



Higher National Unit specification

General information

Unit title: Farm Vehicles and Power (SCQF level 7)

Unit code: HG4Y 34

Superclass: SK

Publication date: September 2016

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit is designed to allow learners to develop the knowledge and skills to enable effective management of farm power associated with both field and fixed equipment. Learners will study the factors influencing the selection and operational performance of farm power units including tractors, All Terrain Vehicles (ATVs) and material handlers. The characteristics of vehicle engines, transmission and hydraulic vehicle systems will be explored to facilitate their effective use. Learners will also study farm electrical systems to enable their safe and economical use.

Outcomes

On successful completion of the unit the learner will be able to:

- 1 Explain the operation and characteristics of engine powered farm vehicles.
- 2 Explain the factors influencing the performance, efficiency and selection of powered farm vehicles.
- 3 Explain the legal, safety and environmental considerations of operating farm vehicles.
- 4 Explain farm electrical power systems.

Credit points and level

1 Higher National unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the unit

Access to this unit is at the discretion of the centre. Learners would benefit from having the Core Skill of *Numeracy* at SCQF level 5 or above.

Higher National Unit Specification: General information (cont)

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Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this unit specification.

There is no automatic certification of Core Skills or Core Skill components in this unit.

Context for delivery

If this unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher 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.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain the operation and characteristics of engine powered farm vehicles.

Knowledge and/or Skills

- ◆ Engine systems
- ◆ Power transmission systems
- ◆ Ancillary vehicle systems

Outcome 2

Explain the factors influencing the performance, efficiency and selection of powered farm vehicles.

Knowledge and/or Skills

- ◆ Vehicle performance
- ◆ Vehicle field efficiency technology
- ◆ Vehicle selection criteria

Outcome 3

Explain the legal, safety and environmental considerations of operating farm vehicles.

Knowledge and/or Skills

- ◆ Legal requirements and restraints on road use
- ◆ Safety and hazard awareness
- ◆ Environmental considerations

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Outcome 4

Explain farm electrical power systems.

Knowledge and/or Skills

- ◆ Electrical distribution systems
- ◆ Provisions for electrical safety
- ◆ Electrical demands of equipment
- ◆ Running costs
- ◆ Safety and legislative obligations

Evidence Requirements for this unit

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can:

For Outcome 1:

- ◆ Explain the operation and maintenance of petrol and diesel engines to include:
 - cooling
 - air supply
 - lubrication
 - fuel systems
- ◆ Identify the application of petrol and diesel engines to farm vehicles.
- ◆ Explain the operational characteristics of two contrasting power transmission systems and their suitability for a farm situation.
- ◆ Explain how a tractor can deliver power and control to two contrasting implements via the Power Take Off (PTO), 3 point linkage (position/draft control), hydraulic valve services, electrical and braking systems.

For Outcome 2:

- ◆ Explain the factors that influence the engine and power take off performance of tractors including the relationship between power, torque, speed and fuel consumption and the effect of gear selection.
- ◆ Explain the factors that influence the drawbar performance of tractors including weight, tyres, tracks, ground condition and compaction.
- ◆ Explain the basic principle of vehicle field efficiency technology.
- ◆ Explain six significant vehicle selection criteria that would be appropriate for a given operating situation.

For Outcome 3:

- ◆ List six legal requirements relating to the use of agricultural vehicles on the road.
- ◆ Explain the safety issues associated with the use of farm vehicles.
- ◆ Explain the environmental impact of farm vehicles.

Higher National Unit specification: Statement of standards (cont)

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For Outcome 4:

- ◆ Outline the layout and component features of a farm electrical distribution system including both three-phase and single-phase applications.
- ◆ Explain the location and function of two electrical safety provisions incorporated in electrical systems.
- ◆ Calculate electrical loads and the running costs of a simple piece of farm equipment.
- ◆ Explain three principal risk factors associated with the use of electricity of farms and the counter measures that can be employed.



Higher National Unit Support Notes

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Unit Support Notes are offered as guidance and 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

Virtually all farm power is produced either by engines or through electricity. The majority of engines are installed in tractors, All Terrain Vehicles (ATVs) and similar vehicles such as material handlers, and it is these vehicles on which this unit is focused. Electrical systems feature on all farms and are vital to milking, cooling, drying, ventilation, processing systems etc. All farmers and agriculturists use these power forms every day and this unit seeks to improve their understanding of the key features of these power forms to enable improved efficiency of use and hence cost effectiveness.

Outcome 1 is concerned with engines and engine driven vehicles and should explore the principles of operation of compression ignition (diesel) and spark ignition (petrol, etc) engines, two and four stroke cycles and the main engine systems including fuel, lubrication and cooling. An awareness of the key features of the main mechanical, completely variable, power-shift and hydrostatic power transmission systems should be developed. The study of vehicles is completed with consideration of the main range of additional vehicle systems. This will include power take off (PTO), hydraulics, braking and 3 point linkage systems but could also consider electrical (for example ISOBUS) and air conditioning systems.

Outcome 2 develops Outcome 1 and considers in detail the performance of key aspects of farm vehicles. The key performance relationships between speed, torque and power must be understood. This could entail studying engine performance curves of torque/speed/power and specific fuel consumption and enable learners to see the need for effective gear selection to optimise either power take off or drawbar performance. This could involve the study of traction and wheel-slip. The learner must understand the methods for improving drawbar performance relative to soil types either through tyre choice, tracks, weights, contact area and the implications for soil compaction. GPS guidance and headland management is a common feature on farm vehicles so an understanding of their operating principles, benefits and terminology should be gained. Terminology such as A-B/contour lines, manual guidance/auto-steer units, pass to pass accuracy, repeatability and correction signals are examples. This can also lead on to the principles of controlled traffic farming (CTF).

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Outcome 3 requires the learner to become familiar with the obligations for operator training and the most frequently contravened legislative requirements relating to weight, speed, width, licensing and fuel duty. It also requires consideration of control and stability loss and this may be exemplified by reference to material handlers where an understanding of load centres, stability curves and the effect of attachments can be easily demonstrated or reference to tractors with implements on slopes with shifting weight transfer and changeable traction levels. The focus on vehicle safety should also include consideration of the maintenance requirements of farm vehicles and in particular typical daily safety checks such as PTO guards, brakes, lights and mirrors etc. Learners should also understand the environmental impact of farm vehicles, emissions, fluid leaks, fuel consumption and compaction/erosion but also appreciate the methods employed to reduce this impact such as AdBlue, GPS and oil drip catchment on hydraulic couplings, etc.

Outcome 4 considers the second most important source of power on farms — electricity. Electricity is used very widely for lighting, heating and power and consequently is frequently taken for granted and even abused rather than properly managed. Hence the aim of this Outcome must be to improve learner's knowledge of the features of a modern electrical system and in particular current safety features such as circuit breakers and residual current devices. Both single and three phase installations should be considered. The safety theme is expanded by raising awareness of the legislative requirements relating to the use of electricity including the regular inspection of the fixed wiring and portable appliances. However, electricity is an expensive commodity and understanding how electricity is charged for, and estimating the running cost of new or existing electrical apparatus is a key skill required by everyone but particularly managers.

Guidance on approaches to delivery of this unit

This unit has been designed for use as part of the Higher National Certificate and Diploma (HNC/D) in Agriculture and is best studied in that context, though it could also be applicable for other industries that use agricultural type vehicles. The unit will normally be primarily delivered in a classroom environment, however, every opportunity should be sought to investigate machines and systems in a working environment or failing this using models and simulations. For example engine performance can be studied as a paper exercise and then reinforced by participating in a tractor power assessment perhaps at a dealer's premises. Models can be used to simulate loading and stability in vehicles and similar practical exercises can be employed in relation to pump performance. There may be opportunities to link this module to programmes of skills certification in tractor driving, forklift operation, etc.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Outcomes 1 and 2 could be assessed together as Outcome 2 develops on Outcome 1. The assessment could use a combination of question types to establish the learner's understanding, this could include multiple-choice, short answer and extended response questions.

Higher National Unit Support Notes (cont)

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Outcome 3 could also be assessed by a combination of multiple-choice, short answer and extended response questions.

Outcome 4 could be assessed through a written and/or recorded oral report of approximately 500 words or equivalent plus supporting diagrams and sketches. The assessment could be based on either outlining an electrical distribution for a given situation or preparing a critique of an existing system that identifies the safety risks and illustrates the provisions for electrical safety. The assignment could include an assessment of the running costs of a piece of equipment.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Opportunities for 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 learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

There is no automatic certification of Core Skills or Core Skills components in this unit, however there may be opportunities to develop the Core Skills of *Numeracy* and *Communication* at SCQF level 6.

The analysis of engine performance data and tractor specifications provides ample opportunities to develop the Using Graphical Information component of Core Skills *Numeracy* at SCQF level 6.

There are opportunities to develop Written Communication at SCQF level 6 in the assessment of all Outcomes.

History of changes to Unit

Version	Description of change	Date

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General information for learners

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This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

Agriculture is a very power intensive industry and most of the power is supplied either by engines or electrically. Engines are nearly always used in farm vehicles such as tractors, All Terrain Vehicles (ATVs), materials handlers and combines, whilst much of the stationary equipment around the farm steading is powered electrically. This unit is designed to increase your understanding of the factors that influence the field performance of tractors and other farm vehicles, the running costs of electrical machines and the safety risks associated with the use of farm vehicles and electrical equipment in a farm environment. It will also give you an appreciation of the factors that need to be considered in the selection of vehicles.

On completion of this unit you will be able to:

- ◆ explain the operation and characteristics of engine powered farm vehicles.
- ◆ explain the factors influencing the performance and efficiency of powered farm vehicles.
- ◆ explain the legal, safety and environmental considerations of operating farm vehicles.
- ◆ explain farm electrical power systems.

The unit includes not only engines but also how the power of engines is transferred through the transmission system to the soil to propel the vehicle or through the power take-off shaft to attached equipment. All the key areas of the tractor are covered including brakes, 3 point linkage and hydraulic systems and this is followed by operational considerations with a particular emphasis on safety. The main elements of matching a power unit to a task are also covered.