

Environmental Protection Agency

§ 86.1363-2007

(a) Start sampling at the beginning of the first mode and continue sampling until the end of the last mode. Calculate emissions as described in 40 CFR 1065.650 and cycle statistics as described in 40 CFR 1065.514.

(b) Measure emissions by testing the engine on a dynamometer with the following ramped-modal duty cycle to determine whether it meets the applicable steady-state emission standards:

RMC mode	Time in mode (seconds)	Engine speed ^{1,2}	Torque (percent) ^{2,3}
1a Steady-state	170	Warm Idle	0
1b Transition	20	Linear Transition	Linear Transition
2a Steady-state	170	A	100
2b Transition	20	A	Linear Transition
3a Steady-state	102	A	25
3b Transition	20	A	Linear Transition
4a Steady-state	100	A	75
4b Transition	20	A	Linear Transition
5a Steady-state	103	A	50
5b Transition	20	Linear Transition	Linear Transition
6a Steady-state	194	B	100
6b Transition	20	B	Linear Transition
7a Steady-state	219	B	25
7b Transition	20	B	Linear Transition
8a Steady-state	220	B	75
8b Transition	20	B	Linear Transition
9a Steady-state	219	B	50
9b Transition	20	Linear Transition	Linear Transition
10a Steady-state	171	C	100
10b Transition	20	C	Linear Transition
11a Steady-state	102	C	25
11b Transition	20	C	Linear Transition
12a Steady-state	100	C	75
12b Transition	20	C	Linear Transition
13a Steady-state	102	C	50
13b Transition	20	Linear Transition	Linear Transition
14 Steady-state	168	Warm Idle	0

¹ Speed terms are defined in 40 CFR part 1065.
² Advance from one mode to the next within a 20-second transition phase. During the transition phase, command a linear progression from the speed or torque setting of the current mode to the speed or torque setting of the next mode.
³ The percent torque is relative to maximum torque at the commanded engine speed.

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

- (1) Hold the speed within your specifications.
- (2) Set the engine to operate at its minimum fueling rate.
- (3) Keep engine torque under 5 percent of maximum test torque.

(d) For full-load operating modes, operate the engine at its maximum fueling rate.

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

(f) Perform the ramped-modal test with a warmed-up engine. If the ramped-modal test follows directly

after testing over the Federal Test Procedure, consider the engine warm. Otherwise, operate the engine to warm it up as described in 40 CFR part 1065, subpart F.

[70 FR 40439, July 13, 2005]

§ 86.1363-2007 Steady-state testing with a discrete-mode cycle.

This section describes an alternate procedure for steady-state testing that manufacturers may use through the 2009 model year.

(a) Use the following 13-mode cycle in dynamometer operation on the test engine:

Mode number	Engine speed ¹	Percent load ²	Weighting factors	Mode length (minutes) ³
1	Idle	0.15	4
2	A	100	0.08	2
3	B	50	0.10	2
4	B	75	0.10	2
5	A	50	0.05	2

Mode number	Engine speed ¹	Percent load ²	Weighting factors	Mode length (minutes) ³
6	A	75	0.05	2
7	A	25	0.05	2
8	B	100	0.09	2
9	B	25	0.10	2
10	C	100	0.08	2
11	C	25	0.05	2
12	C	75	0.05	2
13	C	50	0.05	2

¹ Speed terms are defined in 40 CFR part 1065.

² The percent torque is relative to the maximum torque at the commanded test speed.

³ The percent torque is relative to maximum torque at the commanded engine speed.

(b) Prior to beginning the test sequence, the engine must be warmed-up according to the procedures in § 86.1332–90(d)(3)(i) through (iv).

(c) The test must be performed in the order of the mode numbers in paragraph (a) of this section. Where applicable, the EPA-selected test points identified under § 86.1360–2007(b)(2) must be performed immediately upon completion of mode 13. The engine must be operated for the prescribed time in each mode, completing engine speed and load changes in the first 20 seconds of each mode. The specified speed must be held to within ±50 rpm and the specified torque must be held to within plus or minus two percent of the maximum torque at the test speed.

(d) One filter shall be used for sampling PM over the 13-mode test procedure. The modal weighting factors specified in paragraph (a) of this section shall be taken into account by taking a sample proportional to the exhaust mass flow during each individual mode of the cycle. This can be achieved by adjusting sample flow rate, sampling time, and/or dilution ratio, accordingly, so that the criterion for the effective weighting factors is met. The sampling time per mode must be at least 4 seconds per 0.01 weighting factor. Sampling must be conducted as late as possible within each mode. Particulate sampling shall be completed no earlier than 5 seconds before the end of each mode.

(e) The test must be conducted with all emission-related engine control variables in the highest brake-specific NO_x emissions state which could be encountered for a 30 second or longer averaging period at the given test point and for the conditions under which the engine is being tested.

(f) Manufacturers must follow the exhaust emissions sample analysis procedures under § 86.1340, and the calculation formulas and procedures under § 86.1342, for the 13-mode cycle and the 3 EPA-selected test points as applicable for steady-state testing, including the NO_x correction factor for humidity.

(g) Calculate the weighted average emissions as follows:

(1) For each regulated gaseous pollutant, calculate the weighted average emissions using the following equation:

$$A_{WA} = 1 - \frac{\sum_{i=1}^N [A_{Mi} \cdot WF_i]}{\sum_{i=2}^N [A_{Pi} - WF_i]}$$

Where:

A_{WA} = Weighted average emissions for each regulated gaseous pollutant, in grams per brake horse-power hour.

A_M = Modal average mass emissions level, in grams per hour. Mass emissions must be calculated as described in § 86.1342.

A_P = Modal average power, in brake horsepower. Any power measured during the idle mode (mode 1) is not included in this calculation.

WF = Weighting factor corresponding to each mode of the steady-state test cycle, as defined in paragraph (a) of this section.

i = The modes of the steady-state test cycle defined in paragraph (a) of this section.

n = 13, corresponding to the 13 modes of the steady-state test cycle defined in paragraph (a) of this section.

(2) For PM measurements, a single filter must be used to measure PM over the 13 modes. The brake-specific PM emission level for the test must be calculated as described for a transient hot start test in § 86.1343. Only the power measured during the sampling period shall be used in the calculation.

(h) The test fuel used for supplemental steady-state testing under this section must meet the requirements of §86.1313.

(i) Ambient conditions, charge cooling specifications, and intake and exhaust restrictions for supplemental steady-state testing and maximum allowable emission limit testing under this section must meet the requirements of §86.1330.

[70 FR 40440, July 13, 2005]

§86.1370-2007 Not-To-Exceed test procedures.

(a) *General.* The purpose of this test procedure is to measure in-use emissions of heavy-duty diesel engines while operating within a broad range of speed and load points (the Not-To-Exceed Control Area) and under conditions which can reasonably be expected to be encountered in normal vehicle operation and use. Emission results from this test procedure are to be compared to the Not-To-Exceed Limits specified in §86.007-11(a)(4), or to later Not-To-Exceed Limits. The Not-To-Exceed Limits do not apply for engine-starting conditions. Tests conducted using the procedures specified in §86.1301 are considered valid Not-To-Exceed tests (NOTE: duty cycles and limits on ambient conditions do not apply for Not-To-Exceed tests).

(b) *Not-to-exceed control area for diesel heavy-duty engines.* The Not-To-Exceed Control Area for diesel heavy-duty engines consists of the following engine speed and load points:

(1) All operating speeds greater than the speed calculated using the following formula, where n_{hi} and n_{lo} are determined according to the provisions in §86.1360(c):

$$n_{lo} + 0.15 \times (n_{hi} - n_{lo})$$

(2) All engine load points greater than or equal to 30% or more of the maximum torque value produced by the engine.

(3) Notwithstanding the provisions of paragraphs (b)(1) and (b)(2) of this section, all operating speed and load points with brake specific fuel consumption (BSFC) values within 5% of the minimum BSFC value of the engine. For the purposes of this requirement, BSFC must be calculated under

the general test cell conditions specified in §86.1330. The manufacturer may petition the Administrator at certification to exclude such points if the manufacturer can demonstrate that the engine is not expected to operate at such points in normal vehicle operation and use. Engines equipped with drivelines with multi-speed manual transmissions or automatic transmissions with a finite number of gears are not subject to the requirements of this paragraph (b)(3).

(4) Notwithstanding the provisions of paragraphs (b)(1) through (b)(3) of this section, speed and load points below 30% of the maximum power value produced by the engine shall be excluded from the Not-To-Exceed Control Area for all emissions.

(5) [Reserved]

(6)(i) For petroleum-fueled diesel cycle engines, the manufacturer may identify particular engine-vehicle combinations and may petition the Administrator at certification to exclude operating points from the Not-to-Exceed Control Area defined in §86.1370(b)(1) through (5) if the manufacturer can demonstrate that the engine is not capable of operating at such points when used in the specified engine-vehicle combination(s).

(ii) For diesel cycle engines that are not petroleum-fueled, the manufacturer may petition the Administrator at certification to exclude operating points from the Not-to-Exceed Control Area defined in §86.1370(b)(1) through (5) if the manufacturer can demonstrate that the engine is not expected to operate at such points in normal vehicle operation and use.

(7) Manufacturers may petition the Administrator to limit NTE testing in a single defined region of speeds and loads. Such a defined region must generally be of elliptical or rectangular shape, and must share some portion of its boundary with the outside limits of the NTE zone. Under this provision testing would not be allowed with sampling periods in which operation within that region constitutes more than 5.0 percent of the time-weighted operation within the sampling period. Approval of this limit by the Administrator is contingent on the manufacturer satisfactorily demonstrating that operation