Permanent Diagnostic Trouble Codes

Greg Coburn, Engineering and Research Branch
Workshop Meeting
April 19, 2018
OBD Inspection Failure Criteria

CCR 3340.42.2(c): On or after January 1, 2013, OBD equipped vehicles shall fail the OBD inspection if any one of the following conditions occurs as applicable to the vehicle:

1. The vehicle's MIL does not illuminate when the ignition is on and the engine is off (under prior version of regulation)
2. The vehicle's MIL illuminates continuously or flashes with the engine running (under prior version of regulation)
3. The vehicle's OBD system reports the MIL commanded ‘ON’ (under prior version of regulation)
4. The vehicle's OBD system reports a Diagnostic Trouble Code (DTC) (under prior version of regulation)
OBD Inspection Failure Criteria (cont’d)

(5) The vehicle’s OBD system data indicates the system has not yet been sufficiently operated to determine the presence or absence of a DTC (TBD)

(6) The vehicle’s OBD system does not communicate with the EIS or OIS (under prior version of regulation)

(7) The vehicle’s OBD system data is inappropriate for the vehicle being tested (February 2017)

(8) The vehicle’s OBD system data does not match the original equipment manufacturer (OEM) or an Air Resources Board (ARB) exempted OBD software configuration (TBD)
OBD Inspection Failure Criteria (cont’d)

(9) The vehicle’s OBD system reports incomplete readiness monitor(s) for the following groups (May 2015):

(A) Gasoline-powered vehicles, model-years 1996 - 1999, with more than one (1) incomplete monitor

(B) Gasoline-powered vehicles, model-years 2000+, with any incomplete monitors, excluding the evaporative system monitor

(C) Diesel-powered vehicles model-years 1998 through 2006 with any incomplete monitors

(D) Diesel-powered vehicles model-years 2007 and newer with any incomplete monitors, excluding the particulate filter system monitor
# Current Readiness Standards

<table>
<thead>
<tr>
<th>Model Years</th>
<th>Fuel Type</th>
<th>Number of Incomplete Monitors Allowed to Pass OBD Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-1999</td>
<td>Gas&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Any one</td>
</tr>
<tr>
<td>2000 and newer</td>
<td>Gas&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Evaporative system</td>
</tr>
<tr>
<td>1998-2006</td>
<td>Diesel</td>
<td>Zero</td>
</tr>
<tr>
<td>2007 and newer</td>
<td>Diesel</td>
<td>Any two</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Includes gasoline, compressed natural gas (CNG), liquid natural gas (LNG) and liquid propane gas (LPG)
Not Ready by Model Year & Fuel

[Bar chart showing the percentage of vehicles with permanent diagnostic trouble codes for diesel and gas vehicles by model year from 1998 to 2016.]
Monitor Readiness Decisions

- Monitor Readiness decisions can be aided by considering:
  - **Number** of warmup cycles since DTCs cleared
  - **Distance** traveled since DTCs cleared
  - **Presence** of a PDTC
Warm-up Counts and Distance Traveled

- **Mode $01$ PID $30$:** Number of warm-up cycles conducted since DTCs were cleared
- **Mode $01$ PID $31$:** Distance traveled since DTCs cleared
- Supported by most 2006+ diesel and most 2008+ gasoline vehicles
- Can be used with PDTCs to determine vehicle readiness to test per CCR 3340.42.2(c)(5)
Permanent DTCs

- OEM phase-in 2010 – 2012 model years
- Same codes as regular OBD II fault codes (DTCs)
- Stored in Non-Volatile Random Access Memory (NVRAM)
- Cannot be erased by DTC code clearing or battery disconnect
- Stated purpose is to prevent DTC clearing to obtain a passing test\(^{(1)}\)
- Only the OBD II system itself can clear the PDTC when:
  - The OBD II system’s MIL (not dashboard MIL) is commanded off.
  - The related readiness monitor(s) ran to completion with no malfunction detected.

\(^{(1)}\) SAE J-1979
# PDTC and PID Support by Model Year & Fuel

## PDTCs

**Majority coverage by 2010 (gas and diesel)**

<table>
<thead>
<tr>
<th>MODEL YEAR</th>
<th>TESTS</th>
<th>PID30 SUPPORT</th>
<th>PID31 SUPPORT</th>
<th>PERMDTC SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>361</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>1999</td>
<td>1,388</td>
<td>0.07%</td>
<td>0.07%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2000</td>
<td>1,334</td>
<td>0.15%</td>
<td>0.15%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2001</td>
<td>1,877</td>
<td>0.32%</td>
<td>0.32%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2002</td>
<td>1,933</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2003</td>
<td>2,398</td>
<td>0.17%</td>
<td>0.17%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2004</td>
<td>2,669</td>
<td>38.25%</td>
<td>38.29%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2005</td>
<td>2,521</td>
<td>46.32%</td>
<td>46.32%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2006</td>
<td>3,322</td>
<td>93.71%</td>
<td>93.71%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2007</td>
<td>2,057</td>
<td>99.42%</td>
<td>99.42%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2008</td>
<td>1,999</td>
<td>99.60%</td>
<td>99.60%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2009</td>
<td>722</td>
<td>99.86%</td>
<td>99.86%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

## PID $30

**Number of warm up cycles since codes cleared**

<table>
<thead>
<tr>
<th>MODEL YEAR</th>
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<th>PID31 SUPPORT</th>
<th>PERMDTC SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>700</td>
<td>99.86%</td>
<td>99.86%</td>
<td>73.71%</td>
</tr>
</tbody>
</table>

**Majority coverage by 2006 (diesel) and 2007 (gas)**

<table>
<thead>
<tr>
<th>MODEL YEAR</th>
<th>TESTS</th>
<th>PID30 SUPPORT</th>
<th>PID31 SUPPORT</th>
<th>PERMDTC SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2,220</td>
<td>99.91%</td>
<td>99.91%</td>
<td>99.59%</td>
</tr>
<tr>
<td>2012</td>
<td>1,638</td>
<td>99.82%</td>
<td>99.82%</td>
<td>99.45%</td>
</tr>
<tr>
<td>2013</td>
<td>1,990</td>
<td>99.95%</td>
<td>99.95%</td>
<td>99.65%</td>
</tr>
<tr>
<td>2014</td>
<td>1,935</td>
<td>99.90%</td>
<td>99.90%</td>
<td>99.53%</td>
</tr>
<tr>
<td>2015</td>
<td>4,826</td>
<td>99.90%</td>
<td>99.90%</td>
<td>99.21%</td>
</tr>
<tr>
<td>2016</td>
<td>993</td>
<td>99.89%</td>
<td>99.89%</td>
<td>99.36%</td>
</tr>
<tr>
<td>2017</td>
<td>279</td>
<td>1.00%</td>
<td>1.00%</td>
<td>98.92%</td>
</tr>
</tbody>
</table>

## PID $31

**Distance traveled since codes cleared**

<table>
<thead>
<tr>
<th>MODEL YEAR</th>
<th>TESTS</th>
<th>PID30 SUPPORT</th>
<th>PID31 SUPPORT</th>
<th>PERMDTC SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>39,700</td>
<td>99.93%</td>
<td>99.93%</td>
<td>73.03%</td>
</tr>
</tbody>
</table>

**Majority coverage by 2006 (diesel) and 2007 (gas)**

<table>
<thead>
<tr>
<th>MODEL YEAR</th>
<th>TESTS</th>
<th>PID30 SUPPORT</th>
<th>PID31 SUPPORT</th>
<th>PERMDTC SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>144,465</td>
<td>99.95%</td>
<td>99.95%</td>
<td>99.95%</td>
</tr>
<tr>
<td>2012</td>
<td>22,886</td>
<td>99.93%</td>
<td>99.92%</td>
<td>98.46%</td>
</tr>
<tr>
<td>2013</td>
<td>31,882</td>
<td>99.97%</td>
<td>99.97%</td>
<td>99.14%</td>
</tr>
<tr>
<td>2014</td>
<td>19,500</td>
<td>99.91%</td>
<td>99.91%</td>
<td>99.63%</td>
</tr>
<tr>
<td>2015</td>
<td>17,211</td>
<td>99.95%</td>
<td>99.95%</td>
<td>99.80%</td>
</tr>
<tr>
<td>2016</td>
<td>17,240</td>
<td>99.90%</td>
<td>99.90%</td>
<td>99.78%</td>
</tr>
<tr>
<td>2017</td>
<td>2,967</td>
<td>99.87%</td>
<td>99.87%</td>
<td>99.53%</td>
</tr>
</tbody>
</table>
Evaporative Emissions (Gasoline)

- Evaporated fuel (EVAP) emissions are a significant source of pollution in gasoline vehicles.

- OBD II EVAP monitors can be difficult to set due to:
  - Required warmup cycle, ambient temperature, fuel level, elevation

- Current regulation does not require EVAP monitor readiness for MY2000+ gas vehicles\(^{(1)}\)

- Clearing EVAP related DTCs still possible since the EVAP monitor is not required to complete in order for the vehicle to pass smog

- This creates a loophole where vehicles with EVAP defects can still pass their Smog Check.

\(^{(1)}\) CCR 3342.2(c)(9)(B)
Evaporative Emissions (Gasoline)

- PDTCs can assist in identifying EVAP system problems:
  - Proposal: When the EVAP monitor is incomplete, and an EVAP related PDTC is present, then
  - The vehicle would fail Smog Check unless:
    - The EVAP monitor runs to completion, or
    - 15 warm-up cycles have been completed since code clearing, and
    - 200 miles have been driven since code clearing
      - Sufficient operation of the vehicle would increase the ability for a DTC to reset.
      - Addresses situations where the vehicle has difficulty clearing the PDTC, with the intent not to unduly inconvenience affected motorists.
Analysis of Gasoline Tests

- Examined initial test records from Jan-Feb 2018 on model year 2010 and newer gas vehicles
  - 301,399 initial tests
  - 10,670 initial test failures (3.5%)
- Of the 290,729 passing initial tests, 547 have:
  - Incomplete EVAP monitor, and
  - EVAP related PDTC present, and
  - Less than 15 warm-up cycles, or less than 200 miles driven since DTC cleared
Analysis of Gasoline Tests

- Using the proposed PDTC criteria would result in about 275 additional failures per month
- Initial test fail rate would rise from 3.5% to 3.7%
- Effect of this change would increase as:
  - Newer vehicles age and deteriorate
  - Vehicles come off the model year biennial exemption (only 2010-2012 currently get biennial renewal Smog Checks)
- Top 4 EVAP Related PDTCs
  - EVAP system leak detected (very small leak)
  - EVAP system leak detected (large leak)
  - EVAP system incorrect purge flow
  - EVAP system leak detected (fuel cap loose/off)
Diesel Readiness Monitors

- New Diesel Readiness Monitors
  - NMHC CAT (Non-Methane Hydrocarbon Catalyst)
  - NOx/SCR (NOx Selective Catalytic Reduction)
  - PM Filter (Diesel Particulate Matter Filter)
  - Exhaust Gas Sensor
  - Boost Pressure

- Diesels after-treatment monitors often take longer to run

- Several monitors linked to PM filter regeneration

- Cannot be treated the same as gasoline monitors

- May be treated in similar fashion to the gasoline EVAP monitor
Analysis of Diesel Tests

- Examined initial test records from Jan-March 2018 on model year 2010 and newer diesel vehicles
  - 31,117 initial tests
  - 1,859 initial test failures (6.0%)
- Of the 29,258 passing initial tests, 108 have:
  - Incomplete After-treatment related monitor, and
  - After-treatment related PDTC present, and
  - Less than 15 warm-up cycles, or less than 200 miles driven since DTC cleared
- Using the proposed PDTC criteria would result in about 55 additional failures per month
- Initial test fail rate would rise from 6.0% to 6.3%
**Smog Check Vehicle Inspection Report (VIR)**

**Vehicle Information**
- **Test Date/Time:** 07/05/2017 @ 2:56 PM
- **Model Year:** 2012
- **Vehicle Make:** NISSAN
- **Vehicle Model:** VERSA S
- **VIN (scanned from vehicle):** [Redacted]
- **VIN (manually entered or from DMV document):** [Redacted]
- **License Plate:** [Redacted]
- **License State:** CA
- **Fuel Type:** Gasoline
- **Odometer:** 33333

**Overall Test Result**
- **FAIL**

Your vehicle failed the Smog Check inspection. Check your Owner's Manual to determine if the emission failure is repairable under the vehicle manufacturer warranty. Vehicles purchased new in California have an emission performance warranty for a minimum of 3 years or 36,000 miles that guarantees your vehicle passes the inspection. An emission parts warranty of 7 years or 70,000 miles covers certain high cost parts listed in the Owner's Manual. If your vehicle is a Partial Zero Emission Vehicle (PZEV), the emission warranty extends to 15 years or 150,000 miles. The warranty for PZEV hybrid battery systems is 10 years or 120,000 miles. These warranties require the vehicle has not failed due to lack of scheduled maintenance, and other conditions specified in the vehicle's Owner's Manual. Warranty information by vehicle manufacturer is provided by the Bureau of Automotive Repair at www.bar.ca.gov.

BAR's Consumer Assistance Program (CAP) offers financial assistance with emission repairs and a monetary incentive to retire a vehicle from operation. If a warranty service or coverage problem arises, you may file a complaint with BAR. To learn more about CAP or to file a complaint, visit www.bar.ca.gov.

**Visual Inspection:** PASS  
**Functional Inspection:** FAIL

**Comments:** 2012 Nissan Versa with permanent DTC present: warmins = 29, distance travelled = 804 km; permanent DTCs ON; fails

### Visual Inspection Result Information

<table>
<thead>
<tr>
<th>Result</th>
<th>Inspection Category</th>
<th>Result</th>
<th>Inspection Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS</td>
<td>Air Injection System</td>
<td>PASS</td>
<td>Catalyst</td>
</tr>
<tr>
<td>PASS</td>
<td>Computer, Sensors, Switches, and Wiring</td>
<td>PASS</td>
<td>Knock Sensor Emissions Controls</td>
</tr>
<tr>
<td>PASS</td>
<td>Exhaust Gas Recirculation (EGR)</td>
<td>PASS</td>
<td>Fuel Evaporative System (EVAP)</td>
</tr>
<tr>
<td>PASS</td>
<td>Fuel Metering System</td>
<td>PASS</td>
<td>Other Emission Related Components/Systems</td>
</tr>
<tr>
<td>NOTAPPLICABLE</td>
<td>Turbocharger/Supercharger</td>
<td>PASS</td>
<td>Vacuum Lines to Sensors/Switches</td>
</tr>
</tbody>
</table>

### Emission Control Systems Functional Check Results:

<table>
<thead>
<tr>
<th>Result</th>
<th>Inspection Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS</td>
<td>Liquid Fuel Leak Check</td>
</tr>
<tr>
<td>PASS</td>
<td>Smoke Check</td>
</tr>
</tbody>
</table>

**Permanent Fault Codes:**

- **P0171 - System Too Lean Bank 1**

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**Station ID:** RC099562  
**Inspector Name/ID:** [Redacted]  
**Software Version/OIS ID:** 6.4.906.4/CV003596  
**WONDERFUL WORLD OF SMOG  
16048 NORTH MATHER BOULEVARD  
EUREKA, CA 95501  
(510) 555-1212**
Implementation Constraints

- VID must be updated to distinguish between EVAP and non-EVAP PDTCs in gasoline vehicles

- VID must be updated to distinguish between after-treatment and non after-treatment PDTCs in diesel vehicles

- Problematic vehicle issues:
  - PDTCs not clearing on time
  - PDTCs never clearing
Implementation Plan

- Update VID
- Develop FAQs
- Change DMV registration renewal notice
- Send ET Blasts
- Provide training to industry
- Update CAP failure criteria
- Develop Referee policies
- Update BAR website
- Work with OEM and ARB to fix problematic vehicles
Questions and Comments

Submit additional questions and/or comments to:

Greg Coburn
Bureau of Automotive Repair
10949 N. Mather Boulevard
Rancho Cordova, CA 95670
Phone: 916-403-0154
Email: greg.coburn@dca.ca.gov