

gaseous measurements and the engine’s known or assumed fuel properties. The target value for any compensation algorithm is 0.0% (that is, no bias high and no bias low), regardless of the uncompensated signal’s bias.

**Subpart D—Calibrations and Verifications**

**§ 1065.301 Overview and general provisions.**

(a) This subpart describes required and recommended calibrations and verifications of measurement systems. See subpart C of this part for specifications that apply to individual instruments.

(b) You must generally use complete measurement systems when performing calibrations or verifications in this subpart. For example, this would generally involve evaluating instruments based on values recorded with the complete system you use for recording test data, including analog-to-digital converters. For some calibrations and

verifications, we may specify that you disconnect part of the measurement system to introduce a simulated signal.

(c) If we do not specify a calibration or verification for a portion of a measurement system, calibrate that portion of your system and verify its performance at a frequency consistent with any recommendations from the measurement-system manufacturer, consistent with good engineering judgment.

(d) Use NIST-traceable standards to the tolerances we specify for calibrations and verifications. Where we specify the need to use NIST-traceable standards, you may alternatively ask for our approval to use international standards that are not NIST-traceable.

**§ 1065.303 Summary of required calibration and verifications.**

The following table summarizes the required and recommended calibrations and verifications described in this subpart and indicates when these have to be performed:

TABLE 1 OF § 1065.303—SUMMARY OF REQUIRED CALIBRATION AND VERIFICATIONS

Type of calibration or verification	Minimum frequency <sup>a</sup>
§ 1065.305: accuracy, repeatability and noise.	<i>Accuracy:</i> Not required, but recommended for initial installation. <i>Repeatability:</i> Not required, but recommended for initial installation. <i>Noise:</i> Not required, but recommended for initial installation.
§ 1065.307: linearity .....	<i>Speed:</i> Upon initial installation, within 370 days before testing and after major maintenance. <i>Torque:</i> Upon initial installation, within 370 days before testing and after major maintenance. <i>Electrical power:</i> Upon initial installation, within 370 days before testing and after major maintenance. <i>Clean gas and diluted exhaust flows:</i> Upon initial installation, within 370 days before testing and after major maintenance, unless flow is verified by propane check or by carbon or oxygen balance. <i>Raw exhaust flow:</i> Upon initial installation, within 185 days before testing and after major maintenance, unless flow is verified by propane check or by carbon or oxygen balance. <i>Gas analyzers:</i> Upon initial installation, within 35 days before testing and after major maintenance. <i>PM balance:</i> Upon initial installation, within 370 days before testing and after major maintenance. <i>Stand-alone pressure and temperature:</i> Upon initial installation, within 370 days before testing and after major maintenance.
§ 1065.308: Continuous analyzer system response and recording.	Upon initial installation, after system reconfiguration, and after major maintenance.
§ 1065.309: Continuous analyzer uniform response.	Upon initial installation, after system reconfiguration, and after major maintenance.
§ 1065.310: torque .....	Upon initial installation and after major maintenance.
§ 1065.315: pressure, temperature, dew-point.	Upon initial installation and after major maintenance.
§ 1065.320: fuel flow .....	Upon initial installation and after major maintenance.
§ 1065.325: intake flow .....	Upon initial installation and after major maintenance.
§ 1065.330: exhaust flow .....	Upon initial installation and after major maintenance.
§ 1065.340: diluted exhaust flow (CVS) .....	Upon initial installation and after major maintenance.
§ 1065.341: CVS and batch sampler verification.	Upon initial installation, within 35 days before testing, and after major maintenance.
§ 1065.345: vacuum leak .....	Before each laboratory test according to subpart F of this part and before each field test according to subpart J of this part.

TABLE 1 OF § 1065.303—SUMMARY OF REQUIRED CALIBRATION AND VERIFICATIONS—Continued

Type of calibration or verification	Minimum frequency <sup>a</sup>
§ 1065.350: CO <sub>2</sub> NDIR H <sub>2</sub> O interference ....	Upon initial installation and after major maintenance.
§ 1065.355: CO NDIR CO <sub>2</sub> and H <sub>2</sub> O interference.	Upon initial installation and after major maintenance.
§ 1065.360: FID optimization, etc. ....	<i>Calibrate, optimize, and determine CH<sub>4</sub> response:</i> upon initial installation and after major maintenance. <i>Verify CH<sub>4</sub> response:</i> upon initial installation, within 185 days before testing, and after major maintenance.
§ 1065.362: raw exhaust FID O <sub>2</sub> interference.	Upon initial installation, after FID optimization according to § 1065.360, and after major maintenance.
§ 1065.365: nonmethane cutter penetration	Upon initial installation, within 185 days before testing, and after major maintenance.
§ 1065.370: CLD CO <sub>2</sub> and H <sub>2</sub> O quench ....	Upon initial installation and after major maintenance.
§ 1065.372: NDUV HC and H <sub>2</sub> O interference.	Upon initial installation and after major maintenance.
§ 1065.376: chiller NO <sub>2</sub> penetration .....	Upon initial installation and after major maintenance.
§ 1065.378: NO <sub>2</sub> -to-NO converter conversion.	Upon initial installation, within 35 days before testing, and after major maintenance.
§ 1065.390: PM balance and weighing .....	<i>Independent verification:</i> upon initial installation, within 370 days before testing, and after major maintenance. <i>Zero, span, and reference sample verifications:</i> within 12 hours of weighing, and after major maintenance.
§ 1065.395: Inertial PM balance and weighing.	<i>Independent verification:</i> upon initial installation, within 370 days before testing, and after major maintenance. <i>Other verifications:</i> upon initial installation and after major maintenance.

<sup>a</sup> Perform calibrations and verifications more frequently, according to measurement system manufacturer instructions and good engineering judgment.

**§ 1065.305 Verifications for accuracy, repeatability, and noise.**

(a) This section describes how to determine the accuracy, repeatability, and noise of an instrument. Table 1 of § 1065.205 specifies recommended values for individual instruments.

(b) We do not require you to verify instrument accuracy, repeatability, or noise.

However, it may be useful to consider these verifications to define a specification for a new instrument, to verify the performance of a new instrument upon delivery, or to troubleshoot an existing instrument.

(c) In this section we use the letter “y” to denote a generic measured quantity, the superscript over-bar to denote an arithmetic mean (such as  $\bar{y}$ ), and the subscript “<sub>ref</sub>” to denote the reference quantity being measured.

(d) Conduct these verifications as follows:

(1) Prepare an instrument so it operates at its specified temperatures, pressures, and flows. Perform any instrument linearization or calibration procedures prescribed by the instrument manufacturer.

(2) Zero the instrument as you would before an emission test by introducing a zero signal. Depending on the instru-

ment, this may be a zero-concentration gas, a reference signal, a set of reference thermodynamic conditions, or some combination of these. For gas analyzers, use a zero gas that meets the specifications of § 1065.750.

(3) Span the instrument as you would before an emission test by introducing a span signal. Depending on the instrument, this may be a span-concentration gas, a reference signal, a set of reference thermodynamic conditions, or some combination of these. For gas analyzers, use a span gas that meets the specifications of § 1065.750.

(4) Use the instrument to quantify a NIST-traceable reference quantity,  $y_{ref}$ . For gas analyzers the reference gas must meet the specifications of § 1065.750. Select a reference quantity near the mean value expected during testing. For all gas analyzers, use a quantity near the flow-weighted mean concentration expected at the standard or expected during testing, whichever is greater. For a noise verification, use the same zero gas from paragraph (e) of this section as the reference quantity. In all cases, allow time for the instrument to stabilize while it measures the reference quantity. Stabilization time