

(3) Measure an NO calibration span gas that meets the specifications of § 1065.750 and is near the maximum concentration expected during testing. Record this concentration, X_{NOdry} .

(4) Humidify the NO span gas by bubbling it through distilled water in a sealed vessel. We recommend that you humidify the gas to the highest sample dewpoint that you estimate during emission sampling.

(5) Downstream of the vessel, maintain the humidified gas temperature at least 5 °C above its dewpoint.

(6) Introduce the humidified gas upstream of any sample dryer, if one is used during testing.

(7) Measure the humidified gas dewpoint, T_{dew} , and pressure, p_{total} , as close as possible to the inlet of the analyzer, or to the inlet of the sample dryer, if one is used.

(8) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.

(9) While the analyzer measures the sample's concentration, record the analyzer's output for 30 seconds. Calculate the arithmetic mean of these data. This mean is X_{NOmeas} .

(10) If your CLD is not equipped with a sample dryer, set X_{NOwet} equal to X_{NOmeas} from paragraph (e)(9) of this section.

(11) If your CLD is equipped with a sample dryer, determine X_{NOwet} from X_{NOmeas} by correcting for the removed water according to § 1065.645. Use the amount of water at the sample dryer outlet as X_{H_2Omeas} for this calculation. Refer to § 1065.145(d)(2) and use the humidified gas dewpoint, T_{dew} , and pressure, p_{total} , to determine X_{H_2O} .

(12) Use X_{NOwet} to calculate the quench according to § 1065.675.

* * * * *

(g) * * *

(1) You may omit this verification if you can show by engineering analysis that for your NO_x sampling system and your emission calculations procedures, the combined CO₂ and H₂O interference for your NO_x CLD analyzer always affects your brake-specific NO_x emission results within no more than ±1.0% of the applicable NO_x standard.

* * * * *

56. Section 1065.372 is amended by revising paragraph (e)(1) to read as follows:

§ 1065.372 NDUV analyzer HC and H₂O interference verification.

* * * * *

(e) * * *

(1) You may omit this verification if you can show by engineering analysis that for your NO_x sampling system and your emission calculations procedures, the combined HC and H₂O interference for your NO_x NDUV analyzer always affects your brake-specific NO_x emission results by less than 0.5% of the applicable NO_x standard.

* * * * *

57. Section 1065.376 is revised to read as follows:

§ 1065.376 Chiller NO₂ penetration.

(a) *Scope and frequency.* If you use a chiller to dry a sample upstream of a NO_x measurement instrument, but you don't use an NO₂-to-NO converter upstream of the chiller, you must perform this verification for chiller NO₂ penetration. Perform this verification after initial installation and after major maintenance.

(b) *Measurement principles.* A chiller removes water, which can otherwise interfere with a NO_x measurement. However, liquid water remaining in an improperly designed chiller can remove NO₂ from the sample. If a chiller is used without an NO₂-to-NO converter upstream, it could remove NO₂ from the sample prior NO_x measurement.

(c) *System requirements.* A chiller must allow for measuring at least 95% of the total NO₂ at the maximum expected concentration of NO₂.

(d) *Procedure.* Use the following procedure to verify chiller performance:

(1) *Instrument setup.* Follow the analyzer and chiller manufacturers' start-up and operating instructions. Adjust the analyzer and chiller as needed to optimize performance.

(2) *Equipment setup and data collection.* (i) Zero and span the total NO_x gas analyzer(s) as you would before emission testing.

(ii) Select an NO₂ calibration gas, balance gas of dry air, that has an NO₂ concentration within ±5% of the maximum NO₂ concentration expected during testing.

(iii) Overflow this calibration gas at the gas sampling system's probe or overflow fitting. Allow for stabilization of the total NO_x response, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of recorded total NO_x data and record this value as X_{NOxref} .

(v) Stop flowing the NO₂ calibration gas.

(vi) Next saturate the sampling system by overflowing a dewpoint generator's output, set at a dewpoint of 50 °C, to the gas sampling system's probe or overflow fitting. Sample the dewpoint generator's output through the sampling system and

chiller for at least 10 minutes until the chiller is expected to be removing a constant rate of water.

(vii) Immediately switch back to overflowing the NO₂ calibration gas used to establish X_{NOxref} . Allow for stabilization of the total NO_x response, accounting only for transport delays and instrument response. Calculate the mean of 30 seconds of recorded total NO_x data and record this value as $X_{NOxmeas}$.

(viii) Correct $X_{NOxmeas}$ to X_{NOxdry} based upon the residual water vapor that passed through the chiller at the chiller's outlet temperature and pressure.

(3) *Performance evaluation.* If X_{NOxdry} is less than 95% of X_{NOxref} , repair or replace the chiller.

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

(1) You may omit this verification if you can show by engineering analysis that for your NO_x sampling system and your emission calculations procedures, the chiller always affects your brake-specific NO_x emission results by less than 0.5% of the applicable NO_x standard.

(2) You may use a chiller that you determine does not meet this verification, as long as you try to correct the problem and the measurement deficiency does not adversely affect your ability to show that engines comply with all applicable emission standards.

58. Section 1065.378 is amended by revising paragraphs (d) and (e)(1) to read as follows:

§ 1065.378 NO₂-to-NO converter conversion verification.

* * * * *

(d) *Procedure.* Use the following procedure to verify the performance of a NO₂-to-NO converter:

(1) *Instrument setup.* Follow the analyzer and NO₂-to-NO converter manufacturers' start-up and operating instructions. Adjust the analyzer and converter as needed to optimize performance.

(2) *Equipment setup.* Connect an ozonator's inlet to a zero-air or oxygen source and connect its outlet to one port of a three-way tee fitting. Connect an NO span gas to another port, and connect the NO₂-to-NO converter inlet to the last port.

(3) *Adjustments.* Take the following steps to make adjustments:

(i) With the NO₂-to-NO converter in the bypass mode (i.e., NO mode) and the ozonator off, adjust the NO and zero-gas flows so the NO concentration at the analyzer is at the peak total NO_x concentration expected during testing.

(ii) With the NO₂-to-NO converter still in the bypass mode, turn on the ozonator and adjust the ozonator so the NO concentration measured by the analyzer decreases by the same amount as maximum concentration of NO₂ expected during testing. This ensures that the ozonator is generating NO₂ at the maximum concentration expected during testing.

(4) *Data collection.* Maintain the ozonator adjustment in paragraph (d)(3) of this section, and keep the NO_x analyzer in the NO only mode (i.e., bypass the NO₂-to-NO converter).

(i) Allow for stabilization, accounting only for transport delays and instrument response.

(ii) Calculate the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOxref} .

(iii) Switch the analyzer to the total NO_x mode (that is, sample with the NO₂-to-NO converter) and allow for stabilization, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of sampled data from the analyzer and record this value as $x_{NOxmeas}$.

(v) Turn off the ozonator and allow for stabilization, accounting only for transport delays and instrument response.

(vi) Calculate the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOxref} .

(5) *Performance evaluation.* Divide the quantity of ($x_{NOxmeas} - x_{NOxref}$) by the quantity of ($x_{NOxref} - x_{NOxref}$). If the result is less than 95%, repair or replace the NO₂-to-NO converter.

(e) * * *
(1) You may omit this verification if you can show by engineering analysis that for your NO_x sampling system and your emission calculations procedures, the converter always affects your brake-specific NO_x emission results by less than 0.5% of the applicable NO_x standard.

* * * * *

59. Section 1065.390 is amended by revising paragraphs (d)(8) and (d)(9) and adding paragraph (d)(10) to read as follows:

§ 1065.390 PM balance verifications and weighing process verification.

* * * * *

(d) * * *

(8) Subtract each buoyancy-corrected reference mass from its most recent previously recorded buoyancy-corrected mass.

(9) You may discard reference PM sample media if you positively identify a cause for the media's contamination, such as the media falling onto the floor.

In this case, you do not have to include the contaminated reference media when determining compliance with paragraph (d)(10) of this section.

(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 masses were determined.

Subpart E—[Amended]

60. Section 1065.405 is amended by revising paragraphs (b) and (e) introductory text to read as follows:

§ 1065.405 Test engine preparation and maintenance.

* * * * *

(b) Run the test engine, with all emission control systems operating, long enough to stabilize emission levels to appropriately apply deterioration factors. You must use the same stabilization procedures for all emission-data engines for which you apply the same deterioration factors so that all low-hour emission-data engines are consistent with the low-hour engine used to develop the deterioration factor.

(1) Unless otherwise specified in the standard-setting part, you may consider emission levels stable without measurement if you accumulate 12 h of operation for a spark-ignition engine or 125 h for a compression-ignition engine.

(2) If the engine needs more or less operation to stabilize emission levels, record your reasons and the methods for doing this, and give us these records if we ask for them.

(3) You may stabilize emissions from a catalytic exhaust aftertreatment device by operating it on an engine that is different from the test engine, but only where it is consistent with good engineering judgment. You may alternatively stabilize emissions from a catalytic exhaust aftertreatment device by operating it on an engine-exhaust simulator if it is allowed in the standard-setting part, or if we have issued prior guidance, or if we otherwise approve of the use of an engine-exhaust simulator in advance. This process of stabilizing emissions from a catalytic exhaust aftertreatment device is often called "degreening". Be sure to consider whether degreening under this paragraph (b)(3) will adversely affect your ability to develop

and apply appropriate deterioration factors.

* * * * *

(e) If your engine will be used in a vehicle equipped with a canister for storing evaporative hydrocarbons for eventual combustion in the engine and the test sequence involves a cold-start or hot-start duty cycle, attach a canister to the engine before running an emission test. You may omit using an evaporative canister for any hot-stabilized duty cycles. You may request to omit using an evaporative canister during testing if you can show that it would not affect your ability to show compliance with the applicable emission standards. You do not have to accumulate engine operation before emission testing with an installed canister. Prior to an emission test, use the following steps to attach a canister to your engine:

* * * * *

61. The heading of subpart F is revised to read as follows:

Subpart F—Performing an Emission Test Over Specified Duty Cycles

62. Section 1065.501 is revised to read as follows:

§ 1065.501 Overview.

(a) Use the procedures detailed in this subpart to measure engine emissions over a specified duty cycle. Refer to subpart J of this part for field test procedures that describe how to measure emissions during in-use engine operation. This section describes how to:

(1) Map your engine, if applicable, by recording specified speed and torque data, as measured from the engine's primary output shaft.

(2) Transform normalized duty cycles into reference duty cycles for your engine by using an engine map.

(3) Prepare your engine, equipment, and measurement instruments for an emission test.

(4) Perform pre-test procedures to verify proper operation of certain equipment and analyzers.

(5) Record pre-test data.

(6) Start or restart the engine and sampling systems.

(7) Sample emissions throughout the duty cycle.

(8) Record post-test data.

(9) Perform post-test procedures to verify proper operation of certain equipment and analyzers.

(10) Weigh PM samples.

(b) An emission test generally consists of measuring emissions and other parameters while an engine follows one or more duty cycles that are specified in the standard-setting part. There are two general types of duty cycles:

(1) *Transient cycles.* Transient duty cycles are typically specified in the standard-setting part as a second-by-second sequence of speed commands and torque (or power) commands. Operate an engine over a transient cycle such that the speed and torque of the engine's primary output shaft follows the target values. Proportionally sample emissions and other parameters and use the calculations in subpart G of this part to calculate emissions. Start a transient test according to the standard-setting part, as follows:

(i) A cold-start transient cycle where you start to measure emissions just before starting an engine that has not been warmed up.

(ii) A hot-start transient cycle where you start to measure emissions just before starting a warmed-up engine.

(iii) A hot running transient cycle where you start to measure emissions after an engine is started, warmed up, and running.

(2) *Steady-state cycles.* Steady-state duty cycles are typically specified in the standard-setting part as a list of discrete operating points (modes or notches), where each operating point and has one value of a speed command and one value of a torque (or power) command. Ramped-modal cycles for steady-state testing also list test times for each mode and ramps of speed and torque to follow between modes. Start a steady-state cycle as a hot running test, where you start to measure emissions after an engine is started, warmed up and running. You may run a steady-state duty cycle as a discrete-mode cycle or a ramped-modal cycle, as follows:

(i) *Discrete-mode cycles.* Before emission sampling, stabilize an engine at the first discrete mode. Sample emissions and other parameters for that mode and then stop emission sampling. Record mean values for that mode, and then stabilize the engine at the next mode. Continue to sample each mode discretely and calculate weighted emission results according to the standard-setting part.

(ii) *Ramped-modal cycles.* Perform ramped-modal cycles similar to the way you would perform transient cycles, except that ramped-modal cycles involve mostly steady-state engine operation. Perform a ramped-modal cycle as a sequence of second-by-second speed commands and torque (or power) commands. Proportionally sample emissions and other parameters during the cycle and use the calculations in subpart G of this part to calculate emissions.

(c) Other subparts in this part identify how to select and prepare an engine for testing (subpart E), how to perform the

required engine service accumulation (subpart E), and how to calculate emission results (subpart G).

(d) Subpart J of this part describes how to perform field testing.

63. Section 1065.510 is revised to read as follows:

§ 1065.510 Engine mapping.

(a) *Applicability, scope, and frequency.* An engine map is a data set that consists of a series of paired data points that represent the maximum brake torque versus engine speed, measured at the engine's primary output shaft. Map your engine if the standard-setting part requires engine mapping to generate a duty cycle for your engine configuration. Map your engine while it is connected to a dynamometer or other device that can absorb work output from the engine's primary output shaft according to § 1065.110. Configure any auxiliary work inputs and outputs such as hybrid, turbo-compounding, or thermoelectric systems to represent their in-use configurations, and use the same configuration for emission testing. See Figure 1 of § 1065.210. This may involve configuring initial states of charge and rates and times of auxiliary-work inputs and outputs. We recommend that you contact the Designated Compliance Officer before testing to determine how you should configure any auxiliary-work inputs and outputs. Use the most recent engine map to transform a normalized duty cycle from the standard-setting part to a reference duty cycle specific to your engine. Normalized duty cycles are specified in the standard-setting part. You may update an engine map at any time by repeating the engine-mapping procedure. You must map or re-map an engine before a test if any of the following apply:

(1) If you have not performed an initial engine map.

(2) If the atmospheric pressure near the engine's air inlet is not within ± 5 kPa of the atmospheric pressure recorded at the time of the last engine map.

(3) If the engine or emission-control system has undergone changes that might affect maximum torque performance. This includes changing the configuration of auxiliary work inputs and outputs.

(4) If you capture an incomplete map on your first attempt or you do not complete a map within the specified time tolerance. You may repeat mapping as often as necessary to capture a complete map within the specified time.

(b) *Mapping variable-speed engines.* Map variable-speed engines as follows:

(1) Record the atmospheric pressure.

(2) Warm up the engine by operating it. We recommend operating the engine at any speed and at approximately 75% of its expected maximum power.

Continue the warm-up until the engine coolant, block, or head absolute temperature is within $\pm 2\%$ of its mean value for at least 2 min or until the engine thermostat controls engine temperature.

(3) Operate the engine at its warm idle speed, within manufacturer tolerances, if specified. Apply a representative amount of torque to the engine's primary output shaft if nonzero torque at idle speed is representative of its in-use operation. For example output torque at idle speed might normally occur if the engine is always coupled to a device such as a pump or hydrostatic drive that always applies some amount of nonzero torque at idle. Record at least 30 values of speed and use the mean of those values as measured idle speed for cycle generation.

(4) Set operator demand to maximum and control engine speed at $(95 \pm 1)\%$ of its warm idle speed for at least 15 seconds. For engines with reference duty cycles whose lowest speed is greater than warm idle speed, you may start the map at $(95 \pm 1)\%$ of the lowest reference speed.

(5) Perform one of the following:

(i) For any engine subject only to steady-state duty cycles (i.e., discrete-mode or ramped-modal), you may perform an engine map by using discrete speeds. Select at least 20 evenly spaced setpoints between warm idle and the highest speed above maximum mapped power at which (50 to 75)% of maximum power occurs. If this highest speed is unsafe or unrepresentative (e.g., for ungoverned engines), use good engineering judgment to map up to the maximum safe speed or the maximum representative speed. At each setpoint, stabilize speed and allow torque to stabilize. Record the mean speed and torque at each setpoint. We recommend that you stabilize an engine for at least 15 seconds at each setpoint and record the mean feedback speed and torque of the last (4 to 6) seconds. Use linear interpolation to determine intermediate speeds and torques. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.

(ii) For any variable-speed engine, you may perform an engine map by using a continuous sweep of speed by continuing to record the mean feedback speed and torque at 1 Hz or more frequently and increasing speed at a constant rate such that it takes (4 to 6) min to sweep from 95% of warm idle to the highest speed above maximum

power at which (50 to 75)% of maximum power occurs. If this highest speed is unsafe or unrepresentative (e.g., for ungoverned engines), use good engineering judgment to map up to the maximum safe speed or the maximum representative speed. Stop recording after you complete the sweep. From the series of mean speed and maximum torque values, use linear interpolation to determine intermediate values. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.

(c) *Negative torque mapping.* If your engine is subject to a reference duty cycle that specifies negative torque values (i.e., engine motoring), generate a motoring map by any of the following procedures:

(1) Multiply the positive torques from your map by -40% . Use linear interpolation to determine intermediate values.

(2) Map the amount of negative torque required to motor the engine by repeating paragraph (b) of this section with minimum operator demand.

(3) Determine the amount of negative torque required to motor the engine at the following two points: at warm idle and at the highest speed above maximum power at which (50 to 75)% of maximum power occurs. If this highest speed is unsafe or unrepresentative (e.g., for ungoverned engines), use good engineering judgment to map up to the maximum safe speed or the maximum representative speed. Operate the engine at these two points at minimum operator demand. Use linear interpolation to determine intermediate values.

(d) *Mapping constant-speed engines.* For constant-speed engines, generate a map as follows:

(1) Record the atmospheric pressure.

(2) Warm up the engine by operating it. We recommend operating the engine at approximately 75% of the engine's expected maximum power. Continue the warm-up until the engine coolant, block, or head absolute temperature is within $\pm 2\%$ of its mean value for at least 2 min or until the engine thermostat controls engine temperature.

(3) You may operate the engine with a production constant-speed governor or simulate a constant-speed governor by controlling engine speed with an operator demand control system described in § 1065.110. Use either isochronous or speed-droop governor operation, as appropriate.

(4) With the governor or simulated governor controlling speed using operator demand, operate the engine at

no-load governed speed (at high speed, not low idle) for at least 15 seconds.

(5) Record at 1 Hz the mean of feedback speed and torque. Use the dynamometer to increase torque at a constant rate. Unless the standard-setting part specifies otherwise, complete the map such that it takes (2 to 4) min to sweep from no-load governed speed to the lowest speed below maximum mapped power at which the engine develops (85–95)% of maximum mapped power. You may map your engine to lower speeds. Stop recording after you complete the sweep. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.

(e) *Power mapping.* For all engines, create a power-versus-speed map by transforming torque and speed values to corresponding power values. Use the mean values from the recorded map data. Do not use any interpolated values. Multiply each torque by its corresponding speed and apply the appropriate conversion factors to arrive at units of power (kW). Interpolate intermediate power values between these power values, which were calculated from the recorded map data.

(f) *Measured and declared test speeds and torques.* You may use test speeds and torques that you declare instead of measured speeds and torques if they meet the criteria in this paragraph (f). Otherwise, you must use speeds and torques derived from the engine map.

(1) Measured speeds and torques. Determine the applicable speeds and torques according to § 1065.610:

(i) Measured maximum test speed for variable-speed engines.

(ii) Measured maximum test torque for constant-speed engines.

(iii) Measured “A”, “B”, and “C” speeds for steady-state tests.

(iv) Measured intermediate speed for steady-state tests.

(2) *Required declared speeds.* You must declare the following speeds:

(i) Warmed-up, low-idle speed for variable-speed engines. Declare this speed in a way that is representative of in-use operation. For example, if your engine is typically connected to an automatic transmission or a hydrostatic transmission, declare this speed at the idle speed at which your engine operates when the transmission is engaged.

(ii) Warmed-up, no-load, high-idle speed for constant-speed engines.

(3) *Optional declared speeds.* You may declare an enhanced idle speed according to § 1065.610. You may use a declared value for any of the following as long as the declared value is within

(97.5 to 102.5)% of its corresponding measured value:

(i) Measured maximum test speed for variable-speed engines.

(ii) Measured intermediate speed for steady-state tests.

(iii) Measured “A”, “B”, and “C” speeds for steady-state tests.

(4) *Declared torques.* You may declare an enhanced idle torque according to § 1065.610. You may declare maximum test torque as long as it is within (95 to 100)% of the measured value.

(g) *Other mapping procedures.* You may use other mapping procedures if you believe the procedures specified in this section are unsafe or unrepresentative for your engine. Any alternate techniques you use must satisfy the intent of the specified mapping procedures, which is to determine the maximum available torque at all engine speeds that occur during a duty cycle. Identify any deviations from this section's mapping procedures when you submit data to us.

64. Section 1065.512 is revised to read as follows:

§ 1065.512 Duty cycle generation.

(a) Generate duty cycles according to this section if the standard-setting part requires engine mapping to generate a duty cycle for your engine configuration. The standard-setting part generally defines applicable duty cycles in a normalized format. A normalized duty cycle consists of a sequence of paired values for speed and torque or for speed and power.

(b) Transform normalized values of speed, torque, and power using the following conventions:

(1) Engine speed for variable-speed engines. For variable-speed engines, normalized speed may be expressed as a percentage between idle speed and maximum test speed, f_{ntest} , or speed may be expressed by referring to a defined speed by name, such as “warm idle,” “intermediate speed,” or “A,” “B,” or “C” speed. Section 1065.610 describes how to transform these normalized values into a sequence of reference speeds, f_{nref} . Note that the cycle-validation criteria in § 1065.514 allow an engine to govern itself at its in-use idle speed. This allowance permits you to test engines with enhanced-idle devices and to simulate the effects of transmissions such as automatic transmissions. For example, an enhanced-idle device might be an idle speed value that is normally commanded only under cold-start conditions to quickly warm up the engine and aftertreatment devices.

(2) Engine torque for variable-speed engines. For variable-speed engines,

normalized torque is expressed as a percentage of the mapped torque at the corresponding reference speed. Section 1065.610 describes how to transform normalized torques into a sequence of reference torques, T_{ref} . Section 1065.610 also describes under what conditions you may command T_{ref} greater than the reference torque you calculated from a normalized duty cycle. This provision permits you to command T_{ref} values representing curb-idle transmission torque (CITT). For any negative torque commands, command minimum operator demand and use the dynamometer to control engine speed to the reference speed. Note that the cycle-validation criteria in § 1065.514 allow an engine to pass cycle statistics for torque for any data points recorded during negative torque commands. Also, use the maximum recorded torque at the minimum mapped speed as the maximum torque for any reference speed at or below the minimum mapped speed.

(3) Engine torque for constant-speed engines. For constant-speed engines, normalized torque is expressed as a percentage of maximum test torque, T_{test} . Section 1065.610 describes how to transform normalized torques into a sequence of reference torques, T_{ref} . Section 1065.610 also describes under what conditions you may command T_{ref} greater than 0 Nm when a normalized duty cycle specifies a 0% torque command.

(4) Engine power. For all engines, normalized power is expressed as a percentage of mapped power at maximum test speed, f_{ntest} . Section 1065.610 describes how to transform these normalized values into a sequence of reference powers, P_{ref} . Convert these reference powers to reference speeds and torques for operator demand and dynamometer control.

(c) For variable-speed engines, command reference speeds and torques

sequentially to perform a duty cycle. Issue speed and torque commands at a frequency of at least 1 Hz for transient cycles and at least 1 Hz for steady-state cycles (i.e., discrete-mode and ramped-modal). Linearly interpolate between the 1 Hz reference values specified in the standard-setting part to determine more frequently issued reference speeds and torques. During an emission test, record the reference speeds and torques and the feedback speeds and torques at the same frequency. Use these recorded values to calculate cycle-validation statistics and total work.

(d) For constant-speed engines, operate the engine with the same production governor you used to map the engine in § 1065.510 or simulate the in-use operation of a governor the same way you simulated it to map the engine in § 1065.510. Command reference torque values sequentially to perform a duty cycle. Issue torque commands at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles (i.e., discrete-mode, ramped-modal). Linearly interpolate between the 1 Hz reference values specified in the standard-setting part to determine more frequently issued reference torque values. During an emission test, record the reference torques and the feedback speeds and torques at the same frequency. Use these recorded values to calculate cycle-validation statistics and total work.

(e) You may perform practice duty cycles with the test engine to optimize operator demand and dynamometer controls to meet the cycle-validation criteria specified in § 1065.514.

65. Section 1065.514 is revised to read as follows:

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

Validate the execution of your duty cycle according to this section unless the standard-setting part specifies

otherwise. This section describes how to determine if the engine's operation during the test adequately matched the reference duty cycle. This section applies only to speed, torque, and power from the engine's primary output shaft. Other work inputs and outputs are not subject to cycle-validation criteria. For any data required in this section, use the duty cycle reference and feedback values that you recorded during a test interval.

(a) *Testing performed by EPA.* Our tests must meet the specifications of paragraph (g) of this section, unless we determine that failing to meet the specifications is related to engine performance rather than to shortcomings of the dynamometer or other laboratory equipment.

(b) *Testing performed by manufacturers.* Emission tests that meet the specifications of paragraph (g) of this section satisfy the standard-setting part's requirements for duty cycles. You may ask to use a dynamometer or other laboratory equipment that cannot meet those specifications. We will approve your request as long as using the alternate equipment does not adversely affect your ability to show compliance with the applicable emission standards.

(c) *Time-alignment.* Because time lag between feedback values and the reference values may bias cycle-validation results, you may advance or delay the entire sequence of feedback engine speed and/or torque pairs to synchronize them with the reference sequence.

(d) *Omitting additional points.* Besides engine cranking, you may omit additional points from cycle-validation statistics as described in the following table:

TABLE 1 OF § 1065.514.—PERMISSIBLE CRITERIA FOR OMITTING POINTS FROM DUTY-CYCLE REGRESSION STATISTICS

When operator demand is at its . . .	you may omit . . .	if . . .
For reference duty cycles that are specified in terms of speed and torque (f_{nref} , T_{ref})		
minimum	power and torque	$T_{ref} < 0\%$ (motoring).
minimum	power and speed	$f_{nref} = 0\%$ (idle speed) and $T_{ref} = 0\%$ (idle torque) and $T_{ref} - (2\% \cdot T_{max\ mapped}) < T < T_{ref} + (2\% \cdot T_{max\ mapped})$.
minimum	power and either torque or speed	$f_n > f_{nref}$ or $T > T_{ref}$ but not if $f_n > f_{nref}$ and $T > T_{ref}$.
maximum	power and either torque or speed	$f_n < f_{nref}$ or $T < T_{ref}$ but not if $f_n < f_{nref}$ and $T < T_{ref}$.
For reference duty cycles that are specified in terms of speed and power (f_{nref} , P_{ref})		
minimum	power and torque	$P_{ref} < 0\%$ (motoring).
minimum	power and speed	$f_{nref} = 0\%$ (idle speed) and $P_{ref} = 0\%$ (idle power) and $P_{ref} - (2\% \cdot P_{max\ mapped}) < P < P_{ref} + (2\% \cdot P_{max\ mapped})$.
minimum	power and either torque or speed	$f_n > f_{nref}$ or $P > P_{ref}$ but not if $f_n > f_{nref}$ and $P > P_{ref}$.

TABLE 1 OF § 1065.514.—PERMISSIBLE CRITERIA FOR OMITTING POINTS FROM DUTY-CYCLE REGRESSION STATISTICS—Continued

When operator demand is at its . . .	you may omit . . .	if . . .
maximum	power and either torque or speed	$f_n < f_{ref}$ or $P < P_{ref}$ but not if $f_n < f_{ref}$ and $P < P_{ref}$.

(e) *Statistical parameters.* Use the remaining points to calculate regression statistics described in § 1065.602. Round calculated regression statistics to the same number of significant digits as the criteria to which they are compared. Refer to Table 2 of § 1065.514 for the default criteria and refer to the standard-setting part to determine if there are other criteria for your engine. Calculate the following regression statistics:

- (1) Slopes for feedback speed, a_{1fn} , feedback torque, a_{1T} , and feedback power a_{1P} .
- (2) Intercepts for feedback speed, a_{0fn} , feedback torque, a_{0T} , and feedback power a_{0P} .
- (3) Standard estimates of error for feedback speed, SEE_{fn} , feedback torque, SEE_T , and feedback power SEE_P .
- (4) Coefficients of determination for feedback speed, r^2_{fn} , feedback torque, r^2_T , and feedback power r^2_P .

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

- (1) For variable-speed engines, apply all the statistical criteria in Table 2 of this section.
- (2) For constant-speed engines, apply only the statistical criteria for torque in Table 2 of this section.

TABLE 2 OF § 1065.514.—DEFAULT STATISTICAL CRITERIA FOR VALIDATING DUTY CYCLES

Parameter	Speed	Torque	Power
Slope, a_1	$0.950 \leq a_1 \leq 1.030$	$0.830 \leq a_1 \leq 1.030$	$0.830 \leq a_1 \leq 1.030$.
Absolute value of intercept, $|a_0|$ .....	$\leq 10\%$ of warm idle	$\leq 2.0\%$ of maximum mapped torque.	$\leq 2.0\%$ of maximum mapped power.
Standard error of estimate, SEE ...	$\leq 5.0\%$ of maximum test speed ...	$\leq 10\%$ of maximum mapped torque.	$\leq 10\%$ of maximum mapped power.
Coefficient of determination, r^2	≥ 0.970	≥ 0.850	≥ 0.910 .

66. Section 1065.520 is amended by revising paragraphs (b), (f)(1), (g) introductory text, and (g)(7)(iii) to read as follows:

§ 1065.520 Pre-test verification procedures and pre-test data collection.

- * * * * *
- (b) Unless the standard-setting part specifies different tolerances, verify that ambient conditions are within the following tolerances before the test:
 - (1) Ambient temperature of (20 to 30) °C.
 - (2) Intake air temperature of (20 to 30) °C upstream of all engine components.
 - (3) Atmospheric pressure of (80.000 to 103.325) kPa and within $\pm 5\%$ of the value recorded at the time of the last engine map.

(4) Dilution air conditions as specified in § 1065.140.

- * * * * *
- (f) * * *
- (1) Start the engine and use good engineering judgment to bring it to one of the following:
 - (i) 100% torque at any speed above its peak-torque speed.
 - (ii) 100% operator demand.

* * * * *

(g) After the last practice or preconditioning cycle before an emission test, verify the amount of nonmethane contamination in the exhaust and background HC sampling

systems. You may omit verifying the contamination of a background HC sampling system if its contamination was verified within ten days before testing. For any NMHC measurement system that involves separately measuring methane and subtracting it from a THC measurement, verify the amount of HC contamination using only the THC analyzer response. There is no need to operate any separate methane analyzer for this verification. Perform this verification as follows:

- * * * * *
- (7) * * *
- (iii) 2 $\mu\text{mol/mol}$.
- * * * * *

67. Section 1065.525 is revised to read as follows:

§ 1065.525 Engine starting, restarting, optional repeating of void discrete modes and shutdown.

- (a) Start the engine using one of the following methods:
 - (1) Start the engine as recommended in the owners manual using a production starter motor or air-start system and either an adequately charged battery, a suitable power supply, or a suitable compressed air source.
 - (2) Use the dynamometer to start the engine. To do this, motor the engine within $\pm 25\%$ of its typical in-use cranking speed. Stop cranking within 1 second of starting the engine.

(b) If the engine does not start after 15 seconds of cranking, stop cranking and determine why the engine failed to start, unless the owners manual or the service-repair manual describes the longer cranking time as normal.

- (c) Respond to engine stalling with the following steps:
 - (1) If the engine stalls during warm-up before emission sampling begins, restart the engine and continue warm-up.
 - (2) If the engine stalls during preconditioning before emission sampling begins, restart the engine and restart the preconditioning sequence.
 - (3) If the engine stalls at any time after emission sampling begins for a transient test or ramped-modal cycle test, the test is void.

(4) Except as described in paragraph (d) of this section, void the test if the engine stalls at any time after emission sampling begins.

(d) If emission sampling is interrupted during one of the modes of a discrete-mode test, you may void the results only for that individual mode and perform the following steps to continue the test:

- (i) If the engine has stalled, restart the engine.

- (ii) Use good engineering judgment to restart the test sequence using the appropriate steps in § 1065.530(b).
- (iii) Precondition the engine by operating at the previous mode for

approximately the same amount of time it operated at that mode for the last emission measurement.

(iv) Advance to the mode at which the engine stalled and continue with the duty cycle as specified in the standard-setting part.

(v) Complete the remainder of the test according to the requirements in this subpart.

(e) Shut down the engine according to the manufacturer's specifications.

68. Section 1065.530 is revised to read as follows:

§ 1065.530 Emission test sequence.

(a) Time the start of testing as follows:

(1) Perform one of the following if you precondition sampling systems as described in § 1065.520(f):

(i) For cold-start duty cycles, shut down the engine. Unless the standard-setting part specifies that you may only perform a natural engine cooldown, you may perform a forced engine cooldown. Use good engineering judgment to set up systems to send cooling air across the engine, to send cool oil through the engine lubrication system, to remove heat from coolant through the engine cooling system, and to remove heat from any exhaust aftertreatment systems. In the case of a forced aftertreatment cooldown, good engineering judgment would indicate that you not start flowing cooling air until the aftertreatment system has cooled below its catalytic activation temperature. For platinum-group metal catalysts, this temperature is about 200 °C. Once the aftertreatment system has naturally cooled below its catalytic activation temperature, good engineering judgment would indicate that you use clean air with a temperature of at least 15 °C, and direct the air through the aftertreatment system in the normal direction of exhaust flow. Do not use any cooling procedure that results in unrepresentative emissions (see § 1065.10(c)(1)). You may start a cold-start duty cycle when the temperatures of an engine's lubricant, coolant, and aftertreatment systems are all between (20 and 30) °C.

(ii) For hot-start emission measurements, shut down the engine. Start the hot-start duty cycle as specified in the standard-setting part.

(iii) For testing that involves hot-stabilized emission measurements, such as any steady-state testing, you may continue to operate the engine at maximum test speed and 100% torque if that is the first operating point. Otherwise, operate the engine at warm idle or the first operating point of the duty cycle. In any case, start the emission test within 10 min after you

complete the preconditioning procedure.

(2) If you do not precondition sampling systems, perform one of the following:

(i) For cold-start duty cycles, prepare the engine according to paragraph (a)(1)(i) of this section.

(ii) For hot-start emission measurements, first operate the engine at any speed above peak-torque speed and at (65 to 85)% of maximum mapped power until either the engine coolant, block, or head absolute temperature is within $\pm 2\%$ of its mean value for at least 2 min or until the engine thermostat controls engine temperature. Shut down the engine. Start the duty cycle within 20 min of engine shutdown.

(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 coolant, block, or head absolute temperature is within $\pm 2\%$ of its mean value for at least 2 min, or as the point at which the engine thermostat controls engine temperature.

(b) Take the following steps before emission sampling begins:

(1) For batch sampling, connect clean storage media, such as evacuated bags or tare-weighed filters.

(2) Start all measurement instruments according to the instrument manufacturer's instructions and using good engineering judgment.

(3) Start dilution systems, sample pumps, cooling fans, and the data-collection system.

(4) Pre-heat or pre-cool heat exchangers in the sampling system to within their operating temperature tolerances for a test.

(5) Allow heated or cooled components such as sample lines, filters, chillers, and pumps to stabilize at their operating temperatures.

(6) Verify that there are no significant vacuum-side leaks according to § 1065.345.

(7) Adjust the sample flow rates to desired levels, using bypass flow, if desired.

(8) Zero or re-zero any electronic integrating devices, before the start of any test interval.

(9) Select gas analyzer ranges. You may automatically or manually switch gas analyzer ranges during a test only if switching is performed by changing the span over which the digital resolution of the instrument is applied. During a test you may not switch the gains of an analyzer's analog operational amplifier(s).

(10) Zero and span all continuous analyzers using NIST-traceable gases that meet the specifications of § 1065.750. Span FID analyzers on a carbon number basis of one (1), C_1 . For example, if you use a C_3H_8 span gas of concentration 200 $\mu\text{mol/mol}$, span the FID to respond with a value of 600 $\mu\text{mol/mol}$. Span FID analyzers consistently with the determination of their respective response factors, *RF*, and penetration fractions, *PF*, according to § 1065.365.

(11) We recommend that you verify gas analyzer responses after zeroing and spanning by sampling a calibration gas that has a concentration near one-half of the span gas concentration. Based on the results and good engineering judgment, you may decide whether or not to re-zero, re-span, or re-calibrate a gas analyzer before starting a test.

(12) If you correct for dilution air background concentrations of engine exhaust constituents, start measuring and recording background concentrations.

(13) Drain any condensate from the intake air system and close any intake air condensate drains that are not normally open during in-use operation.

(c) Start testing as follows:

(1) If an engine is already running and warmed up, and starting is not part of the duty cycle, perform the following for the various duty cycles:

(i) Transient and steady-state ramped-modal cycles. Simultaneously start running the duty cycle, sampling exhaust gases, recording data, and integrating measured values.

(ii) Steady-state discrete-mode cycles. Control the engine operation to match the first mode in the test cycle. This will require controlling engine speed and load, engine load, or other operator demand settings, as specified in the standard-setting part. Follow the instructions in the standard-setting part to determine how long to stabilize engine operation at each mode, how long to sample emissions at each mode, and how to transition between modes.

(2) If engine starting is part of the duty cycle, initiate data logging, sampling of exhaust gases, and integrating measured values before attempting to start the engine. Initiate the duty cycle when the engine starts.

(d) At the end of each test interval, continue to operate all sampling and dilution systems to allow the sampling system's response time to elapse. Then stop all sampling and recording, including the recording of background samples. Finally, stop any integrating devices and indicate the end of the duty cycle in the recorded data.

(e) Shut down the engine if you have completed testing or if it is part of the duty cycle.

(f) If testing involves another duty cycle after a soak period with the engine off, start a timer when the engine shuts down, and repeat the steps in paragraphs (b) through (e) of this section as needed.

(g) Take the following steps after emission sampling is complete:

(1) For any proportional batch sample, such as a bag sample or PM sample, verify that proportional sampling was maintained according to § 1065.545. Void any samples that did not maintain proportional sampling according to § 1065.545.

(2) Place any used PM samples into covered or sealed containers and return them to the PM-stabilization environment. Follow the PM sample post-conditioning and total weighing procedures in § 1065.595.

(3) As soon as practical after the duty cycle is complete but no later than 30 minutes after the duty cycle is complete, perform the following:

(i) Zero and span all batch gas analyzers.

(ii) Analyze any gaseous batch samples, including background samples.

(4) After quantifying exhaust gases, verify drift as follows:

(i) For batch and continuous gas analyzers, record the mean analyzer value after stabilizing a zero gas to the analyzer. Stabilization may include time to purge the analyzer of any sample gas, plus any additional time to account for analyzer response.

(ii) Record the mean analyzer value after stabilizing the span gas to the analyzer. Stabilization may include time to purge the analyzer of any sample gas, plus any additional time to account for analyzer response.

(iii) Use these data to validate and correct for drift as described in § 1065.550.

(h) Unless the standard-setting part specifies otherwise, determine whether or not the test meets the cycle-validation criteria in § 1065.514.

(1) If the criteria void the test, you may retest using the same denormalized duty cycle, or you may re-map the engine, denormalize the reference duty cycle based on the new map and retest the engine using the new denormalized duty cycle.

(2) If the criteria void the test for a constant-speed engine only during commands of maximum test torque, you may do the following:

(i) Determine the first and last feedback speeds at which maximum test torque was commanded.

(ii) If the last speed is greater than or equal to 90% of the first speed, the test

is void. You may retest using the same denormalized duty cycle, or you may re-map the engine, denormalize the reference duty cycle based on the new map and retest the engine using the new denormalized duty cycle.

(iii) If the last speed is less than 90% of the first speed, reduce maximum test torque by 5%, and proceed as follows:

(A) Denormalize the entire duty cycle based on the reduced maximum test torque according to § 1065.512.

(B) Retest the engine using the denormalized test cycle that is based on the reduced maximum test torque.

(C) If your engine still fails the cycle criteria, reduce the maximum test torque by another 5% of the original maximum test torque.

(D) If your engine fails after repeating this procedure four times, such that your engine still fails after you have reduced the maximum test torque by 20% of the original maximum test torque, notify us and we will consider specifying a more appropriate duty cycle for your engine under the provisions of § 1065.10(c).

69. Section 1065.545 is amended by revising paragraph (b)(2) to read as follows:

§ 1065.545 Validation of proportional flow control for batch sampling.

* * * * *

(b) * * *

(2) *Positive-displacement pump option.* You may use the 1 Hz (or more frequently) recorded pump-inlet conditions. Demonstrate that the flow density at the pump inlet was constant within $\pm 2.5\%$ of the mean or target density over each test interval. For a CVS pump, you may demonstrate this by showing that the absolute temperature at the pump inlet was constant within $\pm 2\%$ of the mean or target absolute temperature over each test interval.

* * * * *

70. Section 1065.550 is revised to read as follows:

§ 1065.550 Gas analyzer range validation, drift validation, and drift correction.

(a) *Range validation.* If an analyzer operated above 100% of its range at any time during the test, perform the following steps:

(1) For batch sampling, re-analyze the sample using the lowest analyzer range that results in a maximum instrument response below 100%. Report the result from the lowest range from which the analyzer operates below 100% of its range.

(2) For continuous sampling, repeat the entire test using the next higher analyzer range. If the analyzer again

operates above 100% of its range, repeat the test using the next higher range. Continue to repeat the test until the analyzer always operates at less than 100% of its range.

(b) *Drift validation and drift correction.* Calculate two sets of brake-specific emission results. Calculate one set using the data before drift correction and calculate the other set after correcting all the data for drift according to § 1065.672. Use the two sets of brake-specific emission results as follows:

(1) If the difference between the corrected and uncorrected brake-specific emissions are within $\pm 4\%$ of the uncorrected results or within $\pm 4\%$ of the applicable standard for all regulated emissions, the test is validated for drift. If not, the entire test is void.

(2) If the test is validated for drift, you must use only the drift-corrected emission results when reporting emissions, unless you demonstrate to us that using the drift-corrected results adversely affects your ability to demonstrate that your engine complies with the applicable standards.

71. Section 1065.590 is amended by revising paragraph (j)(9) to read as follows:

§ 1065.590 PM sample preconditioning and tare weighing.

* * * * *

(j) * * *

(9) Once weighing is completed, follow the instructions given in paragraphs (g) through (i) of this section.

72. Section 1065.595 is amended by revising paragraph (e) to read as follows:

§ 1065.595 PM sample post-conditioning and total weighing.

* * * * *

(e) To stabilize PM samples, place them in one or more containers that are open to the PM-stabilization environment, which is described in § 1065.190. A PM sample is stabilized as long as it has been in the PM-stabilization environment for one of the following durations, during which the stabilization environment has been within the specifications of § 1065.190:

(1) If you expect that a filter's total surface concentration of PM will be greater than about $0.5 \mu\text{g}/\text{mm}^2$, expose the filter to the stabilization environment for at least 60 minutes before weighing.

(2) If you expect that a filter's total surface concentration of PM will be less than about $0.5 \mu\text{g}/\text{mm}^2$, expose the filter to the stabilization environment for at least 30 minutes before weighing.

(3) If you are unsure of a filter's total surface concentration of PM, expose the filter to the stabilization environment for at least 60 minutes before weighing.

(4) Note that 0.5 µg/mm² is approximately equal to 567 µg of net PM mass on a PM filter with a 38 mm diameter stain area. It is also an approximate surface concentration at 0.07 g/kW·hr for a hot-start test with compression-ignition engines tested according to 40 CFR part 86, subpart N, or 50 mg/mile for a light-duty vehicle tested according to 40 CFR part 86, subpart B.

* * * * *

Subpart G—[Amended]

73. Section 1065.610 is amended by revising paragraph (b)(1) before the equation to read as follows:

§ 1065.610 Duty cycle generation.

* * * * *

(b) *Maximum test torque, T_{test}.* For constant-speed engines, determine the measured T_{test} from the power-versus-speed map, generated according to § 1065.510, as follows:

(1) Based on the map, determine maximum power, P_{max}, and the speed at which maximum power occurs, f_{nPmax}. Divide every recorded power by P_{max} and divide every recorded speed by f_{nPmax}. The result is a normalized power-versus-speed map. Your measured T_{test} is the torque at which the sum of the squares of normalized speed and power is maximum, as follows:

74. Section 1065.642 is amended as follows:

a. By revising the reference “Eq. 1065.640–4” to read “Eq. 1065.640–5”.

b. By revising the reference “Eq. 1065.640–5” in paragraph (b) to read “Eq. 1065.640–6”.

c. By revising the reference “Eq. 1065.640–6” in paragraph (b) to read “Eq. 1065.640–7”.

75. Section 1065.650 is amended by revising the reference to “1065.650–5” in paragraph (e)(4) to be “Eq. 1065.650–5” and adding Equation 1065.650–5 after Equation 1065.650–4 in paragraph (b)(2)(i) to read as follows:

§ 1065.650 Emission calculations.

* * * * *
 (b) * * *
 (2) * * *
 (i) * * *

Where:

$$\Delta t = 1/f_{\text{record}} \quad \text{Eq. 1065.650-5}$$

* * * * *

76. Section 1065.655 is amended by revising paragraphs (c) introductory text and (d)(1)(ii) to read as follows:

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

* * * * *

(c) *Chemical balance procedure.* The calculations for a chemical balance involve a system of equations that require iteration. We recommend using a computer to solve this system of equations. You must guess the initial values of up to three quantities: the amount of water in the measured flow, x_{H2O}, fraction of dilution air in diluted exhaust, x_{dil}, and the amount of products on a C₁ basis per dry mole of dry measured flow, x_{Cproddry}. For each emission concentration, x, and amount of water, x_{H2O}, you must determine their completely dry concentrations, x_{dry} and x_{H2Odry}. You must also use your fuel’s atomic hydrogen-to-carbon ratio, α, and oxygen-to-carbon ratio, β. For your fuel, you may measure α and β or you may use the default values in Table 1 of § 1065.650. Use the following steps to complete a chemical balance:

* * * * *

(d) * * *
 (1) * * *

(ii) During emission testing you route open crankcase flow to the exhaust according to § 1065.130(i).

* * * * *

Subpart H—[Amended]

77. Section 1065.701 is amended by revising paragraphs (c) introductory text and (e) to read as follows:

§ 1065.701 General requirements for test fuels.

* * * * *

(c) *Fuels not specified in this subpart.* If you produce engines that run on a type of fuel (or mixture of fuels) that we do not specify in this subpart, you must get our written approval to establish the appropriate test fuel. See the standard-setting part for provisions related to fuels not specified in this subpart. We will generally allow you to use the fuel if you show us all the following things are true:

- (1) Show that this type of fuel is commercially available.
- (2) Show that your engines will use only the designated fuel in service.
- (3) Show that operating the engines on the fuel we specify would unrepresentatively increase emissions or decrease durability.

* * * * *

(e) *Service accumulation and field testing fuels.* If we do not specify a service-accumulation or field-testing fuel in the standard-setting part, use an appropriate commercially available fuel such as those meeting minimum specifications from the following table:

TABLE 1 OF § 1065.701.—EXAMPLES OF SERVICE-ACCUMULATION AND FIELD-TESTING FUELS

Fuel category	Subcategory	Reference procedure ¹
Diesel	Light distillate and light blends with residual	ASTM D975–04c
	Middle distillate	ASTM D6751–03a
	Biodiesel (B100)	ASTM D6985–04a
Intermediate and residual fuel	All	See § 1065.705
Gasoline	Motor vehicle gasoline	ASTM D4814–04b
	Minor oxygenated gasoline blends	ASTM D4814–04b
Alcohol	Ethanol (Ed75–85)	ASTM D5798–99
	Methanol (M70–M85)	ASTM D5797–96
Aviation fuel	Aviation gasoline	ASTM D910–04a
	Gas turbine	ASTM D1655–04a
Gas turbine fuel	Jet B wide cut	ASTM D6615–04a
	General	ASTM D2880–03

¹ ASTM specifications are incorporated by reference in § 1065.1010.

78. Section 1065.703 is amended by revising Table 1 to read as follows:

§ 1065.703 Distillate diesel fuel.

* * * * *

TABLE 1 OF § 1065.703.—TEST FUEL SPECIFICATIONS FOR DISTILLATE DIESEL FUEL

Item	Units	Ultra low sulfur	Low sulfur	High sulfur	Reference procedure ¹
Cetane Number .....	.....	40–50	40–50	40–50	ASTM D 613–03b
Distillation range	°C.				
Initial boiling point .....	.....	171–204	171–204	171–204	ASTM D 86–04b
10 pct. point .....	.....	204–238	204–238	204–238	
50 pct. point .....	.....	243–282	243–282	243–282	
90 pct. point .....	.....	293–332	293–332	293–332	
Endpoint .....	.....	321–366	321–366	321–366	
Gravity	°API	32–37	32–37	32–37	ASTM D 287–92
Total sulfur	mg/kg	7–15	300–500	2000–4000	ASTM D 2622–03
Aromatics, min. (Remainder shall be paraffins, naphthalenes, and olefins).	g/kg	100	100	100	ASTM D 5186–03
Flashpoint, min	°C	54	54	54	ASTM D 93–02a
Kinematic Viscosity	cSt	2.0–3.2	2.0–3.2	2.0–3.2	ASTM D 445–04

¹ ASTM procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.

79. Section 1065.705 is revised to read as follows:

§ 1065.705 Residual and intermediate residual fuel.

This section describes the specifications for fuels meeting the

definition of residual fuel in 40 CFR 80.2, including fuels marketed as intermediate fuel. Residual fuels for service accumulation and any testing must meet the following specifications:

(a) The fuel must be a commercially available fuel that is representative of

the fuel that will be used by the engine in actual use.

(b) The fuel must meet the specifications for one of the categories in the following table:

TABLE 1 OF § 1065.705.—SERVICE ACCUMULATION AND TEST FUEL SPECIFICATIONS FOR RESIDUAL FUEL

Characteristic	Unit	Category ISO-F–										Test method reference ¹
		RMA 30	RMB 30	RMD 80	RME 180	RMF 180	RMG 380	RMH 380	RMK 380	RMH 700	RMK 700	
Density at 15 °C, max	kg/m ³	960.0	975.0	980.0	991.0		991.0		1010.0	991.0	1010.0	ISO 3675 or ISO 12185: 1996/Cor 1:2001 (see also ISO 8217:2005(E) 7.1).
Kinematic viscosity at 50 °C, max.	cSt	30.0		80.0	180.0		380.0		700.0			ISO 3104:1994/Cor 1:1997.
Flash point, min	°C	60		60	60		60		60			ISO 2719 (see also ISO 8217:2005(E) 7.2).
Pour point (upper) Winter quality, max. Summer quality, max	°C	0	24	30	30		30		30			ISO 3016.
Carbon residue, max	(kg/kg)%	10		14	15	20	18	22	22			ISO 10370:1993/Cor 1:1996.
Ash, max	(kg/kg)%	0.10		0.10	0.10	0.15	0.15		0.15			ISO 6245.
Water, max	(m ³ /m ³)%	0.5		0.5	0.5		0.5		0.5			ISO 3733.
Sulfur, max	(kg/kg)%	3.50		4.00	4.50		4.50		4.50			ISO 8754 or ISO 14596: 1998/Cor 1:1999 (see also ISO 8217:2005(E) 7.3).
Vanadium, max	mg/kg	150		350	200	500	300	600	600			ISO 14597 or IP 501 or IP 470 (see also ISO 8217:2005(E) 7.8).
Total sediment potential, max.	(kg/kg)%	0.10		0.10	0.10		0.10		0.10			ISO 10307–2 (see also ISO 8217:2005(E) 7.6).
Aluminium plus silicon, max.	mg/kg	80		80	80		80		80			ISO 10478 or IP 501 or IP 470 (see also ISO 8217:2005(E) 7.9).
Used lubricating oil (ULO), max.	mg/kg	Fuel shall be free of ULO. We consider a fuel to be free of ULO if one or more of the elements zinc, phosphorus, or calcium is at or below the specified limits. We consider a fuel to contain ULO if all three elements exceed the specified limits.										
Zinc .....	.....	15										IP 501 or IP 470 (see ISO 8217:2005(E) 7.7).

TABLE 1 OF § 1065.705.—SERVICE ACCUMULATION AND TEST FUEL SPECIFICATIONS FOR RESIDUAL FUEL—Continued

Characteristic	Unit	Category ISO-F-										Test method reference ¹
		RMA 30	RMB 30	RMD 80	RME 180	RMF 180	RMG 380	RMH 380	RMK 380	RMH 700	RMK 700	
Phosphorus	15										IP 501 or IP 500 (see ISO 8217:2005(E) 7.7). IP 501 or IP 470 (see ISO 8217:2005(E) 7.7).
Calcium	30										

¹ ISO procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.

80. Section 1065.710 is amended by **§ 1065.710 Gasoline.**
revising Table 1 to read as follows: * * * * *

TABLE 1 OF § 1065.710.—TEST FUEL SPECIFICATIONS FOR GASOLINE

Item	Units	General testing	Low-temperature testing	Reference procedure ¹
Distillation Range	°C.			
Initial boiling point .....	.....	24–35 ²	24–36	ASTM D 86–04b
10% point .....	.....	49–57	37–48	
50% point .....	.....	93–110	82–101	
90% point .....	.....	149–163	158–174	
End point .....	.....	Maximum, 213	Maximum, 212	
Hydrocarbon composition: m ³ /m ³ .				
Olefins .....	.....	Maximum, 0.10	Maximum 0.175	ASTM D 1319–03
Aromatics .....	.....	Maximum, 0.35	Maximum, 0.304	
Saturates .....	.....	Remainder	Remainder	
Lead (organics)	g/liter	Maximum, 0.013	Maximum, 0.013	ASTM D 3237–02
Phosphorous	g/liter	Maximum, 0.0013	Maximum, 0.005	ASTM D 3231–02
Total sulfur	mg/kg	Maximum, 80	Maximum, 80	ASTM D 1266–98
Volatility (Reid Vapor Pressure).	kPa	60.0–63.4 ^{2,3}	77.2–81.4	ASTM D 323–99a

¹ ASTM procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.

² For testing at altitudes above 1 219 m, the specified volatility range is (52.0 to 55.2) kPa and the specified initial boiling point range is (23.9 to 40.6 °C).

³ For testing unrelated to evaporative emissions, the specified range is (55.2 to 63.4) kPa.

81. Section 1065.715 is revised to read as follows:

§ 1065.715 Natural gas.

(a) Except as specified in paragraph (b) of this section, natural gas for testing must meet the specifications in the following table:

TABLE 1 OF § 1065.715.—TEST FUEL SPECIFICATIONS FOR NATURAL GAS

Item	Value ¹ (mol/mol)
Methane, CH ₄	Minimum, 0.87.
Ethane, C ₂ H ₆	Maximum, 0.055.
Propane, C ₃ H ₈	Maximum, 0.012.
Butane, C ₄ H ₁₀	Maximum, 0.0035.
Pentane, C ₅ H ₁₂	Maximum, 0.0013.
C ₆ and higher	Maximum, 0.001.
Oxygen	Maximum, 0.001.

TABLE 1 OF § 1065.715.—TEST FUEL SPECIFICATIONS FOR NATURAL GAS—Continued

Item	Value ¹ (mol/mol)
Inert gases (sum of CO ₂ and N ₂).	Maximum, 0.051.

¹ All parameters are based on the reference procedures in ASTM D 1945–03 (incorporated by reference in § 1065.1010). See § 1065.710(d) for other allowed procedures.

(b) In certain cases you may use test fuel not meeting the specifications in paragraph (a) of this section, as follows:

(1) You may use fuel that your in-use engines normally use, such as pipeline natural gas.

(2) You may use fuel meeting alternate specifications if the standard-setting part allows it.

(3) You may ask for approval to use fuel that does not meet the

specifications in paragraph (a) of this section, but only if using the fuel would not adversely affect your ability to demonstrate compliance with the applicable standards.

(c) When we conduct testing using natural gas, we will use fuel that meets the specifications in paragraph (a) of this section.

(d) At ambient conditions, natural gas must have a distinctive odor detectable down to a concentration in air not more than one-fifth the lower flammable limit.

82. Section 1065.720 is revised to read as follows:

§ 1065.720 Liquefied petroleum gas.

(a) Except as specified in paragraph (b) of this section, liquefied petroleum gas for testing must meet the specifications in the following table:

TABLE 1 OF § 1065.720.—TEST FUEL SPECIFICATIONS FOR LIQUEFIED PETROLEUM GAS

Item	Value	Reference Procedure ¹
Propane, C ₃ H ₈	Minimum, 0.85 m ³ /m ³	ASTM D 2163–91

TABLE 1 OF § 1065.720.—TEST FUEL SPECIFICATIONS FOR LIQUEFIED PETROLEUM GAS—Continued

Item	Value	Reference Procedure ¹
Vapor pressure at 38°C	Maximum, 1400 kPa	ASTM D 1267-02 or 2598-02 ²
Volatility residue (evaporated temperature, 35 °C)	Maximum, -38°C	ASTM D 1837-02a
Butanes	Maximum, 0.05 m ³ /m ³	ASTM D 2163-91
Butenes	Maximum, 0.02 m ³ /m ³	ASTM D 2163-91
Pentenes and heavier	Maximum, 0.005 m ³ /m ³	ASTM D 2163-91
Propene	Maximum, 0.1 m ³ /m ³	ASTM D 2163-91
Residual matter (residue on evap. of 100) ml oil stain observ.)	Maximum, 0.05 ml pass ³	ASTM D 2158-04
Corrosion, copper strip	Maximum, No. 1	ASTM D 1838-03
Sulfur	Maximum, 80 mg/kg	ASTM D 2784-98
Moisture content	pass	ASTM D 2713-91

¹ ASTM procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.

² If these two test methods yield different results, use the results from ASTM D 1267-02.

³ The test fuel must not yield a persistent oil ring when you add 0.3 ml of solvent residue mixture to a filter paper in 0.1 ml increments and examine it in daylight after two minutes.

(b) In certain cases you may use test fuel not meeting the specifications in paragraph (a) of this section, as follows:

(1) You may use fuel that your in-use engines normally use, such as commercial-quality liquefied petroleum gas.

(2) You may use fuel meeting alternate specifications if the standard-setting part allows it.

(3) You may ask for approval to use fuel that does not meet the specifications in paragraph (a) of this section, but only if using the fuel would not adversely affect your ability to demonstrate compliance with the applicable standards.

(c) When we conduct testing using liquefied petroleum gas, we will use fuel that meets the specifications in paragraph (a) of this section.

(d) At ambient conditions, liquefied petroleum gas must have a distinctive odor detectable down to a concentration in air not more than one-fifth the lower flammable limit.

83. Section 1065.750 is amended by revising paragraphs (a)(2), (a)(3), and (a)(4) to read as follows:

§ 1065.750 Analytical Gases.

* * * * *

(a) * * *

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

(i) *FID fuel*. Use FID fuel with a stated H₂ concentration of (0.400 ± 0.004) mol/mol, balance He, and a stated total hydrocarbon concentration of 0.05 μmol/mol or less.

(ii) *FID burner air*. Use FID burner air that meets the specifications of purified air in paragraph (a)(1) of this section. For field testing, you may use ambient air.

(iii) *FID zero gas*. Zero flame-ionization detectors with purified gas that meets the specifications in paragraph (a)(1) of this section, except that the purified gas O₂ 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 flow-weighted mean concentration of O₂ expected during testing.

(iv) *FID propane span gas*. Span and calibrate THC FID with span concentrations of propane, C₃H₈. Calibrate on a carbon number basis of one (C₁). For example, if you use a C₃H₈ span gas of concentration 200 μmol/mol, span a FID to respond with a value of 600 μmol/mol. Note that FID span balance gases may be any combination of purified air and purified nitrogen. We recommend FID analyzer span gases that contain approximately the flow-weighted mean concentration of O₂ expected during testing. If the expected exhaust O₂ concentration is zero, we recommend using a balance gas of purified nitrogen.

(v) *FID methane span gas*. If you always span and calibrate a CH₄ FID with a nonmethane cutter, then span and calibrate the FID with span concentrations of methane, CH₄. Calibrate on a carbon number basis of one (C₁). For example, if you use a CH₄ span gas of concentration 200 μmol/mol, span a FID to respond with a value of 200 μmol/mol. Note that FID span balance gases may be any combination of purified air and purified nitrogen. We recommend FID analyzer span gases that contain approximately the flow-weighted mean concentration of O₂ expected during testing. If the expected exhaust O₂ concentration is zero, we recommend using a balance gas of purified nitrogen.

(3) Use the following gas mixtures, with gases traceable within ±1.0% of the NIST accepted value or other gas standards we approve:

(i) CH₄, balance purified synthetic air and/or N₂ (as applicable).

(ii) C₂H₆, balance purified synthetic air and/or N₂ (as applicable).

(iii) C₃H₈, balance purified synthetic air and/or N₂ (as applicable).

(iv) CO, balance purified N₂.

(v) CO₂, balance purified N₂.

(vi) NO, balance purified N₂.

(vii) NO₂, balance purified synthetic air.

(viii) O₂, balance purified N₂.

(ix) C₃H₈, CO, CO₂, NO, balance purified N₂.

(x) C₃H₈, CH₄, CO, CO₂, NO, balance purified N₂.

(4) You may use gases for species other than those listed in paragraph (a)(3) of this section (such as methanol in air, which you may use to determine response factors), as long as they are traceable to within ±1.0% of the NIST accepted value or other similar standards we approve, and meet the stability requirements of paragraph (b) of this section.

* * * * *

Subpart I—[Amended]

84. Section 1065.805 is amended by revising paragraph (a) to read as follows:

§ 1065.805 Sampling system.

(a) Proportionally dilute engine exhaust, and use batch sampling to collect flow-weighted dilute samples of the applicable alcohols and carbonyls at a constant flow rate. You may not use raw sampling for alcohols and carbonyls.

* * * * *

Subpart J—[Amended]

85. Section 1065.901 is amended by revising paragraph (b) introductory text to read as follows:

§ 1065.901 Applicability.

* * * * *

(b) *Laboratory testing*. You may use PEMS for any testing in a laboratory or

similar environment without restriction or prior approval if the PEMS meets all the specifications for the laboratory equipment that it replaces. You may also use PEMS for any testing in a laboratory or similar environment if we approve it in advance, subject to the following provisions:

* * * * *

86. Section 1065.905 is amended by revising paragraph (e) introductory text to read as follows:

§ 1065.905 General provisions.

* * * * *

(e) *Laboratory testing using PEMS.* You may use PEMS for testing in a laboratory as described in § 1065.901(b). Use the following procedures and specifications when using PEMS for laboratory testing:

* * * * *

87. Section 1065.910 is revised to read as follows:

§ 1065.910 PEMS auxiliary equipment for field testing.

For field testing you may use various types of auxiliary equipment to attach PEMS to a vehicle or engine and to power PEMS.

(a) When you use PEMS, you may route engine intake air or exhaust through a flow meter. Route the engine intake air or exhaust as follows:

(1) *Flexible connections.* Use short flexible connectors where necessary.

(i) You may use flexible connectors to enlarge or reduce the pipe diameters to match that of your test equipment.

(ii) Use flexible connectors that do not exceed a length of three times their largest inside diameter.

(iii) Use four-ply silicone-fiberglass fabric with a temperature rating of at least 315 °C for flexible connectors. You may use connectors with a spring-steel wire helix for support and you may use Nomex™ coverings or linings for durability. You may also use any other nonreactive material with equivalent permeation-resistance and durability, as long as it seals tightly.

(iv) Use stainless-steel hose clamps to seal flexible connectors, or use clamps that seal equivalently.

(v) You may use additional flexible connectors to connect to flow meters.

(2) *Tubing.* Use rigid 300 series stainless steel tubing to connect between flexible connectors. Tubing may be straight or bent to accommodate vehicle geometry. You may use T or Y fittings made of 300 series stainless steel tubing to join multiple connections, or you may cap or plug redundant flow paths if the engine manufacturer recommends it.

(3) *Flow restriction.* Use flowmeters, connectors, and tubing that do not increase flow restriction so much that it exceeds the manufacturer's maximum specified value. You may verify this at the maximum exhaust flow rate by measuring pressure at the manufacturer-specified location with your system connected. You may also perform an engineering analysis to verify an acceptable configuration, taking into account the maximum exhaust flow rate expected, the field test system's flexible connectors, and the tubing's characteristics for pressure drops versus flow.

(b) For vehicles or other motive equipment, we recommend installing PEMS in the same location where a passenger might sit. Follow PEMS manufacturer instructions for installing PEMS in cargo spaces, engine spaces, or externally such that PEMS is directly exposed to the outside environment. Locate PEMS where it will be subject to minimal sources of the following parameters:

(1) Ambient temperature changes.

(2) Ambient pressure changes.

(3) Electromagnetic radiation.

(4) Mechanical shock and vibration.

(5) Ambient hydrocarbons—if using a FID analyzer that uses ambient air as FID burner air.

(c) Use mounting hardware as required for securing flexible connectors, ambient sensors, and other equipment. Use structurally sound mounting points such as vehicle frames, trailer hitch receivers, walkspaces, and payload tie-down fittings. We recommend mounting hardware such as clamps, suction cups, and magnets that are specifically designed for your application. We also recommend considering mounting hardware such as commercially available bicycle racks, trailer hitches, and luggage racks where applicable.

(d) Field testing may require portable electrical power to run your test equipment. Power your equipment, as follows:

(1) You may use electrical power from the vehicle, equipment, or vessel, up to the highest power level, such that all the following are true:

(i) The power system is capable of safely supplying power, such that the power demand for testing does not overload the power system.

(ii) The engine emissions do not change significantly as a result the power demand for testing.

(iii) The power demand for testing does not increase output from the engine by more than 1 % of its maximum power.

(2) You may install your own portable power supply. For example, you may use batteries, fuel cells, a portable generator, or any other power supply to supplement or replace your use of vehicle power. However, you must not supply power to the vehicle, vessel, or equipment's power system under any circumstances.

88. Section 1065.915 is amended by revising paragraph (a) before the table and paragraphs (d)(1) and (d)(5)(iii)(B) to read as follows:

§ 1065.915 PEMS instruments.

(a) *Instrument specifications.* We recommend that you use PEMS that meet the specifications of subpart C of this part. For unrestricted use of PEMS in a laboratory or similar environment, use a PEMS that meets the same specifications as each lab instrument it replaces. For field testing or for testing with PEMS in a laboratory or similar environment, under the provisions of § 1065.905(b), the specifications in the following table apply instead of the specifications in Table 1 of § 1065.205.

* * * * *

(d) * * *

(1) *Recording ECM signals.* If your ECM updates a broadcast signal more or less frequently than 1 Hz, process data as follows:

(i) If your ECM updates a broadcast signal more frequently than 1 Hz, use PEMS to sample and record the signal's value more frequently. Calculate and record the 1 Hz mean of the more frequently updated data.

(ii) If your ECM updates a broadcast signal less frequently than 1 Hz, use PEMS to sample and record the signal's value at the most frequent rate. Linearly interpolate between recorded values and record the interpolated values at 1 Hz.

(iii) Optionally, you may use PEMS to electronically filter the ECM signals to meet the rise time and fall time specifications in Table 1 of this section. Record the filtered signal at 1 Hz.

* * * * *

(5) * * *

(iii) * * *

(B) Use a single BSFC value that approximates the BSFC value over a test interval (as defined in subpart K of this part). This value may be a nominal BSFC value for all engine operation determined over one or more laboratory duty cycles, or it may be any other BSFC that you determine. If you use a nominal BSFC, we recommend that you select a value based on the BSFC measured over laboratory duty cycles that best represent the range of engine operation that defines a test interval for field-

testing. You may use the methods of this paragraph (d)(5)(iii)(B) only if it does not adversely affect your ability to demonstrate compliance with applicable standards.

89. Section 1065.920 is amended by revising paragraphs (a) and (b)(7) introductory text to read as follows:

§ 1065.920 PEMS Calibrations and verifications.

(a) Subsystem calibrations and verifications. Use all the applicable calibrations and verifications in subpart D of this part, including the linearity verifications in § 1065.307, to calibrate and verify PEMS. Note that a PEMS does not have to meet the system-response specifications of § 1065.308 if it meets the overall verification described in paragraph (b) of this section. This section does not apply to ECM signals.

(7) The PEMS passes this verification if any one of the following are true for each constituent:

90. Section 1065.925 is amended by revising paragraph (h)(8) to read as follows:

§ 1065.925 PEMS preparation for field testing.

(8) If corrective action does not resolve the deficiency, you may use a contaminated HC system if it does not prevent you from demonstrating compliance with the applicable emission standards.

91. Section 1065.935 is amended by revising paragraph (e)(1) to read as follows:

§ 1065.935 Emission test sequence for field testing.

(1) Continue sampling as needed to get an appropriate amount of emission measurement, according to the standard setting part. If the standard-setting part does not describe when to stop sampling, develop a written protocol before you start testing to establish how you will stop sampling. You may not determine when to stop testing based on emission results.

Subpart K—[Amended]

92. Section 1065.1001 is amended by revising the definitions for “Regression statistics” and “Tolerance” and adding definitions in alphabetical order for “Mode”, “NIST accepted”, and “Recommend” to read as follows:

§ 1065.1001 Definitions.

- Mode means one of the following: (1) A distinct combination of engine speed and load for steady-state testing. (2) A continuous combination of speeds and load specifying a transition during a ramped-modal test. (3) A distinct operator demand setting, such as would occur when testing locomotives or constant-speed engines. NIST accepted means relating to a value that has been assigned or named by NIST. Recommend has the meaning given in § 1065.201. Regression statistics means any of the regression statistics specified in § 1065.602.

Tolerance means the interval in which 95% of a set of recorded values of a certain quantity must lie, with the remaining 5% of the recorded values deviating from the tolerance interval. Use the specified recording frequencies and time intervals to determine if a quantity is within the applicable tolerance.

93. Section 1065.1005 is amended by revising paragraph (g) to add defined acronyms for “CITT” and “FEL” in the table to read as follows:

§ 1065.1005 Symbols, abbreviations, acronyms, and units of measure.

Table with 2 columns: Acronym, Definition. Rows include CITT (Curb Idle Transmission Torque) and FEL (Family Emission Limit).

94. Section 1065.1010 is amended by revising paragraph (b) and adding paragraph (f) to read as follows:

§ 1065.1010 Reference materials.

(b) ISO material. Table 2 of this section lists material from the International Organization for Standardization that we have incorporated by reference. The first column lists the number and name of the material. The second column lists the section of this part where we reference it. Anyone may purchase copies of these materials from the International Organization for Standardization, Case Postale 56, CH-1211 Geneva 20, Switzerland or http://www.iso.org. Table 2 follows:

TABLE 2 OF § 1065.1010.—ISO MATERIALS

Table with 2 columns: Document No. and name, Part 1065 reference. Lists various ISO standards and their corresponding reference numbers.

TABLE 2 OF § 1065.1010.—ISO MATERIALS—Continued

Document No. and name	Part 1065 reference
ISO 10478:1994, Petroleum products—Determination of aluminum and silicon in fuel oils—Inductively coupled plasma emission and atomic absorption spectroscopy methods	1065.705
IP-470, Aluminum, silicon, vanadium, nickel, iron, calcium, zinc and sodium in residual fuels, by AAS finish	1065.705
IP-500 Phosphorus content of residual fuels by ultra-violet spectrometry	1065.705
IP-501 Aluminum, silicon, vanadium, nickel, iron, sodium, calcium, zinc and phosphorus in residual fuel oil, by ICP finish	1065.705

* * * * *

(f) *Institute of Petroleum material.*
Table 6 of this section lists the Institute of Petroleum standard test methods material from the Energy Institute that

we have incorporated by reference. The first column lists the number and name of the material. The second column lists the section of this part where we reference it. Anyone may purchase

copies of these materials from the Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK, +44 (0)20 7467 7100 or <http://www.energyinst.org.uk>. Table 6 follows:

TABLE 6 OF § 1065.1010.—INSTITUTE OF PETROLEUM MATERIALS

Document No. and name	Part 1065 reference
IP-470, Aluminum, silicon, vanadium, nickel, iron, calcium, zinc and sodium in residual fuels, by AAS finish	1065.705
IP-500 Phosphorus content of residual fuels by ultra-violet spectrometry	1065.705
IP-501 Aluminum, silicon, vanadium, nickel, iron, sodium, calcium, zinc and phosphorus in residual fuel oil, by ICP finish	1065.705

95. The authority citation for part 1068 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

96. Section 1068.1 is amended by revising paragraphs (a) and (b) to read as follows:

§ 1068.1 Does this part apply to me?

(a) The provisions of this part apply to everyone with respect to the following engines and to equipment using the following engines (including owners, operators, parts manufacturers, and persons performing maintenance).

(1) Locomotives and locomotive engines we regulate under 40 CFR part 1033.

(2) Land-based nonroad compression-ignition engines we regulate under 40 CFR part 1039.

(3) Stationary compression-ignition engines certified to the provisions of 40

CFR part 1039, as indicated under 40 CFR part 60, subpart III.

(4) Stationary spark-ignition engines certified to the provisions of 40 CFR parts 1048 or 1054, as indicated under 40 CFR part 60, subpart JJJJ.

(5) Marine compression-ignition engines we regulate under 40 CFR part 1042.

(6) Marine spark-ignition engines we regulate under 40 CFR part 1045.

(7) Large nonroad spark-ignition engines we regulate under 40 CFR part 1048.

(8) Recreational SI engines and vehicles we regulate under 40 CFR part 1051 (such as snowmobiles and off-highway motorcycles).

(9) Small nonroad spark-ignition engines we regulate under 40 CFR part 1054.

(b) This part does not apply to any of the following engine or vehicle categories:

(1) Light-duty motor vehicles (see 40 CFR part 86).

(2) Heavy-duty motor vehicles and motor vehicle engines (see 40 CFR part 86).

(3) Aircraft engines (see 40 CFR part 87).

(4) Land-based nonroad diesel engines we regulate under 40 CFR part 89.

(5) Small nonroad spark-ignition engines we regulate under 40 CFR part 90.

(6) Marine spark-ignition engines we regulate under 40 CFR part 91.

(7) Locomotives and locomotive engines we regulate under 40 CFR part 92.

(8) Marine diesel engines we regulate under 40 CFR parts 89 or 94.

* * * * *

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