United States Environmental Protection Agency

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On-Board Diagnostic (OBD) Regulations and Requirements: Questions and Answers

Certification and Compliance Division
Office of Transportation and Air Quality
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1. What is the origin of vehicle On-Board Diagnostic (OBD) systems?

In the early 1980s, vehicles were equipped with electronics and on-board computers to control many of the engine control systems, such as fuel and ignition. As the engines became more complex, it became necessary for vehicle manufacturers to develop a more efficient method of monitoring for and diagnosing electronic component problems. As a result, the vehicle manufacturers developed the first computerized, on-board diagnostic systems.

2. What is OBD and how does it work?

On-Board Diagnostics is additional computer software that monitors the emission control and emission-related components/systems, along with certain engine components that provide vehicle operational information. By monitoring and evaluating the various components and systems, the on-board computer is able to determine the presence of a malfunction or deterioration that can affect emissions and illuminate the "Check Engine" or "Service Engine Soon" light (also known as the malfunction indicator lamp or MIL) on the dashboard. In some instances, the computer software may identify a problem before there is an overt indication to the vehicle operator. The combination of the various emission control and engine components/systems, the MIL, and the diagnostic computer software make up the On-Board Diagnostic system.

3. What is the difference between the terms "OBD" and "OBD II"?

The terms "OBD" and "OBD II" are used interchangeably to describe the second-generation of On-Board Diagnostics. The first generation of On-Board Diagnostic requirements, called OBD I, was developed by the California Air Resources Board (ARB) and implemented in 1988. As technology and the desire to expand On-Board Diagnostic capability increased, a second-generation of On-Board Diagnostics requirements was envisioned. Consequently, in 1992, ARB published their second version of On-Board Diagnostic regulations called "OBD II", and in 1993, EPA published their first version of On-Board Diagnostic regulations called "Federal OBD". Due to the difference in revision level for ARB and EPA, the terms "OBD II" and "OBD", respectively, emerged. However, as ARB and EPA regulations were further harmonized, the terms began to be used interchangeably to represent the second-generation of On-Board Diagnostics. (Refer to Attachment A of this document for a complete timeline of OBD regulatory implementation).

4. What is the difference between OBD I systems and OBD II systems?

The general differences between OBD I and OBD II can be summarized as follows:

OBD I	OBD II
Monitors and detects component and system electrical failures.	Monitors and detects emission system deterioration and/or malfunction as well as electrical failures.
Malfunction indicator lamp (MIL) extinguishes immediately if problem did not re-occur.	Malfunction indicator lamp (MIL) extinguishes after 3 consecutive trips where the problem did not re-occur.
Emission control or emission related components that OBD must monitor: oxygen sensors, exhaust gas re-circulation (EGR) system, fuel delivery system, Powertrain Control Module (PCM) and other electronic components at manufacturers discretion.	*Emission control or emission related components that OBD must monitor*: catalyst efficiency, oxygen sensor response and heater, exhaust gas re-circulation (EGR) system, fuel delivery system, engine misfire, evaporative system, secondary air system, air conditioning system using R-12, Powertrain Control Module (PCM), and all electronic inputs/outputs to the PCM.
Non-Standardized: Connector location and design, diagnostic trouble codes, terminology, definitions, communications format, and acronyms are not standardized and are implemented at the manufacturer's discretion.	*Standardized:* Connector location and design, diagnostic trouble codes, terminology, definitions, communications format, and acronyms required for all manufacturers.

5. What systems and components are required to be monitored in the Federal OBD regulations?

The Clean Air Act Amendments (CAAA) of 1990 required, at a minimum, the monitoring of the catalyst and the oxygen sensor. Federal OBD regulations extended the monitoring requirements beyond just the catalyst and oxygen sensors and added monitoring of other emission control and emission-related components such as: exhaust gas re-circulation (EGR), secondary air, misfire, fuel metering/trim, oxygen sensor heater, catalyst heater, air conditioning system (if R-12 refrigerant is used), evaporative system, and any electronic emission related components. See the applicable regulations for further detail (a list is provided in Attachment B of this document).

6. What is a waiver, what is a deficiency, and how do they differ?

A waiver is an exemption from an entire monitoring requirement whereas a deficiency is an exemption from a specific aspect of a monitoring requirement. Waivers (only for MY 1994 and 1995 vehicles) and deficiencies (MY 1996 and beyond) must be requested by the manufacturer prior to certification. EPA can grant or deny the waiver or deficiency based on specific regulatory criteria.

For example, if a manufacturer was having difficulty implementing an oxygen sensor monitor on a 1994 or 1995 model year vehicle, the manufacturer could request a waiver and, if granted by the EPA based on the specific regulatory criteria, would be exempt from implementing all of the oxygen sensor monitoring requirements. In contrast, for a 1996 model year and beyond vehicle, if a manufacturer is having difficulty implementing an oxygen sensor monitor, the manufacturer is still required to perform some checks of the oxygen sensor but may request a deficiency for specific checks that cannot be performed. Therefore, the manufacturer still performs some level of oxygen sensor monitoring but not the full level of monitoring that is expected and/or required.

Unlike ARB, which levies fines for more than two deficiencies (fixed amount assessed per vehicle per deficiency), EPA does not levy fines for deficiencies. However, it is EPA's intent to allow one deficiency per model year for each certified OBD system and to limit the carry-over of deficiencies into subsequent model years.

7. Federal OBD regulations were required in 1994, but 1996 is commonly referenced as the year of implementation. What are the reasons for this?

The OBD requirements were implemented beginning with the 1994 model year. However, as discussed above, vehicle manufacturers were allowed to request waivers from OBD monitoring requirements for the 1994 and 1995 model years. Since most manufacturers requested and received OBD waivers during the 1994 and 1995 model years, 1996 is commonly identified as the first year of full implementation once waivers were no longer available.

8. What vehicles and weight classes does Federal OBD apply to and in what model years were they implemented?

Federal OBD requirements apply as follows:

Category	*Implementation Schedule*
Light-Duty Vehicles and Trucks (LDV/Ts) below 8,500 pounds GVWR* w/ gasoline engines	- 1994 Model Year - Waivers available for 1994 and 1995 model years - 1996 model year: waivers not available, full compliance required
Light-Duty Vehicles and Trucks (LDV/Ts) below 8,500 pounds GVWR w/ diesel engines (see #7 below for further discussion)	- 1994 Model Year - Waivers available for 1994-1996 model years - 1997 model year: waivers not available, full compliance required - 2005: aftertreatment monitoring (i.e, monitoring of catalyst, adsorbers, particulate filters, etc.) is required

<table>
<tr><td rowspan="6">Heavy-Duty engines and complete vehicles between 8500-14,000 pounds GVWR **</td><td colspan="3">Phase-In Based on Projected Sales</td></tr>
<tr><td>Model Year</td><td>Gasoline Engines/Vehicles</td><td>Diesel Engines/Vehicles</td></tr>
<tr><td>2004</td><td>40%</td><td>--</td></tr>
<tr><td>2005</td><td>60%</td><td>50%</td></tr>
<tr><td>2006</td><td>80%</td><td>50%</td></tr>
<tr><td>2007</td><td>80%</td><td>100%</td></tr>
<tr><td></td><td>2008</td><td colspan="2">100% (full compliance)</td></tr>
<tr><td>Alternate Fuel Vehicles</td><td colspan="3">(see #12 below for further discussion)</td></tr>
<tr><td>Heavy-Duty engines and complete vehicles above 14,000 pounds GVWR</td><td colspan="3">At this time, there are no requirements for engines/vehicles above 14,000 pounds GVWR.</td></tr>
</table>

** GVWR = Gross Vehicle Weight Rating.*
*** ARB has had requirements for all vehicles below 14,000 pounds GVWR since the 1996 model year, except diesel vehicles which were not required to have OBD until the 1997 model year.*

9. What components/systems on diesel engines/vehicles are monitored by OBD?

The main diesel components monitored for OBD include, but are not limited to, exhaust gas re-circulation (EGR), misfire (complete lack of cylinder combustion), glow plugs and any electronic inputs and outputs to the powertrain control module (PCM).

Due to differences in operation and pollutant criteria, diesel engines do not have the same components and the same OBD monitors as gasoline engines. The main pollutant from diesel engines tends to be oxides of nitrogen (NOx) and particulate matter (PM) versus gasoline engines which, in addition to NOx and PM, produce hydrocarbon (HC) and carbon monoxide (CO) emissions. Specifically, diesel engines do not typically use a three-way catalyst (TWC), oxygen sensors, and evaporative monitors as compared to their gasoline counterparts.

As the NOx and PM emission standards are lowered for diesels, aftertreatment devices (i.e., NOx adsorbers, particulate filters, etc.) may be necessary to meet the emission standards. As a result, diesel engines/vehicles will be required to monitor aftertreatment devices, if equipped, as described in Attachment C.

10. What are the major differences between Federal OBD and California Air Resources Board (ARB) OBD II? How has this changed over the years?

ARB OBD II requirements tend to focus on OBD system design and, as a result, are more technology forcing and provide greater detail for each required OBD monitor. In contrast, Federal OBD regulations tend to focus on the emission performance aspects of emission control and emission-related powertrain systems/components and are more general in description than ARB OBD II regulations. Although the philosophies are different, both are equally comprehensive and effective at ensuring proper design of OBD systems.

The key difference between Federal and ARB OBD regulations are primarily in the area of evaporative system leak diagnostics. Federal OBD requires detection of a 0.040" or greater orifice (i.e., leak, crack, gap, hole) in the evaporative system. In contrast, ARB OBD II requires detection of a 0.020" or greater orifice (i.e., leak, crack, gap, hole) in the evaporative system. There are instances where manufacturers may choose to retain 0.020" leak detection capability on Federal vehicles (i.e., vehicles for sale outside of California), but they are not required to at this time by Federal OBD regulations.

Since EPA accepts compliance with ARB OBD II design requirements, most manufacturers prefer to certify to ARB OBD II design requirements. Over the years, EPA has revised the Federal OBD regulations to harmonize with ARB OBD II regulations to reduce manufacturer certification burden (i.e., one system for all 50 states). The Vehicle Emissions Certification Information (VECI) label under the vehicle's front hood should indicate which regulations the vehicle complies with.

11. Are there other countries that have OBD requirements? If so, what are they and what are the major differences between U.S. OBD systems and these other countries' OBD systems?

Canada: Canada's OBD requirements are essentially similar to EPA's requirements. Likewise, Canada also accepts ARB OBD II systems as EPA does.

European Union (EU): The EU's requirements closely mirror EPA's requirements. However, the EU does not require the OBD system to monitor for the presence of evaporative system vapor leaks and, as a result, the manufacturer or importer must modify a European OBD system to include evaporative system vapor leak diagnostic capability before receiving EPA Federal OBD approval. The European OBD regulations can be found in the Directive 98/69/EC, which contains rules for light-duty vehicles.

Japan: Japan has developed a simple form of OBD requirements. Japan focuses on light duty OBD systems as well, though it is not described in the same detail as in the U.S. regulations. According to Japanese certification standards, California, U.S. and European OBD systems are considered equivalent.

Other countries are also considering adopting OBD requirements along with more stringent emission standards, but have not done so yet.

12. What are the OBD requirements for Alternative Fuel Vehicles?

Dedicated alternate fuel, dual-fuel, bi-fuel, or flexible fuel vehicles are not required to be fully compliant with Federal OBD II requirements during alternate fuel operation until the 2005 model year. Hybrid, electric, and fuel cell vehicles are also considered "alternate fuel" vehicles and are therefore required to meet similar Federal OBD requirements as alternate fuel vehicles.

For dual fuel, bi-fuel or flexible fuel vehicles beginning with the 1996 model year, the OBD system was required to be fully functional during gasoline operation. However, some manufacturers required additional lead time and were granted waivers during gasoline operation until the 1999 model year. OEMs or vehicle converters of dual fuel, bi-fuel or flexible fuel vehicles must also ensure that the integrity of the OBD data stream information is maintained regardless of the fuel the vehicle is operated on (i.e., information pertaining to a trouble code, MIL status, and other OBD data stream fault recorded during gasoline operation should be retained even if the vehicle is switched to alternate fuel operation).

In summary, all alternate fuel vehicles will have OBD II in the 2005 model year regardless of the operating fuel-type. All dual fuel, bi-fuel or flexible fuel vehicles between the 1999 and 2004 model year and most dual fuel, bi-fuel or flexible fuel vehicles between 1996 and 1999 will have full OBD II capability on the gasoline side.

13. What are the OBD requirements for Hybrid Electric and Fuel Cell Vehicles?

The requirements for Hybrid Electric Vehicles (HEVs) are as follows:

The manufacturer must equip each HEV with:

- a maintenance indicator that illuminates when the minimum performance level for each battery system is observed;
- a separate odometer or other device that can accurately measure the mileage accumulation on the engines used on these vehicles;
- and, for HEVs with off-board charging capability, a useful life indicator that must illuminate when the battery system is unable to achieve an all-electric operating range (i.e., at least 75 percent of the full range for the vehicle determined on the Urban Driving Schedule (UDS) portion of the All-Electric Range Test).

At this time, there are no OBD requirements for Fuel Cell vehicles since they are zero emitting. There may be maintenance and safety indicators used but this is not a result of OBD requirements.

14. What are the latest related Code of Federal Regulations (CFR) cites, EPA web sites, and *Federal Register* cites related to OBD?

CFR Cites:
OBD (engine certification) - 40 CFR part 86, section 86.005-17
OBD (chassis certification) - 40 CFR part 86, section 86.1806-05
Certification information requirements - 40 CFR part 9, section 9.1844-01
OBD checks in Inspection and Maintenance Programs - 40 CFR part 51 and 85

Web sites:
Code of Federal Regulations - http://www.access.gpo.gov/nara/cfr/cfr-table-search.html
General OBD info and regulations - http://www.epa.gov/otaq/obd.htm
**You can retrieve CFR sections by using the CFR citations listed in Attachment B (e.g., 40 CFR 86.094-17)*
ARB OBD - http://www.arb.ca.gov/msprog/obdprog/obdprog.htm

15. Who should I contact if I have additional questions regarding OBD?

Since there are many aspects of OBD, there are individuals assigned to specific areas of OBD but you can contact any of the following individuals for OBD questions:

OBD Regulations and Policy, Light-Duty/Heavy-Duty OBD Certification and Compliance:
Arvon L. Mitcham
(734) 214-4522
mitcham.arvon@epa.gov

OBD Inspection and Maintenance Implementation - Technical Issues:
Jim Lindner
(734) 214-4558
lindner.jim@epa.gov

OBD Outreach and Service Information (i.e., OBD emissions-related service materials)
Holly Pugliese
(734) 214-4288
pugliese.holly@epa.gov

Attachment A

History of On-Board Diagnostics (OBD)

Late 1970s - 1980s	Auto manufacturers developed diagnostic systems to check engine performance through the use of electronic feedback control
Mid-1980s	U.S. Environmental Protection Agency (EPA) and California Air Resources Board (ARB) researched OBD system for emissions purposes
1988	ARB published regulations on OBD I (simple, high-level check)
1990	Clean Air Act amended; EPA directed to promulgate OBD regulations building on ARB OBD I regulations
1991	EPA published Notice of Proposed Rulemaking for Federal OBD systems
1992	ARB published regulations on second generation of OBD regulations, commonly called OBD II (more comprehensive monitoring/ checks included)
1993	EPA published Final Rule for Federal OBD systems; differs from ARB OBD II in terms of emission exceedance criteria (additive for EPA vs. multiplicative for ARB); the number of required monitors and evaporative system leak criteria (diurnal emission based for EPA vs. orifice size-based for ARB)
1994/95	EPA implementation begins for light-duty vehicles/trucks less than 8,500 pounds GVWR (ARB OBD II required for all vehicles less than 14,000 pounds GVWR); waivers are allowed for monitored systems, an option almost all manufacturers choose
1996	Full OBD II system compliance is required; waiver option is eliminated although deficiencies for minor OBD system short falls are allowed
1998	EPA published rule that harmonizes Federal OBD requirements with ARB OBD II; adopts multiplicative threshold approach and 0.040" leak monitoring requirement
1999	EPA added provision that requires Federal OBD on complete vehicles between 8,500 pounds and 14,000 pounds GVWR to accompany the requirements for light-duty vehicle/trucks below 8,500 pounds
2000/01	EPA adds separate OBD requirements for gasoline and diesel engines, and new aftertreatment monitoring requirements for all diesel engines/vehicles intended for use in vehicles less than 14,000 pounds GVWR

Attachment B

Federal Register Cites: On-Board Diagnostics (OBD) Regulatory Actions

June 8, 2001 66 FR 30830	Service Information NPRM **[40 CFR ß86.094-38, ß86.096-38 and ß86.1808-01-38]**
January 18, 2001 66 FR 5041	OBD for HD Vehicles and Engines -- Modification of Federal OBD requirements; part of the 2007 HD FRM **[40 CFR ß86.005-17 and ß86.1806-05]**
October 6, 2000 65 FR 59916	OBD for HD Vehicles and Engines -- part of the 2004 HD FRM **[40 CFR ß86.005-17 and ß86.1806-05]**
October 29, 1999 64 FR 58472	OBD for HD Vehicles and Engines -- part of the 2004 HD NPRM **[40 CFR ß86.1806-01]**
December 22, 1998 63 FR 70681	OBD FRM: Modification of Federal OBD for LDVs and LDTs; Extension of Acceptance of California OBD II Requirements (Harmonization FRM) **[40 CFR ß86.099-17]**
April 27, 1998 63 FR 24429	OBD FRM: OBD Check in I/M: Final rule to delay incorporation of OBD checks in I/M programs until 1/1/2001 **[40 CFR parts 51 and 85]**
February 19, 1998 63 FR 8386	OBD Proposed Rule Notice of Document Availability: ARB MO#97-24 containing OBD II regs. proposed for federal certification option via the Harmonization NPRM (5/28/97) **[40 CFR ß86.099-17]**
February 17, 1998 63 FR 7718	OBD FRM: Modification of Federal OBD for LDVs and LDTs; Extension of Deficiency Policy for 99MY **[40 CFR ß86.094-17]**
December 22, 1997 62 FR 66841	OBD NPRM: OBD Checks in I/M; Proposal to delay incorporation of OBD checks in I/M programs until 1/1/2001 **[40 CFR parts 51 and 85]**
May 28, 1997 62 FR 28932	OBD NPRM: Modification of Federal OBD for LDVs and LDTs; Extension of Acceptance of California OBD II Requirements (Harmonization NPRM) **[40 CFR ß86.094-17]**
October 11, 1996 61 FR 53371	OBD II Waiver Decision: California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption; Decision
August 30, 1996 61 FR 45898	OBD FRM: Acceptance of Revised California OBD II Requirements contained in MO#95-34 **[40 CFR ß86.094-17]**
August 6, 1996 61 FR 40940	OBD FRM: OBD Checks in I/M **[40 CFR parts 51 and 85]**

November 1, 1995 60 FR 55521	OBD NPRM: Acceptance of Revised California OBD II Requirements **[40 CFR ß86.094-17]**
August 18, 1995 60 FR 43092	OBD NPRM: OBD Checks in I/M **[40 CFR parts 51 and 85]**
August 11, 1995 60 FR 41066	OBD Notice of opportunity for public hearing and public comment period: California State Motor Vehicles Pollution Control Standards; Opportunity for Public Hearing
August 9, 1995 60 FR 40474	OBD FRM: Regulations Requiring Availability of Information for Use of On-Board Diagnostic Systems and Emission-Related Repairs on 1994 and later Model Year Light-Duty Vehicles and Light-Duty Trucks **[40 CFR ß86.094- 38]**
August 2, 1995 60 FR 39264	OBD DFRM: Revision to Requirements for Storage of Engine Conditions Associated With Extinguishing a Malfunction Indicator Light **[40 CFR ß86.094-17]**
July 25, 1995 60 FR 37945	OBD Removal Notice: Regulations Allowing Optional Compliance with California OBD II Requirements as Satisfying Federal OBD
March 23, 1995 60 FR 15242	OBD DFRM: Acceptance of Revised California OBD II Requirements; OBD Relief for Alternative Fueled Vehicles; and Revisions for Consistency Between Federal OBD and California OBD II; Removal of Federal Anti-Tampering Provisions **[40 CFR ß86.094-17]**
October 7, 1994 59 FR 51114	OBD Notice of Court Decision Regarding Agency Regulations: Regulations Requiring Tampering Prevention for On-Board Diagnostic Systems
July 28, 1994 59 FR 38372	OBD Technical Amendment: OMB Approval Numbers Under the Paperwork Reduction Act
February 19, 1993 58 FR 9468	OBD FRM **[40 CFR ß86.094-17]**
December 13, 1991 56 FR 65035	OBD Extension of comment period
September 24, 1991 56 FR 48272	OBD NPRM **[40 CFR ß86.094-17]**

Attachment C

Overview of On-Board Diagnostic (OBD) Monitoring Requirements for EPA, ARB and Europe

Monitoring Requirement	U.S. EPA Federal OBD		ARB OBD II		European OBD	
	Otto-	Diesel	Otto-	Diesel	Otto-	Diesel
Catalyst	O	a,b	O	a,b	O	O
Catalyst Heater	O	a,b	O	a,b	e	e
Misfire Detection	O	d	O	d	O	e
Evaporative System	O	X	O	X	X	X
Secondary Air	O	X	O	X	e	e
Air Conditioning	g	g	O	O	X	X
Fuel System	O	X	O	O	e	O
Oxygen Sensor	O	a	O	O	O	X
Oxygen Sensor Heater	O	a	O	O	O	X
Exhaust Gas Re-circulation (EGR)	O	O	O	O	e	e
Positive Crankcase Ventilation (PCV)	b	b	O	O	e	e
Thermostat Monitoring	b	b	O	O	e	e
Fuel Filler Cap	f	X	O	X	O	O
Particulate Filter	X	b,c	X	b,c	X	O
Comprehensive Component Monitoring	O	O	O	O	O	O

O = required, X = not required; refer to the letters below for clarification on some requirements (also refer to the applicable regulations for additional details)

a: If the vehicle is equipped with this component/system, it must be monitored

b: Must be monitored unless failure would not cause an emissions exceedance (must be demonstrated/supported with test data)

c: Must be monitored for catastrophic failure only

d: Must monitor for complete lack of cylinder combustion only

e: Covered by a general statement under comprehensive component monitoring

f: Failure should be detected by evaporative system; for a missing cap, a separate fuel cap indicator light may be used

g: Required to be monitored if R-12 is used