



Air Resources Board



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MANUFACTURERS ADVISORY CORRESPONDENCE (MAC) #2017-02

TO: ALL MANUFACTURERS OF
- HEAVY-DUTY ENGINES
- PORTABLE EMISSIONS MEASUREMENT SYSTEMS (PEMS)
ALL OTHER INTERESTED PARTIES

SUBJECT: Heavy-Duty In-Use Testing (HDIUT) Data Drift Validation Handling Process

This letter transmits a Manufacturers Advisory Correspondence (MAC) that clarifies how to handle the optional drift validation associated with Part 1065, Subpart F, Section 1065.550(b)(4) that is incorporated in the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," as amended September 2, 2015 (Test Procedures).

If you have any questions or comments, please contact Mr. Keith Macias, Manager at (626) 575-6600 or via e-mail at keith.macias@arb.ca.gov or Dr. Doh-Won Lee, Air Resources Engineer, at (626) 350-6543 or via e-mail at doh-won.lee@arb.ca.gov.

Sincerely,

Annette Hebert, Chief
Emissions Compliance, Automotive Regulations and Science Division

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website: <http://www.arb.ca.gov>.

California Environmental Protection Agency

**State of California
AIR RESOURCES BOARD**

MANUFACTURERS ADVISORY CORRESPONDENCE (MAC) #2017-02

SUBJECT: Heavy-Duty In-Use Testing (HDIUT) Data Drift Validation Handling Process

APPLICABILITY: Manufacturers who are required to conduct emissions testing, using Portable Emission Measurement Systems (PEMS), subject to California's Heavy-Duty In-Use Compliance regulation, title 13, California Code of Regulations sections 1965.1 and 1956.8.

REFERENCES: "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles, as last amended September 2, 2015 (Test Procedures), Part 1065 Subpart F; Part 1065 Subpart J; and Part II, Subpart T.

BACKGROUND: Part 1065, Subpart J—Field Testing and Portable Emission Measurement Systems (PEMS) of the Test Procedures sets forth requirements for conducting field and laboratory testing with PEMS, which includes data collection, verification of PEMS data, quality assurance and quality control (QA/QC). Manufacturers are required to conduct PEMS testing pursuant to Part 1065, Subpart J and other applicable sections including Part 1065, Subpart F, Section 1065.550—Gas Analyzer Range Verification and Drift Verification and Section 1065.550(b)(4) of the Test Procedures, and to perform QA/QC before submitting data to California Air Resources Board (CARB).

Part 1065, Subpart J, Section 1065.935(g)(5) of the Test Procedures requires manufacturers to invalidate any test intervals that do not meet the drift criterion in Part 1065, Subpart F, Section 1065.550 of the Test Procedures. Part 1065, Subpart F, Section 1065.550 of the Test Procedures allows manufacturers to apply an additional drift validation option for good engineering judgment that manufacturers may choose.

§1065.550 Gas analyzer range verification and drift verification.
(a) Range verification. If an analyzer operated above 100% of its range at any time during the test, perform the following steps:
(1) For batch sampling, re-analyze the sample using the lowest analyzer range that results in a maximum instrument response

below 100%. Report the result from the lowest range from which the analyzer operates below 100% of its range.

(2) For continuous sampling, repeat the entire test using the next higher analyzer range. If the analyzer again operates above 100% of its range, repeat the test using the next higher range. Continue to repeat the test until the analyzer always operates at less than 100% of its range.

(b) Drift verification. Gas analyzer drift verification is required for all gaseous exhaust constituents for which an emission standard applies. It is also required for CO₂ even if there is no CO₂ emission standard. It is not required for other gaseous exhaust constituents for which only a reporting requirement applies (such as CH₄ and N₂O).

(1) Verify drift using one of the following methods:

(i) For regulated exhaust constituents determined from the mass of a single component, perform drift verification based on the regulated constituent. For example, when NO_x mass is determined with a dry sample measured with a CLD and the removed water is corrected based on measured CO₂, CO, THC, and NO_x concentrations, you must verify the calculated NO_x value.

(ii) For regulated exhaust constituents determined from the masses of multiple subcomponents, perform the drift verification based on either the regulated constituent or all the mass subcomponents. For example, when NO_x is measured with separate NO and NO₂ analyzers, you must verify either the NO_x value or both the NO and NO₂ values.

(iii) For regulated exhaust constituents determined from the concentrations of multiple gaseous emission subcomponents prior to performing mass calculations, perform drift verification on the regulated constituent. You may not verify the concentration subcomponents (e.g., THC and CH₄ for NMHC) separately. For example, for NMHC measurements, perform drift verification on NMHC; do not verify THC and CH₄ separately.

(2) Drift verification requires two sets of emission calculations. For each set of calculations, include all the constituents in the drift verification. Calculate one set using the data before drift correction and calculate the other set after correcting all the data for drift according to §1065.672. Note that for purposes of drift verification, you must leave unaltered any negative emission results over a given test interval (i.e., do not set them to zero). These unaltered results are used when verifying either test interval results or composite brake-specific emissions over the entire duty cycle for drift. For each constituent to be verified, both sets of calculations must include the following:

(i) Calculated mass (or mass rate) emission values over each test interval.

(ii) If you are verifying each test interval based on brake-specific values, calculate brake-specific emission values over each test interval.

(iii) If you are verifying over the entire duty cycle, calculate composite brake-specific emission values.

(3) The duty cycle is verified for drift if you satisfy the following criteria:

(i) For each regulated gaseous exhaust constituent, you must satisfy one of the following:

(A) For each test interval of the duty cycle, the difference between the uncorrected and the corrected brake-specific emission values of the regulated constituent must be within $\pm 4\%$ of the uncorrected value or the applicable emissions standard, whichever is greater. Alternatively, the difference between the uncorrected and the corrected emission mass (or mass rate) values of the regulated constituent must be within $\pm 4\%$ of the uncorrected value or the composite work (or power) multiplied by the applicable emissions standard, whichever is greater. For purposes of verifying each test interval, you may use either the reference or actual composite work (or power).

(B) For each test interval of the duty cycle and for each mass subcomponent of the regulated constituent, the difference between the uncorrected and the corrected brake-specific emission values must be within $\pm 4\%$ of the uncorrected value. Alternatively, the difference between the uncorrected and the corrected emissions mass (or mass rate) values must be within $\pm 4\%$ of the uncorrected value.

(C) For the entire duty cycle, the difference between the uncorrected and the corrected composite brake-specific emission values of the regulated constituent must be within $\pm 4\%$ of the uncorrected value or applicable emission standard, whichever is greater.

(D) For the entire duty cycle and for each subcomponent of the regulated constituent, the difference between the uncorrected and the corrected composite brake-specific emission values must be within $\pm 4\%$ of the uncorrected value.

(ii) Where no emission standard applies for CO₂, you must satisfy one of the following:

(A) For each test interval of the duty cycle, the difference between the uncorrected and the corrected brake-specific CO₂ values must be within $\pm 4\%$ of the uncorrected value; or the difference between the uncorrected and the corrected CO₂ mass (or mass rate) values must be within $\pm 4\%$ of the uncorrected value.

(B) For the entire duty cycle, the difference between the uncorrected and the corrected composite brake-specific CO₂ values must be within $\pm 4\%$ of the uncorrected value.

(4) If the test is not verified for drift as described in paragraph (b)(1) of this section, you may consider the test results for the duty cycle to be valid only if, using good engineering judgment, the observed drift does not affect your ability to demonstrate compliance with the applicable emission standards. For example, if the drift-corrected value is less than the standard by at least two times the absolute difference between the uncorrected and corrected values, you may consider the data to be verified for demonstrating compliance with the applicable standard.¹

Currently, manufacturers use this option to include additional testing data contributing toward compliance while rejecting data contributing toward noncompliance, which is not good engineering judgment.

DISCUSSIONS: Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures allows manufacturers an option, dependent on the exercise of good engineering judgment, to save data that do not meet the drift criterion in Part 1065, Subpart F, Section 1065.550(b)(3) of the Test Procedures. This option can be used as long as the drift does not affect the ability to demonstrate compliance and noncompliance with the applicable standard. However, manufacturers have been using this option to save data contributing toward compliance only. This practice is inconsistent with the requirements of Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures

Following a restrictive interpretation of the example stated in Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures, manufacturers accept some drift-corrected values as only valid data when the corrected values plus twice the difference between the corrected and uncorrected values (that is, the highest accountable values showing added drift-affectedness) are under their corresponding emission standards. That is, when the highest accountable values are low enough to show compliance, manufacturers save the associated data and use them toward compliance. When the corrected values minus twice the difference (that is, the lowest accountable values showing also added drift-affectedness) are over the standards, which means that the lowest accountable values are high enough to show noncompliance,

¹ Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures describes an additional drift validation option

however, manufacturers reject the associated noncompliance data as invalid data.

If manufacturers use this option to save data where the highest accountable values are sufficiently below the standards, the manufacturers should also accept such data as valid where the lowest accountable values are sufficiently over the standards. That is, manufacturers should accept data showing both of compliance and noncompliance, which is good engineering judgment, applying the evaluation to accept drift in both directions. However, manufacturers currently reject such data sufficiently over the standards while accepting only data sufficiently under, creating the potential for a truncation bias.

POLICY:

Manufacturers that elect to use the drift validation option in Part 1065, Subpart F, Section 1065.550(b)(4) of the Test Procedures must apply the methodology associated with the drift validation option for both sufficiently under and over the standards, which is good engineering judgment; not under only. Otherwise manufacturers should not use this option. In addition, manufacturers should notify CARB whether they use the option when reporting their HDIUT data.