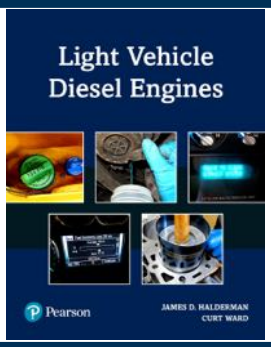
Light Vehicle Diesel Engines

First Edition



Chapter 21
OBD-II DIESEL DIAGNOSIS

LEARNING OBJECTIVES (1 of 2)

21.1 Prepare for the ASE Diesel engine controls diagnosis (A9) certification test content area "A"(General Diagnosis).

21.2 List the steps of the diagnostic process.

21.3 Describe the simple preliminary tests that should be performed at the start of the diagnostic process.

21.4 List six items to check as part of a thorough visual inspection.

LEARNING OBJECTIVES (2 of 2)

21.5 Explain the troubleshooting procedures to follow if no diagnostic trouble code has been set.

21.6 Explain the troubleshooting procedures to follow if a diagnostic trouble code has been set.

21.7 Discuss the type of scan tools that are used to assess vehicle components.

21.8 Describe the methods that can be used to reprogram (reflash) a vehicle computer.

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DIESEL ENGINE DIAGNOSTIC PROCESS (1 of 5)

- **8 steps to narrow possibilities to one**
  - STEP 1: Verify Concern
  - STEP 2: Visual inspection &basic tests
  - STEP 3: Retrieve DTCs
  - STEP 4: Check for TSBs
  - STEP 5: Look carefully at scan tool data
  - STEP 6: Narrow problem to system/cylinder
  - STEP 7: Repair problem, determine root cause
  - STEP 8: Verify repair clear any stored DTCs

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FIGURE 21–1 funnel is one way to visualize diagnostic process. The purpose is to narrow possible causes of a concern until root cause is determined and corrected.

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VERIFY THE CUSTOMER CONCERN

- **Before Diagnosis, Ask Questions:**
  - Are there any warning lights on?
  - What was the temperature outside?
  - Was the engine warm or cold?
  - Was the problem during starting, acceleration, cruise?
  - How far had the vehicle been driven?
  - Has there been service or repair work done lately?

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FIGURE 21–2 Step #1 is to verify customer concern or problem. If problem cannot be verified, then repair cannot be verified.

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VISUAL INSPECTION (1 of 2)

- **Inspection Should Include:**
  - Check the oil level, color of the oil, and smell
    - Determine if there may be diesel fuel in oil
  - Unusual noises, smoke, or smell
  - Check the air cleaner and air duct
  - Check for oil or fuel leaks

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Why Check the Oil First?

FREQUENTLY ASKED QUESTION

- **Oil condition & level issues include:**
- **If engine oil level low**
  - Engine oil consumption
  - Incorrect service or repair
  - Engine oil leaks
- **If engine oil level high**
  - Fuel in the oil (fuel dilution)
  - Incorrect service or repair
  - If engine oil is contaminated with diesel fuel
  - HP fuel injection pump leaking
  - Fuel injector(s) leaking
- **If engine oil is contaminated with coolant**
  - Defective head gasket
  - Leaking engine oil cooler

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FIGURE 21–3 form that customer should fill out if there is a drivablilty concern to help service technician more quickly find roo cause.


ENGINE PERFORMANCE DIAGNOSIS WORKSHEET

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FIGURE 21–4 Step 3 in diagnostic process is to retrieve any store diagnostic trouble codes.

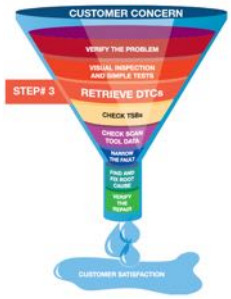

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CHART 21-1 Excessive Exhaust Smoke Colors & Possible Causes

COLOR OF EXHAUST SMOKE	POSSIBLE CAUSES
BLACK or GRAY	• Too much fuel consists of particles of carbon formed when fuel is heated in oxygen lean regions in the combustion chamber (leaking injectors) • Not enough air (restricted air intake or exhaust system)
WHITE	• Diesel fuel not burning (large number of particles of fuel oil larger than 1.0 microns in diameter) • Inoperative glow plugs • Low cylinder compression • Coolant entering combustion chamber (blown head gasket) • Water in fuel (check fuel tank and filters)
BLUE	• Crankcase oil entering the combustion chamber (possible worn piston rings, scored cylinder wall, worn or defective valve guides, or valve stem seals) • Defective turbocharger

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VISUAL INSPECTION (2 of 2)

- **Exhaust Color**
  - **SEE CHART 21–1**.
- **General Tests**
  - Determine General Condition:
    - Low-pressure Fuel System
    - High-pressure Fuel System
    - Intake Air System
    - Engine Mechanical Condition

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CHECK FOR ANY STORED DTCs (1 of 2)

- **Current & Pending**
  - DTC present signaled by MIL
    - Use service information procedures for stored DTC
      - FIGURE 21–4.
  - DTC on scan tool, MIL not on
  - Called pending code
  - Fault has not reoccurred, causing
  - PCM to not turn on MIL

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CHECK FOR ANY STORED DTCs (2 of 2)

- **Pinning Down Causes of Problem**
  - Done by trying to set opposite code
    - If opposite code sets, indicates
    - wiring and connector for sensor is okay
    - Sensor defective

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CHECK TSBs

After checking for stored diagnostic trouble codes (DTCs), check service information for any technical service bulletins that may relate to vehicle being serviced

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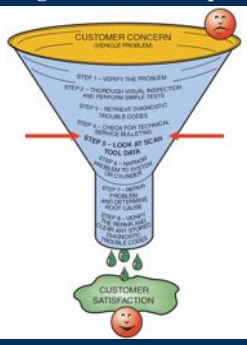
STEP 5 Looking carefully at the scan tool data is very helpful in locating the source of a problem.



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SCAN TOOL DATA (1 of 4)

- **Two Basic Groups**
  - Factory scan tools
    - General Motors—Tech 2
    - Ford—New Generation Star (NGS) and IDS (Integrated Diagnostic Software)
    - Chrysler—DRB-III or Star Scan (CAN-equipped vehicles)
    - Honda—HDS or Master Tech
    - Toyota—Master Tech

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SCAN TOOL DATA (2 of 4)

- All factory scan tools are bidirectional
  - Technician can operate components using the scan tool to confirm component will work when commanded
- All factory scan tools can display all factory parameters
- Aftermarket scan tools
  - Designed to function on more than one brand

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SCAN TOOL DATA (3 of 4)

- Examples:
  Snap-on
  - OTC
  - AutoEnginuity
- Many aftermarket scan tools can display most if not all parameters of factory scan tool
- Aftermarket scan tools may not troubleshoot some faults

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Why Check DTCs before Checking TSBs?

FREQUENTLY ASKED QUESTION

DTCs must be known before searching for service bulletins because bulletins often include information on solving problems that involve a stored diagnostic trouble code (DTC).

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FIGURE 21–5 TECH 2 scan tool is factory scan tool used on General Motors vehicles.

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FIGURE 21–6 Bluetooth adapter that plugs into DLC and transmits global OBD-II information to a smart phone that has a scan tool app installed.

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CHART 21-2 Cummins 5.9 & 6.7 liter. Values obtained by using a scan tool and basic test equipment. Always follow OEM recommended procedures.

Low-pressure pump	8–12 PSI
Pump amperes	4A
Pump volume	45 oz. in 30 seconds
High-pressure pump	5,000–23,000
Pressure at idle	5,600–5,700
Minimum pressure to start	5,000
Electronic fuel control (EFC) maximum fuel pressure	Disconnect EFC to achieve maximum pressure
Fuel injector volts	90V
Fuel injector amperes	20A
Heater current	120–160 A

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CHART 21-3 GM Duramax. Values obtained by using scan tool and basic test equipment. Always follow OEM recommended procedures.

Low-pressure pump vacuum	2–10 in. Hg.
Pump amperes	NA
Pump volume	NA
High-pressure pump	5,000–23,000 PSI
Pressure at idle	5,000–6,000 PSI (30–40 MPa)
Minimum pressure to start	1,500 PSI (10 MPa)
Fuel rail pressure regulator (FRPR) maximum fuel pressure	Disconnect to achieve maximum pressure
Fuel injector volts	48 V or 93 V
Fuel injector amperes	20 A
Glow plug current	160 A

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CHART 21-4 Ford Power Stroke. Values can be obtained by using scan tool and basic test equipment. Always follow OEM recommended procedures.

Low-pressure pump	50–60 PSI
High-pressure pump	500–4,000 PSI
Idle PSI	500 PSI+
Minimum pressure to start	500 PSI (0.85 V)
Injection pressure regulator (IPR) maximum fuel pressure	Apply power and ground to IPR
Injector volts	48 V
Injector amperes	20 A
Glow plug amperes	20–25 A each (160–200 A total)

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SCAN TOOL DATA (4 of 4)

- **GLOBAL OBD II:** Page 245 of text
- **USING GLOBAL MODE$06:** Page 245 of text
- **SELECT MONITOR:** Page 245 of text
- **MODE $06 EXAMPLE:** CHART 21-5

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CHART 21-5 Check Mode $06 data if any of the DTCs are displayed to see limits and why the DTC was set.

MODE $06 TEST RESULT	CONTROLLING MONITOR DTCs
HEGO	P2201, P0139, P2A01
Cat Bank 1	P0420
Diesel EGR	P0401, P0402, P2457, P24A5
Fuel System	P02CD, P02D1, P02D9, P02CF, P0170 P02D7, P02D5, P02D3,P02DB
Boost Pressure Control	P026A, P132B, P0234, P0299, P1249, P00BC, P00BD
NOx Catalyst	P20EE, P207F
Misfire	P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308
PM Catalyst	P2459, P2002, P24A2

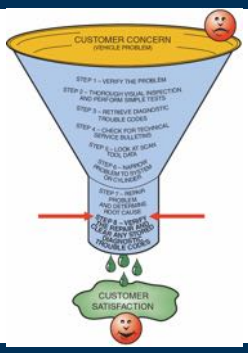
PINPOINT TESTS

- **Pinpoint Test Is Diagnostic Procedure**
  - Designed to narrow root cause to a system or cylinder:
    - Compression test
    - Cylinder leakage test
    - Cylinder contribution (power balance) test
    - Exhaust backpressure test
  - **See Chapter 6 for details**

DETERMINE THE ROOT CAUSE

- **Perform Same Conditions**
  - Vehicle operated under
  - Repair or part replacement must be performed
  - Following OEM recommendations
  - Certain that the root cause found
- **Final Actions**
  - Test drive to verify that original concern fixed

STEP 8 is very important. Be sure that customer's concern has been corrected.



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FLASH PROGRAMMING (1 of 8)

- Periodic revisions to OBD-II software occurs
- Reprogramming
  - Downloading new calibration files
  - From scan tool, PC, or modem
  - into PCM's EEPROM
- Can be done on or off vehicle

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FLASH PROGRAMMING (2 of 8)

- Reprogramming not OBD-II requirement
  - 3 methods for reprogramming EEPROM
    - **Remote programming**
    - **Direct programming**
    - **Off-board programming**

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FIGURE 21–7 first step in reprogramming procedure is to determine current software installed, using a scan tool. Not all scan tools can be used. In most cases using factory scan tool is needed for reprogramming unless scan tool is equipped to handle reprogramming

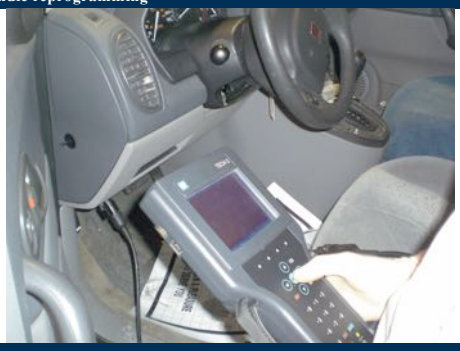

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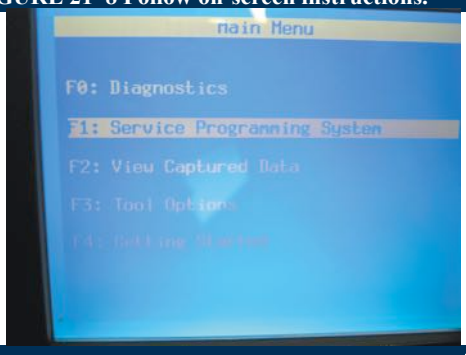
FIGURE 21–8 Follow on-screen instructions.



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FLASH PROGRAMMING (3 of 8)

- **Remote Programming**
  - Uses scan tool to transfer data
  - From shop PC to vehicle's PCMF
  - Connect scan tool to vehicle's DLC
  - Enter vehicle information into scan tool
  - Through programming application software
  - Download VIN and current EEPROM calibration

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FLASH PROGRAMMING (4 of 8)

- **Remote Programming**
  - Disconnect scan tool from DLC
  - Connect to shop PC
  - Download new calibration from PC to scan tool
  - Reconnect scan tool to vehicle's DLC
  - Download new calibration
- **Direct Programming**
  - Uses connection between PC & vehicle DLC

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FIGURE 21–9 Internet connection is usually needed to perform updates although some vehicle manufacturers use CDs, which are updated regularly at a cost to the shop.

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FLASH PROGRAMMING (5 of 8)

- **Off-Board Programming**
  - Used if PCM programmed away from vehicle
  - Uses off-board programming adapter
  - J2534 compliant pass-through system
  - Standardized programming & diagnostic system
  - Uses PC plus standard interface
  - To software device driver

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FIGURE 21–10 battery charger that does not introduce any alternating current (AC) when charging battery is extremely important when programming a PCM.

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FIGURE 21–11 Connecting cables and a computer to perform off-board programming.

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FIGURE 21–12 J2534 pass-through reprogramming system does not need a scan tool to reflash the PCM on most 2004 and newer vehicles.

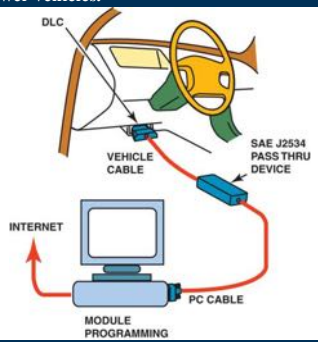

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FIGURE 21–13 A typical J2534 universal reprogrammer that uses the J2534 standards.

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FLASH PROGRAMMING (6 of 8)

- Interface connects to PC and programmable
- ECM on vehicle through J1962 DLC
- Allows programming of all computers
- Using single set of programming hardware
- Programming software from OEM
- Must be functional with J2534 System

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FLASH PROGRAMMING (7 of 8)

- Software for typical pass-through application
- 2 major components
  - First part delivered by CO. furnishes hardware for J2534
  - Second part of pass-through enabling software
  - Usually subset of software with OEM tools
- Internet browser and connection
- needed to access pass-through application

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FLASH PROGRAMMING (8 of 8)

- PCM reset/cleared of previously set DTCs
  - Drive vehicle under circumstances similar
  - To those when problem occurred
  - If 3 passes cannot be achieved
  - Problem fixed and MIL will go out after a few days
  - Clear DTCs using scan tool
  - Battery disconnect

Summary (1 of 2)

- Diagnostic procedure includes following 8 steps:
  - **STEP 1 Verify customer's problem (concern).**
  - **STEP 2 Perform thorough visual inspection and general**
  - **tests.**
  - **STEP 3 Retrieve diagnostic trouble codes (DTCs).**
  - **STEP 4 Check for technical service bulletins (TSBs).**
  - **STEP 5 Look carefully at scan tool data.**
  - **STEP 6 Narrow problem to a system or cylinder.**
  - **STEP 7 Repair problem & determine root cause.**
  - **STEP 8 Verify the repair and check for any stored DTCs.**

Summary (2 of 2)

- Global OBD II can be used by a service technician to do the following:
  - a. Check PCM regarding what it has detected as a fault.
  - b. Verify repair.
  - c. Check if test results are close to failure, which could trigger MIL.
- Mode $06 is most commonly used mode of global
- OBD II because it includes data on the non-continuous monitored system.
- Most aftermarket scan tools and some original equipment
- scan tools can access global OBD-II data