

throttle control systems may be performed. These calibrations may consist of steady-state operations and/or actual practice cycle runs.

(2) Following any practice runs or calibration procedures, the engine shall be cooled per § 86.1335-90.

(b) [Reserved]

[48 FR 52210, Nov. 16, 1983, as amended at 49 FR 48145, Dec. 10, 1984; 52 FR 47874, Dec. 16, 1987; 62 FR 47131, Sept. 5, 1997]

**§ 86.1335-90 Cool-down procedure.**

(a) This cool-down procedure applies to Otto-cycle and diesel engines.

(b) Engines may be soaked at ambient conditions. No substances or fluids may be applied to the engine's internal or external surfaces except for water and air as prescribed in paragraphs (c) and (d) of this section.

(c) For water-cooled engines, two types of cooling are permitted:

(1) Water may be circulated through the engine's water coolant system.

(i) The coolant may be flowed in either direction and at any desired flow rate. The thermostat may be removed or blocked open during the cool-down but must be restored before the exhaust emissions test begins.

(ii) The temperature of the circulated or injected water shall be at least 10 °C (50 °F). In addition, the temperature of the cooling water shall not exceed 30 °C (86 °F) during the last 30 minutes of the cool-down.

(iii) Only water, including the use of a building's standard water supply, or the coolant type that is already in the engine (per § 86.1327-90(e)) is permitted for cool-down purposes.

(2) Flows of air may be directed at the exterior of the engine.

(i) The air shall be directed essentially uniformly over the exterior surface of the engine at any desired flow rate.

(ii) The temperature of the cooling air shall not exceed 86 °F (30 °C) during the last 30 minutes of the cool-down, but may be less than 68 °F (20 °C) at any time.

(d) For air-cooled engines, only cooling as prescribed in paragraph (c)(2) of this section is permitted.

(e)(1) The cold cycle exhaust emission test may begin after a cool-down only when the engine oil and water

temperatures are stabilized between 68 °F and 86 °F (20 °C and 30 °C) for a minimum of fifteen minutes.

(i) These temperature measurements are to be made by temperature measurement devices immersed in the sump oil and in the thermostat housing or cylinder head cooling circuit, the sensor parts of which are not in contact with any engine surface.

(ii) The flow of oil and water shall be shut off during this measurement. Air flow, except as necessary to keep the cell temperature between 68 °F and 86 °F (20 °C and 30 °C), shall be shut off. No engine oil change is permitted during the test sequence.

(2) Direct cooling of engine oil through the use of oil coolers or heat exchangers is permitted. The cold cycle emission test may begin only when the requirements in paragraph (e)(1)(ii) are met.

(3) Any other means for the direct cooling of the engine oil must be approved in advance by the Administrator.

(f)(1) The cold cycle exhaust emission test for engines equipped with exhaust aftertreatment devices may begin after a cool-down only when the aftertreatment device is 77 °F ±9 °F (25 °C ±5 °C), in addition to the temperature restrictions in paragraph (e) of this section. For catalysts, this temperature must be measured at the outlet of the catalyst bed.

(2) Exhaust aftertreatment device cool-down may be accomplished in whatever manner and using whatever coolant deemed appropriate by proper engineering judgment. The aftertreatment device, engine, and exhaust piping configurations shall not be separated, altered, or moved in any way during the cool-down.

(g) For engines with auxiliary emission control devices which are temperature dependent, the cold start shall not begin until the temperature readings of the auxiliary emission control devices are stable at 77 °F ±9 °F (25 °C ±5 °C).

(h) At the completion of the cool-down all of the general requirements specified in § 86.1330, the oil temperature specification set forth in paragraph (e) of this section, and the catalyst temperature specifications in

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paragraph (f) of this section must be met before the cold cycle exhaust emission test may begin.

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### § 86.1336-84 Engine starting, restarting, and shutdown.

(a) The engine shall be started according to the manufacturer's recommended starting procedure in the owner's manual, using either a production starter motor or the dynamometer. The speed at which the engine is cranked (motored) with the dynamometer shall be equal to the cranking speed (nominal speed  $\pm 10$  percent) in the vehicle with a fully charged battery. The time taken to accelerate the engine to cranking speed by the dynamometer shall be equal (nominal  $\pm 0.5$  seconds) to the time required with a starter motor. Motoring by the dynamometer shall be terminated not more than one second after the engine starts. The 24  $\pm 1$ -second free idle period, and declutching if applicable, shall begin when the engine is determined to have started.

(1) Engines equipped with automatic chokes shall be operated according to the manufacturer's operating instructions in the owner's manual, including choke setting and "kick-down" from cold fast idle.

(2) Engines equipped with manual chokes shall be operated according to the manufacturer's operating instructions in the owner's manual.

(3) The operator may use the choke, throttle, etc. where necessary to keep the engine running.

(4) If the manufacturer's operating instructions in the owner's manual do not specify a warm engine starting procedure, the engine (automatic and manual choke engines) shall be started by depressing the throttle half way and cranking the engine until it starts.

(b)(1) If the engine does not start after 15 seconds of cranking, cranking shall cease and the reason for failure to start shall be determined. The gas flow measuring device (or revolution counter) on the constant volume sampler (and the hydrocarbon integrator when testing diesel-fueled engines) shall be turned off during this diagnostic period. In addition, either the CVS should be turned off or the ex-

haust tube disconnected from the tailpipe during the diagnostic period. If failure to start is an operational error, the engine shall be rescheduled for testing from a cold start.

(2) If longer cranking times are necessary and recommended to the ultimate purchaser, such cranking times may be used in lieu of the 15-second limit, provided the owner's manual and the service repair manual indicate that the longer cranking times are normal.

(3) If a failure to start occurs during the cold portion of the test and is caused by an engine malfunction, corrective action of less than 30 minutes duration may be taken (according to § 86.084-25), and the test continued. The sampling system shall be reactivated at the same time cranking begins. When the engine starts, the timing sequence shall begin. If failure to start is caused by engine malfunction and the engine cannot be started, the test shall be voided and corrective action may be taken according to § 86.084-25.

(4) If a failure to start occurs during the hot start portion of the test and is caused by engine malfunction, the engine must be started within one minute of key on. The sampling system shall be reactivated at the same time cranking begins. When the engine starts, the transient engine cycle timing sequence shall begin. If the engine cannot be started within one minute of key on, the test shall be voided, corrective action taken (according to § 86.084-25), and the engine rescheduled for testing.

(c) *Engine stalling.* (1) If the engine stalls during the initial idle period of either the cold or hot start test, the engine shall be restarted immediately using the appropriate cold or hot starting procedure and the test continued.

(2) If the engine stalls anywhere in the cold cycle, except in the initial idle period, the test shall be voided.

(3) If the engine stalls on the hot cycle portion of the test at any time other than the initial idle, the engine may be shut off and resoaked for 20 minutes. The hot cycle may then be rerun. Only one hot start resoak and restart is permitted.

(d) *Engine shutdown.* Engine shutdown shall be performed in accordance with manufacturer's specifications.