



Australian Government

AURETH108 Diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicle

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 and repair faults in the heating, ventilation and air conditioning (HVAC) and rechargeable energy storage cooling systems of battery electric vehicles (BEVs). The unit involves removing and replacing refrigerant, as well as performance testing the HVAC and RESS cooling system. It involves preparing for the task, sourcing a diagnostic testing strategy, diagnosing the cause of the fault, carrying out the repair, performing post-repair testing, and completing workplace processes and documentation. Importance is placed in the unit on applying electrical safety procedures when working on high voltage (HV) rechargeable energy storage systems (RESS).

The unit applies to those who work in the automotive service and repair industry. HVAC and RESS cooling systems include circuits in BEVs.

Licensing requirements apply to this unit. Users are advised to check with the relevant regulatory authority.

Pre-requisite Unit

AURETH101 Depower and reinitialise battery electric vehicles

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. Prepare to diagnose and repair HVAC and rechargeable energy	1.1 Identify job requirements from workplace instructions 1.2 Identify required information for diagnosis activity

ELEMENT	PERFORMANCE CRITERIA
storage cooling systems in battery electric vehicle	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 diagnose and repair activity, assess potential risks and implement control measures in line with workplace policies and procedures 1.5 Identify tools and equipment required for testing strategy and establish serviceability according to workplace procedures
2. Diagnose HVAC and rechargeable energy storage cooling systems in battery electric vehicle	2.1 Implement diagnostic tests set out in testing strategy according to manufacturer and workplace procedures, and workplace health and safety requirements 2.2 Identify cause of fault through analysis of diagnostic test results 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 HVAC and rechargeable energy storage cooling systems in battery electric vehicle	3.1 Identify required information for repair activity 3.2 Identify tools, equipment and materials required for repair activity and establish serviceability according to workplace procedures 3.3 Isolate RESS service plug or manual service disconnect and depower vehicle 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 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	• Locates required sources of information efficiently • Develops a sequenced plan for a specific task.
Reading	• Organises and interprets technical information from workplace procedures, manufacturer procedures and manufacturer specifications • Interprets symbols and wiring diagrams.
Oral communication	• Clarifies instructions • Obtains information from customers and supervisors.
Numeracy	• Matches electrical components and part identification numbers to workplace instructions, vehicle and component part lists, and manufacturer specifications • Interprets vehicle electrical measurements and readings on digital and analogue gauges • Measures voltage, current and resistance • Uses mathematical operations • Calculates deviations from manufacturer specifications.
Planning and organising	• Plans own work requirements • Prioritises actions to achieve required outcomes • Ensures tasks are completed within workplace timeframes.
Technology	• Uses specialised tools.

Unit Mapping Information

Supersedes and is equivalent to AURETH008 Diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicle.

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 AURETH108 Diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicle

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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 and repair heating, ventilation and air conditioning (HVAC) system and rechargeable energy storage system (RESS) cooling system components on two different battery electric vehicles (BEVs), in which the work must involve:
 - repairing or replacing one HVAC system component to correct performance deficiencies
 - repairing or replacing one RESS cooling system component to correct performance deficiencies.

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 HVAC and rechargeable energy storage cooling systems 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 HVAC and rechargeable energy storage cooling systems 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
- workplace health and safety (WHS) requirements relating to diagnosing and repairing HVAC and rechargeable energy storage cooling systems in battery electric vehicles, including procedures for:
 - identifying hazards and controlling risks associated with:
 - working with high voltages in BEV electrical systems
 - wearing jewellery while working around high electrical currents
 - determining appropriate procedures for minimising risk 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 RESS electrical supply
 - stabilising vehicle electrical system
- environmental requirements relating to diagnosing and repairing HVAC and rechargeable energy storage cooling systems in battery electric vehicles, including:
 - trapping, storing and disposing of waste released from HVAC and RESS cooling systems
 - preventing the escape of refrigerant to the atmosphere
- safe operating procedures for tools and equipment, including:
 - those specified in the specific vehicle service maintenance procedures, including:
 - digital multimeter with Cat III 1000 volt rating
 - insulation tester
 - residual voltage tester
 - scan tool
 - oscilloscope
 - temperature and pressure measuring equipment, including:
 - manifold and gauge set
 - contact thermometer
 - infrared thermometer (pyrometer)
 - electronic temperature probe
 - psychrometer (humidity detector)
 - digital vacuum gauge (vacrometer)
 - refrigerant leak detecting equipment, including electronic leak detector
 - refrigerant recovery equipment, including:
 - recovery unit
 - vacuum pump

- electronic scales
- miscellaneous equipment, including:
- valve core removing or replacement tool
- oil injector
- operating principles of HVAC and rechargeable energy storage cooling systems in battery electric vehicles, including:
 - types of HVAC systems, including engine operated and electric motor operated systems
 - types of RESS and RESS charging
 - reasons for cooling the RESS
- purpose and operation of HVAC systems and RESS cooling systems and components, including:
 - alternating current (AC) electric motor compressors
 - HVAC control units
 - HVAC control unit inputs and outputs
 - HVAC ejector cycle systems
 - RESS cooling systems, including air cooling, liquid cooling and HVAC cooled systems
- diagnostic testing procedures for HVAC and rechargeable energy storage cooling systems in battery electric vehicles, including procedures for:
 - accessing and interpreting scan tool system data, including:
 - diagnostic trouble codes (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
 - determining damage to compressor motor windings
 - checking insulation resistance of compressor motor windings
 - checking routing and damage to HV cabling
 - HVAC dynamic and static testing
 - analysing abnormal noise
 - analysing component failure
- repair procedures for HVAC and rechargeable energy storage cooling systems 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 HVAC and rechargeable energy storage cooling systems in battery electric vehicles, including procedures for:
 - DTC clearing procedures

- checking for electrical connector mating
- static and dynamic performance tests of HVAC systems and RESS cooling systems
- procedures for completing ARCTick service decal sticker, including:
 - name of service organisation
 - ARCTick business authority number
 - quantity of refrigerant added
 - refrigerant and oil type
 - service date
 - technician name and licence number.

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 BEV HVAC and RESS cooling 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
- ARC accredited service decal sticker (ARCTick)
- PPE and safety equipment, including electrical safety gloves with 1000 volt rating and HV insulating mat with Australian standards rating
- manufacturer specifications for BEV HVAC and RESS cooling systems
- AS 5732 Electric vehicle operations: Maintenance and repair
- two different BEVs with HVAC and RESS cooling system components accessible for diagnosis and repair or replacement activities
- electrical diagnostic equipment appropriate to the BEV HVAC and RESS cooling being diagnosed and repaired as specified under tools and equipment in the range of conditions
- tools, equipment and materials appropriate for repairing HVAC and RESS cooling systems in BEVs.

Assessors of this unit must satisfy the requirements for assessors in applicable vocational education and training legislation, frameworks and/or standards; and hold an Australian Refrigerant Council (ARC) Refrigerant Handling licence.

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