome 1 emphasis should be placed on the terminology, constructional features and principle of operation of a range of prime movers. The Unit may be delivered by a combination of lectures, investigations, lecturer demonstration, practical activities and industrial visits. The majority of the Unit can be delivered in a practical engineering environment although some aspects of the Unit especially relating to Outcome 1 may be delivered in a classroom.

It is strongly recommended that candidates are inducted into current legislation, regulations and safe working procedures and practices before starting work on prime movers in the workshop. It is important that safe systems of working are established in the workshop environment and that candidates are given a thorough grounding in their responsibilities with regard to safe working and the hazards of working with industrial tools, equipment and live prime movers.

Industrial visits, especially for candidates with little or no employment experience, can be very helpful in providing candidates with useful insights into the installation, operation and adjustment of prime movers in realistic industrial environments.

Candidates should be encouraged to explore both paper based and electronic (including the Internet) sources of information on the construction, sequence of operation and adjustment of prime movers.

Wall charts, videos/DVD's, e-learning materials and models relating to prime movers and their applications can be useful learning and teaching aids.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Reading Core Skill component at SCQF level 5 may be developed in all three Outcomes while candidates are examining information in paper based and electronic form dealing with such subjects as the terminology, technical descriptions and the principle of operation of prime movers.

The Written Communication Core Skill component at SCQF level 5 may be developed in Outcome 1 while candidates provide descriptions of the sequence of operation of prime movers.

National Unit Specification: support notes (cont)

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The Critical Thinking Core Skills component at SCQF level 5 may be developed in Outcomes 2 and 3 while candidates refer to manufacturers product information, data and guidelines when interpreting technical information, assessing serviceability of components, determining idling speeds and when making adjustments to obtain satisfactory performance of the prime mover for given connected loads.

The *Working with Others* Core Skill at SCQF level 4 may be developed in Outcomes 2 and 3 while candidates engage in practical work as they have to interact with their lecturers, support staff and other candidates, for example while sharing engineering workshop areas, tools and 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)*.

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge, understanding and skills in identifying the constructional features and describing the principle of operation of prime movers, overhauling prime movers and undertaking pre-start checks and operating a prime mover.

Outcome 1

Assessment may comprise of a single assessment paper consisting of a series of short answer and structured questions. Partly completed diagrams may be used as part of the assessment. This assessment may be suitable for on-line delivery.

Outcome 2

Assessment should comprise of a practical exercise designed to ensure candidates can gather sufficient evidence to satisfy the Outcome and Performance Criteria. A task instruction sheets and manufacturer's product literature should be available to candidates. A structured form may be used by candidates to record their comments about the conditions of the prime mover component parts.

Outcome 3

Assessment should comprise of a practical exercise designed to ensure candidates can gather sufficient evidence to satisfy the Outcome and Performance Criteria. A task instruction sheets and manufacturer's product literature should be available to candidates

The need for an established safe system of work must be addressed before the candidates begin practical work on prime movers.

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