

Assessment Requirements

Unit LV07K – Knowledge of Diagnosis and Rectification of Light Vehicle Engine Faults

Content:

Single and Multi-Point Petrol Injection Systems

- a. The operation and construction of single and multi-point injection systems including:
 - i. types of air flow sensor
 - ii. fuel supply system
 - iii. fuel pump
 - iv. filter
 - v. fuel regulator
 - vi. injectors
 - vii. sequential injection
 - viii. continuous injection
 - ix. semi-continuous injection
 - x. electronic control unit (ECU)
 - xi. injector pulse width
 - xii. sensors
- b. The operation of each system under various operating conditions including:
 - i. cold starting
 - ii. warm up
 - iii. hot starting
 - iv. acceleration
 - v. deceleration
 - vi. cruising
 - vii. full load
- c. Engine speed limiting and knock sensing.

Engine Management

- a. The function and purpose of engine management systems.
- b. The difference between analogue, digital, programmable and non-programmable systems.
- c. Open loop and closed loop control, types of input and output devices.
- d. The function and operation of digital components and systems.
- e. The operation of engine management systems under various conditions.

Valve Mechanisms

- a. The reasons for variable valve timing and multi-valve arrangements and the effect on performance.
- b. Layout of multi-valve arrangements, components, operation and drive arrangements.
- c. Construction features and operation of variable valve timing engines and electronic control.

Pressure Charged Induction Systems

- a. The meaning of volumetric efficiency; explain the effect of volumetric efficiency on engine performance, torque and power.
- b. The methods used to improve volumetric efficiency:
 - i. variable valve timing
 - ii. turbo-charging
 - iii. supercharging
 - iv. intercoolers
- c. The operation of turbo-chargers and the purpose of:
 - i. turbo-charging

- ii. supercharging
 - iii. intercoolers
 - iv. waste gates
 - v. exhaust gas recirculation
- d. Advantages and disadvantages of pressure charging induction systems.

Terms Associated with Combustion

- a. Flame travel, pre-ignition and detonation.
- b. Fuel properties:
 - i. octane rating
 - ii. flash point
 - iii. fire point
 - iv. volatility
 - v. composition of petrol and diesel fuels
 - vi. hydro-carbon content
- c. Composition of carbon fuels (petrol and diesel):
 - i. % hydrogen and carbon
 - ii. composition of air
 - iii. % oxygen
 - iv. % nitrogen
- d. Combustion process for spark ignition and compression ignition engines:
 - i. air fuel ratio
 - ii. lambda ratio
 - iii. stoichiometric ratio
- e. The by-products of combustion for different engine conditions and fuel mixtures:
 - i. CO
 - ii. CO₂
 - iii. O
 - iv. N
 - v. H₂O
 - vi. NO_x
- f. Describe the legal requirements for exhaust emissions;
 - i. MOT requirements
 - ii. EURO 3
 - iii. 4 & 5 regulations

Assessment, Repair and Restoration of Mechanical Engine Components

- a. How engine mechanical components are assessed and measured for wear and serviceability:
 - i. cylinder bores
 - ii. cylinder heads
 - iii. crankshaft journals
 - iv. valve faces
 - v. valve guides
 - vi. valve seats
 - vii. camshafts
- b. The methods used for the repair and restoration of engine components.

Cooling, Heating and Ventilation

- a. The components, operating principles, and functions of engine cooling systems
- b. Procedures used to remove, replace and adjust cooling system components
 - i. cooling fans and control devices
 - ii. header tanks, radiators and pressure caps
 - iii. heater matrix's and temperature control systems
 - iv. expansion tanks hoses, clips and pipes
 - v. thermostats impellers and coolant

- vi. ventilation systems
- c. The preparation and method of use of appropriate specialist equipment used to evaluate system performance following component replacement
 - i. system pressure testers
 - ii. pressure cap testers
 - iii. hydrometer, or anti-freeze testing equipment
 - iv. chemical tests for the detection of combustion gas
- d. The layout and construction of internal heater systems.
- e. The controls and connections within internal heater system.
- f. Symptoms and faults associated with cooling systems:
 - i. water leaks
 - ii. water in oil
 - iii. internal heating system: efficiency, operation, leaks, controls, air filtration, air leaks and contamination
 - iv. excessively low or high coolant temperature
- g. The procedures used when inspecting
 - i. internal heating system
 - ii. cooling system

Air Conditioning Systems

- a. The operation of air conditioning components including:
 - i. compressors
 - ii. condensers
 - iii. receivers
 - iv. dryers
 - v. connections
 - vi. valves
 - vii. hoses
 - viii. thermostats
 - ix. refrigerants
- b. The layout and operation of air conditioning systems.

Climate Control Systems

- a. Identify components used in climate control systems including:
 - i. sensors
 - ii. speed controls
 - iii. control systems
 - iv. servomotors
 - v. electronic components
- b. The layout of climate control systems.
- c. The operation of climate control system.

Symptoms and Faults in Engine Mechanical Systems and Components

- a. Symptoms and faults related to:
 - i. worn cylinders
 - ii. cylinder liners
 - iii. pistons
 - iv. piston rings
 - v. crankshaft
 - vi. camshaft
 - vii. bearings
 - viii. cylinder head and gasket
 - ix. valves
 - x. valve seats and valve guides

- xi. cambelts
- xii. lubrication system and components
- xiii. oil pump
- xiv. relief valve
- xv. filter
- xvi. turbo-charger
- xvii. supercharger

Diagnosis of Faults in Engine Mechanical Systems and Components

- a. Interpret information for:
 - i. diagnostic tests
 - ii. manufacturer's vehicle and equipment specifications
 - iii. use of equipment
 - iv. testing procedures
 - v. test plans
 - vi. legal requirements
- b. The preparation of tools and equipment for use in diagnostic testing and assessment.
- c. Systematic assessment, testing and inspection of engine components and systems including:
 - i. mechanical system & component condition
 - ii. engine balance
 - iii. power balance
 - iv. performance and operation
 - v. wear
 - vi. run out
 - vii. alignment
- d. Use of appropriate tools and equipment including:
 - i. compression gauges
 - ii. leakage testers
 - iii. cylinder balance tester
 - iv. pressure gauges
 - v. micrometers
 - vi. vernier gauges
- e. Evaluate and interpret test results from diagnostic testing.
- f. Compare test result and values with vehicle manufacturer's specifications and settings.
- g. The procedures for dismantling, components and systems and the use of appropriate equipment and procedures.
- h. Assess, examine and measure components including:
 - i. settings
 - ii. values
 - iii. condition
 - iv. wear and performance of components and systems
- i. Probable faults
 - i. malfunctions
 - ii. incorrect settings
 - iii. wear
- j. Rectification or replacement procedures.

Evaluate operation of components and systems following diagnosis and repair to confirm system performance.

Faults and Symptoms in Ignition Systems

- a. Ignition system failure or malfunctions including:
 - i. no spark
 - ii. misfiring
 - iii. backfiring
 - iv. cold or hot starting problems

- v. poor performance
- vi. pre-ignition
- vii. detonation
- viii. exhaust emission levels
- ix. fuel consumption
- x. low power
- xi. unstable idle speed

Faults and Symptoms in Electronic Petrol and Diesel Injection Systems

- a. Petrol and diesel injection system failures or malfunctions including:
 - i. cold or hot starting problems
 - ii. poor performance
 - iii. exhaust emissions
 - iv. high fuel consumption
 - v. erratic running
 - vi. low power
 - vii. unstable idle speed

Faults and Symptoms in Engine Management Systems

- a. Engine management system failure or malfunctions including:
 - i. misfiring
 - ii. backfiring
 - iii. cold or hot starting problems
 - iv. poor performance
 - v. pre-ignition
 - vi. detonation
 - vii. exhaust emission levels
 - viii. fuel consumption
 - ix. low power
 - x. unstable idle speed

Diagnosis of Faults in Electronic Ignition, Petrol and Diesel Injection and Engine Management Systems

- a. Locate and interpret information for:
 - i. diagnostic tests
 - ii. manufacturer's vehicle and equipment specifications
 - iii. use of equipment
 - iv. testing procedures
 - v. test plans
 - vi. fault codes
 - vii. legal requirements
- b. The preparation of tools and equipment for use in diagnostic testing and assessment.
- c. Conduct systematic assessment, testing of engine systems including:
 - i. component condition and performance
 - ii. component settings
 - iii. component values
 - iv. electrical and electronic values
 - v. system performance and operation
 - vi. use of appropriate tools and equipment including gauges
 - vii. multi-meter
 - viii. breakout box
 - ix. oscilloscope
 - x. diagnostic tester
 - xi. manufacturer's dedicated equipment
 - xii. exhaust gas analyser

- xiii. fuel flow meter
 - xiv. pressure gauges
- d. Evaluate and interpret test results from diagnostic testing.
- e. Compare test result, values and fault codes with vehicle manufacturer's specifications and settings.
- f. The procedures for dismantling, components and systems using appropriate equipment.
- g. Assess, examine and measure components including:
 - i. settings
 - ii. input and output values
 - iii. voltages
 - iv. current consumption
 - v. resistance
 - vi. output patterns with oscilloscope
 - vii. condition
 - viii. wear and performance of components and systems
- h. Identify probable faults and indications of:
 - i. faults
 - ii. malfunctions
 - iii. incorrect settings
 - iv. wear
 - v. values
 - vi. inputs and outputs
 - vii. fault codes
- i. Rectification or replacement procedures.
- j. Evaluation and the operation of components and systems following diagnosis and repair to confirm system performance.

Faults and Symptoms in Vehicle Comfort Systems

- a. System failure, malfunction or ineffectiveness of internal heating system, air conditioning system or climatic control system including:
 - i. leaks
 - ii. abnormal noise
 - iii. ineffective operation
 - iv. failure to operate
 - v. control faults
 - vi. inadequate operation

Diagnosis of Faults in Vehicle Comfort Systems

- a. Locate and interpret information for:
 - i. diagnostic tests
 - ii. manufacturer's vehicle and equipment specifications
 - iii. use of equipment
 - iv. testing procedures
 - v. test plans
 - vi. fault codes
 - vii. legal requirements
- b. The preparation of tools and equipment for use in diagnostic testing and assessment.
- c. Conduct systematic assessment and testing of comfort systems including:
 - i. component condition and performance
 - ii. component settings
 - iii. component values
 - iv. electrical and electronic values
 - v. system performance and operation
 - vi. drive belts
 - vii. controls
 - viii. compressors
 - ix. condensers

- x. receivers
 - xi. dryers
 - xii. connections
 - xiii. valve
 - xiv. hoses
 - xv. thermostats and refrigerants
 - xvi. sensors
 - xvii. speed controls
 - xviii. control systems
 - xix. servomotors
- d. Use of appropriate tools and equipment including:
- i. pressure gauges
 - ii. multi-meter
 - iii. breakout box
 - iv. oscilloscope
 - v. diagnostic tester
 - vi. manufacturer's dedicated equipment
 - vii. flow meter
- e. Evaluate and interpret test results from diagnostic testing.
- f. Compare test result, values and fault codes with vehicle manufacturer's specifications and settings
- g. How to dismantle, components and systems using appropriate equipment and procedures
- h. How to assess, examine and measure components including: settings, input and output values, voltages, current consumption, resistance, output patterns with oscilloscope, pressures, condition, wear and performance of components and systems
- i. Identification of probable faults and indications of faults, malfunctions, incorrect settings, wear, values, inputs and outputs, fault codes, pressures and leaks
- j. Rectification or replacement procedures
- k. Evaluation and operation of components and systems following diagnosis and repair to confirm system performance