

connect the NO<sub>2</sub>-to-NO converter inlet to the last port.

(3) *Adjustments and data collection.* Perform this check as follows:

(i) Set ozonator air off, turn ozonator power off, and set the analyzer to NO mode. Allow for stabilization, accounting only for transport delays and instrument response.

(ii) Use an NO concentration that is representative of the peak total NO<sub>x</sub> concentration expected during testing. The NO<sub>2</sub> content of the gas mixture shall be less than 5% of the NO concentration. Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as  $x_{\text{NOref}}$ .

(iii) Turn on the ozonator O<sub>2</sub> supply and adjust the O<sub>2</sub> flow rate so the NO indicated by the analyzer is about 10 percent less than  $x_{\text{NOref}}$ . Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as  $x_{\text{NO} + \text{O2mix}}$ .

(iv) Switch the ozonator on and adjust the ozone generation rate so the NO measured by the analyzer is 20 percent of  $x_{\text{NOref}}$ , while maintaining at least 10 percent unreacted NO. Record

the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as  $x_{\text{NOmeas}}$ .

(v) Switch the NO<sub>x</sub> analyzer to NO<sub>x</sub> mode and measure total NO<sub>x</sub>. Record the concentration of NO<sub>x</sub> by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as  $x_{\text{NOxmeas}}$ .

(vi) Switch off the ozonator but maintain gas flow through the system. The NO<sub>x</sub> analyzer will indicate the NO<sub>x</sub> in the NO + O<sub>2</sub> mixture. Record the concentration of NO<sub>x</sub> by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as  $x_{\text{NOx} + \text{O2mix}}$ .

(vii) Turn off the ozonator O<sub>2</sub> supply. The NO<sub>x</sub> analyzer will indicate the NO<sub>x</sub> in the original NO-in-N<sub>2</sub> mixture. Record the concentration of NO<sub>x</sub> by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as  $x_{\text{NOxref}}$ . This value should be no more than 5 percent above the  $x_{\text{NOref}}$  value.

(4) *Performance evaluation.* Calculate the efficiency of the NO<sub>x</sub> converter by substituting the concentrations obtained into the following equation:

$$\text{efficiency} = \left( 1 + \frac{x_{\text{NOxmeas}} - x_{\text{NOx} + \text{O2mix}}}{x_{\text{NO} + \text{O2mix}} - x_{\text{NOmeas}}} \right) \cdot 100\%$$

(5) If the result is less than 95%, repair or replace the NO<sub>2</sub>-to-NO converter.

(e) *Exceptions.* The following exceptions apply:

(1) You may omit this verification if you can show by engineering analysis that for your NO<sub>x</sub> sampling system and your emission calculations procedures, the converter always affects your brake-specific NO<sub>x</sub> emission results by less than 0.5% of the applicable NO<sub>x</sub> standard.

[70 FR 40516, July 13, 2005, as amended at 73 FR 37313, June 30, 2008; 73 FR 59330, Oct. 8, 2008]

#### PM MEASUREMENTS

##### § 1065.390 PM balance verifications and weighing process verification.

(a) *Scope and frequency.* This section describes three verifications.

(1) Independent verification of PM balance performance within 370 days before weighing any filter.

(2) Zero and span the balance within 12 h before weighing any filter.

(3) Verify that the mass determination of reference filters before and after a filter weighing session are less than a specified tolerance.

(b) *Independent verification.* Have the balance manufacturer (or a representative approved by the balance manufacturer) verify the balance performance within 370 days of testing.

(c) *Zeroing and spanning.* You must verify balance performance by zeroing and spanning it with at least one calibration weight, and any weights you use must that meet the specifications in §1065.790 to perform this verification.

(1) Use a manual procedure in which you zero the balance and span the balance with at least one calibration weight. If you normally use mean values by repeating the weighing process to improve the accuracy and precision of PM measurements, use the same process to verify balance performance.

(2) You may use an automated procedure to verify balance performance. For example many balances have internal calibration weights that are used automatically to verify balance performance. Note that if you use internal balance weights, the weights must meet the specifications in §1065.790 to perform this verification.

(d) *Reference sample weighing.* Verify all mass readings during a weighing session by weighing reference PM sample media (e.g., filters) before and after a weighing session. A weighing session may be as short as desired, but no longer than 80 hours, and may include both pre-test and post-test mass readings. We recommend that weighing sessions be eight hours or less. Successive mass determinations of each reference PM sample media (e.g., filter) must return the same value within  $\pm 10 \mu\text{g}$  or  $\pm 10\%$  of the net PM mass expected at the standard (if known), whichever is higher. If successive reference PM sample media (e.g., filter) weighing events fail this criterion, invalidate all individual test media (e.g., filter) mass readings occurring between the successive reference media (e.g., filter) mass determinations. You may reweigh these media (e.g., filter) in another weighing session. If you invalidate a pre-test media (e.g., filter) mass determination, that test interval is void. Perform this verification as follows:

(1) Keep at least two samples of unused PM sample media (e.g., filters) in the PM-stabilization environment. Use

these as references. If you collect PM with filters, select unused filters of the same material and size for use as references. You may periodically replace references, using good engineering judgment.

(2) Stabilize references in the PM stabilization environment. Consider references stabilized if they have been in the PM-stabilization environment for a minimum of 30 min, and the PM-stabilization environment has been within the specifications of §1065.190(d) for at least the preceding 60 min.

(3) Exercise the balance several times with a reference sample. We recommend weighing ten samples without recording the values.

(4) Zero and span the balance. Using good engineering judgment, place a test mass such as a calibration weight on the balance, then remove it. After spanning, confirm that the balance returns to a zero reading within the normal stabilization time.

(5) Weigh each of the reference media (e.g., filters) and record their masses. We recommend using substitution weighing as described in §1065.590(j). If you normally use mean values by repeating the weighing process to improve the accuracy and precision of the reference media (e.g., filter) mass, you must use mean values of sample media (e.g., filter) masses.

(6) Record the balance environment dewpoint, ambient temperature, and atmospheric pressure.

(7) Use the recorded ambient conditions to correct results for buoyancy as described in §1065.690. Record the buoyancy-corrected mass of each of the references.

(8) Subtract each reference media's (e.g., filter's) buoyancy-corrected reference mass from its previously measured and recorded buoyancy-corrected mass.

(9) If any of the reference filters' observed mass changes by more than that allowed under this paragraph, you must invalidate all PM mass determinations made since the last successful reference media (e.g. filter) mass validation. You may discard reference PM media (e.g. filters) if only one of the filter's mass changes by more than the allowable amount and you can positively identify a special cause for

that filter's mass change that would not have affected other in-process filters. Thus, the validation can be considered a success. In this case, you do not have to include the contaminated reference media when determining compliance with paragraph (d)(10) of this section, but the affected reference filter must be immediately discarded and replaced prior to the next weighing session.

(10) If any of the reference masses change by more than that allowed under this paragraph (d), invalidate all PM results that were determined between the two times that the reference masses were determined. If you discarded reference PM sample media according to paragraph (d)(9) of this section, you must still have at least one reference mass difference that meets the criteria in this paragraph (d). Otherwise, you must invalidate all PM results that were determined between the two times that the reference media (e.g., filters) masses were determined.

[73 FR 37313, June 30, 2008, as amended at 75 FR 23042, Apr. 30, 2010]

#### **§ 1065.395 Inertial PM balance verifications.**

This section describes how to verify the performance of an inertial PM balance.

(a) *Independent verification.* Have the balance manufacturer (or a representative approved by the balance manufacturer) verify the inertial balance performance within 370 days before testing.

(b) *Other verifications.* Perform other verifications using good engineering judgment and instrument manufacturer recommendations.

### **Subpart E—Engine Selection, Preparation, and Maintenance**

#### **§ 1065.401 Test engine selection.**

While all engine configurations within a certified engine family must comply with the applicable standards in the standard-setting part, you need not test each configuration for certification.

(a) Select an engine configuration within the engine family for testing, as follows:

(1) Test the engine that we specify, whether we issue general guidance or give you specific instructions.

(2) If we do not tell you which engine to test, follow any instructions in the standard-setting part.

(3) If we do not tell you which engine to test and the standard-setting part does not include specifications for selecting test engines, use good engineering judgment to select the engine configuration within the engine family that is most likely to exceed an emission standard.

(b) In the absence of other information, the following characteristics are appropriate to consider when selecting the engine to test:

- (1) Maximum fueling rates.
- (2) Maximum loads.
- (3) Maximum in-use speeds.
- (4) Highest sales volume.

(c) For our testing, we may select any engine configuration within the engine family.

#### **§ 1065.405 Test engine preparation and maintenance.**

This part 1065 describes how to test engines for a variety of purposes, including certification testing, production-line testing, and in-use testing. Depending on which type of testing is being conducted, different preparation and maintenance requirements apply for the test engine.

(a) If you are testing an emission-data engine for certification, make sure it is built to represent production engines. This includes governors that you normally install on production engines. Production engines should also be tested with their installed governors. If you do not install governors on production engines, simulate a governor that is representative of a governor that others will install on your production engines.

(b) Testing generally occurs only after the test engine has undergone a stabilization step (or in-use operation). If the engine has not already been stabilized, run the test engine, with all emission control systems operating, long enough to stabilize emission levels. Note that you must generally use the same stabilization procedures for emission-data engines for which you apply the same deterioration factors so