Unit 13: Vehicle Electronic Ancillary and Information Systems

NQF Level 3: BTEC National

Guided learning hours: 60

Unit abstract

Significant technological developments within the motor vehicle industry have resulted in modern vehicles being equipped with a vast array of additional ancillary and information systems. From anti-lock braking systems (ABS) and stability control, to condition monitoring computers and satellite navigation, these systems contribute to the overall safety and comfort of the vehicle's occupants.

This unit will enable learners to understand the operating principles and constructional details of vehicle electronic ancillary and information systems. Through practical investigation, learners will gain an understanding of the function of these systems and their key components. The unit will also focus on the ways in which ancillary and information systems interrelate with each other and how they interact with a vehicle's driver or passengers.

Learners will carry out inspections on different vehicle ancillary and information systems in order to confirm their correct operation and system integrity.

Learning outcomes

On completion of this unit a learner should:

1 Understand the operating principles and characteristics of vehicle electronic ancillary and information systems

2 Know about the function of key units and components of vehicle electronic ancillary and information systems

3 Understand the interrelationships and interaction of vehicle electronic ancillary and information systems

4 Be able to carry out practical investigations into vehicle electronic ancillary and information systems.

Unit content

1 **Understand the operating principles and characteristics of vehicle electronic ancillary and information systems**

Systems model: use of systems model (input — process — output); characteristics of control strategies employed eg open-loop, closed-loop

Operating principles and characteristics: control systems eg analogue, digital, programmable, non-programmable; main elements of a digital processing system and principal functions eg central processing unit (CPU), memory devices (such as volatile, non-volatile), buses, input/output ports, multiplexing, controller area network (CAN) systems; characteristics eg purpose and applications of the system, operating conditions (such as conditions in which the system is operative or inoperative, 'fail-safe' features), system evaluation to identify benefits, comparative cost, performance, safety, convenience, efficiency

Vehicle electronic ancillary and information systems: electronic ancillary systems eg anti-lock braking systems (ABS), vehicle stability control systems, security and alarm systems, central body electronic systems (such as seat positioning, seat belt tensioning, secondary restraint systems, cargo/cabin compartment climate control); information systems eg driver information (condition monitoring and trip computers), navigation — global positioning system (GPS), communication systems, entertainment systems, proximity (reversing) sensors and road positioning

Operating principles of sensors and actuators: transducers used in vehicle ancillary and information systems eg electromagnetic, Hall-effect, photoelectric, resistive, inductive, capacitive; factors affecting performance and application eg sensitivity, accuracy, linearity and stability; influence of environmental factors eg heat, vibration, moisture, contaminants

2 **Know about the function of key units and components of vehicle electronic ancillary and information systems**

Key units and components of vehicle ancillary systems: functions (input data eg temperature, speed, position; process data eg mapping to input; output data eg electronic/mechanical actuation); key units and components eg sensors (such as temperature, speed, position), processors (such as ABS, electronic climate control unit) actuators (such as resistive, switches, inductive, capacitive, direct current (DC) motors, stepper motors when used for throttle poisoning or ventilation control), solenoids when used on ABS, air conditioning or for multi-position; legal considerations eg modifications to vehicle specification that may affect sensor/system performance (such as fitment of larger wheels/tyres affect on speedometer accuracy, fitment of passenger airbag isolation switches)

Key units and components of vehicle information systems: functions (input data eg temperature, speed, position, levels, electrical values; process data; visual output eg lights, display screen, gauges; audible output eg buzzer, speaker); key units and components (sensors eg temperature, fluid level, speed, GPS; processors eg satellite navigation, on-board diagnostics when used as comfort computing; output units eg display screen, speakers, buzzers, gauges, lights); legal considerations eg fitment of radar detectors

3 **Understand the interrelationships and interaction of vehicle electronic ancillary and information systems**

Interfacing and signal processing: compatibility between components and systems; characteristics of devices which give rise to the need for signal processing (inductive pick-ups, analogue to digital (AD), digital to analogue (DA)); control of output devices eg energy transfer, power output stages, buffer circuits

Representation methods: circuit type eg electrical, electronic, hydraulic, pneumatic; connections; diagrams eg circuit, flow, block, systems

Functional interrelationships: location eg units and components within the vehicle, position/location of components relative to others in the system; functional relationships between the elements of the system; effects eg failures on other components within the system, the operation of the system and on external systems (such as effect of speed sensor failure)

System interaction: ways in which the system under consideration interacts with other vehicle systems and functions eg integration of anti-lock braking and stability control (anti-skid), systems, stability control system obtains information from the steering system, ABS system components interacts with the braking and engine control systems

Driver/passenger interaction: driver/passenger influence on the operation and characteristics of the system (such as seat pad recognition); effects of the system on the driver's/passengers' behaviour, comfort and safety (such as temperature effect on stress levels)

Vehicle interaction: ways in which the system affects the vehicle in relation to other vehicles eg proximity detection; external factors influencing the operation/function of the system eg satellite navigation, ground positioning systems

4 **Be able to carry out practical investigations into vehicle electronic ancillary and information systems**

Inspections: location of systems and key components; means of identification; testing and diagnostic procedures as appropriate to the system under consideration

Safety: relating to the operation, inspection, maintenance and testing of the system

Practical confirmation of system operation and characteristics: observation of the system in operation; examination of system responses to external conditions as appropriate to the system under consideration

Testing considerations: factors affecting performance/reliability and application eg sensitivity, accuracy, linearity and stability; influence of environmental factors eg heat, vibration, moisture, contaminants

Grading grid

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all of the learning outcomes for the unit. The criteria for a pass grade describes the level of achievement required to pass this unit.

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 use a systems model to help explain the operating principles and characteristics associated with vehicle electronic ancillary and information systems P2 describe the operating principles of sensors and actuators P3 describe the functions of the key units and components of two vehicle ancillary systems, including legal considerations P4 describe the functions of key units and components of two vehicle information systems, including legal considerations P5 describe interfacing and signal processing in ancillary and information systems	M1 explain how the malfunction of key units and components can influence the operation of a vehicle electronic ancillary and information system M2 select a vehicle application of vehicle ancillary and information systems and describe specific benefits of the interaction of the systems.	D1 compare the selection of two different sensors, with respect to position and environment control D2 analyse characteristics of two vehicle electronic ancillary and information systems in terms of function, performance, safety and cost.

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:**
P6 use representational methods to help describe the functional interrelationship and interaction between systems P7 explain driver/passenger and vehicle interactions for one ancillary and one information system P8 carry out inspections, in a safe manner, to confirm system operation and integrity on one ancillary and one information system P9 identify the testing considerations to make when carrying out a practical investigation into vehicle electronic ancillary and information systems.		

Essential guidance for tutors

Delivery

Delivery of this unit should be designed to give learners an understanding of the operating principles and characteristics of vehicle electronic ancillary and information systems. This should then progress on to a representative selection of the electronic ancillary and information systems found in current vehicles.

Detailed investigation (including function/operation at component level) is likely to only be possible for a limited number of systems (eg ABS, central body systems). For more complex systems a 'black-box' approach (with the emphasis on functions) will be more appropriate (eg GPS navigation systems).

A balance of theoretical study and practical investigation is likely to provide maximum opportunity for learners to understand systems of this complexity. Videos, simulations and rigs will be effective aids to learning, since 'live' demonstration of the operation of some of the systems (eg vehicle stability control) could be impractical. Practical application/investigation should reflect industry processes and procedures and should be linked to other units wherever possible.

The learning outcomes are ordered in a logical way and could therefore be delivered sequentially. Learning outcome 4 requires practical investigation and as such learners will need the underpinning knowledge and understanding obtained through studying learning outcomes 1, 2 and 3 beforehand.

Note that the use of 'eg' in the content is to give an indication and illustration of the breadth and depth of the area or topic. As such, not all content that follows an 'eg' needs to be taught or assessed.

Assessment

This unit could be assessed using three assignments.

The first assignment could cover P1, P2, P3, the ancillary part of M1 and D1. Learners will need to generate evidence of using a systems model to explain both the operating principles and characteristics (P1) and application of two ancillary systems (P3). Learners will also need to describe the operating principles of sensors and actuators (P2) relating to the ancillary systems described, comparing different sensors in respect of position and environment (D1). This could be combined with a task for attaining the part of M1 explaining ancillary system malfunction. All evidence for this first assignment is likely to be in written form and may include diagrams and sketches.

The second assignment could cover P4, P5, P6 and P7. Learners would need to describe the key units and components of two vehicle information systems (P4). To meet P5 the description of interfacing and signal processing should include compatibility, inductive pick-ups, analogue to digital and digital to analogue, and control of output devices. The inclusion of an appropriate circuit diagram for each system would meet P6 and would need to include the description of functional interrelationship and interaction of systems.

Learners could then be asked to explain driver/passenger and vehicle interactions. Further tasks could be set to extend to the information system element of M1, M2 and D2.

The third assignment will need to be based on practical sessions with learners carrying out inspections on both ancillary and information systems (P8) to industry standards. A written task could ask learners to identify testing considerations for both types of system (P9).

Evidence should include notes, diagrams, test data, and records of the maintenance and diagnostic procedures carried out. Witness statements/observation records, supplemented by annotated photographs, could also form part of the evidence for these practical elements.

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

This unit provides some of the knowledge and understanding for the Automotive Skills National Occupational Standards in Vehicle Maintenance and Repair, particularly:

- Unit MR3: Remove and Replace Electrical Auxiliary Units and Components.

The unit supports, and is supported by *Unit 1: Operation of Vehicle Systems*, *Unit 6: Vehicle Electrical and Electronic Principles* and *Unit 7: Engine Electrical Charging and Starting Systems*.

It also provides an opportunity for learners to develop further the knowledge and understanding gained from *Unit 3: Vehicle Fault Diagnosis and Rectification*.

Essential resources

A range of components, vehicles and equipment will be required for practical investigation, along with an accompanying variety of data sources.

Indicative reading for learners

Textbooks

Denton T — *Automobile Electrical and Electronic Systems* (Butterworth-Heinemann, 2004) ISBN 0750662190

Hillier V A W — *Hillier's Fundamentals of Automotive Electronics* (Nelson Thornes, 1997) ISBN 0748726950

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of Level 3 key skill evidence are given here. Tutors should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Communication Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• using a systems model to explain the operating principles and characteristics associated with vehicle electronic ancillary and information systems • describing the operating principles of sensors and actuators • describing the function of key units and components of vehicle ancillary and information systems, including legal considerations • using representational methods to describe the functional interrelationship and interaction between systems • explaining driver/passenger and vehicle interactions.	C3.3 Write **two** different types of documents about complex subjects. One piece of writing should be an extended document and include at least one image.
Problem solving Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• carrying out inspections in a safe manner to confirm system operation and integrity ancillary and information systems.	PS3.2 Plan and implement at least **one** option for solving the problem, review progress and revise your approach as necessary. PS3.3 Apply agreed methods to check if the problem has been solved, describe the results and review your approach to problem solving.