Assessment Requirements

Unit AE04K – Knowledge of Diagnosis and Rectification of Engine Electrical Faults

Content:

Advanced battery technology

a. Batteries must include:
    i. maintenance free
    ii. sodium-nickel-chloride
    iii. fuel cell
    iv. sodium sulphur and swing lead acid
    v. fuel cell
b. Electrochemistry.
c. Calculation on battery efficiency/rating.

Battery condition and faults

a. Faults including:
    i. battery not holding charge
    ii. unwanted drain
    iii. diluted electrolyte
    iv. Impurities in electrolyte
    v. excessive gassing
    vi. low state of charge
    vii. sulphating
    viii. excessive volt drop during component operation
    ix. open circuit cell
    x. overcharging
    xi. temperature related faults

Operating principles charging systems

a. Charging systems should include:
    i. alternators with internal and external regulators
    ii. water cooled alternators
    iii. integrated alternators (ISAD)
    iv. dynalto systems.
b. Electrical loads imposed by vehicle systems.
c. Rectification and regulation.

Test procedures for diagnosing faults with charging systems

a. Stages in the fault finding process to include:
    i. hand and eye checks
    ii. supply voltage
    iii. generator outputs
    iv. under and off load testing for rectification and regulation
    v. bench testing
    vi. vehicle testing.

Symptoms of faults found on charging systems.

a. Faults to include:
    i. charging light inoperative
    ii. charging light staying on all the time

iii. battery discharges during normal operation
iv. high resistance in charging circuits
v. loose broken wiring/connections

b. Internal faults:
i. diode open circuit
ii. worn brushes
iii. regulator faults
iv. rotor open circuit
v. stator open circuit

Advanced charging system technology.

a. Charge balance calculation.
b. Charging system problems and solutions including:
i. upgrading alternator
ii. power management systems
iii. two stage
iv. dual voltage systems

Advanced starting system technology

a. Outputs in relation to engine size:
i. speed
ii. torque
iii. power
iv. efficiency
b. System design characteristics:
i. DC motor characteristics
ii. parallel
iii. shunt
iv. compound
v. series
c. Electronic starter control.
d. High voltage systems.
e. Inhibitor circuits.
f. Starter types to include:
i. pre – engaged
ii. permanent magnet for heavy and diesel vehicles
iii. integrated starters

Faults and diagnostic procedures for starting systems.

a. Components to include:
i. solenoid
ii. armature
iii. commutator
iv. brush assemblies
v. drive systems
vi. ignition switches
vii. torque drive systems.
b. Faults to include:
i. battery
ii. wiring
iii. starter switch
iv. inhibitor switch
v. pinion
vi. flywheel
vii. bearings

viii. internal starter components

c. Identify stages of fault finding.

Ignition system technology

a. Components to include:
   i. ignition switch
   ii. oil packs
   iii. spark plugs and leads
   iv. distributors and amplifier units
   v. knock sensor
   vi. engine speed sensor
   vii. manifold sensor
   viii. coolant sensor
   ix. ECU
b. Materials used in component manufacture.
c. Systems top include:
   i. constant energy systems
   ii. hall effect
   iii. inductive pulse
   iv. open and closed loop
   v. distributorless ignition
   vi. direct ignition
   vii. advance angle timing
   viii. integrated ignition circuit

The construction of ignition components

a. Spark plugs including:
   i. heat range
   ii. electrode gap
   iii. choosing correct plug
b. Ignition components to include:
   i. ignition switch
   ii. coil packs and leads
   iii. resistors
   iv. amplifier units
   v. electronic systems

Faults and diagnostic procedures for ignition systems

a. Diagnostic equipment and procedures relating to the ignition system and components including:
   i. wiring, and connections
   ii. code readers
   iii. oscilloscopes
   iv. ohmmeter
   v. volt meter
   vi. other dedicated equipment
   vii. testing sequences
b. Faults to include:
   i. no spark
   ii. cold and hot starting problems
   iii. erratic running
   iv. damp components
   v. worn components
   vi. incorrect plug gaps
   vii. high resistance in circuit
   viii. intermittent connections

ix. incorrect timing
x. coil or distributor cap tracking
xi. HT breaking down
xii. running on when switched off
xiii. pinking and knocking
xiv. misfire
xv. erratic idle
xvi. lack of power
xvii. backfire and fouling

The operation and requirements of fuel systems

a. Fuel systems to include:
   i. single point
   ii. multi point control layout
   iii. sequential multi point
   iv. diesel fuel injection
   v. petrol injection
   vi. computer controlled
   vii. lean burn
   viii. common rail
   ix. catalytic converters
b. Theories and terms to include:
   i. combustion
   ii. burn range and rate
   iii. detonation
   iv. mixture strength effects
   v. air-fuel ratios
   vi. fuelling and emissions
   vii. CoNox
   viii. HC
   ix. exhaust emission regulations

The function of fuel system components and the relationship between components

a. Petrol fuel systems:
   i. stepper motors
   ii. sensors
   iii. injectors
   iv. fuel pumps
   v. relays
   vi. cold start
   vii. lambda sensors
   viii. idle control actuators
   ix. single and multipoint injection systems
   x. throttle valve potentiometer
   xi. phase sensor
b. Compression ignition systems:
   i. engine stop solenoid
   ii. injectors
   iii. fuel pumps
   iv. relays
   v. heater plugs
   vi. injection pumps
   vii. High pressure pumps
   viii. filters

c. Block, flow and circuit diagrams.

Faults and diagnostic procedures for fuel system systems

a. The stages of fault finding.
b. Diagnostic procedures for including:
    i. the use of fault code readers
    ii. oscilloscopes
    iii. break out boxes
    iv. on-board diagnostics
    v. other dedicated equipment
c. Faults:
    i. no fuel
    ii. filters dirty or blocked
    iii. fuel pump
    iv. hot and cold start
    v. erratic idle
    vi. misfire
    vii. stalling
    viii. lack of power
    ix. backfire
    x. incorrect co
    xi. air leaks

The operation of engine management components and relationship with vehicle systems

a. Components:
    i. ECU units
    ii. input sensors
    iii. output actuators
b. Data flow, distribution and interconnection
b. Control of phases:
    i. starting
    ii. enrichment
    iii. cold running
    iv. idle
    v. full load
    vi. acceleration
    vii. deceleration
    viii. engine speed limitation
d. CANBUS.
e. Performance mapping implications.
f. Block, flow and circuit diagrams.

Faults and diagnostic procedures for engine management systems

a. The stages of fault finding.
b. Diagnostic procedures including:
    i. the use of fault code readers
    ii. oscilloscope
    iii. break out boxes
    iv. on-board diagnostics
    v. other dedicated equipment
c. Faults:
    i. engine fails to start
    ii. hot and cold start
    iii. erratic idle
    iv. misfire

v. hesitation under acceleration or constant speed
vi. knock
vii. poor response
viii. poor fuel consumption
ix. incorrect CO
x. poor performance
xi. limp home mode
xii. fuses

Adjustments to components are:

a. settings
b. input and output values
c. voltages
d. current consumption
e. resistance
f. output patterns with oscilloscope
g. condition
h. wear and performance