Unit 14: Service and Repair Powershift, Hydrostatic and CVT Transmissions on Land-based Equipment

Unit code: M/600/3442

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to carry out service and repair on powershift, hydrostatic, CVT transmission on land based 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 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 when repairing transmission systems.

In this unit learners will develop the knowledge and skills needed to understand the function and operation of these transmission assemblies and their components.

On completion of this unit learners will be able to perform service and repair operations on powershift, hydrostatic and CVT transmissions and their components. Learners will also understand the construction, function and operation of these units.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on powershift, hydrostatic and CVT transmissions and their components

2 Understand the construction, function and operation of powershift, hydrostatic, CVT transmissions and their components.

Unit content

1 Be able to perform service and repair operations on powershift, hydrostatic and CVT transmissions and their components

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

Tests: operational and diagnostic

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

Health and safety: risk assessment; personal protective equipment (PPE); codes of practice; relevant, current legislation

Environmental considerations: disposal of waste; storage of liquids; relevant, current legislation and codes of practice

2 Understand the construction, function and operation of powershift, hydrostatic, CVT transmissions and their components

Function: power transmission, torque, speed; correct speed and torque for task; change on the move

Transmissions: powershift, hydrostatic, constant velocity transmission (CVT); disadvantages and advantages

Components: eg clutches, gearboxes, pumps, hydrostatic units, hydraulic motors, belts, pulleys, casings, hydraulic oils, filters, pipes, shafts

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 identify transmissions and their components [IE]	**M1** describe the procedures undertaken to remove, dismantle, repair and reinstate the transmission	**D1** evaluate selected land-based equipment transmission types for given tasks.
P2 remove, dismantle, repair and reinstate transmission to manufacturer's specification and standards [SM]		
P3 perform operational and diagnostic tests identifying and categorising faults in transmission [IE, CT, SM]		
P4 interpret technical documentation relating to transmissions to perform diagnostic tests	**M2** compare and contrast transmission types.	
P5 explain the different types of transmissions including their layout, construction, operating principles and functions [RL]		
P6 describe how to remove, dismantle, repair and reinstate powershift, hydrostatic, CVT transmissions and their components [RL]		
P7 evaluate faults in powershift, hydrostatic and CVT transmissions using operational and diagnostic test data. [IE]		

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 transmission practicals, research using the internet and/or library resources 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 undertaking work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out transmission repair and maintenance activities. Assessors should complete observation records and/or witness statements as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Visiting expert speakers could add to the relevance of the subject for learners. For example, land-based machinery technicians or workshop managers could talk about their work, the situations they face and the methods they use.

Whichever delivery methods are used, it is essential that tutors stress the impact transmission systems have on the efficiency of the land-based vehicle.

Learners are required to identify transmissions and their components and to dismantle, remove, repair and reinstate transmissions according to manufacturers' specifications. It is expected that practical activities should form the major part of delivery.

Learners are required to interpret technical documentation, carry out testing and evaluate faults in powershift, hydrostatic and CVT transmissions. These are likely to be delivered through formal lectures, discussion, site visits, workshop practicals and independent learner research. Learners will be aware of the layout, function and operation of transmission systems commonly found in land-based vehicles and be able to explain the different types.

Health and safety issues relating to working in repair workshops or repairing equipment in the field must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities or workshop or field visits. Adequate PPE must be provided and used following the production of suitable risk assessments.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units learners may also be 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 unit; testing of previous knowledge.
Theory session: transmissions and their components.
Demonstration session: transmission components.
Assignment 1: Transmission Testing and Repair (P1, P2, P3, P4, P7, M1). Tutor introduces the assignment brief.
Theory session: transmission faults and their identification.
Demonstration session: transmissions and their components, testing.
Workshop session: transmission testing.
Theory session and group exercise: using and interpreting technical information.
Assignment 2: Powershift, Hydrostatic and CVT Transmissions (P5, P6, M2, D1). Tutor introduces the assignment brief.
Workshop practical: transmission removal, dismantling, repair and re-instatement.
Assignment workshop and self-study.
Unit Review.

Assessment

For P1, learners must identify transmissions and their components for selected land-based vehicles. Learners are expected to provide evidence for each type of transmission system listed in the unit content. Tutors should identify the vehicles or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

P1 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by the tutor, and accompanied by appropriate work logs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

Alternatively, evidence for P1 could take the form of an ICT-based presentation with notes.

For P2, learners must remove, dismantle, repair and reinstate (using manufacturers' service manuals) selected land-based vehicle transmission systems. Learners are expected to provide evidence for three types of transmission systems listed in the unit content. Tutors should identify the systems, and the maintenance, service and repairs required, or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

P2 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate work logs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P3, learners must carry out operational and diagnostic testing procedures (using manufacturers' service manuals) to determine the status of selected land-based vehicle transmission systems and identify and categorise transmission faults. Learners are expected to provide evidence for three types of transmission systems listed in the unit content. These could be the same three types as in P2. Tutors should identify the systems and tests or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. P3 could be assessed in the same manner as P2.

In P4 learners must interpret technical information and documentation relating to transmissions to perform diagnostic tests. This could be assessed in conjunction with P3.

For P5, learners must explain the layout, construction, operation and function of transmission systems employed in selected land-based vehicles. Learners are expected to provide evidence for each type of transmission system listed in the unit content. Tutors should identify the vehicles or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for P1.

P6 requires learners to describe how to remove, dismantle, repair and reinstate powershift, hydrostatic and CVT transmissions and their components. Evidence could be in the same form as for P1.

For P7, learners need to evaluate faults in powershift, hydrostatic and CVT transmissions using operational and diagnostic test data. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence could be in the same form as for P2. Alternatively a written report could be presented.

For M1, learners must describe the procedures undertaken to remove, dismantle, repair and reinstate the transmission. These could be the same transmissions as worked on in P2. Evidence could take the same form as for P1.

M2 requires learners to compare and contrast powershift, hydrostatic and CVT transmissions. Evidence could take the form of an ICT-based presentation with notes.

For D1, learners need to evaluate selected land-based vehicle transmission systems in terms of suitability for tasks, cost and effectiveness. Evidence could take the form of an annotated poster 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, P4, P7, M1	Transmission Testing and Repair	You are a fitter in an agricultural workshop. Three vehicles are brought in with transmission faults. You are required to test the vehicle transmissions, identify the faults, disassemble the transmission, repair the faults, reassemble and test. Produce a report of the procedures carried out.	Practical observation and assessment. Observation records.
P5, P6, M2, D1	Powershift, Hydrostatic and CVT Transmissions	Produce a report explaining the different types of transmission system, comparing and contrasting them and evaluating their use for different tasks.	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
Undertake Work Related Experience in the Land-based Industries	LEO26 Service and repair powershift, hydrostatic, CVT transmissions on land based-equipment
	Undertake and Review Work Related Experience in the Land-based Industries

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

It is essential that this unit is delivered in an applied and vocational context. Work- based experience will also be important. 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

Bell B – *Farm Machinery (Resource Management), 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

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 186152806X

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	identifying transmissions and their components performing operational and diagnostic tests identifying and categorising faults in transmission
Creative thinkers	performing operational and diagnostic tests identifying and categorising faults in transmissions
Reflective learners	explaining the different types of transmissions including their layout, construction, operating principles and functions describing how to remove, dismantle, repair and reinstate powershift, hydrostatic, CVT transmissions and their components
Self-managers	removing, dismantling, repairing and reinstating transmission to manufacturers' specification and standards performing operational and diagnostic tests identifying and categorising faults in transmissions.

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 ...
Team workers	removing, dismantling, repairing and reinstating transmission to manufacturers' specification and standards performing operational and diagnostic tests identifying and categorising faults in transmissions
Effective participators	removing, dismantling, repairing and reinstating transmission to manufacturers' specification and standards performing operational and diagnostic tests identifying and categorising faults in transmissions.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	explaining the different types of transmission including their layout, construction, operating principles and functions describing how to remove, dismantle, repair and reinstate powershift, hydrostatic, CVT transmissions and their components
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	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining the different types of transmission including their layout, construction, operating principles and functions describing how to remove, dismantle, repair and reinstate powershift, hydrostatic, CVT transmissions and their components
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturers' information sources and reference material
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	explaining the different types of transmission including their layout, construction, operating principles and functions describing how to remove, dismantle, repair and reinstate powershift, hydrostatic, CVT transmissions and their components.