OBD I and OBD II
On Board Diagnostics Second Generation (OBD II)
Objectives (1 of 5)

• Explain the differences between OBD I and OBD II
• Explain the criteria to illuminate the MIL
• Know where the DLC is located
Objectives (2 of 5)

• Describe how the MIL is extinguished after a fault is detected.
• Define Trip and Warm Up Cycle
• Know the difference between hard codes and pending codes
• Explain the purpose and function of the various monitors.
ON-BOARD DIAGNOSTICS GENERATION-II (OBD-II)

- PURPOSE AND FUNCTION OF OBD II
  - The automotive industry calls these systems On-Board Diagnostics (OBDs).
  - The California Air Resources Board (CARB) developed the first regulation requiring manufacturers selling vehicles in that state to install OBD.
  - OBD Generation I (OBD I) mandated in 1988
  - OBD II mandated 1996
Introduction

- OBD II is the second generation of on-board diagnostics.
- OBD I vehicles could have emission failures and not turn on the MIL.
- OBD II systems monitor performance of emission systems as well as failures.
OBD I vs OBD II (1 of 2)

- Changes in hardware:
  - Post-catalyst HO2S sensor
  - EVAP leak detection equipment
  - Faster PCMs with more storage capacity
  - Standard data link connector
OBD I vs OBD II (2 of 2)

- Changes in software were the biggest differences.
- PCM has more to do and stores more information.
- OBD II MIL only comes on for emission failures.
- MIL light comes on if a vehicle’s emissions exceed 1.5 times the allowable standard.
OBD II Requirements

- J1930 called for standardized:
  - Service information
  - Component names
  - Under hood labels
  - Trouble code meaning
Test Connector

- OBD II implemented the use of a “generic” scan tool for access to emission-related information.
- The 16 pin connector is also standardized.
- Generic information is limited.
OBD II Monitors

• In this section, we will look at the OBD II system monitors.
MONITORS

- A monitor is an organized method of testing a specific part of the system.
- Monitors are simply tests that the computer performs to evaluate components and systems.
- If a component or system failure is detected while a monitor is running, a DTC will be stored and the MIL illuminated by the second trip.
- The two types of monitors are:
  - CONTINUOUS MONITORS
  - NONCONTINUOUS MONITORS
OBD-II MONITOR INFORMATION
COMPREHENSIVE COMPONENT MONITOR

- The circuits and components covered by the comprehensive component monitor (CCM) do not include those directly monitored by another monitor.
- However, OBD II also requires that inputs from powertrain components to the PCM be tested for rationality, and that outputs to powertrain components from the PCM be tested for functionality.
- Both inputs and outputs are to be checked electrically.
- Rationality checks refer to a PCM comparison of input value to values.
ENABLING CRITERIA

- With so many different tests (monitors) to run, the PCM needs an internal director to keep track of when each monitor should run.
- As mentioned, different manufacturers have different names for this director, such as the diagnostic executive or the task manager.
- Each monitor has enabling criteria.
- These criteria are a set of conditions that must be met before the task manager will give the go-ahead for each monitor to run.
ENABLING CRITERIA

• Most enabling criteria follow simple logic, for example:
  ▫ The task manager will not authorize the start of the O2S monitor until the engine has reached operating temperature and the system has entered closed loop.
  ▫ The task manager will not authorize the start of the EGR monitor when the engine is at idle, because the EGR is always closed at this time.
Catalyst Efficiency Monitor

- It checks catalyst efficiency by looking at post HO2S sensor.
- Post HO2S should have very little response to exhaust stream compared to pre-catalyst HO2S.
- If pre- and post-HO2S are identical, then catalyst is deteriorated.
Misfire Monitor (1 of 3)

- If a cylinder is misfiring:
  - HC emissions produced, which the converter burns causing the converter to overheat
  - Adds oxygen to exhaust, which the computer senses as a lean mixture, adds even more fuel
Misfire Monitor (2 of 3)

- A misfire causes the crankshaft to slow down at regular intervals.
- Crankshaft position sensor is used to monitor speed of crankshaft.
Misfire Monitor (3 of 3)

- Three types of misfire:
  - Type A
    - Catalyst damaging - causes the MIL to flash
  - Type B
    - Emissions failure - steady MIL
  - Type C
    - Same as B, but indicates California I/M failure
Fuel System Monitor

• The fuel system is monitored for proper fuel mixture.
• If the long- and short-term fuel trims stay at their maximum limits for a set period of time, the MIL lights.
HO2S Monitor

- Both upstream and downstream heated oxygen sensors are tested.
- The sensor operation as well as the heater are checked.
EVAP Monitor

- Detects holes in the evaporative system .020” or larger
- Must be able to detect airflow through the system
- Uses either a vacuum or pressure to check for leaks
EGR Monitor

- The EGR system must be checked for flow rates.
- Low or high flow rates can affect emissions.
AIR System Monitor

• The AIR system has to be monitored for air flow in the exhaust.
• The system must also be able to monitor switching valves.
Comprehensive Component Monitor (1 of 2)

- Components are monitored for open or shorted circuits and rationality.
- Rationality may be checked using other sensors.
Comprehensive Component Monitor (2 of 2)

- Some signals checked:
  - ECT
  - MAP
  - TPS
  - MAF
  - Idle and injection control
OBD II Terms

- You should be familiar with the terms used in ODB II.
  - Drive cycle
  - Trip
  - Warm-up cycle
  - Freeze frame
Drive Cycle  (1 of 2)

• A monitor is complete after it has been checked for function and cleared by the PCM.
• To complete a drive cycle, all five trip monitors must be completed followed by the catalyst efficiency monitor.
A drive cycle may not be completed every time the vehicle is driven.
The criteria to complete a monitor have to be met for each test to run.
If the criteria are not met, the test is not run.
• The definition of a trip depends on the test being run.
  ▫ For instance, the EGR test requires a series of idles and accelerations.
• Misfire, comprehensive, and fuel system monitors are run continuously and can complete at any time.
Trip (2 of 4)

- Some DTCs set after a fault is detected on the first trip.
- Some DTCs require two trips with failure to illuminate the MIL.
- For diagnostic purposes, the technician needs to define a trip for the specific code in question.
Trip (3 of 4)

- Diagnostic tests will not be run if there is a problem detected with a required sensor.
For example, the catalyst monitor will not run if there is a problem with the HO2S.

- The HO2S is needed for the catalyst test.
- This prevents unnecessary codes from being generated.
Warm-Up Cycle

• A warm-up cycle consists of:
  ▫ Engine coolant temperature must rise at least 40 degrees.
  ▫ Coolant must reach at least 160 degrees.
  ▫ Most DTCs are erased after 40 warm-up cycles with no additional problems.
Diagnostic Trouble Codes (DTCs) (1 of 2)

- Some DTCs are set with a first test failed.
- Some DTCs require more than one test failed to illuminate the MIL.
- If a test has only failed once and requires two failures to set, a maturing (or pending) code is set.
Diagnostic Trouble Codes (2 of 2)

- If a test fails again, the maturing code becomes a DTC and the MIL is turned on.
- If a test is run and passes three consecutive times, the MIL turns off, but the code is still stored.
The DTC follows J2012 format.

Example P03000 can be broken down to:

- P = powertrain
- 0 = generic
- 3 = ignition system or misfire
- 00 = random misfire
- (Check the text for more.)
Freeze Frames

- When a maturing code is set, a freeze frame is recorded in the PCM.
- The freeze frame is used to help diagnose DTCs.
- Eight vital readings are recorded.
Similar Conditions Window

- If a code sets in the misfire or fuel system monitor:
  - The retest of the system must be done during conditions similar to those that caused the failure.
CARB Readiness Indicator

- Some states use a scan tool to determine that all tests have been run and passed.
- This replaces the traditional tailpipe test.
Exponentially Weighted Moving Average

- This method allows the PCM to filter out some excessively variable information that may cause an erroneous MIL.
- It basically allows new data to be averaged in with old data.
OBD II Scan Tool

- J1978 lists the requirements for a “generic” scan tool interface and its required capability.
- Manufacturers are still allowed to use their own manufacturer-specific scan tool.
- The “generic” scan tool has limited capability and speed compared to the OEM model.
OBD-II DTC NUMBERING DESIGNATION

EXAMPLE: P0302 = CYLINDER #2 MISFIRE DETECTED

FIGURE 3–2 OBD-II DTC identification format.
OBD-II DTC NUMBERING DESIGNATION

- DTC NUMBERING EXPLANATION
- TYPES OF DTCS
  - TYPE A CODES
  - TYPE B CODES
  - TYPE C AND D CODES
What Are Pending Codes?

- Pending codes are set when operating conditions are met and the component or circuit is not within the normal range, yet the conditions have not yet been met to set a DTC. For example, a sensor may require two consecutive faults before a DTC is set. If a scan tool displays a pending code or a failure, a driveability concern could also be present. The pending code can help the technician to determine the root cause before the customer complains of a check engine light indication.