



Australian Government

AURETU204 Diagnose and repair air conditioning and HVAC components

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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 10.0.

Application

This unit describes the skills and knowledge required to diagnose and repair faults in the air conditioning systems, including heating, ventilation and air conditioning (HVAC) systems, fitted to a range of vehicles and machinery for occupants' comfort. The systems used vary based on the work context. 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.

The unit applies to those who work in the automotive service and repair industry. Automotive air conditioning and HVAC systems include those in agricultural machinery, heavy commercial vehicles, light vehicles or mobile plant machinery. This unit does not apply to the diagnosis or repair of HVAC and rechargeable energy storage cooling systems in electric vehicles.

Licensing/Regulatory Information

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

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)

No pre-requisite units

Competency field(s)

Electrical

Unit sector(s)

Electrical Technical - Air Conditioning and HVAC

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 air conditioning and HVAC system	1.1 Identify job requirements from workplace instructions 1.2 Identify required information for diagnosis activity 1.3 Select 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, including hazards specific to the refrigerant class present, 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 air conditioning and HVAC system	2.1 Carry out 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 examination 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. Operate recovery equipment	3.1 Identify vehicle refrigerant with a refrigerant identifier or analyser 3.2 Weigh recovery cylinder and record available capacity and tare weight of cylinder 3.3 Connect recovery equipment to vehicle according to manufacturer specifications, workplace procedures, Australian automotive refrigerant handling code of practice, workplace health and safety and environmental requirements 3.4 Recover refrigerant and transfer into designated recovery cylinder using recovery equipment according to manufacturer specifications, workplace procedures, Australian automotive refrigerant handling code of practice, workplace health and safety and environmental requirements

4. Repair air conditioning and HVAC system	4.1 Identify required information for repair activity 4.2 Identify required repair tools, equipment and materials required for repair activity and establish serviceability according to workplace procedures 4.3 Carry out repairs according to workplace and manufacturer procedures, Australian automotive refrigerant handling code of practice, manufacturer specifications, workplace health and safety and environmental requirements 4.4 Recharge system with required refrigerant gas according to manufacturer specifications, workplace procedures, Australian automotive refrigerant handling code of practice, and workplace health and safety and environmental requirements 4.5 Carry out post-repair testing according to workplace and manufacturer procedures, Australian automotive refrigerant handling code of practice, workplace health and safety and environmental requirements
5. Complete work processes	5.1 Conduct final inspection according to workplace procedures and confirm vehicle is ready for use 5.2 Clear work area and dispose of or recycle materials according to workplace procedures 5.3 Complete service label and workplace 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	- Interprets text, symbols and wiring diagrams relating to diagnostic and repair information from manufacturer specifications and workplace instructions and procedures - Interprets information from safety data sheets (SDS)
Oral communication	- Clarifies instructions - Obtains information from customers and supervisors

Numeracy	• Matches refrigerant classes and identification markings to workplace instructions, parts lists, manufacturer specifications and regulatory requirements • Interprets weight measurements, including tare and gross weights • Interprets readings on pressure gauges • Measures temperatures and pressures and uses mathematical operations, including addition and subtraction, to calculate 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 equipment.

Range of conditions

N/A

Assessment Requirements for AURETU204 Diagnose and repair air conditioning and HVAC components

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 a fault in the air conditioning and HVAC systems of two different vehicles or machinery, in which the work must involve removing, refitting or replacing two of the following:
 - condenser
 - evaporator
 - flow control device
 - compressor
 - heater assembly
 - refrigerant hose
 - dryer or accumulator
- carry out each job on a system with a different refrigerant class:
 - one Class A1 - lower toxicity, no flame propagation
 - one Class A2L - lower toxicity, lower flammability.

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 air conditioning and HVAC systems, including:
 - information provided by customers and supervisors
 - air conditioning and HVAC system manufacturer specifications, including original equipment manufacturer (OEM) technical information access and approval requirements for alternative refrigerants
 - Australian automotive refrigerant handling code of practice
 - Flammable Refrigerants and Safety in Automotive Applications guide
- workplace procedures required to diagnose and repair air conditioning and HVAC systems, including:
 - establishing the 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
 - safe disposal of materials
 - recycling procedures
- work health and safety (WHS) and occupational health and safety (OHS) requirements relating to diagnosing and repairing air conditioning and HVAC systems, including procedures for:
 - interpreting safety data sheets (SDS) for refrigerants and lubricants
 - managing risk of freeze burn and cold burns when handling refrigerants
 - working with system lubricants, including health and safety issues associated with handling refrigerant lubricants
 - refrigerant safety classifications and characteristics of gases relevant to automotive air conditioning systems, including:
 - Class A1 – lower toxicity, no flame propagation, including R-134a
 - Class A2L – lower toxicity, lower flammability, including R-1234yf
 - Class A3 – lower toxicity, higher flammability, including R-600
 - handling, storing and transporting refrigerant cylinders and recovery cylinders across Class A1, A2L and A3 automotive refrigerants, in line with State and Territory safety requirements, including:
 - pressure ratings
 - pressure relief devices
 - outlet connection type
 - regulatory transport requirements, including Dangerous Goods (DG) classes and placarding thresholds
 - storage temperature and security requirements
 - segregation requirements for incompatible refrigerant classes
 - additional requirements for automotive flammable (A2L and A3) refrigerants, including:
 - spark-free equipment and material compatibility (seals, hoses, components)
 - hydrocarbon refrigerants and flammability hazards
 - constraints on the use of flammable refrigerants, including manufacturer approval and warranty conditions
 - selecting and using personal protective equipment (PPE)
 - identifying and using fire safety equipment appropriate for the refrigerant class present

- emergency procedures and incident management requirements and procedures
- procedures for recovering Class A1 (lower toxicity, no flame propagation) and Class A2L (lower toxicity, lower flammability) automotive refrigerant, including:
 - determining original refrigerant type, including:
 - service label
 - testing refrigerant using an analyser or identifier
 - types and location of service ports
 - connecting manifold and gauge set and recovery unit, including types and location of service ports
 - identifying recovery cylinder suitable to the refrigerant
 - operating recovery unit, including weighing recovery cylinder before and after recovery
 - disconnecting and storing recovery unit and cylinder
 - comparison of recovery equipment types and their suitability for different refrigerant classes and contamination scenarios
 - selecting appropriate recovery procedures based on refrigerant type and contamination status, including separate recovery procedures for contaminated refrigerants
 - disposal requirements for different refrigerant types and contaminated refrigerants
- system performance testing, including:
 - using manifold gauges and thermometers to check system pressures and vent temperatures
 - checking system operating pressures
 - checking blower fan output
 - checking engine fan output
 - checking cabin air filters
- environmental requirements under the Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 and procedures in the Australian automotive refrigerant handling code of practice relating to diagnosing and repairing motor vehicle air conditioners, for:
 - preventing loss of refrigerant to the atmosphere
 - preventing refrigerant cross-contamination and gas mixing
- air conditioning and HVAC system principles, including:
 - operating pressures, properties and suitable lubricating oils for Class A1, A2L and A3 automotive refrigerants
 - heat transfer principles, including convection, conduction and radiation

- pressure-temperature relationships
- functions of the following automotive air conditioning components:
 - compressor
 - condenser
 - receiver-drier
 - evaporator
 - flow control device, including thermostatic expansion valves (TXV) and orifice tubes
 - blower fan
 - refrigerant
 - refrigerant hose
- functions of the following heating components:
 - radiator
 - thermostat
 - radiator and heater hoses
 - heater tap
 - heater assembly
- single zone and multi-zone system layouts
- purpose and operation of air conditioning and HVAC systems and components, including:
 - high pressure and low pressure sides of air conditioning systems
 - compressors, including:
 - piston type, including variable displacement compressors
 - scroll type
 - rotary vane type
 - electric compressors
 - clutchless compressors and electromagnetic clutches
 - condensers
 - receiver-dryer, including filters and desiccants
 - flow control devices, including thermostatic expansion valves (TXV) and orifice tubes
 - evaporator
 - thermostat
 - refrigerants
 - compressor lubricant

- pressure relief device
- air conditioner and heating controls, including levers and ducting
- air conditioner and heating electrical circuits and sensors, including:
 - high and low pressure switches
 - temperature sensors
- climate control systems
- diagnostic testing procedures for air conditioning and HVAC systems, including:
 - accessing and interpreting scan tool system data, including:
 - diagnostic trouble codes (DTCs)
 - live data
 - freeze frame data
 - waveforms
 - using diagnostic flow charts
 - using manifold gauges to analyse high and low pressure readings in conjunction with temperature probes, accounting for the pressure-temperature characteristics of different refrigerant classes
 - testing electrical systems, including procedures for:
 - accessing electrical terminals and using test probes without damaging connectors, fuse holders or wiring
 - resistance and voltage drop tests
 - open and short circuit tests
 - checking shorts to signal, power circuits and grounds
- identifying receiver-dryer type and condition, including:
 - sealed receiver-dryer units
 - receiver-dryer units fitted with a replaceable desiccant bag
 - indicators that a replaceable desiccant requires replacement, including moisture saturation indicators and service interval triggers
- repair procedures for air conditioning and HVAC systems, including procedures for:
 - using manifold gauges to recover, evacuate and charge system refrigerants
 - removing and replacing system components
 - replacing flow control device and accumulator
 - checking for refrigerant leaks prior to charging gas, including:
 - pressure testing using oxygen-free nitrogen (OFN)
 - vacuum decay testing

- post-repair testing procedures for air conditioning and HVAC systems, including procedures for checking for:
 - checking for leaks using electronic leak detection or tracer gas testing (e.g. forming gas – nitrogen/hydrogen mix), where compatible with system materials
 - checking for heater core and system water coolant leaks
 - checking system operating pressures using manifold gauge readings
- performance tests of air conditioning and HVAC systems, including checking:
 - ambient temperature
 - centre vent temperature
 - discharge line temperature
 - liquid line temperature
 - suction line temperature
- procedures for completing service label and associated workplace documentation.

Assessment Conditions

Assessment of skills must take place under the following 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 air conditioning and HVAC 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
 - workplace instructions
 - manufacturer specifications for air conditioning and HVAC systems
 - Australian automotive refrigerant handling code of practice
 - service labels
 - procedures for diagnosing and repairing vehicle air conditioning and HVAC systems
 - two different vehicles or machinery with air conditioning and HVAC system faults

- equipment appropriate for the minimum refrigerant class required by the assessment scenario, being at minimum Class A2L (lower toxicity, lower flammability) capable
- diagnosis and repair equipment for air conditioning and HVAC systems, including:
 - manifold and gauge set
 - recovery unit and recovery cylinder
 - leak detection equipment appropriate to the refrigerant class and system being tested, such as:
 - oxygen-free nitrogen (OFN) cylinder and regulator for pressure testing
 - electronic leak detector compatible with the refrigerant class
 - vacuum pump and vacuum gauge for vacuum decay testing
 - multimeter
 - electronic scales
 - oil injector
 - infra-red (non-contact) thermometer
 - temperature probe
 - scan tool.

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 Refrigeration Council (ARCTick) Automotive 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
AURETU104 Diagnose and repair air conditioning and HVAC components	Equivalent	Supersedes and is equivalent to AURETU104 Diagnose and repair air conditioning and HVAC components.

Links

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

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