



## **National Unit specification: general information**

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

**Unit code:** H1MN 11

**Superclass:** SK

**Publication date:** August 2012

**Source:** Scottish Qualifications Authority

**Version:** 02

## **Summary**

The purpose of this Unit is to introduce the candidate to the electrical and hydraulic systems on a range of machinery used in the land-based engineering sector. The candidate will develop the knowledge, understanding and skills to enable them to service land-based vehicles and equipment safely. The Unit is suitable for candidates who wish to progress to apprentice training as engineering technicians working on land-based vehicles and equipment.

This is a mandatory Unit in the National Certificate in Land-based Engineering: An Introduction at SCQF level 4. It may also be taken as a freestanding Unit.

## **Outcomes**

- 1 Interpret simple electrical schematic diagrams and build an electrical circuit.
- 2 Interpret simple hydraulic schematic diagrams and build a hydraulic circuit.
- 3 Test fundamental electrical systems used on land-based vehicles and equipment.
- 4 Test fundamental hydraulic systems used on land-based vehicles and equipment.

## **Recommended entry**

Entry is at the discretion of the centre.

## National Unit specification: general information (cont)

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

### Credit points and level

1 National Unit 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

Achievement of this Unit gives automatic certification of the following Core Skills component:

Complete Core Skill            None

Core Skill component        Critical Thinking at SCQF level 5

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

## **National Unit specification: statement of standards**

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

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.

All practical activities must be carried out under supervision and in accordance with current health and safety legislation and guidance, codes of practice and manufacturers' recommendations. Personal protective equipment (PPE) must be used wherever necessary. A safety induction must be undertaken on workshop practices and the safe use of equipment.

### **Outcome 1**

Interpret simple electrical schematic diagrams and build an electrical circuit.

#### **Performance Criteria**

- (a) Identify symbols using a wiring diagram.
- (b) Trace a fundamental electric circuit from a wiring diagram.
- (c) Using a wiring diagram build a simple electrical circuit.
- (d) Use tools and testing equipment safely and appropriate to the task.

### **Outcome 2**

Interpret simple hydraulic schematic diagrams and build a hydraulic circuit.

#### **Performance Criteria**

- (a) Identify basic fluid power symbols used in hydraulic circuit diagrams.
- (b) Trace a fundamental hydraulic circuit from a hydraulic diagram.
- (c) Use diagram to build an operational hydraulic circuit.
- (d) Use tools and testing equipment safely and appropriate to the task.

### **Outcome 3**

Test fundamental electrical systems used on land-based vehicles and equipment.

#### **Performance Criteria**

- (a) Inspect the electrical systems prior to carrying out tests.
- (b) Test a simple circuit for continuity.
- (c) Test a circuit for voltage, current flow and resistance.
- (d) Use tools and testing equipment safely and appropriate to the task.

## National Unit specification: statement of standards (cont)

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

### Outcome 4

Test fundamental hydraulic systems used on land-based vehicles and equipment.

#### Performance Criteria

- (a) Inspect hydraulic systems prior to carrying out the test.
- (b) Assist with testing operating flow and pressures on hydraulic systems.
- (c) Use tools and testing equipment safely and appropriate to the task.

#### Evidence Requirements for this Unit

All practical activities must be carried out under supervision, and in accordance with current health and safety legislation and guidance, codes of practice and manufacturers' recommendations. Personal protective equipment (PPE) must be used wherever necessary.

A safety induction must be undertaken on workshop practices and the safe use of equipment.

Evidence is required to demonstrate that the candidates have achieved all of the Outcomes and Performance Criteria. Evidence can be produced holistically or Outcome by Outcome.

Written and/or oral and performance evidence must be produced in supervised conditions. All practical tasks must be carried out successfully on at least **one** occasion.

### Outcome 1

Written/oral recorded evidence produced in open-book supervised conditions to demonstrate:

- ◆ the identification of symbols that are used in electrical circuit diagrams which conform to DIN standards
- ◆ tracing a fundamental electric circuit from a given diagram conforming to DIN standards

Performance evidence must include:

- ◆ building a fundamental electrical circuit using an acceptable wiring diagram
- ◆ safe use of tools and testing equipment appropriate to the task, following recommended operating procedures

## **National Unit specification: statement of standards (cont)**

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

### **Outcome 2**

Written/oral recorded evidence produced in open-book conditions to demonstrate:

- ◆ the identification of fluid symbols that are used in hydraulic circuit diagrams which conform to BS/ISO standards
- ◆ tracing a simple basic hydraulic circuit diagram to BS/ISO standards

Performance evidence must include

- ◆ building an operational hydraulic circuit from a diagram
- ◆ safe use of tools and testing equipment appropriate to the task, following recommended operating procedures

### **Outcome 3**

Performance evidence must include:

- ◆ carrying out manufacturer's recommended checks and service procedures on a land-based vehicle's electric system, prior to testing
- ◆ carrying out a continuity test on a simple electric circuit within a land-based vehicle
- ◆ carrying out recommended checks for voltage, current flow and resistance on a vehicle's electric system
- ◆ safe use of tools and testing equipment appropriate to task, following recommended operating procedures

### **Outcome 4**

Performance evidence must include:

- ◆ carrying out visual inspection of a given hydraulic system following manufacturer's recommended inspection procedures, prior to testing
- ◆ performing operating tests on a simple hydraulic system to confirm functionality. The tests must include checks on connections, hydraulic valves and hydraulic cylinders
- ◆ performing tests to check a hydraulic circuit for correct flow and pressure. The tests must include attaching the relevant test equipment (gauges and adapters) and checking pressure and flow as per manufacturers' data and results must be recorded
- ◆ safe use of tools and testing equipment appropriate to task, following recommended operating procedures

## National Unit specification: support notes

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (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 Certificate in Land-based Engineering: An Introduction at SCQF level 4. It may also be offered as a freestanding Unit.

This Unit is aligned to the following Lantra Sector Skills Council's National Occupational Standards (NOS):

- ◆ LEO 1 Recognise and reduce hazards in the land-based engineering work area
- ◆ LEO 22 Service and repair electrical systems on land-based equipment
- ◆ LEO 24 Service and repair hydraulic systems and components on land-based equipment
- ◆ LEO 30 Inspect and test land-based equipment
- ◆ CU5A Establish and maintain working relationships with others

The aim of this Unit is to allow candidates to develop basic knowledge, understanding and skills regarding basic electric/ hydraulic systems. On successful completion of the Unit candidates will have learned to identify the main electrical and hydraulic components and their layout and will understand information from diagrams. Candidates will also have developed the knowledge and skills to trace electric and hydraulic circuits from diagrams and to carry out tests on both electric and hydraulic circuits. Candidates will be able to use diagrams conforming to current DIN and ISO/BS standards, eg to rewire trailer lights and sockets. Candidates will also be able to carry out basic service tasks and operational checks and repairs. Candidates will also have learned to comply with current legislation, safety regulations and safe working procedures and practices while working on electric and hydraulic systems found on land-based machinery.

Candidates must use tools and testing equipment safely and appropriate to the task at all times.

In Outcome 1 candidates will be introduced to electric wiring diagrams and the symbols used which meet the required DIN standards. Candidates should have the opportunity to gain underpinning knowledge and be able to interpret diagrams to enable them to trace and build a simple electric circuit; this could for example be a tractor beacon, tail lights on a trailer or trailer plug or socket.

In Outcome 2 candidates should be introduced to hydraulic system diagrams and symbols used to the required standards. Candidates will trace a hydraulic circuit from a diagram and have the opportunity to gain underpinning knowledge and understanding to be able to reproduce a simple hydraulic system.

## **National Unit specification: support notes (cont)**

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

In Outcome 3 candidates should be allowed to gain practical experience on testing and visually inspecting electric components on a range of land-based equipment. Candidates must check the condition of electric systems prior to carrying out tests; this will be checks on the vehicle's battery and connections as recommended by manufacturer; the candidate will then carry out simple tests for continuity and current flow and resistance

In Outcome 4 candidates - as with Outcome 3 - should be allowed to gain practical experience on inspecting and testing hydraulic systems found on land-based equipment. Candidates will carry out tests for functionality, circuit flow and pressure.

### **Guidance on learning and teaching approaches for this Unit**

It is recommended that the Unit is delivered in the same sequence that the Outcomes are presented. In delivering Outcome 1 and Outcome 2 emphasis should be placed on the terminology, symbols used and the required standards to be observed whilst interpreting schematic drawings. The Unit may be delivered by a combination of tutor led discussions and demonstrations, practical activities and visits to workshops or dealer demonstrations. The majority of the Unit can be delivered in a practical engineering/workshop environment although some aspects of the Unit especially relating to Outcome 1 and Outcome 2 may be delivered in a classroom.

Candidates must be inducted into current legislation, regulations and safe working procedures and practices to National Occupational Standards (NOS) before starting work on electric and hydraulic systems. It is important that safe systems of working are established in the workshop environment and candidates are given a thorough grounding in their responsibilities with regard to safe working and the hazards of working with industrial tools and equipment in relation to electrical and hydraulic systems.

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 importance of inspecting/servicing of electric/hydraulic systems on equipment used in the land-based sector, in a realistic industrial environment. Candidates should be encouraged to explore both paper based and electronic (including the internet) sources of information on land-based equipment electric/hydraulic systems including diagrams, components used in the construction of and the operation and repair/servicing of electric and hydraulic systems. Wall charts, DVDs, e-learning materials and models, components relating to electrics/hydraulic systems and their applications can be useful learning and teaching aids.

## **National Unit specification: support notes (cont)**

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

### **Guidance on approaches to assessment for this Unit**

Practical assignments should be used for Outcomes 1 to 4. These Outcomes would be assessed mainly in a workshop environment but some classroom input may be required to provide underpinning knowledge required to achieve this Unit.

Open-book assessment material can be sourced from college library, internet and relevant workshop manuals and manufacturers data sheets.

Practical activities can be assessed using an observation checklist and candidates could complete a job card or workshop report on their findings to supplement evidence. Practical assessment could be conducted under supervised conditions in small groups (2/3 persons) but each candidate must be assessed individually.

#### **Outcome 1**

Assessment may comprise of an electric schematic diagram where the candidate traces a given electric circuit. Partly completed diagrams paper based or in an electronic format may be used as part of the assessment.

Assessment for identifying symbols used in electric circuit diagrams and for tracing an electric circuit can be a paper based open-book assessment. An alternative may be an on line e-assessment.

Assessment for PC (c) will be a practical task designed to generate evidence of candidates' abilities to build a fundamental electric circuit from an electric diagram.

#### **Outcome 2**

Assessments may comprise of a short test paper or may be in an electronic format where candidates have to identify symbols used in ISO hydraulic circuit diagrams. They may also comprise of a hydraulic schematic diagram where the candidate traces a given hydraulic circuit. Assessment for identifying symbols used in hydraulic circuit diagrams and for tracing a hydraulic circuit can be a paper based open-book assessment. An alternative may be an e-assessment. Partly completed diagrams may be used as part of the assessment.

Assessment for PC (c) will be a practical task designed to generate evidence of candidates' abilities to build a simple basic hydraulic circuit from a hydraulic circuit diagram.

#### **Outcome 3**

Assessment will be by a series of practical tasks designed to generate evidence of candidates' abilities to carry out tests on electric systems and circuits, in a safe manner, following manufacturers' guidelines. Task instruction sheet and manufacturer's data should be available to candidates. A workshop report/job card may be used by candidates to record the condition and serviceability of electric systems components to supplement evidence.



## National Unit specification: support notes (cont)

**Unit title:** Land-based Engineering: An Introduction: Electrics and Hydraulics (SCQF level 5)

### Outcome 4

Assessment will be by a series of practical tasks designed to generate evidence of candidates' abilities to carry out tests on hydraulic systems and circuits, in a safe manner, following manufacturers' guidelines. 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 hydraulic systems.

### 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 social software. 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)*.

### Opportunities for developing Core Skills

In this Unit candidates will develop skills in using information from schematic drawings and carrying out testing procedures to build working electric circuits and working hydraulic systems and to determine the serviceability of components.

Working with Others may be developed throughout all Outcomes as candidates engage in practical tasks in the workshop environment, where they might have to work as part of a team with other candidates sharing tools and test equipment and interact with lecturers assisting with testing systems.

Critical Thinking may be developed throughout all Outcomes as candidates refer to schematic diagrams for both electrics and hydraulics to BS and ISO standards.

*Problem Solving* and *Numeracy* may be developed throughout all Outcomes as candidates carry out electrical and hydraulic testing where the candidate records data and also carry out and rectify any operational issues that occur whilst building circuits.

This Unit has the Critical Thinking component of Problem Solving embedded in it. This means that when candidates achieve the Unit, their Core Skills profile will also be updated to show they have achieved Critical Thinking at SCQF level 5.

### 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](http://www.sqa.org.uk/assessmentarrangements)

## History of changes to Unit

Version	Description of change	Date
02	Core Skills Component Critical Thinking at SCQF level 4 embedded.	06/08/2012

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