April 18, 2016

Clerk of the Board
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Subject: Comments in Response to “Notice of Public Hearing to Consider Amendments to the Aftermarket Diesel Particulate Filters Regulation” (posted March 1, 2016).

Dear Sir or Madam,

Enclosed are comments from Cummins Inc. regarding the above-referenced notice. We thank you for this opportunity to provide our comments. If you have any questions, please contact Khamphet Munnicha at 812-377-3418 or Khamphet.munnicha@cummins.com.

Sincerely,

Mike Cooper
Director
U.S. and Canada Product Certification & Compliance
Cummins Inc.

COMMENTS OF CUMMINS INC.

Introduction

The California Air Resources Board (ARB) is considering amendments to the aftermarket diesel particulate filters (DPF) regulations for MY2007 to MY2009 on-highway heavy-duty (HD) diesel engines. The goal of this rulemaking is to offer a robust evaluation procedure to demonstrate durability and compatibility of an aftermarket DPF to replace an Original Equipment Manufacturer (OEM) DPF.

Cummins Inc. designs, manufactures, distributes and services engines and related technologies (e.g., DPFs) applied in medium- and heavy-duty engines affected by the proposed amendments. The company is an advocate for consistent and responsible regulations and has collaborated with ARB through this rulemaking by providing technical input related to DPF design and evaluation. Cummins is pleased to now offer our comments in response to the "Notice of Public Hearing to Consider Amendments to the Aftermarket Diesel Particulate Filters Regulation" (posted March 1, 2016). Also, as a member of EMA, Cummins participated in the development of comments submitted by this group and support those comments as well.

Emission Control Group

In the proposed evaluation procedures for the aftermarket DPF rulemaking, ARB has defined seven (7) Emission Control Groups (ECG) considering the engine manufacturer, market share and aftertreatment configuration. ARB explains the engine groupings will have similarities of how an aftermarket DPF "will interact with the engines and how the engines interact" with the aftermarket DPF while avoiding onerous, cost-prohibitive testing requirements. Aftermarket manufacturers are also only required to verify the "worst-case" engine within an ECG, assuming dimensionally-scaled versions of the aftermarket DPF will yield acceptable performance for the remaining ECG engines. Unfortunately, the defined ECGs encompass an extremely broad range of engine families, displacements, customer applications, calibration tunings and DPF characteristics (e.g., backpressure profile, soot loading, washcoat and precious metal loading). Cummins has provided ARB confidential business information showing the differences of the varying DPF design and performance impacts for our MY2007 – MY2009 engines. A single test engine does not adequately evaluate compatibility for an entire ECG as differing DPF critical properties (substrate, washcoat, PGM loading, etc.) influence engine system performance, such as exhaust backpressure, that lead to engine specific models to ensure proper and timely regeneration of the DPF. Furthermore, the proposed single test engine lacks sufficient evidence that the aftermarket DPF specifications (e.g., wall thickness,

porosity) are “similar enough” to the OEM DPF for each engine platform within an ECG. Without evaluation of the aftermarket DPF for a given platform, an unintended consequence may be introduction of an aftermarket DPF that is not compatible with some of the engine platforms within an ECG. ARB should consider defining an ECG, at a minimum, based on each engine platform (e.g., displacement) for an OEM as a reasonable alternative to their proposed ECG found in Appendix A of the evaluation procedure.

Testing Procedure

As part of the aftermarket DPF evaluation, manufacturers are required to validate their aftermarket design as shown in the testing sequence in Figure 1. A single aftermarket DPF (“Mod. Part #1”) must be degreened for 25 hours, lab aged for 300 hours and field tested for 500 hours. Between each of these testing sections, an emissions test sequence must be completed and measured results are compared to the emissions standards and/or the previous emissions results. Cummins offers the following comments relative to this testing sequence.

To check catalytic activity, section (f)(2)(C) allows manufacturers to either measure NO_2 (see section (f)(5)(B)) or perform soot accumulation testing as defined in section (f)(5)(C). However, providing these testing options contradict the need to evaluate NO_2 emissions after each aging sequence for “Mod Part #1” as suggested by sections (f)(10)(B)-(D). To fully evaluate catalytic activity and degradation, NO_2 should be evaluated during each emissions test sequence in Figure 1 and ARB should clarify this requirement. Similarly, if the soot accumulation method is valid for checking catalyst activity and will be used by applicants, this evaluation method and additional acceptance criteria should be required by ARB for emissions testing after 300 hours of lab aging and 500 hours of field testing.

Finally, the proposed aging cycle requires 100 hours at 700 C +/- 50C for the A100 Ramped-Modal Cycle Supplemental Emissions Test (RMCSET) operating point for the worst-case test engine of the ECG. The +/- 50 C creates a temperature control range that is too large to allow for a consistent and fair comparison test, as the temperature extremes (650 C, 750 C) will result in different aging characteristics. DPF degradation is mainly a function of temperature and to have a realistic comparison of DPF performance, all DPFs should undergo aging at the same temperature and time. The DPF degradation rate will be different between an aged part at 650 C versus an aged part at 750 C, where manufacturers could purposely perform their testing at the lower temperature range to ensure likelihood of certification. Even consideration of the time (see Appendix 3, Section 3.1), via ARB’s proposed Arrhenius effective aging expression, may not properly account for the temperature effects on catalyst aging under the proposed temperature extremes. For these reasons, the temperature range should

be narrow in order to make sure that the comparison is realistic and representative of the difference between the varying aftermarket designs. As such, a more appropriate temperature range would be +/- 10 C.

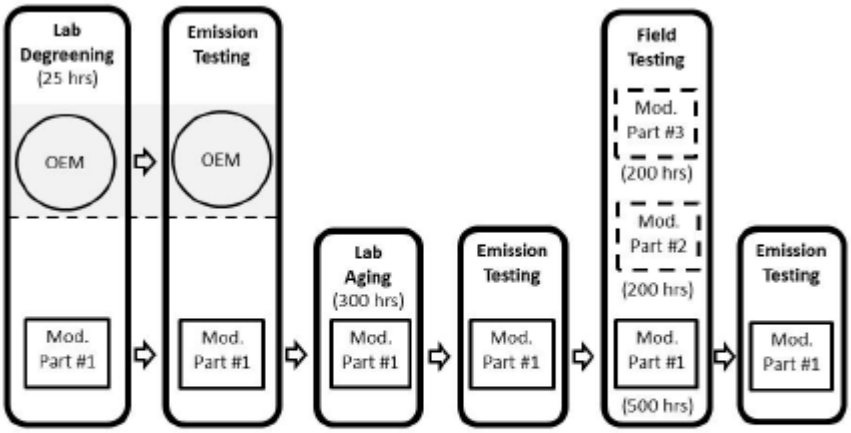

Figure 1. Test sequence for evaluating Aftermarket DPFs. Adapted from ARB's "Staff Report: Initial Statement of Reasons for Proposed [Aftermarket DPF] Rulemaking" (posted March 1, 2016).

Conclusions

Cummins appreciates the opportunity to provide these comments in regards to ARB's proposed rulemaking for evaluating aftermarket DPFs. We look to continuing collaboration with ARB in developing a regulation that achieves their goal for a robust evaluation procedure that ensure compatibility of DPF designs for OEM engines.