(7) If a chart recorder is used, identify and record the most recent zero and span response as the pre-analysis values.

(8) If ADC equipment is used, electronically record the most recent zero and span response as the pre-analysis values.

(9) Measure the emissions (HC required for diesels; NO_X, CO, CO_2 optional) continuously during the cold start cycle. Indicate the start of the test, the range(s) used, and the end of the test on the recording medium (chart paper or ADC equipment). Maintain approximately the same flow rates and system pressures used in paragraph (e)(5) of this section.

(10) Collect background HC, CO, CO_2, and NO_X in a sample bag.

(11) Perform a post-analysis zero and span check for each range used at the conditions specified in paragraph (e)(5) of this section. Record these responses as the post-analysis values.

(12) Neither the zero drift nor the span drift between the pre-analysis and post-analysis checks on any range used may exceed 3 percent for HC, or 2 percent for NO_X, CO, and CO_2, of full scale chart deflection, or the test is void. (If the HC drift is greater than 3 percent of full-scale chart deflection, hydrocarbon hang-up is likely.)

(13) Determine HC background levels for the cold start cycle by introducing the background sample into the overflow sample system.

(14) Determine background levels of NO_X, CO, or CO_2 (if necessary) by the bag technique outlined in paragraph (d) of this section.

(15) Repeat paragraphs (e) (4) through (14) of this section for the hot cycle. The post-analysis zero and span check for the cold start (or previous hot start) cycle may be used for the pre-analysis zero and span for the following hot start cycle.

(f) *HC hang-up.* If HC hang-up is indicated, the following sequence may be performed:

(1) Fill a clean sample bag with background air.

(2) Zero and span the HFID at the analyzer ports.

(3) Analyze the background air sample bag through the analyzer ports.

(4) Analyze the background air through the entire sample probe system.

(5) If the difference between the readings obtained is 2 percent or more of the HFID full scale deflection, clean the sample probe and the sample line.

(6) Reassemble the sample system, heat to specified temperature, and repeat the procedure in paragraphs (f) (1) through (6) of this section.

(g) For CH_3OH (where applicable), introduce test samples into the gas chromatograph and measure the concentration. This concentration is C_{MS} in the calculations.

(h) For HCHO (where applicable), introduce test samples into the high pressure liquid chromatograph and measure the concentration of formaldehyde as a dinitrophenylhydrazine derivative in acetonitrile. This concentration is C_{FS} in the calculations.

[54 FR 14602, Apr. 11, 1989, as amended at 60 FR 34375, June 30, 1995]

§ 86.1340–94 Exhaust sample analysis.

Section 86.1340–94 includes text that specifies requirements that differ from § 86.1340–90. Where a paragraph in § 86.1340–90 is identical and applicable to § 86.1340–94, this may be indicated by specifying the corresponding paragraph and the statement ''[Reserved]. For guidance see § 86.1340–90.''

(a) through (d)(6) [Reserved]. For guidance see § 86.1340–90.

(d)(7) Measure HC (except diesels), CH_4 (natural gas-fueled engines only), CO, CO_2, and NO_X sample bag(s) with approximately the same flow rates and pressures used in § 86.1340–90(d)(3). (Constituents measured continuously do not require bag analysis.)

(d)(8) through (h) [Reserved]. For guidance see § 86.1340–90.

[59 FR 48534, Sept. 21, 1994, as amended at 60 FR 34375, June 30, 1995]

§ 86.1341–90 Test cycle validation criteria.

(a) To minimize the biasing effect of the time lag between the feedback and reference cycle values, the entire engine speed and torque feedback signal sequence may be advanced or delayed in time with respect to the reference speed and torque sequence. If the feedback signals are shifted, both speed and torque must be shifted the same amount in the same direction.

(b) *Brake horsepower-hour calculation*. (1) Calculate the brake horsepower-hour for each pair of engine feedback speed and torque values recorded. Also calculate the reference brake horsepower-hour for each pair of engine speed and torque reference values. Calculations shall be to five significant digits.

(2) In integrating the reference and the feedback horsepower-hour, all negative torque values shall be set equal to zero and included. If integration is performed at a frequency of less than 5 Hz, and if during a given time segment, the torque value changes from positive to negative or negative to positive, then the negative portion must be computed by linear interpolation and set equal to zero and the positive portion included. The same methodology shall be used for integrating both reference and actual brake horsepower-hour.

(c) *Regression line analysis to calculate validation statistics.* (1) Linear regressions of feedback value on reference value shall be performed for speed, torque and brake horsepower on 1 Hz data after the feedback shift has occurred (see paragraph (a) of this section). The method of least squares shall be used, with the best fit equation having the form:

$$y=mx+b$$

Where:

y = The feedback (actual) value of speed (rpm), torque (ft-lbs), or brake horsepower.

m = Slope of the regression line.

x = The reference value (speed, torque, or brake horsepower).

b = The y-intercept of the regression line.

(2) The standard error of estimate (SE) of y on x and the coefficient of determination (r^2) shall be calculated for each regression line.

(3) For a test to be considered valid, the criteria in Figure N90–11 must be met for both cold and hot cycles individually. Point deletions from the regression analyses are permitted where noted in Figure N90–11.

FIGURE N90–11

	Speed	Torque	BHP
Regression Line Tolerances			
Petroleum-fueled and methanol-fueled diesel engines			
Standard error of estimate (SE) of Y on X	100 rpm	13 pct. of power map maximum engine torque	8 pct. of power map maximum BHP.
Slope of the regression line, m	0.970 to 1.030	0.83–1.03 (hot), 0.77–1.03 (cold)	0.89–1.03 (hot), 0.87–1.03 (cold).
Coefficient of determination, r^2	[1] 0.9700	[1] 0.8800 (hot), [1] 0.8500 (cold)	[1] 0.9100.
Y intercept of the regression line, b	50 ρπμ	15 φτ-λβ	5.0
Gasoline-fueled and methanol-fueled Otto-cycle engines			
Standard error of estimate (SE) of Y on X	100 rpm	10% (hot), 11% (cold) of power map max. engine torque.	5% (hot), 6% (cold) of power map maximum BHP.
Slope of the regression line, m	0.980 to 1.020	0.92–1.03 (hot), 0.88–1.03 (cold)	0.93–1.03 (hot), 0.89–1.03 (cold).
Coefficient of determination, r^2	[1] 0.9700	[1] 0.9300 (hot), [1] 0.9000 (cold)	[1] 0.9400 (hot), [1] 0.9300 (cold).
Y intercept of the regression line, b	25 (hot), 40 (cold)	4%(hot), 5 (cold) of power map max. engine torque.	2.0% (hot), 2.5% (cold) of power map BHP.

[1] Minimum.

PERMITTED POINT DELETIONS FROM REGRESSION ANALYSIS

Condition	Points to be deleted
1. Wide Open Throttle and Torque Feedback < Torque Reference	Torque, and/or BHP.
2. Closed Throttle, Not an Idle Point, Torque Feedback > Torque Reference	Torque, and/or BHP.
3. Closed Throttle, Idle Point, and Torque Feedback = CITT (10 ft-lb)	Speed, and/or BHP.

For the purposes of this discussion:

An Idle Point is defined as a point having a Normalized Reference Torque of 0 and a Normalized Reference Speed of 0 and an engine tested as having a manual transmission has a CITT of 0. Point deletion may be applied either to the whole or to any part of the cycle. EXPSTB='00'

(4)(i) For petroleum-fueled and methanol-fueled diesel engines, the integrated brake horsepower-hour for each cycle (cold and hot start) shall be between −15 percent and +5 percent of the integrated brake horsepower-hour for the reference cycle, or the test is void.

(ii) For gasoline-fueled and methanol-fueled Otto-cycle engines, the integrated brake horsepower-hour of the feedback cycle shall be within 5 percent of the integrated brake horsepower-hour of the reference cycle for the cold cycle, or the test is void. The tolerance for the hot cycle shall be 4 percent.

(5) If a dynamometer test run is determined to be statistically or experimentally void, corrective action shall be taken. The engine shall then be allowed to cool (naturally or forced) and the dynamometer test rerun per §86.1337 or be restarted at §86.1336–84(e).

(d) For petroleum-fueled and methanol-fueled diesel engines, all reference torque values specified (in paragraph (f)(2) of appendix I to this part) as ''closed throttle'' shall be deleted from the calculation of cycle torque and power validation statistics.

[54 FR 14604, Apr. 11, 1989, as amended at 62 FR 47134, Sept. 5, 1997]

§86.1341–98 Test cycle validation criteria.

Section 86.1341–98 includes text that specifies requirements that differ from §86.1341–90. Where a paragraph in §86.1341–90 is identical and applicable to §86.1341–98, this may be indicated by specifying the corresponding paragraph and the statement ''[Reserved]. For guidance see §86.1341–90''

(a) Through (b)(2) [Reserved]. For guidance see §86.1341–90.

(b)(3) All feedback torques due to accessory loads, either actual or simulated as defined in §86.1327–90 (d)(4), shall be excluded from both cycle validation and the integrated work used for emissions calculations.

(4) For reference idle portions of the cycle where CITT is not applied, use measured torque values for cycle validation and the reference torque values for calculating the brake horsepower-hour value used in the emission calculations. For reference idle portions of the cycle where CITT is applied, use measured torque values for cycle validation and calculating the brake horsepower-hour value used in the emission calculations.

(c) Through (d) [Reserved]. For guidance see §86.1341–90.

[62 FR 47135, Sept. 5, 1997]

§86.1342–90 Calculations; exhaust emissions.

(a) The final reported transient emission test results should be computed by using the following formula:

$$A_{WM} = \frac{(1/7)(g_C) + (6/7)(g_H)}{(1/7)(BHP - hr_C) + (6/7)(BHP - hr_H)}$$