

Unit 456

Knowledge of diagnosis and rectification of vehicle auxiliary electrical faults

UAN:	A/601/3746
Level:	3
Credit value:	45
GLH:	6
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.

Learning outcome	The learner will:
3.	understand how to diagnose and rectify faults in auxiliary electrical systems

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

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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
 - ii. valves
 - iii. switches
 - iv. relays
 - 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.