



## Higher National Unit specification

### General information for centres

**Unit title:** Farm Power

**Unit code:** F1Y8 34

**Unit purpose:** This Unit is designed to enable candidates to develop the Knowledge and Skills to enable effective management of farm power associated with both field and fixed equipment. Candidates will study the factors influencing the selection and operational performance of farm power units including tractors, All Terrain Vehicles (ATVs) and materials handlers. The characteristics of vehicle engine, transmission and hydraulic vehicle systems will be explored to facilitate their effective use. Candidates will also study electrical, pump and fan systems to enable their safe and economic use in practical farm situations.

On completion of the Unit the candidate should be able to:

- 1 Explain the principles of operation of engine powered farm vehicles.
- 2 Explain the factors influencing the performance and safety of powered farm vehicles.
- 3 Explain farm electrical power systems.
- 4 Explain the principles of safe operation and performance characteristics of agricultural pumps and fans.

**Credit points and level:** 1 HN credit at SCQF level 7: (8 SCQF credit points at SCQF level 7\*)

*\*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.*

**Recommended prior knowledge and skills:** Access to this Unit is at the discretion of the centre. No prior knowledge is required however, it is recommended that candidates have sufficient mathematical skills to understand graphical and tabulated data equivalent to SCQF level 5.

**Core Skills:** There are opportunities to develop the Core Skills of *Problem Solving*, *Communications* and *Numeracy* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

**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.

**Assessment:** This Unit may be assessed using three instruments of assessment. Outcomes 1 and 2 may be jointly assessed by means of a combination of question types including multiple choice, short answer and extended response. Outcome 3 may be assessed using a short assignment and Outcome 4 may be assessed by an extended response to a given situation.

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

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The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

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. Candidates 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 principles of operation of engine powered farm vehicles

#### **Knowledge and/or Skills**

- ◆ Engines and their systems
- ◆ Power transmission systems
- ◆ Ancillary vehicle systems

#### **Evidence Requirements**

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain:

- ◆ the principles of operation of two contrasting engines to include their cooling lubrication and fuel systems and identify their applicability to farm vehicles
- ◆ the operating principles and the operational characteristics of two power transmission systems and their application to farm vehicles to meet two operational requirements
- ◆ the principles of operation and the operational characteristics of steering and braking systems appropriate to a wheeled or a tracked farm vehicle
- ◆ two contrasting means of powering and controlling implements

#### **Assessment Guidelines**

See Outcome 2.

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

**Unit title:** Farm Power

### **Outcome 2**

Explain the factors influencing the performance and safety of powered farm vehicles

#### **Knowledge and/or Skills**

- ◆ Power performance
- ◆ Vehicle safety
- ◆ Vehicle selection criteria
- ◆ Legislative requirements
- ◆ Environmental impact

#### **Evidence Requirements**

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can explain:

- ◆ the factors that influence the drawbar and power take-off performance of tractors to include the relationship between engine speed, torque and power
- ◆ the safe operation of two contrasting farm vehicles on slopes through the consideration of control and stability
- ◆ the six most significant vehicle selection criteria that would be appropriate for a given operating situation
- ◆ the principles of the legislation governing the use of rebated fuel and two other legislative requirements associated with the use of off-road farm vehicles on public roads
- ◆ two environmental concerns associated with the use of off-road farm vehicles

#### **Assessment Guidelines**

This Outcome may be assessed together with Outcome 1 as the Evidence Requirements are a development of those in Outcome 1. The assessment event may use a combination of question types including multiple choice, short answer and extended response.

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

**Unit title:** Farm Power

### Outcome 3

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

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ 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 cost of simple [ $\cos\phi=1.0$ ] equipment
- ◆ explain the three principal risk factors associated with the use of electricity on farms and the counter measures that can be employed

#### Assessment Guidelines

This Outcome may be assessed by means of a short assignment of about 500 words plus supporting diagrams/sketches. The candidate may either, outline an electrical distribution for a given situation, or prepare 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 cost of a piece of equipment.

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

**Unit title:** Farm Power

### **Outcome 4**

Explain the principles of safe operation and performance characteristics of agricultural pumps and fans

#### **Knowledge and/or Skills**

- ◆ Pump and fan types
- ◆ Performance terminology

#### **Evidence Requirements**

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ explain the construction and mode of operation of agricultural pumps and fans. Candidates should be assessed on their explanation of the construction and mode of operation of two pumps and one fan.
- ◆ select an appropriate fan or pump for a given situation with three valid supporting reasons using manufacturers' performance data.

#### **Assessment Guidelines**

This Outcome may be assessed by means of an extended response question in which the candidate describes the given fan or pump types and selects a pump or fan for a given situation through consideration of the application and performance requirements. The candidate could use manufacturers published data to aid the selection.

## Administrative Information

**Unit code:** F1Y8 34  
**Unit title:** Farm Power  
**Superclass category:** SK  
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### History of changes:

Version	Description of change	Date

**Source:** SQA

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## **Higher National Unit specification: support notes**

### **Unit title: Farm Power**

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**

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 materials handlers, and it is these vehicles on which this Unit is focussed. Both engines and electrical motors are used to drive pumps and fans that provide secondary power sources for hydraulic systems and ventilation systems. All farmers and agriculturists use all 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, cooling. An awareness of the key features of the main mechanical, powershift and hydrostatic power transmission systems should be developed as well as exploring the relative advantages of wheel, tyre and track systems for soil engagement. The study of vehicles is completed with consideration of the main range of additional vehicle systems. This may include hydraulic, braking and steering systems but could also consider electrical 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 candidates to see the need for effective gear selection to optimise either power take off or drawbar performance. This will require study of traction and wheel-slip. The candidate must understand the methods for improving drawbar performance relative to soil types through either weights or contact area and the implications for soil compaction. The Outcome also requires consideration of control and stability loss and this may be exemplified by reference to material handlers rather than tractors where an understanding of load centres, stability curves and the effects of attachments such as side-shift can more easily be demonstrated. The focus on vehicle safety should also include consideration of the maintenance requirements of farm vehicles and in particular typical daily checks. This Outcome requires the candidate to become familiar with the obligations for operator training, (operator vehicle checks), and the most frequently contravened legislative requirements relating to loads, speeds, licensing and fuel duty. The six main vehicle selection criteria should be based on current guidelines and codes of practice.

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

### **Unit title: Farm Power**

Outcome 3 considers the second most important power source 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 the candidate'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 (candidates may even consider engine driven generators). The safety theme is expanded by raising the 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.

Outcome 4 considers secondary power of pumps and fans. Candidates should consider both fixed displacement pumps such as gear and piston pumps as well as non-positive displacement centrifugal types. The relationship between flow volume and dynamic pressure head for centrifugal types (and fans) should be well understood, as well as the need for pressure relief of positive displacement types. It is not necessary to consider noise aspects. It is important to consider this Outcome in context hence pumps for tractor hydraulics or for slurry pumping may be appropriate.

### **Guidance on the delivery and assessment of this Unit**

The Unit is specifically designed for use as part of a Group Award in agriculture and it is best studied in this context, though it would have applicability for other industries that use agricultural type tractors. The Unit is expected to be delivered primarily in a classroom environment. However, every opportunity should be sought to investigate machines and systems in a working environment or failing this to use models and simulations. For example, engine performance can be studied as a paper exercise and then reinforced up by participating in a tractor power assessment perhaps at dealers' 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.

The assessment of Outcome 1 and 2 may be combined and assessed using a variety of question types including multiple choice, short answer and extended response. Outcome 3 may be assessed by means of a short assignment of which may be about 500 words plus supporting diagrams/sketches. Outcome 4 may be assessed by means of an extended response question in which the candidate describes the given fan or pump types and selects a pump or fan for a given situation through consideration of the application and performance requirements. Candidates may be encouraged to learn information as in the workplace information should be available for instant recall by practitioners rather than looked up as and when required, particularly as there are safety implications with much of the material. It is however important to ensure the assessments are structured as far as possible. Thus it would be sensible to link questions on say control loss with tyres and loads rather than with questions on specific fuel consumption and two stroke engines.

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

### Unit title: Farm Power

#### *Opportunities for developing Core Skills*

The analysis of engine performance data, tractor specifications and pump/fan characteristics means there is ample opportunity to develop the component Using Graphical Information of the *Numeracy* Core Skill. Successful completion of this Unit may allow candidates to develop of the Core Skill of *Numeracy* at SCQF level 6, however this is not certificated.

Candidates will have an opportunity to analyse a particular situation within Outcome 4. The analysis of agricultural pumps and fan will be assessed and this may give candidates to develop the component Critical Thinking of the Core Skill *Problem Solving* at SCQF level 6. Candidates may analyse a complex agricultural pump and fan and justifying why it may be used in a particular situation. The general skill that candidates may have to complete is 'Analyse a complex situation or issue'.

Assessment of this Unit may allow candidates to develop the Reviewing and Evaluating component of the Core Skill *Problem Solving* at SCQF level 6. Candidates may have opportunities to gather evidence to support their evaluation and to draw conclusions. Candidates are able to gather their own evidence for Outcome 4 and to draw conclusions as to why a particular agricultural pump of fan would match the situation given in the assessment. The general skill that candidates may have to complete is 'review and evaluate a complex problem solving activity'.

There are opportunities for the candidate to develop Written Communication at SCQF level 6 in the assessment of all Outcomes. If candidates complete written work for each Outcome a they will an opportunity to develop the general skill 'produce well structured written communication on complex topics'. Candidates when completing their responses to Outcomes will have to present essential ideas/information and supporting detail in a logical and effective order.

### Open learning

It is possible for this Unit to be delivered by distance learning. Candidates may require access to suitable machinery (tractor, ATV, materials handler/forklift) and access to this equipment would require a degree of planning by the centre. The assessments can be completed on-line, with the exception of the assessment for Outcome 3 which will require a suitable scenario to be prepared.

### Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* ([www.sqa.org.uk](http://www.sqa.org.uk)).

## General information for candidates

### Unit title: Farm Power

Agriculture is a very power expensive 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 explores both these principal power sources as well as considering pumps and fans that produce the power for moving liquids and gases systems. The 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 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 pumps and fans.

In this Unit you will be asked to:

- 1 Explain the principles of operation of engine powered farm vehicles.
- 2 Explain the factors influencing the performance and safety of powered farm vehicles.
- 3 Explain farm electrical power systems.
- 4 Explain the principles of operation and performance characteristics of agricultural pumps and fans.

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, steering, 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.