



National Unit Specification: general information

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

CODE F91T 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 combined theoretical and practical Unit designed to provide candidates with the knowledge and understanding to enable them to identify the type, construction and operating principles of advanced land-based equipment transmission systems, and to develop the skills to test, diagnose faults dismantle, condition assess and rebuild complex transmission systems 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.

OUTCOME

- 1 Identify the type, construction and operating principles of fluid flywheels, torque converter, powershift, hydrostatic and stepless transmission systems used in land-based equipment.
- 2 Remove and replace a powershift or hydrostatic or stepless transmission assembly and related components.
- 3 Dismantle, repair and reinstate a powershift or hydrostatic or stepless transmission fitted to landbased vehicles and equipment.
- 4 Identify and categorise mechanical, hydraulic and electric/electronic faults in powershift or hydrostatic or stepless transmission fitted to land-based equipment.

RECOMMENDED ENTRY

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

- ◆ Hydraulics at SCQF level 6
- ◆ Mechanical Transmission Systems at SCQF level 6

Administrative Information

Superclass: SK

Publication date: August 2010

Source: Scottish Qualifications Authority

Version: 01

© Scottish Qualifications Authority 2010

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

Additional copies of this Unit Specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre, telephone 0845 279 1000.

National Unit Specification: general information (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

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:

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

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

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 the type, construction and operating principles of fluid flywheels, torque converters powershift, hydrostatic and stepless transmission systems used in land-based equipment.

Performance Criteria

- (a) The type, construction and operating principles of the fluid flywheel are correctly identified.
- (b) The type, construction and operating principles of the torque converter are correctly identified.
- (c) The type, construction and operating principles of the power shift system are correctly identified.
- (d) The type, construction and operating principles of the hydrostatic system are correctly identified.
- (e) The type, construction and operating principles of the constantly variable transmission system including belt drives (C.V.T.) are correctly identified.

OUTCOME 2

Remove and replace a powershift or hydrostatic or stepless transmission assembly and related components.

Performance Criteria

- (a) Correctly remove ancillary components from transmission.
- (b) Remove transmission assembly following manufacturer's procedures.
- (c) Refit transmission assembly following manufacturer's procedures.
- (d) Correctly refit ancillary components to transmission.

OUTCOME 3

Performance Criteria

Dismantle, repair and reinstate a powershift or hydrostatic or stepless transmission fitted to landbased vehicles and equipment.

- (a) Dismantle transmission following manufacturer's service procedures.
- (b) Clean and visually inspect transmission components complying with current legislation.
- (c) Correctly carry out repairs necessary to make transmission serviceable.
- (d) Reinstate transmission to manufacturer's standards.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

OUTCOME 4

Identify and categorise mechanical, hydraulic and electric/electronic faults in powershift or hydrostatic or stepless transmission fitted to land-based equipment.

Performance Criteria

- (a) Correctly apply recognised fault finding techniques to identify mechanical faults.
- (b) Correctly apply recognised fault finding techniques to identify hydraulic faults.
- (c) Correctly apply recognised fault finding techniques to identify electric/electronic faults.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

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.

Outcome1

Outcome 1 is a written/graphical and/or recorded oral assessment which is assessed in four parts: one is designed to generate evidence of the candidate's knowledge and understanding of fluid flywheels and torque converters; two is designed to generate evidence of the candidate's knowledge and understanding of powershift transmission systems; three is designed to generate evidence of the candidate's knowledge and understanding of hydrostatic transmission systems and four is designed to generate evidence of the candidate's knowledge and understanding of constantly variable (C.V.T.) transmission systems.

Outcome 2

Outcome 2 is a practical exercise which is assessed in four parts: one which would generate evidence of the candidate's ability to work in a safe and methodical manner removing transmission ancillary components, the second to generate evidence that the candidate can demonstrate the ability to remove the main transmission assembly safely following manufacturers' recognised procedures, the third to generate evidence of the candidate's ability to refit the main transmission assembly following manufacturers' recognised procedures, for the fourth the candidates are required to satisfactorily refit ancillary components to the main transmission assembly. 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, three and four.

Outcome 3

Outcome 3 is a practical exercise which is assessed in four parts: the first to ensure that the candidate can demonstrate the ability to dismantle transmission assemblies safely, following manufacturers' service procedures, identifying component orientation and storing dismantled parts in a systematic manner. The second to generate evidence of the candidate's ability to clean and inspect components, correctly observing recognised health and safety procedures when using cleaning solution. The third relates to the candidate's ability to carry out repairs to make the transmission serviceable. The fourth requires the candidate to reinstate the transmission working to manufacturers' recognised standards and work practices. Assessment must be carried out under supervised conditions using an observation checklist to record whether the candidates have satisfied the criteria in all parts of the Outcome.

National Unit Specification: statement of standards (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

Outcome 4

Outcome 4 must be assessed by a series of practical assessments designed to generate evidence of the candidate's ability to apply fault finding techniques to advanced transmissions used in land-based vehicles and equipment.

Candidate evidence would 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, and a report detailing findings would reinforce the candidate's knowledge and understanding of this task.

- ◆ Candidates must interpret and use manufacturers' workshop manual/data correctly.
- ◆ Candidates must use specialist test equipment correctly
- ◆ Candidates' interpretation of faults should be accurate and based on facts established during diagnosis.

For one fault in each category:

- (a) Mechanical
- (b) Hydraulic
- (c) Electric
- (d) Electronic

National Unit Specification: support notes

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (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 knowledge and understanding of a range of powershift, hydrostatic or stepless transmission systems found on land-based equipment and to apply the skills necessary to undertake the removal, dismantling, repair, rebuild and testing of one powershift or hydrostatic or stepless transmission system. They will also develop diagnostic skills used to 'fault find', undertake evaluation and produce a written report.

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 Engineering: Health, Safety and the Environment Unit.

In **Outcome 1** candidates will learn about fluid flywheels, torque converters, power shift, hydrostatic and C.V.T. transmission systems used on land-based equipment and the methods used to achieve different speeds. The delivery is likely to be theoretical but if the opportunity arises it would be an advantage if the candidates were able to operate a machine fitted with a power shift or hydrostatic or CVT transmission. This would enable the candidate to experience the advantages these transmission systems offer in field working and road applications and also allow them to relate their operating experience to the theories learnt making a more 'holistic' learning experience.

In **Outcome 2** candidates learn about the function of ancillary components and how they can be removed safely without individual risk or damage to components. Once ancillary components have been removed the powershift, hydrostatic or stepless transmission can be removed using appropriate lifting and support equipment. Manufacturers' procedures should always be observed and it is essential that a current workshop manual for the model being worked on should always be to hand. Candidates should at all times be encouraged to refer to this manual. 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.

Candidates should refit the transmission following manufacturers' recommended procedures utilising safe working practices and appropriate lifting equipment. Once the advanced transmission has been re-installed the candidate should refit the ancillary components prior to the transmission being tested.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

In **Outcome 3** a powershift or hydrostatic or stepless transmission should be dismantled, repaired and reinstated following a logical sequence, checking component orientation. Generally powershift, hydrostatic or stepless transmissions are built in a modular fashion which allows dismantling and reinstatement in sub sections. The removal of the mechanical section of the transmission is generally undertaken first followed by the control section of the powershift, hydrostatic or stepless transmission which may include the hydraulics dependent on the system being worked on. The clutches and epicyclic would then be removed. The rebuild normally is the reverse of the dismantling procedure. It is most important that staff working on the transmission should be familiar with the dismantling and reinstatement procedure and should always refer to the manufacturers' recommended procedures, paying particular attention to any requirement to time epicyclic units. Candidates would normally learn about the function of the components in a practical context which would reinforce the knowledge and understanding developed in *Outcome 1*. All components should be thoroughly cleaned using an appropriate cleaning solution, candidates must wear appropriate PPE and observe recognised health and safety procedures. 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 4** the candidate would be introduced to a series of fault finding techniques which would allow them to diagnose faults in the mechanical, hydraulic and electrical/electronic aspects of a land-based transmission system. It is likely the approach would be to introduce simple faults through a series of exercises each developing in complexity and challenge. This work could be carried out on a transmission specifically set up for this purpose. A range of specialist test equipment is likely to be needed and a close working relationship with a manufacturer who could provide technical training, data and access to equipment would be an advantage. The learner should be encouraged to develop an evaluative table to record results in when carrying out tests; this will enable the candidate to evaluate the test results to obtain information for a written report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Health Safety and Environmental

As Outcomes 2, 3 and 4 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 and specific test equipment.

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 transmission.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Core Skill *Problem Solving* at SCQF level 5 may be developed in Outcome 4 where critical thinking, planning, organising, reviewing and evaluating are essential elements required to complete the Outcome successfully. The candidate requires a broad knowledge of complex transmission systems and must be able to use a wide range of routine and advanced skills on progressively more challenging faults in the mechanical, hydraulic and control systems of complex transmissions.

The Core Skill *Working with Others* at SCQF level 4 may be developed in Outcome 2 where the candidate will work as part of a small team to remove and refit a transmission assembly from a land-based vehicle/equipment. 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.

Elements of the Core Skill *Communication* at SCQF level 5 will be developed in Outcomes 1, 2 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, interpret and apply information gained from manufacturers' workshop manuals/data discs/databases or specialist diagnostic equipment. Much of the information is likely to be complex in nature and may not be familiar to the candidate. In Outcome 1 the candidate will be required to read, understand and evaluate the written questions to provide a satisfactory answer.

The Core Skill *Numeracy* at SCQF level 5 may be developed in Outcome 4 where the candidate uses a range of numerical, graphical and statistical data to determine correct transmission operation. Specialist equipment is likely to be used to obtain data that can be used for carrying out diagnostic analysis; the data may be presented in numeric, graph or scope form and will require calculation and/or statistical analysis which may be complex in nature.

The Core Skill *ICT* at SCQF level 5 may be developed in Outcomes 3 and 4 where the candidate may have to access information on manufacturer's databases or data discs. Specialist application of ICT will need to be applied using dedicated hardware/software to diagnose complex faults in Outcome 4. Candidates may be required to link transmission control ECU to manufacturers' interface/database. Some software updates are likely to be done using 'on line' facilities. Transmission calibration/adjustment may be carried out using dedicated manufacturers' interface and laptop computer.

National Unit Specification: support notes (cont)

UNIT Land-based Engineering: Powershift, Hydrostatic and Stepless Transmission Systems (SCQF level 6)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Assessment of health and safety and environment 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 mainly a practical exercise based on commercial practice. Where possible the Outcome sequence should be followed with assessment carried out using observation checklists, the transmission should operate correctly on completion. Outcome 1 may be assessed using written/oral/graphical assessments.

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