

Unit 20: Understand Farm Power Units – Machinery and Operation

Unit code:	L/600/9135
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

This unit aims to introduce learners to the skills and knowledge needed for managing and operating farm power units, and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The aim of this unit is to develop learners' knowledge and understanding of cost effective management of agricultural machinery.

● Unit introduction

Modern agriculture demands the efficient, cost effective management of all resources associated with farming. This is particularly true in the context of agricultural machinery, which can account for a very high proportion of the fixed costs associated with agricultural businesses. Conversely, machinery costs can be reduced significantly by the correct specification, selection and procurement of machinery.

This unit introduces learners to the processes involved in specifying and selecting farm power units and associated machinery. Learners will look at the factors to consider when specifying machinery and the continuing operating costs of the machine.

Methods of obtaining and financing the acquisition of machinery are fundamental considerations and are varied. In the unit learners will investigate the options available for procuring machinery. The efficient management of machinery is important in ensuring the economic viability of the enterprise and the skills associated with estimating machinery costs are considered in some depth within this unit. Options other than owning equipment are also reviewed, such as use of contractors and equipment hire.

The complexity and size of modern agricultural machinery is such that there are significant legal issues associated with procuring and operating equipment. One complicated area is the legislation covering machinery whilst 'on the road', another is certification of the operator. Learners will consider some of the main legal implications in relation to health and safety, construction and use and operation on the highway.

● Learning outcomes

On completion of this unit a learner should:

- 1 Understand the factors associated with the selection of agricultural machinery
- 2 Know the procurement options for agricultural machinery
- 3 Understand the legislation related to agricultural machinery
- 4 Be able to calculate and report on the operating costs of agricultural machinery.

Unit content

1 Understand the factors associated with the selection of agricultural machinery

Farm power unit specification: engine performance; external services eg hydraulic performance, power take off (pto) options; ergonomics; dimensions; compatibility with existing machines; fit for purpose

Machinery specification: power requirements; fitness for purpose eg working width, capacity, dimensions; other considerations eg specialist attachments, electronics, height/width restrictions, road use

Machinery performance: machine capacity eg field capacity, material capacity; work rate and efficiency eg spot rate, field efficiency, seasonal efficiency

Whole life costs: estimated life; repair and maintenance costs; resale value; indirect costs eg downtime

Reliability and after sales support: machine guarantee period; availability of spare parts; dealer support

2 Know the procurement options for agricultural machinery

Purchasing options: direct purchase; sources of finance eg manufacturers' schemes, bank loans, hire purchase, contract hire, leasing

Replacement: valuing; trade-in; straight purchase; new versus secondhand

3 Understand the legislation related to agricultural machinery

Health and safety: current legislation eg Health and Safety at Work Act 1974; regulations eg Provision and Use of Work Equipment Regulations (PUWER) 1998, Lifting Operations and Lifting Equipment Regulations (LOLER) 1998

Construction and use: current legislation eg Construction and Use Regulations 1986

Road traffic: current legislation eg Road Traffic Act 1988

Operator training: training plans; compulsory and recommended training eg telescopic handlers, tractor driving, all terrain vehicles (ATVs); informal training

4 Be able to calculate and report on the operating costs of agricultural machinery

Depreciation: calculation eg straight line, diminishing returns

Interest: calculation eg average value, real interest rate

Service and repair costs: fuel; servicing; repairs eg recording, estimating, predicting

Other costs: tax; insurance; storage; labour

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 explain the factors that affect selection of a named agricultural machine	M1 assess, in a practical situation, the performance of a selected power unit/machine combination and their compatibility	D1 for a mechanised operation, prepare a specification, review technical data and make a recommendation for purchase
P2 assess the performance of a named agricultural machine		
P3 describe the procurement options available for agricultural machinery	M2 prepare detailed options for the procurement of a selected farm power unit	
P4 compare the options for the procurement of a named agricultural machine [TW]		
P5 explain the legislation related to agricultural machinery	M3 prepare a training plan for a new operator of a selected farm power unit/machine combination	D2 evaluate detailed options for the procurement of a farm power unit and make recommendations as to the suitability of the options presented.
P6 discuss the operator training requirements for a selected agricultural machine [EP]		
P7 demonstrate the depreciation costs for a selected agricultural machine	M4 calculate a typical operation cost based on a selected farm power unit/machine combination.	
P8 produce a report on the annual costs of a selected agricultural machine.		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised field practicals, internet and/or library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities are undertaken, so that naturally occurring evidence can be collected. For example, learners may have the opportunity to calculate work rates from routine practical field operations, or to record fuel usage and repair costs, and they should ask for observation records and/or witness statements to be provided as evidence of this.

Whichever delivery methods are used, it is essential that tutors stress the importance of sound environmental management and the need to ensure that the management of machinery operations complies with current legislation, assurance scheme requirements and relevant codes of practice.

Health and safety issues related to working with farm power units and associated machinery must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities.

Tutors should consider integrating the delivery, private study and assessment for this unit with other relevant units and assessment instruments learners are taking as part of their programme of study.

This unit has been designed to give learners an understanding of the issues relating to the management of equipment.

Initially, learners will investigate the factors affecting equipment selection and the decision-making criteria involved. Linked to this is the concept of effective and efficient machinery and equipment management, and ways of measuring this. Learners will identify and investigate the costs of operating machinery and equipment. This is likely to be delivered through formal lectures, discussion, site visits, practicals and independent learner research. Learners will be aware of the specification of modern agricultural machinery, the performance of the machinery in the field and the costs associated with operating the machinery in an industrial situation. Learners should also explore the complex link between field performance and operational cost.

Learners will need to identify and review options for financing machinery and equipment purchase. This part of the unit deals with the procurement of machinery and is likely to be delivered through formal lectures, discussion and independent learner research. Visiting expert speakers could add to the relevance of the subject for learners. For example, representatives from a finance house could provide a useful insight into the sources of finance associated with procurement, or sales representatives from a machinery dealer could talk about current market conditions and the choices to be made when procuring new machinery.

Finally, learners will develop a knowledge of the legislation associated with the procurement and operation of machinery. This could prove challenging to deliver in an interesting and informative manner. While formal lectures will be useful to impart knowledge to learners, the use of relevant case studies and associated discussion will help make legislation and codes of practice more relevant. Visiting expert speakers will also help place learning in context for learners. For example, traffic police officers could provide a useful insight into the use of farm machinery on a public highway.

Outline Learning Plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of unit – testing of prior knowledge.
Site visit to look at machinery and equipment.
Theory session - learner-centred Q and A, on possible buying points.
Site visit/guest speaker on reasons for selecting machinery and equipment for given situations.
Assignment 1: Methods of Obtaining Machinery (P1, P3, P4, M2, D1, D2)
Tutor introduces assignment.
Written assignment on methods of obtaining machinery- auctions, new, secondhand etc.
Assignment 2: Assessment of Machine Performance (P2, M1)
Practical site visit to assess and report on the performance of a selected machine combination.
Theory session - group work - selecting machinery for given situation and feed back to group.
Theory session- the decision- making process.
Assignment 3: Safety and Machine Use (P5, P6, M3)
Assignment on legislation and operator training relevant to machinery use and operation.
Theory session- legislation covering tractors on the highway, age limits etc.
Theory session on legislation.
Site/factory visit- manufacture.
Guest speaker and/ or practical investigation on safety.
Theory session- requirement for operator training.
Assignment 4: Measure of Measuring Efficiency of Machine Use (P7, P8, M4) Written assignment on methods of measuring efficiency of equipment use. Tutor introduces assignment.
Theory session on operating costs and measures of efficiency
Practical sessions - measuring efficiency criteria.
Practical visit to in- field operations. Introduction to efficiency measures.
Assignment and self- study time.
Individual support.
Unit review.

Assessment

To achieve a pass grade learners must meet the eight pass criteria listed in the assessment and grading criteria grid.

For P1, learners must explain the factors that affect the specification and selection of a given farm power unit/machine combination. Tutors should identify the unit/machine combination or agree it through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners. This could include an operation such as mowing grass. Learners are expected to cover the range of factors listed in the unit content. Evidence could take the form of a written description or answers to posed questions. There is potential to link P1 to P5.

P2 requires learners to assess the performance of a named agricultural machine. This needs to be carried out in a practical situation. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners. This could include an operation such as mowing grass or be an 'in-field' tractor operation. A range of scenarios should be reviewed with feedback shared with the whole group.

P3 requires learners to describe the procurement options available for given farm power units and associated machinery. Tutors should identify the power units and machinery or agree them through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners. As a minimum, learners should provide evidence covering three farm power units and associated machinery.

Evidence for P3 could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a project that links to M2. Evidence could be presented as group work. However, each individual's contribution must be identified clearly.

In P4 learners are required to compare options for the procurement of a named agricultural machine. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners. This links to P3.

P5 requires learners to describe the legislation that affects the procurement and operation of given farm power units and associated machinery. Tutors should identify the power unit or agree it through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners. P4 could be assessed through the use of short-answer questions or a project that links to P1 or P2. If possible, the use of an online software package would enhance the experience for learners and provide a good range of question types.

For P6, learners must review the requirements for operator training. This should be for a given range of machinery and the results shared with the peer group. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners.

P7 requires learners to identify and understand methods of depreciating machinery. Whilst this is a theoretical subject it is best to base delivery and assessment on given examples and associated calculations. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners.

P8 requires learners to calculate the annual cost associated with a given farm power unit and associated machinery. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners. Tutors should identify the power unit or agree it through discussion with learners. This could be a tractor, materials handler or combine harvester and a suitable range of associated machines and attachments. For example, if a materials handler is chosen, the associated machinery could include the buckets and forks required; if a combine harvester is studied then monitors, crop lifters, straw choppers and side knives could be considered.

Assessment for P8 could be based on a machine learners have direct experience of, for example from the centre or work experience. Calculations may be carried out manually but there is an excellent opportunity to incorporate the use of spreadsheet software. The importance of making realistic assumptions and estimations will need to be stressed before learners completed this exercise. Evidence could take the form of a presentation or project that links to M3 or D3.

To achieve a merit grade learners must meet all the pass grade criteria and the four merit grade criteria.

For M1, learners must assess, in a practical situation, the performance of a selected power unit/machine combination and their compatibility. Tutors should identify the unit/machine combination or agree it through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners.

M1 could focus on a field-based activity, and require learners to take actual measurements of performance, such as spot rate or field rate. The results of this field activity could then be presented in a short technical report.

For M2, learners must prepare detailed options for the procurement of a selected farm power unit. Tutors should identify the power unit or agree it through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners.

As a minimum, learners should consider at least three of the procurement options detailed in the unit content. M2 could link to P2 or D2. Evidence could be presented in the same format as that for P1.

M3 requires that learners identify the possible training requirements for the operator of a selected power unit/machinery combination and prepare a suitable training plan. Tutors should identify the power unit or agree it through discussion with learners. Where possible, to ensure assessment is fair the size and complexity of the task should be the same for all learners.

To vary the assessment methods used, M3 could be assessed through role play, with learners assuming the roles of manager and operator in order to prepare an agreed plan. If this approach is chosen, an appropriate assessor's observation could be presented as supporting evidence.

M4 requires learners to calculate a typical operation cost based on a selected farm power unit/machine combination. Learners should calculate an operation, as opposed to a machine, cost. Although not essential, there is logic in M4 following on from assessment of P7, and both criteria could be assessed qualitatively within a well-designed exercise.

To achieve a distinction grade learners must meet all the pass and merit grade criteria and the two distinction grade criteria.

For D1, learners must, for a mechanised operation, prepare a specification, review technical data and make a recommendation for purchase. Evidence could take the form of a short report backed up by technical data and information collected and collated by learners.

D2 requires learners to evaluate the detailed options for the procurement of a farm power unit and make recommendations as to the suitability of the options presented. This exercise could be linked to M2, and evidence is likely to be presented in a similar format.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P3, P4, M2, D1, D2	Methods of Obtaining Machinery	Broad review of factors affecting selection and purchase of machinery and equipment. Wide range of equipment to be covered.	Written assignment.
P2, M1	Assessment of Machine Performance	In field exercise in real-life situation.	Q and A and feedback to whole group via short technical report.
P5, P6, M3	Safety and Machine Use	Investigation of real-life scenarios. Range of situations and equipment from simple to complex equipment and operations.	In class questioning. Production of written training plan.
P7, P8, M4	Measure of Measuring Efficiency of Machine Use	In field exercise using real-life situations. Range from small situation to large field scale operations.	Report on machine and system operating costs.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Introduction to Principles of Land-based Machinery	Element CU12.1 Prepare a power vehicle for operation
Introduction to Land-based Machinery Operations	Undertaking Land-based Machinery Operations
	Understand and Use Agricultural Spreaders and Sprayers

Essential resources

Learners will need access to a range of agricultural machines and land to carry out measurements and assessments of field and/or yard operations. Examples of machines could include a range of agricultural tractors, material handlers and harvesting equipment. Field operations might include ploughing, cultivation, sowing, mowing, slurry application and harvesting. Yard operations might include silage feeding, grain handling, materials handling and transport, etc.

Learners will also require access to measuring equipment and IT facilities. Links to businesses such as machinery dealerships will help provide a real-life context for some of the issues being considered.

Tutors delivering this unit should be competent in the operation and management of agricultural machinery. Ideally, they should have recent industrial experience within commercial agriculture, or show evidence of regular contact with the industry and/or technical updating.

Employer engagement and vocational contexts

It is essential this unit is delivered in an applied and vocational context. Work-based experience will also be important and the unit will be enhanced by contact with employers. Centres are encouraged to develop links with local businesses, manufacturers and machinery dealers, who can support the breadth and application of this unit. Employers can provide real work practical exercises, and guest speakers and experts to support the learning experience. Employer engagement will ensure the use of technically up-to-date information and processes.

Indicative reading for learners

Textbooks

Hathaway L and Riney L – *Machinery Maintenance, 3rd Edition* (John Deere Publishing, 1991)
ISBN 0866911308

Hunt D – *Farm Power and Machinery Management, 10th Edition* (Iowa State University Press, 2001)
ISBN 0813817560

Landers A – *Resource Management: Farm Machinery* (Farming Press, 2002) ISBN 0852365403

Nix J – *Farm Management Pocketbook, 37th Edition* (The Andersons Centre, 2006) ISBN 0954120159

Soffe R and MacConnell P – *The Agricultural Notebook, 20th Edition* (Blackwell Science, 2003)
ISBN 0632058293

Witney B – *Choosing and Using Farm Machines* (Land Technology, 1995) ISBN 0952559609

Journals

Crops

Farm Contractor

Farmers Guardian

Farmers Weekly

Landwards

Websites

www.dardni.gov.uk

The Department of Agriculture and Rural Development (DARD) aims to promote sustainable economic growth and the development of the countryside in Northern Ireland.

www.defra.gov.uk

Defra is the UK government department responsible for policy and regulations on the environment, food and rural affairs.

www.hse.gov.uk

Health and Safety Executive

www.iagre.org

Institution of Agricultural Engineers

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Team workers	deciding and prioritising factors for machine selection reviewing machine efficiency in real situations
Effective participators	participating in theory and question and answer sessions participating in presentations.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	Exploring factors that affect selection of agricultural machinery
Creative thinkers	assessing performance of agricultural machinery
Reflective learners	considering operator training for different agricultural machinery
Self-managers	Producing information on the annual costs of a selected agricultural machine.