inlet pressure. With this set of calibration data, calculated the following CFV pressure ratio limit, $Pr_{ratio\text{-}lim}$:

$$Pr_{ratio\text{-}lim} = \frac{P_{out\text{-}cal}}{P_{in\text{-}cal}}$$

Where:

$P_{in\text{-}cal}$ = Venturi inlet pressure (PPI in absolute pressure units), and

$P_{out\text{-}cal}$ = Venturi outlet pressure (PPO in absolute pressure units), measured at the exit of the venturi diffuser outlet.

(B) The venturi pressure ratio ($Pr_{ratio\text{-}i}$) during all emissions tests must be less than, or equal to, the calibration pressure ratio limit ($Pr_{ratio\text{-}lim}$) derived from the CFV calibration data, such that:

$$\frac{P_{out\text{-}i}}{P_{in\text{-}i}} = Pr_{ratio\text{-}i} \leq Pr_{ratio\text{-}lim}$$

Where:

$P_{in\text{-}i}$ and $P_{out\text{-}i}$ are the venturi inlet and outlet pressures, in absolute pressure units, at each i-th interval during the emissions test.

(ii) *Option 2.* Other methods: With prior Administrator approval, any other method may be used that assure that the venturi operates at sonic conditions during emissions tests, provided the method is based upon sound engineering principles.

(c) *CVS System Verification.* The following "gravimetric" technique can be used to verify that the CVS and analytical instruments can accurately measure a mass of gas that has been injected into the system. If the CVS and analytical system will be used only in the testing of petroleum-fueled engines, the system verification may be performed using either propane or carbon monoxide. If the CVS and analytical system will be used with methanol-fueled vehicles as well as petroleum-fueled vehicles, system verification performance check must include a methanol check in addition to either the propane or carbon monoxide check. (Verification can also be accomplished by constant flow metering using critical flow orifice devices.)

(1) Obtain a small cylinder that has been charged with pure propane or carbon monoxide gas (CAUTION—carbon monoxide is poisonous).

(2) Determine a reference cylinder weight to the nearest 0.01 grams.

(3) Operate the CVS in the normal manner and release a quantity of pure propane or carbon monoxide into the system during the sampling period (approximately 5 minutes).

(4) Following completion of step (3) in this paragraph (c) (if methanol injection is required), continue to operate the CVS in the normal manner and release a known quantity of pure methanol (in gaseous form) into the system during the sampling period (approximately five minutes). This step does not need to be performed with each verification, provided that it is performed at least twice annually.

(5) The calculations of §86.144 are performed in the normal way, except in the case of propane. The density of propane (17.30 g/ft^3/carbon atom (0.6109 kg/m^3/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of carbon monoxide, the density of 32.97 g/ft^3 (1.164 kg/m^3) is used. In the case of methanol, the density of 37.71 g/ft^3 (1.332 kg/m^3) is used.

(6) The gravimetric mass is subtracted from the CVS measured mass and then divided by the gravimetric mass to determine the percent accuracy of the system.

(7) The cause for any discrepancy greater than ±2 percent must be found and corrected. (For 1991–1995 calendar years, discrepancies greater than ±2 percent are allowed for the methanol test, provided that they do not exceed ±8 percent for 1991 testing or ±6 percent for 1992–1995 testing.)

[54 FR 14518, Apr. 11, 1989, as amended at 60 FR 34344, June 30, 1995; 62 FR 47121, Sept. 5, 1997; 63 FR 24448, May 4, 1998; 65 FR 8278, Feb. 18, 2000]

§ 86.120–82 Gas meter or flow instrumentation calibration, particulate measurement.

Sampling for particulate emissions requires the use of gas meters or flow instrumentation to measure flow through the particulate filters. The meters or instrumentation shall receive initial and periodic calibrations as follows:

(a) Install a standard air flow measurement device upstream of the gas meter or instrument being calibrated.

This standard device shall measure air flow at standard conditions with an accuracy of ±1 percent. Standard conditions are defined as 68 °F (20 °C) and 29.92 in. Hg (101.3 kPa). A critical flow orifice, a bellmouth, or a laminar flow element is recommended as the standard device.

(b) Flow air through the calibration system at the sample flow rate used for particulate testing and at the backpressure which occurs during the sample test.

(c) When the temperature and pressure in the system have stabilized, measure the gas meter or instrument indicated volume over a time period of at least 5 minutes and until a flow volume of at least ±1 percent accuracy can be determined by the standard device. Record the stabilized air temperature and pressure upstream of the gas meter or instrument being calibrated and as required for the standard device.

(d) Calculate air flow at standard conditions as measured by both the standard device and the gas meter or instrument being calibrated.

(e) Repeat the procedures of paragraphs (b) through (d) of this section using flow rates which are 10 percent above the nominal sampling flow rate and 10 percent below the nominal sampling flow rate.

(f) If the air flow at standard conditions measured by the gas meter or instrument being calibrated differs by more than ±1 percent from the standard measurement at any of the three measured flow rates, then a correction shall be made by either of the following two methods:

(1) Mechanically adjust the gas meter or instrument so that it agrees within 1 percent of the standard measurement at the three specified flow rates, or

(2) Develop a continuous best fit calibration curve for the gas meter (as a function of the standard device flow measurement) from the three calibration points that represents the data to within 1 percent at all points to determine corrected flow.

(g) *Other systems.* A bell prover may be used to calibrate the gas meter if the procedure outlined in ANSI B109.1–1973 is used. Prior approval by the Administrator is not required to use the bell prover.

[45 FR 14515, Mar. 5, 1980]

§ 86.120–94 Gas meter or flow instrumentation calibration; particulate, methanol and formaldehyde measurement.

(a) Sampling for particulate, methanol and formaldehyde emissions requires the use of gas meters or flow instrumentation to determine flow through the particulate filters, methanol impingers and formaldehyde impingers. These instruments shall receive initial and periodic calibrations as follows:

(1)(i) Install a calibration device in series with the instrument. A critical flow orifice, a bellmouth nozzle, a laminar flow element or an NBS traceable flow calibration device is required as the standard device.

(ii) The flow system should be checked for leaks between the calibration and sampling meters, including any pumps that may be part of the system, using good engineering practice.

(2) Flow air through the calibration system at the sample flow rate used for particulate, methanol, and formaldehyde testing and at the backpressure which occurs during the test.

(3) When the temperature and pressure in the system have stabilized, measure the indicated gas volume over a time period of at least five minutes or until a gas volume of at least ±1 percent accuracy can be determined by the standard device. Record the stabilized air temperature and pressure upstream of the instrument and as required for the standard device.

(4) Calculate air flow at standard conditions as measured by both the standard device and the instrument(s). (Standard conditions are defined as 68 °F (20 °C) and 29.92 in Hg (101.3 kPa).)

(5) Repeat the procedures of paragraphs (a)(2) through (4) of this section using at least two flow rates which bracket the typical operating range.

(6) If the air flow at standard conditions measured by the instrument differs by ±1.0 percent of the maximum operating range or ±2.0 percent of the point (whichever is smaller), then a correction shall be made by either of the following two methods: