



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **AURT576093A Analyse and evaluate electrical and electronic faults in electric and hybrid vehicle systems**

Release: 1

## **AURT576093A Analyse and evaluate electrical and electronic faults in electric and hybrid vehicle systems**

### **Modification History**

Not Applicable

### **Unit Descriptor**

|                        |                                                                                                                                                                                                      |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Unit descriptor</b> | This unit covers the competence to analyse and evaluate electrical and electronic faults in electric and hybrid vehicle systems in order to initiate action to sustain, vary or enhance performance. |
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### **Application of the Unit**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| <b>Application of the unit</b> | It includes failure analysis covering the complex diagnosis of multi-system and intermittent faults as well as evaluation of performance achievements and variations. It also requires the candidate to identify, evaluate, select and document the most appropriate response to the stated objective of the analysis and evaluation process.<br>The unit relates to an automotive technologist or subject matter specialist. It encompasses and builds on trade level competencies |
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### **Licensing/Regulatory Information**

Not Applicable

### **Pre-Requisites**

|                           |  |  |
|---------------------------|--|--|
| <b>Prerequisite units</b> |  |  |
|                           |  |  |
|                           |  |  |

## Employability Skills Information

|                             |                                          |
|-----------------------------|------------------------------------------|
| <b>Employability skills</b> | This unit contains employability skills. |
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## Elements and Performance Criteria Pre-Content

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

| ELEMENT                                          | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Identify and confirm the work requirement     | <p>1.1. Work instructions and reports are used to determine the nature and objective of the analysis and evaluation requirements.</p> <p>1.2. Benchmark specifications for correctly functioning hybrid vehicle systems are accessed and interpreted.</p> <p>1.3. OH&amp;S requirements, including regulatory requirements, equipment and system isolation requirements and personal protection needs are observed throughout the work.</p> <p>1.4. Effects of systemic deficiencies/discrepancies or faults are identified and confirmed from indirect and/or direct evidence.</p> <p>1.5. Possible safety impacts of the work are considered and responded to in accordance with regulatory and enterprise obligations and practices.</p>                                                                                                                                                                                 |
| 2. Prepare for analysis and evaluation           | <p>2.1. Evaluative criteria are developed/adopted to meet the objective of the work.</p> <p>2.2. System performance achievements and/or discrepancies are identified from an analysis of technical support information and available on-board diagnostic systems.</p> <p>2.3. Analytical and evaluative methodology, including diagnostic process, sequence, tests and testing equipment are developed and/or identified and selected from the range of available options.</p> <p>2.4. Testing equipment is obtained and prepared for application in accordance with regulatory, manufacturer/component supplier and enterprise requirements.</p> <p>2.5. Tooling and materials required to support the diagnostic process are identified, selected and prepared for use.</p> <p>2.6. Hybrid vehicle system components are prepared for the diagnostic process, including park-up, isolation and cleaning requirements.</p> |
| 3. Apply the analysis and evaluative methodology | <p>3.1. Selected analytical and diagnostic process is followed in accordance with specifications and directions and/or the locally authorised method.</p> <p>3.2. Tests and testing equipment are applied in accordance with regulatory requirements and manufacturer/component supplier specifications.</p> <p>3.3. Analytical and other diagnostic findings are verified, if necessary, by using reliable alternate or optional</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| ELEMENT | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                                                                                                                                                           |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | <p>processes, and documented.</p> <p>3.4. Analytical findings and results are evaluated against agreed criteria.</p> <p>3.5. Valid conclusions are drawn from the available evidence and documented to enterprise requirements.</p> <p>3.6. Information and detail related to the analysis and evaluation is provided to the appropriate parties in accordance with regulatory and commercial obligations.</p> |

| ELEMENT                    | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4. Select response measure | <p>4.1.Options for responding to the objective or need are identified from further research of technical support information.</p> <p>4.2.A response option is selected from an analysis of the options, prevailing circumstance, regulatory requirements and commercial policies.</p> <p>4.3.Selected response option is documented and reported in accordance with regulatory and enterprise requirements and practices.</p>                                                                                                                                                                                    |
| 5. Restore the workplace   | <p>5.1.Materials that can be reused is collected and stored.</p> <p>5.2. Testing equipment and other support materials are cleaned, maintained and prepared ready for further use or stored in accordance with manufacturer/component supplier specifications and enterprise requirements.</p> <p>5.3.Waste and scrap is removed following workplace procedures.</p> <p>5.4.Equipment and work area are cleaned and inspected for serviceable condition in accordance with workplace procedures.</p> <p>5.5.Unserviceable equipment is tagged and faults identified in accordance with workplace procedures.</p> |

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

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

#### Required skills

- research, organise and understand technical information related to contemporary hybrid vehicle systems, monitoring and testing processes, diagnostic methods and options and safety procedures.
- communicate ideas and information to enable confirmation of work requirements and specifications, coordination of work with site supervisor, other workers and customers, reporting of work outcomes and completion of regulatory, commercial and vehicle information systems inputs.
- plan and organise activities, including the planning of analytical processes, establishment of evaluative (success) criteria, preparation and layout of the worksite and the obtaining of testing equipment and materials to avoid backtracking, workflow interruptions or wastage.
- work with others and in a team by recognising dependencies and using cooperative

## **REQUIRED SKILLS AND KNOWLEDGE**

approaches to optimise workflow and productivity.

- use mathematical ideas and techniques to complete measurements, calculate analytical requirements, calibrate and establish testing equipment and present analytical results.
- establish analytical processes, including diagnostic processes, which anticipate and allow for risks, cater for both direct and indirect evidence, avoid or minimise reworking and avoid wastage.
- use the workplace technology related to systems analysis and diagnosis, information research and management systems, testing equipment, maintenance equipment, tooling, calculators and measuring devices.

### **Required knowledge**

- mechanical theory covering the concepts and principles of mechanical, hydraulic and pneumatic systems.
- general knowledge of the concepts, principles and processes involved in planning and implementing systems analysis and evaluation.
- general knowledge of the types, functions and operations of systems.
- general knowledge of the theory of diagnosis, including concept, design and planning.
- general knowledge of the concepts, types, functions, operations and limitations of electric and hybrid vehicle systems.
- detailed knowledge of electrical theory and operation covering automotive digital computers, networked vehicles, voltage, current, resistance, power, capacitance, electrostatics, magnetism, inductance, high-voltage safety requirements, high-voltage battery technology, high-voltage inverter, high-voltage permanent magnet dc motors, high-voltage wire wound field magnet motors, high-voltage single and three-phase ac motors, high-voltage permanent magnet three-phase ac motors, dc stepper motors, series hybrid drive, parallel hybrid drive, discrete electronic components, logic families and radio frequency.
- detailed knowledge of the types, functions, operations and limitations of diagnostic testing equipment.
- general knowledge of the methods and processes for documenting and reporting diagnostic findings and recommendations.
- general knowledge of personal computer operation.

## 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, 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

- Interpret work order and locate and apply information.
- Apply safety requirements, including the isolation of equipment and use of personal protective equipment.
- Follow work instructions, operating procedures and inspection processes to:
  - minimise the risk of injury to self and others
  - prevent damage and wastage of goods, equipment and products
  - maintain required production output and product quality.
- Complete failure analyses on a minimum of three different hybrid vehicle systems with real or simulated multi-system and intermittent faults and identify, evaluate, select and document the most appropriate rectification measure.
- Analyse and validate or recommend variations to a minimum of two available repair/modification procedures for different hybrid vehicle systems.
- Work effectively with others.
- Modify activities to cater for variations in workplace context and environment.

#### Context of, and specific resources for assessment

Assessment may occur on the job or in a workplace simulated facility with process equipment, materials, work instructions and deadlines.

Access to a requirement and objective(s) for analysis and evaluation, operational hybrid vehicle systems with real or simulated faults, monitoring processes and testing equipment appropriate to the objective(s), research facilities and technical information and a work environment.

#### Method of assessment

Assessment of this unit of competence is most likely to be project related under real or simulated conditions and require portfolios or other forms of indirect evidence of process. Direct evidence may include certification of compliance of the final outcome/product or authorisation for use by a competent authority.

| <b>EVIDENCE GUIDE</b> |                                                                                                                                                                                                                                                                                                                                       |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <p>Assessment must confirm the inference that competence is able not only to be satisfied under the particular circumstances, but is able to be transferred to other circumstances.</p> <p>Competence in this unit may be assessed in conjunction with other functional units which together form part of the holistic work role.</p> |

## EVIDENCE GUIDE

### Guidance information for assessment

## 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, if used 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.

|                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Failure analysis and evaluation process</b>                                | The objective of the failure analysis and evaluation process may be to determine fault rectification measures, to effect variation in system characteristics and parameters or to enhance system performance.                                                                                                                                                                                               |
| <b>Electric and hybrid vehicle systems</b>                                    | Electric and hybrid vehicle systems are to include petrol/electric hybrid vehicles, series and parallel drive vehicles, industrial floor cleaners, forklifts and golf buggies.                                                                                                                                                                                                                              |
| <b>Coverage</b>                                                               | Coverage is to include battery technology, motor drive systems, motor controllers, air conditioning systems, electronic protection systems and multi-class bus systems.                                                                                                                                                                                                                                     |
| <b>Electric and hybrid vehicle systems electrical and electronic failures</b> | Electric and hybrid vehicle systems electrical and electronic failures covered by this unit are to include direct faults in input sensors, output actuators, including inverters, high-voltage AC and DC motors, high-voltage generators, wiring harness, computer systems, calibration/adjustment specifications, component specifications, component assembly, component damage and system modifications. |
| <b>Electric and hybrid vehicle systems failures</b>                           | Electric and hybrid vehicle systems failures covered by this unit are to include indirect faults caused by the influence of external systems                                                                                                                                                                                                                                                                |

| <b>RANGE STATEMENT</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      | (electrical and electronic) which may or may not be faulty in their primary operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Unit context</b>                  | <ul style="list-style-type: none"> <li>• OH&amp;S requirements include legislation, vehicle industry regulations, safety management systems, hazardous substances and dangerous goods code and safe operating procedures.</li> <li>• Work is carried out in accordance with legislative obligations, Australian Design Rules, environmental legislation, health regulations, manual handling procedures and organisation insurance requirements.</li> <li>• Work requires individuals to demonstrate research, analytical, judgement and problem-solving skills in the diagnosis of faults.</li> </ul> |
| <b>Evaluative criteria</b>           | Evaluative criteria, sometimes referred to as success factors, detail the criteria against which the achievement of the objectives of the analysis are to be judged. They are to include statistically based criteria and may include other measures.                                                                                                                                                                                                                                                                                                                                                  |
| <b>Isolation procedures</b>          | Equipment isolation procedures are to be to industry and enterprise standards and are to include the disarming of supplementary restraint systems (SRS) by manufacturer/ component supplier specifications.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Testing equipment</b>             | Testing equipment is to include multimeters, lab oscilloscopes, data scanners, test lights, battery testers and test LEDs, and may include manufacturer/component supplier testing equipment.                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Tests</b>                         | Tests to be conducted are to include batteries, drive motor, generator, inverter, chargers, motor controller, emissions, wiring and connector integrity, operation and specification of input and output devices, controlling electronic components and computers, data interpretation and readings related to direct, indirect and intermittent causes.                                                                                                                                                                                                                                               |
| <b>Personal protective equipment</b> | Personal protective equipment is to include that prescribed under legislation, regulations and enterprise policies and practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Information and procedures</b>    | <ul style="list-style-type: none"> <li>• Workplace procedures relating to the use of</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## RANGE STATEMENT

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>tooling and equipment.</p> <ul style="list-style-type: none"> <li>• Workplace procedures relating to reporting and communication.</li> <li>• Manufacturer/component supplier specifications and application procedures for testing equipment and materials.</li> <li>• Manufacturer/component supplier specifications, schematics and operational procedures related to electric and hybrid vehicle systems.</li> <li>• Australian Design Rules.</li> <li>• Vehicle industry regulations.</li> <li>• Vehicle industry publications related to electric and hybrid vehicle system technology and technology changes.</li> </ul> |
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## Unit Sector(s)

|             |           |
|-------------|-----------|
| Unit sector | Technical |
|-------------|-----------|

## Co-requisite units

|                    |  |
|--------------------|--|
| Co-requisite units |  |
|                    |  |
|                    |  |

## Competency field

|                  |  |
|------------------|--|
| Competency field |  |
|------------------|--|