Module 16: General Engine Diagnosis

- TERMS AND DEFINITIONS
- EVALUATING ENGINE PERFORMANCE
- BENEFITS OF OPERATOR QUESTIONNAIRE
- MAJOR CHECKPOINTS IN A VISUAL INSPECTION
- MAJOR PERFORMANCE CHECKPOINTS
- PERFORMANCE TEST MADE WITH THE ENGINE ON A DYNAMOMETER
- FUNCTIONS OF ENGINE COMPUTER FAULT DETECTION
- ENGINE COMPUTER FAULT CODE STORAGE
- ENGINE COMPUTER FAULT CODE RETRIEVAL
- SAE CODE IDENTIFIERS

Terms and Definitions

READY FOR REVIEW

- Aeration is foaming caused by air mixing with a liquid, such as oil or fuel.
- Dynamometer is a device that measures the engine power output by applying a load to the engine.
- Diagnostic data link (DDL) allows shop test equipment to "plug into" the electronic control module (ECM).
- Electronic control module (ECM) is a computer that processes information from engine sensors and controls the fuel injector solenoid.
- Electronic unit injector uses an ECM-controlled, injector-mounted electric solenoid to control the amount and timing of the injected fuel.
- Infrared thermometer is an instrument that measures temperatures up to 500°F (260°C).
- Magnahelic gauge is a sensitive instrument that measures small differences in pressure or vacuum.
- Manometer is a device that measures positive or negative pressure (vacuum).
  Note: A manometer may use a column of water or mercury (Hg) for making measurements.
- Mercury manometers are typically used in high heat applications such as exhaust manifolds.
- Personality module contains customer-specified information concerning engine performance.
- Pyrometer is a device that measures high exhaust temperatures [usually over 300°F (149°C)].
- Snapshot is ECM recordings at the time and operating parameters when a fault occurs.
- Symptom is an indication of a mechanical or electrical/electronic problem.
- Tachometer is a device that measures engine speed.
- Troubleshooting is a process using test instruments to locate and diagnose the cause of failure.

Evaluating Engine Performance

READY FOR REVIEW

- Surveying the operator is the best source of information.
- Visually inspect the vehicle.
  - Fluid levels
  - Fluid condition
  - Component condition
- Test the performance of the vehicle.
  - Without a dynamometer
  - With a dynamometer
- Use computer diagnostic abilities to test the vehicle.
  - On-board system self-tests
  - Hand-held testers
- Locate symptom(s) in the manufacturer's troubleshooting chart.
  - With a symptom
  - With a trouble code

Benefits of Operator Questionnaire

READY FOR REVIEW

- Provides direct communication between the operator and technician
- Assists the technician in troubleshooting, especially when no fault codes are available
- Eliminates wasted technician time by providing specific information

Major Checkpoints in a Visual Inspection

READY FOR REVIEW

- Cooling system
  - Levels
  - Condition (supplemental coolant additive level)
  - Maintenance history
  - Leaks (radiator/hoses/pump)
- Lubricating system
  - Level
  - Condition (sample)
  - Maintenance history
  - Leaks
- Fuel system
  - Fuel level
  - Condition (sample)
  - Leaks
  - Hoses/clamps
  - Wiring harnesses/connectors
- Electrical system
  - Belts
  - Connections (clean and tight/corroded)
  - Wiring harnesses/connectors
  - Battery electrolyte level
  - Charging system
- Air intake system
  - Filter(s)
  - Ducting/hoses
  - Clamps/joints
  - Turbocharger
- Exhaust system
  - Pipes
  - Connections
  - Muffler
  - Turbocharger

Major Performance Checkpoints

READY FOR REVIEW

- Cooling system
  - Pressure test the radiator/cap.
  - Check for bubbles/flow at the operating temperatures.
- Lubrication system
  - Pressure check with a shop gauge
  - Temperature check (sump)
- Fuel system
  - Pressure check
  - Flow (amount in a given time)
  - Aeration
- Electrical system
  - Voltage
  - Current
- Air intake system
  - Restriction level (vacuum)
  - Pressure test the intercooler core.
- Exhaust system
  - Restriction (back pressure)
  - Turbocharger noise

Performance Test Made With the Engine on a Dynamometer

READY FOR REVIEW

- Engine power output
  - Horsepower
  - Torque
- Exhaust smoke analysis
  - Blue—Excess lubrication oil in the combustion chamber
  - Black—Incomplete combustion of fuel
  - White—Noncombustion of fuel
- Fuel consumption
- Crankcase blow-by
- Air intake system
  - Restriction
  - Boost pressure
- Exhaust system
  - Back pressure
  - Temperature
- Lubrication system
  - Pressure
  - Temperature

Functions of Engine Computer Fault Detection

READY FOR REVIEW

- Sensing abnormal operation
  - The ECM detects abnormal input from the sensors.
  - The ECM determines the extent of variation.
  - If engine-threatening, the ECM limits the engine speed and power output.
- Communicating with the driver
  - Warning light
  - Warning buzzer (optional)
  - Power loss as the ECM begins to derate/rampdown
- Communicating with the technician
  - Fault code stored in memory
  - Snapshot data

Engine Computer Fault Code Storage

READY FOR REVIEW

- Inactive fault code
  - The "Check Engine" light illuminates while the problem exists.
  - The fault code is stored in memory.
  - The fault code is erased by a computer command.
- Active fault code
  - The "Check Engine" light comes on and stays on.
  - The fault code is stored in memory.
  - The fault code is erased by a computer command.
- Snapshot data
  - The fault code is stored in memory.
  - The ECM records the time (in engine hours).
  - The ECM records the engine operating conditions for a short time before and after the fault occurred.

Engine Computer Fault Code Retrieval

READY FOR REVIEW

- Hand-held communication tool
  - Connects to the DDL
  - Shows any fault stored in memory
  - Initiates a diagnostic sequence for the ECM to check all electronic components
  - Allows the technician to see the sensor output and actuator response
- Personal computer (PC) with a translator device
  - The translator connects to the DDL, and the PC connects to the translator.
  - Shows the fault codes
  - Shows the snapshot parameters on screen
  - Allows the technician to reprogram the PROM (or EEPROM) with new parameters (some systems)
- The "Check Engine" light
  - System activation (refer to the OEM troubleshooting manual)
    - Engine off, key on
    - OEM-authorized jumper wires or test leads installed in the DDL (some systems)
    - Pressing a diagnostic switch (some systems)
    - Lamp flashes are translated as digits for fault codes.
    - Examples are Code 25 = 2 flashes, pause, 5 flashes; Code 47 = 4 flashes, pause, 7 flashes.
    - Allows the technician access to the fault codes with no test equipment

SAE Code Identifiers

READY FOR REVIEW

- Each fault code uses three, three-digit number groups to describe the problem. An example would be: 128 s110 04.
  - The first three-digit number group is the message identifier (MID) that identifies which microprocessor is broadcasting the code.
  - The second three-digit number group is either the parameter identifier (PID) or the subsystem identifier (SID).
    - The PID gives a numerical value in degrees, volts, or psi.
    - The SID identifies the part that is malfunctioning.
  - The third three-digit number group is the fault mode identifier (FMI) that identifies what is wrong with the sensor signal and indicates whether the problem relates to the current flow or voltage.