

# Unit 12: Service and Repair Suspension Systems on Land-based Equipment

<b>Unit code:</b>	<b>K/600/3438</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>5</b>
<b>Guided learning hours:</b>	<b>30</b>

## ● Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required service and repair suspension systems and components 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

Suspension systems are an increasingly important component of land-based equipment and they are becoming even more complex. Good suspension systems allow high levels of driver comfort, efficiency and prolonged life of the equipment. 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 higher speed vehicles, which incorporate suspension systems that can be complex in design but reliable and effective in operation.

In this unit learners will develop the knowledge and skills needed to understand the function and operation of suspension assemblies and components. Suspension systems can be found in the cab, seat and axles of vehicles and equipment. Learners should be aware of the effect of tyres on the suspension properties of land-based equipment.

On completion of this unit, learners will be able to perform service and repair operations on a range of suspension systems and their components. The use of manufacturers' handbooks and technical information will be emphasised throughout. Learners will also understand how suspension systems are constructed and work.

An integral part of this unit will be interpreting data given in workshop manuals and the application of relevant health and safety regulations. Safe working practices and good housekeeping will be an inherent part of this unit.

## ● Learning outcomes

**On completion of this unit a learner should:**

- 1 Be able to perform service and repair operations on suspension systems and their components
- 2 Understand the construction, function and operation of suspension systems.

# Unit content

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## 1 Be able to perform service and repair operations on suspension systems and their components

*Suspension systems:* cab suspension, seat suspension, axle suspension

*Service suspension assemblies:* recognition of faulty components in suspension assemblies; visual inspection; testing procedures as recommended by manufacturers' service manuals to determine successful repairs to suspension assemblies

*Repair suspension assemblies:* dismantling and rebuilding of suspension assemblies following manufacturers' service manual procedures; visual inspection; adjustments to suspension assemblies as recommended by manufacturers' service manuals

*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 suspension systems

*Suspension systems:* cab suspension, seat suspension, axle suspension

*Cab and seat suspension system components:* cab mounts, dampers, springs, accumulators, levelling devices

*Axle suspension systems:* types eg polymer, metal, hydraulic, pneumatic, beam axle suspension, independent front suspension, independent rear suspension; advantages and disadvantages; uses; user friendliness; costs; maintenance requirements

*Axle suspension components:* types eg leaf spring, coil spring, torsion bar, polymer springs, pneumatic springs, hydraulic springs, damper, anti-roll bar, tyre construction and design, treads and markings

## 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:
<p><b>P1</b> remove, dismantle, repair and reinstate suspension systems and components to manufacturer's specifications</p>	<p><b>M1</b> justify the procedures carried out to identify and repair faults in suspension system assemblies</p>	<p><b>D1</b> evaluate selected land-based equipment suspension systems in terms of effectiveness, maintenance requirements and cost.</p>
<p><b>P2</b> diagnose faults in suspension assemblies and their components and recommend actions [IE, CT, RL, SM]</p>		
<p><b>P3</b> describe the types, construction and operating principles of suspension assemblies and their components [RL]</p>	<p><b>M2</b> justify the suspension system used on selected land-based equipment.</p>	
<p><b>P4</b> describe how to remove, dismantle, repair and reinstate suspension assemblies and components [RL]</p>		
<p><b>P5</b> describe how to diagnose faults in suspension assemblies and components and recommend actions. [RL]</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	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

# Essential guidance for tutors

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## 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 chassis system 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 carry out vehicle chassis maintenance activities 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.

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

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

Learners are required to describe types, construction and operating principles of suspension units and assemblies and their components.

Learners are also required to remove, dismantle, repair and reinstate suspension systems and components. Learners should work on real equipment and in real situations. Delivery can be supported by the use of demonstration rigs and simulations.

The learning outcomes are likely to be delivered through formal lectures, discussion, site visits, supervised workshop practicals and independent learner research. Learners will become aware of the methods and associated activities commonly used in the maintenance and repair of transmission systems.

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 and assessment instruments 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 and review of unit; testing of previous knowledge.
Theory session: benefits of suspension.
Theory session: cab and seat suspension systems.
<b>Assignment 1: Practical Suspension System Repair</b> (P1, P2, M1)
Tutor introduces the assignment brief.
Workshop demonstration and group activity: cab and seat suspension systems.
Workshop practical: seat assemblies.
<b>Assignment 2: Suspension Systems and their Use and Repair</b> (P3, P4, P5, M2, D1)
Tutor introduces the assignment brief.
Workshop practical: cab suspension system investigation, testing and repair.
Theory session: axle suspension systems.
Workshop demonstration and group activity.
Workshop practical: axle suspension systems.
Assignment and self-study.
Unit review.

## Assessment

For P1, learners must remove, dismantle, repair and reinstate suspension systems and their components in accordance with manufacturers' service manuals. Learners are required to demonstrate the skills needed to dismantle and rebuild a minimum of two different land-based equipment suspension system assemblies, ensuring health and safety procedures are adhered to at all times. Tutors should identify the assemblies or agree them through discussion with learners. The assemblies may be the same as those used to provide evidence for other grading criteria. 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 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.

Alternatively, evidence for this could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

For P2, learners must diagnose faults in land-based equipment suspension systems by testing components and assemblies before dismantling and recommend actions. The type and degree of the testing should be determined by the manufacturers' recommendations. Learners should adopt a professional approach to this practical assessment task. 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 describe the types, construction and operating principles of suspension assemblies and their components employed in selected land-based equipment. Learners are expected to cover the function and operation of the suspension assemblies within a minimum of two different pieces of equipment. Tutors should identify the vehicles or agree them through discussion with learners. The vehicles may be the same as those used to provide evidence for other grading criteria. 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.

P4 requires learners to describe how to remove, dismantle, repair and reinstate suspension assemblies and their components. This could build on P1. Evidence could take the form of a written report or presentation.

P5 requires learners to describe how to diagnose faults in suspension system assemblies and components and to recommend actions. This could build on P2. Evidence could take the same form as in P4.

M1 requires learners to justify the procedures carried out to identify and repair faults in suspension system assemblies. This should be an expansion of P1 and evidence could take the same form.

M2 requires learners to justify the suspension system used on selected land-based equipment. Learners must describe a minimum of two different land-based vehicles and how each vehicle's associated suspension system would fit a different situation and why. Tutors should identify the vehicles or agree them through discussion with learners. The vehicles may be the same as those used to provide evidence for other grading criteria. 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.

D1 requires learners to evaluate selected land-based vehicle suspension systems in terms of cost, maintenance requirements and effectiveness. Tutors should identify the systems or agree them through discussion with learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

### 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, M1	Practical Suspension System Repair	You are a fitter in an agricultural repair workshop and required to investigate and repair two suspension systems, explaining the procedures carried out.	Practical observation and assessment. Completed observation records and verbal questioning.
P3, P4, P5, M2, D1	Suspension Systems and their Use and Repair	Report on the methods available to provide suspension systems on equipment and how to maintain, test and repair them.	Written 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	LEO21 Service and repair suspension systems 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, engines, and simulation equipment to support practical investigation and sufficient test and repair equipment and materials to enable accurate diagnosis and measurement. A range of engines for service and repair must be available. Demonstration rigs would greatly aid delivery.

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

Tutors delivering the unit should be familiar with the range of engines available and used by equipment manufacturers both current and dated.

## 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 also provide 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 Guardian*

*Farmers Weekly*

*Profi International*

### Websites

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

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

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

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

[www.iagre.org](http://www.iagre.org)

[www.lantra.co.uk](http://www.lantra.co.uk)

British Agricultural and Garden Machinery

Department for Environment, Food and Rural Affairs

HowStuffWorks

Health and Safety Executive

Institution of Agricultural Engineers

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 ...
<b>Independent enquirers</b>	diagnosing faults in suspension assemblies and their components and recommending actions removing, dismantling, repairing and reinstating suspension systems and their components
<b>Creative thinkers</b>	diagnosing faults in suspension assemblies and their components and recommending actions
<b>Reflective learners</b>	diagnosing faults in suspension assemblies and their components and recommending actions
<b>Self-managers</b>	removing, dismantling, repairing and reinstating suspension systems and their components diagnosing faults in suspension assemblies and their components.

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 ...
<b>Reflective learners</b>	describing the types, construction and operating principles of suspension assemblies and their components describing how to remove, dismantle, repair and reinstate suspension assemblies and components describing how to diagnose faults in suspension assemblies
<b>Team workers</b>	removing, dismantling, repairing and reinstating suspension systems and their components diagnosing faults in suspension assemblies and their components
<b>Effective participators</b>	removing, dismantling, repairing and reinstating suspension systems and their components diagnosing faults in suspension assemblies and their components.

## ● Functional Skills – Level 2

Skill	When learners are ...
<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>	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	<p>describing the types, construction and operating principles of suspension assemblies and their components</p> <p>describing how to diagnose faults in suspension assemblies and components and recommending actions</p> <p>describing how to remove, dismantle repair and reinstate suspension assemblies and components</p>
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	
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	<p>describing the types, construction and operating principles of suspension assemblies and their components</p> <p>describing how to diagnose faults in suspension assemblies and components and recommending actions</p> <p>describing how to remove, dismantle repair and reinstate suspension assemblies and components</p>
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	<p>describing the types, construction and operating principles of suspension assemblies and their components</p> <p>describing how to diagnose faults in suspension assemblies and components and recommending actions</p> <p>describing how to remove, dismantle repair and reinstate suspension assemblies and components.</p>