### Unit 456

**Knowledge of diagnosis and rectification of vehicle auxiliary electrical faults**

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<th>UAN:</th>
<th>A/601/3746</th>
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<td>Level:</td>
<td>3</td>
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<td>Credit value:</td>
<td>45</td>
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<td>GLH:</td>
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**Relationship to NOS:**

This unit is linked to AE06 Diagnose and Rectify Motor Electrical Units and Component Faults.

**Assessment requirements specified by a sector or regulatory body:**

This unit was developed by the IMI, the sector skills council for the automotive retail industry. All assessments have been developed in accordance with the IMI Assessment Requirements for VRQs.

**Aim:**

This unit enables the learner to develop an understanding of diagnosis and rectification of vehicle auxiliary electrical systems and their units. It also covers the evaluation of performance of the systems. This includes Si, CI, Hybrid and Alternative fuel vehicles.

### Learning outcome

The learner will:

1. understand vehicle electrical and electronic principles

#### Assessment criteria

The learner can:

1.1 explain the principles of electrical inputs, outputs, voltages and oscilloscope patterns, digital and fibre optics
1.2 explain the principles of sensor inputs, computer processing and actuator outputs
1.3 identify sensor types (passive and active)
1.4 identify the electrical principles that are related to light vehicle electrical circuits.

### Learning outcome

The learner will:

2. understand how light vehicle auxiliary electrical systems operate

#### Assessment criteria

The learner can:

2.1 identify advanced automotive auxiliary electrical system components
2.2 explain the construction and operation of automotive auxiliary electrical systems
2.3 explain the interaction between electrical, electronic and mechanical components within the system defined
2.4 explain the operation of the electrical and electronic systems for electric, hybrid and alternative fuel vehicles including regenerative braking systems
2.5 explain how electrical systems interlink and interact, including multiplexing and fibre optics
2.6 compare automotive auxiliary electrical system components and assemblies against alternatives to identify differences in construction and operation.

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<th>Learning outcome</th>
<th>The learner will:</th>
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<td>3.</td>
<td>understand how to diagnose and rectify faults in auxiliary electrical systems</td>
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<th>Assessment criteria</th>
<th>The learner can:</th>
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<tr>
<td>3.1</td>
<td>explain the symptoms and causes of faults found in automotive auxiliary electrical systems</td>
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<td>3.2</td>
<td>explain systematic diagnostic techniques used in identifying automotive auxiliary electrical system faults</td>
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<td>3.3</td>
<td>explain how to examine, measure and make suitable adjustments to components</td>
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<td>3.4</td>
<td>explain how to carry out the rectification activities in order to correct the faults in the automotive auxiliary electrical systems</td>
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<td>3.5</td>
<td>explain how to select, prepare and use diagnostic and rectification equipment for automotive auxiliary electrical systems</td>
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<td>3.6</td>
<td>explain how to evaluate and interpret test results found in diagnosing automotive auxiliary electrical system faults against vehicle manufacturer specifications and settings</td>
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<td>3.7</td>
<td>explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance.</td>
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Supporting information

Unit range

The electrical principles that are related to light vehicle electrical circuits:

a. Ohms law
b. Voltage
c. Power
d. Current (AC and DC)
e. Resistance
f. Magnetism
g. Electromagnetism and electromagnetic induction
h. Digital and fibre optic principles
i. Electrical units and symbols
j. Electrical and electronic terminology
k. Relevant electrical safety.

Battery and charging

a. The construction and operation of vehicle batteries including:
   i. low maintenance and maintenance free
   ii. lead acid and nickel cadmium types
   iii. cells
   iv. separators
   v. plates
   vi. electrolyte.
b. The operation of the vehicle charging system:
   i. alternator
   ii. rotor
   iii. stator
   iv. slip ring
   v. brush assembly
   vi. three phase output
   vii. diode rectification pack
   viii. voltage regulation
   ix. phased winding connections
   x. cooling fan
   xi. alternator drive system.

Starting

a. The layout, construction and operation of engine starting systems: inertia and pre-engaged principles.
b. The function and operation of the following components:
   i. inertia and pre-engaged starter motor
   ii. starter ring gear
   iii. pinion
   iv. starter solenoid
v. ignition/starter switch
vi. starter relay (if appropriate)
vii. one-way clutch (pre-engaged starter motor).

Lighting systems and technology
a. Lighting systems should include:
i. Xenon lighting
ii. gas discharge lighting
iii. ballast system
iv. LED
v. intelligent front lighting
vi. blue lights
vii. complex reflectors
viii. fibre optic
ix. optical patterning.

Lighting circuits and the relationship between each circuit
a. Circuits must include:
i. sidelights including number plate lights and marker lights
ii. dipped beam
iii. main beam
iv. dim/dip
v. indicators and hazard lights
vi. high intensity and fog light.

Common faults and testing methods associated with external lighting system
a. Fault diagnosis for:
i. lighting systems failing to operate correctly
ii. switches
iii. relays
iv. bulbs failing to operate.

The operating principles of external lighting systems and multiplexing systems
a. To include all external lighting systems and a good knowledge of multiplexing systems.

The different types of electric windows and mirror systems and components
a. Components should include:
i. window
ii. mirror motors
iii. multi-functional switches
iv. relays
v. total closure modules.

The function of component parts in the electric window and mirror systems
a. Components must include:
i. motors
ii. relays
iii. interfaces
iv. modules
v. switches.
The operating principles of electric windows and mirror systems
a. Operating principles of the following:
   i. motors
   ii. interfaces
   iii. switches
   iv. modules.

Common faults and testing methods associated with electric windows and mirror systems
a. Fault diagnosis for:
   i. electric windows failing to open or close
   ii. electric mirrors fail to adjust
   iii. slow operation on both systems.

The different types of screen heating systems and components
a. Systems must include:
   i. heated front screens
   ii. heated rear screens
   iii. heated mirrors.

The function and operating principles of components for heated screen and mirror systems
a. Components must include:
   i. front and rear screen elements
   ii. mirror elements
   iii. time control relays
   iv. multifunction relays and switches.

Common faults and testing methods associated with heated screen and mirror systems
a. Faults must include:
   i. screen elements not operating
   ii. timer relays not operating and staying on permanently.

The different types of I.C.E. systems and components
a. Systems and components must include:
   i. radio CD and multi play units
   ii. DVD players
   iii. MP3 players
   iv. speakers
   v. aerial systems
   vi. amplifiers
   vii. V.D.U. screens
   viii. Satellite Navigation
   ix. communication units.

The function of components in I.C.E. systems
a. Systems include:
   i. radios
   ii. CD players
   iii. video players
   iv. DVD players
   v. aerial systems
   vi. speakers
vii. amplifiers
viii. VDU screens
ix. mobile communication units.

The operating principles of I.C.E. systems
a. Operation of entertainment systems speaker and aerial systems.

Common faults and testing methods associated with I.C.E. systems
a. Faults to include:
   i. entertainment and navigation units not operating
   ii. speaker, aerial and amplifier systems not functioning correctly
   iii. excessive radio interference (suppression)
   iv. use of diagnostic computers and systems.

The different types of integrated security/warning systems and components
a. Components to include:
   i. control units
   ii. alarm modules
   iii. audible warning units
   iv. immobiliser units
   v. sensing units
   vi. horn
   vii. audible warning speakers.

The function of component parts in integrated security and warning systems
a. Components to include
   i. control units
   ii. alarm modules
   iii. audible warning units
   iv. interior sensing systems
   v. immobiliser units
   vi. relays
   vii. LEDs
   viii. horns.

The operating principles of integrated security and warning systems
a. Operation of alarm systems and audible warning units.

The relevant legislation relevant to security and warning systems
a. Find and apply all relevant legislation for the fitment and use of security and warning systems.

Common faults and testing methods associated with security and warning systems
a. Components to include:
   i. control units
   ii. audible warning units
   iii. immobiliser units
   iv. horns
   v. relays
   vi. LEDs
vii. wiring
viii. connections and protection devices
ix. removal and refitting procedures
x. using computer diagnostics to identify faults
xi. use of manufacturer’s diagnostic equipment.

The different wiper system components
a. Components must include:
   i. wiper motors
   ii. washer motors
   iii. wiper linkage
   iv. multifunction relays
   v. headlamp wash/wipe.

The function of component wiper and washer components
a. Components and systems must include:
   i. wiper motors
   ii. intermittent wash/wipe relays
   iii. parking systems.

The operating principles, faults and testing methods of wiper and washer systems
a. Principles, fault diagnosis and testing for:
   i. wiper motors failing
   ii. damaged linkages
   iii. incorrect operation of intermittent and parking systems
   iv. earth faults
   v. control unit failure.

The different heater, cooling system components and air con.

a. Components include:
   i. heater motors
   ii. speed rheostats
   iii. switches
   iv. valves
   v. radiator cooling fan motors
   vi. relays
   vii. air conditioning units.

The function of component heater, cooling parts and air conditioning
a. Components include:
   i. heater motors
   ii. rheostats
   iii. valves
   iv. switches
   v. cooling fan motors
   vi. air conditioning units
   vii. thermostatic switches.
The operating principles of heater, cooling systems and air conditioning
a. Principles to include:
   i. conduction
   ii. convection
   iii. radiation
   iv. circulation
   v. boiling points
   vi. states of matter (Gas, liquid, solid)
   vii. temperature control
   viii. antifreeze mixtures
   ix. heat transfer.

Common faults and testing methods associated with heater, cooling systems and air conditioning
a. Fault diagnosis for:
   i. heater motor failing to operate on all/one speed
   ii. radiator cooling fan not operating
   iii. valves
   iv. relays
   v. switches not operating
   vi. electrical related faults on the air conditioning system.

The different types of locking system components
a. Door locking actuators, solenoids, deadlocking actuators, anti-theft modules and boot release solenoids.

The function of component parts in the locking system
a. Solenoids, actuators (electrical and pneumatic), multifunctional relays, anti-theft modules and release systems.

The operating principles of locking systems
a. Doors and cabs.

Common faults and testing methods associated with locking systems
a. Door locking actuators, solenoids, connections, wiring, relays, and protection devices/fuses.

The different types of Supplementary Restraint and Airbag systems
a. Components include:
   i. control units
   ii. sensors
   iii. seat belt pretensioners
   iv. airbag assemblies
   v. wiring systems
   vi. warning systems.

The function of component parts in the Supplementary Restraint and Airbag systems
a. Components include:
   i. control units
   ii. interfaces
iii. sensors
iv. airbag units
v. pretensioners.

The operating principles of Supplementary Restraint and Airbag systems
a. Operation of the sensors.
b. Operation of the airbag unit.
c. Operation of the various types of pretension.
d. Safe handling procedures and regulations.

Common faults and testing methods associated Supplementary Restraint and Airbag systems
a. Fault diagnosis for Airbag and SRS faults:
   i. fault code identification
   ii. wiring faults
   iii. component failure
   iv. earth problems
   v. sensor faults.