

Unit 21: Operate and Service Land-based Vehicle Transmission Systems

Unit code:	L/601/4254
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 in transmission systems used in land based vehicles 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 need to improve the efficiency and productivity of land-based vehicles has become more important as land-based businesses analyse their machinery costs. To improve land-based vehicle efficiency manufacturers have developed 'user friendly' transmission systems that can be complex in design but reliable and effective in operation. Those employed in the maintenance, fault diagnosis and repair of land-based vehicles must have the knowledge and skills to undertake complex activities in the repair of transmission systems.

In this unit learners will develop the knowledge and skills needed to understand the function and operation of transmission systems, assemblies and components. How complex transmission systems benefit the efficiency of land-based vehicles is also addressed. Health and safety issues, encountered when carrying out maintenance, service and repair activities, will be stressed through continuous risk assessment.

● Learning outcomes

On completion of this unit a learner should:

- 1 Understand the layout and function of land-based transmission systems
- 2 Be able to operate land-based vehicle transmission systems
- 3 Be able to maintain land-based vehicle transmission systems
- 4 Be able to test and repair land-based transmission systems.

Unit content

1 Understand the layout and function of land-based transmission systems

Commonly found land-based transmission systems: types (two-wheel drive, four-wheel drive, power take-off systems, track laying); layout of systems and assemblies; function of systems and assemblies; types and uses of land-based vehicles using these systems; costs; advantages and disadvantages of systems and assemblies; maintenance requirements

2 Be able to operate land-based vehicle transmission systems

Systems: two-wheel drive systems (drive engagement and disengagement, speed/torque selection, speed reduction, traction); four-wheel drive systems (drive engagement and disengagement, speed/torque selection, speed reduction, equal size wheels, unequal size wheels, articulated, traction); power take-off systems (drive engagement and disengagement, methods of selecting driveline speeds); track laying systems (steering, track types, tensioning methods); reasons for system failure eg incorrect operator use, faulty components; health and safety; risk assessment

Transmission clutches: types eg dual, multi-plate oil immersed, fluid couplers; clutch operation; uses; advantages and disadvantages

Gearboxes: types eg sliding mesh, constant mesh, synchromesh, semi automatic, powershift; constantly variable transmission; gearbox operation; uses; advantages and disadvantages

Final drives: types eg crown wheel and pinion, differential, differential locking, final reduction units, constant velocity joints; uses; advantages and disadvantages

3 Be able to maintain land-based vehicle transmission systems

Maintain, service and repair: reasons for maintenance, servicing and repair; use of manufacturers' service manuals; methods used to maintain, service and repair or replace transmission systems or assemblies as per manufacturers' instructions; use of vehicle 'on board' or remote ICT equipment to adjust and set optimum performance of complex transmission systems; methods used to check the integrity of maintenance, service and repair activities; health and safety; risk assessment; relevant, current legislation

4 Be able test and repair land-based transmission systems

Test transmission assemblies: methods used to test systems and/or identify faulty components eg sensory, electronic, pressure/flow; use of 'on-board' and remote ICT test equipment; use of manufacturers' service manuals; health and safety; risk assessment; relevant, current legislation

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 illustrate the layouts of a given range of land-based vehicle transmission systems [CT, IE, EP]	M1 explain in detail the function of major sub-assemblies of land based transmission systems	D1 compare manufacturers' transmission systems in terms of operation, efficiency and effectiveness
P2 explain the function of a range of land-based vehicle transmission systems [IE, CT, SM]		
P3 evaluate the effectiveness of different land-based transmission systems and explain the work situations to which each would be most suited [IE, CT, SM, RL]		
P4 carry out land-based vehicle transmission systems operations in given situations [EP, TW, SM]	M2 explain in detail the working principles of the major sub assemblies of land-based transmission systems	
P5 report advantages and disadvantages of selected land-based transmission systems [IE, CT, SM, RL]		
P6 explain the working principles of selected land-based transmission systems} [IE, CT, SM, RL]		

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>P7 perform scheduled maintenance operations to land-based vehicle transmission systems in accordance with manufacturers' recommendations [IE, SM, EP]</p>	<p>M3 explain the need for calibration on a modern transmission system</p>	<p>D2 analyse fault diagnosis test results and explain why the symptoms displayed during testing would produce those results.</p>
<p>P8 carry out a calibration procedure, using manufacturers' recommended procedures, on a selected land-based transmission system [SM, IE]</p>		
<p>P9 produce a report outlining the effects of incorrect maintenance and calibrations of land-based transmission systems [IE, CT, SM, RL]</p>		
<p>P10 carry out risk assessments prior to performing repair and test procedures to land-based transmission systems [IE, CT, RL, SM]</p>	<p>M4 explain components identified which would be most likely to fail due to incorrect operator actions in selected transmission systems.</p>	
<p>P11 carry out repair and test procedures to selected land-based transmission systems using manufacturers' recommended procedures [IE, CT, RL, SM, TW]</p>		
<p>P12 demonstrate and evaluate the use of specialist tools and test equipment used to carry out repair and test procedures on land-based vehicle transmission systems. [IE, CT, RL, SM, TW]</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.

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 collections and will link to industrial experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised workshop activities, 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, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate and service a transmission system and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Whichever delivery methods are used, it is essential that tutors stress the importance of sound environmental management and the need to manage equipment using legal methods.

Health and safety issues relating to workshop situations must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities. Adequate PPE must be provided and used following the production of suitable risk assessments.

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.

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 to the unit including safety induction to workshop practices.
Dismantle transmission assemblies.
Assignment 1: Land-based Transmission Systems (P1, P2, P3, M1, D1)
Introduction to assignment practical investigation of transmission systems. Learner-centred research.
Assignment 2: Operate Land-based Transmission Systems (P4, P5, P6, M2)
Introduction to assignment.
Learner-centred research.
Assignment 3: Service and Calibrate Transmission Systems (P7, P8, P9, M3)
Introduction to assignment. Learner-centred research.

Topic and suggested assignments/activities and/assessment

Assignment 4: Carry out Repairs to Transmission Systems (P10, P11, P12, M4, D2)

Introduction to assignment.

Learner-centred research.

Unit review.

Assessment

For P1, P2, P3, learners could be assessed carrying out practical investigations of the constructional differences of three transmission systems. Evidence could be a written assignment based on their findings or, in some instances, could be directly assessed during the practical activity. The size and complexity of the task should be the same for all learners.

For M1, M2 and D1, evidence could be in the form of an assignment. The comparison should be of two complete transmission systems. The size and complexity of the task should be the same for all learners.

For P4, learners should be assessed carrying out practical operations on the transmission systems. Evidence could be in the form of a written assignment based on their findings or, in some instances, could be directly assessed during the practical activity. The size and complexity of the task should be the same for all learners.

For P5 and P6, evidence could be in the form of an assignment based on their findings from P4 or, in some instances, could be directly assessed during the practical activity. The size and complexity of the task should be the same for all learners.

For P7 and P8, learners should be assessed carrying out practical servicing and calibration of the transmission system.

For P9 and M3, evidence could be in the form of a report based on their findings. The size and complexity of the task should be the same for all learners.

For P10, P11, P12, M4 and D2 learners should be assessed carrying out practical testing of the transmission systems. Evidence should be in the form of a written assignment based their findings or, in some instances, could be directly assessed during the practical activity. The size and complexity of the task should be the same for all learners.

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, D1	Land-based Transmission Systems	<p>Learners are required to investigate three different land-based transmission systems eg two-wheel drive, four-wheel drive, track laying, CVT, skid steer.</p> <p>Learners will need to</p> <ol style="list-style-type: none"> 1 illustrate the layout of land-based transmission systems 2 explain the function of land-based transmission systems 3 evaluate the effectiveness of land-based transmission systems 4 explain in detail the function of sub-assemblies land-based transmission systems 5 compare two land-based transmission systems in terms of operation, efficiency and effectiveness. 	Written assignment.
P4, P5, P6, M2	Operate Land-based Transmission Systems	<p>Learners are required to:</p> <ol style="list-style-type: none"> 1 operate transmissions in differing conditions 2 produce a report on advantages and disadvantages of different transmission systems 3 explain the working principles of transmission systems 4 explain in detail the working principles of the major sub-assemblies of land-based transmission systems. 	Practical investigation. Written assignment.
P7, P8, P9, M3	Service and Calibrate Transmission Systems	<p>Learners are required to:</p> <ol style="list-style-type: none"> 1 carry out a routine service on a land-based transmission system 2 calibrate a land-based transmission system 3 produce a report on the effects of incorrect maintenance or calibration 4 explain the need for calibration on a modern land-based transmission system. 	Practical assessment. Written assignment.

Criteria covered	Assignment Title	Scenario	Assessment Method
P10, P11, P12, M4, D2	Carry out Repairs to Transmission systems	Learners are required to: <ol style="list-style-type: none"> 1 carry out a risk assessment prior to repair or test procedures 2 carry out repairs or test procedures to a land-based transmission system 3 evaluate tools and equipment used for repairs or tests 4 explain the components most likely to fail and the reasons for that failure 5 analyse test results. 	Written assessment. Practical assessment.

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 Mechanical Transmissions on Land-based Equipment	Undertake and Review Work Related Experience in the Land-based Industries
LEO4 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 vehicles with relevant transmission systems, simulation equipment to support practical investigation and sufficient test and repair equipment and materials to enable accurate evaluation of transmission assemblies and components.

Manufacturers' training videos, service manuals and test data will make a significant contribution to learner achievement.

Tutors delivering this unit should be familiar with transmission systems as used by current equipment manufacturers.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations such as mechanics and engineers, manufacturers of agricultural machines, manufacturers of engines. This will broaden their knowledge and make the learning experience interesting and contextualised. This could be through guest lecturers or off-site visits to different establishments.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery (Resource Management), 5th Edition* (Old Pond Publishing, 2005) ISBN 1 903366682

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology, 5th Edition* (Nelson Thornes, 2004) ISBN 0748780823

Whipp J and Brooks R – *Transmission, Chassis and Related Systems (Vehicle Maintenance & Repair Series: Level 3), 3rd Edition* (Thomson Learning, 2001) ISBN 1 861 52806X

Journals

Farmers Weekly

Farmers Guardian

Profi International

Websites

www.bagma.com

British Agricultural and Garden Machinery Association

www.defra.gov.uk

Department for Environment, Food and Rural Affairs

www.howstuffworks.com

HowStuffWorks

www.hse.gov.uk

Health and Safety Executive

www.iagre.org

Institution of Agricultural Engineers

www.lantra.co.uk

Lantra Sector Skills Council

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	evaluating the effectiveness of transmission systems reporting on the advantages/disadvantages of transmission systems
Creative thinkers	illustrating the layout of transmission systems explaining the function of transmission systems evaluating the effectiveness of transmission systems
Reflective learners	evaluating the effectiveness of transmission systems explaining working principles of transmission systems reporting the effects of incorrect maintenance on transmission systems
Team workers	carrying out test and repair procedures carrying out transmission operations in given situations
Self-managers	explaining working principles of transmission systems illustrating the layout of transmission systems explaining the function of transmission systems
Effective participators	carrying out transmission operations in given situations carrying out test and repair procedures.

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	evaluating effectiveness of transmissions explaining working principles researching transmissions
Creative thinkers	evaluating effectiveness of transmissions explaining working principles
Reflective learners	evaluating equipment explaining working principles
Team workers	carrying out test and repair procedures reporting results to peers
Self-managers	carrying out test and repair procedures. meeting deadlines analysing complex transmissions
Effective participators	carrying out practical demonstrations presenting results to peers.

● 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	using charts/tables in reporting results using proprietary hardware and software to communicate with OEM equipment eg calibration and fault finding modern transmissions
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	producing an effective file storage hierarchy for assessment work
Follow and understand the need for safety and security practices	
Troubleshoot	carrying out gearbox calibration
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching through a variety of media eg CDs, internet, data transfer, manufacturer downloads, the information required for assessment completion and gearbox calibration
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching information sources to enhance assessment delivery.
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records 	producing and presenting high quality evidence to meet the criteria required for assessments
Bring together information to suit content and purpose	producing and presenting high quality evidence to meet the criteria required for assessments
Present information in ways that are fit for purpose and audience	producing and presenting high quality evidence to meet the criteria required for assessments
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	adhering to local ICT codes of practice

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating gearbox and final drive ratios
Identify the situation or problem and the mathematical methods needed to tackle it	calibrating gearbox sensors
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	
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	reporting the results of practical investigation to peers
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching, interpreting and summarising information
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing assignments and reports.