From: Bunker, Byron
To: Phillip Brooks (Brooks.Phillip@epa.gov)
Cc: Belser, Evan
Subject: One Pager on Diesel Testing Status
Date: Monday, April 25, 2016 9:15:00 PM
Attachments: [redacted]

Hi Phil,

Janet asked that we pull together a one-pager for the Administrator re: everything happening on the various testing programs plus latest news on [redacted]

Attached is the one pager that I sent to Chris. He has sent this forward to Janet who will presumably share it with the Administrator. Most important new information from your team is that we are trending away from thinking there is a serious compliance issue with the [redacted]

I am working on some materials for Wednesday's discussion re: the 3.0 liter vehicles that we I hope to share tomorrow.

Thanks,

Byron

****
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From: Montague, R. Latane
To: Bunker, Byron
Subject: Two Daimler Press Releases from Today we discussed
Date: Friday, April 22, 2016 2:24:50 PM

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http://media.daimler.com/

R. Latane Montague
Partner

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From: Bunker, Byron
To: Grundler, Christopher
Cc: Cook, Leila
Subject: FW: Mercedes Presentation
Date: Friday, April 22, 2016 7:59:00 AM
Attachments: [redacted]

Materials from our meeting on Wednesday with Mercedes. I will have a printed copy for our post VW discussion.

Thanks,

Byron

****
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From: Ball, Joel
Sent: Wednesday, April 20, 2016 1:06 PM
To: Bunker, Byron <bunker.byron@epa.gov>; Wehrly, Linc <wehrly.linc@epa.gov>; Cullen, Daniel <Cullen.Daniel@epa.gov>; Wright, DavidA <Wright.DavidA@epa.gov>; Ott, William <ott.william@epa.gov>; Snyder, Jim <Snyder.Jim@epa.gov>; Dalton, Joel <Dalton.Joel@epa.gov>
Subject: FW: Mercedes Presentation

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From: Ball, Joel
Sent: Wednesday, April 20, 2016 1:04 PM
To: Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>; 'Regenfuss, Mike@ARB' <michael.regenfuss@arb.ca.gov>; 'Montes, Thomas@ARB' <thomas.montes@arb.ca.gov>; Lourenco, Jackie@ARB <Jackie.Lourenco@arb.ca.gov>; 'Valencia, Thomas@ARB'

<tvalenci@arb.ca.gov>; 'john.ng@arb.ca.gov' <john.ng@arb.ca.gov>
Subject: Mercedes Presentation

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From: Bunker, Byron
To: Dvorak, Victor
Cc: Wehrly, Linc
Subject: FW: Collecting our thoughts on defeat devices
Date: Monday, April 11, 2016 1:41:00 PM
Attachments: AC 24 December 1972.pdf
AC 24-2 December 1978.pdf
AC 24-3 January 2001.pdf
(b) (5) [redacted]
vpcd-98-13.pdf

Hi Victor,

Attached to this e-mail are the defeat device guidance letters that I mentioned last week. Also attached is a draft document that we are developing for staff training. The draft document is very much a draft and does not in any way constitute an articulation of final Agency policy.

Thanks,

Byron

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From: Bunker, Byron
Sent: Sunday, March 13, 2016 8:32 PM
To: Orlin, David <Orlin.David@epa.gov>; Kataoka, Mark <Kataoka.Mark@epa.gov>; Phillip Brooks (Brooks.Phillip@epa.gov) <Brooks.Phillip@epa.gov>; Belser, Evan <Belser.Evan@epa.gov>; Kaul, Meetu <Kaul.Meetu@epa.gov>; Orehowsky, Gregory <Orehowsky.Gregory@epa.gov>; Wehrly, Linc <wehrly.linc@epa.gov>; Dalton, Joel <Dalton.Joel@epa.gov>; Ball, Joel <ball.joel@epa.gov>; Wright, DavidA <Wright.DavidA@epa.gov>; Ott, William <ott.william@epa.gov>; Snyder, Jim <Snyder.Jim@epa.gov>; Pidgeon, Bill <pidgeon.bill@epa.gov>; Olechiw, Michael <olechiw.michael@epa.gov>; Charmley, William <charmley.william@epa.gov>; Moulis, Charles <moulis.charles@epa.gov>; Stout, Alan <stout.alan@epa.gov>; Cook, Leila <cook.leila@epa.gov>
Subject: Collecting our thoughts on defeat devices

Attached to this e-mail is a word document that collects excerpts from the various regulatory provisions and circular advisories related to defeat device evaluations. The document also poses several hypothetical fact patterns and attempts to conclude if the described AECDs constitute defeat

devices. The applicable advisory circulars are also attached.

We would like to use this document to help make sure we are all on the same page regarding how to evaluate AECDs against the Defeat Device definition in the context of multiple applicable standards (FTP, US06, SC03 etc.) and the relief for AECDs that are *"substantially included in the Federal emission test procedure"*.

As a starting point to consolidate everyone's thoughts, we would appreciate it if you would review the document and using track changes and comments mark the document up to reflect your conclusions regarding the example cases. We will organize a meeting to discuss this further, but we would like everyone to do a little homework before we get together. (b) (7)(A) [redacted]

Thanks,

Byron

****
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MSPC Advisory Circular

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR PROGRAMS • MOBILE SOURCE POLLUTION CONTROL PROGRAM

Subject: Prohibition of use of Emission Control Defeat Devices

A. Purpose

The purpose of this Advisory Circular is to notify manufacturers that EPA will refuse to certify vehicles equipped with emission control defeat devices and to inform manufacturers as to the authority and criteria for any such refusal by EPA. The Circular also applies the policy set forth to the approval of running changes and field fixes involving the addition of Defeat Devices to vehicles.

B. Background

1. In a letter of July 12, 1972, the Administrator notified all manufacturers of light duty motor vehicles that the Agency considers sensors and devices which may adversely affect emission control under conditions or during operations likely to occur in actual vehicle use to be inconsistent with the intent of the Clean Air Act. Specifically, it is the intent of the Act that vehicles be designed, built, and equipped so that when they are being used by the motoring public emissions will be reduced to the extent indicated by the prescribed standards during the period of their useful life. The fact that it may not be practicable to test prototype or production vehicles in order to assure the reductions under many conditions which the vehicle will encounter does not mean intentional obviation of these reductions outside the parameters of the test procedure is consistent with the Act.

2. The "intent of the Clean Air Act" referred to in the letter has in part been implemented by regulations as regards test vehicles. Paragraph 85.073-9(d) requires that all emission control systems "shall be functioning" during the Federal Test Procedure. Paragraphs 85.073-7(a) and (b) provide that emission data vehicles and durability data vehicles, respectively, "shall be driven...with all emissions control systems installed and operating..." during all mileage accumulation. These provisions are in the regulations to insure that emissions control systems and devices which operate to achieve emissions reductions during emission tests operate similarly during mileage accumulation so that their ability to achieve similar emission reductions during normal use for five years or 50,000 miles may be reasonably assessed.

Devices which are designed to compromise the emission control effectiveness of any system during mileage accumulation as compared with effectiveness during emission testing are inconsistent with the letter and purpose of the test procedures. Hence, EPA cannot certify test vehicles employing such devices.

C. Applicability

The policy outlined in this Advisory Circular is effective and applicable immediately. The provisions of this Advisory Circular apply to certification testing beginning with the 1974 model year and to running changes and field fixes which would involve the addition of any Auxiliary Emission Control Device (AECD) on any model year vehicle.

D. Definitions

1. Auxiliary Emission Control Device (AECD). An AECD is any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system.

2. Defeat Device. A Defeat Device is an AECD that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal urban vehicle operation and use, unless (1) such conditions are substantially included in the Federal emission test procedure, or (2) the need for the AECD is justified in terms of protecting the vehicle against damage or accident, or (3) the AECD does not go beyond the requirements of engine starting.

E. Criteria for Determining the Acceptability of Certain AECDs

1. An AECD is generally deemed to be a Defeat Device if it is determined by EPA to reduce the effectiveness of an emission control system:

a. In response to any ambient, underhood or passenger compartment air temperature outside the 68°- 86° F range;

b. In response to any accessory operating condition not encountered during the Federal emission test;

c. After any time span in a specific vehicle operating mode.

2. AECDs that generally are acceptable include those which reduce the effectiveness of an emission control system in response to:

a. Engine temperatures (as sensed by oil or coolant temperature or some other direct indicator) which are outside the range of normal, stabilized operating temperatures;

b. Unusual engine, emission control system, or vehicle operating conditions which may reasonably be expected to cause damage or destruction to the engine or vehicle;

c. Unusual engine, emission control system, or vehicle operating conditions which may reasonably be expected to present a safety problem;

d. The engagement of the transmission gear, as long as no time delay is employed.

F. Determination of Acceptability of Specific Devices

1. All AECDs must be described in the manufacturer's application for certification. Based upon the description of the device, data derived from such testing as EPA may require or conduct, and any showings made by the manufacturer, EPA will determine whether the device is acceptable or whether it is a Defeat Device.

2. The categories in Section E. above, are illustrative only. Therefore, the acceptability of each device will be determined on an individual basis since some devices may not fit into one of the categories in Section E. above, others are difficult to categorize, and still others may have more than one purpose. If the device is determined to be a Defeat Device, EPA will advise the manufacturer in writing that test vehicles incorporating such a device are not eligible to provide data on the basis of which certification may be issued.

3. The policy stated herein will also be applied with respect to determinations by EPA under 40 CFR 85.073-33 and 34 (running changes), and approvals under 40 CFR 85.073-5(f) (carry-over data).

4. Any 1974 model year vehicle which has begun mileage accumulation with a Defeat Device installed and operating is disallowed, unless the manufacturer can show that such operation cannot reasonably be concluded to have an impact on the deterioration of the emission control system.

G. Use of Carry-over Data

If, in accordance with Advisory Circular No. 17, a manufacturer has proposed the use of carry-over data for 1974, such data will be accepted to the extent that the data did not originate from vehicles equipped with Defeat Devices. If Defeat Devices were used on 1973 model year durability vehicles to generate data intended to be used as the basis for 1974 model year certification, testing of 1974 model year durability vehicles which do not contain such devices may be required, depending upon EPA's judgment whether the use of the device may reasonably be expected to have affected deterioration of the 1973 vehicle.

If Defeat Devices were used on 1973 model year emission data vehicles to generate data intended to be used as the basis for 1974 model year certification, testing of 1974 model year emission data vehicles which do not contain such devices will be required.

Mobile Source Pollution Control
Program

FILE COPY

OMSAPC ADVISORY CIRCULAR

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR AND WASTL MANAGEMENT

Subject: "Prohibition of Emission Control Defeat Devices" - Optional Objective Criteria

I. Purpose

The purpose of this advisory circular (A/C) is to provide optional objective criteria to the manufacturers to assist the manufacturers and EPA in evaluating any Auxiliary Emission Control Device (AECD) which may be questionable. This A/C supplements and does not supersede A/C No. 24 which remains in effect.

II. Background

A. On December 11, 1972, A/C 24 was published. In that A/C, guidelines and policy were discussed that dealt with the subject of defeat devices, which are defined as AECD's that reduce the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal urban vehicle operation and use, subject to some considerations outlined in A/C 24. 40 CFR 86.079-22 specifically prohibits the incorporation of defeat devices in vehicles or engines described by an application for certification.

B. Since A/C 24 was published in 1972 (almost six years ago), two developments have occurred which have indicated the need to provide additional guidance to the manufacturers regarding defeat devices.

1. The first development has been in the implementation of A/C 24. A/C 24 is somewhat general. This has necessarily led to situations in which EPA personnel may have had to make judgmental decisions about the acceptability/nonacceptability of various AECD's on a case-by-case basis. It would appear that giving manufacturers the opportunity to elect to have defeat device issues evaluated against an objective criterion would be desirable.

2. The second development has been the rapid advance in the introduction of more sophisticated emission control systems, especially those that offer new flexibility in control capability. The most obvious example of this new technology has been the rapid introduction of electronic control and modulation devices. It is EPA's judgment that the application of electronic controls for emission control and other reasons on motor vehicles and engines will increase substantially in the next few years, and in the early 1980's most, if not all, motor vehicles and engines will incorporate some sort of electronic control system.

C. 1. When A/C 24 was published, most, if not all, AECD's were much less sophisticated than current and future systems and were easier to evaluate on a subjective basis. For example, the use of a temperature sensing switch on the doorpost of a vehicle that was used to trigger a significant loss of emission control when ambient temperatures were outside the FTP range was relatively easy to evaluate.

2. Now, however, EPA is faced with the task of evaluating electronic control systems which may receive inputs from multiple sensors and control multiple actuators that affect the emission control system's performance. It is clear that such emission control sytems are AECDs under the definition of A/C 24, and the problem that EPA is faced with is determining which systems represent defeat devices and which systems do not. Using A/C 24 to evaluate the types of devices that were in question during 1972 was relatively straightforward, but the elements of design which are important in the evaluation of the new technology may not be hardware items. Such elements of design could be control system logic (i.e., computer software), and/or calibrations, and/or hardware items.

3. While the greater flexibility of the new technology could be used to improve emission control capability, there is concern on EPA's part that the new technology may result in reductions in the effectiveness of emission control systems. The California Air Resources Board came to a similar conclusion in a Staff Report.*

D. Given the complicated nature of the new technology, and the difficulty of evaluating the overall emission impact of multiple, continuously variable emission control system parameters, an optional procedure that could be elected by the manufacturers may be needed to assist the manufacturers in receiving timely and consistent evaluation of this complex new technology.

III. Applicability

This advisory circular supplement is effective as an option available to manufacturers of 1980 and later model year light-duty vehicles and light-duty trucks.

IV. Optional Objective Criteria for Determinations on Defeat Devices

A. The following guidelines set forth the showing by a manufacturer which EPA would view as demonstrating that an AECD is not a defeat device with respect to NOx within Federal Test Procedure (FTP) temperatures. In order to successfully utilize this option, each tested vehicle which contains a given questionable AECD would be expected to satisfy the appropriate criterion.

*State of California Air Resources Board Staff Report, 78-1-3, December 23, 1977.

1. For an element of design whose NOx emissions during conditions reasonably expected to be encountered in normal urban vehicle operation and use within FTP temperature ranges is of concern, a manufacturer may elect to demonstrate that the NOx emissions of the vehicle or vehicles in question are less than or equal to the following guidelines values. The test cycle used to generate the emission values is the Highway Fuel Economy Test (HwFET).

FTP Temperature Range

HwFET NOx Guidelines

Vehicle Type	Guideline*
Light-Duty Vehicles	1.22 times the applicable FTP NOx standard
Light-Duty Trucks	1.28 times the applicable FTP NOx standard

V. Defeat Device Determination for Devices Identified as Suspect Under the Guidelines of Advisory Circular No. 24

A. For those devices which EPA has identified as potential defeat devices by the criteria set forth in 40 CFR §86.079-22 and Advisory Circular No. 24 (with respect to their effect on NOx emissions at highway speeds):

1. The manufacturer may choose not to use the HwFET NOx guidelines criteria to satisfy EPA that the device is not a defeat device. In those cases, EPA will make a determination whether the device is or is not a defeat device based upon criteria set forth in the regulations and Advisory Circular No. 24. However, the manufacturer's decision not to use the HwFET NOx guidelines will not preclude EPA from taking highway NOx emissions into account as is currently the practice. In this case, EPA will not use HwFET NOx performance as a firm, objective basis for deciding the acceptance of a potential defeat device but rather as additional information to assist EPA in making its decision in the context of A/C 24. If EPA ultimately determines that the device will not be considered a defeat device, this determination will be valid for that device for the entire product line as described in the manufacturer's application for certification. Likewise, a device that is ultimately determined a defeat device will be judged a defeat device for the entire product line.

2. The manufacturer may choose to use the HwFET NOx guidelines to demonstrate that the device should not be considered a defeat device. EPA will then monitor the HwFET NOx levels on certification and fuel economy vehicles (emission-data, running change, and fuel economy data vehicles) which incorporate the device. If the resulting HwFET NOx levels are less than or equal to the appropriate guideline levels, EPA will

*For all guideline values in this A/C, the resultant product is to be rounded to the same number of significant figures as the applicable FTP requirement.

not judge that specific vehicle to incorporate a defeat device with respect to highway NOx emissions within FTP temperatures. However, because a specific device can be used with different vehicle calibrations or itself be calibrated in many different ways, EPA will withhold judgment on the device in general. If the resulting HwFET NOx level is greater than the established levels, the manufacturer (according to paragraph F, below) must demonstrate to EPA why the device as applied to the specific vehicle and calibration, in light of the data from emission-data, fuel economy data, or running change vehicles, should not be a defeat device under the general provisions of A/C 24.

VI. Actions to be Taken if a Device Is Determined to be a Potential Defeat Device

A. If, prior to the issuance of a certificate, a device is determined to be a potential defeat device, EPA will withhold issuance of a certificate of conformity until the issue is resolved.

B. If the device is determined to be a potential defeat device under the provisions of A/C 24, and at the manufacturer's option has been qualified and accepted for certification within an engine family based on HwFET levels which do not exceed the NOx guideline, EPA may take further action if additional data generated subsequent to certification of an engine family exceed the HwFET NOx guideline. Potential sources of such data include emission results on fuel economy data vehicles. In such cases, EPA will:

1. Normally disallow the use of the HwFET NOx guideline for future demonstration during that model year (i.e., for running change approval) that the device in question should not be considered a defeat device within that engine family. The criteria that would be used to evaluate such subsequent running changes would be the general guidelines in the regulations and A/C No. 24.

2. Deny any unapproved request for carryover or carry-across of any data from the engine family which included the vehicles exhibiting HwFET levels above the NOx ratio guidelines.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
2565 PLYMOUTH ROAD
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OFFICE OF
AIR AND RADIATION

January 19, 2001

CCD-01-02 (HD)

Dear Manufacturer

Subject: Advisory Circular 24-3

Enclosed for your use is an Advisory Circular (A/C) 24-3, "Implementation of Requirements Prohibiting Defeat Devices for On-Highway Heavy-Duty Diesel Engines." We have prepared this A/C to assist manufacturers in better understanding how EPA will implement the Clean Air Act prohibition of defeat devices as they might occur in heavy-duty diesel engines certified for use in on-highway applications. In particular, this A/C focuses on how data generated under the Supplemental Emission Test and the Not-To-Exceed test will be used when evaluating the emission performance of diesel engines designed to meet the 2.4 g/bhp-hr HC+NOx emission standard prior to model year 2007 when acceptable emission performance over these tests are mandated by our regulations. This A/C references and incorporates a number of the provisions included in the October 15, 1998 guidance letter to manufacturers, "Subject: Heavy-duty Diesel Engines Controlled by Onboard Computers: Guidance on Reporting and Evaluating Auxiliary Emission Control Devices and the Defeat Device Prohibition of the Clean Air Act."

From the enclosed A/C 24-3, we have described how manufacturers can use data generated over these tests to provide themselves with greater assurance that their engines and emission control systems do not contain devices or design strategies that could be considered by EPA as possible defeat devices. Additionally, we encourage manufacturers to supply information to EPA during certification regarding performance over these cycles. Supplying such data will help speed EPA's review of the application and enable completing certification in the minimum amount of time.

If you have additional questions regarding this guidance, please do not hesitate to contact your EPA certification representative. If a widespread industry response suggests a general follow-up meeting would be useful, we will schedule this at the earliest opportunity to assure maximum time is available to manufacturers to reflect this guidance in their future certification programs.

Sincerely,

Gregory A. Green

Gregory A Green, Director
Certification and Compliance Division
Office of Transportation and Air Quality

Bruce C. Buckheit

Bruce C. Buckheit, Director
Air Enforcement Division
Office of Regulatory Enforcement

Enclosure

Printed on Recycled Paper

January 19, 2001

Advisory Circular Number 24-3: Implementation of Requirements Prohibiting Defeat Devices for On-Highway Heavy-Duty Engines

I. Purpose

The purpose of this advisory circular (A/C) is to provide manufacturers additional guidance regarding EPA's procedures for evaluating Auxiliary Emission Control Devices (AECDs) associated with on-highway heavy-duty diesel engines designed to meet the 2.4 g/bhp-hr NMHC + NOx FTP emission standard. Specifically, this A/C extends 1998 Guidance Document VPCD-98-13 to those technologies expected to be used to meet the 2004 model year standards and provides objective screening criteria to assist both the manufacturer and EPA in evaluating AECDs. This A/C supplements and does not supersede A/C 24 and A/C 24-2 which remain in effect. This A/C also references and incorporates portions of the 1998 guidance document which also remains in effect and is the particular source for clarifying AECD reporting requirements.

II. Background

A. On December 11, 1972, EPA published A/C 24 which provided general implementation guidelines and policies regarding how EPA would enforce the prohibition on defeat devices.

B. On December 6, 1978, EPA published Advisory Circular 24-2, "Prohibition of Emission Control Defeat Devices - Optional Objective Criteria," which provided additional guidance from the Agency regarding the prohibition on the use of defeat devices, including the use of the Highway Fuel Economy Test as a supplemental test for evaluating the emission impact of AECDs for use on passenger automobiles and light trucks.

A/C 24-2 was developed to address two issues in particular. First, while the Clean Air Act and implementing regulations clearly prohibit defeat devices, earlier defeat device guidance on how EPA and manufacturers should implement this prohibition was somewhat general, commonly requiring case-by-case judgmental decisions by EPA. It was determined beneficial to provide objective criteria which both manufacturers and EPA could use in evaluating potential defeat devices. Second, the rapid development of sophisticated emission control systems and strategies, typically relying on advanced electronic and computer controls, provided new opportunities for optimizing emission control performance of light-duty vehicles and light-duty trucks. However, the increased sophistication and complexity also made it more difficult and time consuming for both manufacturers and EPA to evaluate AECDs for potential defeat devices. The criteria could be routinely employed by the manufacturer during the development process and prior to submitting an application for certification. It has become routine practice for the manufacturer to share with EPA the results of its own evaluation using these objective criteria. The availability of data demonstrating emission performance at or below this objective criteria significantly assisted EPA in its evaluation process and has resulted in more timely review of a manufacturer's application for certification. While this guidance provides an

objective means for manufacturers and the Agency to evaluate AECDs, as described below, such objective criteria are appropriately used as screening tools and are not binding limits.

C. Much the same situation now exists with heavy-duty engines. More sophisticated and complex emission controls are being used and the trend toward such controls continues. For the engines designed to meet the 2004 model year standards, EPA anticipates improvements in fuel metering, the use of advanced turbocharger designs and the use of cooled EGR systems, for example, to be common. These systems will be closely controlled using advanced electronics including on board computers, analogous to the trends in light duty emission controls in earlier years. Thus, as was the case for light duty vehicles and trucks, the concerns for how best to implement the defeat device prohibitions needs to reflect these technology trends. Similarly, the benefits of adopting objective screening criteria for the heavy-duty program are also apparent.

D. EPA described such a set of objective screening criteria in its October 15, 1998 guidance letter to manufacturers, "Subject: Heavy-duty Diesel Engines Controlled by Onboard Computers: Guidance on Reporting and Evaluating Auxiliary Emission Control Devices and the Defeat Device Prohibition of the Clean Air Act." We issued this guidance to ensure manufacturers clearly understand the need and regulatory obligation to identify and report AECDs for EPA evaluation against the defeat device prohibition. This guidance also established screening tools to assist EPA in evaluating the appropriateness and impact of AECDs which affect emissions performance outside of FTP operating conditions. This guidance letter included specific test procedures and emission performance assessment criteria applicable to heavy-duty on-highway diesel engines for the 2000 and later model years as well as design screening criteria applicable to the 2000 and later model years of both heavy-duty diesel highway engines and nonroad diesel engines.

The emissions performance screening tools included in the October 1998 manufacturer letter centered around the EURO III steady state test and the not-to-exceed (NTE) test (hereafter referred to as the Supplemental Emission Test and NTE test). Technical specifications and testing requirements for these tests were included in the guidance letter as well as specific emission performance screening limits. Also included were objective design-based criteria which defined when it is appropriate to activate certain commonly used AECDs (such as injection timing advance during cold engine operation to prevent misfire and limit white smoke). AECDs which do not exceed the emissions performance screening criteria when evaluated according to these test procedures and which fall acceptably within the design-based screening criteria would then, absent other information suggesting potential defeat device concern, be considered by EPA to not warrant further defeat device investigation and would be considered acceptable for certification.

This Advisory Circular 24-3 incorporates much of the information contained in the October 1998 guidance letter as it pertains to heavy-duty on-highway diesel engines, updating some of the technical information and expanding on the description of EPA's implementation policy. Nevertheless, the reader may wish to consult the October 1998 guidance letter for additional discussion on the need and procedures for identifying AECD's and for additional background.

E. Finally as background, EPA published final requirements for model year 2004 and later engines on October 6, 2000 (65 FR 59896). Applicable beginning with the 2007 model year, engines must comply with the Supplemental Emission Test and the NTE test limits as well as the FTP standards. These regulations adopted some modifications to the Supplemental Emission Test and NTE test procedures and the compliance requirements compared to those specified in the October 1998 manufacturer guidance letter.

III. Applicability

This advisory circular is applicable to heavy-duty diesel engines certified for use in on-highway applications and in compliance with the 2.4 g/bhp-hr NMHC + NOx emission standard.

IV. Definitions

For on-highway heavy-duty diesel engines, the following regulatory provisions apply:

1. Auxiliary Emission Control Device (AECD). An AECD is any element of design that senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, deactivating, or modulating the operation of any part of the emission control system. See 20 CFR 86.082-2 and 86.094-2.

2. Defeat Device. A Defeat Device is an AECD that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use, unless (1) such conditions are substantially included in the applicable Federal Emission Test Procedure for heavy-duty vehicles and heavy-duty engines described in subpart N of 40 CFR Part 86; (2) the need for the AECD is justified in terms of protecting the vehicle or engine against damage or accident; or (3) the AECD does not go beyond the requirements of engine starting.

V. Consideration of Basic Design

As discussed above, an AECD can include any element of design or control strategy including, for example, elements of the basic fuel metering and timing strategy imbedded within the engine's computer control system as well as switches, timing devices and other pieces of hardware since any of these could clearly be recognized as devices which could impact emission performance during operation outside that well represented by the FTP. In determining whether there is a need for the AECD to prevent damage to the engine, EPA will consider the whole engine and emission control system to evaluate any impact on emission performance outside of the FTP operating conditions.

This approach to defeat device evaluation by considering the entire system is appropriate due to the many interdependencies between individual components or elements of design in modern heavy-duty engines. For example, turbocharger systems can be limited by high compressor discharge temperature which in turn is influenced by a wide range of parameters including such parameters as the ambient temperature, altitude, under hood cooling design, EGR strategy and calibration, and the horsepower requirements of the engine during these non-FTP operating modes. In evaluating whether an AECD is needed to protect the engine's turbocharger system against over temperature conditions which could result in damage to the turbocharger system, EPA needs to evaluate the design strategy across the wide range of such inter-related parameters, for example, to determine if the protection is necessary, or is the result of the selection of inferior designs. As set out in the 1998 guidance, EPA will not approve an AECD for a frail engine design where the need for engine protection is the result inadequate design of the engine, when viewed in comparison to available technology.

EPA prefers to rely on emission performance rather than design specifications in determining whether a manufacturer's proposed product offering qualifies for emissions certification. Thus a variety of design strategies may be acceptable if they all provide acceptable emissions performance. Indeed, EPA encourages design innovations on the part of individual manufacturers as this can result in improved product offerings and less cost to manufacturers and consumers. However, in the case of defeat device evaluations, we must evaluate any increase in emission levels by considering the design strategy selected by the manufacturer.

In evaluating whether an AECD is a defeat device, EPA will consider the impact on emissions during operating conditions not well represented by the FTP using the objective screening criteria set forth in this A/C. If the AECD's impact on emissions performance is not within the guidelines described in section VI. 1 and VI. 2 of this A/C or the AECD is not accepted via the specific design criteria described in section VI. 3 of this A/C, then EPA will consider whether the emission control system represents a reasonable design attempt by the manufacturer to control emissions over all operating conditions. If an AECD is expected to cause an excessive increase in any regulated pollutant, EPA will consider whether design alternatives are available which would make the engine/emission control system less susceptible to the need for an AECD that increases emissions to the extent of the proposed AECD.

A. AECDs required to protect the engine/emission control system

This type of an AECD would generally modulate some part of the system during non-FTP operating conditions for the purpose of protecting the system against damage. Using the example of over temperature protection of a turbocharger, EPA will consider whether alternative engine and emission control systems including turbocharger systems are available that would further limit the concern for over temperature damage or otherwise reduce the likelihood of high temperature operation so as to also avoid damage to the turbocharger. In determining what alternative engine and emission control system designs are available, EPA will consider those designs available in other applications including those applications certified by other manufacturers which would be reasonably transferable to this particular manufacturer's design. If a manufacturer chose to certify a heavy-duty diesel engine without incorporating an element of

design typically found on other certified designs (for example, the manufacturer chooses to use an aluminum or copper EGR cooler which requires, for corrosion protection, reducing or shutting off-EGR over a broad range of conditions not represented during the FTP, rather than using stainless steel for the EGR cooler which would require more limited, if any, AECDs for protection), EPA would consider whether the improved emission control design (stainless steel EGR cooler in this example) was reasonably available for use by the manufacturer and would have resulted in less need for an AECD which reduces the effectiveness of the emission control system. If EPA determines these conditions exist, then EPA reserves the right to determine the use of the AECD represents a defeat device.

B. AECDs which are incapable of adequately controlling emissions during non-FTP operating conditions.

The AECD examples discussed above generally describe a type of AECD which actuates or adjusts an engine or emission control system parameter during non-FTP operating conditions in a manner different from how they operated during the FTP and, in doing so, results in increased emissions. It is also possible to have an AECD which, due to its inferior design, results in higher emission levels under non-FTP conditions compared to alternatively available designs. An example might be a relatively unsophisticated EGR system which performs well enough under FTP conditions to meet the FTP standards, but this same operation under speeds and loads not well represented by the FTP or at higher temperatures would result in insufficient exhaust gas re-circulation and significantly increased NOx emissions. EPA will examine the anticipated emission performance under non-FTP operating conditions and, if the emission levels exceed those of the objective criteria described in section VI., will consider the basic design strategy of the engine and could determine the existence of an unacceptable AECD even if the strategy physically has the same limits or range of operation during both FTP and non-FTP operating conditions. The existence of a defeat device strategy may be determined especially if the manufacturer's choice of a basic design strategy is incapable of approaching the same degree of control compared to alternative systems more typical of the industry.

VI. Screening Tools to Assist in Evaluating AECDs

EPA will use three objective screening tools in evaluating compliance with the defeat device prohibition. The first two tools are emission performance screening tools called the Supplemental Emission Test Limits and Not-to-Exceed (NTE) Limits. The third tool is a set of design-based screening criteria. EPA will also use any other available information relevant to determine compliance with the defeat device prohibition.

1. The Supplemental Emission Test is a test based on the European steady-state engine certification test. The test consists of 13 steady-state modes covering a broad range of highway-type operating conditions. The Supplemental Emission Test demonstrates the emissions performance of engines over these highway-type operating conditions. The testing and technical requirements for conducting the supplemental EURO III test are described in 40 CFR

86.1360; these are the requirements adopted for mandatory testing beginning with the 2007 model year for these engines. These testing requirements update those included in the October 18, 1998 guidance letter to manufacturers described earlier; the manufacturer should follow the procedures adopted in the regulations rather than those included in the October 1998 guidance letter.

The acceptable emission performance limits which EPA will use under this A/C for this Supplemental Emission Test are described in 40 CFR xxxxx.

EPA may choose to conduct this Supplemental Emission Test over the same temperature and altitude range as the FTP standards.

2. In addition to Supplemental Emission Test results, EPA will use a Not-to-Exceed (NTE) test to screen for a wide variety of potential defeat devices. The NTE defines a broad range of engine speed and load points (called the NTE Control Area) under which engines are expected to emit at reasonable levels in normal ambient conditions. The testing and technical requirements for conducting the NTE test are described in 40 CFR 81.1370; these are the requirements adopted for mandatory testing beginning with the 2007 model year for these engines. These testing requirements update those included in the October 18, 1998 guidance letter to manufacturers described earlier; the manufacturer should follow the procedures adopted in the regulations rather than those included in the October 1998 guidance letter.

The acceptable emission performance limits which EPA will use under this A/C for this NTE test are described in 40 CFR 86.007-11(a)(4)(i).

EPA may choose to conduct this NTE test over temperatures ranging up to 100 degrees F and altitudes ranging up to 5500 feet; these are the temperature and altitude ranges required under the mandatory test program described in 40 CFR 86.007-11(a)(4)(ii).

3. Finally, EPA will use objective design-based screening criteria to evaluate specific AECDs with respect to the prohibition against defeat devices. The design criteria are the same as described in Attachment III to the 1998 guidance letter referenced earlier.

A particular engine strategy, as reported in the certification application satisfies the objective design-based screening criteria if it is within the criteria described in Attachment III to the 1998 guidance letter.

VII. EPA Evaluation of Potential Defeat Devices

A manufacturer has a responsibility to describe all AECDs in its application for certification. Thorough disclosure of the presence of such an AECD and its expected impact on emission performance is essential in allowing EPA to evaluate the AECD and determine whether it represents a defeat device. Clearly, any AECD which is not fully identified in the manufacturer's application for certification and for which emissions impacts are not provided

cannot be appropriately evaluated by EPA and therefore cannot be determined to be acceptable by EPA.

One way that a manufacturer can help assure itself that a device or control strategy does not represent a defeat device is to conduct tests under the Supplemental Emission Test and NTE tests adopted as part of the 2004 Heavy Duty Engine standards final rule (October 6, 2000; 65 FR 59896). Where manufacturers provide data on their certification test engines which demonstrate that the device or control strategy does not cause the engine to exceed the NTE and Supplemental Emission Test screening limits set forth in this A/C, EPA believes there will be no need for additional testing or evaluation by EPA unless EPA has some specific reason for questioning the accuracy of the manufacturer-supplied data (for example due to questionable implementation of the test procedures) or believes the data does not suggest acceptable performance under other operating conditions (for example, if a manufacturer supplied data on a limited portion of the NTE Control Area and not under conditions expected to result in maximum emission levels, then EPA may choose to conduct additional testing to better represent, in this example, NTE performance). EPA does not intend to conduct confirmatory testing during certification to evaluate AECDs for manufacturers who have supplied valid test data demonstrating that their AECDs do not result in exceeding the emission performance levels provided via this A/C. If all available data sufficiently demonstrate that the AECDs are not expected to result in emission levels exceeding the screening criteria, EPA sees no need for further information to evaluate whether satisfactory emission control is maintained over a wide range of typical in-use operating conditions. Absent other information raising significant concern about the potential existence of a defeat device, such as an identified AECD that appears designed to circumvent the screening criteria, EPA would intend to rely upon this emission performance data and the manufacturer's description of its AECDs in issuing a certificate of emission compliance.

A determination of acceptable performance during testing of a certification engine of course does not necessarily mean acceptable emission performance on typical production engines or during typical consumer operation. EPA expects that manufacturers will assure their production line and in-use engines also conform to the applicable standards and the prohibition against defeat devices. EPA may choose to evaluate such engines after certification approval and expects to use the same screening tools to evaluate compliance with the defeat device prohibition.

EPA intends to use its authority 40 CFR 86.004-16 and CFR 86.091 - 29 (b) to test certification engines according to procedures referenced above, when appropriate, to evaluate the emission impacts of any AECD which the Agency is concerned may result in increases in emissions during operation not well represented by the FTP. This includes testing according to the Supplemental Emission Test and NTE test procedures as well as testing at ambient temperature and altitude conditions described above. Any such testing that the Agency deems necessary in order to complete its defeat device evaluation may, according to 40 CFR 86.091-29(b)(2), be conducted at a site of EPA's choice including the manufacturer's test facility. Any such necessary testing must be completed and the results considered before EPA will proceed with any decision to certify the affected engine family(ies). Therefore manufacturers should

consider the potential need for such supplemental testing in planning their certification program so as to assure that any potential investigation which might include supplemental testing not delay any needed production start.

EPA will also use the objective design-based criteria as described in Attachment III to the 1998 guidance letter.

Engines tested according to these procedures and not exceeding the screening criteria performance limits referenced above, meeting the deign-based objective criteria and absent any other information suggesting a defeat device concern will be determined by EPA to not warrant further defeat device investigation. Engines failing to satisfy these criteria will need to be further evaluated on a case-by-case basis and may be determined to be incorporating prohibited defeat devices. For AECDs which cause emissions to exceed these performance criteria, EPA will evaluate the need for the AECD based upon the information supplied by the manufacturer in its application for certification. EPA may conduct additional testing or may request the manufacturer supply additional information if necessary to make a defeat device determination.

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OFFICE OF
AIR AND RADIATION

October 15, 1998 VPCD-98-13 (HD Engine)

Dear Manufacturer:

Subject: Heavy-duty Diesel Engines Controlled by Onboard Computers: Guidance on Reporting and Evaluating Auxiliary Emission Control Devices and the Defeat Device Prohibition of the Clean Air Act

Enclosed with this letter is a guidance document which addresses the identification and reporting of certain on-board computer controlled systems on electronically controlled diesel engines used in heavy-duty motor vehicles and nonroad equipment for purposes of certification under Title II of the Clean Air Act. This document also confirms and clarifies prior EPA interpretation of the Clean Air Act's prohibition against defeat devices as applied to engines with these types of onboard computer controls. Finally, this document provides objective screening tools to assist manufacturers and EPA in evaluating Auxiliary Emission Control Devices as they relate to the prohibition against defeat devices and the certification of on-highway diesel engines that utilize them. EPA intends to develop similar screening tools for other classes in the future.

This guidance is being issued jointly by EPA's Office of Mobile Sources and Office of Regulatory Enforcement, because these offices are responsible for the certification that engines meet emission standards for their useful lives, and for the enforcement of the Clean Air Act prohibition against strategies which reduce the effectiveness of emission control systems respectively

If you have any questions about this guidance, please contact your certification team representative.

Sincerely,

Jane Armstrong

Jane Armstrong, Director
Vehicle Programs and Compliance Division
Office of Mobile Sources

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Enc.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

October 15, 1998

Heavy-duty Diesel Engines Controlled by Onboard Computers: Guidance on Reporting and Evaluating Auxiliary Emission Control Devices and the Defeat Device Prohibition of the Clean Air Act

I. Purpose

This guidance addresses the identification and reporting of certain onboard computer controlled systems on electronically controlled diesel engines used in heavy-duty motor vehicles and nonroad equipment, for purposes of certification under Title II of the Clean Air Act. This document also confirms and clarifies prior EPA interpretation of the Clean Air Act's prohibition against defeat devices as applied to engines with these types of onboard computer controls. Finally, this document provides objective screening tools to assist manufacturers and EPA in evaluating these Auxiliary Emissions Control Devices (AECDs) as they relate to the prohibition against defeat devices and the certification of engines that utilize these AECDs. Unless otherwise noted, the term "heavy-duty diesel engines" in this guidance refers to both on-highway heavy-duty diesel engines and nonroad diesel engines.

EPA is issuing this guidance at this time because (1) in the near future almost all on-highway heavy-duty diesel engines and many non-road diesel engines will have onboard computers controlling the operation of the engine and its emissions control system; (2) the increased complexity of computer controlled engine management systems, including the various sensors and software associated with these systems, has led to an increase in the number and types of AECDs; and (3) recent investigations and enforcement actions by the Agency and the State of California have revealed that the manufacturers of the majority of the on-highway heavy duty diesel engines sold in this country have employed onboard computer strategies that are defeat devices.

II. Background

The Clean Air Act's federal mobile source program has three basic elements. First, Congress authorized EPA to promulgate emission standards to control emissions that lead to harmful air pollution. This includes setting specific emission limits that vehicles and engines must meet when tested in accordance with established test procedures. Second, Congress also prohibited manufacturers from using devices that "defeat" the pollution control system used during the emission standards testing. This second element, known as the statutory "defeat device prohibition," is similar to other restrictions under the Clean Air Act that prohibit factory or power plant operators from turning off or disabling their pollution control systems. The third element of the statutory scheme involves compliance related measures, including a certification program, assembly line audits, in-use recall, and authority to assess civil penalties for violations of the Clean Air Act's prohibitions. All three elements reflect that the purpose of

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the emissions standards, defeat device prohibition, and compliance measures is to achieve the desired emissions reductions during actual operation and not just during operation under laboratory conditions.

EPA's regulations implement these Clean Air Act provisions in several ways. First, EPA has established detailed test procedures that are used to measure compliance with the emissions standards. These are known as the "Federal Test Procedure" or "FTP." EPA has also prohibited the use of defeat devices in these and other engines. Second, a manufacturer is required to obtain a certificate of conformity from EPA prior to introduction of a new heavy-duty diesel engine into commerce. The manufacturer must submit a complete and truthful application to EPA, including any required test information. To implement the defeat device prohibition, manufacturers also must provide a detailed description of the basic pollution control system for the vehicle or engine, and identify and provide a detailed description of each element of design that may change the emission control system compared to its operation during FTP testing to demonstrate compliance with the emission standards. If EPA determines that the vehicle or engine will comply with the emission standards, the defeat device prohibition, and other requirements, for its useful life, then EPA issues a certificate of conformity. Thereafter, EPA may require or conduct assembly line and in-use testing and may suspend production and order the manufacturer to recall vehicles or engines that do not meet emission standards throughout their useful life. EPA also has the authority to seek fines and other sanctions where a manufacturer introduces into commerce a vehicle or engine that differs from that described in the manufacturer's certification application or that contains a defeat device.

III. Prior Agency Guidance

EPA has published prior guidance documents addressing issues relating to the subject of this guidance. For example, Advisory Circular 24 ("A/C 24") (1972) generally defines and discusses defeat devices and AECDs. A/C 24-2 (1978) provides guidance relevant to the use of electronic engine controls. It clarifies that electronic control systems that affect the emissions control system's performance are AECDs.

In addition, EPA has interpreted the AECD and defeat device requirements in the context of several rulemakings. See. e.g., 57 FR 31894 (July 17, 1992), including discussion of emission control system logic, on-board computer software, calibrations and hardware items as AECDs and providing objective criteria to aid in evaluating AECDs that controlled emissions of carbon monoxide; and 59 FR 23418 (May 5, 1994), stating that onboard computer algorithms that improve fuel economy but increase NOx emissions in diesel engines during highway driving by retarding timing during transient engine operating conditions and advancing timing during steady state operating conditions are illegal defeat devices.

Most recently, EPA issued guidance to light-duty vehicle manufacturers emphasizing that all applications for certification must include a detailed description of each AECD. The detailed description of the AECD should include parameters sensed and controlled and the

effect on emissions, both on- and off-cycle. This guidance also reiterated that manufacturers must justify any AECD that results in a reduction in the effectiveness of the emissions control system. (See, Dear Manufacturer Letter dated May 27, 1998.)

IV. Applicability

This guidance is applicable as follows: 1) prior guidance continues to be applicable including A/C 24 and A/C 24-2; 2) guidance related to the specific design information about electronic control AECDs that must be submitted with applications for certification is applicable to all heavy-duty diesel engines which utilize electronic controls beginning with applications for certification submitted to EPA on or after December 1, 1998; 3) guidance related to the manufacturer's use of objective emissions screening tools in certificate applications applies to model year 2000 and later on-highway heavy-duty diesel engines; 4) guidance related to the manufacturer's use of objective design screening criteria in certificate applications applies to model year 2000 and later on-highway heavy-duty diesel engines.

While this guidance specifically addresses issues arising in the context of heavy-duty diesel engines using retarded injection timing for NOx control, manufacturers of other vehicles or engines should use the discussion of AECDs relating to onboard computers and electronic controls during the certification process, and compliance with the prohibition against defeat devices, because the same regulatory and statutory requirements concerning AECDs and defeat devices apply to these manufacturers as to manufacturers of heavy-duty diesel engines.

V. Definitions

For on-highway heavy-duty diesel engines, the following regulatory definitions apply:

1. Auxiliary Emission Control Device (AECD). An AECD is any element of design that senses temperature, vehicle speed, engine rpm, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, deactivating, or modulating the operation of any part of the emission control system. See 40 CFR 86.082-2 and 86.094-2.

2. Defeat Device. A Defeat Device is an AECD that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use, unless (1) such conditions are substantially included in the Federal emission test procedure; (2) the need for the AECD is justified in terms of protecting the vehicle or engine against damage or accident; or (3) the AECD does not go beyond the requirements of engine starting. See 40 CFR 86.094-2.

For nonroad diesel engines, the following regulatory definitions apply:

1. Auxiliary Emission Control Device (AECD) means any element of design that senses temperature, vehicle speed, engine rpm, transmission gear, or any other parameter

for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system. See 40 CFR 89.2

2. Defeat Device means any device, system or element of design which senses operation outside normal emission test conditions and reduces emission control effectiveness. A defeat device includes any auxiliary emission control device (AECD) that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal operation and use unless such conditions are included in the test procedure. A defeat device does not include such items that either operate only during engine starting or are necessary to protect the engine (or equipment) against damage or accident during its operation. See 40 CFR 89.107-96.

VI. Auxiliary Emission Control Devices (AECDs)

Recent EPA and CARB investigations have revealed that heavy-duty diesel engine manufacturers are not fully and appropriately reporting AECDs as part of the certification process. This is particularly evident for electronically controlled engines, where numerous sensors, software calibrations, and algorithms may be used to modulate and control multiple aspects of the engine operation, including operation of some or all of the emission control system. Any software or hardware that modulates, activates, or deactivates any part of the emissions control system is an AECD under the Agency's regulations. The following is intended to provide manufacturers with specific examples of the types of design elements that EPA considers to be AECDs, and which must be reported and justified in the application for certification. The following is not intended to be an exhaustive listing of all AECDs, but rather, is intended to provide guidance as to what may constitute an AECD.

1. As set out in A/C 24-2, electronic engine control systems are AECDs, where the computer may receive inputs from various sensors and control multiple actuators that affect the emission control system.

2. Current heavy-duty diesel engines employ retarded fuel injection timing as the primary emissions control device for NOx emissions. In such engines, the basic emission control system includes the software incorporated in the on-board computer that contains the operating parameters for fuel injection timing employed during FTP testing. Any mechanical system or software that alters the fuel injection timing that is employed to control emissions on the FTP is an AECD. Examples of such AECDs include strategies that adjust fuel injection timing based on barometric pressure, intake manifold pressure, engine rpm, fuel rate, average fuel rate, ambient temperature, actual or inferred gear ratio, intake manifold temperature, engine coolant temperature, oil temperature, the derivative(s) of these inputs, use of cruise control, idle periods, power-take-off (PTO) systems, or any similar inputs for the purpose of determining diesel fuel injection timing. A software strategy that is incorporated in the on-board computer, but does not command or change fuel injection timing during the FTP test, is not considered employed during the FTP, or substantially included in the FTP. For example, a strategy that changes fuel injection timing at ambient temperatures below FTP limits is not

employed during the FTP and is not substantially included in the FTP.

3. In order to meet future emission standards it is likely that manufacturers will use technologies such as exhaust gas recirculation (EGR) and/or NOx after treatment devices, perhaps in conjunction with fuel injection timing strategies. These systems will almost certainly require modulation by an engine computer employing software and/or hardware that embodies a control strategy. Mechanical or electronic elements of design that modify the operation of the EGR or after treatment devices are also AECDs.

VII. Reporting AECDs

Manufacturers are required to describe all AECDs and justify any that reduce the effectiveness of the emission control system. The AECD reporting guidelines below are effective for certification applications submitted to EPA on or after December 1, 1998, that relate to heavy-duty diesel engines.[1]

A manufacturer must, in the initial certification application, provide the following information to satisfy its obligation to disclose electronic control AECDs that relate to diesel fuel injection timing.

A technical description of the AECD which explains:

(a) its purpose (for example, turbo charger protection at high operating temperatures, white smoke control on engine start-up),

(b) the parameters sensed or controlled by the AECD (for example, sensing: engine oil temperature, engine rpm, engine fuel rate, barometric pressure; controlling: fuel injection timing),

(c) the conditions under which the AECD is activated to influence fuel injection timing or another part of the emission control system (for example, at cold oil temperatures, under overheat conditions), and

(d) the impact of the AECD on engine emissions (for example, reduction in white smoke with increase in NOx).

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[1] While this specific guidance does not require resubmission of applications submitted before December 1, 1998, this does not relieve manufacturers from the obligation to comply fully with the applicable regulations for reporting and justifying AECDs, consistent with previously issued guidance on these matters.

example, intake manifold air temperature below 10°C), and the extent to which the AECD activates, deactivates, or modulates the operation of any part of the emissions control system, including fuel injection timing (for example, timing increases from 10 degrees BTDC to 15 degrees BTDC).

3. A demonstration that the strategy is the minimum strategy needed to offset the identified reason for the AECD.

4. For nonroad heavy-duty engines, the manufacturer should submit the base timing map (e.g., the base timing over the range of engine and speeds and loads).

Attachment I contains a sample AECD report using these guidelines.

VIII. Screening Tools to Assist in Evaluating AECDs

EPA will use three objective tools to assist in evaluating compliance with the defeat device prohibition. The first two tools are emission performance screening tools called the Supplemental EURO III Limits and Not-to-Exceed Limits, and only apply to on-highway heavy-duty diesel engines. The third tool is a set of design-based screening criteria that apply to all heavy-duty diesel engines (on-highway and nonroad). EPA will also use any other available information relevant to determine compliance with the defeat device prohibition.

1. The Supplemental EURO III is a test based on the European steady-state engine certification test. The test consists of 13 steady-state modes covering a broad range of highway-type operating conditions. The Supplemental EURO III test demonstrates the emissions performance of engines over these highway-type operating conditions. The testing and technical requirements for conducting the Supplemental EURO III test are described in Attachment II.

An engine satisfies the screening criteria of the Supplemental EURO III test if it meets the following emissions limits when tested in accordance with Attachment II:

Pollutant	Weighted Composite Emission Limit
NOx (or NOx + NMHC as appropriate)	1.0X FTP-based numerical standard or 1.0X FEL as applicable
HC (or NOx + NMHC as appropriate)	1.0X FTP-based numerical standard or 1.0X FEL as applicable
CO	1.0X FTP-based numerical standard or 1.0X FEL as applicable

Pollutant	Weighted Composite Emission Limit
PM (cycle composite only, not weighted)	1.0X FTP-based numerical standard or 1.0X FEL as applicable

FEL = Family Emission Limit for engines participating in the Averaging, Banking, and Trading program.

If the manufacturer chooses to submit EURO III data, it should submit test results and other data specified in Section 1.1 of Attachment II in its application for certification, along with a statement that the test results correspond to the maximum NOx producing state that could be encountered for a 30 second or longer period at each test point.

EPA will use the Supplemental EURO III screening test and the emissions limits above to evaluate the performance of post-1999 model year on-highway heavy-duty diesel engines. EPA may use the screening test and emissions limits for prior model years, where appropriate.

2. In addition to EURO III test results, EPA will use a Not-to-Exceed (NTE) tool to screen for a wide variety of potential defeat devices. The NTE defines a broad range of engine speed and load points (called the NTE Control Area), under which engines are expected to emit at reasonable levels in all normal ambient conditions. A technical description of the NTE is also included in Attachment II.

An engine satisfies the screening criteria of the NTE if it meets the following emissions limits when operated within the NTE Control Area:

Pollutant		Maximum Allowable Limit
NOx (or NOx + NMHC, where appropriate)		1.25X FTP-based numerical standard or 1.25X FEL as applicable
Smoke		filter smoke number of 1.0
Alternate Opacity	Steady State Limit	10 second average smoke opacity of 4% for a 5 inch path limit
	Transient Limit	30 second average smoke opacity of 4% for a 5 inch path limit

Note: Either the Smoke or Alternate Opacity Limits apply, but not both.

The manufacturer need not submit test data at the time of certification to satisfy the NTE screening limits. However, the manufacturer should state in the certification application that the engine is designed to meet the NTE limits defined above and in Attachment II, and have a sound technical basis for making such statement.

EPA will use the NTE screening test and the emissions limits above to evaluate the performance of post-1999 model year on-highway heavy-duty diesel engines. EPA may use the screening test and emissions limits for prior model years, where appropriate.

3. Finally, EPA will use objective design-based screening criteria to evaluate specific AECDs with respect to the prohibition against defeat devices. The design screening criteria are described in Attachment III.

A particular engine strategy, as reported in the certification application using the guidelines described in Section VII above, satisfies the objective design-based screening criteria if it is within the criteria described in Attachment III. Any allowance for strategies to protect against white smoke and misfire that increase NOx emissions will only be available until a NOx + NMHC standard or requirement is applicable, as discussed more fully below

EPA will use the design-based screening criteria to evaluate the performance of post-1999 model year on-highway heavy-duty diesel engines. EPA may use the criteria for prior model years, where appropriate.

IX. Evaluating AECDs During the Certification Process

1 For on-highway heavy-duty diesel engines:

Except as noted below, if an engine manufacturer demonstrates to EPA's satisfaction that an engine family satisfies each of the three screening tools described above and in Attachments II and III, including submitting the relevant test results and statements, then absent other information suggesting the existence of a defeat device, EPA does not intend to pursue further investigation of the engine family for the purposes of certification with respect to the prohibition against defeat devices.

If an engine manufacturer does not satisfy each of the three screening tools, EPA will evaluate the appropriateness of engine control strategies on a case-by-case basis. For example, if a particular design is not within the criteria of Attachment III, the manufacturer should demonstrate at the time of certification that the particular strategy is the minimum strategy necessary to protect against engine damage, white smoke or misfire. Any strategies or elements of design not discussed here will be addressed by EPA on a case-by-case basis during the annual certification process.

EPA reserves the right to use the Supplemental EURO III and NTE screening tests and limits described herein to evaluate certification, assembly line, and in-use engines with regard to the prohibition against defeat devices, whether or not the engine manufacturer has submitted the information and test results described above during the certification process. In addition, EPA reserves the right to conduct further investigation of any engine family where appropriate under the circumstances.

2. For nonroad diesel engines:

The Supplemental EURO III and NTE screening tools are not applicable to nonroad diesel engines. However, if an engine manufacturer demonstrates to EPA's satisfaction that an engine family satisfies the design screening thresholds in Attachment III, or the manufacturer has sufficiently demonstrated that the particular strategy is the minimum strategy necessary to protect against engine damage, white smoke, or misfire, then absent other information suggesting the existence of a defeat device EPA does not intend to pursue further investigation of the engine family for the purposes of certification with respect to the prohibition against defeat devices based on the kind of strategies discussed in Attachment III. The allowance for a minimum strategy to protect against white smoke and misfire will only be available until a NOx+NMHC standard or requirement is applicable, as discussed more fully below. Any strategies or elements of design not discussed here will be addressed by EPA on a case-by-case basis during the annual certification process.

EPA reserves the right to conduct further investigation of any engine family where appropriate under the circumstances.

X. Defeat Devices, Normal Operation and Use and the Frail Engine

The agency believes that the manufacturer is obligated to design and install an emissions control system that functions effectively in the real world, i.e., "in normal operation and use." The definition of defeat devices concerns the effectiveness of the emissions control system during such real world operating conditions, and provides an exemption for disclosed AECDs that are justified in terms of protecting the engine or vehicle from damage. Given the myriad of potential operating scenarios, there are occasions when manufacturers are entitled to modulate the pollution control system, where fully disclosed, because it is necessary to protect the vehicle or engine from damage. However, whether an AECD is justified as necessary depends in part on considerations of currently available technology. For example, engine protection would not justify an AECD if the need for engine protection is the result of inadequate design of the engine, when viewed in comparison to currently available technology.

Some manufacturers have employed strategies that advance timing when the vehicle is operated at altitudes above a specified threshold, in some cases as low as several hundred feet. Significant parts of this country are at altitudes above this threshold. It is the agency's view that driving in these areas is included within normal operation and use. This guidance sets out altitude screening criteria for use in evaluating AECDs, based in part on the Agency's view of the technical capability of currently available technology.

Many manufacturers have over temperature protection strategies that advance timing when coolant or other temperatures reach certain thresholds. While such engine protection strategies are clearly contemplated by the exemption from the defeat device definition, the exemption would not apply where a manufacturer does not specify adequate cooling capacity for vehicles using the engine but relies instead on the over temperature protection strategy to

cool the engine in normal operation and use. In the summer, many areas of the country experience numerous days where the temperature approaches or exceeds 100 degrees F ambient. The adverse health impacts from excess NOx emissions - excessive ozone formation – are most acute on hot days. EPA believes that vehicle operation at 100 degrees F and above is "normal" and that NOx emission controls can and should be designed to work on the hot summer days when they are needed the most. Accordingly, EPA will screen over temperature protection strategies to determine whether the engine has been designed to operate without the need for over temperature protection during normal operation and use, and also whether the emission system degradation that occurs when the strategy is activated is no more than necessary to protect a well-designed engine.

Nearly all manufacturers of heavy duty diesels have installed pollution control systems that control HC at cooler ambient temperatures by advancing fuel injection timing, thereby degrading NOx control efficiency. Operation at cooler temperatures is "normal," except for extreme cold temperatures. However, absent the modification of the NOx control operating parameters, significant quantities of unburned hydrocarbons ("white smoke") could be emitted. EPA understands that current diesel engines may require fuel injection timing modulations under certain such conditions to prevent unwanted white smoke emissions or engine misfire conditions, and that current diesel engines lack the technology needed to adequately control both NOx and HC emissions in these cases. EPA intends to allow such strategies on current technology engines, but only to the extent such strategies are necessary to overcome white smoke or engine misfire and only where such strategies represent the minimum fuel injection timing advance necessary.

XI. Enforcement of the Statutory Prohibition Against Defeat Devices

EPA's Office of Enforcement and Compliance Assurance (OECA) is responsible for enforcing the statutory prohibition against defeat devices found in Section 203(a)(3)(B) of the Clean Air Act. OECA will use the same threshold levels and the same screening tests (i.e., the Supplemental EURO III, NTE, and design criteria) when evaluating whether to investigate potential defeat device and AECD reporting violations. In general, if the engines in question satisfy the design-based criteria in this guidance and the Supplemental EURO III and NTE screening, OECA will consider those engines to be a lower priority for further investigative scrutiny. In addition, OECA intends to promulgate a specific grant of enforcement discretion until the NOx plus NMHC standards become effective and not to seek to enforce the defeat device prohibition as it relates to limited white smoke and black smoke protection schemes for heavy duty diesels that use retarded injection timing as the principal NOx control measure. OECA will do so only where such schemes are fully disclosed in the initial application for certification and approved by the Office of Mobile Sources. However, OECA reserves the right to conduct further investigation and to take enforcement action in any other circumstance where the strategy in question is an attempt to circumvent the threshold levels or the Supplemental EURO III and NTE screens or otherwise constitutes an unreported AECD, defeat device, or other violation of law.

Attachment I - Sample AECD Reporting Guidelines

The following is a sample AECD reporting format intended to show the level of detail EPA expects from engine manufacturers when they report AECDs on heavy-duty diesel engines. The sample format is applicable to all electronically controlled heavy-duty diesel engines. The use of particular parameters or emission values is intended to be illustrative of the nature of the reporting required and not to suggest that EPA would approve or disapprove the particular AECD described. The sample report contains a limited number of examples; EPA expects that a typical heavy-duty diesel engine uses a number of additional AECDs.

[Engine Company] uses the following electronic strategies as AECDs for engine family XSP012.9D6DAAW.

General Overview

[Engine Company] uses the following AECDs on its electronically controlled diesel engines: cold start, altitude, white smoke and misfire prevention, and inlet air temperature white smoke and misfire prevention.

Each AECD determines an injection timing value for the given condition (altitude, temperature, etc.). The timing values from the individual AECDs are compared and the largest value is added to the base timing value. The resulting timing value is the final ECU timing command, for a given load and speed. Each AECD is fully described below.

Coolant Temperature Strategy

Technical description – The coolant temperature strategy is used to prevent misfire and incomplete combustion when the engine itself is cold. A cold engine environment delays the start of the diesel engine combustion process which can cause misfire and allow unburned fuel (HC) to enter the exhaust in the form of white smoke. Furthermore, once combustion is initiated at low engine temperatures, the fuel does not burn completely which produces PM in the form of black smoke. Advanced injection timing compensates for the ignition delay and accelerates the warming of the engine to temperatures which promote complete combustion.

Engine coolant temperature is sensed via a thermistor located in the engine block. Below the calibrated threshold temperature, injection timing is advanced as coolant temperature decreases. The strategy decreases white smoke/HC and increases NOx. Based on test data, we estimate that the NOx increase is less than 10 percent during operation of the strategy and that the strategy is operative less that 2 percent of the annual operating miles of this engine, which is ordinarily used in line haul applications. Because NOx generation is low during cold temperatures, NOx levels remain below the FTP levels. This strategy is fully active and operational during the cold start portion of the FTP.

Calibration description – Injection advance is initiated at coolant temperatures below 80F as described in Figure 1.

[A statement as to whether these levels are within the thresholds provided in this guidance.]

Altitude strategy

Technical description – The altitude strategy is used to prevent engine misfire. Reduced engine cylinder pressures at high altitude delays the start of combustion, which can cause misfire and white smoke (HC) emissions. Timing advance compensates for the ignition delay. A sensor located in the engine compartment measures ambient pressure. At ambient pressures below the calibrated threshold, fuel injection timing advance increases with reduced pressure (increased altitude).

Calibration description – Injection advance is initiated at ambient pressures less than 80 kPa (approximately 6,000 ft.) and increases linearly down to 50 kPa (approximately 12,000 ft.). See Figure 2. Based on field tests conducted in Denver in 1996, the extent of advance is the minimum needed to prevent misfire and white smoke. Review of the 30 point plot for this engine, attached, suggests a linear increase in NOx emissions from 0 at 6,000 feet to an 8 percent increase at 12,000 feet. Other emissions are improved.

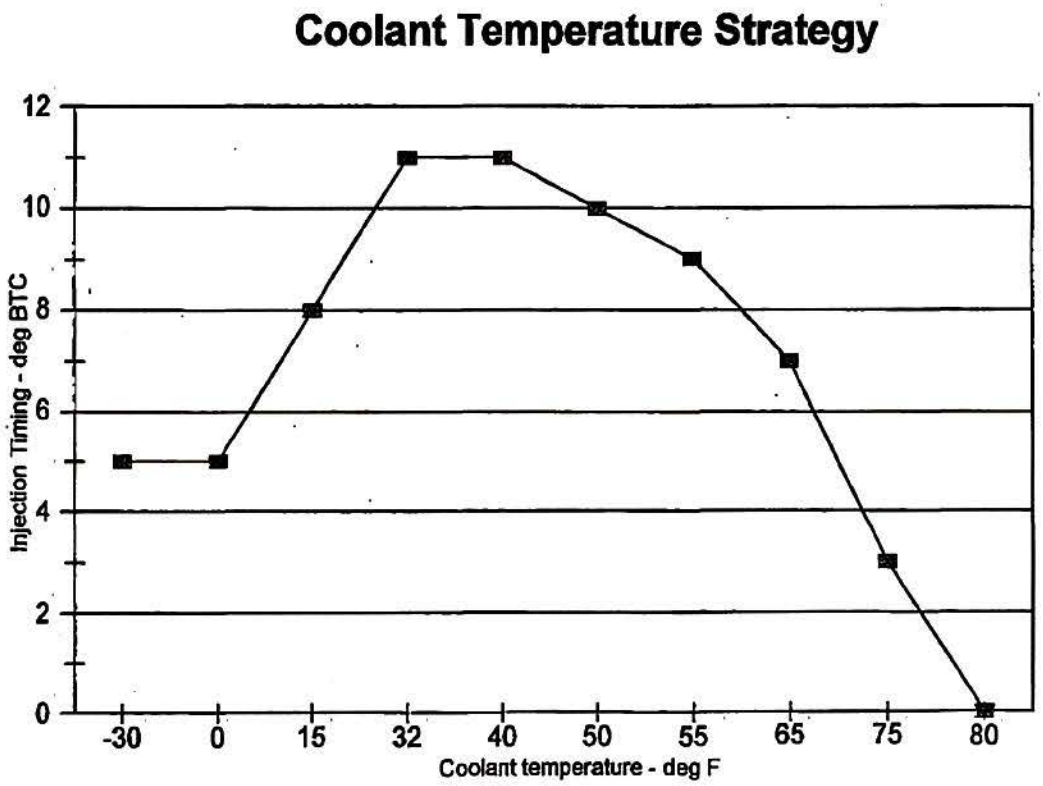
[A statement as to whether these levels are within the thresholds provided in this guidance.]

Inlet Air Temperature

Technical Description - The inlet air strategy is used to advance fuel injection timing under cold operating conditions to reduce engine misfire and reduce white smoke. A sensor located in the intake manifold measures the air temperature after the turbo charger and air-to-air intercooler.

Calibration Description - The system is calibrated such that no timing advance is present unless the engine is operating below one-half maximum fueling, and the intake manifold air is below 55F. Based on test data, the extent of advance is the minimum needed to prevent misfire and reduce white smoke. Figure 3 shows the intake manifold temperature versus amount of timing advance.

[A statement as to whether this value is within the thresholds provided in this guidance.]


Coolant Temperature Strategy
Injection Timing - deg BTC
12
10
8
6
4
2
0
-30
0
15
32
40
50
55
65
75
80
Coolant temperature - deg F

FIGURE

Altitude Timing Strategy

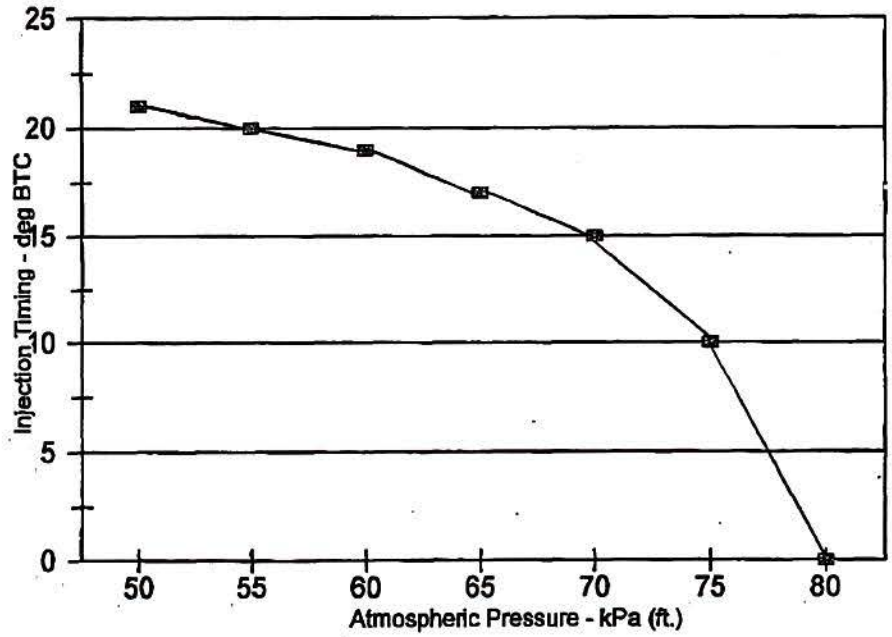


FIGURE 2

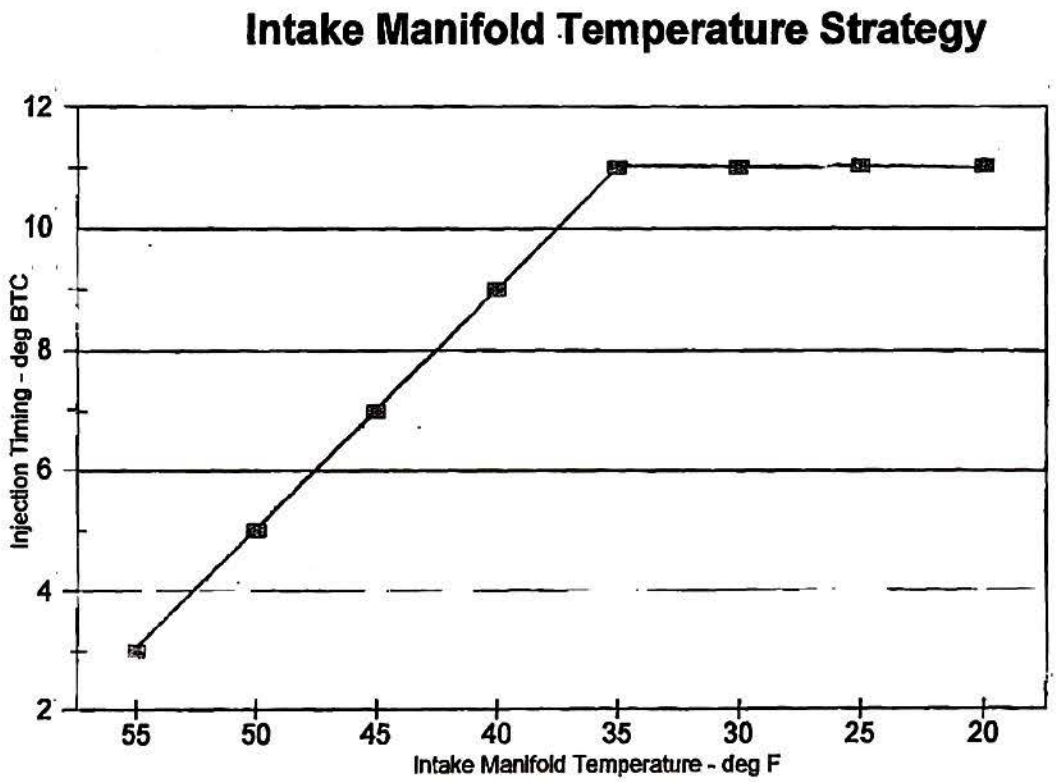

Intake Manifold Temperature Strategy
12
10
8
6
4
2
Injection Timing - deg BTC
55
50
45
40
35
30
25
20
Intake Manifold Temperature - deg F

FIGURE 3

Attachment II - Technical and Testing Requirements for Supplemental EURO III and NTE[2]

1. EURO III Requirements. The weighted average emission limit values applicable to the EURO III test set forth in this guidance apply to engines tested using the EURO III steady state test and emission weighting protocols identified as the "ESC test" in Annex III to the Proposal adopted by the Commission of the European Union on December 3, 1997.[3] The modal test point definition and weighting factors will be taken directly from Annex III. Except as specifically stated in this attachment in all other respects testing shall be conducted in accordance with 40 CFR Part 86, unless the company proposes, and EPA approves, an alternative procedure. The applicable weighted average emission levels and maximum allowable emission levels specified in the guidance apply to engines when new and in-use throughout the Useful Life of the engine and during all normal operation and use. In order to satisfy the Supplemental EURO III screening guidelines, the manufacturer must adhere to the requirements and protocols described in Sections 1.1 through 1.3 below.

1.1. The manufacturer must provide weighted average emission results of all regulated gaseous emissions and cycle composite PM results from the ESC test as part of the certification process. In addition to the weighted average data, the manufacturer must supply brake-specific gaseous emission data for each of the 13 test points in the ESC test. For each of these 13 test points, the manufacturer must provide upon request the concentrations and mass flow rates of all regulated gaseous emissions plus CO_2, as well as exhaust smoke opacity ("k" value) and the values of all emission-related engine

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[2] If the manufacturer has received a waiver for certain emissions pursuant to 40 CFR 86.094-23(c)(2)(i), then that emissions waiver applies to the Supplemental EURO III provisions as well. Except as specifically noted herein, all existing EPA regulations and policies shall apply to any testing conducted under this test protocol. Exceedances of the EURO III and Not to Exceed Limits would be appropriate where the manufacturer demonstrates to EPA's satisfaction during the certification process that the excess emissions are due to the requirements of engine starting, or conditions resulting from the need to protect the engine or vehicle against damage or accident and there are no other reasonable means to protect the engine or vehicle. In addition, during the term of this guidance, exceedances would be appropriate if the manufacturer demonstrates to EPA's satisfaction during the certification process that the excess emissions are due to extreme ambient conditions and that there are no reasonable means of meeting such limits under such ambient conditions. All procedures set forth in this attachment shall be implemented in accordance with sound engineering practice.

[3] Proposal adopted by the Commission of the European Union on 3 December 1997, for presentation to the European Council and Parliament, titled Draft Proposal for a Directive of the European Parliament and the Council Amending Directive 88/77/EEC of 3 December 1987 on the Approximation of the Laws of the Member States Relating to the Measures to be Taken Against the Emission of Gaseous and Particulate Pollutants From Diesel Engines for Use in Vehicles." Fuel meeting the specifications of 40 CFR 86.1313-94(b) for exhaust emissions testing will be substituted for the fuel specified in this Directive.

control variables.

1.1.1 The ESC test shall be conducted with all emission-related engine control variables in the highest brake-specific NO_x emissions state which could be encountered for a 30 second or longer period at the given test point. The manufacturer shall include a statement that the test results correspond to the maximum NO_x producing condition for a 30 second or longer period reasonably expected to be encountered at each test point during normal engine operation and use.

1.1.2 Any regulated gaseous emissions at any of the test points, or any interpolated points in the ESC control area (as defined in Section 1.2 below), shall be at or below the Not-to-Exceed Limits specified in the guidance if within the Not-to-Exceed Region as defined in Section 2 below.

1.1.3 As part of its certification application, the manufacturer shall submit a statement that its engines will meet the applicable EURO III limit values and testing requirements during all normal engine operation and use, including the limits described in sections 1.2 - 1.3.

1.1.4 For the purposes of submission of the certification application, the manufacturer shall conduct the ESC test within the temperature range of 68F to 86F.

1.2 For gaseous emissions, the 13 ESC test point results described in section 1.1, along with the four-point linear interpolation procedure of the ESC test protocol (Annex III, Appendix 1, Sections 4.6, 4.6.1, and 4.6.2) for intermediate conditions, shall define maximum allowable emission limits (See Figure 1). The ESC control area extends from the 25% to the 75% engine speeds, at engine loads of 25% to 100%, as defined in Annex III.

1.2.1 If the weighted composite ESC test result for any gaseous emission is lower

ESC Maximum Allowable Emission Limits
Sample - For Illustration Only

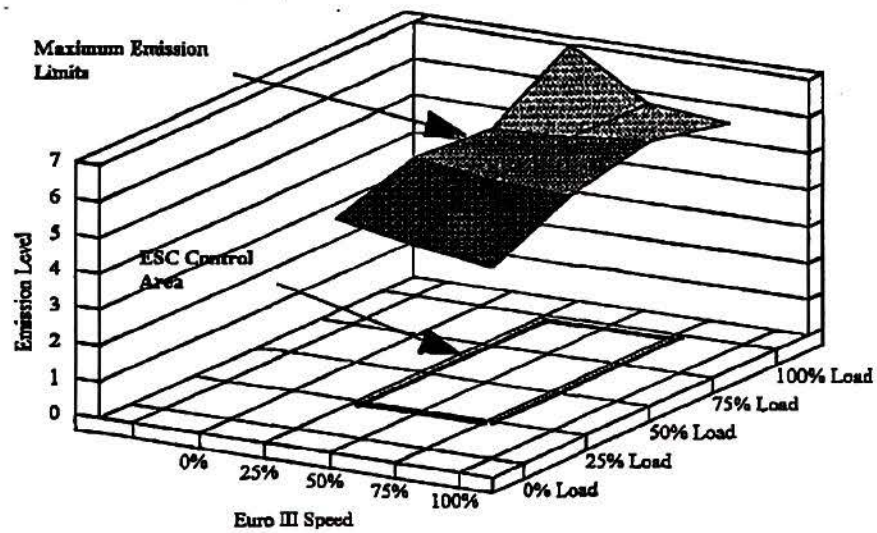

Figure 1

than specified in the guidance, the 13 ESC test values for that pollutant shall first be multiplied by the ratio of the limit value to the composite value and then by 1.05 for interpolation allowance before determining the maximum allowable emission limits of Section 1.2.[4]

1.3 In addition to the steady state testing protocols of the ESC test, engines may be tested under conditions that may reasonably be expected to be encountered in normal vehicle operation and use. The engine may be tested in a vehicle in actual use or on a dynamometer, under steady state or transient conditions and under varying ambient conditions. Test results within the ESC control area shall be compared to the maximum allowable emission limit for the same engine speed and load. The engine, when operated within the ESC control area, must meet with the maximum allowable

[4] The 10% allowance for NOx at interpolated points found in Section 6.2.3 of Annex 1 of the December 1997 Directive for evaluating compliance within the limit values of the Directive is reduced to 5%.

emissions limits.

1.3.1 Where the test conditions identified in 1.3 require departures from specific provisions of Annex III or 40 CFR Part 86 (e.g., sampling time) testing shall be conducted using good engineering practices.

1.3.2 When engine dynamometer testing is performed by the manufacturer under non-FTP conditions, such testing shall be done on existing equipment, and carried out only within the limits of operation of available test equipment with regard to ambient temperature, humidity and altitude. EPA may conduct its own testing at any ambient temperature, humidity or altitude.

1.3.3 When tested under transient conditions, emission values to be compared to the maximum allowable limits shall represent an average of at least 30 seconds.

1.3.4 Until further guidance is issued, the humidity correction factors found in 40 CFR Part 86 shall be used for NOx. Outside the temperature range of 68-86 degrees F, NOx emissions shall be corrected to 68F if below 68F or to 86F if above 86F.

2. Not To Exceed Limits . The Not-To-Exceed Limits (NOx or NOx + NMHC, Smoke, and/or Alternate Opacity) specified in the guidance apply to engines when tested under conditions which can reasonably be expected to be encountered in normal vehicle operation and use. The applicable Not-to-Exceed Limits specified in the guidance apply to engines when new and in-use throughout the Useful Life of the engine. In order to satisfy the Not-to-Exceed screening guidelines, the manufacturer must adhere to the requirements and protocols described in Sections 2.1, 2.2, and 3 below.

2.1. Except as described in paragraph 2.1.2, the Not To Exceed Control Area includes all operating speeds above the "15% ESC Speed" calculated as in section 2.1.1, and all engine load points at 30% or more of the maximum torque value produced by the engine. In addition, notwithstanding the provisions of section 2.1.2, the Not To Exceed Control Area includes all operating speed and load points with brake specific fuel consumption (BSFC) values within 5% of the minimum BSFC value of the engine, unless during Certification the manufacturer demonstrates to the satisfaction of EPA that the engine is not expected to operate at such points in normal vehicle operation and use. Current engine designs equipped with drivelines with multi-speed manual transmissions or automatic transmissions with a finite number of gears are not subject to the 5% minimum BSFC additional NTE region.

2.1.1. The 15% ESC Speed is calculated using the formula $n_{lo} + 0.15(n_{hi} - n_{lo})$, where n_{lo} and n_{hi} are the low and high engine speeds defined in Annex III,

Appendix 1, Section 1.1 of the earlier referenced December 3, 1997 Proposal of the Commission of the European Union.

2.1.2. The area below 30% of the maximum power value produced by the engine is excluded from the Not to Exceed Control Area.

2.2 Within the Not-To-Exceed Control Area, the applicable Not-to-Exceed Limit value specified in the guidance applies to emissions of NO_x (or NO_x+NMHC where applicable), when averaged over a minimum time of 30 seconds. In addition, within the Not to Exceed Control Area, the Smoke or alternate Opacity Limit values apply as specified in the guidance. Engines may be tested under conditions that may reasonably be expected to be encountered in normal vehicle operation and use. Testing by the manufacturer under non-FTP conditions shall be done on existing equipment, and shall be carried out only within the limits of operation of the available test equipment with regard to ambient temperature, humidity and altitude. EPA may test the engine in a vehicle in actual use or on a dynamometer, under steady state or transient conditions and under varying ambient conditions.

2.2.1 As part of its certification application, the manufacturer must submit a statement that its engines will comply with the applicable Not To Exceed and Smoke or alternate Opacity limit values under all conditions which may reasonably be expected to be encountered in normal vehicle operation and use.

2.2.2 Until further guidance is issued, the humidity correction factors found in 40 CFR Part 86 shall be used for NOx. Outside the temperature range of 68-86 degrees F, NOx emissions shall be corrected to 68F if below 68F or to 86F if above 86F.

3. Supplemental Emissions Test Smoke Measurements. Supplemental emissions test may involve steady-state or transient smoke measurements. Steady-state smoke measurements may be conducted using opacimeters or filter-type smokemeters. Opacimeter types include partial-flow and full-flow. Only full flow opacimeters may be used to measure smoke during transient conditions.

3.1 For steady-state or transient smoke testing using full-flow opacimeters, equipment meeting the requirements of 40 CFR Part 86, subpart I "Emission regulations for New Diesel Heavy-Duty Engines; Smoke Exhaust Test Procedure" or ISO/DIS-11614 "Reciprocating internal combustion compression ignition engines - Apparatus for measurement of the opacity and for determination of the light absorption coefficient of exhaust gas" is recommended.

3.1.1 All full-flow opacimeter measurements shall be reported as the equivalent % opacity for a 5 inch effective optical path length using the

Beer-Lambert relationship.

3.1.2 Zero and full-scale (100% opacity) span shall be adjusted prior to testing.

3.1.3 Post test zero and span checks shall be performed. For valid tests, zero and span drift between the pre-test and post-test checks shall be less than 2% of full scale.

3.1.4 Opacimeter calibration and linearity checks shall be performed using manufacturer's recommendations or good engineering practice.

3.2 For steady-state testing using filter-type smokemeter, equipment meeting the requirements of ISO-8178-3 and ISO/FDIS-10054 "Internal combustion compression ignition engines - Measurement apparatus for smoke from engines operating under steady-state conditions - Filter-type smokemeter" is recommended.

3.2.1 All filter-type smokemeter results shall be reported as filter smoke number (FSN) that is similar to the Bosch smoke number (BSN) scale.

3.2.2 Filter-type smokemeters shall be calibrated every 90 days using manufacturer's recommended practices or good engineering practice.

3.3 For steady-state testing using partial-flow opacimeter, equipment meeting the requirements of ISO-8178-3 and ISO/DIS-11614 is recommended.

3.3.1 All partial-flow opacimeter measurements shall be reported as the equivalent % opacity for 5 inch effective optical path length using the Beer-Lambert relationship.

3.3.2 Zero and full-scale (100% opacity) span shall be adjusted prior to testing.

3.3.3 Post test zero and full scale span checks shall be performed. For valid tests, zero and span drift between the pre-test and post-test checks shall be less than 2% of full scale.

3.3.4 Opacimeter calibration and linearity checks shall be performed using manufacturer's recommendations or good engineering practice.

3.4 Replicate smoke tests may be run to improve confidence in single test or stabilization. If replicate tests are run, 3 additional valid tests will be run, and the final reported test results must be the average of all the valid tests.

3.5 A minimum of 30 seconds sampling time will be used for average transient smoke measurements.

Attachment III - Design Screening Thresholds

Cold Operation (White Smoke) Strategies

In general, manufacturers advance diesel fuel injection timing under cold operation conditions to prevent misfire and limit white smoke and black smoke. Cold temperature fuel injection timing advance is generally used when 1) the engine itself is cold, and/or 2) the combustion air is cold.

Cold Combustion Air

Air temperature is generally measured either within the engine intake manifold (after the turbo charger and air cooler), or in the pre-turbo charger side of the intake system (under the hood of the vehicle or equipment or in the air cleaner). For engine systems that measure intake manifold air temperature to determine cold air fuel injection timing advance, EPA is establishing a screening threshold of 60F. For any intake manifold temperature strategy that advances injection timing at intake manifold temperatures above this threshold, the manufacturer must demonstrate that the strategy is the minimum strategy necessary to protect against engine damage, white smoke, or misfire. For any system that measures air temperature on the pre-turbo charger side of the intake system (i.e. ambient of underhood air), the manufacturer must demonstrate that the strategy is the minimum strategy necessary to protect against engine damage, white smoke, or misfire.

Cold Engine

Engine temperature is generally measured either in the engine coolant system or the engine oil system. A/C 24 stated that AECDs that reduce the effectiveness of the emission control system in response to engine temperature (as sensed by a direct measure such as oil or coolant temperature) are generally acceptable provided the adverse impact occurs outside the range of normal, stabilized operating temperatures. For the purposes of this guidance, normal, stabilized operating temperature shall be considered to be within 5 percent of thermostatically controlled engine operating temperature (measured in degrees Fahrenheit).

Altitude Strategies

In general, manufacturers advance diesel fuel injection timing at higher altitude conditions to reduce the risk of turbocharger damage, prevent misfire and limit white smoke and black smoke. EPA is establishing a screening threshold of 5,500 feet (or the equivalent pressure). In addition, when descending from an altitude above 5,500 feet (or the equivalent pressure), the altitude timing advance may not remain engaged below 5,300 feet. For any altitude strategy that advances injection timing at altitudes below the 5,500 feet threshold, or which maintain timing advance below the 5,300 feet threshold, the manufacturer must demonstrate that the strategy is the minimum strategy necessary to protect against engine damage, white smoke, or misfire.

Acceleration and Rapid Load Change Strategies

In general, engine manufacturers advance diesel fuel injection timing under conditions of rapid acceleration or rapid load changes to prevent misfire and limit white smoke and black smoke. Once a rapid acceleration or load change is detected, the timing advance may last up to several seconds. EPA is establishing a screening threshold of 3 seconds of timing advance for a rapid acceleration or load strategy. For any acceleration strategy that advances injection timing for longer than three seconds per rapid acceleration or load change, the manufacturer must demonstrate that the strategy is the minimum strategy necessary to protect against engine damage, white smoke, black smoke, or misfire.

Idle Strategies

In general, engine manufacturers advance diesel fuel injection timing under idle or extended idle conditions to prevent misfire, limit white smoke and/or maintain stable engine operation and temperatures. EPA is establishing a screening threshold such that all idle strategies must be limited directly to an engine operating parameter such as coolant temperature, oil temperature, etc., that would indicate the need to advance timing to prevent misfire, limit white smoke and/or maintain stable engine operation and temperatures.

From:	Bunker, Byron
To:	Hebert, Annette@ARB; Wehrly, Linc; Lourenco, Jackie@ARB; Nguyen, Duc@ARB; Montes, Thomas@ARB; Lemieux, Sharon@ARB; Greuel, Justin; Jackson, Judy; Ball, Joel; Wright, DavidA
Cc:	Patterson, Susan; Manners, Mary; Cohen, Janet
Subject:	RE: April Meeting with Mercedes
Date:	Friday, April 01, 2016 2:48:00 PM

Linc,

Please schedule the Mercedes meeting after noon to make sure Annette can join and to give a reasonable start time for the staff in California. [redacted] I am not asking for that if we don't need it, but if we do need such a meeting this might be a good time to have it.

Cle & Justin,

Annette will be with us on the 4/20 from around 10:30 to 5:00. Linc is scheduling one meeting with Mercedes that Annette will need to participate in. If either of your teams have work that it would make sense to discuss with Annette and me together, this would be a good time to have those meetings. We would plan to tie the appropriate California staff in by video. Justin if you and Jackie are ready, this might be a good time to talk about dividing up AECD and DF review work.

Sue,

Can you try to get us C35 from 11 to 6 PM with a video unit? I would like to be able to use the same meeting all day for meetings with the various California staff and our team. At the moment, I think the only meeting with an outside party will be Mercedes.

Thanks,

Byron

****

Byron Bunker
Director Compliance Division
Office of Transportation and Air Quality
Environmental Protection Agency
2000 Traverwood Drive
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Bunker.Byron@epa.gov
Phone: (734) 214-4155
Mobile: (734) 353-9623
****

From: Hebert, Annette@ARB [mailto:annette.hebert@arb.ca.gov]
Sent: Friday, April 01, 2016 2:31 PM

To: Wehrly, Linc <wehrly.linc@epa.gov>; Bunker, Byron <bunker.byron@epa.gov>; Lourenco, Jackie@ARB <Jackie.Lourenco@arb.ca.gov>; Nguyen, Duc@ARB <Duc.Nguyen@arb.ca.gov>; Montes, Thomas@ARB <thomas.montes@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>
Subject: RE: April Meeting with Mercedes

Yes, and I will be there as well. But not at EPA until 1030 am or so, but there the whole day. So if we can make the meeting to accommodate my late morning arrival it would be appreciated. Thanks.

Annette Hebert, Chief
Emissions Compliance, Automotive Regulations and Science (ECARS) Division
California Air Resources Board
(626)450-6150
ahebert@arb.ca.gov

From: Wehrly, Linc [mailto:wehrly.linc@epa.gov]
Sent: Friday, March 25, 2016 12:49 PM
To: Bunker, Byron; Hebert, Annette@ARB; Lourenco, Jackie@ARB; Nguyen, Duc@ARB; Montes, Thomas@ARB; Lemieux, Sharon@ARB
Subject: RE: April Meeting with Mercedes

The presumption with Mercedes was that this meeting would be in Ann Arbor.

Linc Wehrly
Director, Light-Duty Vehicle Center
Compliance Division
Office of Transportation and Air Quality
United States Environmental Protection Agency
(734) 214-4286
wehrly.linc@epa.gov

From: Bunker, Byron
Sent: Friday, March 25, 2016 3:45 PM
To: Wehrly, Linc <wehrly.linc@epa.gov>; Hebert, Annette@ARB <annette.hebert@arb.ca.gov>; Lourenco, Jackie@ARB (Jackie.Lourenco@arb.ca.gov) <Jackie.Lourenco@arb.ca.gov>; Nguyen, Duc@ARB <Duc.Nguyen@arb.ca.gov>; Montes, Thomas@ARB <thomas.montes@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>
Subject: RE: April Meeting with Mercedes

April 20th works well for me. Is this in AA or El Monte? If AA, we should see if anyone from ARB that will be in Chicago on Tuesday wants to come to AA for the meeting.

****

Byron Bunker
Director Compliance Division

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****

From: Wehrly, Linc
Sent: Friday, March 25, 2016 3:28 PM
To: Bunker, Byron <bunker.byron@epa.gov>; Hebert, Annette@ARB <annette.hebert@arb.ca.gov>; Lourenco, Jackie@ARB (Jackie.Lourenco@arb.ca.gov) <Jackie.Lourenco@arb.ca.gov>; Nguyen, Duc@ARB <Duc.Nguyen@arb.ca.gov>; Montes, Thomas@ARB <thomas.montes@arb.ca.gov>; Lemieux, Sharon@ARB <sharon.lemieux@arb.ca.gov>
Subject: April Meeting with Mercedes

All,

I spoke with Latane Montague and Mercedes could meet on April 20th instead of the 19th to continue the diesel discussion. Does the 20th work for everyone? I told him I would get back with him early next week.

Thanks,
Linc

Linc Wehrly
Director, Light-Duty Vehicle Center
Compliance Division
Office of Transportation and Air Quality
United States Environmental Protection Agency
(734) 214-4286
wehrly.linc@epa.gov

From:	Montague, R. Latane
To:	Bunker, Byron
Cc:	Wehrly, Linc
Subject:	RE: Meeting Materials for Dr. Breuer"s Meeting Last Friday
Date:	Tuesday, March 15, 2016 4:22:20 PM
Attachments:	715_2007 (2).pdf (b) (4) [redacted]

Byron,
Joerg asked me to forward two items in follow-up to your joint meeting with Chris.

The first is a pdf with the EU regulations that were discussed during the meeting that contain the EU definition of defeat device and related exceptions. The key sections are on page 5 and are highlighted in yellow.

The second pdf is the final version of the powerpoint Dr. Breuer presented, which has a few changes from the pre-meeting drafts. As we discussed, the slide presentation contains confidential business information, and has accordingly be marked Confidential. Mercedes submits it with a request for confidential treatment under the appropriate FOIA exemptions.

Please let me know if I can provide any further information.

Best Regards,

Latane

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From: Montague, R. Latane
To: Bunker, Byron
Subject: FW: Confidential Mercedes Presentations from January 20 Meeting at CARB in El Monte
Date: Monday, March 14, 2016 1:59:07 PM
Attachments: (b) (4) [redacted]

Byron,
Attached are the meeting presentations from our meeting on January 20 with CARB, Linc and Joel (that we submitted with a request for confidential treatment).

John Lippa will get the NOx by test phase data and the A2L to Linc shortly with cc to you and me.

(b) (7)(A), (b) (4) [redacted]

Best Regards,
Latane

From: Montague, R. Latane
Sent: Thursday, January 21, 2016 5:38 PM
To: jlourenc@arb.ca.gov; Wehrly.linc@Epa.gov
Subject: Confidential Mercedes Presentations from January 20 Meeting at CARB in El Monte

Jackie and Linc,

Thanks for the opportunity to meet yesterday in California (and by phone) to discuss the CARB and EPA diesel testing program results for the (b) (4) [redacted]

Mercedes asked me to make sure you had the final version of the materials presented. They also asked me to make sure you understood that the materials are confidential, and to take any necessary procedural steps to make it clear that they have been submitted to EPA and CARB under a request for confidential treatment, and get the benefit of all applicable FOIA and CPRA exemptions.

Accordingly, the attached materials have been marked CONFIDENTIAL. They contain confidential business information and trade secrets, and should be protected from disclosure under both the California Public Records Act (Cal. Gov. Code § 6254.7(d) and § 6254(k)) and FOIA (5 U.S.C. 552(b)(4) and 40 CFR Part 2, Subpart B).

Mercedes requests that confidentiality be granted in perpetuity and would appreciate your notifying me in the event that CARB or EPA receives a request for disclosure or otherwise

seeks to disclose this information.

If you have any questions about this request, don't hesitate to contact me at the number below.

Thank you.

Latane

R. Latane Montague
Partner

Hogan Lovells
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Washington, DC 20004

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Fax: +1 202 637 5910
Email: latane.montague@hoganlovells.com

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From:	Montague, R. Latane
To:	Bunker, Byron
Subject:	RE: Meeting Materials for Dr. Breuer"s Meeting Tomorrow
Date:	Sunday, March 13, 2016 6:00:51 PM

Byron,
I spoke with Joerg Friday after your meeting, and I agree it would be good for us to get another meeting set up in the near future to follow up on the January 20 meeting that was held in El Monte, perhaps in Ann Arbor this time.

I will try to give you a call Monday to discuss timing and content.

From: Bunker, Byron [mailto:bunker.byron@epa.gov]
Sent: Friday, March 11, 2016 6:41 AM
To: Montague, R. Latane
Subject: Re: Meeting Materials for Dr. Breuer's Meeting Tomorrow

Thanks Latane. I really appreciate you sharing these in advance.

I would avoid going through every slide and instead use the slides to make the two or three key points you want to make. I would also drop the slides that blame the NGO. Those aren't very compelling and they look like you aren't taking the issue head on when ascribe motives to the NGO. Better to assume they have the right motives and address the issue with facts about your vehicle.

Thanks,

Byron

Sent from my iPhone

On Mar 10, 2016, at 6:17 PM, Montague, R. Latane <latane.montague@hoganlovells.com> wrote:

> Byron,
> As we discussed, here is the current draft of the materials Dr. Breuer will bring to his meeting with Chris tomorrow.
>
> Mercedes asked me to make sure EPA understood that the materials contain confidential information, and that we take any necessary steps to make it clear that they have been submitted to EPA under a request for confidential treatment, and get the benefit of all applicable FOIA exemptions.
>
> Accordingly, the attached materials have been marked CONFIDENTIAL and should be protected from disclosure under both FOIA (5 U.S.C. 552(b)(4) and 40 CFR Part 2, Subpart B).

Mercedes requests that confidentiality be granted in perpetuity and would appreciate your notifying me in the event that EPA receives a request for disclosure or otherwise seeks to disclose this information.

I hope this information is helpful.

Please don't hesitate to let me know if you have any other questions.

Latane

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(b) (4) [redacted]

From: Montague, R. Latane
To: Bunker, Byron
Subject: Re: Meeting Materials for Dr. Breuer"s Meeting Tomorrow
Date: Friday, March 11, 2016 6:50:15 AM

Thanks Byron, that has been consistent with my advice and I will reiterate the high road approach!

Latane

On Mar 11, 2016, at 12:41 PM, Bunker, Byron <bunker.byron@epa.gov> wrote:

> Thanks Latane. I really appreciate you sharing these in advance.
>
> (b) (4) [redacted]
>
> Thanks,
>
> Byron
>
> Sent from my iPhone
>
> On Mar 10, 2016, at 6:17 PM, Montague, R. Latane <latane.montague@hoganlovells.com> wrote:
>
>> Byron,
>> As we discussed, here is the current draft of the materials Dr. Breuer will bring to his meeting with Chris tomorrow.
>>
>> Mercedes asked me to make sure EPA understood that the materials contain confidential information, and that we take any necessary steps to make it clear that they have been submitted to EPA under a request for confidential treatment, and get the benefit of all applicable FOIA exemptions.
>>
>> Accordingly, the attached materials have been marked CONFIDENTIAL and should be protected from disclosure under both FOIA (5 U.S.C. 552(b)(4) and 40 CFR Part 2, Subpart B).
>>
>> Mercedes requests that confidentiality be granted in perpetuity and would appreciate your notifying me in the event that EPA

receives a request for disclosure or otherwise seeks to disclose this information.

I hope this information is helpful.

Please don't hesitate to let me know if you have any other questions.

Latane

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<EPA Talking Points on TNO_study3-10-16_Confidential.pdf>

<2016-02-26_JB Handout_Confidential Draft.pdf>

From: Montague, R. Latane
To: Bunker, Byron
Cc: Wehrly, Linc
Subject: Meeting Materials for Dr. Breuer"s Meeting Tomorrow
Date: Thursday, March 10, 2016 6:17:28 PM
Attachments: (b) (4) [redacted]

Byron,
As we discussed, here is the current draft of the materials Dr. Breuer will bring to his meeting with Chris tomorrow.

Mercedes asked me to make sure EPA understood that the materials contain confidential information, and that we take any necessary steps to make it clear that they have been submitted to EPA under a request for confidential treatment, and get the benefit of all applicable FOIA exemptions.

Accordingly, the attached materials have been marked CONFIDENTIAL and should be protected from disclosure under both FOIA (5 U.S.C. 552(b)(4) and 40 CFR Part 2, Subpart B).

Mercedes requests that confidentiality be granted in perpetuity and would appreciate your notifying me in the event that EPA receives a request for disclosure or otherwise seeks to disclose this information.

I hope this information is helpful.

Please don't hesitate to let me know if you have any other questions.

Latane

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From: Lavergne2, Josee (EC/EC)
To: Wehrly, Linc; Bunker, Byron
Cc: Collins, Kevin (EC/EC)
Subject: (b) (4) [redacted]
Date: Wednesday, December 30, 2015 4:26:10 PM

Bonjour Byron and Linc,

Did you have time to analyse these results? Any conclusions?

Feel free to call me (613-990-7848) or Kevin (613-949-9285) during the first week in January...

Happy New Year to you both!

From: Lavergne2, Josee (EC/EC)
Sent: December 11, 2015 2:21 PM
To: 'Wehrly, Linc'; 'bunker.byron@epa.gov' (bunker.byron@epa.gov)
Cc: Collins, Kevin (EC/EC)
Subject: (b) (4) [redacted]

Hi Linc and Byron,

Attached are the (b) (4) [redacted] test results. We have noted very high NOx emissions at what seem to be fairly random times. The emissions jump up very high (2.5 g/mile) for a while, but then come down. This same phenomenon was observed during on-road PEMS testing. CO2 emissions do not behave as if the vehicle were undergoing a regeneration, and we are as yet unable to explain the results. We will see if the phenomenon occurs again with the second (b) (4) [redacted], which went into the testing lab earlier this week.

I'm hoping that you will share your conclusion with us shortly, assuming that you have similar results...

Don't hesitate to talk to Kevin if you have questions,

Josée Lavergne
Manager, Vehicles and Engines Testing for Emissions Verification (VETEV)
Transportation Division
613-990-7848
Gestionnaire, Essais et vérifications des émissions pour les véhicules et les moteurs (EVEVM)
Division du transport

From: Lavergne2, Josee (EC/EC)
To: Wehrly, Linc; Bunker, Byron
Cc: Collins, Kevin (EC/EC)
Subject: (b) (4) [redacted]
Date: Friday, December 11, 2015 2:23:39 PM
Attachments: (b) (4) [redacted]

Hi Linc and Byron,

(b) (4), (b) (7)(A) [redacted]

I'm hoping that you will share your conclusion with us shortly, assuming that you have similar results...

Don't hesitate to talk to Kevin if you have questions,

Josée Lavergne
Manager, Vehicles and Engines Testing for Emissions Verification (VETEV)
Transportation Division
613-990-7848
Gestionnaire, Essais et vérifications des émissions pour les véhicules et les moteurs (EVEVM)
Division du transport

From: joerg.breuer@daimler.com
To: Bunker, Byron; Charmley, William; william.craven@mbusa.com
Subject: AW: Detroit meeting topic
Date: Thursday, January 08, 2015 5:00:41 PM

Thanks for the fast feedback!

We certainly do not intend to get into technical discussions in this meeting – if Chris Grundler could provide some indications regarding the timing of EPA's next steps we would be very happy.

Mit freundlichen Grüßen/ Kind regards

Dr. Jörg Breuer

Director Certification, Regulatory Affairs & Environment
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Von: Bunker, Byron [mailto:bunker.byron@epa.gov]
Gesendet: Donnerstag, 8. Januar 2015 22:53
An: Charmley, William; Craven, William (171)
Cc: Breuer, Joerg (059)
Betreff: RE: Detroit meeting topic

Chris is certainly aware of the timing and the importance of getting this right. There is no preparation necessary for Chris to talk about that.

If Professor Weber wants to talk about the appropriate test weight, I would suggest that discussion should be done with our technical team at another time.

Thanks,

Byron

****

Byron Bunker
Director Compliance Division
Office of Transportation and Air Quality
Environmental Protection Agency
2000 Traverwood Drive

Ann Arbor, MI 48105
Bunker.Byron@epa.gov
Phone: (734) 214-4155
Mobile: (734) 353-9623
****

From: Charmley, William
Sent: Thursday, January 08, 2015 3:48 PM
To: william.craven@mbusa.com; Bunker, Byron
Cc: joerg.breuer@daimler.com
Subject: Re: Detroit meeting topic

Bill - I will ask Byron to weigh in on this

Byron - please take a look at Bill's question. Could Chris be prepared to talk about this?

Thanks
Bill

Bill Charmley, US EPA
Assessment and Standards Division
Office of Transportation and Air Quality
Ann Arbor, Michigan
Desk ph = 734-214-4466
Mobile ph = 734-545-0333
Email = charmley.william@epa.gov

From: william.craven@mbusa.com
Sent: Thursday, January 8, 2015 3:25 PM
To: Charmley, William
Cc: joerg.breuer@daimler.com
Subject: Detroit meeting topic

Bill,

(b) (4) [redacted] What do you think?

Bill

William Craven
General Manager, Regulatory Affairs
Daimler
1717 Pennsylvania Ave, Suite 825
Washington, DC
Phone-(202) 649 4509
Mobil- (202) 361 0121

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