

# Unit 7: Understanding Land-based Vehicle Chassis Systems

<b>Unit code:</b>	<b>M/601/4280</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

This unit aims to develop learners skills and understanding of land-based vehicle chassis systems 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 higher speed vehicles, which incorporate chassis 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 potentially costly and complex activities.

In this unit learners will have the opportunity to develop the knowledge and skills needed to understand the function and operation of chassis system assemblies and components. The benefits of the components and assemblies for the efficiency of the land-based vehicles, along with health and safety issues to consider when carrying out service and repair activities, will be stressed during delivery of the unit.

## ● Learning outcomes

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

- 1 Understand the function, operation and maintenance requirements of land-based vehicle steering systems
- 2 Understand the function, operation and maintenance requirements of land-based vehicle braking systems
- 3 Understand the function, operation and maintenance requirements of land-based vehicle suspension systems
- 4 Be able to carry out serviceability tests and repairs to land-based vehicle steering, braking and suspension systems.

## Unit content

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### 1 Understand the function, operation and maintenance requirements of land-based vehicle steering systems

*Steering systems:* types eg manual, power assisted, hydrostatic; steering modes eg front, rear, four-wheel, articulated, skid-steer, crab steer; advantages and disadvantages; uses; user friendliness; costs; maintenance requirements; health and safety; personal protective equipment (PPE)

*Components:* types eg steering box types, rack and pinion, linkage, steering metering valve

*Steering principles:* Ackerman layout; toe in/out; castor, camber and king pin inclination; other relevant types

*Steering maintenance:* eg check for play, alignment, force required to turn

### 2 Understand the function, operation and maintenance requirements of land-based vehicle braking systems

*Braking systems:* types eg disc brakes, drum brakes; hydraulic operation; mechanical operation; pneumatic operation; hydro-pneumatic operation; split braking circuits; over-run brakes; advantages and disadvantages; uses; user friendliness; costs; health and safety; PPE

*Components:* types eg leading and trailing shoe arrangements, single and multi-disc arrangements, wheel cylinders, master cylinders, calipers, adjusters, servo, ABS, park brake mechanisms

*Maintenance requirements:* eg balance, wear, replace, refit, skim, measure, runout

### 3 Understand the function, operation and maintenance requirements of land-based vehicle suspension systems

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

*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

*Maintenance requirements:* eg checks on effectiveness, sag, checks, measure, visual checks, Health and safety, PPE

### 4 Be able to carry out serviceability tests and repairs to land-based vehicle steering, braking and suspension systems

*Test steering, suspension and braking assemblies:* recognition of faulty components in steering, suspension and braking assemblies; visual inspection; testing procedures as recommended by manufacturers' service manuals to determine successful repairs to steering, suspension and braking assemblies; health and safety; PPE

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

## 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> explain the function and operation of land-based vehicle steering systems [IE, RL, TW, EP, CT, SM]</p>	<p><b>M1</b> explain situations where selected land-based vehicle steering systems would be preferred</p>	<p><b>D1</b> fully evaluate selected land-based vehicle steering and braking systems in terms of cost, maintenance requirements and effectiveness suggesting possible improvements</p>
<p><b>P2</b> examine land-based vehicle steering systems and assess their need for maintenance or repair [IE, RL, TW, EP, CT, SM]</p>		
<p><b>P3</b> carry out routine maintenance tasks to steering systems in accordance with manufacturer's requirements [IE, RL, TW, EP, CT, SM]</p>		
<p><b>P4</b> explain the function and operation of land-based vehicle braking systems [IE, RL, TW, EP, CT, SM]</p>	<p><b>M2</b> explain situations where selected land-based vehicle braking systems would be preferred</p>	
<p><b>P5</b> examine land-based vehicle braking systems and assess their need for maintenance or repair [IE, RL, TW, EP, CT, SM]</p>		
<p><b>P6</b> carry out routine maintenance tasks to braking systems in accordance with manufacturer's requirements [IE, RL, TW, EP, CT, SM]</p>		

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>P7</b> explain the function and operation of land-based vehicle suspension systems [IE, RL, TW, EP, CT, SM]</p>	<p><b>M3</b> explain situations where selected land-based vehicle suspension systems would be preferred</p>	<p><b>D2</b> fully evaluate selected land-based vehicle suspension systems in terms of cost, maintenance requirements and effectiveness then suggest possible improvements.</p>	
<p><b>P8</b> examine land-based vehicle suspension systems and assess their need for maintenance and repair [IE, RL, TW, EP, CT, SM]</p>			
<p><b>P9</b> carry out routine maintenance tasks to suspension systems in accordance with manufacturer's requirements [IE, RL, TW, EP, CT, SM]</p>			
<p><b>P10</b> outline the procedure to be adopted for the removal of chassis system units from a land-based vehicle in preparation for overhaul or repair [IE, RL, TW, EP, CT, SM]</p>			<p><b>M4</b> carry out testing and repairs to selected land-based vehicle chassis system assemblies in accordance with manufacturers' service manuals efficiently, within agreed timescales, without assistance.</p>
<p><b>P11</b> assess risks prior to performing practical removal, overhaul or repair procedures to chassis system units [IE, RL, TW, EP, CT, SM]</p>			
<p><b>P12</b> carry out a removal, overhaul and repair task on land-based vehicle chassis system units and check the integrity of the unit on completion. [IE, RL, TW, EP, CT, SM]</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

## 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. However, the majority of the delivery should be through practical investigation. Delivery should stimulate, motivate, educate and enthuse learners.

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

## 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
<b>Assignment 1: Steering Systems</b> (P1, P2, P3) Tutor introduces the assignment Practical activities.
<b>Assignment 2: Braking Systems</b> (P4, P5, P6) Tutor introduces the assignment Practical activities.
<b>Assignment 3: Suspension System</b> (P7, P8, P9) Practical activities.
<b>Assignment 4: Chassis System</b> (P10, P11, P12, M4) Practical assessments.
<b>Assignment 5: Evaluations of Chassis Systems</b> (M1, M2, M3, D1, D2) Unit review.

## Assessment

Tutors are encouraged to use varied and practical assessment methods where possible. Assessment activities could be in the form of a presentation utilising suitable software or a pictorial display with fully annotated photographs. Work logs and comprehensive job cards endorsed by the tutor would also be suitable.

For P1, learners must explain the function and operation of steering systems used in selected land-based vehicles. Learners are expected to cover the function and operation of the steering assemblies within a minimum of three different land-based vehicles.

Learners should examine (P2), then carry out (P3), appropriate practical activities in relation to steering systems. Direct observation from a tutor supported by a job card would be sufficient evidence or the other forms of evidence listed above would also be suitable. Practical activities must be carried out in accordance with manufacturers' specifications

For P4, learners must explain the function and operation of braking systems used in selected land-based vehicles. Learners are expected to cover the function and operation of the assemblies within a minimum of three different land-based vehicles. The vehicles may be the same as those used to provide evidence for other grading criteria.

Learners should examine (P5), then carry out (P6), appropriate practical activities in relation to braking systems. Direct observation from a tutor supported by a job card would be sufficient evidence or the other forms of evidence listed above would also be suitable. Practical activities must be carried out in accordance with manufacturers' specifications

For P7, learners must explain the function and operation of suspension systems used in selected land-based vehicles. Learners are expected to cover the function and operation of the suspension assemblies within a minimum of three different land-based vehicles. The vehicles may be the same as those used to provide evidence for other grading criteria.

Learners should examine, (P8) then carry out (P9), appropriate practical activities in relation to suspension systems. Direct observation from a tutor supported by a job card would be sufficient evidence or the forms of evidence listed above would also be suitable. Practical activities must be carried out in accordance with manufacturers' specifications

For M1, M2 and M3, learners should explain situations where steering, braking and suspension systems are preferred. They must give justifiable reasons. Learners could compare and contrast different systems that are also used in similar situations. Assessment in this area should provoke active classroom discussion which could generate the required evidence.

For P10, P11, P12 and M4, learners should work individually with the aid of a manufacturer's workshop manual, or similar, to test and repair selected land-based vehicle chassis system assemblies in accordance with manufacturers' service manuals. They should carry this out efficiently, within agreed timescales and without assistance. Evidence could be in the form of a video, a witness statement, time-lapse photography etc.

For D1 and D2, learners must fully evaluate steering, braking and suspension systems in terms of cost, maintenance requirements and effectiveness. A simple table of pros and cons would not be sufficient. Learners should compare all aspects of the systems then suggest how improvements could be made. Evidence could be in the form of a formal report or presentation.

### Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3	Steering	Land-based vehicles employ a variety of steering systems. You need to understand them, assess them for wear then carry out maintenance.	Observation of practical activities. Job card.
P4, P5, P6	Braking	Land-based vehicles employ a variety of braking systems. You need to understand them, assess them for wear then carry out maintenance.	Observation of practical activities. Job card.

Criteria covered	Assignment title	Scenario	Assessment method
P7, P8, P9	Suspension	Land-based Vehicles employ a variety of suspension systems. You need to understand them, assess them for wear then carry out maintenance.	Observation of practical. Job card.
P10, P11, P12, M4	Chassis Systems	Many maintenance procedures in land-based engineering have timescales. Show that you are able to carry out this work safely and efficiently with the aid of workshop manuals.	Practical observation. Video recording.
M1, M2, M3, D1, D2	Evaluation of Chassis Systems	Continual improvement of chassis systems relies on feedback and development, describe why systems are used and suggest alternatives.	Investigative report. Presentation. Debate.

## Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment	Undertake and Review Work-related Experience in the Land-based Industries

## Essential resources

Learners will need access to a range of vehicles with relevant chassis systems, simulation equipment to support practical investigation and sufficient test and repair equipment and materials to enable accurate evaluation of chassis 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 chassis 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 that specialise in research and development. This will broaden their depth of 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 86152806X

### Journals

*Farmers Guardian*

*Farmers Weekly*

*Profi International*

### Websites

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

British Agricultural and Garden Machinery Association

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

Department for Environment, Food and Rural Affairs

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

Health and Safety Executive

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

Institution of Agricultural Engineers

[www.lantra.co.uk](http://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 ...
<b>Independent enquirers</b>	explaining the function of systems
<b>Creative thinkers</b>	evaluating systems
<b>Reflective learners</b>	describing systems
<b>Team workers</b>	presenting evaluations of systems
<b>Self-managers</b>	working to timescales
<b>Effective participators</b>	taking part in debate.

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>Independent enquirers</b>	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
<b>Creative thinkers</b>	asking questions to extend their thinking during lectures and practical sessions suggesting alternatives solutions to common systems
<b>Reflective learners</b>	identifying opportunities for their own achievements setting goals for themselves eg completing a task within a timescale reviewing progress in practical tasks and coursework
<b>Team workers</b>	working with others to carry out planning and group activities in class reaching clear agreements regarding who is carrying out which tasks during practicals
<b>Self-managers</b>	showing initiative and commitment when faced with practical problems dealing with pressures in a time constrained situation
<b>Effective participators</b>	discussing issues of suitability when debating chassis systems identifying improvements to current systems.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	researching continual improvements in relation chassis systems
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	producing a presentation of continual improvements made to chassis systems
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
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	delivering a presentation on continual improvements in chassis systems discussing continual improvements and suggesting alternatives
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing a report on continual improvement relating to chassis systems, describing the systems used.