

multiplied by the square root of eight (8).

(v) Be sampled at the same time by a pair of filters in series (one primary and one backup filter) so that:

(A) The backup filter holder shall be located no more than 4 inches (100 mm) downstream of the primary filter holder.

(B) The primary and backup filters shall not be in contact with each other.

(C) The filters may be weighed separately or as a pair with the filters placed stain side to stain side.

(D) The single filter method incorporates a bypass system for passing the sample through the filters at the desired time.

(vi) Have a pressure drop increase between the beginning and end of the test of no more than 7.4 in Hg (25kPa).

(vii) Filters of identical quality shall be used when performing correlation tests specified in paragraph (c)(1)(vi) of this section.

(19) *Weighing chamber specifications.*

(i) The temperature of the chamber (room) in which the particulate filters are conditioned and weighed shall be maintained to within 72 °F ±5 °F (22 °C ±3 °C) during all filter conditioning and weighing.

(ii) The humidity of the chamber (room) in which the particulate filters are conditioned and weighed shall be maintained to a dewpoint of 49 °F ±5 °F (9.5 °C ±3 °C) and a relative humidity of 45 percent ±8 percent during all filter conditioning and weighing.

(iii) The chamber (room) environment shall be free of any ambient contaminants (such as dust) that would settle on the particulate filters during their stabilization. This shall be determined as follows:

(A) At least two unused reference filters or reference filter pairs shall be weighed within four (4) hours of, but preferably at the same time as the sample filter (pair) weighings.

(B) The reference filters are to be the same size and material as the sample filters.

(C) If the average weight of reference filters (reference filter pairs) changes between sample filter weighings by more than ±5.0 percent (±7.5 percent for the filter pair respectively) of the recommended minimum filter loading in

paragraphs (c)(18)(iii) or (c)(18)(iv) of this section, then all sample filters shall be discarded and the tests repeated.

(20) The analytical balance used to determine the weights of all filters shall have a precision (standard deviation) of 20 µg and resolution of 10 µg. For filters less than 70 mm diameter, the precision and resolution shall be 2 µg and 1 µg, respectively.

(21) All filters shall be neutralized to eliminate the effects of static electricity prior to weighing.

**§ 7.87 Test to determine the maximum fuel-air ratio.**

(a) *Test procedure.* (1) Couple the diesel engine to the dynamometer and connect the sampling and measurement devices specified in § 7.86.

(2) Prior to testing, zero and span the CO and NO<sub>x</sub> analyzers to the lowest analyzer range that will be used during this test.

(3) While running the engine, the following shall apply:

(i) The parameter for the laboratory atmospheric factor,  $f_a$ , shall be:  $0.98 \leq f_a \leq 1.02$ ;

(A) The equation is  $f_a = (99/P_s) * ((T_a + 273)/298)^{0.7}$  for a naturally aspirated and mechanically supercharged engines; or

(B) The equation is  $f_a = (99/P_s)^{0.7 * ((T_a + 273)/298)^{1.5}}$  for a turbocharged engine with or without cooling of the intake air.

Where:

$P_s$  = dry atmospheric pressure (kPa)

$T_a$  = intake air temperature (°C)

(ii) The air inlet restriction shall be set within ±10 percent of the recommended maximum air inlet restriction as specified by the engine manufacturer at the engine operating condition giving maximum air flow to determine the concentration of CO as specified in paragraph (a)(6) of this section.

(iii) The exhaust backpressure restriction shall be set within ±10 percent of the maximum exhaust backpressure as specified by the engine manufacturer at the engine operating condition giving maximum rated horsepower to determine the concentrations of CO and NO<sub>x</sub> as specified in paragraph (a)(6) of this section.

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(iv) The air inlet restriction shall be set within ±10 percent of a recommended clean air filter at the engine operating condition giving maximum air flow as specified by the engine manufacturer to determine the concentration of NO<sub>x</sub> as specified in paragraph (a)(6) of this section.

(4) The engine shall be at a steady-state condition when the exhaust gas samples are collected and other test data is measured.

(5) In a category A engine, 1.0 ±0.1 percent CH<sub>4</sub> shall be injected into the engine's intake air.

(6) Operate the engine at several speed/torque conditions to determine the concentrations of CO and NO<sub>x</sub>, dry basis, in the raw exhaust.

(b) *Acceptable performance.* The CO and NO<sub>x</sub> concentrations in the raw exhaust shall not exceed the limits specified in § 7.84(b) throughout the specified operational range of the engine.

**§ 7.88 Test to determine the gaseous ventilation rate.**

The test shall be performed in the order listed in Table E-2. The test for determination of the particulate index described in § 7.89 may be done simultaneously with this test.

(a) *Test procedure.* (1) Couple the diesel engine to the dynamometer and attach the sampling and measurement devices specified in § 7.86.

(2) A minimum time of 10 minutes is required for each test mode.

(3) CO, CO<sub>2</sub>, NO<sub>x</sub>, and CH<sub>4</sub> analyzers shall be zeroed and spanned at the analyzer range to be used prior to testing.

(4) Run the engine.

(i) The parameter for  $f_a$  shall be calculated in accordance with § 7.87(a)(3).

(ii) The air inlet and exhaust backpressure restrictions on the engine

shall be set as specified in §§ 7.87(a)(3) (iii) and (iv).

(5) The engine shall be at a steady-state condition before starting the test modes.

(i) The output from the gas analyzers shall be measured and recorded with exhaust gas flowing through the analyzers a minimum of the last three (3) minutes of each mode.

(ii) To evaluate the gaseous emissions, the last 60 seconds of each mode shall be averaged.

(iii) A 1.0 ±0.1 percent CH<sub>4</sub>, by volume, shall be injected into the engine's intake air for category A engines.

(iv) The engine speed and torque shall be measured and recorded at each test mode.

(v) The data required for use in the gaseous ventilation calculations specified in paragraph (a)(9) of this section shall be measured and recorded at each test mode.

(6) Operate the engine at each rated speed and horsepower rating requested by the applicant according to Table E-2 in order to measure the raw exhaust gas concentration, dry basis, of CO, CO<sub>2</sub>, NO, and NO<sub>2</sub>, and CH<sub>4</sub>- exhaust (category A engines only).

(i) Test speeds shall be maintained within ±1 percent of rated speed or ±3 RPM, whichever is greater, except for low idle which shall be within the tolerances established by the manufacturer.

(ii) The specified torque shall be held so that the average over the period during which the measurements are taken is within ±2 percent of the maximum torque at the test speed.

(7) The concentration of CH<sub>4</sub> in the intake air shall be measured for category A engines.

TABLE E-2—GASEOUS TEST MODES

Speed	Rated speed				Intermediate speed			Low-idle speed
	100	75	50	10	100	75	50	
% Torque	100	75	50	10	100	75	50	0

(8) After completion of the test modes, the following shall be done:

(i) Zero and span the analyzers at the ranges used during the test.

(ii) The gaseous emission test shall be acceptable if the difference in the zero and span results taken before the test and after the test are less than 2 percent.