



Australian Government

AURETU3004 Diagnose and repair air conditioning and HVAC systems

Release 1

AURETU3004 Diagnose and repair air conditioning and HVAC systems

Modification History

Release	Comment
Release 1	Replaces AURT322666A Repair/retrofit air conditioning systems Performance Criteria, Range Statement and Critical Aspects updated to reflect technologies

Unit Descriptor

Unit descriptor	This unit describes the performance outcomes required to diagnose and repair air conditioning systems including heating, ventilation, air conditioning and cooling (HVAC) systems that are fitted to a range of vehicles and equipment for passenger convenience and comfort. The unit involves diagnosing deviations from correct operation, repairing vehicle air conditioning and HVAC system components and associated systems, and applying post-repair testing procedures. The unit also involves identifying and confirming work requirements; preparing for work; testing systems; identifying faults and causes and appropriate repair; retesting air conditioning and HVAC systems; and completing work finalisation processes, including clean-up and documentation. Licensing, legislative, regulatory or certification requirements apply to this unit. Users are advised to check with the relevant regulatory authority.
-----------------	---

Application of the Unit

Application of the unit	Work applies to automotive air conditioners, including HVAC systems fitted to vehicles in light and heavy vehicle, mining, construction, agricultural, motorcycle and outdoor power equipment environments. Work requires individuals to demonstrate some judgement and problem-solving skills in managing own work activities and contributing to a productive team environment.
--------------------------------	---

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

Employability Skills Information

Employability skills	This unit contains employability skills.
-----------------------------	--

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.
---	--

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Prepare to diagnose and repair air conditioning and HVAC system	1.1. Workplace instructions are used to determine job requirements 1.2. Workplace health and safety (WHS) requirements are observed throughout the work 1.3. Procedures and information are sourced and interpreted 1.4. Australian Refrigeration Council (ARC) code of practice is sourced and complied with 1.5. Options for diagnosing faults are identified and used, using appropriate tools and diagnostic techniques 1.6. Tools and equipment are identified for effective diagnosis and repair methods 1.7. Critical precautions in relation to working with air conditioning, refrigerant and refrigerant oils are observed
2. Diagnose air conditioning and HVAC system	2.1. Air conditioning and HVAC systems are tested to isolate faults according to workplace procedures and without causing damage to components or systems as a result of inappropriate testing procedures 2.2. Faults are identified from test results and causes of faults are determined 2.3. Diagnosis findings are reported according to workplace procedures, including recommendations for necessary repairs or adjustments
3. Repair air conditioning and HVAC system	3.1. Repair options are analysed and those most appropriate to the circumstances are selected 3.2. Appropriate tools and recognised techniques and materials are selected and prepared 3.3. Repairs and component replacements and adjustments are carried out without causing damage, according to workplace procedures and manufacturer and component supplier specifications
4. Retest air conditioning and HVAC system	4.1. Retests are carried out to ensure correct and safe air conditioning and HVAC system performance operation 4.2. Post-repair testing is carried out according to workplace procedures and relevant legislation
5. Prepare vehicle and equipment for delivery to customer after repair is completed	5.1. Final inspection is made to ensure work is to workplace expectations 5.2. Vehicle is cleaned to workplace expectations and presented ready for use 5.3. Workplace documentation is processed according to

ELEMENT	PERFORMANCE CRITERIA
	workplace procedures 5.4.Appropriate decal sticker is placed in engine compartment
6. Clean up work area and finalise work processes	6.1.Material that can be reused is collected and stored in the appropriate designated area and according to workplace sustainability practices 6.2.Waste and scrap are removed following workplace procedures and disposed of according to environmental regulations 6.3.Equipment and work area are cleaned and inspected for serviceable condition according to workplace procedures 6.4.Faulty equipment is identified, tagged and isolated according to workplace procedures and WHS regulations 6.5.Operator maintenance is completed according to manufacturer and component supplier specifications, site procedures and relevant industry codes of practice 6.6.Tools and equipment are maintained according to workplace procedures

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

- communication skills to:
 - follow verbal and written instructions
 - clarify workplace instructions and determine job requirements
 - gain information from appropriate persons and assistance as required
- initiative and enterprise skills to:
 - apply learning when diagnosing and repairing various air conditioning and HVAC systems
 - recognise a workplace problem or potential problem and take action
- learning skills to identify sources of information, assistance and expert knowledge to expand skills, knowledge and understanding
- literacy skills to:
 - read and follow information in written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents
 - obtain and record measurements
 - document required repairs and parts
- numeracy skills to:
 - test, measure and analyse test equipment results compared to desired system performance
 - assess tolerances and apply accurate measurements and adjustments
- planning and organising skills to:
 - plan own work requirements and prioritise actions to achieve required outcomes and ensure tasks are completed on time
 - identify risk factors and take action to minimise them
- problem-solving skills to:
 - determine the underlying causes of faults
 - refer problems outside area of responsibility to appropriate person and suggest possible causes
 - seek information and assistance as required to solve problems
- self-management skills to:
 - select and use appropriate equipment, materials, processes and procedures
 - recognise limitations and seek timely advice
 - follow workplace documentation, such as codes of practice and operating procedures
- teamwork skills to apply knowledge of own role to complete activities efficiently to support team activities and tasks
- technical skills to use workplace technology and tools relating to repairing air conditioning and HVAC systems, including:
 - specialist tools and equipment

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

- measuring equipment
- computerised technology
- technology skills to:
 - operate diagnostic and test equipment
 - use technology to collect, analyse and provide information

Required knowledge

- WHS regulations, requirements, equipment, material and personal safety requirements, including:
 - legislation relating to automotive air conditioning and HVAC systems
 - ARC code of practice
- principles of operation of automotive air conditioning and HVAC systems, including:
 - piston, scroll and rotary vane compressors
 - electric compressors
 - variable displacement compressors
 - clutchless compressors
- application, purpose and operation of air conditioning and HVAC systems, including:
 - climate control
 - multi-zone systems
- techniques for reading and interpreting technical information, including:
 - refrigerant saturation temperatures in relation to ambient temperatures and changing levels of humidity
 - graphic symbols and diagrams
- diagnostic and testing procedures, including:
 - use of manifold gauges and surface probe thermocouples for complete system analysis
 - diagnostic procedures for air conditioning and HVAC systems, including:
 - accessing and interpreting diagnostic trouble codes (DTC)
 - diagnostic flow charts
 - analysis of system operation using gauges, temperature probes, electrical test equipment, scan tools, oscilloscopes and other industry-relevant test equipment
 - visual, aural and functional assessments, including:
 - component damage and wear
 - component corrosion
 - vacuum and leaks
- repair procedures, including:
 - component removal and replacement procedures
 - component and associated system adjustment procedures

Evidence Guide

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment

Critical aspects for assessment and evidence required to demonstrate competency in this unit

The evidence required to demonstrate competency in this unit must be relevant to workplace operations and satisfy all of the requirements of the performance criteria and required skills and knowledge.

A person who demonstrates competency in this unit must be able to:

- observe safety procedures and requirements, in particular the dangers associated with handling refrigerants
- select methods and techniques appropriate to diagnosing and repairing an air conditioning system
- complete preparatory activity in a systematic manner
- diagnose and repair a range of vehicle air conditioning and HVAC systems, including:
 - climate control
 - single and multi-zone
 - electric compressors
- apply safe operation of automotive refrigerant tools and equipment
- record relevant details in relation to workplace and licensing requirements of the ARC code of practice
- demonstrate understanding of the environmental regulations and refrigerant waste disposal procedures
- conduct diagnosis and repair procedures according to workplace, manufacturer and component supplier requirements
- present vehicle and equipment in a condition that complies with workplace requirements
- complete workplace and equipment documents to ARC code of practice requirements
- clean up work area and maintain equipment to workplace standards.

Context of, and specific resources for assessment

Competency is to be assessed in the workplace or a simulated workplace environment that accurately reflects performance in a real workplace setting.

Assessment is to occur:

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment

- using standard workplace practices and procedures
- following safety requirements
- applying environmental constraints.

Assessment is to comply with relevant:

- regulatory requirements
- Australian standards
- ARC code of practice.

The following resources must be made available for the assessment of this unit:

- workplace location or simulated workplace
- vehicles with air conditioning and HVAC faults relevant to the qualification being sought
- equipment appropriate for the diagnosing and repairing a range of vehicle air conditioning and HVAC systems relevant to the qualification being sought, including:
 - manifold and gauge set
 - recovery unit
 - vacuum pump
 - electronic leak detector
 - nitrogen cylinder and regulator
 - digital vacuum gauge (vacrometer)
 - digital multimeter
 - electronic scales
 - oil injector
 - infra-red thermometer (pyrometer)
 - electronic temperature probe
 - valve core removing/replacement tool
 - psychrometer (humidity detector)
 - various refrigerant hoses and couplers
 - diagnostic scan tool
- specifications and workplace instructions
- service procedures for above equipment appropriate for the diagnosis, repair, replacement and adjustment of vehicle air conditioning and HVAC systems.

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment**Method of assessment**

Assessment must satisfy the endorsed Assessment Guidelines of this Training Package.

Assessment methods must confirm consistency and accuracy of performance (over time and in a range of workplace relevant contexts) together with the application of required skills and knowledge.

Assessment methods must be by direct observation of tasks and include questioning on required skills and knowledge to ensure correct interpretation and application.

Competence in this unit may be assessed in conjunction with other units which together form part of a holistic work role.

Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate the needs of diverse clients.

Assessment processes and techniques must be culturally sensitive and appropriate to the language, literacy and numeracy capacity of the candidate and the work being performed.

Range Statement

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

<i>Workplace instructions</i> may include:	• electronic or hard copy instructions • verbal instructions • written instructions • safe work procedures relating to refrigerant recovery and replacement.
<i>Job requirements</i> may include:	• diagnosis and repair methods, processes and equipment.
<i>Workplace health and safety requirements</i> may include:	• material safety data sheets (MSDS) • first aid kit • personal protective clothing and equipment • use of tools and equipment • safe handling of material • use of fire-fighting equipment • workplace safety policies and procedures • workplace first aid equipment • water shower or equivalent • hazard control, including control of hazardous materials and toxic substances.
<i>Procedures and information</i> may include:	• verbal, written and graphical instructions • signage • work schedules, plans and specifications • work bulletins and memos • MSDS • diagrams and sketches • safe work procedures relating to the diagnosis and repair of air conditioning and HVAC systems • regulatory and legislative requirements relating to automotive industry • Australian Design Rules • engineer's design specifications and instructions • workplace work specifications and requirements • instructions issued by authorised workplace or external persons • Australian standards

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

	• ARC code of practice • vehicle service requirements and repair manuals.
<i>Options for diagnosing faults</i> may include:	• isolation of faults • component inspection and evaluation • use and application of air conditioning diagnostic tools.
<i>Tools and equipment:</i>	• are to include the following specialist tools, which are mandatory under the ARC code of practice: • manifold and gauge set • recovery unit • vacuum pump • electronic leak detector • electronic scales • may include: • normal hand tools • nitrogen cylinder and regulator • digital vacuum gauge (vacrometer) • oil injector • infra-red thermometer (pyrometer) • electronic temperature probe • valve core removing/replacement tool • psychrometer (humidity detector) • various refrigerant hoses and couplers • digital multimeter • diagnostic scan tool.
<i>Critical precautions</i> may include:	• dangers associated with working with refrigerants and lubricants, including: • frostbite (refrigerant boiling point -36.7°C) • carcinogenic oil • care taken with some flammable refrigerants.
<i>Air conditioning and HVAC systems</i> may include:	• single zone and multi-zone, including: • climate control • electric compressors • R12 systems

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

	• R134a systems • R1234yf systems • high and low pressure switches • pressure relief valve • temperature sensors • sunlight sensors • carbon dioxide sensors • zone temperature sensors.
<i>Inappropriate testing procedures</i> may include:	• intrusive testing (which must not be performed as it is not a recommended test and repair method), which includes: • back probing terminals and connectors and fuse holders with inappropriate test probes • probing terminal and connectors with inappropriate test probes • pushing sharp probes and objects into wiring insulation.
<i>Faults</i> may include:	• system containing atmospheric air with moisture • electrical sensor malfunction • dislodged temperature sensor or transfer valve • faulty pressure relief valve • vacuum leak • air flow restriction or blockage • receiver drier blockage • evaporator fan not working • electrical fault • electrical system fault.
<i>Repair options</i> may include:	• component repair procedures, including: • removal, replacement and adjustment procedures • dismantle, repair, re-assembly and adjustment procedures.
<i>Post-repair testing</i> may include:	• validating effectiveness of the repair action, including the following checks: • ambient temperature • centre vent temperature • condenser and suction line temperature • manifold gauge pressure readings

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

	• refrigerant leaks • confirming that reported fault has been rectified • confirming that no other faults are present as a result of the repair action.
<i>Information on decal sticker</i> must include:	• name of the service organisation • quantity of refrigerant added • refrigerant and oil type • service date • technician's licence number • vehicle odometer reading.

Unit Sector(s)

Competency field	Electrical
Unit sector	Technical – Air Conditioning and HVAC

Co-requisite units

Not applicable.

Competency field