



Australian Government

AURETH008 Diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicle

Release: 1

AURETH008 Diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicle

Modification History

Release	Comment
Release 1	New unit of competency.

Application

This unit describes the performance outcomes required to diagnose and repair faults in the heating, ventilation and air conditioning (HVAC) system and cooling system of the rechargeable energy storage system (RESS) 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, selecting the correct diagnostic procedure, carrying out the diagnosis and 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) RESS.

It applies to those working 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

AURETH001 Depower and reinitialise battery electric vehicles

Competency Field

Electrical

Unit Sector

Technical - Hybrid Vehicle and Battery Electric Vehicle

Elements and Performance Criteria

Elements	Performance Criteria
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold and italicised text is used, further information is detailed in the range of conditions section.
1. Prepare to diagnose and repair HVAC and RESS cooling system	1.1 Job requirements are determined from workplace instructions 1.2 Diagnostic information is sourced and interpreted 1.3 Diagnostic options are analysed and those most appropriate to the circumstances are selected 1.4 Hazards associated with the work are identified and risks are managed according to safety requirements and AS 5732 Electric vehicle operations: Maintenance and repair 1.5 Diagnostic tools and equipment are selected and checked for serviceability
2. Diagnose HVAC and RESS cooling system	2.1 Diagnostic tests are carried out according to manufacturer specifications, workplace procedures and safety requirements 2.2 Faults are identified from diagnostic test results and causes of faults are determined 2.3 Diagnosis findings and recommendations for necessary repairs or adjustments are reported according to workplace procedures
3. Repair HVAC and RESS cooling system	3.1 Repair information is sourced and interpreted 3.2 Repair options are analysed and those most appropriate to the circumstances are selected 3.3 Repair tools, equipment and materials are selected and checked 3.4 RESS service plug or manual service disconnect is located and isolated to depower vehicle HV RESS according to manufacturer specifications 3.5 HVAC and RESS cooling system components are replaced, repaired or adjusted as required according to manufacturer specifications, workplace procedures, safety and environmental requirements, and without causing damage to components or systems 3.6 RESS service plug or manual service disconnect is reconnected and vehicle is reactivated 3.7 Post-repair testing is carried out according to workplace procedures to confirm fault rectification, and any further problems detected as having been introduced during the repair process are rectified

Elements	Performance Criteria
Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold and italicised text is used, further information is detailed in the range of conditions section.
4. Complete work processes	4.1 Final inspection is made to ensure work is to workplace expectations and vehicle is presented ready for use 4.2 Work area is cleaned, waste and non-recyclable materials are disposed of, and recyclable material is collected 4.3 Tools and equipment are checked and stored and faulty electrical equipment is identified, tagged and isolated according to workplace procedures 4.4 <i>Australian Refrigeration Council accredited service decal sticker (ARCTick)</i> and other required workplace documentation are completed and processed according to workplace procedures

Foundation Skills

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

Skills	Description
Learning skills to:	identify and locate various sources of information efficiently.
Reading skills to:	interpret text, symbols and wiring diagrams in diagnostic and repair information in manufacturer specifications and workplace instructions and procedures.
Writing skills to:	legibly and accurately fill out workplace documentation when reporting diagnostic findings, making repair recommendations, and recording parts and material used.
Oral communication skills to:	- clarify instructions - report diagnostic findings and make repair recommendations.
Numeracy skills to:	- match electrical components and part identification numbers to workplace instructions, vehicle and component part lists, and manufacturer specifications - interpret vehicle electrical measurements and readings - measure voltage, current and resistance and use basic mathematical operations, including addition and subtraction, to calculate deviations from manufacturer specifications.
Planning and organising skills to:	plan own work requirements and prioritise actions to achieve required outcomes and ensure tasks are completed within workplace timeframes.

Skills	Description
Technology skills to:	• use specialised equipment, including multimeters and scan tools.

Range of Conditions

This section specifies work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included. Bold italicised wording, if used in the performance criteria, is detailed below.

<i>Safety requirements</i> must include:	• work health and safety (WHS) and occupational health and safety (OHS) requirements, including procedures for: • identifying hazards and controlling risks associated with: • working with high voltages in BEV electrical systems • wearing jewellery whilst working around high electrical currents • working with refrigerants at boiling point given risk of frostbite • working with system lubricants, including carcinogenic oils • handling flammable refrigerants • determining appropriate procedures for minimising risk associated with hazards, including applying electrical safety precautions: • using personal protective equipment (PPE), including electrical safety gloves with 1000 volt rating and HV insulating mat with Australian standards rating • identifying and using fire safety equipment as appropriate • using the ‘one hand rule’ • following live system warning tags and signs • depowering the vehicle • isolating the HV RESS electrical supply • stabilising the vehicle electrical system.
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Tools and equipment must include:	- those specified in the specific vehicle service maintenance procedures, including: - digital multimeter with Cat III 1000 volt rating - insulation tester - scan tool - residual voltage tester, if specified in original equipment manufacturer (OEM) test requirements - 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.
Environmental requirements must include:	- procedures for: - trapping, storing and disposing of waste released from HVAC and RESS cooling systems - preventing the escape of refrigerant to the atmosphere.
Australian Refrigeration Council accredited service decal sticker (ARCtick) information must include:	- name of the service organisation - name of technician - Refrigerant Handling Licence Number - vehicle registration number - service date - refrigerant type - lubricant type.

Unit Mapping Information

Equivalent to AURETH4008 Diagnose and repair high voltage cabin heating and cooling systems in battery electric vehicles

Links

Companion Volume implementation guides are found in VETNet -

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

Assessment Requirements for AURETH008 Diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicle

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Performance Evidence

Before competency can be determined, individuals must demonstrate they can perform the following according to the standard defined in the unit's elements and performance criteria, range of conditions and foundation skills:

- 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

Individuals must be able to demonstrate knowledge of:

- work health and safety (WHS) and occupational health and safety (OHS) requirements relating to diagnosing and repairing HVAC and RESS cooling systems, 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
 - working with refrigerants at boiling point given risk of frostbite
 - working with system lubricants, including carcinogenic oils
 - handling flammable refrigerants
 - determining appropriate procedures for minimising risk associated with hazards, including applying electrical safety precautions:

- using personal protective equipment (PPE), including electrical safety gloves with 1000 volt rating and high voltage (HV) insulating mat with Australian standards rating
- identifying and using fire safety equipment as appropriate
- using the 'one hand rule'
- following live system warning tags and signs
- depowering the vehicle
- isolating the HV RESS electrical supply
- stabilising the vehicle electrical system
- environmental requirements, including procedures for:
 - trapping, storing and disposing of waste released from HVAC and RESS cooling systems
 - preventing the escape of refrigerant to the atmosphere
- key requirements of AS 5732 Electric vehicle operations: Maintenance and repair
- operating principles of HVAC systems and RESS cooling systems and associated components, including:
 - types of HVAC systems, including engine operated and electric motor operated systems
 - types of RESS and RESS charging
 - reasons for cooling the RESS
- application, 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 RESS cooling systems, including:
 - accessing and interpreting scan tool system data, including:
 - diagnostic trouble codes (DTCs)
 - live data
 - freeze frame data
 - waveforms
 - using diagnostic flow charts
 - testing electrical systems, 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 systems and RESS cooling systems, including:
 - tightening connections
 - replacing faulty or damaged cable connections
 - removing and replacing faulty or damaged components
- post-repair testing procedures for HVAC and RESS cooling systems, including:
 - DTC clearing procedures
 - checking for electrical connector mating
 - static and dynamic performance tests of HVAC systems and RESS cooling systems.

Assessment Conditions

Assessors must satisfy NVR/AQTF assessor requirements and hold an Australian Refrigerant Council (ARC) Refrigerant Handling licence.

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.

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