Attachment F

15-Day Modifications to the Original Proposal

Proposed Amendments to the California Exhaust Emission Standards and Test Procedures for New 2013 and Later Small Off-Road Engines; Engine-Testing Procedures (Part 1065)

[Note: The originally proposed modifications to the regulatory language are shown in underline to indicate additions and ~~strikethrough~~ to indicate deletions. The proposed 15-day modifications to the proposed regulations are shown in double underline to indicate additions and ~~double strikethrough~~ to indicate deletions. Only these double underlined and ~~double strikethrough~~ modifications are subject to comment during this comment period. Only text with proposed 15-day modifications are included in this attachment. For all amendments to Part 1065 approved by the Board during the December 9, 2021, hearing, refer to Staff Report: Initial Statement of Reasons Appendix G. The symbol "* * * * *" indicates that intervening text for which modifications are not proposed is not shown. [Bracketed text] is not part of the proposed amendments. Final page numbers subject to change upon Office of Administrative Law approval.]

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§ 1065.2 Submitting information to CARB under this part.

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(c) We may void any Executive Orders ~~certificates~~ or approvals associated with a submission of information if we find that you intentionally submitted false, incomplete, or misleading information. For example, if we find that you intentionally submitted incomplete information to mislead ~~EPA~~ CARB when requesting approval to use alternate test procedures, we may void the Executive Orders ~~certificates~~ for all engines families certified based on emission data collected using the alternate procedures. This paragraph (c) would also apply if you ignore data from incomplete tests or from repeat tests with higher emission results.

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§ 1065.15 Overview of procedures for laboratory and field testing.
This section outlines the procedures to test engines that are subject to emission standards.

(a) In the standard-setting part, we set brake-specific emission standards in g/(kW·hr) (or g/(hp·hr)), for the following constituents:

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(3) Particulate ~~mass~~ matter, PM.

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§ 1065.190 PM-stabilization and weighing environments for gravimetric analysis.
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(d) Maintain the following ambient conditions within the two environments during all stabilization and weighing:

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(3) *Dewpoint tolerances.* If the expected fraction of sulfuric acid in PM is unknown, we recommend controlling dewpoint at within ±1 °C tolerance. This would limit any dewpoint-related change in PM to less than ±2%, even for PM that is 50% sulfuric acid. If you know your expected fraction of sulfuric acid in PM, we recommend that you select an appropriate dewpoint tolerance for showing compliance with emission standards using the following table as a guide:

Table 1 of § 1065.190—Dewpoint Tolerance as a Function of % PM Change and % Sulfuric Acid PM

Expected sulfuric acid fraction of PM ~~(percent)~~	±0.5% PM mass change	±1~~.0~~% PM mass change	±2~~.0~~% PM mass change
5%	±3~~.0~~ °C	±6~~.0~~ °C	±12 °C
50%	±0.3~~0~~ °C	±0.6~~0~~ °C	±1.2 °C
100%	±0.15 °C	±0.3~~0~~ °C	±0.6~~0~~ °C

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§ 1065.260 ~~Flame-ionization~~ Flame-ionization ~~Flame-ionization~~ Flame-ionization detector.
(a) *Application*. Use a ~~flame-ionization~~ flame-ionization ~~flame-ionization~~ flame-ionization detector (FID) analyzer to measure hydrocarbon concentrations in raw or diluted exhaust for either batch or continuous sampling. Determine hydrocarbon concentrations on a carbon number basis of one, C_1. ~~Determine methane and nonmethane hydrocarbon values as described in paragraph (e)~~ For measuring THC or THCE you must use a FID analyzer. For measuring CH_4 you must meet the requirements of paragraph (f) of this section. See subpart I of this part for special provisions that apply to measuring hydrocarbons when testing with oxygenated fuels.

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§ 1065.275 N_2O measurement devices.

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(b) *Instrument types.* You may use any of the following analyzers to measure N_2O:

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~~(3)~~ (4) *Photoacoustic analyzer.* ~~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.

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§ 1065.280 Paramagnetic and magnetopneumatic O_2 detection analyzers.

(a) *Application.* You may use a paramagnetic detection (PMD) or magnetopneumatic detection (MPD) analyzer to measure O_2 concentration in raw or diluted exhaust for batch or continuous sampling. You may use good enginering judgment to develop calculations that use O_2 measurements with ~~intake air or fuel flow measurements to calculate exhaust flow rate according to § 1065.650~~ a chemical balance of fuel, intake air, and exhaust to calculate exhaust flow rate.

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§ 1065.307 Linearity verification.

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(d) *Reference signals.* This paragraph (d) describes recommended methods for generating reference values for the linearity-verification protocol in paragraph (c) of this section. Use reference values that simulate actual values, or introduce an actual value and measure it with a reference-measurement system. In the latter case, the reference value is the value reported by the reference-measurement system. Reference values and reference-measurement systems must be ~~NIST~~ SI-traceable. We recommend using calibration reference quantities that are ~~NIST~~ SI-traceable within 0.5% uncertainty, if not specified ~~otherwise in other sections of~~ elsewhere in this part 1065. Use the following recommended methods to generate reference values or use good engineering judgment to select a different reference:

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(6) *Gas division.* Use one of the two reference signals:

(i) At the outlet of the gas-division system, connect a gas analyzer that meets the linearity verification described in this section and has not been linearized with the gas divider being verified. For example, verify the linearity of an analyzer using a series of reference analytical gases directly from compressed gas cylinders that meet the specifications of § 1065.750. We recommend using a FID analyzer or a PMD or MPD O_2 analyzer because of their inherent linearity. Operate this analyzer consistent with how you would operate it during an emission test. Connect a span gas containing only a single constituent of interest with balance of purified air or purified N_2 to the gas-divider inlet. Use the gas-division system to divide the span gas with purified air or nitrogen. Select gas divisions that you typically use. Use a selected gas division as the measured value. Use the analyzer response divided by the span gas concentration as the reference gas-division value. Because the instrument response is not absolutely constant, sample and record values of x_{refi} for 30 seconds and use the arithmetic mean of the values, $\dot{x}_{ref}$, as the reference value. Refer to § 1065.602 for an example of calculating arithmetic mean.

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(e) *Measurement systems that require linearity verification.* Table 1 of this section indicates measurement systems that require linearity verifications, subject to the following provisions:

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(3) The expression "max" generally refers to the absolute value of the reference value used during ~~the~~ linearity verification that is furthest from zero. This is the value used to scale the first and third tolerances in Table 1 of this section using a_0 and SEE. For example, if the reference values chosen to validate a pressure transducer vary from −10 to −1 kPa, then p_{max} is +10 kPa. If the reference values used to validate a temperature device vary from 290 to 390 K, then T_{max} is 390 K. For gas dividers where "max" is expressed as, x_{max}/x_{span}; x_{max} is the maximum gas concentration used during the verification, x_{span} is the undivided, undiluted, span gas concentration, and the resulting ratio is the maximum divider point reference value used during the verification (typically 1). The following are special cases where "max" refers to a different value:

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(vii) For linearity verification of an intake-air flow rate meter, ~~n_{max}~~ $\dot{n}_{max}$ is the manufacturer's specified maximum intake-air flow rate (converted to molar flow rate) of the lowest-power engine expected during testing.

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(f) *Performance criteria for measurement systems.* Table 1 follows:

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§ 1065.309 Continuous gas analyzer system-response and updating-recording verification – for gas analyzers continuously compensated for other gas species.

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(d) *Procedure.* Use the following procedure to verify the response of each continuously compensated analyzer (verify the combined signal, not each individual continuously combined concentration signal):

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(2) *Equipment setup.* We recommend using minimal lengths of gas transfer lines between all connections and fast-acting three-way valves (2 inlets, 1 outlet) to control the flow of zero and blended span gases to the sample system's probe inlet or a tee near the outlet of the probe. If you inject the gas at a tee near the outlet of the probe, you may correct the transformation time, t_{50}, for an estimate of the transport time from the probe inlet to the tee. Normally the gas flow rate is higher than the ~~probe~~ sample flow rate and the excess is overflowed out the inlet of the probe. If the gas flow rate is lower than the ~~probe~~ sample flow rate, the gas concentrations must be adjusted to account for the dilution from ambient air drawn into the probe. We recommend you use the final, stabilized analyzer reading as the final gas concentration. Select span gases for the species being continuously combined, other than H_2O. Select concentrations of compensating species that will yield concentrations of these species at the analyzer inlet that covers the range of concentrations expected during testing. You may use binary or multi-gas span gases. You may use a gas blending or mixing device to blend span gases. A gas blending or mixing device is recommended when blending span gases diluted in N_2 with span gases diluted in air. You may use a multi-gas span gas, such as NO-CO-CO_2-C_3H_8-CH_4, to verify multiple analyzers at the same time. In designing your experimental setup, avoid pressure pulsations due to stopping the flow through the gas blending device. The change in gas concentration must be at least 20% of the analyzer's range. If H_2O correction is applicable, then span gases must be humidified before entering the analyzer; however, you may not humidify NO_2 span gas by passing it through a sealed humidification vessel that contains ~~water~~ H_2O. You must humidify NO_2 span gas with another moist gas stream. We recommend humidifying your NO-CO-CO_2-C_3H_8-CH_4, balance N_2, blended gas by ~~flowing the gas mixture through a sealed vessel that humidifies the gas by bubbling it~~

~~through distilled water~~ bubbling the gas mixture that meets the specifications in § 1065.750 through distilled H_2O in a sealed vessel and then mixing the gas with dry NO_2 gas, balance purified ~~synthetic~~ air, or by using a device that introduces distilled H_2O as vapor into a controlled span gas flow. If ~~your system does not use a sample dryer to remove water from the sample gas, you must humidify your span gas to the highest sample H_2O content that you estimate during emission sampling~~ the sample does not pass through a dryer during emission testing, humidify your span gas to an H_2O level at or above the maximum expected during emission testing. If ~~your system uses a~~ the sample ~~does not pass~~ passes through a dryer during emission testing, it must pass the sample dryer verification check in § 1065.342, and you must humidify your span gas to an H_2O ~~content greater than or equal to~~ level at or above the level determined in § 1065.145(e)(2) for that dryer. If you are humidifying span gases without NO_2, use good engineering judgment to ensure that the wall temperatures in the transfer lines, fittings, and valves from the humidifying system to the probe are above the dewpoint required for the target H_2O content. If you are humidifying span gases with NO_2, use good engineering judgment to ensure that there is no condensation in the transfer lines, fittings, or valves from the point where humidified gas is mixed with NO_2 span gas to the probe. We recommend that you design your setup so that the wall temperatures in the transfer lines, fittings, and valves from the humidifying system to the probe are at least 5 °C above the local sample gas dewpoint. Operate the measurement and sample handling system as you do for emission testing. Make no modifications to the sample handling system to reduce the risk of condensation. Flow humidified gas through the sampling system before this check to allow stabilization of the measurement system's sampling handling system to occur, as it would for an emission test.

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§ 1065.341 CVS and ~~batch sampler~~ PFD flow verification (propane check).
This section describes two optional methods, using propane as a tracer gas, to verify CVS and PFD flow streams. You may use good engineering judgment and safe practices to use other tracer gases, such as CO_2 or CO. The first method, described in paragraphs (a) through (e) of this section, applies for the CVS diluted exhaust flow measurement system. ~~It~~The first method may also apply for other single-flow measurement systems as described in Table 2 of §1065.307. Paragraph (g) of this section describes a second method you may use to verify flow measurements in a PFD for determining the PFD dilution ratio.

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~~(b)~~ (a) A propane check uses either a reference mass or a reference flow rate of C_3H_8 as a tracer gas in a CVS. Note that if you use a reference flow rate, account for any non-ideal gas behavior of C_3H_8 in the reference flow meter. Refer to ~~§ 1065.640 and § 1065.642~~ §§ 1065.640 and 1065.642, which describe how to calibrate and use certain flow meters. Do not use any ideal gas assumptions in ~~§ 1065.640 and § 1065.642~~ §§ 1065.640 and 1065.642. The propane check compares the calculated mass of injected C_3H_8 using HC measurements and CVS flow rate measurements with the reference value.

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(e) Perform post-test procedure as follows:

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(3) Calculate total C_3H_8 mass based on your CVS and HC data as described in § 1065.650 and § 1065.660, using the molar mass of C_3H_8, M_{C3H8}, instead of the effective molar mass of HC, M_{HC}.

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(f) A failed propane check might indicate one or more problems requiring corrective action, as follows:

Table 1 of § 1065.341 - Troubleshooting Guide for Propane Checks

Problem	Recommended Corrective Action
Incorrect analyzer calibration	Recalibrate, repair, or replace the FID analyzer.
Leaks	Inspect CVS tunnel, connections, fasteners, and HC sampling system. Repair or replace components.
Poor mixing	Perform the verification as described in this section while traversing a sampling probe across the tunnel's diameter, vertically and horizontally. If the analyzer response indicates any deviation exceeding ±2 % of the mean measured concentration, consider operating the CVS at a higher flow rate or installing a mixing plate or orifice to improve mixing.
Hydrocarbon contamination in the sample system	Perform the hydrocarbon-contamination verification as described in §1065.520.
Change in CVS calibration	Perform a calibration of the CVS flow meter as described in §1065.340.

Flow meter entrance effects	Inspect the CVS tunnel to determine whether the entrance effects from the piping configuration upstream of the flow meter adversely affect the flow measurement.
Other problems with the CVS or sampling verification hardware or software	Inspect the CVS system and related verification hardware, and software for discrepancies.

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§ 1065.350 H_2O interference verification for CO_2 NDIR analyzers.

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(d) *Procedure.* Perform the interference verification as follows:

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(7) While the analyzer measures the sample's concentration, record 30 seconds of sampled data. Calculate the arithmetic mean of this data. The analyzer meets the interference verification if this value is within (0.0 ±0.4) mmol/mol.

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§ 1065.365 Nonmethane cutter penetration fractions.

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(f) *Procedure for a FID calibrated with ~~methane~~ CH_4, bypassing the NMC.* If you use a FID with an NMC that is calibrated with ~~methane,~~ CH_4~~,~~ by bypassing the NMC, determine its combined ethane (C_2H_6) response factor and penetration fraction, $RFPF_{C2H6[NMC\text{-}FID]}$, as well as its CH_4 penetration fraction, $PF_{CH4[NMC\text{-}FID]}$, as follows:

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(9) Divide the mean C_2H_6 concentration by the reference concentration of C_2H_6, converted to a C_1 basis. The result is the combined C_2H_6 ~~combined~~ response factor and C_2H_6 penetration fraction, $RFPF_{C2H6[NMC\text{-}FID]}$. Use this combined C_2H_6 response factor and C_2H_6 penetration fraction according to § 1065.660(b)(2)(iii)~~, § 1065.660(c)~~ or (d)(1)(iii)~~,~~ or § 1065.665, as applicable.

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§ 1065.375 Interference verification for N_2O analyzers.

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(d) *Procedure.* Perform the interference verification as follows:

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(7) While the analyzer measures the sample's concentration, record its output for 30 seconds. Calculate the arithmetic mean of this data. When performed with all the gases simultaneously, this is the combined interference.

§ 1065.410 Maintenance limits for stabilized test engines.

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(c) ~~Keep a record of the inspection and update your application to document any changes as a result of the inspection. You may use equipment, instruments, or engineering grade tools to identify bad engine components. Any equipment, instruments, or tools used for scheduled maintenance on emission data engines must be representative of what is planned to be available to dealerships and other service outlets.~~ If you inspect an engine, keep a record of the inspection and update your application for certification to document any changes that result. You may use any kind of equipment, instrument, or tool that is available at dealerships and other service outlets to identify ~~bad engine~~ malfunctioning components or perform maintenance.

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§ 1065.514 Cycle-validation criteria for operation over specified duty cycles.

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(f) Cycle-validation criteria. Unless the standard-setting part specifies otherwise, use the following criteria to validate a duty cycle:

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(3) For discrete-mode steady-state testing, apply cycle-validation criteria by treating the sampling periods from the series of test modes as a continuous sampling period, analogous to ramped-modal testing and apply statistical criteria as described in paragraph (f)(1) or ~~(f)~~(2) of this section. Note that if the gaseous and particulate test intervals are different periods of time, separate validations are required for the gaseous and particulate test intervals. Table 2 follows:

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§ 1065.530 Emission test sequence.

(a) Time the start of testing as follows:

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(2) If you do not precondition ~~sampling systems~~ the engine as described in § 1065.518, perform one of the following:

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(iii) For testing that involves hot-stabilized emission measurements, bring the engine either to warm idle or the first operating point of the duty cycle. Start the test within 10 min of achieving temperature stability. Determine temperature stability ~~either~~ as the point at which the engine thermostat controls engine temperature or as the point at which ~~the engine coolant, block, or head absolute temperature is within ±2% of its mean value~~ measured operating temperature has stayed within ±2% of the mean value for at least 2 min~~, or as the point at which the engine thermostat controls engine temperature.~~ based on the following parameters:

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§ 1065.543 Carbon balance error verification.

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(b) Perform the carbon balance error verification after emission sampling is complete for a test interval or duty cycle as described in §1065.530(g). Testing must include measured values as needed to determine intake air, fuel flow, and carbon-related gaseous exhaust emissions. You may optionally account for the flow of carbon-carrying fluids other than intake air and fuel into the system. Perform carbon balance error verification as follows:

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(2) You meet verification criteria for an individual test interval if the absolute values of carbon balance error quantities are at or below the following limit values:

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(ii) Calculate the carbon mass rate absolute error limit, $L_{\varepsilon aCrate}$, in grams per hour to three decimal places for comparison to the absolute value of ε_{aCrate}, using the following equation:

$L_{\varepsilon aCrate} = d \cdot P_{max}$
Eq. 1065.543-2

Where:
d = power-specific carbon mass rate absolute error coefficient = 0.31 g/(kW·hr).
P_{max} = maximum power from the engine map generated according to §1065.510. If measured, P_{max} is not available, use a manufacturer-declared value for P_{max}.

Example:
d = 0.31 g/(kW·hr)
P_{max} = 230.0 kW
$L_{\varepsilon aCrate}$ ~~= 0.31 · 230.0~~ = 71.300 g/hr

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§ 1065.640 Flow meter calibration calculations.

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(d) *SSV calibration.* Perform the following steps to calibrate an SSV flow meter:

(1) Calculate the Reynolds number, $Re^{\#}$, for each reference molar flow rate, $\dot{n}_{ref}$, using the throat diameter of the venturi, d_t. Because the dynamic viscosity, μ, is needed to compute $Re^{\#}$, you may use your own fluid viscosity model to determine μ for your calibration gas (usually air), using good engineering judgment. Alternatively, you may use the Sutherland three-coefficient viscosity model to approximate μ, as shown in the following sample calculation for Re #:

$$Re^{\#} = \frac{4 \cdot M_{mix} \cdot \dot{n}_{ref}}{\pi \cdot d_t \cdot \mu}$$ Eq. 1065.640-10

Where, using the Sutherland three-coefficient viscosity model as captured in Table 4 of this section:

$$\mu = \mu_0 \cdot \left(\frac{T_{in}}{T_0} \right)^{\frac{3}{2}} \cdot \left(\frac{T_0 + S}{T_{in} + S} \right)$$ E1. 1065.640-11

Where:
μ = Dynamic viscosity of calibration gas.
μ_0 = Sutherland reference viscosity.

T_0 = Sutherland reference temperature.
S = Sutherland constant.

Table 4 of § 1065.640—Sutherland Three-Coefficient Viscosity Model Parameters

Gas[a]	μ_0	T_0	S	Temperature range within ± 2% error[b]	Pressure limit[b]
	kg/(m·s)	K	K	K	kPa
Air	$1.716 \cdot 10^{-5}$	273	111	170 to 1900	≤ 1800
CO_2	$1.370 \cdot 10^{-5}$	273	222	190 to 1700	≤ 3600
H_2O	$1.12 \cdot 10^{-5}$	350	1064	360 to 1500	≤ 10000
O_2	$1.919 \cdot 10^{-5}$	273	139	190 to 2000	≤ 2500
N_2	$1.663 \cdot 10^{-5}$	273	107	100 to 1500	≤ 1600

[a]Use tabulated parameters only for the pure gases, as listed. Do not combine parameters in calculations to calculate viscosities of gas mixtures.
[b]The model results are valid only for ambient conditions in the specified ranges.

Example:
$\mu_0 = 1.716 \cdot 10^{-5}$ kg/(m·s)
$T_0 = 273.11$ K
$S = 110.56111$ K

$$\mu = 1.716 \cdot 10^{-5} \cdot \left(\frac{298.15}{273} \right)^{\frac{3}{2}} \cdot \left(\frac{273+111}{298.15+111} \right)$$

$\mu = 1.837$ 1.838$\cdot 10^{-5}$ kg/(m·s)
M_{mix} = 28.7805 g/mol = 0.0287805 kg/mol

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(2) Create an equation for C_d versus $Re^{\#}$, using paired values of ($Re^{\#}$, C_d). For the equation, you may use any mathematical expression, including a polynomial or a power series. The following equation is an example of a commonly used mathematical expression for relating C_d and Re #: as a function of $Re^{\#}$, using paired values of the two quantities. The equation may involve any mathematical expression, including a polynomial or a power series. The following equation is an example of a commonly used mathematical expression for relating C_d and $Re^{\#}$:

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§ 1065.642~~ SSV, CFV, and PDP~~ PDP, SSV, and CFV molar flow rate calculations.

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(b) *SSV molar flow rate.*~~ Based on the C d versus Re # equation you determined according to § 1065.640, calculate~~ Calculate SSV molar flow rate, $\dot{n}$, ~~during an emission test~~ as follows:

$$\dot{n} = C_d \cdot C_f \cdot \frac{A_t \cdot p_{in}}{\sqrt{Z \cdot M_{mix} \cdot R \cdot T_{in}}}$$ Eq. 1065.642-3

Where:
C_d = discharge coefficient, as determined based on the $_d$ versus $Re^{\#}$ *equation in §1065.640(d)(2).*
C_f = flow coefficient, as determined in §1065.640(c)~~(2)~~(3)(ii).
A_t = venturi throat cross-sectional area.
P_{in} = static absolute pressure at the venturi inlet.
Z = compressibility factor.
M_{mix} = molar mass of gas mixture.
R = molar gas constant.
T_{in} = absolute temperature at the venturi inlet.

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(c) *CFV molar flow rate.*~~ Some CFV flow meters consist of a single venturi and some consist of multiple venturis, where different combinations of venturis are used to meter different flow rates.~~ If you use multiple venturis and you~~ calibrated~~ calibrate each venturi independently to determine a separate discharge coefficient, C_d (or calibration coefficient, K_v), for each venturi, calculate the individual molar flow rates through each venturi and sum all their flow rates to determine~~ n~~ CFV flow rate, $\dot{n}$. If you use multiple venturis and you calibrated~~ each combination of venturis~~ venturis in combination, calculate~~ n as~~ $\dot{n}$ using the sum of the active venturi throat areas as A_t, the square root of the sum of the squares of the active venturi throat diameters as d_t, and the ratio of the venturi throat to inlet diameters as the ratio of the square root of the sum of the active venturi throat diameters~~, d~~ (d_t) to the diameter of the common entrance to all ~~of~~ the venturis~~, D~~ (D). ~~To calculate the molar flow rate through one venturi or one combination of venturis, use its respective mean C_d and other constants you determined according to § 1065.640 and calculate its molar flow rate n during an emission test, as follows:~~

(1) To calculate ṅ through one venturi or one combination of venturis, use its respective mean C_d and other constants you determined according to §1065.640 and calculate ṅ as follows:

$$\dot{n} = C_d \cdot C_f \cdot \frac{A_t \cdot p_{in}}{\sqrt{Z \cdot M_{mix} \cdot R \cdot T_{in}}}$$ Eq. 1065.642-4

Where:
C_f = flow coefficient, as determined in §1065.640(c)(3).

Example:
C_d = 0.985
C_f = 0.7219
A_t = 0.00456 m^2
p_{in} = 98.836 kPa = 98836 Pa = 98836 kg/(m·s^2)
Z = 1
M_{mix} = 28.7805 g/mol = 0.0287805 kg/mol
R = 8.314472 J/(mol·K) = 8.314472 (m^2·kg)/(s^2·mol·K)
T_{in} = 378.15 K

$$\dot{n} = 0.985 \cdot 0.7219 \cdot \frac{0.00456 \cdot 98836}{\sqrt{1 \cdot 0.0287805 \cdot 8.314472 \cdot 378.15}}$$

ṅ = 33.690 mol/s

(2) To calculate the molar flow rate through one venturi or a combination of venturis, you may use its respective mean, K_v, and other constants you determined according to §1065.640 and calculate its molar flow rate ṅ during an emission test. Note that if you follow the permissible ranges of dilution air dewpoint versus calibration air dewpoint in Table 3 of §1065.640, you may set $M_{mix-cal}$ and M_{mix} equal to 1. Calculate ṅ as follows:

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Where:

$$K_v = \frac{V_{stdref} \cdot \sqrt{T_{in-cal}}}{p_{in-cal}}$$ Eq. 1065.642-6

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§ 1065.644 Vacuum-decay leak rate.

This section describes how to calculate the leak rate of a vacuum-decay leak verification, which is described in § 1065.345(e). Use ~~Eq. 1065.644-1~~ the following equation to calculate the leak rate, $\dot{n}_{leak}$, and compare it to the criterion specified in § 1065.345(e).

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§ 1065.650 Emission calculations.

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(c) *Total mass of emissions over a test interval.* To calculate the total mass of an emission, multiply a concentration by its respective flow. For all systems, make preliminary calculations as described in paragraph (c)(1) of this section, then use the method in paragraphs (c)(2) through (4) of this section that is appropriate for your system. Calculate the total mass of emissions as follows:

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(3) *Batch sampling.* For batch sampling, the concentration is a single value from a proportionally extracted batch sample (such as a bag, filter, impinger, or cartridge). In this case, multiply the mean concentration of the batch sample by the total flow from which the sample was extracted. You may calculate total flow by integrating a changing flow rate or by determining the mean of a constant flow rate, as follows:

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(ii) *Constant flow rate.* If you batch sample from a constant exhaust flow rate, extract a sample at a proportional or constant flow rate. We consider the following to be examples of constant exhaust flows: CVS diluted exhaust with a CVS flow meter that has either an upstream heat exchanger, electronic flow control, or both. Determine the mean molar flow rate from which you extracted the constant flow rate sample. Multiply the mean concentration of the batch sample by the mean molar flow rate of the exhaust from which the sample was extracted, and multiply the result by the time of the test interval. If the total emission is a molar quantity, convert this quantity to a mass by multiplying it by its molar mass, M. The result is the mass of the emission, m. In the case of PM emissions, where the mean PM concentration is already in units of mass per mole of sample, $\bar{M}_{PM}$, simply multiply it by the total flow, and the result is the total mass of PM, m_{PM}.

(A) Calculate m for sampling with constant flow using the following equations:

$$m = M \cdot \overline{x} \cdot \overline{\dot{n}} \cdot \Delta t$$ Eq. 1065.650-7

~~and~~ (B) Calculate $\overline{M}$ for PM or any other analysis of a batch sample that yields a mass per mole of sample~~,~~ using the following equation:

$$\overline{M} = M \cdot \overline{x}$$ Eq. 1065.650-8

(C) The following example illustrates a calculation of m_{PM}:

~~Example:~~
$\overline{M}_{PM}$ = 144.0 µg/mol = 144.0·10^{-6} g/mol
$\overline{n}_{dexh}$ = 57.692 mol/s
Δt = 1200 s
m_{PM} = 144.0·10^{-6}·57.692·1200~~g~~
m_{PM} = 9.9692 g

* * * * *

(d) *Total work over a test interval.* To calculate the total work from the engine over a test interval, add the total work from all the work paths described in § 1065.210 that cross the system boundary including electrical energy/work, mechanical shaft work, and fluid pumping work. For all work paths, except the engine's primary output shaft (crankshaft), the total work for the path over the test interval is the integration of the net work flow rate (power) out of the system boundary. When energy/work flows into the system boundary, this work flow rate signal becomes negative; in this case, include these negative work rate values in the integration to calculate total work from that work path. Some work paths may result in a negative total work. Include negative total work values from any work path in the calculated total work from the engine rather than setting the values to zero. The rest of this paragraph (d) describes how to calculate total work from the engine's primary output shaft over a test interval. Before integrating power on the engine's primary output shaft, adjust the speed and torque data for the time alignment used in § 1065.514(c). Any advance or delay used on the feedback signals for cycle validation must also be used for calculating work. Account for work of accessories according to § 1065.110. Exclude any work during cranking and starting. Exclude work during actual motoring operation (negative feedback torques), unless the engine was connected to one or more energy storage devices. Examples of such energy storage devices include hybrid powertrain batteries and hydraulic accumulators, like the ones illustrated in Figure 1 of § 1065.210. Exclude any work during reference zero-load idle periods (0% speed or idle speed with 0 N·m

reference torque). Note, that there must be two consecutive reference zero load idle points to establish a period where ~~this~~ the zero-load exclusion applies. Include work during idle points with simulated minimum torque such as Curb Idle Transmissions Torque (CITT) for automatic transmissions in "drive". The work calculation method described in paragraphs ~~(b)~~ (d)(1) through (7) of this section meets ~~these~~ the requirements of this paragraph (d) using rectangular integration. You may use other logic that gives equivalent results. For example, you may use a trapezoidal integration method as described in paragraph ~~(b)~~ (d)(8) of this section.

* * * * *

(7) Integrate the resulting values for power over the test interval. Calculate total work as follows:

$$W = \sum_{i=1}^{N} P_i \cdot \Delta t$$ Eq. 1065.650-10

Where:

W = Total Work from the Primary Output Shaft

P_i = Instantaneous Power from the Primary Output Shaft Over an Interval i.

$$P_i = f_{ni} \cdot T_i$$ Eq. 1065.650-11

Example:
N = 9000
f_{n1} = 1800.2 r/min
f_{n2} = 1805.8 r/min
T_1 = 177.23 N·m
T_2 = 175.00 N·m
C_{rev} = 2·π rad/r~~ev~~
C_{t1} = 60 s/min
C_p = 1000 (N·m·rad/s)/kW
f_{record} = 5 Hz
C_{t2} = 3600 s/hr

* * * * *

§ 1065.655 Chemical balances of fuel, intake air, and exhaust.

* * * * *

(b) *Procedures that require chemical balances.* We require chemical balances when you determine the following:

(1) A value proportional to total work, W, when you choose to determine brake-specific emissions as described in § 1065.650~~(e)~~(f).

* * * * *

(d) *Carbon mass fraction of fuel.* Determine carbon mass fraction of fuel, w_c, ~~using one of the following methods:~~

~~(1) You may calculate w_c as described in this paragraph (d)(1) based on measured fuel properties. To do so, you must determine values for α and β in all cases, but you may set γ and δ to zero if the default value listed in Table 1 of this section is zero.~~ based on the fuel properties as determined in paragraph (e) of this section, optionally accounting for any contribution to α, β, γ, and δ, from any fluid injected into the exhaust, if applicable. Calculate w_c using the following equation:

* * * * *

Example:
α = 1.8
β = 0.05
γ = 0.0003
δ = 0.0001
M_C = 12.0107
M_H = ~~1.01~~ 1.00794
M_O = 15.9994
M_S = 32.065
M_N = 14.0067

$$w_C = \frac{1 \cdot 12.0107}{1 \cdot 12.0107 + 1.8 \cdot 1.00794 + 0.05 \cdot 15.9994 + 0.0003 \cdot 32.065 + 0.0001 \cdot 14.0067}$$

w_c = ~~0.8205~~ 0.8206

* * * * *

(e) *Fuel and injected fluid composition.* Determine fuel composition and the composition of any fluid injected into the exhaust, represented by α, β, γ, and δ, as described in this paragraph (e). When using measured fuel or other injected fluid properties, you must determine values for α and β~~,~~ in all cases. If you determine compositions based on measured values and the default value listed in Table ~~1~~ 2 of this section is zero, you may set γ and δ to zero; otherwise determine γ and δ (along with α and β) based on measured values. Determine elemental mass fractions and values for α, β, γ, and δ, as follows:

* * * * *

(4) Calculate α, β, γ, and δ using the following equations:

* * * * *

Where:
N = total number of fuels and injected fluids over the duty cycle.
j = an indexing variable that represents one fuel or injected fluid, starting with j = 1.
~~m_j~~ $\dot{m}_j$ = the mass flow rate of the fuel or any injected fluid j. For applications using a single fuel and no injected fluid, set this value to 1. For batch measurements, divide the total mass of fuel over the test interval duration to determine a mass rate.
W_{Hj} = hydrogen mass fraction of fuel or any injected fluid j.
W_{Cj} = carbon mass fraction of fuel or any injected fluid j.
W_{Oj} = oxygen mass fraction of fuel or any injected fluid j.
W_{Sj} = sulfur mass fraction of fuel or any injected fluid j.
W_{Nj} = nitrogen mass fraction of fuel or any injected fluid j.

* * * * *

(~~e~~) (f) *Calculated raw exhaust molar flow rate from measured intake air molar flow rate or fuel mass flow rate.* You may calculate the raw exhaust molar flow rate from which you sampled emissions, $\dot{n}_{exh}$, based on the measured intake air molar flow rate, $\dot{n}_{int}$, or the measured fuel mass flow rate, $\dot{m}_{fuel}$, and the values calculated using the chemical balance in paragraph (c) of this section. Note that the chemical balance must be based on raw exhaust gas concentrations. Solve for the chemical balance in paragraph (c) of this section at the same frequency that you update and record $\dot{n}_{int}$ or $\dot{m}_{fuel}$. For laboratory tests, calculating raw exhaust molar flow rate using measured fuel mass flow rate is valid only for steady-state testing. See § 1065.915(d)(5)(iv) for application to field testing.

* * * * *

(3) ~~*Fuel*~~ *Fluid mass flow rate calculation.* This calculation may be used only for steady-state laboratory testing. You may not use this calculation if the standard-setting part requires carbon balance error verification as described in §1065.543. See §1065.915(d)(5)(iv) for application to field testing. ~~Based on $\dot{m}_{fuel}$, calculate $\dot{n}_{exh}$ as follows~~ Calculate $\dot{n}_{exh}$ based on $\dot{m}_j$ using the following equation:

$$\dot{n}_{exh} = \frac{\dot{m}_{fuel} \cdot w_c \cdot \left(1 + x_{H2Oexhdry}\right)}{M_c \cdot x_{Ccombdry}} \quad \text{Eq. 1065.655-21}$$

~~$$\dot{n}_{exh} = \sum_{j=1}^{N} \dot{m}_j \cdot \frac{w_C \cdot \left(1 + x_{H2Oexhdry}\right)}{M_C \cdot x_{Ccombdry}}$$~~ $$\dot{n}_{exh} = \sum_{j=1}^{N} \dot{m}_j \cdot \frac{w_{C_j} \cdot \left(1 + x_{H2Oexhdry_j}\right)}{M_C \cdot x_{Ccombdry_j}}$$ Eq. 1065.655-25

Where:

$\dot{n}_{exh}$ = raw exhaust molar flow rate from which you measured emissions

~~$\dot{m}_{fuel}$ = fuel flow rate including humidity in intake air.~~

j = an indexing variable that represents one fuel or injected fluid, starting with $j = 1$.

N = total number of fuels and injected fluids over the duty cycle.

$\dot{m}_j$ = the mass flow rate of the fuel or any injected fluid j.

W_{Cj} = carbon mass fraction of the fuel and any injected fluid j.

Example:

$N = 1$

$J = 1$

~~$\dot{m}_{fuel}$~~ $\dot{m}_1$ = 7.559 g/s

w_{c1} = 0.869 g/g

M_{C1} = 12.0107 g/mol

$x_{Ccombdry1}$ = 99.87 mmol/mol = 0.09987 mol/mol

$x_{H2Oexhdry1}$ = 107.64 mmol/mol = 0.10764 mol/mol

$$\dot{n}_{exh} = 7.559 \cdot \frac{0.869 \cdot \left(1 + 0.10764\right)}{12.0107 \cdot 0.09987}$$

$\dot{n}_{exh}$ = 6.066 mol/s

* * * * *

§ 1065.660 THC, NMHC, and CH_4 determination.

* * * * *

(c) *NMNEHC determination.* Use one of the following methods to determine

* * * * *

(2) For a GC-FID, NMC FID, or FTIR, calculate x_{NMNEHC} using the THC analyzer's methane response factor, $RF_{CH4[THC\text{-}FID]}$, and ethane response factor, $RF_{C2H6[THC\text{-}FID]}$, from §1065.360, the initial contamination and dry-to-wet corrected THC concentration, $x_{THC[THC\text{-}FID]cor}$, as determined in paragraph (a) of this section, the dry-to-wet corrected methane concentration, x_{CH4}, as determined in paragraph (d) of this section, and the dry-to-wet corrected ethane concentration, x_{C2H6}, as determined in paragraph (e) of this section as follows

* * * * *

Example:

$x_{THC[THC\text{-}FID]cor}$ = 145.6 µmol/mol

$RF_{CH4[THC\text{-}FID]}$ = 0.970

x_{CH4} = 18.9 µmol/mol

$RF_{C2H6[THC\text{-}FID]}$ = 1.02

x_{C2H6} = 10.6 µmol/mol

x_{NMHC} = ~~145.6 − 0.970×18.9 − 1.02×10.6~~ 145.6 - 0.970·18.9 - 1.02·10.6

x_{NMHC} = 116.5 µmol/mol

* * * * *

§ 1065.750 Analytical gases.

* * * * *

(a) Subparts C, D, F, and J of this part refer to the following gas specifications:

* * * * *

(2) Use the following gases with a FID analyzer:

* * * * *

(iii) *FID zero gas.* Zero ~~flame ionization~~ ~~flame ionization~~ flame-ionization detectors with purified gas that meets the specifications in paragraph (a)(1) of this section, except that the purified gas O_2 concentration may be any value. Note that FID zero balance

gases may be any combination of purified air and purified nitrogen. We recommend FID analyzer zero gases that contain approximately the expected flow-weighted mean concentration of O_2 in the exhaust sample during testing.

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§ 1065.1001 Definitions.

* * * * *

Test interval means a duration of time over which you determine ~~brake-specific~~ mass of emissions. For example, the standard-setting part may specify a complete laboratory duty cycle as a cold-start test interval, plus a hot-start test interval. As another example, a standard-setting part may specify a field-test interval, such as a "not-to-exceed" (NTE) event, as a duration of time over which an engine operates within a certain range of speed and torque. In cases where multiple test intervals occur over a duty cycle, the standard-setting part may specify additional calculations that weight and combine results to arrive at composite values for comparison against the applicable standards in this chapter.

* * * * *

§ 1065.1005 Symbols, abbreviations, acronyms, and units of measure.
The procedures in this part generally follow the International System of Units (SI), as detailed in NIST Special Publication 811, ~~1995 Edition, "Guide for the Use of the International System, of Units (SI),"~ which we incorporate by reference in § 1065.1010. See ~~§ 1065.25~~ § 1065.20 for specific provisions related to these conventions. This section summarizes the way we use symbols, units of measure, and other abbreviations.

(a) *Symbols for quantities*. This part uses the following symbols and units of measure for various quantities:

Table 1 of § 1065.1005 - Symbols for Quantities

Symbol	Quantity	Unit	Unit symbol	~~Base~~ Units in terms of SI base units
~~%~~	~~percent~~	~~001~~	~~%~~	~~10^{-2}~~
~~A~~α	atomic hydrogen-to-carbon ratio	mole per mole	mol/mol	1
A	area	square meter	m^2	m^2
a_0	intercept of least squares regression			

a_1	slope of least squares regression			
a_g	acceleration of Earth's gravity	meter per square second	m/s^2	$m \cdot s^{-2}$
β	ratio of diameters	meter per meter	m/m	1
β	atomic oxygen to carbon ratio	mole per mole	mol/mol	1
$C_\#$	number of carbon atoms in a molecule			
c	power-specific carbon mass error coefficient	gram per kilowatt-hour	g/(kW·hr)	$3.6^{-1} \cdot 10^{-9} \cdot m^{-2} \cdot s^2$
C_d	discharge coefficient			
C_f	flow coefficient			
δ	atomic nitrogen-to-carbon ratio	mole per mole	mol/mol	1
d	Diameter	meter	m	m
d	power-specific carbon mass rate absolute error coefficient	gram per kilowatt-hour	g/(kW·hr)	$3.6^{-1} \cdot 10^{-9} \cdot m^{-2} \cdot s^2$
DR	dilution ratio	mole per mol	mol/mol	1
ε	error between a quantity and its reference			
e	brake-specific ~~basis~~ emission or fuel consumption	gram per kilowatt hour	g/(kW·hr)	~~$g \cdot 3.6^{-1} \cdot 10^{6} \cdot m^{-2} \cdot kgs^2$~~ $3.6^{-1} \cdot 10^{-9} \cdot m^{-2} \cdot s^2$
F	F-test statistic			
f	frequency	hertz	Hz	s^{-1}
f_n	~~rotational frequency~~ angular speed (shaft)	revolutions per minute	~~rev~~/min	~~$2pi60$~~ $\pi \cdot 30^{-1} \cdot s^{-1}$
γ	ratio of specific heats	(joule per kilogram kelvin) per (joule per kilogram kelvin)	(J/(kg·K))/(J/(kg·K))	1

~~ɣ~~	atomic sulfur-to-carbon ratio	mole per mole	mol/mol	1
K	correction factor			1
K_v	calibration coefficient		$m^4 \cdot s \cdot K^{0.5}/kg$	$m^4 \cdot kg^{-1} s \cdot K^{0.5}$
l	length	meter	m	m
μ	viscosity, dynamic	pascal second	$Pa^{-1} \cdot s$	$m^{-1} \cdot kg \cdot s^{-1}$
M	molar mass~~[1]~~[1]	gram per mole	g/mol	$10^{-3} \cdot kg \cdot mol^{-1}$
m	mass	kilogram	kg	kg
$\dot{m}$	mass rate	kilogram per second	kg/s	$kg \cdot s^{-1}$
v	viscosity, kinematic	meter squared per second	m^2/s	$m^2 \cdot s^{-1}$
N	total number in series			
n	amount of substance	mole	mol	mol
$\dot{n}$	amount of substance rate	mole per second	mol/s	$mol \cdot s^{-1}$
P	power	kilowatt	kW	$10^3 \cdot m^2 \cdot kg \cdot s^{-3}$
PF	penetration fraction			
p	pressure	pascal	Pa	$m^{-1} \cdot kg \cdot s^{-2}$
ρ	mass density	kilogram per cubic meter	kg/m^3	$kg \cdot m^{-3}$
Δp	differential static pressure	pascal	Pa	$m^{-1} \cdot kg \cdot s^{-2}$
r	ratio of pressures	pascal per pascal	Pa/Pa	1
~~R~~^{2}r^2	coefficient of determination			
Ra	average surface roughness	micrometer	μm	m^{-6}
$Re^{\#}$	Reynolds number			
RF	response factor			
RH ~~%~~	relative humidity	0.01	%	10^{-2}
σ	non-biased standard deviation			
S	Sutherland constant	kelvin	K	K

SEE	standard estimate of error			
T	absolute temperature	kelvin	K	K
T	Celsius temperature	degree Celsius	°C	K-273.15
T	torque (moment of force)	newton meter	N·m	$m^2 \cdot kg \cdot s^{-2}$
ϑ	plane angle	degrees	°	rad
t	time	second	s	s
Δt	time interval, period, 1/frequency	second	s	s
V	volume cubic meter	m^3	m^3	m^3
$\dot{V}$	volume rate	cubic meter per second	m^3/s	$m^3 \cdot s^{-1}$
W	work	kilowatt hour	kW·h	$3.6 \cdot 10^{-6} \cdot m^2 \cdot kg \cdot s^{-2}$
w_c	carbon mass fraction	gram per gram	g/g	1
x	amount of substance mole fraction[2b2]	mole per mole	mol/mol	1
$\bar{x}$	flow-weighted mean concentration	mole per mole	mol/mol	1
y	generic variable			
Z	compressibility factor			

[1a1] See paragraph (f)(2) of this section for the values to use for molar masses. Note that in the cases of NO_X and HC, the regulations specify effective molar masses based on assumed speciation rather than actual speciation.
[2b2] Note that mole fractions for THC, THCE, NMHC, NMHCE, and NOTHC are expressed on a C_1 equivalent basis.

* * * * *

(c) *Prefixes.* This part uses the following prefixes to define a quantity for units and unit symbols:

Table 3 of § 1065.1005 - Prefixes

Symbol	Quantity	Value

μ	micro	10^{-6}
m	milli	10^{-3}
c	centi	10^{-2}
k	kilo	10^{3}
M	mega	10^{6}

(d) *Superscripts*. This part uses the following superscripts ~~to define a quantity~~ for modifying quantity symbols:

Table 4 of § 1065.1005 - Superscripts

Superscript	Quantity
overbar (such as $\bar{y}$)	arithmetic mean.
overdot (such as $\dot{y}$)	quantity per unit time.

(e) *Subscripts*. This part uses the following subscripts ~~to define a quantity~~ for modifying quantity symbols:

Table 5 of § 1065.1005 - Subscripts

Subscript	Quantity
a	absolute (e.g. absolute difference or error).
abs	absolute quantity.
act	actual condition.
air	air, dry
amb	ambient.
atmos	atmospheric.
bkgnd	background.
C	carbon mass.
cal	calibration quantity.
CFV	critical flow venturi.
comb	combined.
composite	composite value.
cor	corrected quantity.
dil	dilution air.
dew	dewpoint.
dexh	diluted exhaust.
dry	dry condition.
dutycycle	duty cycle.
ε	related to a difference or error quantity.
exh	raw exhaust.
exp	expected quantity.

fluid	fluid stream.
fn	feedback speed.
frict	friction.
fuel	fuel consumption.
hi, idle	condition at high-idle.
i	an individual of a series.
idle	condition at idle.
in	quantity in.
init	initial quantity, typically before an emission test.
int	intake air.
j	an individual of a series.
mapped	conditions over which an engine can operate.
max	the maximum (i.e., peak) value expected at the standard over a test interval; not the maximum of an instrument range.
meas	measured quantity.
media	PM sample media.
mix	mixture of diluted exhaust and air.
norm	normalized.
out	quantity out.
P	power.
part	partial quantity.
PDP	positive-displacement pump.
post	after the test interval.
pre	before the test interval.
prod	stoichiometric product.
r	relative (e.g., relative difference or error).
record	record rate.
ref	reference quantity.
rev	revolution.
sat	saturated condition.
s	slip.
~~slip~~	~~PDP slip.~~
span	span quantity.
SSV	subsonic venturi.
std	standard condition.
stroke	engine strokes per power stroke.
T	torque.
test	test quantity.
test, alt	alternate test quantity.
uncor	uncorrected quantity
vac	vacuum side of the sampling system.

weight	calibration weight.
zero	zero quantity.

(f) *Constants.*

* * * * *

(2) This part uses the following molar masses or effective molar masses of chemical species:

Table 7 of § 1065.1005 – Molar Masses

Symbol	Quantity	g/mol(10^{-3}·kg·mol^{-1})
M_{air}	molar mass of dry air[1]	28.96559
M_{Ar}	molar mass of argon	39.948
M_C	molar mass of carbon	12.0107
M_{CH3OH}	molar mass of methanol	32.04186
M_{C2H5OH}	molar mass of ethanol	46.06844
M_{C2H4O}	molar mass of acetaldehyde	44.05256
M_{CH4N2O}	molar mass of urea	60.05526
M_{C2H6}	molar mass of ethane	30.06904
M_{C3H8}	molar mass of propane	44.09562
M_{C3H7OH}	molar mass of propanol	60.09502
M_{CH4}	molar mass of methane	16.0425
M_{CO}	molar mass of carbon monoxide	28.0101
M_{CO2}	molar mass of carbon dioxide	44.0095
M_H	molar mass of atomic hydrogen	1.00794
M_{H2}	molar mass of molecular hydrogen	2.01588
M_{H2O}	molar mass of water	18.01528
M_{CH2O}	molar mass of formaldehyde	30.02598
M_{He}	molar mass of helium	4.002602
M_N	molar mass of atomic nitrogen	14.0067
M_{N2}	molar mass of molecular nitrogen	28.0134
M_{NH3}	molar mass of ammonia	17.03052

M_{NMHC}	effective molar mass of nonmethane hydrocarbon[2b]	13.875389
M_{NMHCE}	effective molar mass of nonmethane equivalent hydrocarbon[2b2]	13.875389
M_{NMNEHC}	effective C_1 molar mass of nonmethane-nonethane hydrocarbon[b2]	13.875389
M_{NOx}	effective molar mass of oxides of nitrogen[3c3]	46.0055
M_{N2O}	effective molar mass of nitrous oxide	44.0128
M_O	molar mass of atomic oxygen	15.9994
M_{O2}	molar mass of molecular oxygen	31.9988
~~M_{C3H8}~~	~~molar mass of propane~~	~~44.09562~~
M_S	molar mass of sulfur	32.065
M_{THC}	effective molar mass of total hydrocarbon[2b2]	13.875389
M_{THCE}	effective molar mass of total hydrocarbon equivalent[2b2]	13.875389

[1a1] See paragraph (f)(1) of this section for the composition of dry air.
[2b2] The effective molar masses of THC, THCE, NMHC, ~~and NMHCE are defined by~~ NMHCE, and NMNEHC are defined on a C_1 basis and are based on an atomic hydrogen-to-carbon ratio, α, of 1.85 (with β, γ, and δ equal to zero).
[3c3] The effective molar mass of NOx is defined by the molar mass of nitrogen dioxide, NO_2.

* * * * *

(g) *Other acronyms and abbreviations.* This part uses the following additional abbreviations and acronyms:

Table 10 of § 1065.1005 – Other Acronyms and Abbreviations

ABS	acrylonitrile-butadiene-styrene.
ASTM	ASTM International
BMD	bag mini-diluter.
BSFC	brake-specific fuel consumption.

CARB	California Air Resources Board.
CFR	Code of Federal Regulations.
CFV	critical-flow venturi.
~~CI~~	~~compression-ignition.~~
CITT	Curb Idle Transmission Torque.
CLD	chemiluminescent detector.
CVS	constant-volume sampler.
DF	deterioration factor.
ECM	electronic control module.
EFC	electronic flow control.
e.g.	for example.
EGR	exhaust gas recirculation.
EPA	Environmental Protection Agency.
FEL	Family Emission Limit.
FID	~~flame-ionization~~ ~~flame-ionization~~ flame-ionization detector.
FTIR	Fourier transform infrared.
GC	gas chromatograph.
GC-ECD	gas chromatograph with an electron-capture detector.
GC-FID	gas chromatograph with a flame ionization detector.
HEPA	high-efficiency particulate air.
IBP	initial boiling point.
IBR	incorporated by reference.
i.e.	in other words.
ISO	International Organization for Standardization.
LPG	liquefied petroleum gas.
MPD	magnetopneumatic detection.
NDIR	nondispersive infrared.
NDUV	nondispersive ultraviolet.
NIST	National Institute for Standards and Technology.
NMC	nonmethane cutter.

PDP	positive-displacement pump.
PEMS	portable emission measurement system.
PFD	partial-flow dilution.
PLOT	porous layer open tubular.
PMD	paramagnetic detection.
PMP	Polymethylpentene.
pt.	a single point at the mean value expected at the standard.
psi	pounds per square inch.
PTFE	polytetrafluoroethylene (commonly known as Teflon™).
RE	rounding error.
RESS	rechargeable energy storage system.
RFPF	response factor penetration fraction.
RMC	ramped-modal cycle.
rms	root-mean square.
RTD	resistive temperature detector.
SAW	surface acoustic wave.
SEE	standard estimate of error.
SSV	subsonic venturi.
SI	spark-ignition.
THC-FID	total hydrocarbon flame ionization detector.
TINV	inverse student *t*-test function in Microsoft Excel.
UCL	upper confidence limit.
UFM	ultrasonic flow meter.
U.S.C.	United States Code.

§ 1065.1010 ~~Reference materials~~ Incorporation by Reference.

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