



Australian Government

AURETH016 Diagnose and repair complex faults in battery electric vehicle powertrains

Release: 1

AURETH016 Diagnose and repair complex faults in battery electric vehicle powertrains

Modification History

Release	Comments
Release 1	This version first released with the Automotive Retail, Service and Repair Training Package Version 7.0. Newly created unit.

Application

This unit describes the skills and knowledge required to diagnose and repair complex faults in battery electric vehicle (BEV) powertrains. It involves confirming the existence of a fault, developing a diagnostic testing strategy, diagnosing the cause of fault, carrying out the repair, performing post-repair testing and completing workplace processes and documentation.

It applies to the skills and knowledge required of individuals who work in the automotive service and repair industry and apply battery electric vehicle safety procedures.

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

Pre-requisite Unit

AURETH101 Depower and reinitialise battery electric vehicles

Unit Sector

Electric Technical – Hybrid Vehicle and Battery Electric 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. Prepare to diagnose and repair complex faults in battery electric vehicle powertrains	1.1 Identify job requirements from workplace instructions 1.2 Identify information required for diagnostic activity from customers and supervisors 1.3 Assess diagnostic options, source testing strategy and identify cause of fault according to workplace and

	manufacturer procedures 1.4 Identify hazards and environmental issues associated with diagnostic and repair activity, assess potential risks and implement control measures according to workplace policies and procedures 1.5 Identify tools and equipment required for testing strategy and establish serviceability according to workplace procedures
2. Diagnose complex faults in battery electric vehicle powertrains	2.1 Implement diagnostic tests according to testing strategy, manufacturer and workplace procedures, and workplace health and safety requirements 2.2 Analyse diagnostic test results and identify cause of fault 2.3 Confirm and report cause of fault according to workplace procedures 2.4 Develop and report recommendations for necessary repairs according to workplace procedures
3. Repair complex faults in battery electric vehicle powertrains	3.1 Identify information required for repair activity 3.2 Identify tools, equipment and materials required for repair activity and establish serviceability according to workplace procedures 3.3 Isolate rechargeable energy storage system (RESS) service plug or manual service disconnect and depower vehicle high voltage (HV) RESS according to manufacturer specifications 3.4 Carry out repairs according to workplace and manufacturer procedures, manufacturer specifications, workplace health and safety and environmental requirements 3.5 Reconnect RESS service plug or manual service disconnect and repower vehicle HV RESS 3.6 Carry out post-repair testing according to workplace and manufacturer procedures, workplace health and safety and environmental requirements
4. Complete work processes	4.1 Conduct final inspection according to workplace procedures and confirm vehicle is ready for use 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	efficiently locates required sources of information
Numeracy	- matches electrical components and part identification numbers to workplace instructions, vehicle, machinery and component part lists, and manufacturer specifications - interprets vehicle electrical measurements and readings - measures voltage, current and resistance and uses mathematical operations - calculates deviations from manufacturer specifications
Reading	- organises and interprets technical information from workplace procedures, manufacturer procedures and manufacturer specifications - interprets text, symbols and wiring diagrams in information relating to electrical system testing and repair equipment from manufacturer specifications and workplace instructions and procedures
Writing	legibly and accurately fills out workplace documentation when reporting work performed and recording parts and material used
Oral communication	clarifies instructions
Planning and organising	- plans own work requirements - prioritises actions to achieve required outcomes - ensures tasks are completed within workplace timeframes
Technology	uses specialised diagnostic equipment

Unit Mapping Information

Newly created unit.

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 AURETH016 Diagnose and repair complex faults in battery electric vehicle powertrains

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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:

- safely depower a battery electric vehicle (BEV) in each of the following charging systems:
 - BEV with an AC charging system
 - BEV with a DC charging system
- diagnose at least one complex fault in a powertrain for the above
- carry out repair of faults identified from diagnostic tests during the above for at least one of the following faults:
 - insulation faults in high voltage (HV) cables of the traction motor
 - HV component faults
 - low voltage (LV) interlock fault
 - traction motor noise fault
 - traction motor sensor fault

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 vehicle complex faults in BEV powertrains, including:
 - manufacturer specific procedures
 - Australian Standards (AS) 5732 Electric vehicle operations - Maintenance and repair
- workplace procedures and work health and safety (WHS) requirements relating to diagnosing and repairing BEV powertrains, including:
 - documentation procedures
 - housekeeping procedures, including:

- examination and storage of tools and equipment
- identification, tagging and isolation of faulty equipment
- safe disposal and recycling of materials
- using personal protective equipment (PPE)
- using of fire safety equipment
- identifying hazards and controlling risks associated with:
 - working on vehicle high voltages on vehicle electrical systems
 - wearing jewellery while working around high current wiring systems
- safe manual handling techniques, including those for lifting and moving high voltage (HV) rechargeable energy storage systems
- procedures for minimising risks associated with hazards, including applying electrical safety precautions when:
 - using personal protective equipment (PPE), including electrical safety gloves with 1000 volt rating and Australian standards rated HV insulating mat
 - identifying and using firefighting equipment
 - using the one hand rule
 - following live system warning tags and signs
 - depowering vehicle
 - isolating HV Rechargeable Energy Storage System (RESS) electrical supply
 - stabilising vehicle electrical system
- operating principles of BEV components, including:
 - AC power
 - induction motors
 - driver invertors
 - AC/DC and DC/DC power conversion
 - AC and DC charging systems
 - electric braking systems
 - HV battery components and architecture, including state of charge (SOC) and internal component monitoring
 - HV battery management systems
 - HV battery discharge procedures
 - HV system precharge concepts
 - driver assist systems for BEVs
 - infotainment systems in BEV
 - safety interlocks
 - short circuit monitoring
 - open circuit monitoring
 - onboard charging and communication protocols
- diagnostic testing procedures for high voltage traction motors in BEVs, including procedures for:
 - accessing and interpreting scan tool system data, including:

- diagnostic trouble codes (DTCs)
- live data
- freeze frame data
- using diagnostic flow charts
- testing the electrical system, including:
 - accessing electrical terminals and using test probes without damaging connectors, fuse holders or wiring
 - determining damage to traction motor
 - windings
 - checking insulation resistance of traction motor windings
 - checking routing and damage to HV cabling
 - conducting vehicle dynamic and static tests
 - analysing abnormal noise
 - analysing component failure
- repair procedures for battery electric vehicle powertrains, including:
 - removing and replacing damaged components
 - removing and replacing the powertrain
- post repair procedures for battery electric vehicle powertrains, including:
 - DTC clearing procedures
 - checking for electrical connector mating static and dynamic performance tests of powertrains.

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 diagnosis and repair of complex faults in battery electric vehicle powertrains, 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:

- workplace instructions
- PPE, including electrical safety gloves with 1000 volt rating and Australian standards rated HV insulating mat.
- AS 5732 Electric vehicle operations: Maintenance and repair
- manufacturer battery electric vehicle powertrain specifications
- BEVs with an AC and DC charging system and one complex powertrain fault in each BEV
- battery electric vehicle powertrain diagnostic equipment, including:

- digital multimeter with CAT III 1000 volt rating
- insulation tester
- scan tool
- oscilloscope
- residual voltage tester, if specified in original equipment manufacturer (OEM) test requirements
- tools, equipment and materials appropriate for diagnosing complex faults in battery electric vehicle powertrains

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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