

(5) Measure HC, CO, CO<sub>2</sub>, and, if appropriate, NO<sub>x</sub>, concentrations of samples.

(6) Check zero and span points. If difference is greater than 2 percent of full scale, repeat the procedure in paragraphs (a) (1) through (5) of this section.

(b) For CH<sub>3</sub>OH (methanol-fueled vehicles), introduce test samples into the gas chromatograph and measure the concentration. This concentration is C<sub>MS</sub> in the calculations.

(c) For HCHO (methanol-fueled vehicles), 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<sub>FS</sub> in the calculations.

[54 FR 14552, Apr. 11, 1989, as amended at 59 FR 48515, Sept. 21, 1994; 60 FR 34357, June 30, 1995]

#### § 86.542-90 Records required.

The following information shall be recorded with respect to each test:

- (a) Test number.
- (b) System or device tested (brief description).
- (c) Date and time of day for each part of the test schedule.
- (d) Instrument operator.
- (e) Driver or operator.
- (f) *Vehicle*: Make, Vehicle identification number, Model year, Transmission type, Odometer reading at initiation of preconditioning, Engine displacement, Engine family, Emission control system, Recommended idle RPM, Nominal fuel tank capacity, Inertial loading, Actual curb mass recorded at 0 kilometers, and Drive wheel tire pressure.
- (g) *Dynamometer serial number*: As an alternative to recording the dynamometer serial number, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided the test cell records show the pertinent instrument information.
- (h) All pertinent instrument information such as tuning-gain-serial number-detector number-range. As an alternative, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, pro-

vided test cell calibration records show the pertinent instrument information.

(i) Recorder Charts: Identify zero, span, exhaust gas, and dilution air sample traces.

(j) Test cell barometric pressure, ambient temperature and humidity.

NOTE: A central laboratory barometer may be used; *Provided*, that individual test cell barometric pressures are shown to be within ±0.1 percent of the barometric pressure at the central barometer location.

(k) [Reserved]

(l) Pressure of the mixture of exhaust and dilution air entering the CVS metering device, the pressure increase across the device, and the temperature at the inlet. The temperature may be recorded continuously or digitally to determine temperature variations.

(m) The number of revolutions of the positive displacement pump accumulated during each test phase while exhaust samples are being collected. The number of standard cubic meters metered by a critical flow venturi during each test phase would be the equivalent record for a CFV-CVS.

(n) The humidity of the dilution air.

NOTE: If conditioning columns are not used (see §§ 86.522 and 86.544) this measurement can be deleted. If the conditioning columns are used and the dilution air is taken from the test cell, the ambient humidity can be used for this measurement.

(o) The driving distance for each of the three phases of test, calculated from the measured roll or shaft revolutions.

(p) Additional required records for methanol-fueled vehicles:

(1) Specification of the methanol fuel, or fuel mixtures, used during testing.

(2) Volume of sample passed through the methanol sampling system and the volume of deionized water in each impinger.

(3) The methanol calibration information from the GC standards.

(4) The concentration of the GC analyses of the test samples (methanol).

(5) Volume of sample passed through the formaldehyde sampling system.

(6) The formaldehyde calibration information from the HPLC standards.

(7) The concentration of the HPLC analysis of the test sample (formaldehyde).

(q) *Additional required records for natural gas-fueled vehicles.* Composition, including all carbon containing compounds; e.g. CO<sub>2</sub>, of the natural gas-fuel used during the test. C<sub>1</sub> and C<sub>2</sub> compounds shall be individually reported. C<sub>3</sub> and heavier hydrocarbons and C<sub>6</sub> and heavier compounds may be reported as a group.

(r) *Additional required records for liquefied petroleum gas-fueled vehicles.* Composition of the liquefied petroleum gas-fuel used during the test. Each hydrocarbon compound present, through C<sub>4</sub> compounds, shall be individually reported. C<sub>5</sub> and heavier hydrocarbons may be reported as a group.

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#### § 86.544-90 Calculations; exhaust emissions.

The final reported test results, with oxides of nitrogen being optional for model years prior to 2006 and required for 2006 and later model years, shall be computed by use of the following formula: (The results of all emission tests shall be rounded, in accordance with ASTM E29-93a (incorporated by reference in § 86.1), to the number of places to the right of the decimal point indicated by expressing the applicable standard to three significant figures.)

$$(a) Y_{wm} = 0.43 \left( \frac{Y_{ct} + Y_s}{D_{ct} + D_s} \right) + 0.57 \left( \frac{Y_{ht} + Y_s}{D_{ht} + D_s} \right)$$

Where:

(1) Y<sub>wm</sub> = Weighted mass emissions of CO<sub>2</sub> or of each pollutant (*i.e.*, HC, CO, or NO<sub>x</sub>) in grams per vehicle kilometer and if appropriate, the weighted carbon mass equivalent of total hydrocarbon equivalent, in grams per vehicle kilometer.

(2) Y<sub>ct</sub> = Mass emissions as calculated from the “transient” phase of the cold-start test, in grams per test phase.

(3) Y<sub>ht</sub> = Mass emissions as calculated from the “transient” phase of the hot-start test, in grams per test phase.

(4) Y<sub>s</sub> = Mass emissions as calculated from the “stabilized” phase of the cold-start test, in grams per test phase.

(5) D<sub>ct</sub> = The measured driving distance from the “transient” phase of the cold-start test, in kilometers.

(6) D<sub>ht</sub> = The measured driving distance from the “transient” phase of the hot-start test, in kilometers.

(7) D<sub>s</sub> = The measured driving distance from the “stabilized” phase of the cold-start test, in kilometers.

(b) The mass of each pollutant for each phase of both the cold-start test and the hot-start test is determined from the following:

(1) Hydrocarbon mass:

$$HC_{mass} = V_{mix} \times \text{Density}_{HC} \times (HC_{conc} / 1,000,000)$$

(2) Oxides of nitrogen mass:

$$NOx_{mass} = V_{mix} \times \text{Density}_{NO2} \times K_H \times (NOx_{conc} / 1,000,000)$$

(3) Carbon monoxide mass:

$$CO_{mass} = V_{mix} \times \text{Density}_{CO} \times (CO_{conc} / 1,000,000)$$

(4) Carbon dioxide mass:

$$CO_{2mass} = V_{mix} \times \text{Density}_{CO2} \times (CO_{2conc} / 100)$$

(5) Methanol mass:

$$CH_3OH_{mass} = V_{mix} \times \text{Density}_{CH_3OH} \times (CH_3OH_{conc} / 1,000,000)$$

(6) Formaldehyde mass:

$$HCHO_{mass} = V_{mix} \times \text{Density}_{HCHO} \times (HCHO_{conc} / 1,000,000)$$

(7) Total hydrocarbon equivalent:

$$(i) THCE = HC_{mass} + 13.8756/32.042 \times (CH_3OH)_{mass} + 13.8756/30.0262 \times (HCHO)_{mass}$$

(c) Meaning of symbols:

(1) (i) HC<sub>mass</sub> = Hydrocarbon emissions, in grams per test phase.

(ii) Density<sub>HC</sub> = Density of HC in exhaust gas.

(A) *For gasoline-fuel*; Density<sub>HC</sub> = 576.8 g/m<sup>3</sup>-carbon atom (16.33 g/ft<sup>3</sup>-carbon atom), assuming an average carbon to hydrogen ratio of 1:1.85, at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(B) *For natural gas and liquefied petroleum gas-fuel*; Density<sub>HC</sub> = 41.57(12.011+H/C(1.008)) g/m<sup>3</sup>-carbon atom (1.1771(12.011+H/C(1.008)) g/ft<sup>3</sup>-carbon atom) where H/C is the hydrogen to carbon ratio of the hydrocarbon components of test fuel, at 20 °C (68 °F) and 101.3 kPa (760mm Hg) pressure.

(iii) (A) HC<sub>conc</sub> = Hydrocarbon concentration of the dilute exhaust sample corrected for background, in ppm carbon equivalent, *i.e.*, equivalent propane×3.

(B) HC<sub>conc</sub> = HC<sub>e</sub> - HC<sub>d</sub>(1 - (1/DF))