

# Unit 31: Working with Land-based Machinery (Application Equipment)

<b>Unit code:</b>	<b>H/601/4289</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

This unit aims to introduce learners to the skills and knowledge in land based application equipment 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.

## ● Unit introduction

The costs involved in purchasing, maintaining and using land-based machinery and equipment are increasing and, as a result, there is an increasing need to provide a high standard of maintenance and repair to ensure tasks are carried out on time, to agreed costs, in accordance with current legislative requirements and considering environmental constraints.

The unit focuses on developing the learners' knowledge of working principles and capabilities of a range of land-based machines used to apply a range of materials to the land. Machines may be categorised as liquid chemical applicators to apply a broad range of liquid pesticides, granular applicators to apply a broad range of granular and powder pesticides and fertilisers, manure spreaders designed to apply liquid and solid manure, irrigation equipment to apply water to growing crops. Practical fieldwork activities will consolidate learners' skills, safe field procedures and machine settings so they understand fieldwork-rate expectations.

Experience in field operations will enable learners to recognise faults and identify the need for repairs as well as routine servicing to enable the machine to operate efficiently.

Throughout the unit learners will be encouraged to assess safe and legal working procedures, minimise wear rates on machine components and operate power units efficiently with regard to environmental pollution.

## ● Learning outcomes

**On completion of this unit learners should:**

- 1 Understand the function of land-based application equipment
- 2 Be able to prepare land-based application equipment for field use
- 3 Be able to test, overhaul and repair land based application equipment
- 4 Be able to operate land-based application equipment.

# Unit content

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## 1 Understand the function of land-based application equipment

*Function and operation of land-based application machinery:* liquid pesticide application, hydraulic nozzle sprayer, controlled droplet application, variable geometry boom, air assisted and boom sleeved sprayers; granular/powder application, single and twin spinning discs, oscillating spout, pneumatic boom; manure and slurry spreaders, rear discharge, rotary, vacuum fill-pressure discharge tankers, pump fill-pump discharge tankers, waste and rain water distribution; irrigation equipment, pumps, irrigation pipes and meters, hose reels irrigators, centre pivot irrigators, rain gun distributors, boom applicator units

## 2 Be able to prepare land-based application equipment for field use

*Prepare machinery for field use:* removal from storage, decontamination and cleaning, correct connection to suitable power unit, lubrication, service schedule, manufacturers' recommendations, planning service around fieldwork requirements, service records, warranty constraints, component and load security, component modification and substitution, safe working practices, health and safety issues, contamination, pollution, risk assessments, PPE

## 3 Be able to test, overhaul and repair land based application equipment

*Test application equipment:* check driveline operation, check controls and adjustments, run to working speed, sensory checks, calibration checks; overhaul and repair application equipment, damage, wear, corrosion, linkage, hydraulics, electrical equipment, mechanical drivelines, safety overload protection devices, bearings, seals, valves, repair overhaul/remanufacture decisions, fit for purpose, repair strategies, safe working practices, health and safety issues, contamination, pollution, risk assessments, PPE, correct disposal of wastes

## 4 Be able to operate land-based application equipment

*Operate equipment:* hydraulic nozzle sprayer, check liquid flow, pressures, clean filters, select and fit nozzles, operate controls, set up for application rates, calibrate, field procedures; granule/powder distributor, correct linkage settings, material flow rate adjustments, balance of spread, spread widths, calibration, field procedures, headland attachments; manure and slurry spreaders, filling procedures rotor speeds, chain attachments, safe start-up procedures, forward speed, pollution controls, feed gate settings, apron conveyor speeds, field procedures, safe working practices, health and safety issues, contamination, pollution, risk assessments, PPE, decontamination, preparation for storage, correct disposal of wastes

## 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:
<b>P1</b> explain the function of a given range of land-based application machines [CT, IE]	<b>M1</b> examine in detail the function and operation of a given land-based application machine	<b>D1</b> evaluate selected repair and overhaul activities carried out on land-based application equipment making appropriate recommendations for improvement.
<b>P2</b> explain the operating principles of a given range of land-based application machines		
<b>P3</b> compare the operating principles of application machines designed for similar purpose but use different engineering solutions		
<b>P4</b> prepare given application machines for field operations [IE]	<b>M2</b> prepare, service and report on a given application machine recommending appropriate improvements	
<b>P5</b> carry out routine service tasks according to manufacturers' instructions		
<b>P6</b> report on the condition of given land-based application machines.		
<b>P7</b> produce risk assessments to enable safe practices to be followed while working on contaminated application equipment [EP]	<b>M3</b> explain common causes of component failure on selected land-based application equipment.	
<b>P8</b> carry out tests to verify the serviceability of a given range of land-based application machines		
<b>P9</b> carry out repair and overhaul procedures on given land-based application machines		

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:
<p><b>P10</b> plan field procedures and assess risks prior to meeting field operation objectives [SM]</p>		
<p><b>P11</b> carry out adjustments and settings to meet specific work rates and targets using identified application equipment</p>		
<p><b>P12</b> report on quality of work and suggest how changes to procedures and settings could improve the quality and efficiency of work.</p>		

**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.

<b>Key</b>	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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# Essential guidance for tutors

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## Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable shows and events and will link to industrial experience placements.

Before delivering this unit, it is expected that learners will have completed a course of instruction where they demonstrate competence in tractor operation. Machines chosen to deliver this unit should be typical to the learner's area of study, for example it is not expected that learners from a predominately arable area will carry out extensive learning on grassland equipment. However, It is in the interest of learners to broaden their knowledge base to cater for possible future developments in their career.

Learning opportunities should be spread over as wide a range of techniques as possible to stimulate, motivate and enthuse learners. In addition to formal lecture situations, practical investigations, visits to working demonstrations, supervised practical field operations and use of internet resources are recommended. Where work placement or workshop practice is carried out witness testimonies, job cards, and copies of service records will enhance an evidence portfolio recording completed practical service and repair tasks.

Due to the complexity of many machines, it is essential that tutors emphasise safe working practices, health and safety issues and assessment of hazards and risk. Risk assessments are to be undertaken before practical activities are carried out and correct PPE used. Where waste materials, washings and redundant replaced components are to be disposed of, learners must follow procedures in accordance with current legislations and company practice.

Learning outcome 1 looks at the construction and working principles of a range of land-based application machines with a view to developing learners' understanding of the expectations of machines in the field.

Learning outcome 2 requires learners to develop skills in and an understanding of machine preparation and service procedures that must be performed in accordance with manufacturers' guidelines. Learners also need to identify the need for and perform non-scheduled maintenance tasks to take into account wear on service components which may not be covered in manufacturers' routine maintenance guidelines.

Learning outcome 3 requires learners to carry out inspections on land-based application machines, typically available in their area of study, to identify areas and components requiring repair or replacement. Learners will carry out repair and replacement of worn and damaged components in accordance with manufacturers' specifications and will follow codes of practice, current regulations and correct waste disposal techniques.

Learning outcome 4 will give learners an understanding of field procedures and machine expectations. It is essential that land-based engineers have an understanding of the expected machine capabilities to enable them communicate with potential operators.

## 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 the unit.

### **Assignment 1: Function and Operating Principles of Application Machines** (P1, P2, P3, M1)

Tutor introduces assignment brief.

Introduction to machines, application methods, material types, field situations.

Discuss function of machines, compare different machines producing similar work.

### **Assignment 2; Prepare and Service Application Machines** (P4, P5, P6, M2)

Tutor introduces assignment brief.

Hitching and setting machines ready for fieldwork, carry out pre-work maintenance.

Discuss contamination and pollution issues and legal requirements for pesticides applications.

Introduce service manuals and documentation. Outline routine and non-routine service procedures.

Carry out routine and non-routine service and maintenance tasks to appropriate granular application machines.

Carry out routine and non-routine service and maintenance tasks to appropriate pesticides application machines.

Carry out routine and non-routine service and repair tasks for land-based application equipment (manure/slurry).

Produce condition reports on identified application machines.

### **Assignment 3: Application Machine Overhaul** (P7, P8, P9, M3)

Tutor introduces assignment brief.

Discuss risk assessment process prior to maintaining, repairing and using application machines.

Introduce calibration exercises for application machines.

Carry out calibration checks on application machines.

Carry out overhaul procedures on application machines (liquid and granules).

Carry out overhaul procedures on application machines (manure and slurry).

### **Assignment 4: Application Machines Field Operations** (P10, P11, P12, D1)

Tutor introduces assignment brief.

Carry out field practice with application equipment (manure/slurry).

Feedback to individuals.

## Assessment

For P1, learners need to explain the purpose of a liquid pesticides application unit, constructed to meet current legislation, one type of granular fertiliser distributor, one type of manure spreader and one slurry applicator. Evidence may be directly assessed in a practical situation or through a written description backed up by illustrations. If assessed in the practical situation evidence must be recorded by the tutor in a suitable observation record.

For P2, learners need to explain the operating principles of machines highlighted in P1 to outline construction and design, power unit requirements, drivelines, adjustments, orientation of major working components and material flow through the machine. Written descriptions should be supported by a clearly labelled diagrams where possible.

For P3, learners need to compare four machines (highlighted in P1) with alternative types of machines designed to produce similar results, including a minimum of cost, efficiency, work rates and power unit requirements.

For P4, learners will prepare a selected range of machines for field operations. Learners will attach machines to suitable power units correctly and safely and carry out pre-operational service tasks according to manufacturers' schedules. Where adjustments are needed, they must be to manufacturers' tolerances.

For P5, learners must carry out routine service tasks according to manufacturers' schedules and recommendations. Learners could produce a logbook or portfolio to evidence service procedures carried out, machine details, service data and completed job cards indicating time taken, parts and materials used, feedback to and tutor and learner signatures.

For P6, learners need to produce a report on the condition of one liquid pesticide or granule applicator and one manure or slurry spreader as discussed and agreed with the tutor. To ensure fairness the complexity of the machines should be the same for all learners. The report should cover the main frame of the machine plus all fixed and moving components that, if worn damaged or broken, may affect the working efficiency of the machine. The report should suggest any repairs, replacements or refabrications needed to restore the machine to its original condition.

For P7, learners must produce a set of risk assessments covering the health and safety issues and possible environmental pollution issues when working with contaminated machines.

For P8, learners will carry out a series of tests to verify the serviceability of a range of application machines. Tests will include sensory investigations, liquid pressure and flow, material output, balance of spread, application patterns, air/vacuum release valves and calibration with different materials.

For P9, learners must rectify the findings in P6 by overhauling the machines. While assessing learners, tutors can give guidance to ensure overhaul procedures conform to machine specifications and work is carried out safely and in accordance with codes of practice and current legislation.

For P10, learners need to plan field procedures for a specified range of application machines. They will report on suitable field procedures prior to operations on a given plot of land and produce a risk assessment for each operation.

For P11, learners will set up and carry out field adjustments to a range of specified machines to set criteria, including application rate, evenness of spread and correct bout widths. Learners will be assessed on following safe and efficient procedures and quality of work produced. Learners will operate specified machines to demonstrate efficient use, correct field procedures, regard for pollution and emissions and safe and legal practices.

For P12, learners will evaluate their fieldwork and report on whether the criteria specified in P12 have been met and suggest improvements or alternative practices to improve performance.

For M1, M2, M3 and D1, learners need to demonstrate their understanding of machining and equipment. Evidence could be in the form of a report or presentation.

### **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, P2, P3, M1	Function and Operating Principles of Application Machines	A large range of machines are available to apply materials to land, several of which may be capable of handling more than one type of material. Select a range of machine to apply liquid pesticides, granular fertilisers and liquid and solid waste to land. Compare these with similar machines available to produce similar outcomes.	Practical observations and assessment. Verbal or written evidence.
P4, P5, P6, M2	Prepare and Service Application Machines	Carry out maintenance tasks to manufacturers' recommendations to ensure efficiency of land-based machines.  Following a period of use machines are to be inspected for condition, particularly wear areas, damage and distortion. Carry out thorough inspections to highlight areas needing attention.	Practical assessment. Written or verbal discussions. Production of portfolio of evidence. Condition reports. Checklists.
P7, P8, P9, M3	Application Machine Overhaul	After replacement, repair, remanufacture decisions have been made in the condition report, the machine needs to be overhauled prior to a further period of field operations. Carry out overhaul procedures using safe and efficient procedures.	Practical observations. Job cards and documentation to accompany condition reports in evidence portfolio.
P10, P11, P12, D1	Application Machines Field Operations	You are to apply a range of materials to land. Attach selected machines to suitable power units and safely transport to site. Where necessary machines will need working positions changing and adjustments to field operation settings to meet application criteria. Re-adjust machine and power unit settings to achieve efficient operation standards.	Practical. Observations. Verbal report.

## 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
Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment	Inspect and Test Land-based Machinery and Equipment
LEO4 Core Land-based Engineering Principles – Mechanical Principles	

Level 2	Level 3
LEO5 Core Land-based Engineering Principles – Tools and Equipment	
LEO8 Core Land-based Engineering Principles – Servicing and Maintenance	

## Essential resources

Learners will need access to a range of modern hydraulic nozzle sprayers, granular application machines, manure and slurry spreaders, together with suitable power units to enable fieldwork and settings to be carried out. Sufficient land area to enable machines to be operated and their work evaluated also needs to be available.

Suitable workshop facilities to enable routine, non-routine and overhaul tasks to be carried out in accordance to manufacturers' recommendations will be needed.

## Employer engagement and vocational contexts

Centres are encouraged to develop links with contractors, dealers and farmers to enable modern equipment to be made available. Visits, where possible, to shows and working demonstrations could enhance learners' appreciation of modern technology and the systems available. Work experience will benefit learners who have little prior experience in the service and use of land-based application machinery.

## Indicative reading for learners

### Textbooks

Bell B – *Farm Machinery (Resources Management)* (Old Pond Publishing, 2005) ISBN 1 903366682

Cairns B – *The Farmers and Groundsmans guide to Planning Vehicle and Machinery Maintenance* (The Crowood Press Ltd) ISBN 1 847971 104

Culpin C – *Farm Machinery, 12th edition*, (Blackwell Scientific, 1992) ISBN 0632031597

Witney B – *Choosing and Using Farm Machinery, First Edition* (Longman Higher Education) ISBN 0582456006

### Journals and other publications

*Profi International*

### Other publications

Manufacturers' publications and manuals

Lubrication charts and data sheets

Safe use of Pesticides

### Websites

[www.bagma.com](http://www.bagma.com)

British Agricultural and Garden Machinery Association

[www.defra.gov.uk](http://www.defra.gov.uk)

Dept for Environment, Food and Rural Affairs

[www.hse.gov.uk](http://www.hse.gov.uk)

Health and Safety Executive

## 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 ...
Independent enquirers	producing a condition report for identified machines
Creative thinkers	comparing machines that produce similar outcomes
Reflective learners	following manufacturers' service instructions carrying out calibration exercises
Self-managers	identifying overhaul procedures to reinstate machines to working order
Effective participators	carrying out field operations
Independent enquirers	producing a condition report for identified machines.

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	researching machine functions and work expectations
Creative thinkers	carrying out field operations and procedures selecting and attaching machines to suitable power units
Reflective learners	planning work experience
Self-managers	planning overhaul procedures on machines
Effective participators	assisting tutors to organise visits to shows, demonstrations
Independent enquirers	researching machine functions and work expectations.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	recording service data recording component faults and rectification strategies
Follow and understand the need for safety and security practices	assessing hazards and risk prior to field operations and workshop processes
Troubleshoot	inspecting machine condition
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	explaining operating principles of machines measuring and checking for distortion completing service and repair tasks
Bring together information to suit content and purpose	integrating information on condition report and distortion/alignment checks prior to overhaul procedures
Present information in ways that are fit for purpose and audience	
Evaluate the selection and use of ICT tools and facilities used to present information	
<b>Mathematics</b>	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	

Skill	When learners are ...
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	measuring machines for distortion or misalignment carrying out calibration procedures
Draw conclusions and provide mathematical justifications	carrying out calibration procedures
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining machine use and working principles
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturers' instructions.
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	