

PRELIMINARY DRAFT

State of California
AIR RESOURCES BOARD
Department of Consumer Affairs
BUREAU OF AUTOMOTIVE REPAIR
Smog Check Program

**Implementation Study
to Incorporate
Diesel Vehicles into Smog Check**

November 1, 2008

Implementation Study to Incorporate

Diesel Vehicles into Smog Check

November 1, 2008

Background

Assembly Bill 1488 (Mendoza, Chapter 739, Statutes of 2007) requires the Bureau of Automotive Repair (BAR) to include by January 2010, model-years 1998 and newer diesel-fueled (diesel) vehicles in the Smog Check Program. This legislation requires the BAR to work in consultation with the California Air Resources Board (ARB) to create the diesel vehicle test procedures, and requires the Department of Motor Vehicles (DMV) to work in consultation with the ARB to identify vehicles for inspection.

At a minimum, AB 1488 requires that 1998 and newer vehicles with a gross vehicle weight rating (GVWR) of less than 8501 pounds be included in the Smog Check Program on January 1, 2010. In addition, the legislation requires the inclusion of diesel-powered vehicles less than 14,000 pounds GVWR once DMV determines the best method for identifying these vehicles, and ARB/BAR implement applicable test procedures. After working with the DMV and the ARB, the three agencies agreed that it would be most cost effective to include diesel vehicles up to 14,000 pounds GVWR so that program changes could be made all at once. This will result in significant cost savings to the State because DMV will only have to make changes to the system once, and emission benefits will be realized to the State sooner.

The bill indicates that the test will, at a minimum, consist of visual checks of the emission control systems (ECS), and an On Board Diagnostics (OBD) test. In addition, AB 1870 (Lieber, Chapter 761, Statutes of 2006) requires a visible smoke test.

Like gasoline-fueled (gasoline) vehicles, the newest four model-years will not be required to obtain a Smog Check inspection in order to register a vehicle when ownership changes. However, unlike gasoline vehicles, the newest six model-years of diesel vehicles will be required to obtain a biennial Smog Check inspection. In calendar year 2010 there will be approximately 540,000 diesel vehicles registered in California subject to the diesel program. DMV will begin sending notifications in January 2010 to registered owners of diesel vehicles with Vehicle Identification Numbers (VIN) ending in even numbers, and the VINs ending in odd numbers will be sent the following year beginning January 2011.

Minor changes to the BAR-97 Emissions Inspection System (EIS) software will be required in order to perform diesel Smog Check inspections by January 2010. The BAR is contracting with the current EIS manufacturers to make the necessary changes to the software.

Joint Study on Test Procedures for Diesel Vehicles

In March 2008, the BAR began working with the ARB to develop test procedures. Motorists owning certain model years and brands of diesel vehicles were contacted by an ARB contractor to see if they would voluntarily participate in the study. Motorists interested were provided \$500, and a full tank of fuel.

The study included an OBD test, a visible smoke test and visual checks for defective or tampered emission control systems. The study was designed to determine if all of the BAR-97 analyzers were able to communicate with the on-board computer systems on 1998 and newer diesel vehicles. A variety of methods to check for visible smoke were evaluated. Also ARB and BAR evaluated how best to gather the vehicle identification information needed to locate and inspect emission control devices. Photographs were taken of the following items on each of the vehicles inspected in the study, including:

Implementation Study to Incorporate Diesel Vehicles into Smog Check

November 1, 2008

- Vehicle Emission Control Information (VECI) label
 - Engine family ID
 - Certification type (California or Federal)
- Vehicle doorpost label
 - GVWR
 - Model-Year
 - Make
 - VIN
- ECS components

Table 1 below shows the model year distribution of the vehicles included in the study. Table 2 shows the vehicle type, and the make/model distribution. These tables show that the vehicles included in the study cover a broad range of models and vehicle types that generally reflect the population of diesel vehicles driven on California roads that will be subject to the Smog Check Program. Although a total of 127 vehicles have been tested as of the date of this report, the study continues to capture information on as many additional diesel vehicles as possible.

**Table 1
Model Year Distribution**

Model-Year	Number of Vehicles
1998	14
1999	12
2000	13
2001	9
2002	10
2003	9
2004	15
2005	15
2006	21
2007	8
2008	1
Total	127

**Table 2
Vehicle Type and Make/Model Distribution**

Type	Make/Model	Number of Vehicles
Passenger Car	VW New Beetle	10
	VW Jetta	13
	VW Passat	6
	VW Golf	6
	Mercedes E-300	7
	Mercedes E-320	4
SUV	Jeep Liberty	3
	VW Touareg	5
	Ford Excursion	4
	Hummer H1	10

Type	Make/Model	Number of Vehicles
Pickup	Chevy Silverado 2500HD	6
	Dodge RAM 2500	11
	Ford F-250	11
	Dodge RAM 3500	16
	Ford F-350	6
Van	Chevy Express 2500HD	1
	Ford E-350	6
	Ford E-450	2
Total		127

OBDII Scan (On Board Diagnostics)

As part of the study, BAR-97 analyzers were obtained from each manufacturer to determine if any of the analyzers had problems identifying Diagnostic Trouble Codes (DTC) or readiness codes that were set by OBD in the vehicle's engine management computer. No unexpected problems were identified.

Besides checking for OBDII communications capability, the OBDII status of each vehicle was collected and evaluated. As an example, out of the eleven non-tampered vehicles that were found to have the Malfunction Indicator Light (MIL) on, four vehicles from the same manufacturer had a P0380 code for "glow plugs." Diagnostic Trouble Codes (DTC), the number of occurrences and an estimated repair cost are listed in Table 3 for vehicles tested in the study that had the MIL commanded "on".

Table 3
Malfunction Indicator Light – Diagnostic Trouble Codes (DTC)

DTC	Description	Occurrences	Diagnosis	Estimated Repair Cost (Parts+Labor)
P0380	glow plug/heater circuit	4	replace 1 glow plug	\$105
P0720	output speed sensor	2	replace speed sensor	\$140
P0605	internal control module ROM error	1	replace ECU	\$1800
P0216	injector or injection timing control circuit	1	replace 1 injector	\$657
P0420	catalyst efficiency	1	replace catalytic converter	\$1368
P0300	random multiple cylinder misfire	1	replace 5 injectors	\$1521
P0403	exhaust gas recirculation control	1	replace EGR motor	emissions warranty
P2121	pedal position sensor performance/rationality	1	not emissions-related	n/a

Gasoline vehicles currently have a \$450 repair cost limit that will now also apply to diesel vehicles subject to the Smog Check Program. The repair cost limit does not apply to vehicles that are tampered, or that fail the visible smoke inspection. Emission warranties may cover the repair for some of these faults, but Table 3 shows that that

Implementation Study to Incorporate Diesel Vehicles into Smog Check

November 1, 2008

some needed repairs exceed the current \$450 repair cost limit. As a result, the percentage of waivers issued to diesel vehicles subject to Smog Check may be higher than for gasoline vehicles.

Visible Smoke Test

In the study, some tampered diesel vehicles passed the visual checks, the OBD test, and BAR's existing 10-second idle visible smoke test. Therefore, ARB and BAR determined that a new test would need to be developed to expose fuel mixture issues caused by tampering. Several different tests were studied. One of the tests evaluated was the Society of Automotive Engineers (SAE) snap-idle test. However, since it was designed for use with heavy-duty diesel vehicles, a problem emerged when it was applied to passenger cars and small SUVs. Testing revealed that the manufacturer's engine RPM limits could be exceeded, potentially causing false failures. Nevertheless, in order to identify a malfunctioning or modified diesel engine, the study showed that the engine RPM must be increased. Therefore, it was determined that a modified snap-idle test for visible smoke would be best suited to reach the Smog Check Program goals of a safe, accurate, and repeatable test.

A new snap-idle test was developed that meets all of our goals and, in addition, it is very simple to perform. No additional equipment will be required to perform this test. The new test is described in the Recommendations section of this paper.

Visual Checks of Emission Control Systems (ECS)

Visual checks for tampered ECS found that 9 of 127 vehicles in the study had missing, modified, or disconnected ECS as shown in Table 4. Since the vehicles included in this study all came from volunteers, the level of tampering when the program is implemented may be higher. Both ARB and BAR staff believe that, since no Smog Check inspection of the ECS has been required until now on these vehicles, the visual inspection for modifications (tampering) is very important to the success of this program.

**Table 4
Tamper Types Studied**

Tamper Types	Number
performance engine control computer "piggy-back" device installed	5
performance air cleaner installed**	1
catalytic converter missing	1
performance air cleaner installed**	1
performance cylinder heads installed	1
aftermarket radio caused OBD communication failure*	1

* This was not an intentional tamper, but it was a disabled part of the vehicle's OBD system.

** This will **not** be considered an illegal tamper.

To identify what emission control devices were required on a particular vehicle for the visual check, the ARB technicians used the VECI label (also referred to as the "underhood label") or an ECS guide that provided information about the ECS components required on the vehicle when it was emissions-certified by the ARB.

Some of the emission control devices on diesel vehicles are different than on gasoline powered vehicles. Table 5 shows where technicians will be instructed to enter the results of the visual checks for the diesel Smog Check inspection procedures used on the BAR-97 EIS.

Table 5

BAR-97 Diesel Inspection Components

Use the existing BAR-97 inspection prompts...	...to record the visual inspection results of these Diesel ECS
Positive Crankcase Ventilation (PCV)	Crankcase Depression Regulator (CDR) or PCV.
Catalytic Converter	Diesel Oxidation Catalyst (DOC) OR (OC)
	Diesel Particulate Filter (DPF)
	Periodic Trap Oxidizer (PTOX)
	NOx Adsorber Catalyst
Selective Catalytic Reduction (SCR – Urea Injection)	
Exhaust Gas Recirculation (EGR)	Diesel EGR
Fuel Injection	Diesel Fuel Injection (DFI)
Oxygen Sensor and Connectors	Pressure sensors, temperature sensors, and Lambda (Oxygen) sensors
Wiring of Sensors/Switches/Computer	Wiring of Sensors/Switches/Computer
Vacuum Line Connections to Sensors/Switches	Vacuum Line Connections to Sensors/Switches
Other Emission-Related Components	Other Diesel Emission-Related Components
	Turbocharger (TC)/Supercharger, Cylinder Heads, Exhaust Manifolds, Intake Manifolds, Charge Air Cooler (CAC) and any other emissions-related components
	Diesel Visible Smoke Test

Since diesel fuel is not as volatile as gasoline, evaporative emissions control systems are not used on diesel vehicles. Therefore, the ARB and the BAR have agreed that it is not necessary to perform the low pressure fuel evaporative test, the liquid fuel leak check, or the fuel cap leak test that is performed on gasoline-powered vehicles.

Currently, ECS Application Guides that are used by technicians as a reference contain some information on diesel engines. The BAR will contact the publishers of the ECS Application Guides to expand and improve the information on diesel vehicles.

Recommendations for Diesel Vehicle Inspection Procedures

Based on the information gathered from the vehicle testing performed during the joint ARB/BAR study on diesel vehicles subject to the Smog Check Program, recommended test procedures were developed for visual checks of required emission control devices, an OBD check, and a visible smoke test. The following test procedures are recommended:

I. Visual Checks

Technicians shall conduct visual checks in accordance with the inspection procedures described in the Smog Check Inspection Procedures Manual and as prompted by the EIS.

Step 1: Technicians must use all available information necessary to determine the vehicle's emission control requirements, including but not limited to, the under-hood emission control label, a current emission control application guide, emission control repair manuals, emission component location guides, manufacturer emission control recalls, vacuum/pressure hose routing diagrams, Air Resources Board (ARB) aftermarket parts listings, the aftermarket part label, and any reliable vehicle manufacturer sources.

Step 2: If a vehicle is equipped with parts that modify the original emission control configuration, technicians must verify whether those parts are ARB approved or exempted. (Not all aftermarket parts modify the original emission control configuration and therefore do not require ARB approval or exemption. For more information, see the Aftermarket Parts Verification Guidelines included in the Smog Check Reference Guide, and/or the ARB website, as described below). If the installed parts are not ARB approved or exempted, and the original emissions control configuration has been modified, the corresponding emission controls are considered "Modified" and the vehicle **shall fail** the inspection.

Step 3: To verify ARB approval or exemption, technicians must check the Aftermarket Parts Label affixed either directly to the part or near the part. This label contains an ARB Executive Order (EO) number that can be used to verify approval or exemption. With the EO number, reference the ARB EO parts listings and/or part manufacturer catalog. The ARB EO parts listings contain information about parts with ARB EO numbers, the part manufacturers and the applicable vehicles on which the parts can be installed. The ARB EO part listings can be found on the ARB website at www.arb.ca.gov then choose "Aftermarket Parts". The ARB aftermarket parts listings may also provide information about modifications that are necessary and acceptable for installation of a particular part, kit or system.

Step 4: If the Aftermarket Parts Label is missing or illegible, the technician may proceed with the inspection, provided the parts can be confirmed as ARB approved or exempted by comparing the part number marked on the part with the ARB EO parts listings, or the parts manufacturer's catalog.

Step 5: Technicians must inspect the emission control systems as listed in Table 1 and enter the inspection results as prompted by the EIS. Check that each system is complete and installed per the vehicle manufacturer's original configuration or, when applicable, an ARB-approved aftermarket configuration.

Step 6: If any required emission control systems are found to be tampered or defective, the vehicle shall fail the inspection.

II. OBD Test (including OBDII Scan)

Diesel vehicles will be subject to the OBD tests. As with gasoline-powered CAN vehicles, diesel vehicles with the CAN protocol will be temporarily excluded from the OBDII portion of the inspection. The BAR-97 cannot perform the OBD scan for any vehicles with the newer Controller Area Network (CAN) OBD communication protocol.

On 1998-2003 diesel vehicles, performance of the OBD scan will be controlled by the BAR-97 software and the Vehicle Lookup Table (VLT). To prevent the vehicles from falsely failing the OBD scan, this process will rely on the technician to correctly identify the Certification Type (e.g. Federal or California) from the Vehicle Emission Control Information (VECI) label.

When the OBD test is performed, the technician shall:

Step 1: Determine that the dashboard MIL is operational by turning the ignition key to the "ON" position with the engine turned off (i.e., not running). The MIL will illuminate if it is operational.

Step 2: The MIL then must be checked for a light "ON", indicating a failing condition. All OBDII-equipped vehicles that are compatible that can be checked by the BAR-97 must be connected to the EIS when prompted.

Step 3: Finally, MIL status, OBD readiness status codes, and DTCs will be downloaded to the BAR-97 and automatically evaluated by the software.

- o The vehicle shall fail Smog Check when failing any portion of the ODB test.

III. Visible Smoke Test

Technicians shall use the following recommended visible smoke test procedure when testing diesel-powered vehicles. The Visible Smoke Test procedure consists of the following parts:

General Test Procedure

1. The Idle Test – With the engine at normal operating temperature, and running at idle. Observe the tailpipe exhaust plume of the vehicle for 10 seconds.
2. The Idle PCV/CDR Test – The technician shall get out of the vehicle with the engine idling, and look for visible smoke from the PCV/CDR system for 10 seconds.
3. The Snap Test – The technician shall push the accelerator pedal quickly from the idle position to between 2000 and 3000 RPM, then immediately release the accelerator pedal, allowing the engine to return to idle. For many vehicles, you will be able to quickly push the accelerator pedal all the way to the floor and stay within the designated RPM range.
4. Enter Test Result into the EIS.
5. Document any failure on the Vehicle Inspection Report and the consumers invoice.

Specific Test Procedures

When the technician performs the test, the following steps shall be followed:

Step 1 - Vehicle Preparation:

- o Position the vehicle to ensure that there are no drafts that can disturb the exhaust plume that could artificially disperse smoke from the exhaust.
- o Turn off all auxiliary engine cooling fans that are used for ASM testing.
- o Verify the engine is at normal operating temperature.
- o Verify that all vehicle accessories, including air conditioning, are OFF.
- o Ensure that the transmission is in "Park" (Automatic Transmission) or "Neutral" (Manual Transmission) with the parking brake set, and the wheels chocked.

Step 2 - Test Preparation and familiarization with the vehicle:

- o Setup any means necessary such as adjust the seating position and the mirror position to observe the exhaust plume during the snap test, and become familiar with the accelerator pedal and engine response.

Implementation Study to Incorporate Diesel Vehicles into Smog Check

November 1, 2008

- o Perform the first of three snap tests as defined above in #3. "The Snap Test".
 - o Check the vehicle's engine RPM during the first snap test. If it does not fall between 2,000 and 3,000 RPM, you can do one of the following:
 - Press and release the accelerator pedal more quickly or more slowly as needed to stay within the designated RPM range; or
 - Quickly press the pedal only part way to the floor before releasing it.
- The technician shall ensure that the vehicle's engine speed does not exceed 3000 RPM.
- o The technician shall not check for smoke during the first snap test and, any visible smoke observed during the first snap test will not result in a failure.

Step 3 – Perform the Idle Test and Observe Tailpipe Smoke:

- o With the engine at normal operating temperature and running at idle.
- o Go around to the vehicle's tailpipe.
- o Observe the tailpipe exhaust plume of the vehicle for 10 seconds.

Step 4 - Idle Test of Crankcase (PCV/CDR) Smoke:

- o Leave the vehicle's engine running at idle and go around to the vehicle engine compartment.
- o Open the hood to the engine compartment, and locate any crankcase areas of concern.
- o Continuously watch the crankcase (PCV/CDR) system for 10 seconds.

Step 5 – Perform the Snap Test and Observe Tailpipe Smoke:

- o When prompted by the EIS for the "Other Emissions Related Components".
- o Using means necessary such as looking out the rear window of the vehicle or using the vehicle's rear view mirrors, watch for visible smoke coming from the tailpipe(s) exhaust plume each time the engine RPM is increased.
- o Perform the second of three snap tests as defined above in #3. "The Snap Test", while watching for visible smoke.
- o Return to Idle, and wait for at least one second, and no more than five seconds.
- o Perform the third (and final) snap test as defined above in #3. "The Snap Test", while watching for visible smoke.

Step 6 – PASS/FAIL Determination:

- o **PASS** the vehicle for the visible smoke test portion of the inspection if the vehicle Passes all three smoke tests (Idle, Snap and PCV/CDR).
- o **FAIL** the vehicle if
 - There is **any** visible smoke during the idle test
 - **OR** there is **any** visible smoke coming from the PCV/CDR system
 - **OR** there is a visible smoke plume coming from the vicinity of the tailpipe(s) exhaust plume on either of the last two Snap Tests **AND** the plume lingers for more than **3 seconds**.
- o Smoke from any area other than the vehicle's tailpipe(s) or PCV/CDR system, regardless of the cause, does not constitute a failure of the Visible Smoke Test.
- o No vehicle will be failed for steam. Steam is always white and usually evaporates quickly or condenses, while smoke may dissipate but never evaporates.

Step 7 - Entering Test Results into the EIS:

- o For vehicles that meet the passing criteria above, enter "P" (Pass) in the "Other Emission Related Controls" category of the visual inspection portion of the Smog Check, when prompted by the EIS.
- o For vehicles that fail the visible smoke check according the criteria above, enter "F" (Defective) in the "Other Emission Related Controls" category of the visual inspection portion, when prompted by the EIS.

Implementation Study to Incorporate

Diesel Vehicles into Smog Check

November 1, 2008

- Note: The EIS currently allows only one entry for the visual inspection of all components covered under the "Other Emission Related Controls" category. Therefore, if the vehicle passes the visible smoke test but fails a visual check of any component covered under the "Other Emission Related Controls" category, enter the appropriate failure code: "D" (Disconnected), "M" (Modified) or "S" (Missing). However, if the vehicle passes the visual inspection for components including in the "Other Emission Related Controls" category but fails the visible smoke test, enter "F" (Defective) into the EIS.

Step 8 - Documentation Provided to Consumer: If the vehicle fails the Visible Smoke Test, the technician shall:

- Document the failure on the customer's copy of the Vehicle Inspection Report (VIR) in the "Other Emission Related Components" section. Make a clear notation on the VIR, such as "Failed for visible smoke," or "Failed visible smoke test." Write down what part of the visible smoke test the vehicle failed, such as "Failed Crankcase Smoke," "Failed Idle Tailpipe Smoke," or "Failed Snap Tailpipe Smoke".
- Document the failure on the customer's invoice with "Failed for visible smoke," or "Failed visible smoke test." Write down what part of the visible smoke test the vehicle failed, such as "Failed Crankcase Smoke," "Failed Idle Tailpipe Smoke," or "Failed Snap Tailpipe Smoke".
- Provide to the customer the Bureau's Diesel Test Consumer Information Sheet, with the applicable items completed on the checklist