

§ 86.884-11 Instrument checks.

(a) The smokemeter shall be checked according to the following procedure prior to each test:

(1) [Reserved]

(2) The zero control shall be adjusted under conditions of "no smoke" to give a recorder or data collection equipment response of zero;

(3) Calibrated neutral density filters having approximately 10, 20, and 40 percent opacity shall be employed to check the linearity of the instrument. The filter(s) shall be inserted in the light path perpendicular to the axis of the beam and adjacent to the opening from which the beam of light from the light source emanates, and the recorder response shall be noted. Filters with exposed filtering media should be checked for opacity every six months; all other filters shall be checked every year, using NBS or equivalent reference filters. Deviations in excess of 1 percent of the nominal opacity shall be corrected.

(b) The instruments for measuring and recording engine rpm, engine torque, air inlet restrictions, exhaust system backpressure, throttle position, etc., which are used in the test prescribed herein, shall be calibrated in accordance with good engineering practice.

[48 FR 52203, Nov. 16, 1983, as amended at 49 FR 48141, Dec. 10, 1984]

§ 86.884-12 Test run.

(a) The temperature of the air supplied to the engine shall be between 68 °F and 86 °F. The engine fuel inlet temperature shall be 100 °F ±10 °F and shall be measured at a point specified by the manufacturer. The observed barometric pressure shall be between 28.5 inches and 31 inches Hg. Higher air temperature or lower barometric pressure may be used, if desired, but no allowance will be made for possible increased smoke emissions because of such conditions.

(b) The governor and fuel system shall have been adjusted to provide engine performance at the levels in the application for certification required under § 86.084-21.

(c) The following steps shall be taken for each test:

(1) Start cooling system;

(2) Warm up the engine by the procedure described in § 86.1332-84(d)(3) (i) through (v).

(3) Determine by experimentation the dynamometer inertia and dynamometer load required to perform the acceleration in the dynamometer cycle for smoke emission tests (§ 86.884-7(a)(2)). In a manner appropriate for the dynamometer and controls being used, arrange to conduct the acceleration mode;

(4) Install smokemeter optical unit and connect it to the recorder/data collection system. Connect the engine rpm and throttle position sensing devices to the recorder/data collection system;

(5) Turn on purge air to the optical unit of the smokemeter, if purge air is used;

(6) Check and record zero and span settings of the smokemeter. (If a recorder is used, a chart speed of approximately one inch per minute shall be used.) The optical unit shall be retracted from its position about the exhaust stream if the engine is left running;

(7) Precondition the engine by operating it for 10 minutes at maximum rated horsepower;

(8) Proceed with the sequence of smoke emission measurements on the engine dynamometer as prescribed in § 86.884-7;

(9) (i) During the test sequence of § 86.884-7, continuously record smoke measurements, engine rpm, and throttle position.

(ii) If a chart recorder is used for data collection, it shall be run at a minimum chart speed of one inch per minute during the idle mode and transitional periods, and eight inches per minute during the acceleration and lugging modes.

(iii) Automatic data collection equipment, if used, shall sample at least two records per second.

(iv) The smoke meter zero and full scale response may be rechecked and reset during the idle mode of each test sequence.

(v) If either zero or full-scale drift is in excess of 2 percent opacity, the smokemeter controls must be readjusted and the test must be repeated;

- (10) Turn off engine;
- (11)(i) Check zero and reset if necessary.
- (ii) Check span response (*linearity*) of the smokemeter by inserting neutral density filters.
- (iii) If either zero drift *or the linearity check* is in excess of two percent opacity, the results shall be invalidated.

[48 FR 52203, Nov. 16, 1983, as amended at 49 FR 48141, Dec. 10, 1984; 52 FR 47870, Dec. 16, 1987]

§ 86.884-13 Data analysis.

The following procedure shall be used to analyze the test data:

(a) Locate the modes specified in § 86.884-7(a)(1) through (a)(4) by applying the following starting and ending criteria:

(1) The idle mode specified in § 86.884-7(a)(1) starts when engine preconditioning or the lugging mode of a preceding cycle has been completed and ends when the engine speed is raised above the idle speed.

(2) The acceleration mode specified in § 86.884-7(a)(2)(i) starts when the preceding idle mode has been completed and ends when the throttle is in the fully open position, as indicated by the throttle position trace as specified in § 86.884-7(a)(2)(ii).

(3) The acceleration mode specified in § 86.884-7(a)(2)(ii) starts when the preceding acceleration mode has been completed and ends when the engine speed reaches 85 percent of the rated speed.

(4) The transition period specified in § 86.884-7(a)(2)(iii) starts when the preceding acceleration mode has been completed and ends when the throttle is in the fully open position as indicated by the throttle position trace, as specified in § 86.884-7(a)(2)(iv).

(5) The acceleration mode specified in § 86.884-7(a)(2)(iv) starts when the preceding transition period has been completed and ends when the engine speed reaches 95 percent of the rated speed.

(6) The transition period specified in § 86.884-7 (a)(3)(i) starts when the preceding acceleration mode has been completed and ends when the engine speed is 50 rpm below the rated speed and the provisions of § 86.884-7 (a)(3)(i) are met.

(7) The lugging mode specified in § 86.884-7(a)(3)(ii) starts when the preceding transition period has been completed and ends when the engine speed is at the intermediate speed.

(b) Determine if the test requirements of § 86.884-7 are met by applying the following modal criteria:

(1) Idle mode as specified in § 86.884-7(a)(1):

(i) Duration: 5 to 5.5 minutes.

(ii) Speed: within specification during the last four minutes of the mode.

(2) Acceleration mode as specified in § 86.884-7(a)(2)(i).

(i) Duration: three seconds or less.

(ii) Speed increase: 200±50 rpm.

(3) Acceleration mode as specified in § 86.884-7(a)(2)(ii);

(i) Linearity: ±100 rpm as specified in paragraph (c) of this section.

(ii) Duration: 3.5 to 6.5 seconds.

(iii) Throttle position: fully open until speed is at least 85 percent of the rated speed.

(4) Transition period as specified in § 86.884-7(a)(2)(iii):

(i) Throttle position: moved rapidly to, and held in, the fully closed position.

(5) Acceleration mode as specified in § 86.884-7(a)(2)(iv):

(i) Duration: 8 to 12 seconds.

(ii) Throttle position: fully open when speed is at intermediate speed.

(6) Transition period as specified in § 86.884-7(a)(3)(i):

(i) Duration: 50 to 60 seconds.

(ii) Average speed during the last 10 seconds shall be within ±50 rpm of rated speed.

(iii) Average observed power during the last 10 seconds shall be at least 95 percent of the horsepower developed during the preconditioning mode.

(7) Lugging mode as specified in § 86.884-7(a)(3)(ii):

(i) Linearity: ±100 rpm as specified in paragraph (c) of this section.

(ii) Duration: 30 to 40 seconds.

(iii) Speed at end: intermediate speed.

(c) Determine if the linearity requirements of § 86.884-7 were met by means of the following procedure:

(1) For the acceleration mode specified in § 86.884-7(a)(2)(ii), note the maximum deflection of the rpm trace from a straight line drawn between the