

Unit 6: Inspect and Test Land-based Machinery and Equipment

Unit code:	A/600/3444
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 inspect and test land-based machinery and equipment. This unit aims to introduce learners to skills and knowledge in land-based machinery and equipment inspection and testing 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 skills needed to inspect and test land-based machinery and equipment are fundamental for the qualified land-based engineer. These skills need to become more diverse with the technological developments of land-based machinery, particularly in relation to electronic and hydraulic systems. The land-based engineer now has to carry out complex test procedures using sophisticated diagnostic equipment to identify if a fault is being caused by electronic, hydraulic or mechanical components of the system.

In this unit learners will develop the knowledge, skills and understanding needed to carry out appropriate test procedures using diagnostic equipment, which will enable them to identify complex system faults correctly. Learners will study how to select appropriate, safe diagnostic test equipment for described symptoms and recommend the most appropriate, cost and time efficient methods of rectifying faults. Learners are expected to use logical test procedures, following manufacturers' guidelines, and consult and interpret data from appropriate sources, for example workshop manuals.

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 inspect and test land-based machinery and equipment
- 2 Be able to analyse and interpret findings
- 3 Understand how to inspect and test land-based machinery and equipment
- 4 Understand how to formulate and recommend actions.

Unit content

1 Be able to inspect and test land-based machinery and equipment

Reasons for inspection and testing: compliance (manufacturers'/technical/legislation); verification of repair; accident or incident occurrence; diagnosis

Machinery information: service history; Technical reference date

Inspection and testing: criteria for inspection and testing (equipment must be serviceable, calibrated, certification in date); recognised methods and procedures; safe working practices; risk assessment

2 Be able to analyse and interpret findings

Data analysis: elimination of any influence of external factors affecting the performance; approved methods and procedures eg dynamometer tests, oil sampling; failure cause and effect; importance of accurate data collection

Data interpretation: comparison of analysis against the product specification and identify any deviations; determination of implications of the findings; presentation of findings

3 Understand how to inspect and test land-based machinery and equipment

Methods used: logical elimination; simulation; comparison; isolation of components; comparing results against manufacturer's specification

Equipment: specialist equipment eg multi-meter, emission testers, flow meters, manufacturers' diagnostic testing equipment, voltmeters, pressure testers, dynamometers, oscilloscopes

Reporting: analysis; interpretation; presentation; methods of reporting; appropriate reporting channels

4 Understand how to formulate and recommend actions

Actions following inspection and testing: repair, modify, update, substitution, impound, beyond economic repair, service, pass/fail, unsafe; recognition of operator training to avoid reoccurrence of failures

Implications: warranty, cost effectiveness, integrity of repair, insurance considerations, timescale, health and safety, impact on dealership operations, impact on customer operations

Repair classification: warranty, insurance claim, forced breakage, lack of maintenance, unauthorised intervention, sabotage/vandalism, overload, operator abuse, inappropriate usage

Regulation and standards: industry standards; manufacturers' guidelines; current, relevant legislation and codes of practice eg Health and Safety at Work Act 1974; Provision and Use of Work Equipment Regulations 1998 (PUWER); Control of Substances Hazardous to Health (COSHH); Federation of European Producers of Abrasives (FEPA) documents and standards, Reporting Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR); Portable Appliance Testing (PAT); manufacturers' instructions

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 establish the objectives of the inspection or test [IE]	M1 explain the operations carried out	D1 justify the testing carried out identifying alternatives where relevant to verify the results
P2 observe and record information to evaluate the condition, application and performance of equipment [IE, SM]		
P3 prepare and carry out test(s) [SM]		
P4 check that the data gathered is accurate and takes account of the test conditions [RL, SM]	M2 explain how data collected might be affected by test conditions	
P5 recognise the cause and effect of failure/s [IE]		
P6 analyse the data using approved methods and procedures [IE,CT]		
P7 present findings and recommendations [RL]		

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:
P8 describe methods used to investigate intermittent faults [RL]	M3 explain methods used to determine faults and establish conformity for given situations	D2 verify test and inspection data to end user.
P9 describe the causes and symptoms of malfunction [RL]		
P10 describe the methods, diagnostic and specialist equipment used to establish conformity with manufacturer's/technical/legislation requirements [RL]		
P11 describe the difference between a characteristic and a malfunction [RL]		
P12 describe actions that could be considered following inspection and testing and their implications [RL]		
P13 explain how to recognise the need for operator training requirements to avoid reoccurrence of failures. [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.

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 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 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 agricultural equipment 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.

Whichever delivery methods are used, it is essential that tutors stress the importance of sound environmental management.

Learners will be required to inspect and test machinery and equipment and analyse the findings. Tutor should encourage learners to use a variety of testing methods and this can be delivered as individual practical sessions. Health and safety within the workshop must be paramount at all times.

Learners must also understand the methods used to test machinery and equipment and how to formulate and recommend actions. This is likely to be delivered through formal lectures, discussion, possible site visits, demonstrations and supervised practical sessions and independent learner research.

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 and assessment instruments learners are 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 – reasons for Inspection and testing.
Theory Session – settings and base reference points; outside influences.
Workshop session and demonstration – initial inspection; testing and diagnostic equipment.

Topic and suggested assignments/activities and/assessment

Assignment 1: Land-based Equipment Practical Testing (P1, P2, P3, P4, P5, P6, P7, P8, M1, M2)

Tutor introduces assignment brief.

Theory session- sources of information- inspection criteria.

Assignment 2: Reporting Test Results (P9, P10, P11, P12, P13, M3, D1, D2)

Tutor introduces assignment brief.

Workshop session – inspection and testing.

Theory Session – regulations and standards; health and safety, risk assessment.

Theory session – data analysis.

Practical Workshop – data analysis and interpretation.

Theory session – classification of repair and legislation.

Theory session – formulating actions and recommendations.

Theory and workshop session – presentation of results.

Assignment and self-study time.

Unit review.

Assessment

For P1, learners must establish the objectives of inspection or testing in three given activities. Tutors should identify the activities 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 for this could take the form of work sheets/written reports and/or verbal reporting.

P2, P3 and P4 cover the inspection and testing for given machinery and equipment. Learners must cover a minimum of three items of machinery or equipment. Wherever possible, each machine or piece of equipment should have a different problem so that learners carry out different test procedures. Appropriate risk assessment must be undertaken before any practical activities.

Learners could be assessed directly by the tutor whilst undertaking 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 placement, witness statements should be provided by a suitable representative and verified by the tutor.

P5, P6 and P7 cover the analysis and interpretation of findings from the practical inspection and testing and could be assessed as in P2, P3 and P4. 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 P8, P9, P10, and P11 learners must describe the methods used in inspection and testing and the presentation of results. These could be assessed in the same manner as for P5, P6 and P7. Evidence might be a project that links to M3.

P12 and P13 cover actions and other considerations related to inspection and testing. These could be assessed in the same way as for P5, P6 and P7. Evidence could be in the form of a project linking to P8 and M4.

For M1, learners must explain recognised testing procedures to analyse results. 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 form of a project or presentation, or collected orally during practical sessions using an appropriate record.

For M2, learners must explain how data might be affected by test conditions and why it needs to be collected accurately. Evidence might be collected during practical sessions using observation records or as part of a project or presentation.

For M3 and M4, learners need to explain the methods used and the importance of operator training. Evidence could be in the form of a project that links to M1 and M2.

For D1, learners must justify the testing carried out and discuss alternative testing to verify results, perhaps from practical activities. This could be assessed using a presentation or through a findings report.

For D2, learners must confirm test and inspection data and report it to the end user. The assessment could take the form of an assignment, findings report or presentation using appropriate software.

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, P5, P6, P7, P8, M1, M2	Land-based Equipment Practical Testing	You are employed in an agricultural engineering workshop and three different items of equipment have been brought in as their operator/owner does not think they are working properly. You are required to identify possible problems and carry out tests, recording the results to identify the cause.	Written work sheets. Recorded practical observations.
P9, P10, P11, P12, P13, M3, D1, D2	Reporting Test Results	Produce a report for your line manager and the operator/owner summarising the available testing procedures and identifying the tasks carried out and conclusions, including any training needs.	Written report. Presentation to peers.

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
Land-based Engineering Operations – Understand How to Use, Service and Maintain Tools and Equipment	LEO30 Inspect and Test Land-based Equipment
	Understanding and Working with Land-based Vehicle Engine Technology

Essential resources

Learners will need access to a range of machinery and equipment, simulation equipment to support practical investigation and sufficient test and repair equipment and materials to enable accurate evaluation of 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 land-based machinery and equipment 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

HSE – *Essentials of Health and Safety at Work* (HSE Books, 2006) ISBN 0717661792

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

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	establishing the objectives of the inspection or test observing and recording information analysing the data using approved methods and procedures recognising the cause and effect of failure(s)
Creative thinkers	Analysing the data using approved methods and procedures
Reflective learners	checking that collected data is accurate explaining how to recognise the need for operator training presenting findings and recommendations describing methods used to investigate intermittent faults
Self-managers	preparing and carrying out test procedures on machinery and equipment observing and recording information checking that gathered data is accurate.

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	working in teams to inspect machinery and equipment
Effective participators	participating in group discussions relating to machine and equipment testing.

● Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	using manufacturers' information and data sheets for diagnostic testing and inspection
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records 	reporting on test results and justifying the testing carried out presenting findings and recommendations
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	reporting on test results and justifying the testing carried out presenting findings and recommendations
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	establishing the objectives of the inspection or test reporting on test results and justifying the testing carried out
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	Using manufacturers' information and data sheets for diagnostic testing and inspection
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	reporting on test results and justifying the testing carried out and identifying alternatives where relevant presenting findings and recommendations.