

Unit 5: Service and Repair Hydraulic Systems and Components on Land-based Equipment

Unit code:	H/600/3440
QCF Level 3:	BTEC National
Credit value:	5
Guided learning hours:	30

● Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to repair and service hydraulic systems in land-based equipment.

● Unit introduction

Recent developments have led to improved efficiency in the operation and performance of hydraulic systems and components fitted to land-based vehicles.

In this unit learners will develop the knowledge and skills required to understand the construction, function and operation of land-based hydraulic systems and components. They will explore the need for accurate fault diagnosis and repair of land-based hydraulic systems and components.

Learners will develop an understanding of hydraulic systems and components and their relationship to the improved efficiency and performance of land-based vehicles.

Interpreting data given in workshop manuals and applying relevant health and safety regulations will form an integral part of this unit.

● Learning outcomes

On completion of this unit a learner should:

- 1 Be able to perform service and maintenance operations on hydraulic systems and their components
- 2 Understand the construction, function and operation of hydraulic circuit systems and their components used in land-based engineering applications.

Unit content

1 Be able to perform service and maintenance operations on hydraulic systems and their components

Maintenance and service: manufacturers' recommendations; service tasks; use of operator and workshop manuals; completing service records; costs; inspection; evaluation; test eg pressure; flow; temperature

Repair procedures: requirements eg assembly refurbishment, assembly/component replacement; costs

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

Faults: cause of inadequate system performance eg component failure, control systems failure, operator error; fault diagnosis; methods eg sensory, measure component tolerance, vehicle

2 Understand the construction, function and operation of hydraulic circuit systems and their components used in land-based engineering applications

Principles of systems: characteristics of fluids (Pascal's Law)

Hydraulic systems and components: pumps, fixed, variable displacement; hose and fitting types; pressure maintaining valves; relief valves; anti-cavitation and auxiliary relief valves; shock valves; control valves; distributors; solenoid valves; proportional control valves; pressure differential valves; pilot operated valves; trailer brake valve; direction flow valves; flow dividers; orbital valves; priority valves; restrictors; load sensing circuits/systems and valves; hydrostatic circuits; reservoirs; accumulators

System contamination: filtration; straining

Actuators: linear, single acting, double acting; cushioned; rotary

System layouts: hydraulic systems eg open centre, closed centre, three point linkage, auxiliary hydraulics; use of British Standards (BS) symbols

Operation: electronic control eg strain pins, pulse width modulation, engine control unit (ECU), headland control, hydraulic eg draft control, position control, intermix, load sensing, pressure control, flow control

Repair to manufacturers' specifications: interpretation and comparison of test results to manufacturers' specifications; options and recommendations
Assessment and grading criteria

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>P1 inspect performance of hydraulic systems and components [IE, TW, SM]</p>	<p>M1 explain common causes of component failure in hydraulic systems using information from diagnostic tests</p>	<p>D1 evaluate the operation and performance characteristics of open centre and closed centre hydraulic systems.</p>
<p>P2 prepare the system to be tested and carry out tests using diagnostic tools to assess system performance [IE, TW, SM]</p>		
<p>P3 interpret diagnostic results and recommend action [IE, CT, RL, SM]</p>		
<p>P4 remove, dismantle, repair and reinstate system and components to manufacturer's specifications [EP, TW, 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>P5 interpret circuit diagrams and symbols and their functions within the system [IE, CT, RL, SM]</p>	<p>M2 design hydraulic systems and components to achieve given objectives.</p>	
<p>P6 explain how to dismantle, repair and reinstate hydraulic components and systems [IE, CT, SM]</p>		
<p>P7 explain the application of valves and the function of hydraulic systems and components [IE, CT, SM]</p>		
<p>P8 identify diagnostic test/s that will evaluate hydraulic system performance [IE, CT, SM]</p>		
<p>P9 interpret and compare test results. [IE, 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.

Key	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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Essential guidance for tutors

Delivery

Delivery of this unit will involve practical and written assessments, visits to workshops and could link easily to work related 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 undertaking any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to repair a piece of materials handling equipment. Assessors should complete relevant 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 learners are taking as part of their programme of study.

Learning outcome 1 looks at the maintenance, fault diagnosis and repair of hydraulic systems and components. This can be delivered as individual practical sessions as well as through formal lectures and discussions. Health and safety within the workshop must be paramount at all times.

Learning outcome 2 covers the theoretical aspects of hydraulic systems and components. This is likely to be delivered through formal lectures, discussion, possible site visits, demonstrations, supervised practical sessions and independent learner research.

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.

Assignment 1: Perform Service and Maintenance Operations on Hydraulic Systems and their Components (P1, P2, P3, P4, M1)

Introduction to the assignment and learner-centred research.

Topic and suggested assignments/activities and/assessment

Prepare the system to be tested, carry out tests using diagnostic tools, inspect performance, interpret diagnostic results and recommend actions.

Remove, dismantle, repair and reinstate system and components to manufacturer's specifications.

Assignment 2: Construction, Function and Operation of Hydraulic Circuit Systems and their Components used in Land-based Engineering Applications (P5, P6, P7, P8, P9, M2, D1)

Introduction to the assignment and learner-centred research.

Interpret circuit diagrams and symbols, explain the application and function within hydraulic systems/circuits.

Explain how to dismantle, repair and reinstate hydraulic components and systems.

Identify diagnostic tests that will evaluate hydraulic system performance, interpret and compare test results.

Unit review.

Assessment

Where possible, to ensure fairness of assessment the size and complexity of tasks should be the same for all learners.

For P1, P2 and P3, learners are required to prepare hydraulic systems to be tested, carry out tests using diagnostic tools, inspect performance, interpret diagnostic results and recommend actions. Tutors should identify the systems or agree them through discussion with learners. It is expected that, as a minimum, learners will provide evidence for two hydraulic systems, preferably those commonly used in the land-based industry sector that is their primary area of interest.

For P4, learners are required to remove, dismantle, repair and reinstate hydraulic systems and components to manufacturers' specifications. Tutors should identify the systems or agree them through discussion with learners. It is expected that, as a minimum, learners will provide evidence for two hydraulic systems or components, preferably those commonly used in the land-based industry sector that is their primary area of interest.

For P5, learners are required to interpret circuit diagrams and symbols within a hydraulic system. Tutors should identify the systems or agree them through discussion with learners. It is expected that, as a minimum, learners will provide evidence for two hydraulic systems, preferably those commonly used in the land-based industry sector that is their primary interest area of interest.

For P6, learners need to explain how to dismantle, repair and reinstate hydraulic components and systems. Tutors should identify the systems 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. It is expected that, as a minimum, learners will provide evidence for two hydraulic systems, preferably those commonly used in the land-based industry sector that is their primary area of interest.

For P7, learners are required to explain the application of valves and the function of hydraulic systems and components. Tutors should identify the systems 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. It is expected that, as a minimum, learners will provide evidence for three hydraulic systems, one fitted with mechanical three point linkage control, one with electronic three point linkage control and one with a load sensing control system, preferably those commonly used in the land-based industry sector that is their primary area of interest.

For P8 and P9, learners need to identify diagnostic tests that will evaluate hydraulic system performance, interpret and compare test results for hydraulic systems and components. Tutors should identify the systems 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. It is expected that, as a minimum, learners will provide evidence for two hydraulic systems, preferably those commonly used in the land-based industry sector that is their primary area of interest.

For M1, learners need to provide information on causes of component failure in hydraulic systems using information from diagnostic test results. Tutors should identify the systems and the test and component, or agree them through discussion with learners. It is expected that, as a minimum, learners will provide evidence for two faulty components or assemblies for each type of system. Evidence could be in the same form as for P2.

For M2, learners are required to design hydraulic systems to achieve given objectives. It is expected that learners will include relevant British Standards (BS) symbols in their designs. Tutors should identify the objectives or agree them through discussion with learners. Learners are expected to provide, as a minimum, evidence for two hydraulic systems. The objectives could include, for example, systems to handle goods with a machine or the sequencing of operations within a machine.

For D1, learners are required to evaluate open centre and closed centre hydraulic systems for both operation and performance. Tutors should identify the systems 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. It is expected that, as a minimum, learners will evaluate at least one open centre and one closed centre hydraulic system in terms of their operation and performance characteristics. Evidence could take the form of an ICT-based 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, P3, P4, M1	Perform Service and Maintenance Operations on Hydraulic Systems and their Components	You are working for a local agricultural dealership that specialises in the repair of hydraulic systems. You will test and repair different types of hydraulic systems.	Practical. Report. Job card. Work logs.
P5, P6, P7, P8, P9, M2, D1	Construction, Function and Operation of Hydraulic Circuit Systems and their Components used in Land-based Engineering Applications	You are working for a local agricultural dealership that specialises in the repair of hydraulic systems. You will need to interpret design and explain hydraulic systems and components. Explain to others how to repair hydraulic systems and components and identify types of tests and evaluate test results in terms of performance.	Assignment/report. Presentation.

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 Hydraulic Systems and Components on Land-based Equipment	LEO24 Service and Repair Hydraulic Systems and Components on Land-based Equipment

Essential resources

Learners will need access to a range of vehicles with relevant hydraulic systems and components, simulation equipment to support practical investigation and sufficient test and repair equipment and materials to enable accurate evaluation of hydraulic systems 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 hydraulic 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 to broaden their depth of knowledge and make the learning experience interesting and vocationally relevant. This could be through either guest lectures, work placements 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, Coombes P and Rogers D – *Hillier's Fundamentals of Motor Vehicle Technology: Powertrain Electronics, 5th Edition* (Nelson Thornes, 2006) ISBN 0748780998

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

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	explaining the function of hydraulic system components assessing risk explaining principles of operation
Creative thinkers	explaining the function of hydraulic system components assessing risk explaining principles of operation discussing the correct selection of components
Reflective learners	discussing the correct selection of components describing methods of fault diagnosis
Team workers	planning and carrying out testing and repair work diagnosing faults using a variety of sources
Self-managers	planning and carrying out maintenance and repair work diagnosing faults using a variety of sources
Effective participators	diagnosing faults using a variety of sources.

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	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions adapting ideas as circumstances change eg fault diagnosis on a variety of machinery
Reflective learners	identifying opportunities for their own achievements setting goals for themselves eg time management reviewing progress in practical tasks and coursework
Team workers	working with others to carry out repair and maintenance tasks reaching clear agreements regarding who is carrying out which tasks during practical activities working together when diagnosing faults
Self-managers	dealing with pressures in an emergency situation managing time and resources during practical activities
Effective participators	discussing issues of concern relating to time management and resources during practical activities identifying improvements that could be implemented during practical tasks.

● 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	completing their course work using ICT facilities using interactive materials for teaching and learning
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	researching hydraulic circuit systems and components on the internet
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
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	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	planning an activity and getting relevant information from relevant sources presenting findings and justifying methods
Identify the situation or problem and the mathematical methods needed to tackle it	
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	reading material on the subject from a variety of sources for their assignment work reading manufacturers' specifications and using correct engineering terminology.
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	