



Australian Government

AURETHX09 Diagnose and repair DC to DC converters in battery electric vehicles

AURETHX09 Diagnose and repair DC to DC converters in battery electric vehicles

Modification History

Release	Comments
1	This unit of competency was first released in AUR Automotive Retail, Service and Repair Training Package Release 11.0.

Application

This unit describes the skills and knowledge required to diagnose and repair faults in the high voltage (HV) direct current (DC) to low voltage (LV) DC converters of battery electric vehicles (BEVs).

The unit involves preparing for the task, sourcing a diagnostic testing strategy, diagnosing the cause of the fault, depowering the high voltage RESS, carrying out the repair, reinitialising the vehicle, performing post-repair testing, and completing workplace processes and documentation.

The unit emphasises the safe application of electrical safety procedures when working on the high voltage RESS. This unit applies the same voltage definitions as Australian Standards (AS) 5732 Electric vehicle operations - Maintenance and repair.

The unit applies to those who work in the automotive service and repair industry and applies to vehicles fitted with a RESS and a high voltage to low voltage DC converter. Repair in this unit is at component replacement level and does not include board-level repair of DC to DC converters. Work is undertaken in line with manufacturer specifications and AS 5732.

Licensing/Regulatory Information

Licensing, legislative and certification requirements that apply to this unit can vary between States, Territories and industry sectors, and must be sourced from state jurisdictions prior to applying the unit.

Pre-requisite unit(s)

AURETHX01 Depower and reinitialise electric vehicles

AURETR125 Test, charge and replace batteries and jump-start vehicles

Competency field(s)

N/A

Unit sector(s)

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. Prepare to diagnose and repair DC to DC converters	1.1 Determine job requirements from workplace instructions 1.2 Access and interpret manufacturer procedures, workplace procedures and applicable standards required for the diagnosis activity 1.3 Analyse diagnostic options and source testing strategy to identify cause of fault using workplace and manufacturer procedures 1.4 Identify hazards and environmental issues associated with the diagnosis and repair activity, assess risks and implement control measures according to safety requirements, workplace policies and procedures, and AS 5732 1.5 Select tools, PPE and equipment required for the testing strategy and establish serviceability according to workplace procedures
2. Diagnose DC to DC converters	2.1 Implement diagnostic tests set out in testing strategy according to manufacturer and workplace procedures, and work health and safety requirements 2.2 Retrieve and interpret converter live data and fault codes, including data on the interaction between the converter and vehicle energy management systems, according to manufacturer procedures 2.3 Identify root cause of fault through analysis of diagnostic test results 2.4 Confirm and report root cause of fault according to workplace procedures 2.5 Identify any faults requiring work outside of job role or scope, and escalate according to workplace and manufacturer procedures 2.6 Develop and report recommendations for necessary repairs according to workplace procedures
3. Repair DC to DC converters	3.1 Access and interpret manufacturer procedures, workplace procedures and applicable standards required for the repair activity

	3.2 Select tools, PPE, equipment and materials required for the repair activity and establish serviceability according to workplace procedures 3.3 Isolate high voltage RESS using the isolation method specified in manufacturer procedures, and confirm system is depowered by verifying residual voltage is at or below the threshold according to manufacturer procedures and AS 5732 3.4 Secure isolation against accidental or unauthorised reactivation according to workplace and manufacturer procedures 3.5 Carry out repairs according to workplace and manufacturer procedures, manufacturer specifications, work health and safety and environmental requirements 3.6 Reinitialise vehicle according to manufacturer procedures 3.7 Carry out post-repair testing according to workplace procedures, work 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

Range of conditions

N/A

Assessment Requirements for AURETHX09 Diagnose and repair DC to DC converters in battery electric vehicles

Performance Evidence

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

- diagnose and repair the DC to DC converter and its system components on at least two battery electric vehicles, which may be of the same or of different vehicle types, to correct performance deficiencies

In the course of the above work, the candidate must:

- identify and apply manufacturer-specific information and procedures, WHS and AS 5732 requirements
- identify energy sources and isolate relevant circuits and equipment in accordance with WHS requirements and relevant standards
- select and use diagnostic and test equipment appropriate to the task and the vehicle
- retrieve and interpret converter live data and diagnostic trouble codes (DTCs)
- measure converter voltage input and output, compare measured values with manufacturer specifications, and identify and respond to abnormal readings
- carry out any coding, pairing or initialisation required after component replacement, according to manufacturer procedures
- confirm correct operation through post-repair testing
- complete workplace documentation.

Knowledge Evidence

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

- the requirements to diagnose and repair DC to DC converters in battery electric vehicles, including:
 - information provided by customers and supervisors
 - Australian Standards (AS) 5732 Electric vehicle operations - Maintenance and repair
 - manufacturer specifications and procedures
- workplace procedures required to diagnose and repair DC to DC converters in battery electric vehicles, including:
 - establishing 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
 - disposal of excess materials
 - recycling procedures
- limits of own job role and scope of work, and workplace procedures for escalating work outside that scope, including who to notify and the information to provide
- workplace health and safety (WHS) requirements relating to diagnosing and repairing DC to DC converters in battery electric vehicles, including procedures for:
 - determining appropriate procedures for minimising risk associated with hazards, including applying electrical safety precautions when:
 - establishing and controlling a high voltage isolation zone, including exclusion zones and arc flash boundaries
 - responding to an electric shock or high voltage incident, including first aid response and notifiable incident reporting requirements
- environmental requirements relating to diagnosing and repairing DC to DC converters in battery electric vehicles, including procedures for trapping, storing and disposing of waste produced during repair.
- safe operating procedures for tools and equipment, including:
 - digital multimeter and other test equipment rated in accordance with manufacturer specifications and the applicable standard
 - insulation tester
 - residual voltage tester
 - scan tool
 - oscilloscope
- operating principles of DC to DC converters in battery electric vehicles, including:
 - step-down converters
 - step-up converters
 - continuous current mode
 - discontinuous current mode
 - signal noise, including radio frequency (RF) noise, input noise and output noise
- purpose and operation of DC to DC converters in battery electric vehicles, including:
 - linear converters
 - switched mode conversion

- magnetic converters
- capacitive converters
 - risks around capacitive systems
 - safe discharge processes of capacitive systems
- system communication and interaction between the DC to DC converter and vehicle energy management systems
- software diagnostics for DC to DC converters, including control module software versions and update procedures
- diagnostic testing procedures for DC to DC converters in battery electric vehicles, including procedures for:
 - accessing and interpreting scan tool system data, including:
 - DTCs
 - live data
 - using diagnostic flow charts
 - electrical system testing, including procedures for:
 - accessing electrical terminals and using test probes without damaging connectors, fuse holders or wiring
 - checking voltage input and output of DC to DC converters
 - checking routing and damage to cabling
- repair procedures for DC to DC converters in battery electric vehicles, including procedures for:
 - tightening connections
 - replacing faulty or damaged cable connections
 - removing and replacing faulty or damaged components
- post-repair testing procedures for DC to DC converters in battery electric vehicles, including procedures for:
 - DTC clearing procedures
 - manufacturer-required coding, pairing or initialisation procedures following replacement of instrument clusters or interlock modules
 - checking for electrical connector mating.

Assessment Conditions

Assessment must include direct observation by the assessor of the individual diagnosing and repairing DC to DC converters in a BEV.

Where assessment of competency includes third-party evidence, it must identify the individual and each vehicle by VIN, include BEV DC to DC converter repair information that they worked on, and be signed by a workplace supervisor competent in diagnosing and

repairing DC to DC converters in BEVs. Assessors must confirm its authenticity with the third party.

The following resources must be made available:

- workplace, or simulated workplace, appropriate to the vehicles being diagnosed and repaired
- PPE and safety equipment, including:
 - electrical safety gloves of an appropriate voltage rating, in accordance with AS 5732
 - arc-rated clothing and face protection,
 - an insulating mat
- manufacturer specifications and repair procedures for the DC to DC converters of the vehicles being diagnosed and repaired
- AS 5732 Electric vehicle operations: Maintenance and repair
- the vehicles specified in the performance evidence, with the DC to DC converters accessible for diagnostic and repair or replacement activities
- tools and equipment specified in the manufacturer service procedures for diagnosing and repairing the vehicle, including electrical diagnostic equipment:
 - digital multimeter and other test equipment rated in accordance with manufacturer specifications and the applicable standard
 - insulation tester
 - scan tool, or equivalent electronic isolation and diagnostic equipment
 - oscilloscope
 - residual voltage tester, if specified in original equipment manufacturer (OEM) test requirements
- materials appropriate for repairing DC to DC converters and their components.

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

Mandatory Workplace Requirements

Assessment of performance evidence may be in a workplace setting or an environment that accurately represents a real workplace.

Unit Mapping Information

Previous Code and Title	Equivalence	Comments
AURETH109 Diagnose and repair DC to DC converters in battery electric vehicles	Equivalent	

Links

Companion volumes, including implementation guides, are found on the national training register - <https://training.gov.au/training/details/AUR>.

DRAFT