



Australian Government

**AURETHX15 Diagnose, remove and
replace heavy electric vehicle rechargeable
energy storage systems**

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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, remove and replace high voltage (HV) rechargeable energy storage systems (RESS) in heavy electric vehicles.

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 removal and replacement, reinitialising the vehicle, performing post-replacement testing, and completing workplace processes and documentation.

The unit emphasises the safe application of electrical safety procedures when working on the high voltage RESS. The 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. 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

Competency field(s)

N/A

Unit sector(s)

Electrical 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, remove and replace heavy electric vehicle rechargeable energy storage systems	1.1 Determine job requirements from workplace instructions 1.2 Access and interpret manufacturer procedures, workplace procedures and applicable standards required for the diagnostic activity 1.3 Assess diagnostic options and source testing strategy according to workplace and manufacturer specifications 1.4 Identify hazards and environmental issues associated with the diagnostic, removal and replacement activity, assess risks and implement control measures according to safety requirements, workplace policies and procedures, and AS 5732 1.5 Select PPE, tools and equipment required for the testing strategy and establish serviceability according to workplace procedures
2. Diagnose heavy electric vehicle rechargeable energy storage systems	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 root cause of fault 2.3 Confirm and report root cause of fault according to workplace procedures 2.4 Develop and report recommendations for necessary removal and replacement according to workplace procedures
3. Remove and replace heavy electric vehicle rechargeable energy storage systems	3.1 Access and interpret manufacturer procedures, workplace procedures and applicable standards required for the removal and replacement activity 3.2 Select tools, equipment and materials required for the removal and replacement activity and establish serviceability according to workplace procedures 3.3 Depower vehicle high voltage system and secure the isolation according to manufacturer procedures 3.4 Identify potential stored energy sources and implement control measures

	3.5 Select lifting and handling equipment rated for the mass of the RESS and apply lifting and handling controls according to manufacturer specifications and workplace procedures 3.6 Carry out removal and replacement of high voltage RESS according to manufacturer specifications, workplace procedures, work health and safety and environmental requirements 3.7 Reinitialise vehicle according to manufacturer procedures 3.8 Carry out post-removal and replacement 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 or recycle materials according to workplace procedures 4.3 Complete documentation according to workplace procedures 4.4 Check tools and equipment are stored, and faulty equipment is identified, tagged and isolated according to workplace procedures

Range of conditions

N/A

Assessment Requirements for AURETHX15 Diagnose, remove and replace heavy electric vehicle rechargeable energy storage systems

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, remove and replace the high voltage (HV) rechargeable energy storage system (RESS) in at least two heavy electric vehicles, which may be of the same or of different vehicle types.

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

- depower and reinitialise each vehicle according to manufacturer procedures
- identify potential stored energy sources and implement control measures
- select and use lifting and handling equipment rated for the mass of the RESS, and apply lifting and handling controls, according to manufacturer specifications and workplace procedures
- retrieve and interpret RESS live data and fault codes
- select and use diagnostic and test equipment appropriate to the work and to the vehicle type
- confirm correct operation through post-replacement 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, remove and replace HV RESS in heavy vehicle BEVs, including information from:
 - customers and supervisors
 - Australian Standards (AS) 5732 Electric vehicle operations - Maintenance and repair
 - manufacturer specifications and procedures
- workplace procedures required to diagnose, remove and replace HV RESS in BEVs, including:
 - documentation procedures
 - housekeeping procedures, including those for:
 - examining and storing tools and equipment

- identifying, tagging and isolating faulty equipment
 - disposing and recycling of excess materials
- workplace health and safety requirements relating to diagnosing, removing and replacing HV RESS in BEVs, including procedures for:
 - 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, according to workplace emergency procedures, including evacuation, exclusion zone control and notifiable incident reporting requirements
 - using personal protective equipment (PPE), including arc-rated (CAL-rated) protective clothing of an appropriate rating
 - mechanical lifting and handling of the RESS, including:
 - determining the mass, dimensions and lifting points of the RESS from manufacturer specifications
 - selecting lifting, handling and support equipment rated for the load and specified in the manufacturer removal and replacement procedure
 - controlling the risks of a suspended or supported load, including exclusion zones and restrictions on working beneath the load
 - supporting, securing and transporting the RESS during removal, storage and refitting, including protection of the enclosure, terminals and cabling
- environmental requirements relating to diagnosing, removing and replacing HV RESS in BEVs, including procedures for trapping, storing and disposing of waste produced during activity
- safe operating procedures for electrical 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 HV RESS in BEVs, including:
 - battery pack construction, including:
 - battery types
 - battery internal resistance
 - battery pack system, including:

- charging characteristics
- open circuit cells
- short circuit cells
- series cell configuration
- methods of interconnecting cells and modules within a RESS pack, including busbars and welded or bolted straps
- physical arrangement of cells and modules within a RESS pack and its effect on thermal management and structural integrity
- purpose and operation of HV RESS in BEVs and components, including:
 - HV battery charger and direct current (DC) to DC converter
 - battery management system (BMS)
 - power distribution unit (PDU)
- diagnostic testing procedures for HV RESS in BEVs, including procedures for:
 - accessing and interpreting scan tool system data, including:
 - diagnostic trouble codes (DTCs)
 - live data
 - freeze frame data
 - waveforms
 - using diagnostic flow charts
- repair procedures for HV RESS in BEVs, including procedures for:
 - battery cell replacement
 - charging and discharging procedures
 - sensor replacement
 - battery management system or power distribution replacement
- electrical system testing, including procedures for:
 - accessing electrical terminals and using test probes without damaging connectors, fuse holders or wiring
 - vehicle dynamic and static testing procedures
 - analysing abnormal noise
 - analysing component failure
 - testing RESS cooling system
 - tightening connections
 - replacing faulty or damaged cable connections
 - removing and replacing faulty or damaged components

Assessment Conditions

Assessment must include direct observation by the assessor of the individual diagnosing, removing and replacing the RESS.

Where assessment of competency includes third-party evidence, it must identify the individual and the VIN of each electric vehicle where the RESS that they have removed and replaced. 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, removed and replaced
- PPE and safety equipment, including electrical safety gloves of an appropriate voltage rating in accordance with AS 5732, arc-rated clothing and face protection, and an insulating mat
- manufacturer specifications for BEV and RESS
- AS 5732 Electric vehicle operations - Maintenance and repair
- the vehicles specified in the performance evidence, with the RESS and associated components accessible for diagnosis, removal and replacement activities
- electrical diagnostic equipment appropriate to the BEVs, including:
 - digital multimeter and other test equipment rated in accordance with manufacturer specifications and the applicable standard
 - insulation tester
 - residual voltage tester, if specified in original equipment manufacturer (OEM) specifications
 - scan tool, or equivalent electronic isolation and diagnostic equipment
 - oscilloscope
- tools, equipment and materials required for removing and replacing BEV RESS and their components.
- lifting, handling and support equipment rated for the mass of the RESS being removed and replaced, as specified in the manufacturer removal and replacement procedure
- post repair testing procedures for HV RESS in heavy vehicle BEVs, including procedures for:
 - DTC clearing procedures
 - checking for electrical connector mating
 - verifying correct RESS communication and integration with vehicle systems following replacement
 - static and dynamic performance testing.

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
AURETH015 Diagnose, remove and replace heavy electric vehicle rechargeable energy storage systems	Equivalent	

Links

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