



User Manual

OBD Concepts and Application

Kit # 53-160

53-160 Kit OBD™ Contents

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Chapter 1 - Vehicle Safety

Important Equipment Guidelines and Safety Precautions

Read this section carefully before operating your software.

- When using a vehicle and/or OBD test equipment indoors, **always make sure that there is proper ventilation.**
- Extreme care should be observed when running a vehicle, as components of the vehicle's exhaust may be very hot. **Do not touch the exposed metal surfaces of the vehicle's exhaust.**
- Beware of moving parts when working in or around a vehicle. Never wear loose fitting clothes around a vehicle. **Clothes may become entangled within the moving parts of a vehicle causing severe injury.**

Chapter 2 - What is OBD-II?

The Specialty Equipment Market Association (SEMA) defines OBD as “a set of monitoring strategies incorporated into the on-board computer to detect component or system malfunctions.” OBD stands for *On-Board Diagnostics*. The ‘II’ in OBD-II states that this is the second ‘generation’ of *On-Board Diagnostics*.

Around 30 years ago, vehicle manufacturers began installing components into vehicles that helped them measure and/or reduce emission levels. Some time later, (around 1985) the OBD-I standard spawned from this for 1988 and later model year vehicles. OBD-I, however, was quickly found to be somewhat limited in its’ requirements. In 1989, the OBD-II standard was introduced for all 1996 and later model year vehicles less than 14,000 lbs. (OBD-II was incorporated into some previous model year vehicles, but not required until 1996) Vehicles that support the OBD-II standard monitor nearly all components that can affect the emission levels of the vehicle thus, providing aid to technicians in diagnosing vehicle problems in order to keep the vehicle performing as clean as possible. Upon detecting a problem, the OBD-II system illuminates the ‘Check Engine’ light (MIL) and stores current data (i.e. sensor voltages, temperatures, etc.) into memory. This allows a technician to load the stored data at a later date. Reviewing of the stored data should aid the technician in diagnosing and repairing the problem.

Chapter 3 - OBD Parts Reference

A. Diagnostic interface (Part # 496-00904)

B. Serial cable (Part # 434-00905)



Part # 496-00904



Part # 434-00905

Chapter 4 - Quick Start Guide

- 1) Locate diagnostic interface and serial cable.



Figure 5-1

- 2) Plug 'female' end of serial cable into appropriate plug on diagnostic interface.(Fig. 5-1)
- 3) Plug opposite end of serial cable into the Serial Port of the PC.
- 4) Start Computer
- 5) Access the program Autogas .

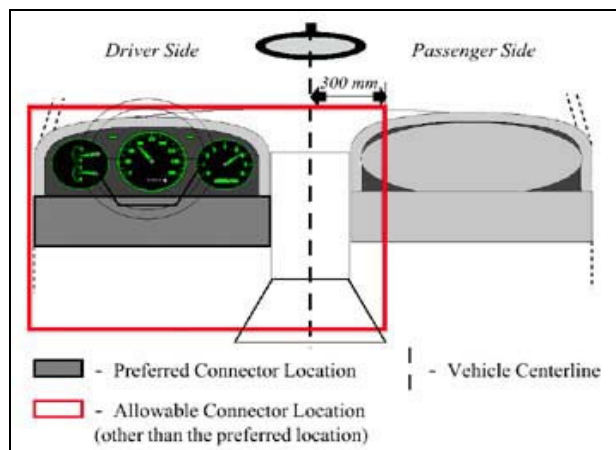


Figure 5-2

(from US EPA Document VPCD-98-14)

- 6) Locate the vehicle's DLC (data link connector) and plug in the diagnostic interface. (Figure 5-2 and 5-3)



Figure 5-3

- 7) Start the engine of the vehicle. (*Note: This may also be done with the key in the key-on-engine-off position, however it is recommended that the engine be running*)
- 8) Select the “Manual Meters” tab from the Service Menu and check the box ENABLE to activate the ODB application. This will allow you to have Live Readings of OBD data. This routine needs to be done only one time as part of the general setup of the system.
- 9) In the Manual Meters screen, select “Change Tachometer “ and a screen will be displayed showing the different types of ignition (Ex. DIS, Standard, OBD, etc.). Select the OBD check box and press continue. This will give you the readings for Live Data of OBD such as RPM, Temperature, etc.

Obtain Diagnostic Trouble Code (DTC) status

- 1) Choose *ODB Diagnostics...* from the *Service Menu Utilities*.
- 2) After the screen loads, the software will request the *stored* Diagnostic Trouble Codes (these are the codes referred to in the Readiness test). The software will display the results on the screen.
- 3) The software will then request *pending* Diagnostic Trouble Codes. These results will also be displayed.

(Note: If a trouble code's definition isn't completely readable, the user can click on the code in question and a message box will display the entire line.)

Obtain Freeze Frame data

- 1) Choose *Freeze Frame...* from the *Service Menu Utilities*. (vehicle must be connected)
- 2) After the screen loads, the software will request the Freeze Frame data from the vehicle.

(Note: If particular field in the grid isn't completely readable, the user can click on the field in question and a message box will display the entire line.)

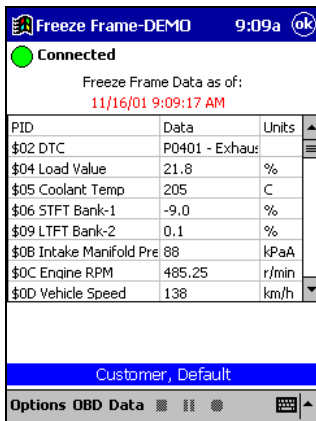


Figure 5-15

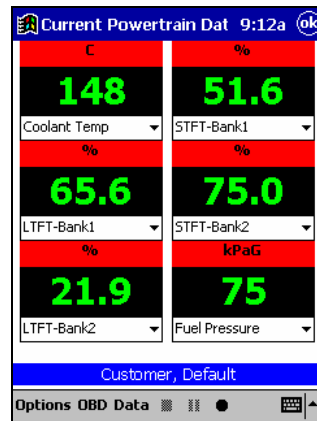
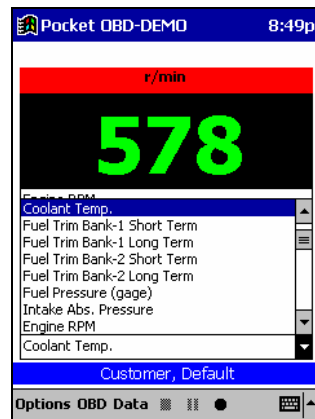
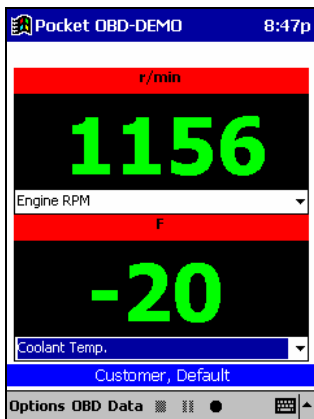


Figure 5-16

Using Digital Meters

- 1) Choose *Digital Meters...* from the *OBD* menu. (vehicle must be connected)
- 2) Select data you wish to display from the selection box underneath each meter. (Please be patient while the data stream begins.)

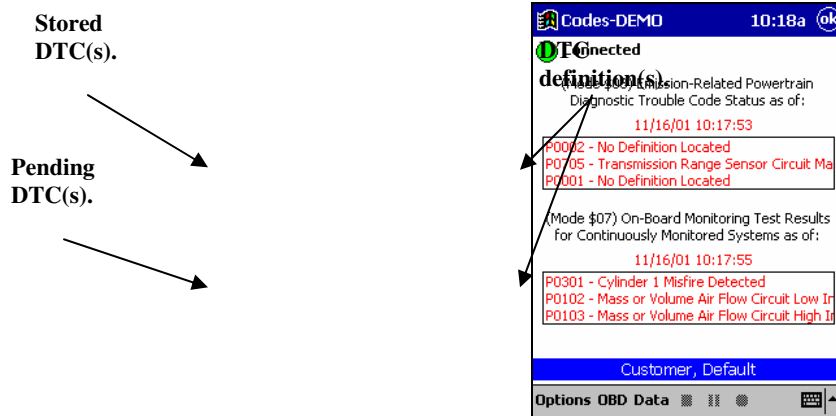


Diagnostic Trouble Codes

This section will request all stored emission-related powertrain codes from the vehicle or request any DTCs that are reported after a single driving cycle after clearing diagnostic information.

Choose *Trouble Codes* from the *Service Menu Utilities* to get to this screen. The screen will load and request *stored* DTCs and *pending* DTCs from the connected vehicle.

Data collected from the vehicle will be displayed in the appropriate boxes on the screen. If a particular trouble code description is too long to be read in the boxes on the screen, the user can click on the test and a message box will appear with the entire line.



Each digit in the Diagnostic Trouble Code has special meaning.

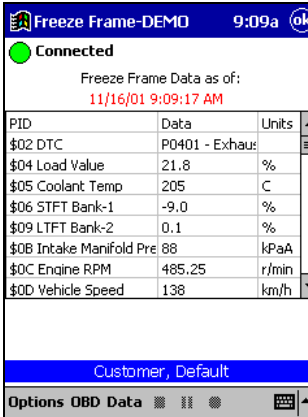
- The first digit in the DTC indicates the system where the fault is located. 'P' stands for Powertrain.
- The second digit indicates either a generic trouble code (0) or manufacturer specific trouble code (1).
- The third digit indicates the specific system or sub-system of where the fault is located. (see below)
 - 1-Fuel and Air Metering
 - 2-Fuel and Air Metering (injector circuit malfunction only)
 - 3-Ignition System or Misfire
 - 4-Auxiliary Emission Control System
 - 5-Vehicle Speed Control and Idle Control System
 - 6-Computer Output Circuits
 - 7-Transmission
 - 8-Transmission
- The last two digits indicate the specific section of the system that the malfunction has occurred.

Freeze Frame status

This section will request emission related data values, which were stored during the freeze frame required by OBD regulations. When a DTC is set, the vehicle will record 'current' engine parameters as a freeze frame. The trouble code and the status of certain engine parameters when the DTC was set will be displayed.

In order to update freeze frame data from a connected vehicle, choose *Freeze Frame* from the *OBD* menu. Once the screen loads, the software will request the Freeze Frame data from the connected vehicle. Please be patient while the data is gathered. The software will request and display all supported freeze frame data from the vehicle. It should be noted that if no data is displayed on the screen or if the DTC associated with the freeze frame data is reported as 'P0000', there is no stored Freeze Frame data on this particular vehicle at this time. If a description is too long to be read in the boxes on the screen, the user can click on the test and a message box will appear with the entire line.

\$02 DTC row →



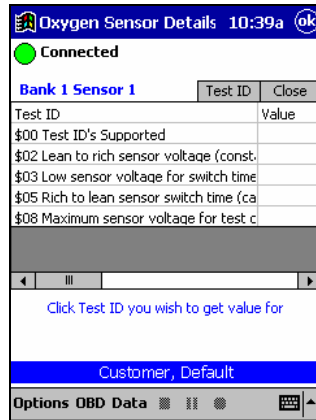
PID	Data	Units
\$02 DTC	P0401 - Exhaust	
\$04 Load Value	21.8	%
\$05 Coolant Temp	205	C
\$06 STFT Bank-1	-9.0	%
\$09 LTFT Bank-2	0.1	%
\$0B Intake Manifold Pre	88	kPaA
\$0C Engine RPM	485.25	r/min
\$0D Vehicle Speed	138	km/h

Oxygen Sensor Monitoring status

This section allows access to the on-board oxygen sensor monitoring test results. Vehicle manufacturers are not required to support this section, therefore this section may be unusable depending on the particular vehicle being tested.

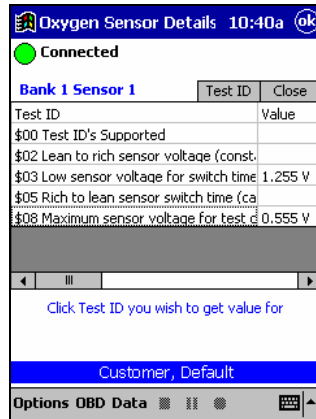
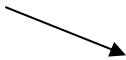
Access this section by choosing *Oxygen Sensor Details* from the *Utilities* menu. Upon entering this screen, the software will attempt to retrieve the locations of Oxygen Sensors on the connected vehicle.

Clicking on a supported sensor on the list will take you to the details screen pertaining to that sensor.



When this section loads for the first time, the above Figure will appear. (The sensor bank and number may differ)

Click Test ID to request value



To view a chart of the Oxygen Sensor Output, click the *Test ID* button . This image shows an example of where each Test ID value is retrieved.

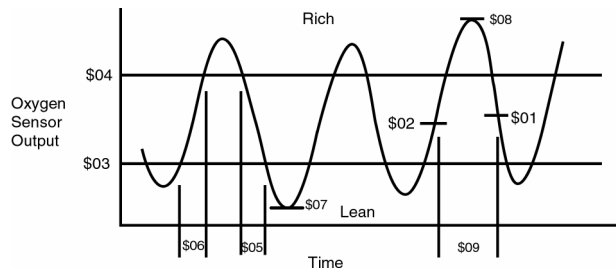
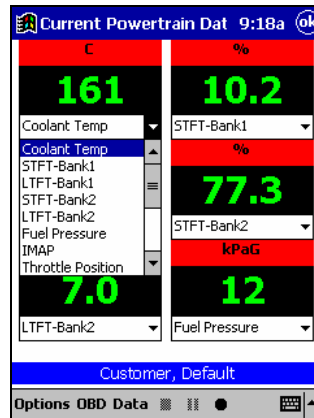


Figure 9-9
(from SAE Document J1979)

Digital Meters

It is from the Digital Meters screen that the user can request current powertrain diagnostic data from the vehicle. To get to this screen, select *Digital Meters* from the *OBD* menu. This data returned from the OBD-II system is not stored data, it is data as last determined by the system. Select the information you wish to display from the combo box(es) located underneath the appropriate meter. Please allow a few moments for the data to begin updating



Note: In order for data to be printed or viewed at a later time from the OBD Application, it must be saved or recorded.

The results may be printed at any time using the Equipment's printer. The proper printer type for the printer being used must be chosen.

Chapter 5 - OBD-II Technical Details

The different areas of diagnostic testing are separated into diagnostic test modes (see below). These diagnostic test modes are defined by SAE document J1979 (see Appendix A).

Diagnostic Test Modes (SAE document J1979)

- Current Powertrain Data
 - Mode \$01
 - This is the mode used in the *Readiness, Digital Meters*
 - This test mode displays 'real-time' data as determined by the OBD-II system. Data available in this mode will vary between vehicles. A PID (Parameter Identification) number is assigned to each system that can provide data through

- the OBD-II interface. These include, but are not limited to: Calculated load value (PID \$04), Engine coolant temperature (PID \$05), Engine RPM (PID \$12), and Oxygen Sensor Locations (PID \$13). Not all vehicles support all PIDs. Sending a Mode \$01 PID \$00 will return which PIDs this vehicle supports.
- Powertrain Freeze Frame Data
 - Mode \$02
 - This is the mode used in the *Freeze Frame* section
 - This test mode is used to display data that is stored by the OBD-II system at the time the MIL is illuminated. This mode allows a technician to view the stored values of certain PIDs at the time a problem is detected. This Mode performs in much the same way as Mode \$01.
 - Emission-Related Powertrain Diagnostic Trouble Codes
 - Mode \$03
 - This is one of the modes used in the *Trouble Code* section of Utilities Menu.
 - This test mode is used to obtain/display stored emission-related powertrain trouble codes. The SAE (Society of Automotive Engineers) defines a Diagnostic Trouble Code to be an alphanumeric identifier for a fault condition identified by the OBD system.
 - Clear/Reset Emission-Related Diagnostic Information
 - Mode \$04
 - This mode can be utilized from the *Readiness* section
 - This test mode is used to clear all of the stored emission-related diagnostic information.
 - Oxygen Sensor Monitoring Test Results
 - Mode \$05
 - This mode is used in the *Oxygen Sensor Details* section.
 - This test mode is used to access the on-board oxygen sensor monitoring test results. Some vehicles may not support this mode as it is not an OBD-II requirement.
 - On-Board Monitoring Test Results for Non-Continuously Monitored Systems
 - Mode \$06
 - This mode is to allow access to the on-board monitoring test results of specific systems that are not continuously monitored.
 - This mode is implemented based on the software revision level
 - On-Board Monitoring Test Results for Continuously Monitored Systems
 - Mode \$07
 - This is one of the modes used in the *Trouble Code* section .
 - This mode obtains test results for emission-related powertrain systems that are continuously monitored during normal driving conditions. This mode is to be used by a repair technician after potentially fixing vehicle's problem and then clearing its codes (see Mode \$04). Results from this test do not necessarily indicate a faulty system. These results are reported after a single driving cycle.

If the results indicate a failure after more driving cycles the MIL will be illuminated and this code(s) will be set to Mode \$03.

- Control of On-Board System, Test or Component
 - Mode \$08
 - This mode allows the control the operation of an on-board system, test, or component.
 - This mode is currently not implemented in all software versions.
- Vehicle Information
 - Mode \$09
 - This mode is used to request vehicle specific information. The Vehicle Identification Number (VIN) and calibration IDs are part this mode.
 - Vehicle manufacturers are not required to support this mode at this time.
 - This mode is currently not implemented in all software versions.

Pocket OBD abbreviations

- Fuel System 1 – Fuel System 1 status
 - OL – Open loop. Has not yet satisfied conditions to go closed loop.
 - CL – Closed loop. Using oxygen sensor(s) as feedback for fuel control.
 - OL-D – Open loop due to driving conditions (power enrichment, deceleration enrichment).
 - OL-F – Open loop due to detected system fault.
 - CL-F – Closed loop, but fault with at least one oxygen sensor- may be using single oxygen sensor for fuel control.
- Fuel System 2 – Fuel System 2 status
 - See Fuel System 1
- Calc. Load Value – Calculated load value
- Coolant Temp. – Engine coolant temperature
- Fuel Trim Bank-1 Short Term – Short term fuel trim - Bank 1
- Fuel Trim Bank-1 Long Term – Long term fuel trim - Bank 1
- Fuel Trim Bank-2 Short Term – Short term fuel trim - Bank 2
- Fuel Trim Bank-2 Long Term – Long term fuel trim - Bank 2
- Fuel Pressure (gage) – Fuel pressure (gage)
- Intake Abs. Pressure – Intake manifold absolute pressure
- Engine RPM – Engine RPM
- Vehicle speed – Vehicle speed
- Ignition Timing – Ignition timing advance for #1 cylinder
- Intake Air Temp – Intake air temperature
- MAF Air Flow – Air flow rate from MAF sensor
- Throttle Position – Absolute throttle position sensor
- Air Status - Commanded – Commanded secondary air status
 - UP – upstream of first catalytic convertor
 - DWN – downstream of first catalytic converter inlet
 - OFF – atmosphere/off
 - ERR – error

- O2 Sensor Location – Location of oxygen sensors installed in the vehicle where sensor 1 is closest to the engine.
- O2 Volts B1- S1 – Oxygen sensor output voltage, Bank 1 – Sensor 1
- O2 Volts B1- S2 – Oxygen sensor output voltage, Bank 1 – Sensor 2
- O2 Volts B1- S3 – Oxygen sensor output voltage, Bank 1 – Sensor 3
- O2 Volts B1- S4 – Oxygen sensor output voltage, Bank 1 – Sensor 4
- O2 Volts B2- S1 – Oxygen sensor output voltage, Bank 2 – Sensor 1
- O2 Volts B2- S2 – Oxygen sensor output voltage, Bank 2 – Sensor 2
- O2 Volts B2- S3 – Oxygen sensor output voltage, Bank 2 – Sensor 3
- O2 Volts B2- S4 – Oxygen sensor output voltage, Bank 2 – Sensor 4
- Fuel Trim B1-S1 – Short term fuel trim from Bank 1 – Sensor 1
- Fuel Trim B1-S2 – Short term fuel trim from Bank 1 – Sensor 2
- Fuel Trim B1-S3 – Short term fuel trim from Bank 1 – Sensor 3
- Fuel Trim B1-S4 – Short term fuel trim from Bank 1 – Sensor 4
- Fuel Trim B2-S1 – Short term fuel trim from Bank 2 – Sensor 1
- Fuel Trim B2-S2 – Short term fuel trim from Bank 2 – Sensor 2
- Fuel Trim B2-S3 – Short term fuel trim from Bank 2 – Sensor 3
- Fuel Trim B2-S4 – Short term fuel trim from Bank 2 – Sensor 4
- OBD – OBD requirements to which vehicle is designed
 - II – OBD II (California ARB)
 - Fed – OBD (Federal EPA)
 - I & II – OBD and OBD II
 - I – OBDI
 - Not – Not intended to meet any OBD requirements
 - EOBD – EOBD (Europe)
- Alt-O2S Loc – Alternate oxygen sensor locations
- Auxiliary Input Status – Auxiliary Input Status
 - Not – Power Take-Off not active
 - Act – Power Take-Off active

Chapter 6 - Vehicle Requirements

This software must be used with vehicles that are model year 1996 or newer (for gasoline powered vehicles) and be OBD II compliant. If the vehicle is diesel powered, it must be model year 1997 or newer and OBD II compliant. These vehicles will have a 'Diagnostic Link Connector' underneath the dashboard. There will also be a sticker underneath the hood that states that the vehicle is OBD II compliant.

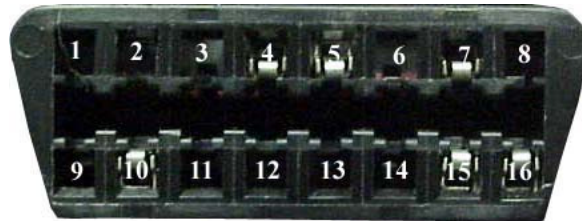
Manufacturers/Protocols (in general, protocols may vary)

- 1) General Motors – J1850 VPW
- 2) Ford – J1850 PWM
- 3) Chrysler – ISO 9141-2

4) European – ISO 9141-2 or ISO 14230

Some protocols may also be determined by the particular pins located on the vehicles' OBD-II interface. (Note: All protocols have pins 4 and 5.) (see Figure 12-1)

- a) J1850 VPW – this protocol will have metal inserts in pins 2, 16 and not 10.
- b) J1850 PWM – this protocol will have metal inserts in pins 7, 15, and 16.
- c) ISO 9141-2 – this protocol will have metal inserts in pins 2, 10, and 16.



Chapter 7 - Sample EPA Test

(from Environmental Protection Agency document EPA420-R-01-015 June 2001)

- 1) Input (manual or scan) required vehicle and owner information.
- 2) Locate and visually determine proper MIL (light illuminates briefly) performance when key is put in the KOEO (key on, engine off) position. Input results into scan tool.
- 3) Locate vehicle's data link connector (DLC) and plug the scan tool's diagnostic interface into it. It is recommended that this be done with key off, however can be done either way.
- 4) Start the engine of the vehicle. (This is known as KOER, or 'key off, engine running' position.) If the MIL remains illuminated while engine is running, this results in vehicle failure. If the MIL illuminates during this phase but was not observed in Step 2, the vehicle should not be failed for Step 2.
- 5) Perform generic OBD tests.
 - a. Obtain readiness status (Mode \$01 PID \$01 as described in Chapter 11)
 - b. Obtain MIL status (on or off)
 - c. If MIL status is 'on' check for DTCs (Diagnostic Trouble Codes, Mode \$03 as described in Chapter 11)
- 6) If the data is not automatically recorded, the data from the above test should be saved at this time.
- 7) Turn off vehicle ignition and then disconnect scan tool.
- 8) If the vehicle has failed (see reasons below) the owner shall be provided a test report that will include any DTCs detected, status of MIL (as determined by scan tool), and a customer alert statement (as defined by section 2223 of the Code of Federal Regulations Title 40, part 85 document).

Some reasons for failure or rejection (actual implementation may have other reasons for failure or rejection)

- Failure #1 – The vehicle is a 1996 or newer vehicle and the data link connector (DLC) is missing, has been tampered with, or is otherwise inoperable.
- Failure #2 – The MIL does not illuminate at all when the ignition key is turned to the KOEO (see above) position.
- Failure #3 – The MIL illuminates continuously or flashes while in the KOER position ‘AND’ #5c above determined that no DTCs were present; this could indicate a serial data link failure.
- Failure #4 – The MIL status (as determined by scan tool) is ‘on’ AND the scan tool reports any of the DTCs (see #5c above) located in section 2207 of the Code of Federal Regulations Title 40, part 85 document. This failure is regardless of whether or not the MIL is actually illuminated. (It is NOT appropriate to fail a vehicle if DTCs are present AND the scan tool reports the MIL status as ‘off’. These codes are considered ‘pending’ DTCs and may clear themselves over time.)
- Failure #5 – (borrowed from document referenced in Failure #4, section 2222) The MIL status (as determined by scan tool) is ‘on’ and the actual MIL (as determined by visual inspection) is not illuminated.
- Rejection #1 – The number of OBD system monitors showing ‘not ready’ status exceeds the number allowed for the model year in question.

Chapter 8 - Glossary of terms

Diagnostic Test Mode – A level of diagnostic capability in an On Board Diagnostic (OBD) system. This may include different functional states to observe signals, a base level to read diagnostic trouble codes, a monitor level which includes information on signal levels, bi-directional control with on/off board aids, and the ability to interface with remote diagnosis.

DLC (Data Link Connector) – Connector providing access and/or control of the vehicle information, operating conditions and diagnostic information.

DTC (Diagnostic Trouble Code) – An alphanumeric identifier for a fault condition identified by the On Board Diagnostic System.

Freeze Frame – A block of memory containing the vehicle operating conditions for a specific time.

MIL (Malfunction Indicator Lamp) – Check engine light. A required on board indicator to alert the driver of an emission-related malfunction.

OBD (On Board Diagnostic) – A system that monitors some or all computer input and control signals. Signal(s) outside of the predetermined limits imply a fault in the system or in a related system.

PID (Parameter Identification) – Identifies an address in memory which contains vehicle operating information.

Protocol – The ‘type’ of communication interface the vehicle’s OBD system uses.

References

Additional information and the documents referenced in this manual are available from:

Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
(202) 260-2090
www.epa.gov

Society of Automotive Engineers
400 Commonwealth Dr.
Warrendale, PA 15096
(877) 606-7323
www.sae.org

U.S. Government Printing Office
Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954
www.gpo.gov