



Australian Government

**AURETHX08 Diagnose and repair HVAC
and rechargeable energy storage cooling in
battery electric vehicles**

AURETHX08 Diagnose and repair HVAC and rechargeable energy storage cooling 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 heating, ventilation and air conditioning (HVAC) and rechargeable energy storage cooling systems 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 (HV) rechargeable energy storage system (RESS), removing and replacing refrigerant, carrying out the repair, reinitialising the vehicle, performance testing the HVAC and RESS cooling system, and completing workplace processes and documentation.

This unit emphasises the safe application of electrical safety procedures when working on the high voltage RESS. The unit applies the same voltage definitions as 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, including requirements for handling refrigerant, can vary between States, Territories and industry sectors, and must be sourced from state jurisdictions prior to applying the unit.

An Australian Refrigeration Council (ARCTick) Automotive Refrigerant Handling Licence is required for those carrying out this work. An ARCTick trainee licence is required to undertake this training.

Pre-requisite unit(s)

AURETHX01 Depower and reinitialise electric vehicles

AURETU203 Service air conditioning and HVAC systems

AURETU204 Diagnose and repair air conditioning and HVAC components

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 HVAC and rechargeable energy storage cooling systems	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 and equipment required for the testing strategy and establish serviceability according to workplace procedures
2. Diagnose HVAC and rechargeable energy storage cooling systems	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 thermal management system live data, including data on software-controlled operation of the HVAC and RESS cooling 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 HVAC and rechargeable energy storage cooling systems	3.1 Access and interpret manufacturer procedures, workplace procedures and applicable standards required for the repair activity 3.2 Select tools, 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 AURETHX08 Diagnose and repair HVAC and rechargeable energy storage cooling 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 heating, ventilation and air conditioning (HVAC) system and rechargeable energy storage system (RESS) cooling system components on at least two battery electric vehicles, 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.

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

- depower and reinitialise each vehicle according to manufacturer procedures
- retrieve and interpret thermal management system live data
- recover, evacuate and charge refrigerant without releasing refrigerant to the atmosphere in accordance with regulatory requirements, Australian Automotive Refrigerant Handling Code of Practice and industry standards
- select and use diagnostic and test equipment appropriate to the work and to the vehicle type
- confirm correct operation through post-repair performance 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 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
 - safety data sheets (SDS)
- workplace procedures required to diagnose and repair HVAC and rechargeable energy storage cooling systems in battery electric vehicles, including:

- personal protective equipment (PPE)
- 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 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 PPE, including arc-rated (CAL-rated) protective clothing of an appropriate rating
 - 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

Assessment Conditions

Assessment must include direct observation by the assessor of the individual depowering, verifying the absence of voltage, and reinitialising an electric vehicle.

Where assessment of competency includes third-party evidence, it must identify the individual and each electric vehicle by VIN, include HVAC and RESS cooling systems repair information that they worked on, and be signed by a workplace supervisor competent in depowering and reinitialising electric vehicles. Assessors must confirm its authenticity with the third party.

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 of an appropriate voltage rating in accordance with AS 5732, arc-rated clothing and face protection, and an insulating mat
- 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 in accordance with manufacturer specifications and the applicable standards
- 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.

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

Links

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