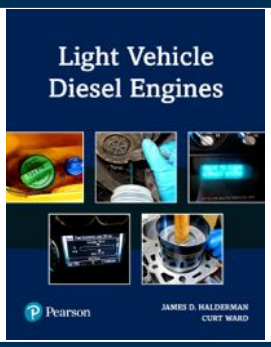
Light Vehicle Diesel Engines

First Edition



Chapter 20
OBD-II Diesel Monitors

LEARNING OBJECTIVES (1 of 2)

20.1 Prepare for the Light Vehicle Diesel Engine (A9) ASE certification fuel system diagnosis and repair test content area.

20.2 Identify the major monitors on a modern light-diesel vehicle

20.3 Understand the information obtained from an on-board diagnostics monitor and the criteria to enable an OBD monitor.

LEARNING OBJECTIVES (2 of 2)

20.4 Discuss continuous vs. non-continuous monitors.

20.5 Describe the comprehensive component monitor (CCM).

20.6 Explain enabling conditions.

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MAJOR SYSTEM MONITORS (1 of 4)

- **OBD II Self-Diagnostic Capability**
  - OBD-II software for diesel vehicles continues to evolve
  - Snapshot of most commonly used systems
  - Refer to OEM service information for specific details
  - Understanding of major monitor operation
  - Helps to quickly and accurately diagnose failures

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MAJOR SYSTEM MONITORS (2 of 4)

- **2 Types of Monitors:**
  - **Continuous**
    - Conditions Met Monitors Run
    - For Remainder Of Drive Cycle
      - Comprehensive Component Monitor
      - Misfire Monitor A: 200 RPM, B: 1000
      - Fuel Trim Monitor
  - **Non-Continuous**
    - Run Once Per Drive Cycle
    - Not Run Again Until Conditions Met

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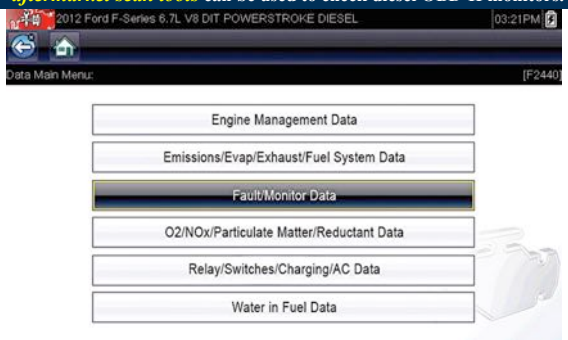
FIGURE 20–1 Snap-On Solus scan tool screen capture of the menu to check for the monitor data. All factory scan tools and *enhanced aftermarket scan tools* can be used to check diesel OBD-II monitors.



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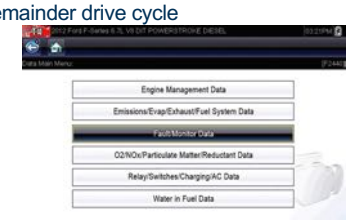
MAJOR SYSTEM MONITORS (3 of 4)

- **3 Different Continuous Monitors**
  - When required conditions occur
  - Continuous monitors run
  - Monitors run for remainder drive cycle



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MAJOR SYSTEM MONITORS (4 of 4)

- **Non-Continuous Monitors:**
  - Run at most once per vehicle drive cycle
  - Once monitor has run to completion,
  - Readiness status on scan tool
  - Shows “complete” or “done”
  - Monitors that have not run to completion
  - Show on SCAN TOOL as “incomplete”

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COMPREHENSIVE COMPONENT MONITOR (CCM) (1 of 4)

- **CCM: Continuous Monitor That Monitors**
  - **Inputs & Outputs In OBD-II System**
  - OBD II requires inputs from powertrain components to PCM
  - Be tested for **rationality,** and that outputs to powertrain
  - Components from PCM be tested for **functionality.**
  - Inputs and outputs are to be checked *electrically*.
  - Rationality checks refer to PCM
  - Comparison of input value to values.

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COMPREHENSIVE COMPONENT MONITOR (CCM) (2 of 4)

- **Comprehensive Component Monitor (CCM)**
  - Watches sensors & actuators
  - CCM is internal program in PCM
  - Monitors components or circuits that
    - Provide input/output signals to PCM
  - Fault appears, will set code & activate MIL
  - Sensors tested at KO or after engine start-up
  - Some tested after meeting engine conditions
  - Detect fault on 2 consecutive trips before MIL ON

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COMPREHENSIVE COMPONENT MONITOR (CCM) (3 of 4)

- **Some Components tested by CCM:**
  - **Glow plugs and glow plug module**
  - **Manifold absolute pressure (MAP) sensor**
    - **(senses turbocharger boost pressure)**
  - **Injection control pressure (ICP) sensor**
  - **Accelerator pedal position (APP) sensor**
  - **Crankshaft position sensor (CKP)**
  - **Engine coolant temperature (ECT) sensor**
  - **Mass airflow (MAF) sensor**
  - **Wastegate control operation**

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COMPREHENSIVE COMPONENT MONITOR (CCM) (4 of 4)

- **Electrical Test**
  - **Refers to PCM check of**
  - **Both input/outputs for following:**
    - **Opens**
    - **Shorts**
    - **Grounds**

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ENABLING CRITERIA (1 of 2)

- **Pending**
  - Under some situations PCM will not run monitor
  - If MIL is ON & DTC stored from another monitor
  - PCM postpones monitors pending a resolution of the original fault
  - Does not run test until problem is remedied
- **Conflict**
  - Times, PCM does not run monitor if another monitor is in progress
  - Effects of another monitor running could result in an erroneous failure
- **Suspend**
  - PCM may not allow 2 trip fault to mature
  - Suspend fault if condition exists that may induce erroneous failure
  - Prevents illuminating the MIL for wrong fault

ENABLING CRITERIA (2 of 2)

- **Enabling Criteria Follow Simple Logic:**
  - if catalyst monitor is running during a road test
  - PCM detects a misfire, catalyst monitor will be
  - Suspended for duration of misfire.

MISFIRE MONITOR (1 of 3)

- **Misfire Monitor Purpose**
  - Detect imbalance in engine when
  - Cylinder fails to produce combustion pressure
  - Similar to other cylinders
  - Uses CKP & CMP Sensors to calculate
  - Rotational speed & acceleration of engine
  - Comparing acceleration of each firing event
  - Determine if cylinder is not firing correctly

MISFIRE MONITOR (2 of 3)

- **Monitor Operation**
  - Unlike gasoline-engine
  - Current diesel engines do not use
  - **Type A & Type B Misfire Strategy**
    - Similar to Gasoline Type B misfire
    - Store one trip failure
    - % misfire over 1,000 RPM
    - Exceed FTP STD
    - 2ND consecutive drive cycle
    - MIL illuminates DTC stored

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FIGURE 20–2 misfire monitor is enabled on Duramax diesel as seen on Tech 2 scan tool. PCM set P0300, meaning random misfire code because it was not able to detect which of eight cylinders was cause of misfire.

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MISFIRE MONITOR (3 of 3)

- **EWMA Monitor** (Exponentially Weighted Moving Average)
  - Mathematical method used to determine performance
  - Calculations used for following monitors:
    - Catalyst monitor
    - EGR monitor
    - PCM runs six consecutive failed tests; fails in one trip
    - 3 consecutive failed tests on next trip, then fails
    - 3 consecutive good trips used to extinguish MIL
    - 40 warm-up cycles used to erase DTC & freeze-frame

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CHART 20-1 Summary showing details of how PCM handles each of mentioned monitors and what it takes to turn off MIL.

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FUEL SYSTEM MONITOR (1 of 3)

- **Fuel System Components**
  - **May Be Monitored Include:**
    - **High-pressure Rail Sensor**
    - **High-pressure Pump**
    - **Pressure Control Valve**
    - **Volume Control Valve**
    - **Low-pressure Lift Pump**
    - **Fuel Injectors**

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FUEL SYSTEM MONITOR (2 of 3)

- **PCM Uses Fuel Pressure Monitor**
  - Continuously monitor fuel system data
  - Compares it to what is expected
  - Based on programming

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FUEL SYSTEM MONITOR (3 of 3)

- **NMHC (non-methane hydrocarbon) Catalyst Monitor**
  - Diesel oxidation catalyst (DOC)
  - Catalyst capable of reducing levels
  - Hydrocarbons and carbon monoxi
    - **NOTE: Many OEMS prevent DPF from regenerating if DTC stored for oxidation catalyst (DOC) due to Absence of heat from oxidation process would create failure in regeneration.**

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NON-CONTINUOUS MONITOR (1 of 7)

- **NO_X & SCR Catalyst Monitor**
  - **Monitor NO_X & SCR**
    - Measure catalyst efficiency
    - Ensure it is capable of reducing levels of NOx

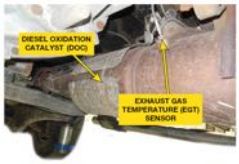

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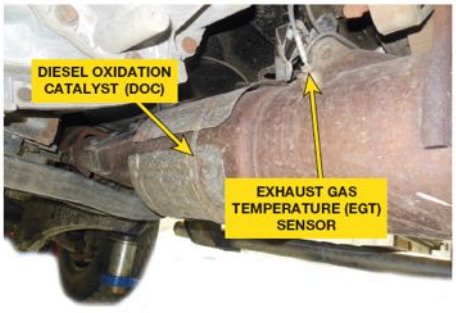
FIGURE 20–3 Diesel oxidation catalyst with a temperature sensor on 6.7 liter Power Stroke diesel engine used in F-250 pickup truck.



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NON-CONTINUOUS MONITOR (2 of 7)

- **Exhaust Gas Sensor Monitor**
  - Determine if NOx sensors and/or O2 sensors
  - Functioning properly

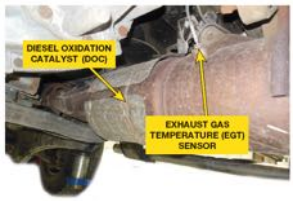

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FIGURE 20–4 NOx absorber catalyst used by some OEMS usually before 2010 when NOx emission standards were greatly reduced, requiring most manufacturers to start using SCR

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NON-CONTINUOUS MONITOR (3 of 7)

- **Boost Pressure Monitor**
  - Ensure volume of air through engine
  - Desired Volume
  - Under/OVER pressure will affect engine performance
  - Affect vehicle emission levels

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FIGURE 20–5 boost system monitor information as displayed on a Tech 2 scan tool used on Duramax diesel.

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"Boost Pressure Failure"

TECH TIP

The leading cause of an under-boost code, and a lack of performance, is hose clamps on the air intake air system not being torqued to specification, allowing air under pressure to escape to the atmosphere. Therefore, if P0299 DTC (turbocharger has excessively low output) occurs, perform a thorough inspection to make certain that hose clamps are properly torqued to factory specification.

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NON-CONTINUOUS MONITOR (4 of 7)

- **Particulate Matter (PM) Filter Monitor**
  - Determining filter restrictions, leaks, substrate removal
  - Tracking incomplete regeneration events

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FIGURE 20–6 failed particulate filter that was so hot from being over-fueled it caused the substrate to melt.

NON-CONTINUOUS MONITOR (5 of 7)

- **Exhaust Gas Recirculation (EGR) Monitor**
  - Determine if flow through EGR system is within
  - Designed specification.
- **Exhaust Gas Recirculation (EGR) Cooler Monitor**
  - Lower temperatures of exhaust gases
  - Flowing through intake manifold

FIGURE 20–7 A partially clogged EGR cooler. While they may be able to be cleaned, most are simply replaced because the time needed to clean them exceeds the cost of a new part.

What Are the Monitors for Diesels?

FREQUENTLY ASKED QUESTION

- Readiness monitors were changed for the 2010 model year (MY) to reflect changes that occurred with use of high-pressure common rail-type diesel engines and more restrictive emissions standards. 11 readiness monitor bits in diesel OBD system, which is same # as in gasoline OBD system, only 9 are currently assigned for diesels. **SEE CHART 20–2**

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CHART 20-2 Diesel OBD readiness monitors

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NON-CONTINUOUS MONITOR (6 of 7)

- **Cooling System Monitor**
  - Checks operating temperature
  - During warm-up cycle.

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NON-CONTINUOUS MONITOR (7 of 7)

- **Crankcase Ventilation Monitor**
  - 2007, diesel-equipped vehicles
    - No longer allowed vent unfiltered crankcase gases
    - Diesel engine makes very little intake manifold vacuum, PCV not possible
    - Install & monitor crankcase ventilation system
    - Captured Unburned hydrocarbons
    - returned them to engine to be burned
    - Ensure system flows & NOT leaking to ambient air

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FIGURE 20–8 (a) To get access to crankcase breather filter, top plastic cover has to be removed from this Cummins 6.7 liter diesel engine.

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FIGURE 20–8 (b) crankcase breather filter is attached to cylinder head cover and can be replaced if needed based on reading from the crankcase pressure sensor.

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Summary (1 of 4)

- The major systems monitors on current light-duty diesel vehicles are divided into two categories, continuous and non-continuous.
- A comprehensive component monitor (CCM) is a continuous monitor that monitors the inputs and outputs in the OBD-II system.
- Many PCM sensors and output devices are tested at key-on or immediately after engine start-up. Some devices are tested by the CCM only after the engine meets certain engine conditions.

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Summary (2 of 4)

- The misfire monitor is able to detect an imbalance in the engine when a cylinder fails to produce a combustion pressure similar to other cylinders and the pre-programmed data in the PCM.
- The exhaust gas sensor monitor is designed to determine if the NOx sensors and/or O2 sensors are functioning properly.
- The PCM uses fuel pressure monitor to continuously monitor the fuel system data and compares it to what is expected based on programming.

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Summary (3 of 4)

- The misfire monitor is able to detect an imbalance in the engine when a cylinder fails to produce a combustion pressure similar to other cylinders and pre programmed data in the PCM.
- The exhaust gas recirculation (EGR) monitor is designed to determine if the flow through the EGR system is within designed specification.
- The exhaust gas recirculation (EGR) cooler monitor is designed to lower the temperatures of the exhaust gases that are flowing through the intake manifold.

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Summary (4 of 4)

- The cooling system monitor checks the operating temperature of the engine during the warm-up cycle.
- The particulate matter (PM) filter monitor is responsible for determining filter restrictions, filter leaks, filter substrate removal, and tracking incomplete regeneration events.
- The purpose of the crankcase ventilation monitor is to ensure the system flows and is not leaking to the ambient air.

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