

# Unit 13: Service and Repair Pneumatic Systems and Components for Land-based Equipment

<b>Unit code:</b>	<b>K/600/3441</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 to carry out service and repair on pneumatic systems and components for 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

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

In this unit learners will develop the knowledge and skills required to understand the construction, function and operation of pneumatic systems used in land-based machinery and equipment and to support the need for accurate fault diagnosis and repair of land-based pneumatic systems. Learners will develop an understanding of pneumatic systems and their relationship to the improved efficiency and performance of land-based vehicles.

Initially, learners will develop the practical skills needed to maintain, test and repair pneumatic systems used on land-based vehicles and equipment.

They will then focus on the understanding the construction and operation of pneumatic systems used on land-based vehicles and equipment.

An integral part of the unit will be interpreting data given in workshop manuals and the application of relevant health and safety regulations.

## ● Learning outcomes

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

- 1 Be able to perform service and repair operations on pneumatic systems and components
- 2 Understand the construction, function and operation of pneumatic systems and components used in land-based engineering.

# Unit content

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

*Maintenance and service:* manufacturers' recommendations; service tasks; use of operator and workshop manuals; completing service records; costs

*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

## 2 Understand the construction, function and operation of pneumatic systems and components used in land-based engineering

*Components:* air compressors, air pressure regulating valves, relief valves, dump valves, air pressure control valves, handbrake valves, footbrake valves, diaphragm operated valves, air activated cylinders, air cushions, fail-safe/emergency system components, air receivers and dryers

*System layouts; use of British Standards (BS) symbols, circuit diagrams and their interpretation*

*Operation:* eg air braking systems

## 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:
<b>P1</b> inspect performance of pneumatic systems and components [IE, SM]	<b>M1</b> identify faulty components or assemblies in selected pneumatic systems from test results and explain why	<b>D1</b> justify the use of pneumatic systems for a range of land-based applications.
<b>P2</b> prepare system to be tested and carry out tests using diagnostic tools [SM]		
<b>P3</b> interpret and record the results and recommend action [IE]		
<b>P4</b> remove, dismantle, repair and reinstate system and components to manufacturers' specification [SM]		
<b>P5</b> interpret circuit diagrams and symbols and their functions within a pneumatic system [IE]	<b>M2</b> evaluate the use of pneumatic systems in land-based equipment.	
<b>P6</b> explain the application and function of pneumatic systems and components [RL]		
<b>P7</b> explain diagnostic tests and how to interpret the results [RL]		
<b>P8</b> describe how to dismantle, repair and reinstate pneumatic systems and components. [RL]		

**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 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 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 operation and 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 learners. For example, land-based machinery technicians or workshop managers could talk about their work, the situations they face and the methods they use.

Tutors must ensure that a suitable range of pneumatic systems and applications are covered during delivery of this unit.

Learners should work with both real pneumatic systems in situ and demonstration rigs. Delivery should involve theory sessions and demonstrations by the tutor followed by learner tasks. An understanding of the characteristics of gases (Pascal's Law) and the compressibility of air is required. Fault diagnosis and repair is an integral part of this unit.

Health and safety issues relating to working in repair workshops must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities and before learners visit any workshop. Adequate personal protective equipment (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.

The learning outcomes are directly linked and 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 pneumatic systems commonly found in land-based vehicles and equipment.

## 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: pneumatics in land-based equipment.

### **Assignment 1: The Repair and Reinstatement of a Pneumatic System** (P3, P4, P5, P6, P8)

Tutor introduces the assignment brief.

Theory session: pneumatic system components.

Workshop group activity: investigate pneumatic systems.

Workshop demonstration: pneumatic systems and their components.

Theory session: system and component maintenance.

Workshop session: component and system overhaul and maintenance; disassembly and assembly.

### **Assignment 2: The Testing of Pneumatic Systems** (P1, P2, P7, M1)

Tutor introduces the assignment brief.

Theory session: system inspection, diagnosis and fault finding.

### **Assignment 3: The Application of Pneumatics in Land-based Technology** (M2, D1)

Tutor introduces the assignment brief.

Workshop session: system inspection, diagnosis and fault finding.

Theory session: symbols and circuit diagrams.

Assignment and self-study.

Unit review.

## Assessment

For P1, learners must inspect the performance of pneumatic systems and components systems used in selected land-based vehicles and equipment. Tutors should identify the vehicles and/or equipment 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 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 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.

P2 requires learners to prepare a pneumatic system to be tested and to carry out tests using diagnostic tools. Tutors should identify the systems or agree them through discussion with learners. The pneumatic system may be the same as that 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.

For P3, learners must interpret and record the results and recommend actions following testing of pneumatic systems and components. This might be a continuation of P2 and 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 P4, learners are required to remove, dismantle, repair and reinstate a pneumatic system and components to the manufacturer's specification. Learners' evidence is expected to cover aspects of maintenance, service and repair. 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. Evidence could be in the same form as for P3.

P5 requires learners to interpret circuit diagrams of pneumatic systems and their symbols. This could be a classroom-based task undertaken individually or as a group task. The circuit diagrams could be real, for example from a manufacturer's handbook. Evidence could take the form of a written report interpreting the diagram or peer group presentation. Alternatively assessment could be by verbal questioning.

In P6 learners are required to explain the application and function of pneumatic systems and components. This could be for pneumatic braking systems or pneumatic spreaders or drills. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence and assessment could be in the same form as for P1.

P7 requires learners to explain the diagnostic tests available for pneumatic systems and how to interpret the results. Evidence could be in the form of a written report or, alternatively, the evidence and assessment could be as in P1.

P8 requires learners to describe how to dismantle, repair and reinstate pneumatic systems and components. P8 could be assessed directly by the tutor during practical activities. Evidence and assessment could be in the same form as in P1.

For M1, learners must identify faulty components or assemblies in selected pneumatic systems and explain why they were identified and how they are faulty. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. M1 could be assessed directly by the tutor during practical activities. Evidence may be in the same form as for P1.

For M2, learners must evaluate the use of pneumatic systems in land-based equipment. Evidence could take the form of a written report.

For D1, learners must justify the use of pneumatic systems for a range of land-based applications. Tutors should identify the applications and/or equipment 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 take the form of a written 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
P3, P4, P5, P6, P8	The Repair and Reinstatement of a Pneumatic System	You are working in a repair workshop and have to inspect, repair and reinstate a pneumatic system.  You will need to maintain observation reports and explain the processes carried out and the function of the components.	Practical observation and assessment.  Completed observation records and verbal questioning.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P7, M1	The Testing of Pneumatic Systems	You are required to test a pneumatic system and its components, recording the results and reporting on the findings.	Practical observation and assessment. Completed observation records and verbal questioning.
M2, D1	The Application of Pneumatics in Land-based Technology	Review the use of pneumatic systems in land-based equipment.	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 links with many units in this specification and has particular links with:

Level 2	Level 3
Service and Repair Pneumatic Systems and Components for Land-based equipment	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 equipment employing relevant pneumatic 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 pneumatic 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, machinery dealers and workshops, who can support the breadth and application of this unit. Employers can provide real-work practical exercises and also 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

HSE – *Essential of Health and Safety at Work* (HSE Books, 2006) ISBN 0717661794

Parr E – *Hydraulics and Pneumatics: A Technician's and Engineer's Guide, 3rd Edition* (Butterworth-Heinemann, 2011)

Turner I – *Engineering Applications of Pneumatics and Hydraulics* (Butterworth-Heinemann, 1995) ISBN 0340625260

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

HowStuffWorks

[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>	inspecting performance of pneumatic systems and components interpreting and recording results and recommending actions interpreting circuit diagrams
<b>Reflective learners</b>	explaining the application and function of pneumatic systems and components explaining diagnostic tests and how to interpret the results describing how to dismantle, repair and reinstate pneumatic systems and components
<b>Self-managers</b>	inspecting the performance of pneumatic systems and components preparing systems to be tested and carrying out tests using diagnostic tools removing, dismantling, repairing and reinstating system and 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>	inspecting performance of pneumatic systems and components
<b>Team workers</b>	removing, dismantling, repairing and reinstating a system and components to manufacturers' specification
<b>Effective participators</b>	removing, dismantling, repairing and reinstating a system and components to manufacturers' specification.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	using computer-based manufacturer's data and handbooks
Follow and understand the need for safety and security practices	
Troubleshoot	
<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>	recording pneumatic test results
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	giving presentation to peers on the application and function of pneumatic systems and 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	
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining the application and function of pneumatic systems and their components
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturer's data sheets, manuals and specifications
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing a report to evaluate the use of pneumatic systems in land-based equipment writing a report to justify the use of pneumatics systems for a range of land-based applications.