Subpart F—Test Procedures

§ 1048.501 What procedures must I use to test my engines?

(a) Use the equipment and procedures for spark-ignition engines in 40 CFR part 1065 to show your engines meet the duty-cycle emission standards in § 1048.101(a) and (b). Measure HC, NO_X, CO, and CO_2 emissions using the full-flow dilute sampling procedures in 40 CFR part 1065. Use the applicable duty cycles in §§ 1048.505 and 1048.510.

(b) We describe in § 1048.515 the supplemental procedures for showing that your engines meet the field-testing emission standards in § 1048.101(c).

(c) Use the fuels specified in 40 CFR part 1065, subpart C, for all the testing we require in this part, except as noted in § 1048.515. Use these test fuels or any commercially available fuel for service accumulation.

(d) To test engines for evaporative emissions, use the equipment and procedures specified for testing diurnal emissions in 40 CFR 86.107–96 and 86.133–96 with fuel meeting the specifications in 40 CFR part 1065, subpart C. Measure emissions from a test engine with a complete fuel system. Reported emission levels must be based on the highest emissions from three successive 24-hour periods of cycling temperatures. Note that you may not be required to test for evaporative emissions during certification if you certify by design, as specified in § 1048.245.

(e) You may use special or alternate procedures, as described in 40 CFR 1065.10.

(f) We may reject data you generate using alternate procedures if later testing with the procedures in 40 CFR part 1065 shows contradictory emission data.

§ 1048.505 What steady-state duty cycles apply for laboratory testing?

(a) Measure emissions by testing the engine on a dynamometer with one or more of the following sets of steady-state duty cycles to show that the engine meets the steady-state standards in § 1048.101(b):

(1) Use the 7-mode duty cycle described in the following table for engines from an engine family that will be used only in variable-speed applications:

TABLE 1 OF § 1048.505—7-MODE DUTY CYCLE [1]

Mode No.	Engine speed	Observed torque [2]	Minimum time in mode (minutes)	Weighting factors
1	Maximum test speed	25	3.0	0.06
2	Intermediate test speed	100	3.0	0.02
3	Intermediate test speed	75	3.0	0.05
4	Intermediate test speed	50	3.0	0.32
5	Intermediate test speed	25	3.0	0.30
6	Intermediate test speed	10	3.0	0.10
7	Idle	0	3.0	0.15

[1] This duty cycle is analogous to the C2 cycle specified in ISO 8178–4.
[2] The percent torque is relative to the maximum torque at the given engine speed.

(2) Use the 5-mode duty cycle described in the following table if you certify an engine family for operation only at a single, rated speed:

TABLE 2 OF § 1048.505—5-MODE DUTY CYCLE FOR CONSTANT-SPEED ENGINES [1]

Mode No.	Engine speed	Torque [2]	Minimum time in mode (minutes)	Weighting factors
1	Maximum test	100	3.0	0.05
2	Maximum test	75	3.0	0.25
3	Maximum test	50	3.0	0.30
4	Maximum test	25	3.0	0.30
5	Maximum test	10	3.0	0.10

[1] This duty cycle is analogous to the D2 cycle specified in ISO 8178–4.
[2] The percent torque is relative to the maximum torque at maximum test speed.

(3) Use both of the duty cycles described in paragraphs (a)(1) and (a)(2) of this section if you will not restrict an engine family to constant-speed or variable-speed applications.

(4) Use only the duty cycle specified in paragraph (a)(2) of this section for all severe-duty engines.

(5) Use the 2-mode duty cycle described in the following table for high-load engines instead of the other duty cycles in this paragraph (a):

TABLE 3 OF § 1048.505—2-MODE DUTY CYCLE FOR HIGH-LOAD ENGINES [1]

Mode No.	Engine speed	Torque [2]	Minimum time in mode (minutes)	Weighting factors
1	Maximum test	100	3.0	0.50
2	Maximum test	75	3.0	0.50

[1] This duty cycle is derived from the D1 cycle specified in ISO 8178–4.
[2] The percent torque is relative to the maximum torque at maximum test speed.

(b) If we test an engine to confirm that it meets the duty-cycle emission standards, we will use the steady-state duty cycles that apply for that engine family.

(c) During idle mode, operate the engine with the following parameters:

(1) Hold the speed within your specifications.

(2) Keep the throttle at the idle-stop position.

(3) Keep engine torque under 5 percent of the peak torque value at maximum test speed.

(d) For the full-load operating mode, operate the engine at wide-open throttle.

(e) See 40 CFR part 1065 for detailed specifications of tolerances and calculations.

(f) In the normal test sequence described in 40 CFR part 1065, subpart F, steady-state testing generally follows the transient test. For those cases where we do not require transient testing, perform the steady-state test after an appropriate warm-up period, consistent with good engineering judgment.

§ 1048.510 What transient duty cycles apply for laboratory testing?

(a) Starting with the 2007 model year, measure emissions by testing the engine on a dynamometer with one of the following transient duty cycles to show that the engine meets the transient emission standards in § 1048.101(a):

(1) If you certify an engine family for constant-speed operation only, use the transient duty-cycle described in Appendix I of this part.

(2) For all other engines, use the transient duty-cycle described in Appendix II of this part.

(b) If we test an engine to confirm that it meets the duty-cycle emission standards, we will use the transient duty cycle that applies for that engine family.

(c) Warm up the test engine as follows:

(1) Operate the engine for the first 180 seconds of the appropriate duty cycle, then allow it to idle without load for 30 seconds. At the end of the 30-second idling period, start measuring emissions as the engine operates over the prescribed duty cycle. For severe-duty engines, this engine warm-up procedure may include up to 15 minutes of operation over the appropriate duty cycle.

(2) If the engine was already operating before a test, use good engineering judgment to let the engine cool down enough so measured emissions during the next test will accurately represent those from an engine starting at room temperature. For example, if an engine starting at room temperature warms up enough in three minutes to start closed-loop operation and achieve full catalyst activity, then minimal engine cooling is necessary before starting the next test.

(3) You are not required to measure emissions while the engine is warming up. However, you must design your emission-control system to start working as soon as possible after engine