

## Environmental Protection Agency

## § 91.408

test mode the emission concentration traces and the associated analyzer range(s).

(2) Observed engine torque.

(3) Observed engine rpm.

(4) Engine intake air flow, if applicable.

(5) Test cell temperature and humidity for each mode.

(6) For raw gas testing; fuel flow for each mode. Fuel flow measurement is not required for dilute testing but is allowed. If the fuel flow measurement is a volume measurement system, record the fuel temperature in the measurement system for fuel density corrections to the mass flow rate. If the fuel temperature is within 3 °C of the calibration temperature, no density correction is required.

(7) Engine intake temperature and humidity for each mode, if applicable.

(8) Exhaust sample line temperature, if applicable.

(e) *Test data; post-test.* (1) Recorder chart or equivalent. Identify the hang-up check.

(2) Recorder chart or equivalent. Identify the zero traces for each range used and the span traces for each range used.

(3) Total number of hours of operation accumulated on the engine (to the nearest tenth hour).

(4) Barometric pressure, post-test segment.

### § 91.406 Engine parameters to be measured and recorded.

Measure or calculate, then record, the engine parameters in Table 1 in appendix A of this subpart.

### § 91.407 Engine inlet and exhaust systems.

(a) The marine engine manufacturer is liable for emission compliance over the full range of restrictions that are specified by the manufacturer for that particular engine.

(b) The air inlet filter system and exhaust muffler system combination used on the test engine must be the systems expected to yield the highest emission levels.

### § 91.408 Pre-test procedures.

(a) *Engine service accumulation and stabilization procedure.* Use the service

accumulation procedure determined by the manufacturer for exhaust emission stabilizing of an engine, consistent with good engineering practice (see § 91.117).

(1) The manufacturer determines, for each engine family, the number of hours at which the engine exhaust emission control system combination is stabilized for emission testing. However, this stabilization procedure may not exceed 12 hours. The manufacturer must maintain, and provide to the Administrator upon request, a record of the rationale used in making this determination. If the manufacturer can document that, at some time prior to the full 12 hour service accumulation period, the engine emissions are decreasing for the remainder of the 12 hours, the service accumulation may be completed at that time. The manufacturer may elect to accumulate 12 hours on each test engine within an engine family without making this determination.

(2) During service accumulation, the fuel and lubricants specified in § 91.308 must be used.

(3) Engine maintenance during service accumulation is allowed only in accordance with § 91.117.

(b) *Engine pre-test preparation.* (1) Drain and charge the fuel tank(s) with the specified test fuel (see § 91.308) to 50 percent of the tank's nominal capacity. If an external fuel tank is used, the engine fuel inlet system pressure must be typical of what the engine will see in use.

(2) Operate the engine on the dynamometer measuring the fuel consumption (fuel consumption required only for raw gas sampling method) and torque before and after the emission sampling equipment is installed, including the sample probe, using mode 1 from Table 2 in appendix A of this subpart. The emission sampling equipment may not significantly affect the operational characteristics of the engine (typically, the results should agree within five percent).

(c) *Analyzer pre-test procedures.* (1) If necessary, warm up and stabilize the analyzer(s) before calibrations are performed.

(2) Replace or clean the filter elements and then vacuum leak check the

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system per §91.324(a). If necessary, allow the heated sample line, filters, and pumps to reach operating temperature.

(3) Perform the following system checks:

(i) If necessary, check the sample-line temperature. Heated FID sample line temperature must be maintained between 110 °C and 230 °C, a heated NO<sub>x</sub> sample line temperature must be maintained between 60 °C and 230 °C.

(ii) Check that the system response time has been accounted for prior to sample collection data recording.

(iii) A hang-up check is permitted.

(4) Check analyzer zero and span before and after each test at a minimum. Further, check analyzer zero and span any time a range change is made or at the maximum demonstrated time span for stability for each analyzer used.

(d) Check system flow rates and pressures and reset if necessary.

### §91.409 Engine dynamometer test run.

(a) Engine and dynamometer start-up.

(1) Only adjustments in accordance with §91.118 may be made to the test engine prior to starting a test.

(2) If necessary, warm up the dynamometer as recommended by the dynamometer manufacturer or good engineering practice.

(3) At the manufacturer's option, the engine can be run with the throttle in a fixed position or by using the engine's governor (if the engine is manufactured with a governor). In either case, the engine speed and load must meet the requirements specified in paragraph (b)(12) of this section.

(b) Each test consists of the following:

(1) Record the general test data as specified in §91.405.

(2) Precondition the engine in the following manner:

(i) Operate the engine at idle for 2 to 3 minutes;

(ii) Operate the engine at a power greater than or equal to 50 percent power at the rated speed for 5 to 7 minutes;

(iii) Operate the engine at rated speed and maximum power for 25 to 30 minutes;

(iv) Option. For four-stroke engines, where appropriate, it is permitted to precondition the engine at rated speed and maximum power until the oil and water temperatures are stabilized. The temperatures are defined as stabilized if they are maintained within 2 percent of point for 2 minutes. The engine must be operated a minimum of 10 minutes for this option. This optional procedure may be substituted for step in paragraphs (b)(2)(iii) of this section;

(v) Option. If the engine has been operating on service accumulation for a minimum of 40 minutes, the service accumulation may be substituted for steps in paragraphs (b)(2) (i) through (iii) of this section.

(3) Record all pre-test data specified in §91.405(c).

(4) Start the test cycle (see §91.410) within 10 minutes of the completion of the steps required by paragraph (b)(2) of this section.

(5) During the first mode calculate the torque corresponding to 71.6, 46.5, and 25.3 percent of the maximum observed torque for the rated speed (see Table 2 in appendix A of this subpart).

(6) Once engine speed and load are set for a mode, run the engine for a sufficient period of time to achieve thermal stability. At the manufacturer's option, determine and document the appropriate criterion for thermal stability for each engine family.

(7) Record all modal data specified in §91.405(e) for a minimum time period of the last two minutes of each mode. Longer averaging periods are acceptable, but the data averaged must be from a continuous time period. The duration of time during which this data is recorded is referred to as the "sampling period." The data collected during the sampling period is used for modal emission calculations.

(8) Continuously record the analyzer's response to the exhaust gas during the sampling period.

(9) Modes may be repeated.

(10) If a delay of more than one hour occurs between the end of one mode and the beginning of another mode, the test is void and must be restarted as described at paragraph (b)(1) of this section.

(11) The engine speed and load must be maintained within the requirements