



Australian Government

AURETH114 Diagnose complex faults in hybrid and battery electric vehicle network management systems

Release: 1

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Modification History

Release	Comments
Release 1	This version first released with AUR Automotive Retail, Service and Repair Training Package Version 6.0

Application

This unit describes the skills and knowledge required to diagnose complex faults in hybrid, plug-in hybrid and battery electric vehicle (HEV, PHEV and BEV) network management systems and determine the repair action necessary to restore system performance. The systems used vary based on the work context. It involves confirming the existence of a fault, developing a diagnostic testing strategy, diagnosing the cause of the fault, reporting conclusions and making repair recommendations. Importance is placed in the unit on applying electrical safety procedures when working on high voltage (HV) rechargeable energy storage systems (RESS). Complex faults are outside the normal scope of a technician's diagnosis and repair work. They include intermittent faults, multi-system faults, faults introduced as a result of system repairs, and indirect faults caused by the influence of external systems, requiring the application of complex diagnostic processes to resolve.

The unit applies to those who work in the automotive service and repair industry.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Unit Sector

Electrical Technical – Hybrid Vehicle and Battery Vehicle

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Identify and confirm the work requirement	1.1 Identify job requirements from workplace instructions. 1.2 Confirm nature of fault according to workplace procedures 1.3 Identify hazards and environmental issues associated with diagnose and repair activity, assess potential risks and implement

ELEMENT	PERFORMANCE CRITERIA
	control measures in line with workplace policies and procedures
2. Prepare to diagnose complex faults	2.1 Identify required information for diagnosis activity 2.2 Analyse diagnostic options and develop testing strategy, including diagnostic method sequence, tests and testing processes 2.3 Identify tools and equipment required for testing strategy and establish serviceability according to workplace procedures
3. Apply diagnostic procedures	3.1 Implement diagnostic tests set out in testing strategy according to manufacturer and workplace procedures, and workplace health and safety requirements 3.2 Verify and report diagnostic findings using reliable alternative process according to manufacturer specifications and workplace procedures 3.3 Develop and report recommendations for necessary repairs according to workplace procedures 3.4 Communicate findings to workplace supervisor and customer and confirm next steps
4. Complete work processes	4.1 Conduct final inspection according to workplace procedures and confirm vehicle is ready for repair process or return to customer 4.2 Clear work area and dispose of or recycle materials according to workplace procedures 4.3 Complete documentation according to workplace procedures

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance but not explicit in the performance criteria.

SKILL	DESCRIPTION
Learning	- Locates required sources of information efficiently - Develops own approach to a task, including steps to confirm findings - Applies diagnostic skills to different vehicles or machinery.
Reading	Researches, organises and interprets technical information from manufacturer and workshop literature when seeking network management system specifications and procedures.
Oral communication	- Clarifies instructions - Obtains information from customers and supervisors.
Numeracy	Measures network management system components and uses mathematical operations to calculate tolerances and deviations

SKILL	DESCRIPTION
	from manufacturer specifications.
Planning and organising	Plans own work requirements and prioritise and sequence actions to achieve required outcomes and ensure tasks are completed within workplace timeframes.
Technology	Uses specialised diagnostic equipment.

Unit Mapping Information

Supersedes and is equivalent to AURETH014 Diagnose complex faults in hybrid and battery electric vehicle network management systems.

Links

Companion Volume Implementation Guide is found on VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b4278d82-d487-4070-a8c4-78045ec695b1>

Assessment Requirements for AURETH114 Diagnose complex faults in hybrid and battery electric vehicle network management systems

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Performance Evidence

The candidate must demonstrate the ability to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including evidence of the ability to:

- diagnose complex faults in the embedded network management systems of:
 - at least one battery electric vehicle (BEV)
 - at least one hybrid electric vehicle (HEV) or one plug-in hybrid electric vehicle (PHEV)
- develop a testing strategy to diagnose the cause of at least two of the following complex faults, each present in one of the above vehicles:
 - an intermittent fault
 - a fault that affects more than one system
 - a fault introduced as a result of a system repair
 - an indirect fault caused by the influence of external systems.

Knowledge Evidence

The candidate must be able to demonstrate knowledge to complete the tasks outlined in the elements, performance criteria and foundation skills of this unit, including knowledge of:

- methods to locate and interpret information required to diagnose and repair complex faults in hybrid and battery electric vehicle network management systems, including:
 - hybrid and battery electric vehicle network management systems system manufacturer specifications
- workplace procedures required to diagnose and repair complex faults in hybrid and battery electric vehicle network management systems, including:
 - establishing the serviceability of tools and equipment
 - documentation procedures
 - housekeeping procedures, including:
 - examination of tools and equipment

- storage of equipment
- identification, tagging and isolation of faulty equipment
- safe disposal of materials
- recycling procedures
- workplace health and safety (WHS) requirements relating to diagnosing complex faults in hybrid and battery electric vehicle network management systems, including procedures for:
 - identifying hazards and controlling risks associated with:
 - working with high voltages on vehicle electrical systems
 - working with hazardous materials and toxic substances
 - wearing jewellery while working around high electrical currents
 - minimising risk, including:
 - analysing task to define risk
 - applying electrical safety precautions, including one hand rule, live system warning tags and signs, depowering the vehicle, isolating the high voltage (HV) rechargeable energy storage system (RESS) electrical supply, and stabilising the vehicle electrical system
 - using personal protective equipment (PPE), including electrical safety gloves with 1000 volt rating and Australian standards rated HV insulating mat
 - identifying and using fire safety equipment
 - lifting and moving the RESS using safe manual handling techniques
 - using workplace first aid equipment
- environmental requirements relating to hybrid and battery electric vehicle network management systems
- types of complex faults relating to hybrid and battery electric vehicle network management systems, including:
 - intermittent
 - multi-system
 - introduced as a result of system repair
 - indirect, caused by the influence of external systems
- operating principles of network management systems and data multiplexing in HEVs, PHEVs and BEVs
- key features of hybrid and battery electric vehicle network management systems, including:
 - direct current (DC) electric motor types, including:
 - separately excited motors
 - permanent magnet motors
 - alternating current (AC) electric motor types, including:
 - induction motors
 - brushless motors
 - motor controllers, including:
 - variable pulse width DC types

- variable frequency, variable amplitude AC types
- inverters and converters, including:
 - AC to DC
 - DC to AC
- batteries, including:
 - lead acid batteries
 - nickel metal hydride batteries
 - lithium ion batteries
 - ultra capacitors and super capacitors
- parallel hybrid electric vehicles
- series hybrid electric vehicles
- power split hybrid electric vehicles
- testing procedures for hybrid and battery electric vehicle network management systems, including:
 - vehicle dynamic and static testing
 - abnormal noise analysis
 - component failure analysis
 - vehicle continuous and non-continuous monitored systems
- key features and limitations of diagnostic testing equipment required to diagnose complex faults relating to hybrid and battery electric vehicle network management systems
- procedures for accessing and interpreting scan tool system data, including:
 - diagnostic trouble codes (DTCs), including:
 - conditions that set the DTCs
 - conditions for running DTCs
 - live data.

Assessment Conditions

Competency is to be assessed in the workplace or a simulated environment that accurately reflects performance in a real workplace setting.

Assessment must include direct observation of tasks.

Where assessment of competency includes third-party evidence, individuals must provide evidence that links them to the HEV, PHEV and BEV network management systems that they have worked on, e.g. repair orders.

Assessors must verify performance evidence through questioning on skills and knowledge to ensure correct interpretation and application.

The following resources must be made available:

- automotive repair workplace or simulated workplace
- workplace instructions
- AS 5732 Electric vehicle operations: Maintenance and repair

- manufacturer HEV, PHEV and BEV network management system specifications
- one BEV and one HEV or PHEV with complex network management system faults
- BEV, HEV and PHEV network management system diagnostic equipment, including:
 - digital multimeter
 - scan tool
 - oscilloscope
 - specialist BEV, PHEV and HEV tools and equipment as specified in original equipment manufacturer requirements
- tools, equipment and materials appropriate for diagnosing complex faults in HEV, PHEV and BEV network management systems.

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards.

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