CARB has defined and approved regulations for medium and heavy-duty applications

Following the successful implementation of regulations introducing on-board monitoring and diagnostic systems for passenger cars and light trucks in 1996, it was only a matter of time before similar systems would be mandated for heavy commercial vehicles. It therefore comes as no surprise that exhaust emissions from heavy-duty vehicles are now in the crosshairs of governmental regulation. In 2005, the California Air Resources Board (CARB) has defined and approved regulations that describe on-board diagnostic system functionality for vehicles with a Gross Vehicle Weight Rating (GVWR) exceeding 14,000 lbs (6.35 tons).

The regulation, known as “Title 13, California Code of Regulations, Section 1971.3, Heavy-duty (HD) OBD”, was approved by CARB in July 2005. The HD OBD regulation prescribes enhancements in functionality for the on-board monitoring of components while the vehicle is in operation, as well as support for external test devices that will be able to connect to the HD OBD system and obtain operational data. The regulation specifically covers gasoline and diesel engines, which includes medium and heavy-duty applications within all classes of on-road trucks.

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General timeline information includes a phase-in plan. It sets the 2010 model year as the target date and calls for each engine manufacturer to have one engine family – a grouping of power plants with similar horsepower and torque rating based on the same engine design – equipped with HD OBD. There is one important exception to the aforementioned engine family and timeframe specifications. The requirement for standardized communications with an external test device has been waived for the 2010 model year. However, in the 2013 model year, all heavy-duty vehicles must include HD OBD and provide required standardized communications with an external test device, e.g., physical layer, data link layer, communications protocol, and diagnostic messages.

The California Air Resources Board reviews the regulation biennially to ensure that engine manufacturers and technology advancements are on track to meet the HD OBD requirements. More often than not, this review process yields modifications to the definitions of existing functions or the adoption of new features. These changes become necessary as in-dustry experts continue to develop new technologies that are necessary to fulfill the regulation.

Communications Protocol Highlights

• SAE J1939 – can only be used with gasoline and diesel engines
• SAE J1939 – can only be used with diesel engines

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Possible Changes to SAE J1979/ISO 15031-5 E/E Diagnostic Test Modes.

<table>
<thead>
<tr>
<th>New Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ModeService $0A – Permanent Fault Codes</td>
<td></td>
</tr>
<tr>
<td>May allow an external test device to obtain permanent fault code information from an HD OBD ECU.</td>
<td></td>
</tr>
<tr>
<td>2 Readiness Monitor Labels for Diesel Engines</td>
<td></td>
</tr>
<tr>
<td>May be patterned after existing mode/service $03.</td>
<td></td>
</tr>
<tr>
<td>3 Additional PIDs for Diesel Engines</td>
<td></td>
</tr>
<tr>
<td>May have additional status bytes.</td>
<td></td>
</tr>
<tr>
<td>4 Additional DTCs for Diesel Engines</td>
<td></td>
</tr>
<tr>
<td>Driven because emission controls of diesel engines are much different than those already defined for gasoline engines.</td>
<td></td>
</tr>
<tr>
<td>5 Additional In-Use Performance Tracking Elements for Diesel Engines</td>
<td></td>
</tr>
<tr>
<td>May use a Fuel Type PID to allow for an external test device to re-map existing PID $01 and $41 bits to either gasoline or diesel readiness monitor labels.</td>
<td></td>
</tr>
</tbody>
</table>

Gasoline engine functionality

The proposed HD OBD gasoline engine regulation is largely similar to the specifications in the existing CARB regulation for passenger cars and light duty trucks. Vehicle evaporative system monitoring is required, with the capability to detect leaks down to an orifice size of 0.150 inch in diameter. ECU for HD OBD-compliant gasoline engines are required to support a permanent fault function by the 2010 model year. The term “permanent” implies that neither an external test device (e.g., scan tool) nor a loss of power to the ECU may cause the DTCs in ECU memory to be cleared. The communication protocol prescribed for communications between an ECU and tester is specified as ISO 15765-4. “Diagnoses on Controller Area Networks (CAN)”.

Diesel engine functionality

It should be noted that, prior to all gasoline engines becoming HD OBD-compliant in 2013, these engines must, as a minimum, comply with the specifications of “Title 13, California Code of Regulations, Section 1971, Engine Manufacturer Diagnostics (EMD)”, for the 2007 through 2012 model years. ECU for HD OBD-compliant diesel engines are required to support a permanent fault function by the 2010 model year. The communication protocol prescribed for communications between an ECU and tester is specified as ISO 15765-4 or SAE J1939. ECU for HD OBD-compliant diesel engines are required to support a permanent fault function by the 2010 model year. The communication protocol prescribed for communications between an ECU and tester is specified as ISO 15765-4 or SAE J1939.
As is the case with passenger cars and light duty trucks, some monitors operate once per driving cycle, while others run continuously. What is new with HD OBD, though, is the requirement for the operation of once-per-driving-cycle monitors to be enabled again after four hours of continuous vehicle operation. As it is common for engines of large trucks to keep running throughout the day, this requirement was driven by the mix of quasi-continuous engine operation, occasional roadside rest stops, and long idle periods. In adherence to the same timeline as gasoline engines, it is worthy of note that, prior to all diesel engines becoming HD OBD-compliant in 2013, these engines must, as a minimum, comply with the specifications of “Title 13, California Code of Regulations, Section 1971, Engine Manufacturer Diagnostics (EMD)”, for the 2007 through 2012 model years.

**Summary**

*Title 13, California Code of Regulations, Section 1971.1, Heavy-duty (HD) OBD*, calls for a drastic change in functionality of electronic engine control units for diesel powered heavy-duty vehicles. Previously, the ECU Otto had to ensure functional operation of the engine, while supporting factory-specific diagnostic routines. Now, with HD OBD, a similarly standardized functionality is about to be introduced to the diesel engine of tomorrow.

**Industry documentation**

To add the required modes, services, and data definitions for HD OBD, it is quite likely that SAE J1979/ISO 15031-5, the harmonized document that defines the modes and services used by a generic scan tool, will require pertinent updates. A list of possible changes is shown in the table on the previous page. As a note of interest, the SAE “Truck and Bus Command and Control” committee is developing a new recommended practice “J1999-03 On-Board Diagnostics Implementation Guide”. The intent of this document is to describe guidelines for implementation of On-Board Diagnostics (OBD) on heavy-duty vehicles (HDV) using the J1939 standards documentation.

The focus of this document is to aid OEM-engine manufacturers to satisfy the following active regulations developing around the globe: “State of California Air Resources Board (ABAB Title 13, CCR 1971.1, United States Environmental Protection Agency, European Commission directives EUR IV and V; UN/ECE WP 29 GRPE WWH OBD Global Technical Regulation (GTR)”.

**Dates & Events**

**September 2006**

- September 26 – 27, 2006
  - Mess Tec Masters
  - Oberhausen, Germany

**October 2006**

- October 2 – 4, 2006
  - IFF Congress
  - New Trends in Engine Control, Simulation and Modeling
  - Rueil-Malmaison, France

- October 4 – 5, 2006
  - Normandy Motor Meetings
  - Rouen, France

- October 9 – 11, 2006
  - Aachen Colloquium Automobile and Engine Technology
  - Aachen, Germany

- October 11 – 13, 2006
  - IZB – International Suppliers Fair
  - Wolfsburg, Germany

- October 16 – 18, 2006
  - Convergence
  - Detroit, MI, USA

- October 20, 2006
  - ETAS Seminar
  - Nagoya, Japan

- October 22 – 27, 2006
  - FISITA
  - World Automotive Congress
  - Yokohama, Japan

**October 2006**

- October 24 – 25, 2006
  - International Automotive Electronics Congress
  - Paris, France

- October 25 – 26, 2006
  - FKFS Conference AutoTest
  - Stuttgart, Germany

- October 27 – 28, 2006
  - Automatic Testing Expo North America
  - Detroit, MI, USA

- November 2006

- November 30, 2006
  - FlexRay Product Day
  - Böblingen, Germany

**February 2007**

- February 13 – 15, 2007
  - embedded world
  - Nuremberg, Germany