# Unit 30: Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

**Unit code:** K/601/4262

**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 involved in the construction, operation and servicing of machines designed to prepare seedbeds and plant seeds 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 a 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.

This unit focuses on developing learner knowledge of working principles and capabilities of a range of land-based machines used for the preparation of seedbeds for a variety of crops and soil conditions. Practical fieldwork activities will consolidate operator skills, safe field procedures and machine settings so learners understand field work-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 operation and function of land-based cultivation and planting machines

2 Be able to carry out routine service and non-routine maintenance to land-based cultivation and planting machines

3 Be able to carry out inspection and overhaul procedures on land-based cultivation and planting machines

4 Understand how machines produce different seedbeds to cater for different crops and planting techniques.

# Unit content

## 1 Understand the operation and function of land-based cultivation and planting machines

*Operation and function of cultivating and planting machines:*

*Mole ploughs, mouldboard ploughs; subsoilers, primary/secondary and combination cultivators*

*Non powered cultivators, fixed tine, spring/vibrating tine, disc harrows, seed harrows, rolls and presses, ridging machines, bed formers, stone and clod separation*

*Powered cultivators, vertical rotor, horizontal rotor*

*Seed only and combination drills, disc coulter, tine coulter, direct drill, broadcast seeders, full width seeders, air drills, precision seeders, planters and transplanters*

*Power unit requirement, correct attachment, traction aids, flotation aids*

## 2 Be able to carry out routine service and non-routine maintenance to land- based cultivation and planting machines

*Routine service:* pre-season, post-season, periodic, preventative, pre-storage, decontamination, pollution control, scheduling work, manufacturers' recommendations, service records, manufacturers' warranty procedures

*Non-routine:* repair or replacement due to wear or damage, substitution of component type, component security, machine modifications

*Safety:* safe working practices, health and safety issues, risk assessments, PPE

## 3 Be able to carry out inspection and overhaul procedures on land-based cultivation and planting machines

*Machine inspection:* linkage wear, framework/chassis cracks or damage, component alignment, calibration checks, damage to soil engaging components, wear indicators and limits, power drive components, hydraulic/air supply

*Overhaul procedures:* replacement of worn components, replacement of bearings and seals, wear on seeder mechanisms, calibration of delivery mechanisms, timing of components, damage repair/ refabrication, economics, component realignment, maintenance and repair of guards

*Safety*: risk assessments, safe working practices, decontamination of chemicals, health and safety issues, PPE, correct disposal of wastes, field testing

## 4 Understand how machines produce different seedbeds to cater for different crops and planting techniques.

*Seedbeds:* soil types, fineness of seedbed, drainage, waste burial, compaction, cultivating depth, sowing/planting depth and spacing, bed forming, tramlining working speed, machine settings, manufacturers' instructions

*Different crops:* grass seed, cerials, pulses, roots, bulbs, brassica transplants

*Planting techniques*: broadcast, drilling, spacing, row width, beds, ridges, tramlining, headlands

# 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** compare the function of a given range of cultivation and planting machines [CT, IE] | **M1** compare the working principles of selected land-based cultivation and planting machinery | **D1** evaluate selected repair and overhaul activities carried out on land-based cultivation and planting machinery making appropriate recommendations for improvement. |
| **P2** explain the operating principles of a range of cultivation and planting machines | | |
| **P3** evaluate a range of available machines, which have similar functions but use different operating principles | | |
| **P4** carry out routine service tasks to a given range of machines in accordance with manufacturer's schedules [IE, SM, EP] | **M2** explain possible effects a lack of maintenance could have on the performance of selected land-based cultivation and planting machinery | |
| **P5** carry out non-routine maintenance tasks to a given range of machines which are not outlined in manufacturer's service schedules | | |
| **P6** discuss the consequences on the performance of cultivation and planting machines that have not been subjected to adequate service and maintenance | | |

| 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:** |
| **P7** produce condition reports on a given range of cultivation and planting machines [CT, IE] | **M3** explain common causes of component failure on selected land-based cultivation and planting machinery. | |
| **P8** carry out distortion and alignment checks on a given range of cultivation and planting machines | | |
| **P9** carry out overhaul procedures to a given range of cultivation and planting machines | | |
| **P10** prepare a given range of cultivation and planting machines for work | | |
| **P11** operate and adjust a given range of machines to achieve given objectives | | |
| **P12** evaluate the quality of work and work rates of a given range of cultivation and planting machines when subjected to different settings and conditions. | | |

**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

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 their 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 establishment equipment. However, it is in the interest of learners to broaden their knowledge base in terms of 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 or 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 cultivation and planting 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 calibration procedures and service processes 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 cultivation and planting 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 to 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 to 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 Land-based Cultivation and Planting Machines** (P1, P2, P3, M1).<br>Tutor introduces assignment brief. |
| Introduction to machines, soil types, crop varieties, seedbed types. |
| Discuss function of machines, compare different machines producing similar work. |
| **Assignment 2: Service Cultivation and Planting Machines** (P4, P5, P6, M2).<br>Tutor introduces assignment brief. |
| Introduce service manuals and documentation. Outline routine and non- routine service procedures. |
| Carry out routine and non-routine service and repair tasks on appropriate land-based cultivation machines. |
| Carry out routine and non-routine service and repair tasks for land-based seeding and planting equipment. |
| Introduce calibration exercises for seeding and planting machines. |
| Carry out calibration procedures on seeding and planting machines. |
| **Assignment 3: Report on Condition and Overhaul Cultivation and Planting Machines** (P7, P8, P9, M3, D1)<br>Tutor introduces assignment brief. |
| Production of machine inspection reports on machine condition. |
| Carry out distortion and alignment checks on cultivating and planting machines. |
| Carry out overhaul procedures to cultivation machines. |
| Carry out overhaul procedures to seeding and planting machines. |
| **Assignment 4: Operate Cultivation and Planting Machines Operate Cultivation and Planting Machin**es (P10,P11,P12, D1)<br>Tutor to introduce assignment brief. |
| Hitching and setting machines ready for field work, carry out pre-work maintenance. |
| Prepare risk assessments prior to carrying out field practice with specified cultivation and planting machines. |
| Carry out field operations procedures with a range of cultivation and planting machines. |
| Feedback to individuals on assignments. |

## Assessment

For P1, learners need to produce evidence to show their understanding of the purpose of two types of cultivation machine; one powered one non-powered, one seeding machine and one planting machine. Each machine should have its purpose explained highlighting the soil types, seedbed and crops it is suited to. Evidence may be directly assessed in a practical situation or as 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 the machines used in P1, including 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 clearly labelled diagrams where possible.

For P3, learners need to evaluate the four machines (highlighted in P1) in relation to alternative types of machines designed to produce similar results. This should include a minimum of cost, efficiency, work rates and power unit requirements.

For P4, learners need to carry out routine service tasks according to manufacturers' schedules. Where critical adjustments are to be made to compensate for wear limits, these adjustments must be to manufacturers'

tolerances. Learners will be expected to evidence the service procedures they carried out in a logbook or portfolio containing machine details, service data and completed job cards indicating time taken, parts and materials used, tutor feedback and tutor and learner signatures.

For P5, learners must carry out non-routine service tasks and extend their portfolio of evidence.

For P6, learners need to discuss the consequences of performance on machines that have not been serviced correctly according to manufacturers' schedules and recommendations. This could be assessed directly by tutors during practical activities or by way of written assignment. If assessed during practical activities tutors are to complete signed evidence records, this documentation could be included in the service record logbook or portfolio.

For P7, learners need to produce a comprehensive report on the condition of one cultivation machine and one seeding or planting machine 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.

For P8, learners must carry out a series of measurements and tests to identify misalignment or distortion on the machines used in P7. Measurements are to be recorded and where possible compared to manufacturers' data so that learners can decide the best strategy to implement to rectify problems. Evidence could be recorded and assessed as part of a practical session and added to the report for P7.

For P9, learners will rectify findings in P7 and P8 by overhauling the machines. While assessing learners, tutors can give guidance to ensure overhaul procedures conform to machine specification and work is carried out safely and in accordance with codes of practice and current legislation.

For P10, learners will set up and carry out initial adjustments to a specified range of cultivation and planting equipment, and suitable power unit, in preparation for field operations.

For P11, learners will carry out field adjustments to a range of specified machines to set criteria, including working depth, quality of seedbed and seeding/planting rates where applicable. 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 P11 have been met and suggest improvements or alternative practices to improve performance.

For M1, M2 and M3, learners need to provide in-depth information on cultivation and planting equipment. This could be in the form of a report or presentation. For D1, learners could provide appropriately recorded oral evidence or a report.

### 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 Land-based Cultivation and Planting Machines | Provide evidence to explain the function and operation of selected machines and how they compare with other machines available to carry out the same work. | Practical observation and assessment.<br>Verbal or written evidence. |

| Criteria covered | Assignment title | Scenario | Assessment method |
|---|---|---|---|
| P4,P5,P6, M2 | Service Cultivation and Planting Machines | Carry out maintenance tasks to manufacturers' recommendations to ensure the efficiency of land-based machines. | Practical assessment.<br>Written or verbal discussions. |
| P7,P8,P9, M3, D1 | Report on Condition and Overhaul Cultivation and Planting Machines | Produce a checklist to outline the condition of machines before carrying out overhaul tasks. | Written condition reports and practical observation. |
| P10,P11,P12, D1 | Operate Cultivation and Planting Machines | Prepare and operate a range of machines in the field to produce a variety of seedbeds to suit a range of seeding and planting requirements g cereals seeding, potato planting and precision seeding. | Practical observations of fieldwork procedures.<br>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 links with many units in this specification and has particular links with:

| Level 2 | Level 3 |
|---|---|
| Service and Repair Land-based Soil Preparation and Plant Establishment Equipment | Undertake and Review Work Related Experience in the Land-based industries |
| ELEO4 Core Land-based Engineering Principles – Mechanical Principles | |
| 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 ploughs, primary and secondary cultivation machines, seeding machines and planting machines, 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 must also 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 cultivation and planting machinery.

## Indicative reading for learners

### Textbooks

### Books

Bell B, – *Farm Machinery (Resource Management)* (Old Pond Publishing, 2005) ISBN 1903366682

Cairns B – *The Farmers and Groundsmans guide to Planning Vehicle and Machinery Maintenance* (The Crowood Press Ltd) ISBN 1847971104

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

*Profi International*

### Other publications

Manufacturers' publications and manuals

Lubrication charts and data sheets

### Websites

| | |
|---|---|
| www.bagma.com | British Agricultural and Garden Machinery Association |
| www.defra.gov.uk | Dept for Environment, Food and Rural Affairs |
| 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 an identified machine |
| **Creative thinkers** | comparing machines that produce similar outcomes |
| **Reflective learners** | following manufacturers' service instructions<br>carrying out calibration exercises |
| **Self-managers** | identifying overhaul procedures to reinstate machines to working order |
| **Effective participators** | carrying out field operations<br>carrying out distortion and alignment checks on 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<br>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 etc. |

## Functional Skills – Level 2

| Skill | When learners are ... |
|---|---|
| **ICT – Use ICT systems** | |
| 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<br>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 |
| **ICT – Find and select information** | |
| 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 | |
| **ICT – Develop, present and communicate information** | |
| Enter, develop and format information independently to suit its meaning and purpose including:<br>• text and tables<br>• images<br>• numbers<br>• records | explaining operating principles of machines<br>measuring and checking for distortion<br>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 | |
| Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists | |
| **Mathematics** | |
| Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations | carrying out distortion checks |
| Identify the situation or problem and the mathematical methods needed to tackle it | |

| Skill | When learners are ... |
|---|---|
| Select and apply a range of skills to find solutions | |
| 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 |
| Draw conclusions and provide mathematical justifications | |
| **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 | |