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§ 1065.15 Engine testing.

(a) This part describes the procedures for performing exhaust emission tests on engines that must meet emission standards.

(b) Generally, you must test an engine while operating it on a laboratory dynamometer over a prescribed sequence. (Subpart J of this part describes in-use testing of engines installed in vehicles or equipment.) You need to sample and analyze the exhaust gases generated during engine operation to determine the concentration of the regulated pollutants.

(c) Concentrations are converted into units of grams of pollutant per kilowatt-hour (g/kW-hr) or similar units for comparison to emission standards. If the applicable emission standards are expressed as g/bhp-hr, references in this part to kW should generally be interpreted to mean horsepower.

§ 1065.20 Limits for test conditions.

(a) Unless specified elsewhere in this chapter, you may conduct tests to determine compliance with duty-cycle emission standards at ambient temperatures of 20–30° C (68–86° F), ambient pressures of 600–775 mm Hg, and any ambient humidity level.

(b) Follow the standard-setting part for ambient conditions when testing to determine compliance with not-to-exceed or other off-cycle emission standards.

(c) For engine testing in a laboratory, you may heat, cool, and/or dehumidify the dilution air before it enters the CVS.

(d) For engine testing in a laboratory, if the barometric pressure observed while generating the maximum-torque curve changes by more than 25 mm Hg from the value measured when you started mapping, you must remap the engine. Also, to have a valid test, the average barometric pressure observed during the exhaust emission test must be within 25 mm Hg of the average observed during the maximum torque curve generation (see § 1065.510).

Subpart B—Equipment and Analyzers

§ 1065.101 Overview.

This subpart describes equipment and analyzers for measuring emissions. Subpart D of this part describes how to calibrate these devices and subpart C of this part defines the accuracy and purity specifications of analytical gases.

§ 1065.105 Dynamometer and engine equipment specifications.

(a) The engine dynamometer system must be able to control engine torque and speed simultaneously over the applicable test cycles within the accuracies specified in § 1065.530. If your dynamometer cannot meet the accuracy requirements in § 1065.530, you must get our approval before using it. For transient testing, issue command set points for engine torque and speed at 5 Hz or greater (10 Hz recommended). Record feedback engine torque and speed at least once every second during the test. In addition to these general requirements, make sure your engine or dynamometer's readout signals for speed and torque meet the following accuracies for all testing:

(1) Engine speed readout must be accurate to within ±2 percent of the absolute standard value. A 60-tooth (or greater) wheel in combination with a common mode rejection frequency counter is considered an absolute standard for engine or dynamometer speed.

(2) Engine flywheel torque readout must meet one of the two following standards for accuracy:

(i) Within ±3 percent of the NIST true value torque (as defined in § 1065.315).

(ii) The following accuracies:

If the full-scale torque value is...	Engine flywheel torque readout must be within...
T ≤ 550 ft-lbs.	±2.5 ft-lbs. of NIST true value.
550 < T ≤ 1050 ft-lbs.	±5.0 ft-lbs. of NIST true value.
T > 1050 ft-lbs.	±10.0 ft-lbs. of NIST true value.

(3) Option: You may use internal dynamometer signals (such as armature current) to measure torque if you can show that the engine flywheel torque

during the test cycle conforms to paragraph (b)(2) of this section. Your measurements must compensate for increased or decreased flywheel torque because of the armature's inertia during accelerations and decelerations in the test cycle.

(b) To verify that the test engine has followed the test cycle correctly, collect the dynamometer or engine readout signals for speed and torque so you can statistically correlate the engine's actual performance with the test cycle (see § 1065.530). Normally, to do this, you would convert analog signals from the dynamometer or engine into digital values for computer storage, but all conversions must meet two criteria:

(1) Speed values used to evaluate cycles must be accurate to within 2 percent of the readout value for dynamometer or engine speed.

(2) Engine flywheel torque values used to evaluate cycles must be accurate to within 2 percent of the readout value for dynamometer or engine flywheel torque.

(c) You may combine the tolerances in paragraphs (a) and (b) of this section if you use the root mean square (RMS) method and refer accuracies of the RMS values to absolute-standard or NIST true values.

(1) Speed values used to evaluate cycles must be accurate to within ±2.8 percent of the absolute standard values, as defined in paragraph (a)(1) of this section.

(2) Engine flywheel torque values used to evaluate cycles must be accurate to within ±3.6 percent of NIST true values, as determined in § 1065.315.

§ 1065.110 Exhaust gas sampling system; spark-ignition (SI) engines.

(a) *General.* The exhaust gas sampling system described in this section is designed to measure the true mass of gaseous emissions in the exhaust of SI engines. (If the standard-setting part requires determination of THCE or NMHCE for your engine, then see subpart I of this part for additional requirements.) Under the constant-volume sampler (CVS) concept, you must measure the total volume of the mixture of exhaust and dilution air and collect a continuously proportioned volume of sample for analysis. You must control flow rates so that the ratio of sample flow to CVS flow remains constant. You then determine the mass emissions from the sample concentration and total flow over the test period.

(1) Do not let the CVS or dilution air inlet system artificially lower exhaust system backpressure. To verify proper backpressures, measure pressure in the raw exhaust immediately upstream of the inlet to the CVS. Continuously measure and compare the static pressure of the raw exhaust observed during a transient cycle—with and without the CVS operating. Static pressure measured with the CVS system operating must remain within ±5 inches of water (1.2 kPa) of the static pressure measured when disconnected from the CVS, at identical moments in the test cycle. (Note: We will use sampling systems that can maintain the static pressure to within ±1 inch of water (0.25 kPa) if your written request shows that this closer tolerance is necessary.) This requirement serves as a design specification for the CVS/dilution air inlet system, and should be performed as often as good engineering practice dictates (for example, after installing an uncharacterized CVS, adding an unknown inlet restriction on the dilution air, or otherwise altering the system).

(2) The system for measuring temperature (sensors and readout) must have an accuracy and precision of ±3.4° F (±1.9° C). The temperature measuring system for a CVS without a heat exchanger must respond within 1.50 seconds to 62.5 percent of a temperature change (as measured in hot silicone oil). For a CVS with a heat exchanger, there is no specific requirement for response time.

(3) The system for measuring pressure (sensors and readout) must have an accuracy and precision of ±3 mm Hg (0.4 kPa).

(4) The flow capacity of the CVS must be large enough to keep water from condensing in the system. You may dehumidify the dilution air before it enters the CVS. You also may heat or cool the air if three conditions exist:

(i) The air (or air plus exhaust gas) temperature does not exceed 250° F (121° C).