



## Higher National Unit specification

### General information for centres

**Unit title:** Crop Protection and Harvesting Mechanisation

**Unit code:** F1Y6 34

**Unit purpose:** This Unit is designed to enable candidates to develop the Knowledge and Skills required to select and manage the machinery for field scale crop protection and the machinery for harvesting of cereal and forage crops. Candidates are required to identify the factors that influence the selection and operational performance of the machines and take an holistic view to plan the mechanisation of crop protection and harvesting systems with due regard to the significant environmental issues.

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

- 1 Explain the application of techniques and mechanisms for crop protection.
- 2 Explain the operation, use and management of cereal harvesting equipment.
- 3 Explain the use of equipment for the production of forage crops.

**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. There are no specific prior knowledge requirements for this Unit. However a knowledge of agricultural crop production systems would be highly advantageous. This might be evidenced by possession of the Unit F1Y4 34 *Arable Crop Production*.

**Core Skills:** There are opportunities to develop the Core Skills of *Problems Solving* and *Communications* 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:** Each of the Outcomes of this Unit is assessed by its own assessment event. Outcomes 1 and 2 may be each assessed by means of closed-book tests. Outcome 3 concerns the synthesis of a system as well as some material that should be known. Hence Outcome 3 is assessed by means of a small planning assignment supported by short answer questions.

## **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 application of techniques and mechanisms for crop protection

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

- ◆ Crop protection techniques
- ◆ Environmental impact
- ◆ Pesticide application technology
- ◆ Legislative requirements
- ◆ Code of Practice for Certificated Machine Operatives

#### **Evidence Requirements**

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

- ◆ the environmental impact of two alternative crop protection techniques
- ◆ the features and layout of two contrasting machines used for pesticide application
- ◆ three key factors that influence the performance of a given pesticide application method
- ◆ the application procedure that should be followed by certificated machine operatives conforming to best practice and legal requirements for a given situation

#### **Assessment Guidelines**

This Outcome may be assessed by means of a closed-book test using short answer questions to cover the Evidence Requirements. It is suggested that no more than 20 short answer questions are used.

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

**Unit title:** Crop Protection and Harvesting Mechanisation

### **Outcome 2**

Explain the operation, use and management of cereal harvesting equipment

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

- ◆ Combine harvester designs
- ◆ Modes of operation
- ◆ Combine performance
- ◆ Combine management
- ◆ Relevant Health and Safety Requirements

#### **Evidence Requirements**

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

- ◆ describe the layout of either a conventional straw walker combine harvester or a combine harvester with rotary separation
- ◆ explain the function and mode of operation of the following combine harvester systems, including:
  - header Unit
  - grain separation
  - grain cleaning
- ◆ explain the effect of four significant operator adjustments and the operating environment on combine performance
- ◆ calculate the spot and overall workrates of a specified cereal harvesting operation
- ◆ explain the pre- and post-season machine management requirement appropriate to a specified combine

#### **Assessment Guidelines**

This Outcome can be assessed by means of a closed-book test. It is recommended that a variety of style of questions are used including missing word, multiple choice, short and extended response types appropriate to the Evidence Requirements and that the number of questions be approximately 20.

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

**Unit title:** Crop Protection and Harvesting Mechanisation

### Outcome 3

Explain the use of equipment for the production of forage crops

#### Knowledge and/or Skills

- ◆ Forage conservation techniques
- ◆ Forage machinery
- ◆ Performance characteristics of forage equipment
- ◆ Machine matching
- ◆ Operations planning
- ◆ Health and Safety requirements

#### Evidence Requirements

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

- ◆ explain the conservation of forage in the form of hay and silage
  - ◆ explain the principles of operation of any two of the following three pieces of forage machinery:
    - mower or mower conditioner
    - forage harvester or self loading forage wagon
    - roll or square baler
- Candidates should for each of the selected pieces of equipment explain the effects of three significant operator adjustments and one other factor on the field performance of the machine.
- ◆ select a machine to match others in a forage production system in accordance with commercial practice
  - ◆ explain the importance of operations planning in relation to a forage conservation system
  - ◆ explain the relevant Health and Safety requirements

#### Assessment Guidelines

This Outcome may be assessed by an assignment. It is recommended that a pro forma assignment is used which helps guide the candidates through the sections in a logical manner building from a knowledge of the objectives of forage conservation, through the available machines and the extent to which they enable objectives to be met, to finally selecting a machine and planning the conservation operation. The pro forma could include short questions to cover the relevant Evidence Requirements.

## Administrative Information

**Unit code:** F1Y6 34

**Unit title:** Crop Protection and Harvesting Mechanisation

**Superclass category:** SK

**Original date of publication:** August 2008

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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: Crop Protection and Harvesting Mechanisation

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 is focussed on the mechanisation of arable and grass crop production. In particular it considers in detail the growth and harvesting stages of the production cycle. Hence it is concerned with the mechanisation of crop protection and the application of pesticides, the harvesting of cereal crops using the combine harvester, and the harvesting of forage (predominantly grass) crops. The Unit does not include fertilisation of the growing crop except in as far as the application of sprayers for liquid fertiliser application.

The context is therefore exclusively on agricultural field crops, and hence does not consider the mechanisation that may be employed in protected growing structures or in field scale production of horticultural and amenity crops.

The three main areas of protection, cereal harvesting and grass harvesting are each considered in a separate Outcome.

**Outcome 1** considers crop protection. The emphasis of this Outcome must be clearly focussed on the least intervention of the technique that is likely to achieve market requirements for the least environmental impact. Hence consideration of cultural and biological control in addition to chemical control is expected. Nevertheless pesticide application technologies, particularly spray equipment and techniques are likely to dominate this section. Consideration of the characteristics of hydraulic nozzle, and CDA and air assisted technologies and the associated issues of calibration, evenness, drift, bout matching and tramlining should be investigated. Machine design factors such as materials of construction, boom suspension systems, and variable rate technology should be reviewed, as should the environmental impact of operator competence and certification. It will also be important to consider safety, both from the point of view of the machine (including legal requirements such as the Code of Practice for Certificated Machine Operatives and relevant COSHH regulations), but also the safety of the operative and those nearby.

**Outcome 2** considers the harvesting of cereal crops and consequently considers in detail the combine. It is perhaps best to consider the combine as a series of systems each of which can be reviewed to identify the options and the features or factors that will influence its ability to harvest the crop in the desired condition. Thus the variety of designs of header units, threshing mechanisms, grain/straw separation mechanisms, grain cleaning and straw handling units and their respective characteristics will need to be studied. The need to meet market requirements and maximise recovery of grain should lead to consideration of such issues as the influence of moisture content, machine adjustments, grain cleanliness, grain loss. Similarly the economic imperatives should stimulate discussion of the significant management factors such as selection criteria, integration with the rest of the harvesting system, operator environment and operating regime. Highlighting the environmental benefits of enhanced combine management is essential.

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

### **Unit title: Crop Protection and Harvesting Mechanisation**

The final Outcome considers the harvesting phase of grass (and other) forage crop production. Hence the study must include consideration of the principles of operation and the performance characteristics and application of the various types of mower, conditioner, rakes, harvesters, balers, wrappers and the storage or ensiling process and take into account relevant Health and Safety requirements. In each case the key selection criteria should be identified so that it is clear how a complete system can be developed appropriate to the situation. It will be necessary for the candidates to become familiar with spot and overall workrates and how they are determined to facilitate system planning.

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

It is recommended that this Unit be delivered through a series of lectures with supporting machine investigations and practical exercises. For example, whilst studying Outcome 1, a lecture on sprayers could be followed by a practical exercise to investigate the relationship between pressure, flow and spray quality of a hydraulic nozzle. Another example might be whilst studying Outcome 3 a practical exercise can be used to identify and describe the adjustments and safety features on a mower conditioner. The practical sessions can be used to develop the candidates' ability to produce sketches, a worthwhile transferable skill.

The assessment for Outcomes 1 and 2 may be assessed by a closed-book assignment. It is recommended that these be kept short. For example it is unnecessary to seek descriptions of both rotor type and straw walker type of separating mechanisms in combines in the same test, knowledge of one would prove the candidates awareness of the need to separate grain and straw and the principles involved. It is also important to concentrate on those parts and adjustments on the machines that have profound and significant effect on machine performance. For example for a candidate to know the significance of the drum rotor clearances, or fan speed on the operational performance of a combine is important, whereas the castor angle adjustment on the rear axle is not. Hence the questions should be straightforward and concentrate on the most significant issues.

The assessment for Outcome 3 however, is slightly different. The focus of this section, in addition to being on the constructional and operational characteristics of the machines, consider more of the planning and machinery integration aspects. Hence the candidate is assessed on their ability to determine a specification for a machine as part of a coherent set of machines for a system. Hence the Outcome may consider in more detail the size of tractor/mower combination needed to work fast enough to keep ahead of the forage harvester than the construction of the mower. The assessment should reflect this. Hence the assignment might involve producing grass silage for a dairy herd or for a group of farms. Hence the candidate should determine the quantities requiring to be conserved, identify the grass area needed and then identify the sizes and types of machines to produce the requisite quantities of silage in the relevant time period. The candidate should then describe the construction and features of the machines with the desired specification.

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

**Unit title:** Crop Protection and Harvesting Mechanisation

### ***Opportunities for developing Core Skills***

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 all Outcomes they will an opportunity to develop the general skill ‘produce well structured written communication on complex topics’. Candidates when completing their assessment material will have to present essential ideas/information and supporting detail in a logical and effective order.

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 Outcomes 1, 2 and 3 and to draw conclusions as to whether the information obtained meets their requirements. The general skill that candidates may complete is ‘review and evaluate a complex problem solving activity’.

### **Open learning**

It is possible to offer this Unit by distance learning. It may be beneficial for candidates to have access to a very wide range of farm machines and preferably to see their effects whilst in action to aid their understanding. To access this farm machinery will require a degree of planning by centres may need as many of the machines in question only operate once per year.

### **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: Crop Protection and Harvesting Mechanisation**

Production agriculture is mostly concerned with the production of livestock and crops. This Unit will introduce you to the part that machines play in the production cycle crops. Growing crops are subject to challenges by pests, weeds and diseases and keeping these under control is a major activity on farms. As a consequence many machines have been developed to help, from mechanical weeders to machines to apply chemical pesticides. This Unit looks at these machines, how they work, the things that affect how well they work, the problems they can cause, and their place in production agriculture.

The Unit goes on to consider the mechanisation of the harvest, primarily of cereal and grass crops. Hence you will look at combine harvesters, what they do, how they do it, how well they work and why they are one of the most expensive pieces of equipment on the farm. You will learn about traditional straw walker designs and the very latest in grain separation technology.

You will also study the full range of equipment used in forage systems. This includes mowers, harvesters, balers (which may also be used for straw from the combine) and ensiling equipment and learn how to size and specify the features of the equipment so that it all matches together in a coherent system.

Given the damage that can be done to the environment if these machines are used incorrectly this Unit introduces you to good practice throughout.

Each of your Outcomes of this Unit is assessed by its own assessment event. You may be assessed in Outcomes 1 and 2 by means of closed-book tests. Outcome 3 concerns the synthesis of a system as well as some material that should be known. Hence you may be assessed in Outcome 3 by means of a small planning assignment supported by short answer questions.