

Environmental Protection Agency

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§ 89.413 Raw sampling procedures.

Follow these procedures when sampling for gaseous emissions.

(a) The gaseous emission sampling probe must be installed at least 0.5 m or 3 times the diameter of the exhaust pipe—whichever is the larger—upstream of the exit of the exhaust gas system.

(b) In the case of a multi-cylinder engine with a branched exhaust manifold, the inlet of the probe shall be located sufficiently far downstream so as to ensure that the sample is representative of the average exhaust emissions from all cylinders.

(c) In multi-cylinder engines having distinct groups of manifolds, such as in a “Vee” engine configuration, it is permissible to:

(1) Sample after all exhaust pipes have been connected together into a single exhaust pipe.

(2) For each mode, sample from each exhaust pipe and average the gaseous concentrations to determine a value for each mode.

(3) Sample from all exhaust pipes simultaneously with the sample lines connected to a common manifold prior to the analyzer. It must be demonstrated that the flow rate through each individual sample line is ± 4 percent of the average flow rate through all the sample lines.

(4) Use another method, if it has been approved in advance by the Administrator.

(d) All gaseous heated sampling lines shall be fitted with a heated filter to extract solid particles from the flow of gas required for analysis. The sample line for CO and CO₂ analysis may be heated or unheated.

[59 FR 31335, June 17, 1994. Redesignated and amended at 63 FR 56996, 57016, Oct. 23, 1998]

§ 89.414 Air flow measurement specifications.

(a) The air flow measurement method used must have a range large enough to accurately measure the air flow over the engine operating range during the test. Overall measurement accuracy must be ± 2 percent of the maximum engine value for all modes. The Administrator must be advised of the method used prior to testing.

(b) When an engine system incorporates devices that affect the air flow measurement (such as air bleeds) that result in understated exhaust emission results, corrections to the exhaust emission results shall be made to account for such effects.

[59 FR 31335, June 17, 1994. Redesignated and amended at 63 FR 56996, 57017, Oct. 23, 1998]

§ 89.415 Fuel flow measurement specifications.

The fuel flow rate measurement instrument must have a minimum accuracy of 2 percent of the engine maximum fuel flow rate. The controlling parameters are the elapsed time measurement of the event and the weight or volume measurement.

[63 FR 57017, Oct. 23, 1998]

§ 89.416 Raw exhaust gas flow.

The exhaust gas flow shall be determined by one of the methods described in this section and conform to the tolerances of table 3 in appendix A to subpart D:

(a) Measurement of the air flow and the fuel flow by suitable metering systems (for details see SAE J244. This procedure has been incorporated by reference. See § 89.6.) and calculation of the exhaust gas flow as follows:

$$G_{EXHW} = G_{AIRW} + G_{FUEL} \quad (\text{for wet exhaust mass})$$

or

$$V_{EXHD} = V_{AIRD} + (-.767) \times G_{FUEL} \quad (\text{for dry exhaust volume})$$

or

$$V_{EXHW} = V_{AIRW} + .749 \times G_{FUEL} \quad (\text{for wet exhaust volume})$$

(b) Exhaust mass calculation from fuel consumption (see § 89.415) and exhaust gas concentrations using the method found in § 89.418.

[59 FR 31335, June 17, 1994. Redesignated at 63 FR 56996, Oct. 23, 1998]

§ 89.417 Data evaluation for gaseous emissions.

For the evaluation of the gaseous emission recording, the last 60 seconds of each mode are recorded, and the average values for HC, CO, CO₂, and NO_x during each mode are determined from

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the average concentration readings determined from the corresponding calibration data.

[59 FR 31335, June 17, 1994. Redesignated at 63 FR 56996, Oct. 23, 1998]

§ 89.418 Raw emission sampling calculations.

(a) The final test results shall be derived through the steps described in this section.

(b) The exhaust gas flow rate G_{EXHW} and V_{EXHW} shall be determined for each mode.

(1) For measurements using the mass flow method, see § 89.416(a).

(2) For measurements using the fuel consumption and exhaust gas concentrations method, use the following equations:

$$G_{EXHW} = G_{fuel} + G_{aird} \left(1 + \left(\frac{H}{1000} \right) \right)$$

Where:

$$G_{aird} = \frac{G_{fuel}}{(fla)} = \frac{\text{Mass Fuel Measured}}{G_{airw} \times \left(1 - \frac{H}{1000} \right)}$$

$$(fla) = \frac{4.77 (1 + \alpha/4) (fla)_{stoich}}{\frac{1}{X} - \left(\frac{DCO}{2X(10^6)} \right) - \left(\frac{DHC}{X(10^6)} \right) + \frac{\alpha}{4} \left(1 - \frac{DHC}{X(10^6)} \right) - \frac{0.75 \alpha}{\left(\frac{K}{\left(\frac{DCO}{X(10^6)} \right)} \right) + \left(\frac{(1-K)}{\left(1 - \frac{DHC}{X(10^6)} \right)} \right)}$$

$$(fla)_{stoich} = \frac{M_c + \alpha M_H}{138.18 (1 + \alpha/4)}$$

$$X = \frac{DCO_2}{10^2} + \frac{DCO}{10^6} + \frac{DHC}{10^6}$$

$K = 3.5$

(3) Humidity values may be calculated from either one of the following equations:

$$H = \frac{6.22 \times R_a \times p_d}{p_R - (p_d \times R_a \times 10^{-2})}$$

or