

modified to zero percent speed, Curb Idle Transmission Torque (CITT), except as permitted in §86.1337-90(a)(9). Also, all points with speed equal to or less than zero percent and torque less than CITT shall be modified to CITT. Motoring torque shall remain unchanged. In order to provide a smooth torque transition, all consecutive torque points that are between 0 and CITT shall be changed to CITT if the first of these is preceded or the last of these is succeeded by idle points. The manufacturer's specified CITT shall be based upon that value observed in typical applications at the mean of the manufacturers' specified idle speed range at stabilized temperature conditions.

(f) *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 preceeding 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 §86.1341 for allowances in the cycle validation criteria.)

(g) *Measured rated rpm.* The measured rated rpm corresponds to the 100 percent rpm values specified in the reference cycles (paragraphs (f) (1) and (2) of appendix I to this part). It is generally intended to represent the rpm at which maximum brake horsepower occurs. For the purposes of this test se-

quence, it shall either be defined as the manufacturer's specified rated speed, or calculated in the following way, whichever yields the higher speed:

(1) From the maximum torque curve generated per §86.1332, find the maximum observed brake horsepower of the engine.

(2) Calculate 98 percent of the observed maximum brake horsepower, and determine from the maximum torque curve the highest and lowest engine rpms at which this brake horsepower is observed.

(3) The highest and lowest of the 98 percent power rpms represent the endpoints of an rpm range. The midpoint of this range shall be considered the measured rated rpm for cycle generation purposes.

[54 FR 14599, Apr. 11, 1989, as amended at 62 FR 47131, Sept. 5, 1997; 63 FR 24449, May 4, 1998; 65 FR 8279, Feb. 18, 2000]

**§ 86.1333-2010 Transient test cycle generation.**

(a) *Generating transient test cycles.* The heavy-duty transient engine cycles for Otto-cycle and diesel engines are listed in Appendix I((f) (1), (2) and (3)) to this part. These second-by-second listings represent torque and rpm maneuvers characteristic of heavy-duty engines. Both rpm and torque are normalized (expressed as a percentage of maximum) in these listings.

(1) To unnormalize rpm, use the following equations:

(i) For diesel engines:

$$\text{Actualrpm} = \frac{\% \text{rpm} \cdot (\text{MaxTestSpeed} - \text{CurbIdleSpeed})}{112} + \text{CurbIdleSpeed}$$

Where:

MaxTestSpeed = the maximum test speed as calculated in 40 CFR part 1065.

(ii) For Otto-cycle engines:

$$\text{Actualrpm} = \frac{\% \text{rpm} \cdot (\text{MaxTestSpeed} - \text{CurbIdleSpeed})}{112} + \text{CurbIdleSpeed}$$

Where:

MaxTestSpeed = the maximum test speed as calculated in 40 CFR part 1065.

**§ 86.1334-84**

**40 CFR Ch. I (7-1-07 Edition)**

(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.)

[70 FR 40438, July 13, 2005]

**§ 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 dis-

carded. 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