

Assessment Requirements

Unit HV07K – Knowledge of Diagnosis and Rectification of Heavy Vehicle Engine Faults

Content:

- a. The construction and operation of engine systems
 - i. electronic diesel control systems (EDC)
 - ii. common rail fuel systems
 - iii. unit injection fuel systems
 - iv. engine management
 - v. pressure charged induction systems
 - vi. exhaust emission reduction systems
 - vii. mechanical fuel injection systems
 - viii. valve mechanisms
 - ix. heating, ventilation and cooling

Common Rail and Unit Injection Systems

- a. The operation and construction of common rail and unit injection systems including:
 - i. types of air flow sensor
 - ii. fuel supply system
 - iii. fuel pump
 - iv. filter
 - v. fuel regulator
 - vi. injectors
 - vii. main injection
 - viii. pre injection
 - ix. post 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

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.

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 geometry turbo-charging
 - ii. turbo-charging

- iii. supercharging
- iv. aftercoolers (intercooler)
- c. The operation of turbo-chargers and the purpose of:
 - i. turbo-charging
 - ii. supercharging
 - iii. aftercoolers (intercooler)
 - iv. waste gates
 - v. exhaust gas recirculation
- d. Advantages and disadvantages of pressure charging induction systems.

Terms Associated with Combustion

- a. Phases of combustion, flame travel, pre-injection and diesel knock.
- b. Fuel properties:
 - i. cetane rating
 - ii. flash point
 - iii. fire point
 - iv. volatility
 - v. composition of compression ignition fuels
 - vi. hydro-carbon content
- c. Composition of carbon fuels:
 - i. % hydrogen and carbon
 - ii. composition of air

The by-products of combustion for compression ignition engines:

- i. Carbon Monoxide
- ii. Carbon dioxide
- iii. Oxides of Nitrogen
- iv. Particulates

Diesel Exhaust Emission Control

- a. Describe the legal requirements for exhaust emissions;
 - i. MOT requirements
 - ii. EU regulations
- b. The operation and construction of Selective Catalytic Reduction systems
- c. The operation and construction of Exhaust Gas Recirculation systems

Assessment, Repair and Restoration of Mechanical Engine Components

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

Symptoms and Faults in Engine Mechanical Systems and Components

- a. Symptoms and faults related to:
 - i. engine mechanical components
 - ii. injection systems
 - iii. fuel supply systems
 - iv. engine management system
 - v. pressure charged induction systems
 - vi. exhaust emission reduction systems

- vii. valve mechanisms
- viii. heating and ventilation
- ix. cooling
- x. worn cylinders
- xi. cylinder liners
- xii. pistons
- xiii. piston rings
- xiv. crankshaft
- xv. camshaft
- xvi. bearings
- xvii. cylinder head and gasket
- xviii. valves
- xix. valve seats and valve guides
- xx. camshaft drives
- xxi. lubrication system and components
- xxii. oil pump
- xxiii. relief valve
- xxiv. filter
- xxv. 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. Make suitable adjustments to components including:
 - i. settings
 - ii. input and output values
 - iii. voltages
 - iv. current consumption
 - v. resistance
 - vi. output patterns with oscilloscope
 - vii. pressures
 - viii. condition
 - ix. wear and performance
- j. Probable faults
 - i. malfunctions
 - ii. incorrect settings
 - iii. wear
- k. Rectification or replacement procedures.
- l. Evaluate operation of components and systems following diagnosis and repair to confirm system performance.

Faults and Symptoms in Electronic Diesel Injection Systems

- a. 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 power
 - vi. unstable idle speed

Faults and Symptoms in Engine Management Systems

- a. Engine management system failure or malfunctions including:
 - vii. misfiring
 - viii. cold or hot starting problems
 - ix. poor performance
 - x. diesel knock
 - xi. exhaust emission levels
 - xii. fuel consumption
 - xiii. low power
 - x. unstable idle speed

Diagnosis of Faults in Electronic 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
 - iii. electrical and electronic values
 - iv. system performance and operation

- v. use of appropriate tools and equipment including gauges
- vi. multi-meter
- vii. breakout box
- viii. oscilloscope
- ix. diagnostic tester
- x. manufacturer's dedicated equipment
- xi. exhaust gas analyser
- xii. 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