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(2) Torque is normalized to the maximum torque at the rpm listed with it. Therefore, to unnormalize the torque values in the cycle, the maximum torque curve for the engine in question must be used. The generation of the maximum torque curve is described in 40 CFR part 1065.

(b) *Example of the unnormalization procedure.* Unnormalize the following test point, given Maximum Test speed = 3800 rpm and Curb Idle Speed = 600 rpm.

PercentRPM	PercentTorque
43	82

(1) Calculate actual rpm:

$$\text{Actualrpm} = \frac{43 \cdot (3800 - 600)}{112} + 600 = 1{,}829\text{rpm}$$

(2) Determine actual torque: Determine the maximum observed torque at 1829 rpm from the maximum torque curve. Then multiply this value (e.g., 358 ft-lbs) by 0.82. This results in an actual torque of 294 ft-lbs.

(c) *Clutch operation.* Manual transmission engines may be tested with a clutch. If used, the clutch shall be disengaged at all zero percent speeds, zero percent torque points, but may be engaged up to two points preceding a non-zero point, and may be engaged for time segments with zero percent speed and torque points of durations less than four seconds. (See 40 CFR 1065.514 for allowances in the cycle validation criteria.)

(d) Determine idle speeds as specified in § 86.1337–2007(a)(9).

[70 FR 40438, July 13, 2005, as amended at 73 FR 37192, June 30, 2008]

§ 86.1334–84 Pre-test engine and dynamometer preparation.

(a) *Control system calibration.* (1) Before the cold soak or cool down:

(i) Final calibration of the dynamometer and throttle control systems may be performed. These calibrations may consist of steady-state operations and/or actual practice cycle runs, and must be completed before sampling system preconditioning (if applicable).

(ii) Conduct sampling system preconditioning for diesel engines (optional for model years prior to 2007) by operating the engine at a condition of rated-speed, 100 percent torque for a minimum of 20 minutes while simultaneously operating the CVS and secondary dilution system and taking particulate matter emissions samples from the secondary dilution tunnel . Particulate sample filters need not be stabilized or weighed, and may be discarded. Filter media may be changed during conditioning as long as the total sampled time through the filters and sampling system exceeds 20 minutes. Flow rates shall be set at the approximate flow rates selected for transient testing. Torque shall be reduced from 100 percent torque while maintaining the rated speed condition as necessary to prevent exceeding the maximum sample zone temperature specifications of § 86.1310–2007.

(2) Following sampling system preconditioning cycle, 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; 66 FR 5186, Jan. 18, 2001]]

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

[62 FR 47131, Sept. 5, 1997]

§ 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 ±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 ±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 ±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