Procedure for Approving Aftermarket Diesel Particulate Filters (DPF) Intended as Modified Parts For 2007 - 2009 On-Road Heavy-Duty Diesel Engines

Public Workshop

April 7, 2015

California Environmental Protection Agency

Air Resources Board
Purpose

- Establish a procedure for evaluation and approval of DPFs as modified parts

- Procedure ensures:
  - DPF is functional with real and durable emission reductions
  - DPF is compatible and fully integrated with the engine (i.e., does not impact engine durability or functionality)

- Provide end users additional market place options when purchasing DPFs intended as substitutes for non-functional OEM parts

- Focus is on 2007-2009 engines certified with DPFs
Overview

- Background
- Projected Schedule
- Proposed Procedure
- Questions and Open Discussion
Background
Existing Programs
Replacement Parts

- Definition - 13 CCR 1900 (b)(23) “...is functionally identical to the original equipment part in all respects which in any way affect emissions (including durability)...”

- Testing and specifications equivalent to OEM certification

- Must be able to provide sufficient information to show that product meets these requirements (13 CCR 2221 and 2224)
Modified Parts - DPFs

Proposed Regulation

- Modified parts
  - Not identical in all respects to certified emissions control component
  - Existing procedures deemed inadequate for certain emission critical parts like DOCs, DPFs, etc.
  - Separate evaluation procedure and approval path needed for aftermarket DPFs
Projected Schedule

- Second public workshop
- Individual stakeholder meetings (in April)
- Comments/feedbacks for contributions to the board package (in April)
- 45-Day comment period – (October 2 through November 16, 2015)
- Board hearing (Sacramento) – November 19 and 20, 2015
Proposed Aftermarket Modified Part Procedure
Proposed procedure includes:

- Applicability
- Application process
- Testing
- Warranties
- Other Requirements
- Draft procedure available online
Applicability

- Market-ready new aftermarket DPFs intended as modified parts
- 2007-2009 on-road heavy-duty diesel engines with DPFs
- NOT for the following:
  - DPFs covered under verification provisions
  - DPFs intended as replacement parts
  - Used DPFs
Application Process
Application Format and Process

- Two types of application
  - Preliminary application (PA)
  - Final application (FA)
- Application process (see flow chart on next slide)
Manufacturer submits preliminary application

Application includes all ARB required information?

Yes: ARB sends “approval test plan” letter to manufacturer

No: ARB asks for more information within 45 days

Manufacturer responds within 45 days

ARB sends “incomplete” letter to request more information within 45 days

ARB asks for more information within 45 days

Manufacturer responds within 60 days & 3 times

Yes: ARB issues EO within 60 days

No: ARB sends “termination” letter to manufacturer. Manufacturer needs to wait for 60 days for re-submission

Manufacturer conducts all required testing and submits final application

ARB reviews in detail if final application meets all requirements?

Yes: ARB issues EO within 60 days

No: Manufacturer responds within 60 days & 3 times

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Pre-application

- Defined emission control group (ECG). Limit 1 per application.
- Contact persons/phones/emails/addresses
- Complete information on the OEM and modified part
- Detailed test plan (all required tests, test facilities, fleet/vehicles/engines, equipment/instruments, etc.)
- Warranty information
- Statement of compliance
- Detailed application format - see draft procedure
Final Application

- Testing reports and results
- Testing data and QA/QC data
- Third-party statements and letters
- Signed statement of compliance letter
- Owner’s manual /installation manual
- Sample scale drawings of labels
- Other supporting information
Emission Control Group

- Proposed definition:
  - Single OEM
  - OEM DPF part number within a single OEM
  - An ECG must only include a single modified part

- Based upon:
  - Robust review of OEM data
  - Consultation with stakeholders
  - Differences between OEMs
  - Effects on the engine must be considered
Testing
Testing Goals

- Ensure the device-equipped engine is compliant with the original certification
  - Account for infrequent regeneration adjustment factors (IRAFs)
  - AECDs
- Ensure the device is durable
- Ensure the device is compatible with the engine
  - No fault, EMD, ECU impacts, etc.
  - No effect on engine function or normal operations
Testing Sequence

Lab Aging (500 hr) (T, BP, RPM, Photos)

OEM

Mod. Part

Emission Testing (FTP, 1cold +3 hot)

OEM

Mod. Part

Field Testing (T, BP, RPM, Photos, 3rd Party Letter, etc.)

Mod. Part (500 hr)

Mod. Part (200 hr)

Mod. Part (200 hr)

Emission Testing (FTP, 1cold +3 hot)

Mod. Part
# Laboratory Aging Protocol

## Table 1 ARB Modified Aging Cycles

1. Temperature ramping period during the aging cycle is not considered as part of the 500 hours aging time.
2. Cooling down period during the aging cycle is not considered as part of the 500 hours aging time.

<table>
<thead>
<tr>
<th>Mode #</th>
<th>Description</th>
<th>Parameters</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2007 ramped-modal cycle</td>
<td>Engine Speed &amp; Torque</td>
<td>Code of Federal Regulations, Title 40, part 86, Subpart N 40 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time Duration</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2007 ramped-modal cycle</td>
<td>Engine Speed &amp; Torque</td>
<td>Code of Federal Regulations, Title 40, part 86, Subpart N 40 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time Duration</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ramped temperature(^1)</td>
<td>Target Temperature (DPF Inlet)</td>
<td>670°C ±20 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine Speed &amp; Torque</td>
<td>2007 ramped-modal cycle Mode A100 2 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time Duration</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Active Regeneration</td>
<td>Target Temperature (DPF Inlet)</td>
<td>670°C ±20 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine Speed &amp; Torque</td>
<td>2007 ramped-modal cycle Mode A100 40 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time Duration</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Cooling down(^2)</td>
<td>Target Temperature</td>
<td>Back to 2007 ramped-modal cycle Mode A100 exhaust temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>Shut off supplemental fuel supply</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine Speed &amp; Torque</td>
<td>2007 ramped-modal cycle Mode A100</td>
</tr>
</tbody>
</table>

\(^1\)Temperature ramping period during the aging cycle is not considered as part of the 500 hours aging time.

\(^2\)Cooling down period during the aging cycle is not considered as part of the 500 hours aging time.
Laboratory Aging Protocol
Continued

- Multipoint temperature measurement requirement

Figure 1 Temperature sensor locations for DPF aging

- Effective aging time concept
  - The temperature difference between DPF inlet and inside of DPF
  - Aging time is a function of aging temperature as defined by the Arrhenius equation
  - Use multipoint temperature data to achieve targeted aging time
Laboratory Aging Protocol
Chemical Aging

- Lubricant oil exposure requirement
  - Use observed field average oil consumption to estimate oil exposure target for the modified part warranty period.
  - Use 500 hours aging period to estimate the aging oil consumption.
  - Oil satisfies OEM specifications (e.g., CJ-4).
  - Oil consumption acceleration options to achieve target oil consumption.
  - Method (e.g. “drain and weigh” every 24 hours or use AVL 406 Oil Consumption Meter) to track actual oil consumption during aging process.
Emission Testing Requirements

- Engine must be representative of the emission control group
- FTP heavy-duty transient cycle
- 1 cold start plus 3 hot starts
- Emissions testing during regeneration of a soot loaded filter
- Other testing as necessary (e.g., CFR 1065, Subpart L for semi-volatile organic compounds, dioxins)
- Detailed requirements in draft procedure
Proposed Acceptance Criteria
Lab Aged OEM vs. Lab Aged AMP

- NMHC, NOx (or NMHC + NOx), CO, PM must meet certification emission standards
- NOx shall not exceed 10% of certification level
- Average backpressure and temperature no greater than 10% above or below OEM
- No EMD fault or warning codes
Compatibility
Field Trials

- Independent datalogger requirements (≤10 sec intervals)
  - Timestamp
  - Engine RPM
  - Temperature
  - Backpressure
- All ECU codes
- Third party letters
- Photographs of the device
Field Trial Requirements

During the field trial the device must not:

- Cause EMD/OBD error/fault codes or ECU interference
- Require maintenance or cleaning
- Damage engine or cause it to exceed manufacturer limits
- Interfere with the vehicle’s normal functions
- Have emissions exceeding certified standards
- Have component failures or lose physical integrity
- Show inappropriate regeneration patterns

Vehicle must not experience failure of other emission control components
Proposed Acceptance Criteria
Lab Aged AMP vs. Field Aged AMP

- NMHC, NOx (or NMHC + NOx), CO, PM must meet certification emission standards
- NOx shall not exceed 10% of certification level
- Average exhaust temperature within 10%
- Average exhaust backpressure within 20%
- No EMD fault or warning codes
Other Requirements
Warranty

- Product Warranty
  - 5 years or 150,000 miles from date of installation, whichever is shorter

- Installation Warranty
  - 5 years or 150,000 miles from date of installation, whichever is shorter

- Consistent with other aftermarket part warranties
Other Aftermarket Program

Warranties

- **Catalytic converter**
  - 5 years/50,000 miles
  - Some OEMs offer lifetime warranty for replacement exhaust systems

- **Highway motorcycle**
  - If ≤4 year from purchase date, full warranty as certification (i.e., 5 year/12-30k km, depending on Class I, II, III)
  - If >4 year from purchase date, 3 year or half applicable mileage of certification, whichever occurs first
  - Installation warranty: 2 year/12,000 km
Recordkeeping

- Manufacturers & installers maintain information on:
  - Valid end user contact information
  - Description of vehicles and engines on which the units are installed
  - Date of purchase/installation
  - Hours/miles on engine at time of installation
  - Reason DPF was replaced
  - Vehicle assessment prior to installation
  - Device serial number

- Records maintained for 4 years from date of installation, or no less than one year beyond the warranty period, whichever is longer.
Vehicle Pre-Installation Assessment

Manufacturers must ensure the following are met:

- Appropriate vehicle/engine
- Engine and DOC are in proper state of maintenance
- No engine error codes, etc.
- Vehicle is in original OEM exhaust aftertreatment configuration
- Aftermarket part is installed in same location and orientation as OEM part with no change to other OEM components
- Original DPF is out of warranty
- Authorized installer
Labeling

- Legible, visible, durable
- EO number issued by ARB
- Unique serial number
- Name, address, phone number of manufacturer
- Part number
- Date (month/year) of manufacture
- Directional flow arrow
- Other information such as filter “birth weight” to help the end user clean their filter.
Additional Requirements

- Prohibit resale of used DPF
- Recall process if:
  - Catastrophic failures / safety issues
  - Enforcement action
  - Parts fail QC
  - Part causes engine issues or other parts to fail on the engine
  - High warranty claims, and/or operation failure issues
- Audit testing
  - Testing or inspection of new or in-use units
  - ARB can require a manufacturer to provide a device for inspection and testing
ARB developed a survey including 15 questions.

Who should answer questions?
- Industry associations
- Individual aftermarket DPF manufacturers
- Installers and/or service providers

Survey will provide costs and economic impact estimates for this board item.
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Draft evaluation procedure:
http://www.arb.ca.gov/diesel/mod-part/mod-part.htm
Questions/Comments