CALIBRATION DATA MEASUREMENT—Continued

Parameter	Sym	Units	Tolerance
(iv) Air Flow	Q_S	Std ft³/min (m³/min).	± 5% of NIST "true" value
(v) SSV inlet depression	P_I	in. H_2O (kPa)	± .23 in. H_2O (±.057kPa)
(vi) Pressure drop between the inlet and throat of SSV	DP	in. H_2O (kPa)	±.05 in. H_2O (±.012kPa)
(vii) Water vapor pressure of inlet air	P_V	in. Hg (kPa)	±.10 in. Hg (± .34kPa)
(vii) Temperature at SSV inlet	T_I	°F (°C)	±4.0 °F (2.2 °C)

(4) Set up equipment similar to CFV or PDP calibration except the variable flow restrictor valve can be deleted or set in the open position, and the pressure drop reading device must be added. The calibration test must be conducted with the test subsonic venturi in place in its permanent position. Any subsequent changes in upstream or downstream configuration could cause a shift in calibration. Leaks between the calibration metering device and the SSV must be eliminated.

(5) Adjust the variable flow blower or restrictor valve to its maximum in-use flow rate. Allow the system to stabilize and record data from all instruments. Be sure to avoid choke condition.

(6) Vary the flow through a minimum of eight steps covering the intended in-use operating range of the SSV.

(7) Data analyses. If the calibration venturi is used at the tunnel inlet (free standing), then assume a value of β=0. If the SSV installed in the CVS tunnel, use the actual inside tunnel diameter and the throat diameter to compute β.

(i) Assume an initial value for Cd = 0.98 to calculate Q_m for the calculation of Reynolds number, Re,:

$$Re = \frac{6.667E4 * Q_m}{\pi * d * \mu}$$

Where: μ = viscosity of air, centipoise

$$\mu = K_\mu * \frac{T_k^{1.5}}{(T_K + 110.4)}$$

$K\mu$=1.458E–3

T_K=(T_I °C+273.16)

(ii) From the initial calibration of the venturi, establish an equation of Cd as a function of Re. The following functional forms should be reviewed, but a power series, least-squares fit polynomial equation may result in the best fit. Many factors involved in the installation of SSV and the operating range of the Reynolds number can affect the functional relationship of the Cd with Re. Calculate Cd based on this initial equation of Re. Compute a final Q_m based on this calculated Cd for both the calibration nozzle and the inline SSV.

(8)(i) Compute the percent difference in air flow between the calibration venturi and the inline SSV. If the difference in percent of point is greater than 1%, compute a new Cd and Re for the in-tunnel venturi as follows:

Cd_{new}=Actual Air Flow/Theoretical Air Flow=Qm_{act} /Qm_{theo}

$$Re_{new} = \frac{0.8Qm_{cal}}{\pi * d * \mu}$$

(ii) Qm_{act} is flow measured by the calibration venturi and Qm_{theo} is the theoretical calculated flow based on the in-tunnel SSV conditions with Cd set equal to 1. Re_{new} is based on the calibrated venturi flow, but the in-tunnel SSV properties. Recalculate a new curve fit of Cd_{new} for the inline venturi as a function of Re_{new} following the guidelines in paragraph (e)(7) of this section. Agreement of the fit should be within 1.0% of point. Install the new Cd curve fit in the test cell flow computing device and conduct the propane injection, flow verification test.

(f) *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. (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 into the system during the sampling period (approximately 5 minutes).

(4) Following completion of step (3) above (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 § 86.1342 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 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 ±6 percent.)

(8) The Administrator, upon request, may waive the requirement to comply with ±2 percent methanol recovery tolerance, and instead require compliance with a higher tolerance (not to exceed ±6 percent), provided that:

(i) The Administrator determines that compliance with these specified tolerances is not practically feasible; and

(ii) The manufacturer makes information available to the Administrator which indicates that the calibration tests and their results are consistent with good laboratory practice, and that the results are consistent with the results of calibration testing conducted by the Administrator.

[54 FR 14591, Apr. 11, 1989, as amended at 60 FR 34371, June 30, 1995; 63 FR 24449, May 4, 1998; 65 FR 8279, Feb. 18, 2000; 66 FR 5181, Jan. 18, 2001]

§ 86.1320–90 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, or 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 sample 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.