

California Environmental Protection Agency



STAFF REPORT: INITIAL STATEMENT OF REASONS

**PUBLIC HEARING TO ADOPT GASEOUS POLLUTANT MEASUREMENT
ALLOWANCES FOR CALIFORNIA'S HEAVY-DUTY
DIESEL IN-USE COMPLIANCE REGULATION**

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EXECUTIVE SUMMARY

In 2006, the Air Resources Board (ARB or Board) adopted a new in-use compliance regulation and test procedures (ARB (2006)). that allows for a more efficient and cost effective in-use compliance program for heavy-duty diesel engines (HDDE)(This new program, called the manufacturer-run heavy-duty diesel in-use testing program (HDIUT), requires the manufacturers to test a set number of their certified engine families each year using portable emission measurement systems (PEMS) installed on selected test vehicles. The HDIUT program evaluates HDDE compliance with the Not-to-Exceed (NTE) emission test limits that are part of the certification requirements for HDDE. The NTE test limits are not a prescribed test cycle but a wide range of engine operation that can be expected to occur during normal highway operation. An engine family that exceeds the in-use limits is subject to remedial action.

The adopted HDIUT program incorporated temporary measurement allowances when testing for compliance using PEMS. Measurement allowances are needed to account for measurement error associated with using PEMS in the field during over-the-road vehicle operation, instead of testing the engine in a controlled laboratory environment on an engine dynamometer. Prior to the adoption of this rule, an agreement was made between ARB, the United States Environmental Protection Agency (U.S. EPA), and the Engine Manufacturers Association (EMA), along with individual engine manufacturers, to fund a research program to establish better measurement allowances for each regulated pollutant (ARB, U.S. EPA, EMA (2005a)). A research program was developed through the guidance of a Measurement Allowance Steering Committee (MASC), comprised of members from ARB, U.S. EPA, and the engine manufacturers (ARB, U.S. EPA, EMA (2005b)). Testing, statistical modeling, and model validation of three different emission measurement methods have been completed by the main contractor, Southwest Research Institute, in San Antonio, Texas, with the help of the University of California's (at Riverside), Center for Environmental Research and Technology.

The intent of the research program was to develop a single set of measurement allowances based on the most stringent validated method that would replace the temporary allowances in the adopted rule. However, because there were some technical issues that delayed the program, only one measurement allowances method was validated during the initial modeling and analysis (SwRI (2007a)), (CE-CERT (2007)). The MASC recommended using the allowances based on this method for in-use testing of engines certified in 2007 through 2009 model years. The MASC also agreed to continue the work to validate all three emission measurement methods in order to obtain more representative measurement allowances for 2010 and later model years. SwRI conducted further analyses and modeling, resulting in the validation of all three measurement methods (SwRI (2007b)). The measurement allowances proposed by staff to the Board are given in Table ES-1, below:

Table ES-1 HDIUT Measurement Allowance Values by Model Year (g/bhp-hr)¹

| Pollutant | 2007 – 2009 Model Year | 2010 and Subsequent Model Year |
|------------------|-------------------------------|---------------------------------------|
| NOx | 0.45 | 0.15 |
| NMHC | 0.02 | 0.01 |
| CO | 0.50 | 0.25 |

¹ Grams per brake-horsepower-hour

If adopted, these values would be added to the emissions measured by the PEMS to compensate for testing uncertainties when performing compliance testing in the field.

Economic and Air Quality Impacts

Staff's proposal would replace the current temporary measurement allowance values with values developed and validated through an extensive testing and modeling research program. Since the proposed allowances are smaller than the temporary allowances previously adopted, it is possible that engine manufacturers could be subject to additional remedial action. The impact on the engine manufacturers, and the impact on air quality, is expected to be slight. No impact on private businesses or persons is expected.

I. INTRODUCTION

The federal Clean Air Act grants California the authority to adopt and enforce rules to control mobile source emissions within California. In 2006, the Air Resources Board (ARB or Board) adopted a new in-use compliance regulation and test procedures (ARB (2006)) that allow for a more efficient and cost effective test method to conduct in-use compliance testing of heavy-duty diesel engines (HDDE). This new testing method, called the manufacturer-run heavy-duty diesel in-use testing program (HDIUT), requires the manufacturers to test a set number of their certified engine families each year using demonstrated and proven portable emission measurement systems (PEMS) that can be installed on selected test vehicles. These test vehicles are then tested with PEMS when they are placed in normal revenue service. An engine family that fails the in-use testing is subject to remedial action. The previous method to conduct in-use compliance testing required the removal of the test engine from the vehicle and testing it in a laboratory on an engine dynamometer, which was very costly and time consuming.

The adopted HDIUT program was developed through a coordinated effort among ARB, the United States Environmental Protection Agency (U.S. EPA), and the Engine Manufacturers Association (EMA) along with individual manufacturers (ARB, U.S. EPA, EMA (2003)). The success of this regulatory testing program depends on ensuring that the PEMS can correctly measure the exhaust emissions from heavy-duty diesel vehicles in the field. Compared to a controlled laboratory setting, these in-field instruments can potentially be influenced by uncontrollable factors such as ambient conditions and mechanical vibration. Thus, ARB, U.S. EPA, and the engine manufacturers agreed to determine a measurement allowance for each pollutant to account for any potential difference in measurement accuracy (ARB, U.S. EPA, EMA (2005a)). The staff's proposal, if adopted by the Board, would formally establish revised measurement allowances for gaseous pollutants, to be used in the HDIUT program. Measurement allowances for particulate matter are not part of staff's proposal. Such allowances are currently being evaluated and will be presented to the Board for consideration at a later date.

II. BACKGROUND

In January 2001, the U.S. EPA adopted new HDDE emission standards, along with modified Not-to-Exceed (NTE) and European Stationary Cycle (ESC) test requirements for 2007 and subsequent model year engines. In October 2001, the ARB harmonized with the federal program by adopting identical 2007 HDDE emission standards, and NTE and ESC requirements. The NTE limits are designed to apply under any conditions reasonably expected to occur during normal vehicle use. The test procedure for the NTE limits is different from all previous HDDE test procedures in that it is not based on any kind of test cycle, but instead allows testing at a wide range of engine and

ambient conditions that can occur in any normal vehicle operation. The NTE limits, as well as many other provisions of the 2007 HDDE rule, were intended to ensure that engines and vehicles designed to meet the original Federal Test Procedure (FTP) standards over the engine certification test cycle in the laboratory continued to effectively control emissions under all driving conditions reasonably expected to occur during normal vehicle use. The NTE protocol allows testing on an engine dynamometer, chassis dynamometer, or with PEMS during over-the-road operation. The maximum allowable NTE emissions, when averaged over a minimum time of 30 seconds, must not exceed an emission limit that is a multiple of the FTP standards.

In late 2001, EMA challenged ARB and U.S. EPA's adoption of the NTE limits. This led ARB, U.S. EPA, and EMA to start a lengthy and ultimately productive discussion on settling EMA's concerns with the NTE requirements and included an agreement among all parties to develop an effective in-use compliance program. Consequently, on June 3, 2003, ARB, the U.S. EPA, and EMA mutually developed a detailed outline (ARB, U.S. EPA, EMA, (2003)) for a future regulation that included a manufacturer-run HDIUT program for diesel-fueled engines and vehicles. Based on this collaborative effort, U.S. EPA adopted a manufacturer-run HDIUT program in June 2005, and in September 2006 ARB adopted an essentially identical such program (ARB (2006)). As part of this effort, ARB, the U.S. EPA, and EMA, agreed to develop an improved set of measurement allowances for each pollutant to account for any potential difference in measurement accuracy between PEMS and laboratory instruments.

III. SUMMARY OF PROPOSAL

A. APPLICABILITY

The proposed amendments to the HDIUT program would apply to the gaseous emissions of all 2007 and subsequent model year engine dynamometer certified diesel engines to be installed in vehicles with gross vehicle weight ratings greater than 8,500 pounds.

B. MEASUREMENT ALLOWANCES

1. OVERVIEW

Under an agreement among ARB, the U.S. EPA, and EMA, it was recognized that measurement allowances for each regulated pollutant would need to be developed before an enforceable HDIUT program could commence. The measurement allowance represents the incremental error between measuring emissions under controlled conditions in a laboratory with lab-grade equipment, and measuring emissions in the field using PEMS. Thus, in practical terms, a measurement allowance of "X" would be added to the NTE emission limit plus

the in-use compliance testing margin to calculate the NTE threshold value against which all emission results are compared for compliance determination.

In early 2005, ARB, U.S. EPA, and EMA agreed to use interim measurement allowance values of 0.50 grams per brake horsepower hour (g/bhp-hr) for oxides of nitrogen (NO_x), 0.17 g/bhp-hr for non-methane hydrocarbon (NMHC), and 0.60 g/bhp-hr for carbon monoxide (CO) for pilot program testing. It was also agreed that these values would be revised once the measurement allowance values were determined through a coordinated research program.

To this end, ARB, U.S. EPA, and EMA formed a measurement allowance steering committee (MASC) that jointly financed a research contract with Southwest Research Institute (SwRI), in San Antonio, Texas. This program, completed in December, 2006, involved extensive testing and utilized a comprehensive statistical (“Monte Carlo”) model to account for all the variables (e.g. ambient conditions, vibrations etc.) that could influence the results¹. In addition to the variables, the model itself could be run in three different ways (“methods 1, 2, and 3”)² based on specific assumptions and inputs. It was agreed by the MASC that the measurement allowance determined from using any of these methods would be acceptable provided the modeling results were validated³. It was also agreed that the numerically lowest validated measurement allowances would ultimately be used in the HDIUT program.

2. STAFF’S PROPOSAL

The initial Monte Carlo model results validated only one method (method 1). The initial validation work was completed in January 2007, and left very little time to proceed with further analysis without delaying the implementation of an enforceable HDIUT program for an additional year (from 2007 to 2008). Thus, ARB and U.S. EPA agreed to finalize and use the initial validated measurement allowances for the program. Specifically, it was agreed that these initial allowance values would be used for a minimum of three years, through 2009. The U.S. EPA and ARB agreed to continue to work with SwRI, and conduct additional testing and modeling analyses in an effort to validate all three measurement methods (including method 2 and 3).

On June 21, 2007, SwRI presented the results of the additional modeling work they had completed. This work resulted in validation of all three methods (SwRI (2007b)). After further discussion with EMA and the engine manufacturers, it

¹ Additional discussion on the determination of measurement allowances through laboratory testing, computer modeling, and over-the-road testing validation is provided in Appendix C and Reference SwRI (2007a)

² See Emission Calculations, 40 CFR Part 1065, Sections G and J and Reference U.S. EPA (2005c)

³ Additional discussion on the “validation” methodology is provided in Appendix C and References SwRI (2007a), and CE-CERT (2007)

was agreed that the newly validated and more stringent measurement allowances should be used when conducting the HDIUT program on 2010 and subsequent model year HDDEs, while the initial method 1 validated measurement allowances should still be allowed for 2007 through 2009 model year HDDEs. Shown in Table 2 below are the proposed gaseous measurement allowances to be used in the HDIUT program.

Table 1 HDIUT Measurement Allowance Values by Model Year (g/bhp-hr)¹

| Pollutant | 2007 – 2009 Model Year | 2010 and Subsequent Model Year |
|------------------|-------------------------------|---------------------------------------|
| NOx | 0.45 | 0.15 |
| NMHC | 0.02 | 0.01 |
| CO | 0.50 | 0.25 |

¹ Grams per brake horsepower-hour

IV. DIFFERENCES AND SIMILARITIES BETWEEN CALIFORNIA AND FEDERAL REGULATIONS

The U.S. EPA has not yet adopted staff’s proposed measurement allowances, but intends to do so within the next six months. With regard to HDIUT in general, the U.S. EPA’s and ARB’s programs are essentially identical. Specifically, the engine family selection, test vehicle selection, testing protocol, test data collection and reporting, pass/fail criteria, etc., are all identical to the U.S. EPA’s rule. The only element of ARB’s program that arguably differs from U.S. EPA’s program is ARB’s authority to independently pursue remedial action on a non-complying engine family. This authority to enforce its own regulations is consistent with all ARB programs.

V. ECONOMIC IMPACTS

A. LEGAL REQUIREMENTS

Government Code Sections 11346.3 and 11346.5(a) require state agencies adopting and amending any administrative regulations to identify and assess the potential for adverse economic impacts on California businesses and individuals. State agencies are also required to estimate the cost or savings to any state or local agency and school districts. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion,

elimination or creation, and the ability of California business to compete with business in other states.

State agencies are also required to estimate the cost or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any non-discretionary cost or saving to the local agencies and the cost or saving in federal funding to the State.

B. AFFECTED BUSINESSES

Since the proposed allowances are smaller than the temporary allowances previously adopted, it is possible that engine manufacturers could be subject to additional remedial action. However, the impact on manufacturers is expected to be slight. No impact on private businesses or persons is expected. Also, there is no impact expected on PEMS manufacturers.

C. POTENTIAL COSTS TO ENGINE MANUFACTURERS

As stated above, the proposed allowances are smaller than the temporary allowances previously adopted, and thus it is possible that engine manufacturers could be subject to additional costs associated with remedial action. However, incremental costs on the engine manufacturers are expected to be slight and absorbable.

D. POTENTIAL IMPACTS ON BUSINESS COMPETITIVENESS

The proposed regulation is not expected to adversely impact the ability of California businesses to compete with similar businesses in other states.

E. POTENTIAL IMPACTS ON JOBS AND BUSINESS CREATION, ELIMINATION, OR EXPANSION

The proposed regulation is not expected to significantly impact the creation, elimination or expansion of jobs and businesses in California and is already covered by the adoption of the HDIUT regulation,

F. POTENTIAL COSTS TO LOCAL AND STATE AGENCIES

The proposed amendments to the Procedure will not create costs or savings, as defined in Government Code Section 11346.5 (a) (6), to any State agency or in federal funding to the State, costs or mandate to any local agency or school district whether or not reimbursable by the State pursuant to Part 7 (commencing with Section 17500, Division 4, Title 2 of the Government Code), or other non-

discretionary savings to local agencies. The staff has not encountered information that indicates that any of these impacts is to be expected.

No additional net costs for local and state agencies will be accrued as a result of the proposed regulation.

VI. ENVIRONMENTAL IMPACTS

A. AIR QUALITY IMPACTS

The implementation of the adopted HDIUT program will ensure that the expected emission benefits of 2007 HDDE standards are realized. The HDIUT program will encourage manufacturers to design and build robust engines and emission control systems to comply with the emission requirements during their useful life in order to avoid failure of in-use compliance testing which could ultimately lead to costly recalls or extended parts warranties. With regards to staff's proposal, there may be slight improvement in air quality due to the adoption of more stringent measurement allowances for the HDIUT program.

B. ENVIRONMENTAL JUSTICE

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. The Board has established a framework for incorporating environmental justice into ARB's programs consistent with the directives of State law. The proposed regulation would benefit all Californians by ensuring that HDDEs comply with certification emission standards throughout their useful life. Communities located in proximity to ports, distribution centers, and other areas with high heavy-duty diesel vehicle activity would particularly benefit from the proposed regulation.

VII. REGULATORY ALTERNATIVES

No other alternatives to the proposed requirement have been evaluated since the proposed measurement allowances are necessary in order for the adopted HDIUT program to go forward.

VIII. REMAINING, NON-CONTROVERSIAL ISSUES

There are no specific issues, controversial or otherwise, related to this proposal or its potential impact on the implementation of the adopted HDIUT program.

IX. SUMMARY AND STAFF RECOMMENDATIONS

The proposed measurement allowances for gaseous pollutants are necessary for a successful implementation of California's heavy-duty diesel in-use compliance regulations. Specifically, the use of measurement allowances when conducting in-use testing of 2007 and newer HDDEs will allow for an effective and enforceable in-use compliance program for HDDEs and ensure that the emission benefits expected from the 2007 HDDE emission standards are realized.

Staff therefore recommends that the Board adopt the proposed measurement allowances for gaseous pollutants, as set forth in the amendments to section 1956.8, title 13, California Code of Regulations, and the incorporated "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel-Cycle Engines and Vehicles" (Appendices A and B).

X. REFERENCES

1. SwRI (2007a), Determination of PEMS Measurement Allowances for Gaseous Emissions Regulated Under the Heavy-Duty Diesel Engine In-Use Testing Program, March 2007
2. CE-CERT (2007), Measurement Allowance Project – On-Road Validation, March 2007
3. ARB (2006), Regulatory Documents for California’s Heavy-Duty Diesel In-Use Compliance Regulation, Regulation adopted September 28, 2006
(<http://www.arb.ca.gov/regact/inuse06/inuse06.htm>)
4. ARB, U.S. EPA, EMA (2003), Outline of Regulatory Proposal (NPRM) for Manufacturer-Run In-Use Heavy-Duty Vehicle NTE Testing Program, May 9, 2003
(<http://www.epa.gov/otaq/hd-hwy.htm>)
5. ARB, U.S. EPA, EMA (2005a), Memorandum of Agreement, Program to Develop Emission Measurement Accuracy Margins for Heavy-Duty In-Use Testing, May 2005
(<http://www.epa.gov/otaq/hd-hwy.htm>)
6. ARB, U.S. EPA, EMA (2005b), Test Plan to Determine PEMS Measurement Allowances for the Gaseous Emissions Regulated under the Manufacturer-Run Heavy-Duty Diesel Engine In-Use Testing Program, October 25, 2005
(<http://www.epa.gov/otaq/hd-hwy.htm>)
7. U.S. EPA (2005c). Test Procedures for Testing Highway and Nonroad Engines and Omnibus Technical Amendments, (Federal Register, Vol. 70, No. 133, PP 40420 – 40468, Wednesday, July 13, 2005)
(<http://www.epa.gov/otaq/hd-hwy.htm>)
8. SwRI (2007b), Results of HDIUT Modeling Runs Using Revised Error Surfaces, Janet Buckingham and Robert L. Mason, June 21, 2007