Unit 10: Maintain Electronic Control and Monitoring Systems on Land-based Equipment

Unit code: M/600/3439

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 maintain electronic control and monitoring systems on land based equipment. This unit also aims to introduce learners to 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 agricultural tractors and equipment has led to ever more complicated electronic control and monitoring systems. Sophisticated reliable and effective electronic control and monitoring systems have been developed. Workers employed in maintenance, fault diagnosis and repair of land-based electronic control and monitoring systems must have the knowledge and skills necessary to undertake complex activities to repair electronic control and monitoring systems.

This unit explores the function and operation of electronic control and monitoring systems' assemblies and components. Improved efficiency of the land-based equipment and components will be identified and health and safety issues encountered when carrying out service and repair activities will be considered.

Learners will consider the function, operation and maintenance of land-based electronic control and monitoring systems.

Learning outcomes

On completion of this unit a learner should:

1 Be able to maintain electronic control and monitoring systems

2 Understand how to maintain electronic control and monitoring systems.

Unit content

1 Be able to maintain electronic control and monitoring systems

Systems and components: identification and location of electronic control and monitoring systems eg position control, draft control, velocity, temperature, level, mass, flow, rev/min, sequences of operation; identification and location of components eg position, force, pressure, proximity, displacement, velocity, vibration, shock, temperature, flow, strain RPM; preparation of systems to be tested; diagnostic testing to evaluate or rectify system performance (methods, tools, equipment); health and safety; risk assessment

Maintenance: electronic control systems and their components; confirmation of integrity

Initial settings/calibration: field settings; adjustments; health and safety

Calibration/adjustment of a typical system: eg position control sensor calibration; position control, level control, speed sensing, temperature control

Digital instruments: use of instruments eg multi-meter, oscilloscope, fault code readers, gas analysers

Fault diagnosis: common faults eg faults in power supply, sensor, transducer; malfunction indicator lamps; diagnostic trouble codes; manufacturers' recommended testing procedures; health and safety

2 Understand how to maintain electronic control and monitoring systems

Application and operation: applications eg engine management, transmission management, headland management, performance monitoring, closed circuit television monitoring, equipment instrumentation, driver information, suspension control, hydraulic control, pilot steering, global positioning service, multiplexing, telemetry, automatic guidance systems; establishment of parameters, calibration and verification of performance; retrieval and storage of information to meet manufacturers specifications; control and monitoring signals eg CAN bus, ISO bus, GPS/satellite; causes and effects of interference eg wireless, Pulse Width, Modulation PWM;

Components: function of components eg transistors, capacitors, regulators, resistors, transformers, thermisters, transducers, transmitters, actuators, electronic control units (ECU); types and methods of inhibiting external electronic influences eg screening, twisted pairs, grounding/earthing; methods used to check system integrity eg connections, wiring routes/fixings, grounding/earthing

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 identify and locate electronic control and monitoring systems and their components to retrieve and interpret stored information [TW, EP, SM]	**M1** collect and analyse test data to enable the condition of selected computer application and control components	**D1** recognise and review the results of a given incorrectly adjusted digital control system.
P2 establish parameters, calibrate and verify performance of the electronic control and monitoring systems		
P3 maintain electronic control and monitoring systems and their components to confirm integrity		
P4 prepare the system to be tested and carry out a diagnostic test using diagnostic tools and equipment to evaluate or rectify system performance		

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:**
P5 summarise electronic control and monitoring systems and their application [IE, CT, SM, RL]	**M2** evaluate the use of selected digital instruments for testing electronic control and monitoring systems.	
P6 summarise how control and monitoring signals are generated and communicated, and the causes and effects of interference [IE, CT, EP, SM, RL]		
P7 summarise the function of electronic components [IE, CT, SM, RL]		
P8 describe the tools and equipment used to test, repair and reinstate electronic control and monitoring systems and their components		
P9 describe the methods used to check and maintain system integrity		
P10 summarise how to retrieve, interpret, reinstate and verify information stored in electronic control units (ECU).		

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

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised computer application and control practicals, internet and/or library-based research and the use of personal and/or industrial experience would all be suitable.

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 prior to 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 electronic 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 and the techniques they use.

Whichever delivery methods are used, it is essential that tutors stress the impact computer application and control technologies have on the efficiency of the land-based equipment.

Health and safety issues relating to working in repair workshops must be stressed and regularly reinforced, and risk assessments must be undertaken prior to 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.

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 unit including safety introduction.
Assignment 1: Testing Control and Monitoring Systems (P1, P2, P3, P4, M1, D1)
Control and monitoring systems make up and function of components. Control and monitoring systems signal generation.
Assignment 2: Test Equipment and Testing Methodology (P8, P9, P10)
Information storage and interrogation methods.
Assignment 3: Control and Monitoring Systems (P5, P6, P7, M2)
Unit review.

Assessment

For P1, P2, P3 and P4 learners are required to demonstrate maintenance of electronic control and monitoring 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 tasks should be the same for all learners. Evidence should take the form of a practical assessment with notes and could include a pictorial presentation with notes (possibly using appropriate software or an overhead projector), or an annotated assignment.

For P5, P6 and P7 learners need to provide information on electronic control and monitoring systems. Learners should include information covering a minimum of two systems. Evidence could take the form of an assignment including a pictorial presentation with notes (possibly using appropriate software or an overhead projector).

For P8, P9 and P10 learners must describe the tools and diagnostic equipment used to carry out information retrieval, tests and maintenance. Evidence could take the form of a report or question and answer session during practical activities.

For M1, learners are required to collect and analyse data from a minimum of two control and monitoring systems. Evidence could be in the same format as P5.

For M2, learners are required to evaluate the equipment used to test control and monitoring systems and to retrieve data. Evidence could be in the same format as P5.

For D1, learners need to provide a review of the results of given incorrectly adjusted digital control systems. The systems must have a minimum of two incorrect adjustments to be analysed. Evidence could be in the same format as P5.

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, D1	Testing Control and Monitoring Systems	Learners are required to carry out tests on two control and monitoring systems. Record and analyse results. Evaluate test equipment and recognise results of incorrect settings.	Practical assessment. Written assignment.
P8, P9, P10	Test Equipment and Testing Methodology	Learners are required to describe the tools and methods used to carry out the tests in assessment above and summarise the retrieval of information from the above systems.	Written assignment.
P5,P6, P7, M2	Identify control and monitoring systems and summarise their function, methods of signal generation and applications.	Learners are required to investigate control and monitoring systems, methods of signal generation and the function of components within the system.	Written assignment.

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	LEO 23 Service and Repair Electronic Control and Monitoring Systems on Land-based Equipment
Service and Repair Electrical systems on land-based equipment	Land based Engineering Operations – Service and Repair Engines and Components
	Inspect and Test Land-based Machinery and Equipment

Essential resources

Learners will need access to manufacturers' service and repair manuals for a range of land-based machines and equipment that utilises computer application and control systems. Learners should also have access to computer control systems and test equipment as well as be given the chance to relate this in its industrial setting. They should also have access to current equipment that utilises the type of system covered in this work.

Tutors delivering this unit should be familiar with digital technology and control 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 such as Mechanics and engineers, Manufacturers of agricultural machines, Manufacturers of engines. This will broaden their depth of knowledge and make the learning experience interesting and contextualised. This could be through either guest lecturers or off site visits to different establishments.

Indicative reading for learners

Textbooks

Crispin A – *Programmable Logic Controllers and Their Engineering Applications, 2nd Edition* (McGraw-Hill Education, 1996) ISBN 0077093178

Incorporated Analog Devices – *Transducer Interfacing Handbook: A Guide to Analog Signal Conditioning* (Analog Devices Inc, 1980) ISBN 0916550052

Journals

Farmers Guardian

Farmers Weekly

Profi International

Website

www.howstuffworks.com HowStuffWorks

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	investigating control and monitoring systems
Creative thinkers	analysing data from testing monitoring and control systems
Reflective learners	evaluating tests and testing equipment for monitoring and control systems
Team workers	carrying out tests on monitoring and control systems
Self-managers	delivering assessment materials to deadlines
Effective participators	feedback on test results to tutor and peer group.

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	testing monitoring and control systems Interrogating on board data storage producing assessments
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	assessment tasks for control and monitoring systems
Manage information storage to enable efficient retrieval	interrogating on board data storage
Follow and understand the need for safety and security practices	testing monitoring and control systems
Troubleshoot	diagnosis and rectification of faults in control and monitoring systems
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	investigating control and monitoring systems
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	investigating control and monitoring systems
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	delivering assessment material.
Bring together information to suit content and purpose	delivering assessment material.
Present information in ways that are fit for purpose and audience	delivering assessment material.
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	presenting results of tests on monitoring and control systems

Skill	When learners are ...
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	presenting results of tests on monitoring and control systems
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	investigating control and monitoring systems
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	delivering assessment material.