

September 2009	April 2010 (e-CFR)
<p>§ 1065.275 N₂O measurement devices.</p> <p>(a) <i>General component requirements.</i> We recommend that you use an analyzer that meets the specifications in Table 1 of 40 CFR 1065.205. Note that your system must meet the linearity verification in 40 CFR 1065.307.</p> <p>(b) <i>Instrument types.</i> You may use any of the following analyzers to measure N₂O:</p> <p>(1) <i>Nondispersive infra-red (NDIR) analyzer.</i> You may use an NDIR analyzer that has compensation algorithms that are functions of other 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.</p> <p>(2) <i>Fourier transform infra-red (FTIR) analyzer.</i> You may use an FTIR analyzer that has compensation algorithms that are functions of other 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. Use EPA Test Method 320 "Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy" for spectral interpretation (see 40 CFR part 63 appendix A).</p> <p>(3) <i>Photoacoustic analyzer.</i> You may use a photoacoustic analyzer that has compensation algorithms that are functions of other gaseous measurements. 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. Use an optical wheel configuration that gives analytical priority to measurement of the least stable components in the sample. Select a sample integration time of at least 5 seconds. Take into account sample chamber and sample line volumes when determining flush times for your instrument.</p> <p>(4) <i>Gas chromatograph (GC) analyzer.</i> You may use a gas chromatograph with Electron Capture Detector (ECD) to measure N₂O concentrations of diluted exhaust for batch sampling. You may use a packed or porous layer open tubular (PLOT) column phase of suitable polarity and length to achieve adequate resolution of the N₂O peak for analysis. Examples of acceptable columns are a PLOT column consisting of bonded polystyrene-divinylbenzene or a Porapack Q packed column. Take the column temperature profile and carrier gas selection into consideration when setting up your method to achieve adequate N₂O peak resolution.</p> <p>(c) <i>Interference validation.</i> Perform interference validation for NDIR, FTIR, and Photoacoustic analyzers using the procedures of § 86.168–12 as follows:</p> <p>(1) Certain interference gases can positively interfere with these analyzers by causing a response similar to N₂O as follows:</p> <p>(i) The interference gases for NDIR analyzers are CO, CO₂, H₂O, CH₄ and SO₂. Note that interference species, with the exception of H₂O, are dependent on the N₂O infrared absorption band chosen by the instrument manufacturer and should be determined independently for each analyzer.</p> <p>(ii) Use good engineering judgment to determine interference gases for FTIR. Note that interference species, with the exception of H₂O, are dependent on the N₂O</p>	<p>§ 1065.275 N₂O measurement devices.</p> <p>(a) <i>General component requirements.</i> We recommend that you use an analyzer that meets the specifications in Table 1 of § 1065.205. Note that your system must meet the linearity verification in § 1065.307.</p> <p>(b) <i>Instrument types.</i> You may use any of the following analyzers to measure N₂O:</p> <p>(1) <i>Nondispersive infra-red (NDIR) analyzer.</i> You may use an NDIR analyzer that has compensation algorithms that are functions of other 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.</p> <p>(2) <i>Fourier transform infra-red (FTIR) analyzer.</i> You may use an FTIR analyzer that has compensation algorithms that are functions of other 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. Use appropriate analytical procedures for interpretation of infrared spectra. For example, EPA Test Method 320 is considered a valid method for spectral interpretation (see http://www.epa.gov/ttn/emc/methods/method320.html).</p> <p>(3) <i>Photoacoustic analyzer.</i> You may use a photoacoustic analyzer that has compensation algorithms that are functions of other gaseous measurements. 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. Use an optical wheel configuration that gives analytical priority to measurement of the least stable components in the sample. Select a sample integration time of at least 5 seconds. Take into account sample chamber and sample line volumes when determining flush times for your instrument.</p> <p>(4) <i>Gas chromatograph analyzer.</i> You may use a gas chromatograph with an electron-capture detector (GC–ECD) to measure N₂O concentrations of diluted exhaust for batch sampling.</p> <p>(i) You may use a packed or porous layer open tubular (PLOT) column phase of suitable polarity and length to achieve adequate resolution of the N₂O peak for analysis. Examples of acceptable columns are a PLOT column consisting of bonded polystyrene-divinylbenzene or a Porapack Q packed column. Take the column temperature profile and carrier gas selection into consideration when setting up your method to achieve adequate N₂O peak resolution.</p> <p>(ii) Use good engineering judgment to zero your instrument and correct for drift. You do not need to follow the specific procedures in § 1065.530 and § 1065.550(b) that would otherwise apply. For example, you may perform a span gas measurement before and after sample analysis without zeroing. Use the average area counts of the pre-span and post-span measurements to generate a response factor (area counts/span gas concentration), which you then multiply by the area counts from your sample to generate the sample concentration.</p> <p>(c) <i>Interference validation.</i> Perform interference validation for NDIR, FTIR, and photoacoustic analyzers using the procedures of § 1065.375. Interference validation is not required for GC–ECD. Certain interference gases can positively interfere with NDIR, FTIR, and photoacoustic analyzers by causing a response similar to N₂O. When running the interference verification for these analyzers, use interference gases as follows:</p>

<p>infrared absorption band chosen by the instrument manufacturer and should be determined independently for each analyzer.</p> <p>(iii) The interference gases for photoacoustic analyzers are CO, CO₂, and H₂O.</p> <p>(2) Analyzers must have combined interference that is within (0.0 +/- 1.0) mol/mol. We strongly recommend a lower interference that is within (0.0 +/- 0.5) mol/. 9. A new § 86.168–12 is added to subpart B to read as follows:</p>	<p>(1) The interference gases for NDIR analyzers are CO, CO₂, H₂O, CH₄ and SO₂. Note that interference species, with the exception of H₂O, are dependent on the N₂O infrared absorption band chosen by the instrument manufacturer and should be determined dently for each analyzer.</p> <p>(2) Use good engineering judgment to determine interference gases for FTIR. Note that interference species, with the exception of H₂O, are dependent on the N₂O infrared absorption band chosen by the instrument manufacturer and should be determined independently for each analyzer.</p> <p>(3) The interference gases for photoacoustic analyzers are CO, CO₂, and H₂O.</p>
<p>§ 86.168–12 Interference verification for N₂O analyzers.</p> <p>(a) <i>Scope and frequency.</i> See 40 CFR 1065.275 to determine whether you need to verify the amount of interference after initial analyzer installation and after major maintenance.</p> <p>(b) <i>Measurement principles.</i> Interference gasses can positively interfere with certain analyzers by causing a response similar to N₂O. If the analyzer uses compensation algorithms that utilize measurements of other gases to meet this interference verification, simultaneously conduct these other measurements to test the compensation algorithms during the analyzer interference verification.</p> <p>(c) <i>System requirements.</i> See 40 CFR 1065.275 for system requirements related to allowable interference levels.</p> <p>(d) <i>Procedure.</i> Perform the interference verification as follows: (1) Start, operate, zero, and span the N₂O FTIR analyzer as you would before an emission test. If the sample is passed through a dryer during emission testing, you may run this verification test with the dryer if it meets the requirements of 40 CFR 1065.342. Operate the dryer at the same conditions as you will for an emission test. You may also run this verification test without the sample dryer. (2) Create a humidified test gas by bubbling a multi component span gas that incorporates the target interference species and meets the specifications in 40 CFR 1065.750 through distilled water in a sealed vessel. If the sample is not passed through a dryer during emission testing, control the vessel temperature to generate an H₂O level at least as high as the maximum expected during emission testing. If the sample is passed through a dryer during emission testing, control the vessel temperature to generate an H₂O level at least as high as the level determined in 40 CFR 1065.145(e)(2) for that dryer. Use interference span gas concentrations that are at least as high as the maximum expected during testing. (3) Introduce the humidified interference test gas into the sample system. You may introduce it downstream of any sample dryer, if one is used during testing. (4) If the sample is not passed through a dryer during this verification test, measure the water mole fraction, x_{H_2O}, of the humidified interference test gas as close as possible to the inlet of the analyzer. For example, measure dewpoint, T_{dew}, and absolute pressure, p_{total}, to calculate x_{H_2O}. Verify that the water content meets the requirement in paragraph (d)(2) of this section. If the sample is passed through a dryer during this verification test, you must verify that the water content of the humidified test gas downstream of the vessel meets the requirement in paragraph (d)(2) of this section based on either direct measurement of the water content (e.g., dewpoint and pressure) or an estimate based on the vessel pressure and temperature. Use good engineering judgment to estimate the water content. For example, you</p>	<p>§ 1065.375 Interference verification for N₂O analyzers.</p> <p>(a) <i>Scope and frequency.</i> See §1065.275 to determine whether you need to verify the amount of interference after initial analyzer installation and after major maintenance.</p> <p>(b) <i>Measurement principles.</i> Interference gasses can positively interfere with certain analyzers by causing a response similar to N₂O. If the analyzer uses compensation algorithms that utilize measurements of other gases to meet this interference verification, simultaneously conduct these other measurements to test the compensation algorithms during the analyzer interference verification.</p> <p>(c) <i>System requirements.</i> Analyzers must have combined interference that is within (0.0 ± 1.0) µmol/mol. We strongly recommend a lower interference that is within (0.0 ± 0.5) µmol/mol.</p> <p>(d) <i>Procedure.</i> Perform the interference verification as follows: (1) Start, operate, zero, and span the N₂O analyzer as you would before an emission test. If the sample is passed through a dryer during emission testing, you may run this verification test with the dryer if it meets the requirements of §1065.342. Operate the dryer at the same conditions as you will for an emission test. You may also run this verification test without the sample dryer. (2) Create a humidified test gas by bubbling a multi component span gas that incorporates the target interference species and meets the specifications in §1065.750 through distilled water in a sealed vessel. If the sample is not passed through a dryer during emission testing, control the vessel temperature to generate an H₂O level at least as high as the maximum expected during emission testing. If the sample is passed through a dryer during emission testing, control the vessel temperature to generate an H₂O level at least as high as the level determined in §1065.145(e)(2) for that dryer. Use interference span gas concentrations that are at least as high as the maximum expected during testing. (3) Introduce the humidified interference test gas into the sample system. You may introduce it downstream of any sample dryer, if one is used during testing. (4) If the sample is not passed through a dryer during this verification test, measure the water mole fraction, x_{H_2O}, of the humidified interference test gas as close as possible to the inlet of the analyzer. For example, measure dewpoint, T_{dew}, and absolute pressure, p_{total}, to calculate x_{H_2O}. Verify that the water content meets the requirement in paragraph (d)(2) of this section. If the sample is passed through a dryer during this verification test, you must verify that the water content of the humidified test gas downstream of the vessel meets the requirement in paragraph (d)(2) of this section based on either direct measurement of the water content (e.g., dewpoint and pressure) or an estimate based on the vessel pressure and temperature. Use good engineering judgment to estimate the water content. For example, you may use previous direct measurements of water content to verify the vessel's level of saturation.</p>

<p>may use previous direct measurements of water content to verify the vessel's level of saturation.</p> <p>(5) If a sample dryer is not used in this verification test, use good engineering judgment to prevent condensation in the transfer lines, fittings, or valves from the point where x_{H_2O} is measured to the analyzer. We recommend that you design your system so that the wall temperatures in the transfer lines, fittings, and valves from the point where x_{H_2O} is measured to the analyzer are at least 5 °C above the local sample gas dewpoint.</p> <p>(6) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.</p> <p>(7) While the analyzer measures the sample's concentration, record its output for 30 seconds. Calculate the arithmetic mean of this data.</p> <p>(8) The analyzer meets the interference verification if the result of paragraph (d)(7) of this section meets the tolerance in 40 CFR 1065.275.</p> <p>(9) You may also run interference procedures separately for individual interference gases. If the interference gas levels used are higher than the maximum levels expected during testing, you may scale down each observed interference value by multiplying the observed interference by the ratio of the maximum expected concentration value to the actual value used during this procedure. You may run separate interference concentrations of H₂O (down to 0.025 mol/mol H₂O content) that are lower than the maximum levels expected during testing, but you must scale up the observed H₂O interference by multiplying the observed interference by the ratio of the maximum expected H₂O concentration value to the actual value used during this procedure. The sum of the scaled interference values must meet the tolerance specified in 40 CFR 1065.275.</p>	<p>(5) If a sample dryer is not used in this verification test, use good engineering judgment to prevent condensation in the transfer lines, fittings, or valves from the point where x_{H_2O} is measured to the analyzer. We recommend that you design your system so that the wall temperatures in the transfer lines, fittings, and valves from the point where x_{H_2O} is measured to the analyzer are at least 5 °C above the local sample gas dewpoint.</p> <p>(6) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.</p> <p>(7) While the analyzer measures the sample's concentration, record its output for 30 seconds. Calculate the arithmetic mean of this data.</p> <p>(8) The analyzer meets the interference verification if the result of paragraph (d)(7) of this section meets the tolerance in paragraph (c) of this section.</p> <p>(9) You may also run interference procedures separately for individual interference gases. If the interference gas levels used are higher than the maximum levels expected during testing, you may scale down each observed interference value by multiplying the observed interference by the ratio of the maximum expected concentration value to the actual value used during this procedure. You may run separate interference concentrations of H₂O (down to 0.025 mol/mol H₂O content) that are lower than the maximum levels expected during testing, but you must scale up the observed H₂O interference by multiplying the observed interference by the ratio of the maximum expected H₂O concentration value to the actual value used during this procedure. The sum of the scaled interference values must meet the tolerance specified in paragraph (c) of this section.</p>
<p>§ 86.167–12 N₂O measurement devices.</p> <p>(a) <i>General component requirements.</i> We recommend that you use an analyzer that meets the specifications in Table 1 of 40 CFR 1065.205. Note that your system must meet the linearity verification in 40 CFR 1065.307.</p> <p>(b) <i>Instrument types.</i> You may use any of the following analyzers to measure N₂O:</p> <p>(1) <i>Nondispersive infra-red (NDIR) analyzer.</i> You may use an NDIR analyzer that has compensation algorithms that are functions of other 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.</p> <p>(2) <i>Fourier transform infra-red (FTIR) analyzer.</i> You may use an FTIR analyzer that has compensation algorithms that are functions of other 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. Use EPA Test Method 320 "Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy" for spectral</p>	<p>-</p>

<p>interpretation (see 40 CFR part 63 appendix A).</p> <p>(3) <i>Photoacoustic analyzer</i>. You may use a photoacoustic analyzer that has compensation algorithms that are functions of other gaseous measurements. 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. Use an optical wheel configuration that</p>	
<p>§ 86.111–94 Exhaust gas analytical system. * * * * *</p> <p>(b) <i>Major component description</i>. The exhaust gas analytical system, Figure B94–7, consists of a flame ionization detector (FID) (heated, 235 ° } 15 °F (113 ° } 8 °C) for methanol-fueled vehicles) for the determination of THC, a methane analyzer (consisting of a gas chromatograph combined with a FID) for the determination of CH₄, nondispersive infrared analyzers (NDIR) for the determination of CO and CO₂, a chemiluminescence analyzer (CL) for the determination of NO_x, and an analyzer meeting the requirements specified in § 86.167–12 for the determination of N₂O for 2012 and later model year vehicles. A heated flame ionization detector (HFID) is used for the continuous determination of THC from petroleum-fueled diesel-cycle vehicles (may also be used with methanol-fueled diesel-cycle vehicles), Figure B94–5 (or B94–6). The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high-pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements: * * * * *</p> <p>4. Section 86.127–00 is amended as follows:</p> <ol style="list-style-type: none"> By revising the introductory text. By revising paragraph (a) introductory text. By revising paragraph (a)(1), By revising paragraph (b). By revising paragraph (c). By revising paragraphs (d) and (e). 	<p>§86.111-94 Exhaust gas analytical system. * * * * *</p> <p>(b) Major component description. The exhaust gas analytical system, Figure B94–7, consists of a flame ionization detector (FID) (heated, 235 °±15 °F (113 °±8 °C) for methanol-fueled vehicles) for the determination of THC, a methane analyzer (consisting of a gas chromatograph combined with a FID) for the determination of CH₄, non-dispersive infrared analyzers (NDIR) for the determination of CO and CO₂, a chemiluminescence analyzer (CL) for the determination of NO_x, and an analyzer meeting the requirements specified in 40 CFR 1065.275 for the determination of N₂O (required for 2015 and later model year vehicles). A heated flame ionization detector (HFID) is used for the continuous determination of THC from petroleum-fueled diesel-cycle vehicles (may also be used with methanol-fueled diesel-cycle vehicles), Figure B94–5 (or B94–6). The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high-pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements: 1267 * * * * *</p> <p>6. Section 86.113-04 is amended by revising the entry for RVP in the table in paragraph (a)(1) to read as follows:</p>

§ 1065.205 Performance specifications for measurement instruments.

Your test system as a whole must meet all the applicable calibrations, verifications, and test-validation criteria specified in subparts D and F of this part or subpart J of this part for using PEMS and for performing field testing. We recommend that your instruments meet the specifications in Table 1 of this section for all ranges you use for testing. We also recommend that you keep any documentation you receive from instrument manufacturers showing that your instruments meet the specifications in Table 1 of this section.

Table 1 of §1065.205—Recommended performance specifications for measurement instruments

Measurement Instrument	Measured quantity symbol	Complete System Rise time (t_{10-90}) and Fall time (t_{90-10}) ^a	Recording update frequency	Accuracy ^b	Repeatability ^b	Noise ^b
Engine speed transducer	f_n	1 s	1 Hz means	2.0 % of pt. or 0.5 % of max.	1.0 % of pt. or 0.25 % of max.	0.05 % of max
Engine torque transducer	T	1 s	1 Hz means	2.0 % of pt. or 1.0 % of max.	1.0 % of pt. or 0.5 % of max.	0.05 % of max.
Electrical work (active-power meter)	W	1 s	1 Hz means	2.0 % of pt. or 0.5 % of max.	1.0 % of pt. or 0.25 % of max.	0.05 % of max
General pressure transducer (not a part of another instrument)	p	5 s	1 Hz	2.0 % of pt. or 1.0 % of max.	1.0 % of pt. or 0.50 % of max.	0.1 % of max
Atmospheric pressure meter used for PM-stabilization and balance environments	p_{atmos}	50 s	5 times per hour	50 Pa	25 Pa	5 Pa
General purpose atmospheric pressure meter	p_{atmos}	50 s	5 times per hour	250 Pa	100Pa	50 Pa
Temperature sensor for PM-stabilization and balance environments	T	50 s	0.1 Hz	0.25 K	0.1 K	0.1 K
Other temperature sensor (not a part of another instrument)	T	10 s	0.5 Hz	0.4 % of pt. K or 0.2 % of max. K	0.2 % of pt. K or 0.1 % of max. K	0.1 % of max
Dewpoint sensor for PM-stabilization and balance environments	T_{dew}	50 s	0.1 Hz	0.25 K	0.1 K	0.02 K
Other dewpoint sensor	T_{dew}	50 s	0.1 Hz	1 K	0.5 K	0.1 K
Fuel flow meter (Fuel totalizer)	\dot{m}	5 s (N/A)	1 Hz (N/A)	2.0 % of pt. or 1.5 % of max.	1.0 % of pt. or 0.75 % of max.	0.5 % of max.
Total diluted exhaust meter (CVS) (With heat exchanger before meter)	\dot{n}	1 s (5 s)	1 Hz means (1 Hz)	2.0 % of pt. or 1.5 % of max.	1.0 % of pt. or 0.75 % of max.	1.0 % of max.
Dilution air, inlet air, exhaust, and sample flow meters	\dot{n}	1 s	1 Hz means of 5 Hz samples	2.5 % of pt. or 1.5 % of max.	1.25 % of pt. or 0.75 % of max.	1.0 % of max.
Continuous gas analyzer	x	5 s	1 Hz	2.0 % of pt. or 2.0 % of meas.	1.0 % of pt. or 1.0 % of meas.	1.0 % of max.
Batch gas analyzer	x	N/A	N/A	2.0 % of pt. or 2.0 % of meas.	1.0 % of pt. or 1.0 % of meas.	1.0 % of max.
Gravimetric PM balance	m_{PM}	N/A	N/A	See §1065.790	0.5 µg	N/A
Inertial PM balance	m_{VM}	5 s	1 Hz	2.0 % of pt. or 2.0 % of meas.	1.0 % of pt. or 1.0 % of meas.	0.2 % of max.

^a The performance specifications identified in the table apply separately for rise time and fall time.

^b Accuracy, repeatability, and noise are all determined with the same collected data, as described in §1065.305, and based on absolute values. "pt." refers to the overall flow-weighted mean value expected at the standard; "max." refers to the peak value expected at the standard over any test interval, not the maximum of the instrument's range; "meas" refers to the actual flow-weighted mean measured over any test interval.