

## Environmental Protection Agency

## § 86.109-90

during each phase of the test procedure.

(b) Two types of dynamometer roll configurations are currently approved by the Administrator:

(1) A small twin-roll dynamometer that has a nominal roll diameter of 8.65 inches and a nominal roll spacing of 17 inches; and

(2)(i) An electric dynamometer that has a single roll with a nominal diameter of 48 inches (1.20 to 1.25 meters).

(ii)(A) The dynamometer must be capable of dynamically controlling inertia load during the US06 test cycle as a function of a vehicle throttle position signal if a manufacturer desires using the following test option. Any time the duration of throttle operation greater than or equal to 85% of wide open throttle (WOT) is greater than or equal to eight seconds, the test inertia load may be adjusted during any of five EPA specified acceleration events by an amount of load that will eliminate additional throttle operation greater than or equal to 85% of WOT.

(B)(1) The specific US06 schedule accelerations time periods where inertia load adjustments may be applied are:

(i) 49 through 69 seconds;

(ii) 83 through 97 seconds;

(iii) 135 through 165 seconds;

(iv) 315 through 335 seconds; and

(v) 568 through 583 seconds.

(2) During these five time intervals when inertia load adjustment is occurring, inertia load adjustment is discontinued when throttle operation is less than 85% of WOT or at the end of the specified time interval.

(C) Each type of generic application for implementing this concept must receive the Administrator's approval before a manufacturer may use these inertia adjustments for official US06 schedule certification tests.

(c) Other dynamometer configurations may be used for testing if it can be demonstrated that the simulated road load power and inertia are equivalent, and if approved in advance by the Administrator.

(d) An electric dynamometer meeting the requirements of paragraph (b)(2) of this section, or a dynamometer approved as equivalent under paragraph (c) of this section, must be used for all

types of emission testing in the following situations.

(1)(i) Gasoline vehicles which are part of an engine family which is designated to meet the phase-in of SFTP compliance required under the implementation schedule of table A00-1 of § 86.000-08, or table A00-3, or table A00-5 of § 86.000-09.

(ii) Diesel LDVs and LDT1s which are part of an engine family which is designated to meet the phase-in of SFTP compliance required under the implementation schedule of table A00-1 of § 86.000-08, or table A00-3, or table A00-5 of § 86.000-09.

(2) Starting with the 2002 model year, any light-duty vehicle or light light-duty truck which uses any regulated fuel.

(3) Starting with the 2004 model year, any heavy light-duty truck which uses any regulated fuel.

[61 FR 54890, Oct. 22, 1996]

### § 86.108-79 Dynamometer.

(a) The dynamometer shall have a power absorption unit for simulation of road load power and flywheels or other means of simulating the inertia weight as specified in § 86.129.

(b)(1) The dynamometer shall have a roll or shaft revolution counter for determination of distance driven.

(2) In lieu of the requirement in (b) (1) of this section the manufacturer shall provide some means, approved in advance by the Administrator, for the determination of distance driven.

(c) Small twin-roll dynamometers shall have a nominal roll diameter of 8.65 inches and a nominal roll spacing of 17 inches. Large single-roll dynamometers shall have a nominal roll diameter of 48 inches. Dynamometers with other roll specifications may be used if the total simulated road load power can be shown to be equivalent, and if approved in advance by the Administrator.

[42 FR 45651, Sept. 12, 1977]

### § 86.109-90 Exhaust gas sampling system; Otto-cycle vehicles.

(a)(1) *General.* The exhaust gas sampling system described in this paragraph is designed to measure the true

mass of gaseous emissions in the exhaust of either Otto-cycle light-duty vehicles and light-duty trucks. In the CVS concept of measuring mass emissions, two conditions must be satisfied: the total volume of the mixture of exhaust and dilution air must be measured, and a continuously proportioned volume of sample must be collected for analysis. Mass emissions are determined from the sample concentration and total flow over the test period.

(2) *Vehicle tailpipe to CVS Duct.* For methanol-fueled vehicles, cooling of the exhaust gases in the duct connecting the vehicle tailpipe to the CVS shall be minimized. This may be accomplished by:

(i) Using a duct of unrestricted length maintained at  $235^{\circ}\pm 15^{\circ}$  F ( $113^{\circ}\pm 8^{\circ}$  C), heating and possible cooling capabilities are required; or

(ii) Using a short duct (up to 12 feet long) constructed of smooth wall pipe with a minimum of flexible sections, maintained at  $235^{\circ}\pm 15^{\circ}$  F ( $113^{\circ}\pm 8^{\circ}$  C) prior to the test and during the 10 minute hot soak segment and uninsulated during the test (insulation may remain in place and/or heating may occur during testing provided

maximum temperature is not exceeded); or

(iii) Using smooth wall duct less than five feet long with no required heating.

(iv) Omitting the duct and performing the exhaust gas dilution function at the vehicle tailpipe exit.

(3) *Positive displacement pump.* The Positive Displacement Pump-Constant Volume Sampler (PDP-CVS), Figure B90-1 satisfies the first condition by metering at a constant temperature and pressure through the pump. The total volume is measured by counting the revolutions made by the calibrated positive displacement pump. The proportional samples for the bag sample, and for methanol-fueled vehicles, the methanol sample (Figure B90-2) and the formaldehyde sample (Figure B90-3), are achieved by sampling at a constant flow rate. For methanol-fueled vehicles, the sample lines for the methanol and formaldehyde samples are heated to  $235^{\circ}\pm 15^{\circ}$  F ( $113^{\circ}\pm 8^{\circ}$  C).

NOTE: For 1990 through 1994 model year methanol-fueled vehicles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.

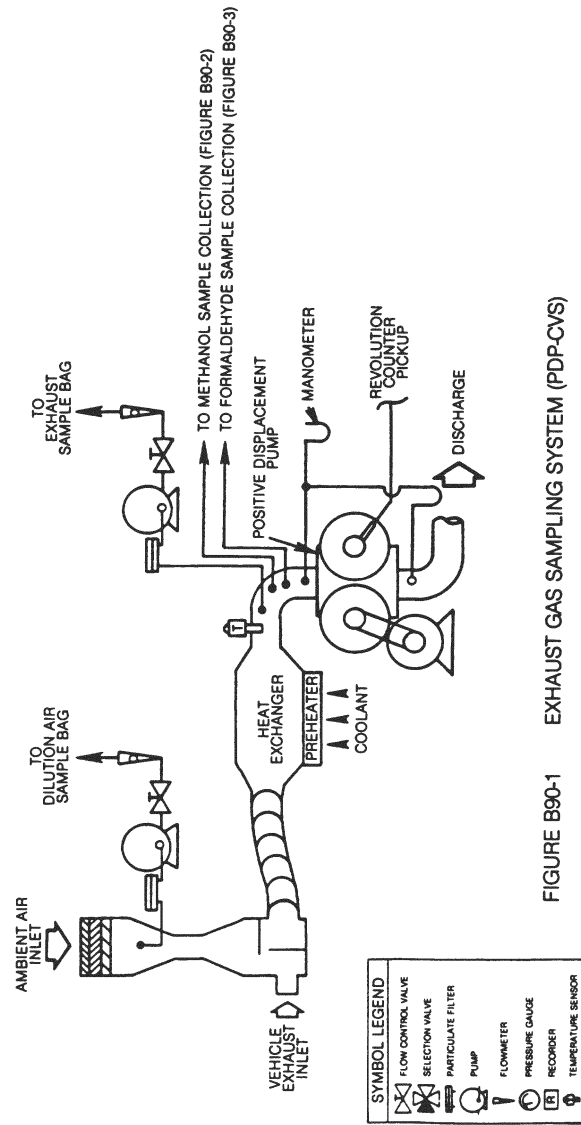


FIGURE B90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)

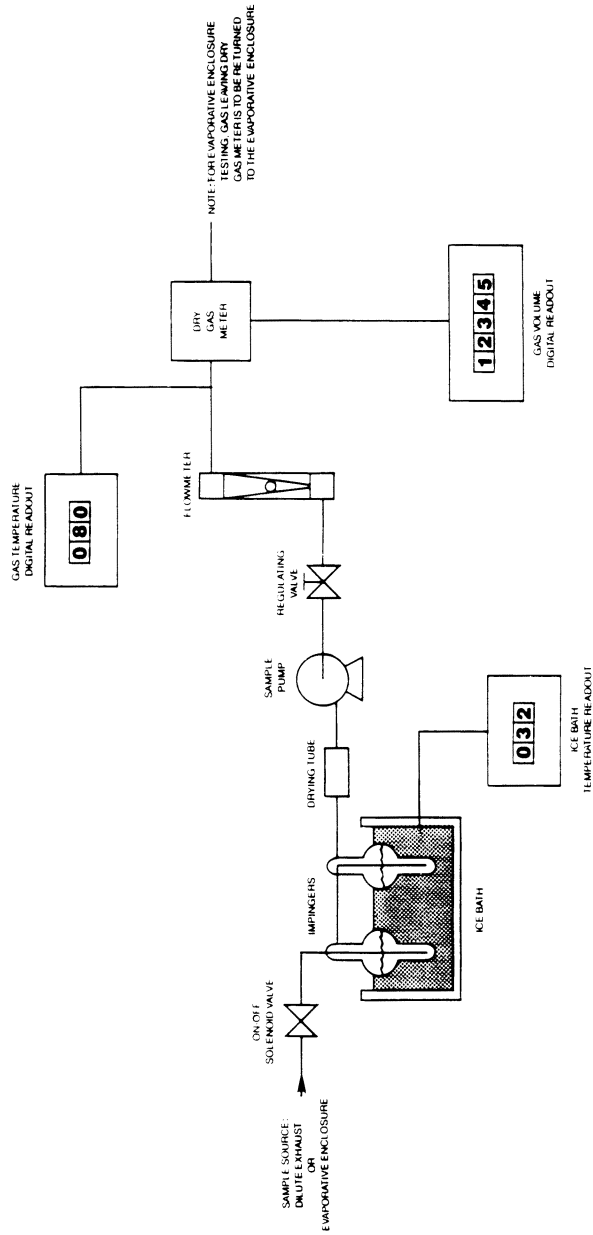


FIGURE B9-2 METHANOL SAMPLE COLLECTION FLOW SCHEMATIC

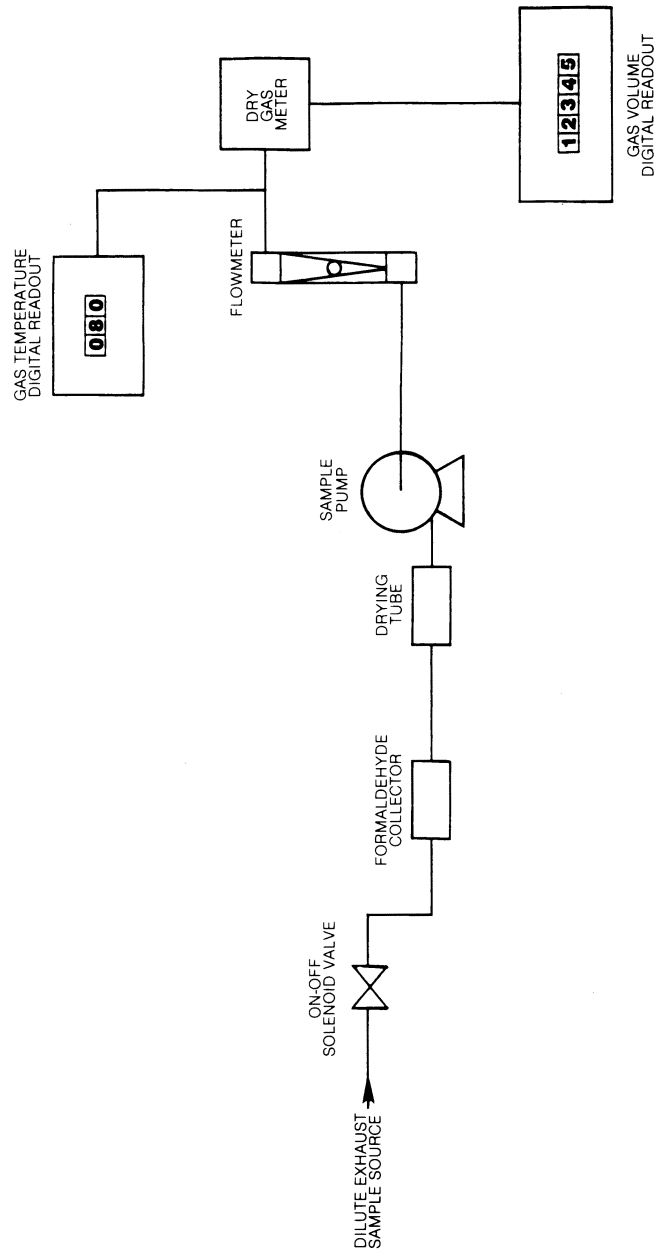


FIGURE B90-3 FORMALDEHYDE SAMPLE COLLECTION FLOW SCHEMATIC

(4) *Critical flow venturi.* The operation of the Critical Flow Venturi—Constant Volume Sampler (CFV-CVS) sample system, Figure B90-4, is based upon the

principles of fluid dynamics associated with critical flow. Proportional sampling throughout temperature excursions is maintained by use of small

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CFVs in the sample lines (for methanol-fueled vehicles, one line supplies sample for the bag sample, another line supplies sample for the methanol sample, and a third line supplies sample for the formaldehyde sample.) The methanol and formaldehyde sample lines are heated to  $235^{\circ}\pm 15^{\circ}$  F ( $113^{\circ}\pm 8^{\circ}$  C) with care being taken to ensure that the CFVs of the sample probes are not heated since heating of the CFVs would cause loss of proportionality. The variable mixture flow rate is maintained at

sonic velocity, is inversely proportional to the square root of the gas temperature, and is computed continuously. Since the pressure and temperature are the same at all venturi inlets, the sample volume is proportional to the total volume.

NOTE: For 1990 through 1994 model year methanol-fueled vehicles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.

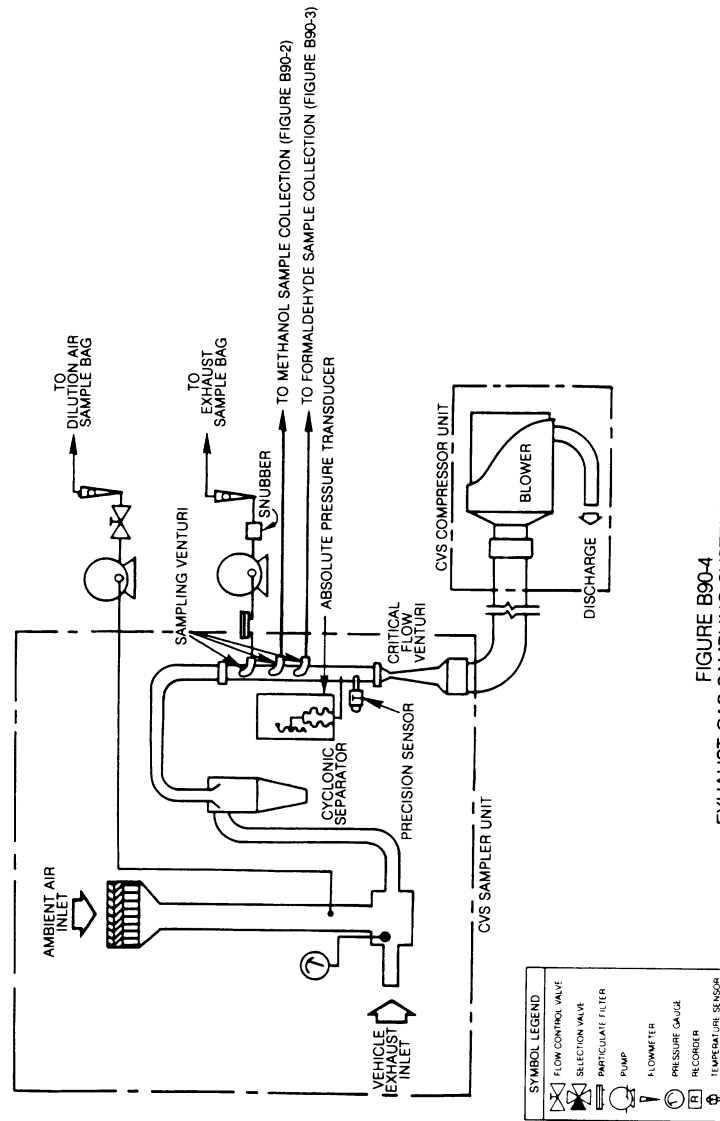


FIGURE B90-4  
EXHAUST GAS SAMPLING SYSTEM (CFV-CVS)

(5) *Other systems.* Other sampling systems may be used if shown to yield equivalent results, and if approved in advance by the Administrator.

(b) *Component description, PDP-CVS.* The PDP-CVS, Figure B90-1, consists of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling systems

(see Figure B90-2 for methanol sampling system and Figure B90-3 for formaldehyde sampling system) sampling lines which are heated to  $235 \pm 15$  °F ( $113 \pm 8$  °C) in the case of the methanol-fueled vehicles (heating of the sample lines may be omitted, provided the methanol and formaldehyde sample collection systems are close coupled to

the probes thereby preventing loss of sample due to cooling and resulting condensation in the sample lines), and associated valves, pressure and temperature sensors. The PDP-CVS shall conform to the following requirements:

(1) Static pressure variations at the tailpipe(s) of the vehicle shall remain within  $\pm 5$  inches of water (1.2 kPa) of the static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s). (Sampling systems capable of maintaining the static pressure to within  $\pm 1$  inch of water (0.25 kPa) will be used by the Administrator if a written request substantiates the need for this closer tolerance.)

(2) The gas mixture temperature, measured at a point immediately ahead of the positive displacement pump, shall be within  $\pm 10$  °F ( $\pm 5.6$  °C) of the designed operating temperature at the start of the test. The gas mixture temperature variation from its value at the start of the test shall be limited to  $\pm 10$  °F ( $\pm 5.6$  °C) during the entire test. The temperature measuring system shall have an accuracy and precision of  $\pm 2$  °F (1.1 °C).

(3) The pressure gauges shall have an accuracy and precision of  $\pm 1.6$  inches of water (0.4 kPa).

(4) The flow capacity of the CVS shall be large enough to eliminate water condensation in the system. (300 to 350 cfm (0.142 to 0.165 m<sup>3</sup>/s) is sufficient for most petroleum-fueled vehicles. Higher flow rates are required for methanol fueled vehicles. Procedures for determining CVS flow rates are detailed in "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3-83-009.)

(5) Sample collection bags for dilution air and exhaust samples shall be of sufficient size so as not to impede sample flow. A single dilution air sample, covering the total test period, may be collected for determination of formaldehyde background (methanol-fueled vehicles).

(6) The methanol sample collection system and the formaldehyde sample collection system shall each be of sufficient capacity so as to collect samples of adequate size for analysis without significant impact on the volume of dilute exhaust passing through the PDP.

(c) *Component description, CFV-CVS.* The CFV-CVS sample system, Figure B90-4, consists of a dilution air filter and mixing assembly, a cyclone particulate separator, unheated sampling ventureries for the bag samples, and for the methanol and formaldehyde samples from methanol-fueled vehicles, samples lines heated to  $235 \pm 15$  °F ( $113 \pm 8$  °C) for the methanol and formaldehyde samples from methanol fueled vehicles (heating of the sample lines may be omitted provided, the methanol and formaldehyde sample collection systems are close coupled to the probes thereby preventing loss of sample due to cooling and resulting condensation in the sample lines), a critical flow venturi, and assorted valves, and pressure and temperature sensors. The CFV sample system shall conform to the following requirements:

(1) Static pressure variations at the tailpipe(s) of the vehicle shall remain within  $\pm 5$  inches of water (1.2 kPa) of the static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s). (Sampling systems capable of maintaining the static pressure to within  $\pm 1$  inch of water (0.25 kPa) will be used by the Administrator if a written request substantiates the need for this closer tolerance.)

(2) The temperature measuring system shall have an accuracy and precision of  $\pm 2$  °F (1.1 °C) and a response time of 0.100 seconds to 62.5 percent of a temperature change (as measured in hot silicone oil).

(3) The pressure measuring system shall have an accuracy and precision of  $\pm 1.6$  inches of water (0.4 kPa).

(4) The flow capacity of the CVS shall be large enough to virtually eliminate water condensation in the system (300 to 350 cfm (0.142 to 0.165 m<sup>3</sup>/s) is sufficient for most petroleum-fueled vehicles). Higher flow rates are required with methanol-fueled vehicles. Procedures for determining CVS flow rates are detailed in "Calculation of Emission and Fuel Economy When Using Alternative Fuels," EPA 460/3-83-009.

(5) Sample collection bags for dilution air and exhaust samples shall be of sufficient size so as not to impede sample flow. A single dilution air sample covering the total test period may be



collected for determination of formaldehyde background for methanol-fueled vehicles.

(6) The methanol sample collection system and the formaldehyde sample collection system shall each be of sufficient capacity so as to collect samples of adequate size for analysis without significant impact on the volume of dilute exhaust passing through the CFV-CVS.

[54 FR 14500, Apr. 11, 1989]

**§ 86.109-94 Exhaust gas sampling system; Otto-cycle vehicles not requiring particulate emission measurements.**

(a)(1) *General.* The exhaust gas sampling system described in this paragraph is designed to measure the true mass of gaseous emissions in the exhaust of either Otto-cycle light-duty vehicles or light-duty trucks which are waived from requirements for the measurement of particulate emissions. In the CVS concept of measuring mass emissions, two conditions must be satisfied: the total volume of the mixture of exhaust and dilution air must be measured, and a continuously proportioned volume of sample must be collected for analysis. Mass emissions are determined from the sample concentration and total flow over the test period.

(2) *Vehicle tailpipe to CVS Duct.* For methanol-fueled vehicles, cooling of the exhaust gases in the duct connecting the vehicle tailpipe to the CVS shall be minimized. This may be accomplished by:

(i) Using a duct of unrestricted length maintained at a temperature above the maximum dew point of the exhaust, but below 250 °F (121 °C); heating and possibly cooling capabilities are required; or

(ii) Using a short duct (up to 12 feet long) constructed of smooth wall pipe

with a minimum of flexible sections, maintained at a temperature above the maximum dew point of the exhaust, but below 250 °F (121 °C), prior to the test and during the 10 minute hot soak segment and uninsulated during the test (insulation may remain in place and/or heating may occur during testing provided maximum temperature is not exceeded); or

(iii) Using smooth wall duct less than five feet long with no required heating. A maximum of two short flexible connectors are allowed under this option; or

(iv) Omitting the duct and performing the exhaust gas dilution function at the vehicle tailpipe exit.

(3) *Positive displacement pump.* The Positive Displacement Pump-Constant Volume Sampler (PDP-CVS), Figure B94-1 satisfies the first condition by metering at a constant temperature and pressure through the pump. The total volume is measured by counting the revolutions made by the calibrated positive displacement pump. The proportional samples for the bag sample, and for methanol-fueled vehicles, the methanol sample (Figure B94-2) and the formaldehyde sample (Figure B94-3), are achieved by sampling at a constant flow rate. For methanol-fueled vehicles, the sample lines for the methanol and formaldehyde samples are heated to prevent condensation. The temperature of the sample lines shall be more than 5 °F (3 °C) above the maximum dew point of the sample, but below 250 °F (121 °C). (Note: For 1990 through 1994 model year methanol-fueled vehicles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.)