

**ENVIRONMENTAL PROTECTION  
AGENCY**
**40 CFR Parts 9, 85, 86, 88 and 600**
**[AMS-FRL-5203-6]**
**Control of Air Pollution From New and In-Use Motor Vehicles and New and In-Use Motor Vehicle Engines; Technical Amendments to the Test Procedures for Methanol-Fueled Motor Vehicles and Motor Vehicle Engines and Petroleum-Fueled Motor Vehicles; Final Rule**
**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Final rule.

**SUMMARY:** This rule changes the test procedures previously promulgated for methanol-fueled vehicles (April 11, 1989). These revisions make minor corrections to the procedures, provide additional options, and clarify the Agency's regulatory intent. The changes are expected to allow manufacturers more flexibility in complying with the applicable regulations, without sacrificing accuracy of test results. This action is a part of an ongoing cooperative interaction between Agency staff and the affected automobile and engine manufacturers to develop the most efficient test procedures possible for alternative fuels such as methanol. Among the most significant changes are revisions to the testing requirements for flexible fuel vehicles (FFVs), the allowance of electronic mass flow controllers for methanol and formaldehyde sample systems, the allowance of lower temperatures for some heated components, establishment of wider tolerances for SHED and CVS (Constant Volume Sampler) verifications, and specification of the fuel to be used with all flame ionization detectors. It should be noted that the revision related to flame ionization detectors affects all light-duty vehicles, including gasoline-fueled vehicles.

In compliance with the Paperwork Reduction Act, this rule also displays the Office of Management and Budget (OMB) control numbers issued under the Paperwork Reduction Act (PRA) for the final rules titled "Emission Standards for Clean-fuel Vehicles and Engines, Requirements for Clean-Fuel Vehicle Conversions, and California Pilot Test Program" and the "Standards for Emissions from Natural Gas-Fueled, and Liquefied Petroleum Gas-Fueled Motor Vehicles and Motor Vehicle Engines, and Certification Procedures for Aftermarket Conversions". Also included in this Final Rule are minor changes that were proposed in the

"Gaseous-Fueled Vehicles" and "Clean Fuel Fleets" Notices of Proposed Rulemaking, but were not finalized in the respective Final Rules.

**EFFECTIVE DATE:** This final rule is effective July 31, 1995, except the amendments to part 9 are effective June 30, 1995.

Sections 85.503, 85.505, 86.094-23, 86.094-24, 86.095-35, 86.098-28, 86.113-94, 86.142-90, 86.150-98, 86.513-94, 86.542-90, 86.1242-90, 86.1344-94 published at 59 FR 48472 and § 600.113-93 published at 59 FR 39638 and 48472, containing information collection requirements which have now been approved by OMB, are effective June 30, 1995.

Sections 88.104 (b) and (d), 88.201-94 through 88.206-94, and 88.306-94(b) (1), (2), and (4) published at 59 FR 50042, containing information collection requirements which have been now approved by OMB, are effective June 30, 1995.

**ADDRESSES:** Material relevant to this rulemaking is contained in the Docket A-92-02. The docket is located at the Air Docket Section (LE-131), U.S. Environmental Protection Agency, Room M-1500, 401 M Street SW., Washington, DC 20460, and may be inspected between 8 a.m. and 3 p.m. Monday through Friday. Information may also be obtained from the U.S. Environmental Protection Agency, Office of Mobile Sources, Regulation Development and Support Division, Engine and Vehicle Regulation Branch, 2565 Plymouth Road, Ann Arbor, MI 48105.

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**SUPPLEMENTARY INFORMATION:**
**Introduction**

On April 11, 1989, EPA published final regulations which extended the Federal Motor Vehicle Control Program to methanol-fueled vehicles (54 FR 14427). Where possible, the regulations simply applied the existing petroleum-fueled vehicle test procedures to methanol-fueled vehicles. In some cases where that was not possible, it was necessary to incorporate procedures that were more complicated than the procedures used to test petroleum-fueled vehicles. Since that time, several methanol-fueled vehicles have been certified. Overall, the methanol-fueled vehicle test procedures have proven to be accurate and reliable, though some minor issues have been raised.

On March 1, 1993, EPA published a Notice of Proposed Rulemaking (NPRM) proposing several revisions to the test procedures that were established for methanol-fueled vehicles in 1989 (58 FR 11816). This rulemaking was initiated to address the minor issues which arose while implementing the previously promulgated certification procedures for methanol-fueled vehicles. Some of the issues require only a clarification of the Agency's regulatory intent, while others require changes to the test procedures specified in the CFR. The revisions being promulgated today are essentially the same revisions that were proposed, though some of proposed revisions are not being finalized. Also, some of the revisions were modified slightly in response to public comments on the proposal.

The test procedure changes being finalized today include both changes to the existing procedures and allowances for different procedures to be used in place of some of those procedures previously required. The substantive changes are described below. However, the reader is advised to read the actual regulatory language, which is also printed here, for the complete changes.

Also included in this action are minor changes that were proposed in the "Gaseous-Fueled Vehicles" (57 FR 52912, November 5, 1992) and "Clean Fuel Fleets" (58 FR 32474, June 10, 1993) Notices of Proposed Rulemaking, but were omitted from the regulations of the respective Final Rules. For details, see "Issues" 12 and 16

The following discussion is organized by issue. For each issue, there are separate sections describing what was proposed, the public comments and EPA's response to them, and a summary of the changes that are actually being finalized by today's action.

**Issues: Proposal, Public Comments, and Final Action**
**1. Test Fuels**
**Proposal**

Manufacturers of methanol-fueled flexible fuel vehicles (FFVs) have been required to comply with the methanol-fueled vehicle standards when using any fuel mixture within the vehicle's design range. (FFVs are vehicles that are designed to operate using a methanol fuel, gasoline and all mixtures of the two). In order to ensure that such vehicles meet the standards over the full range of fuel mixtures, the previous regulations (e.g., 40 CFR 86.113) required that manufacturers submit test data for worst case fuel mixtures. However, it became apparent that implementation of such an approach is

problematic, because the worst case fuel mixture may vary for the various pollutants. Therefore, rather than attempting to identify a single worst case fuel, the Agency proposed that manufacturers demonstrate compliance by submitting test data for three fuel mixtures during certification. The three proposed mixtures were: the methanol fuel expected to be found in use, gasoline, and the highest volatility mixture. The use of straight methanol fuel (e.g., M85<sup>1</sup>) and straight gasoline would demonstrate compliance at the two extremes of operation. The high volatility mixture would ensure proper evaporative emissions controls. This mixture was proposed to be approximately M10. The Agency indicated that it would retain the right to perform its confirmatory testing using any mixtures within the design range and to continue to require compliance with the standards over the full range as well.

For mileage accumulation of FFVs, the previous regulations also required the use of the worst case fuel mixtures. For reasons similar to those discussed above, the Agency proposed to allow manufacturers to alternate between the methanol fuel (e.g., M85) and gasoline, at mileage intervals not to exceed 5000 miles. The Agency also proposed requiring that the total volume of the methanol fuel used for mileage accumulation be at least 25 percent, but not more than 75 percent of the total fuel volume used.

The original regulations specified that methanol test fuels be representative of in-use fuels, did not include detailed specifications of test fuel composition, as has been done for gasoline. This issue was discussed in the NPRM, but no revisions to this requirement were proposed.

#### Public Comments

The American Automobile Manufacturers Association (AAMA) recommended that EPA not require manufacturers to use all three fuels (gasoline, M10, and M85) to demonstrate compliance for each engine family, when the manufacturers certify many methanol-fueled engine families. They argued that the testing burden associated with using three fuels for a large number of engine families would be too great. Instead, AAMA recommended that EPA allow the

manufacturers to certify most methanol-fueled engine families using only M85, as long as they tested one or two engine families using all three fuels. While the Agency recognizes that the testing burden using three fuels can be significantly more than using one fuel (as is the case with gasoline), the Agency does not believe the AAMA recommendation is sufficient to demonstrate compliance over the entire range of fuel mixtures for all engine families. Compliance using M85 does not ensure compliance using either gasoline, or M10; and compliance of one FFV engine family using gasoline and M10 does not ensure compliance for all other FFV engine families.

AAMA also disagreed with EPA's proposal to not adopt a permanent and well defined methanol certification fuel specification. They stated that "it would become difficult, if not impossible, to demonstrate compliance with all fuels if the fuel properties are allowed to drift at random." The Agency, however, feels strongly that certification fuel must be representative of in-use fuels. EPA recognizes that test reproducibility is very important, and thus does not wish to have test fuel properties varying randomly. The Agency will issue guidance as to the fuel property specifications which define the representative methanol fuel(s). The specifications will only change to the extent that the fuel market as a whole changes, and EPA does not expect that changes in the specifications will be significant from one year to the next.

A related point that is worth clarifying pertains to the possibility of EPA regulating in-use methanol fuels. While the Agency recognizes that fuel properties such as chloride content (which effects the corrosivity of the fuel), sulfur content (which can effect catalyst efficiency), or vapor pressure (which can effect cold-starting) could impact emissions, it has stated previously that it currently has no plans to regulate commercial methanol fuels. This position has been misinterpreted to mean that EPA has already decided that it will not regulate commercial methanol fuels at any time in the future. However, it is actually probable that EPA would regulate commercial methanol fuels if it became apparent that in-use methanol fuel quality was adversely affecting the environment. The Agency has no current plans to regulate commercial methanol fuels because it is optimistic that methanol fuel suppliers will voluntarily adopt industry-wide standards that will make EPA regulation unnecessary.

#### Final Action

The Agency will still require that FFVs comply with the standards when operating on any fuel mixture within the design range, but the means by which this compliance is demonstrated is being changed. Rather than attempting to identify a single worst case fuel, manufacturers will now be required to demonstrate compliance by submitting test data for three fuel mixtures during certification. These three mixtures are: the methanol fuel expected to be found in use, gasoline, and the highest volatility mixture. The highest volatility mixture will be M10 (more specifically, it will contain between nine and thirteen percent methanol).

While the Agency will accept testing on the above fuels as an adequate demonstration for certification, it should be emphasized that the Agency will retain the right to perform its confirmatory testing using any mixtures within the design range and will require compliance with the standards over the full range as well.

For mileage accumulation of FFVs, EPA will require manufacturers to alternate between the methanol fuel (e.g., M85) and gasoline, at mileage intervals not to exceed 5000 miles. There is an additional requirement that the total volume of the methanol fuel (e.g., M85) used for mileage accumulation be at least 25 percent, but not more than 75 percent of the total fuel volume used. The Agency believes that these requirements will be sufficient to demonstrate the durability of FFVs in use, where the vehicles may be operated on only methanol, only gasoline, or alternately on both fuels. EPA is not dictating which test fuel mixtures should be used for the emissions tests performed to determine deterioration factors, but the Agency is currently recommending that deterioration factors be determined for both the alcohol fuel and the gasoline fuel.

Implicit in the rationale for the approach discussed above is the assumption that there would be a reasonable possibility that a significant number of in-use FFVs would be operated using both M85 and gasoline. This assumption, however, would not necessarily be valid for FFV models which had a very significant drop in performance when fueled with gasoline. If the drop in performance were so drastic that the vehicle became only marginally functional, then it would be very unlikely that the vehicle operator would fuel the vehicle with gasoline unless it were an emergency situation,

<sup>1</sup> Methanol fuels are commonly identified by their methanol content using the abbreviation MXX, where XX is the volumetric percent of the fuel which is methanol. M85, which is currently the most common methanol fuel for light-duty vehicles, contains 85 percent methanol and 15 percent gasoline.

where the fuel tank was empty and no methanol fuel was available. Such a vehicle is said to have only "limp home" capability when operated with gasoline. The Agency recognizes that it would be reasonable for these vehicles to be considered dedicated methanol-fueled vehicles for the purposes of certification, and thus to be certified using only methanol fuel (M85) for emissions testing and mileage accumulation. The regulations have been modified to make this clear. Manufacturers should obtain written approval to classify such vehicles as dedicated vehicles from the Administrator prior to the start of testing. In determining how to classify such vehicles, the Administrator would consider the significance of the drop in performance using gasoline, the expected availability of methanol fuel, and the expected vehicle use (i.e., personal, taxi fleets, delivery vehicles, etc.). For example, a methanol-fueled vehicle which lost 80 percent of its normal power when using gasoline could be considered a dedicated vehicle; although, if the vehicle was designed to be significantly overpowered, and still had adequate acceleration with only 20 percent of its normal power, it would not be considered a dedicated vehicle.

The regulations still do not specify methanol test fuels more precisely than to require that the methanol test fuels be representative of in-use fuels. The broad nature of this requirement is the result of EPA's previous experience with gasoline. Because in-use gasolines changed so significantly from the fuel used in certification, especially in the area of vapor pressure, it became necessary for the Agency to promulgate extensive regulations for in-use gasoline. The Agency hopes that regulation of in-use methanol fuel quality will not be necessary, and that industry-wide methanol fuel standards will be adopted on a voluntary basis. Such standards would be accepted by EPA as appropriate certification fuel standards, assuming that in-use fuels consistently complied with the standards, since it would ensure that the certification fuel is representative of in-use fuels. EPA recognizes that, since the current market for methanol fuels is not well defined, it is not possible at this time to determine one methanol fuel that is truly representative of in-use fuels in all respects. For previous certification of methanol-fueled vehicles, the Agency decided that mixtures of chemical grade methanol and certification gasoline were sufficiently representative to ensure that

certification emissions results would accurately reflect the behavior of in-use methanol-fueled vehicles using market fuels. This approach is consistent with the California Air Resources Board certification fuel specifications, except that California's specification<sup>2</sup> does not require that the methanol be chemical grade, and that it requires the use of California's certification gasoline. Therefore, until such time that the methanol fuel market is large enough to allow a better determination of a representative fuel or until industry-wide standards are adopted by fuel suppliers, the Agency will use, and require manufacturers to use either a combination of chemical grade methanol and certification gasoline in proportions that reflect the composition of the intended in-use fuel, or California's certification methanol fuel. For current M85-fueled vehicles this will be 84–88 percent (by volume) methanol and the remainder gasoline. For M100-fueled vehicles, the fuel will be neat chemical grade methanol, although it may contain small amounts of fuel additives, provided that the manufacturer can demonstrate that those same additives will be included in the in-use fuel.

## *2. Methanol and Formaldehyde Sampling and Analysis*

### *Proposal*

The original regulations for methanol-fueled vehicles specified separate sampling systems for methanol and formaldehyde. In the NPRM for this action, the Agency proposed revisions in several areas related to these requirements, although the most basic aspects of the requirements remain unchanged. Under the proposed regulations, the samples would still be collected by bubbling the sample gas through two impingers, or, in the case of formaldehyde, through a cartridge impregnated with dinitrophenylhydrazine (DNPH); and the impinger fluid or cartridge would still be analyzed for methanol or formaldehyde using chromatographic methods.

The most significant of the proposed changes affected the required sampling flow rates. The previous regulations included minimum requirements for flow rates through impingers and cartridges. They were included to ensure that sufficient amounts of methanol and formaldehyde are collected to allow for accurate detection by the chromatographic instruments.

Because there can be significant variations from system to system, however, a single minimum flow rate is not appropriate for all systems. To correct this, the Agency proposed to eliminate these minimum flow rates, and to instead establish minimum concentrations for the primary impingers and cartridges. More specifically, EPA proposed that systems (and procedures) be required to be designed such that testing of a vehicle or engine that emitted the maximum allowable level of methanol, or emitted formaldehyde at a level that was ten percent of the maximum emission level of methanol would result in analyte concentrations that were 25 times higher than the levels of detection for the instruments used. Systems that did not meet this requirement due to high limits of detection were to be allowed, provided that the resultant methanol concentration was greater than 25 mg/l, and the resultant formaldehyde concentration is greater than 2.5 mg/l. For any vehicles or engines that have an applicable formaldehyde standard, the analyte concentrations used for design would be those that would result from the maximum emission level allowed by that standard. The Agency also proposed to add an additional design requirement that the amount of methanol collected in the secondary impinger not be more than ten percent of the total amount collected.

Another set of proposed revisions dealt with the method of flow measurement. In several parts of the previous regulations, dry gas meters were specifically required for sampling and calibration systems. This was because dry gas meters were considered to be the most appropriate type of flow meter for these applications at the time the test procedures for methanol-fueled vehicles were originally developed. It has become apparent, however, that these specifications were no longer necessary. Therefore, the Agency proposed to allow other types of flow meters to be used, provided that they meet an accuracy specification of  $\pm 2$  percent.

### *Public Comments*

The comments received regarding methanol and formaldehyde sampling and analysis were generally supportive of the Agency's proposals. Some of the comments, however, requested clarification of regulatory language. In response, EPA has modified the regulatory language regarding the design requirements for sample flow rates, the use of secondary impingers and cartridges, and the accuracy specifications for sample flow meters.

<sup>2</sup> California Code of Regulations, Title 13, Section 2292.

## Final Action

Sampling systems (and procedures) will be required to be designed such that testing of a vehicle or engine that emitted the maximum allowable level of methanol (e.g., 0.95 g/mi methanol, or 14 g/FTP, for a 0.41 g/mi THCE<sup>3</sup> standard), or emitted formaldehyde at a level that was twenty percent of the maximum emission level of the lowest applicable THCE or NMHCE (e.g., 0.082 g/mi formaldehyde, or 1.2 g/FTP, for a 0.41 THCE standard) during the first phase of the test would result in analyte concentrations that were at least 25 times higher than the levels of detection for the instruments used. As proposed, systems that do not meet this requirement due to high limits of detection will be allowed, provided that the resultant methanol concentration is greater than 25 mg/l, and the resultant formaldehyde concentration is greater than 2.5 mg/l. For any vehicles or engines that have an applicable formaldehyde standard, the analyte concentrations used for design would be those that would result from the maximum emission level allowed by that standard. The Agency is also requiring that the amount of methanol collected in the secondary impinger not be more than ten percent of the total amount collected.

Also, the Agency will allow other types of flow meters to be used, provided that they meet the accuracy specifications of §§ 86.120–90 or 86.1320–90. The specifications of these sections require accuracy of  $\pm 1$  percent of the maximum operating range and  $\pm 2$  percent of the reading.

### 3. Proportional Sampling

#### Proposal

Prior to this action, there were only two methods allowed by the regulations for obtaining proportional samples when testing light-duty vehicles: the Positive Displacement Pump-Constant Volume Sampler (PDP-CVS) method and the Critical Flow Venturi-Constant Volume Sampler (CFV-CVS) method. However, EPA proposed a third option for methanol-fueled vehicles. This method is based on the current CFV-CVS system, but allows proportional sampling of methanol and formaldehyde to be maintained by electronically monitoring the CVS flow rate and electronically controlling the sample flows. Similar approaches have been used for some years in heavy-duty diesel testing and in light-duty research testing. When using this approach, the

ratio of sample flow to CVS flow was to be required to remain within  $\pm 5$  percent of the set-point ratio.

#### Public Comments

AAMA supported the Agency's proposals, and added that flow controllers should vary the sample flow rate inversely with the square root of the bulk stream temperature. EPA agrees, and has added such language to the regulations.

#### Final Action

EPA is finalizing this revision as proposed. The Agency is not requiring that these electronically-controlled sampling systems also include separate flow meters to measure total sample volumes, but will allow them. It should be emphasized that even though this option is only being specified for methanol and formaldehyde sampling systems, the Agency would consider allowing similar approaches for other samples as equivalent procedures. (For example, paragraph (a)(5) of § 86.109–94 specifically allows the use of sampling procedures other than those specified in that section, provided that they can be shown to "yield equivalent or superior results".)

### 4. Prevention of Condensation

#### Proposal

Exhaust from methanol-fueled vehicles generally has much higher water vapor content than conventional vehicles, which can lead to water condensation under certain testing conditions, when the gas comes into contact with surfaces at temperatures below its dew point. Such condensation can create very significant problems with respect to testing accuracy, since both methanol and formaldehyde are soluble in water. However, if the gas comes into contact with very hot surfaces, the methanol can undergo decomposition reactions. For these reasons, in the previous rulemaking, EPA required that sample lines and transfer systems be heated to  $235 \pm 15$  °F (as measured at the surface in contact with the raw and diluted exhaust gases). Some manufacturers, however, have indicated a concern that this temperature requirement may be too high for their systems. The Agency proposed to change its regulatory focus from specifying the temperature requirement, toward allowing manufacturers to determine the most appropriate temperatures for their own individual systems. The requirements to heat many of the components remained, but EPA proposed changing the lower limit to the maximum dew point of the

exhaust mixture. Comments were requested on whether it will be necessary to measure dew point continuously for each test.

It had also been suggested that heavy-duty engine manufacturers should be allowed to use ducts up to 32 feet in length to transfer the exhaust from the engine to the dilution tunnel. Testing by Southwest Research Institute (SwRI) showed no significant difference between the emission results from test systems using ducts 13 and 32 feet in length.<sup>4</sup> Therefore, the Agency proposed to allow transfer ducts up to 32 feet in length (as is currently allowed for petroleum-fueled engines). However, since the SwRI testing did not provide data for systems in which the duct temperature exceeded 315 °C, this allowance required that the maximum duct temperature not exceed 315 °C.

EPA also proposed allowing heating and dehumidifying the dilution air, with some restrictions. The proposed restrictions limited the maximum temperature and affect how the dilution air flow rate is calculated.

#### Public Comments

The comments received regarding the prevention of condensation were generally supportive of the Agency's proposals. AAMA stated that, based on their testing experience, measurement of the dew point is not necessary, provided that dilution systems are designed properly. EPA agrees that continuous measurement of the dew point is not necessary, and thus will also allow the absence of condensation to be demonstrated through engineering analyses.

Detroit Diesel Corporation (DDC) supported EPA's proposal to allow longer unheated exhaust transfer ducts for heavy-duty engines, but requested that the Agency raise the maximum temperature from 315 °C (as proposed) to 350 °C. Further, they indicated that they believed that a limit on the average temperature of the duct would be more appropriate than a limit on the maximum temperature.

EPA recognizes that the 315 °C limit was based on testing of only one engine, and that other larger engines could easily result in higher temperatures of the duct. However, the Agency does not consider it to be unreasonable to expect manufacturers to make the slight modifications to the duct that would be necessary to prevent the maximum duct temperature from exceeding 315 °C. Simple modifications such as the

<sup>3</sup> THCE and NMHCE are replacing OMHCE and OMNMHCE; see discussion in "15. Other Issues."

<sup>4</sup> "Effect of Exhaust Pipe Length on Emissions From a Heavy-Duty Methanol Engine," SwRI-4962, May 1992, Docket Item A-92-02-II-D-7.

addition of fins, or the use of cooling fans, should be able to increase the heat transfer away from the duct sufficiently to allow the systems to comply with this requirement even when testing larger engines. The Agency also does not agree that a limit on the average temperature would be more appropriate. While it is true that controlling the average temperature would account for the length of time that the exhaust is exposed to the higher temperatures, it would allow the exhaust to be exposed to very high temperatures. Therefore, EPA has decided that a limit on the maximum temperature is appropriate at this time, especially given the increased complexity of determining the average temperature of the duct instead of only the maximum temperature.

#### Final Action

The Agency has changed its regulatory focus from specifying the temperature requirement, to allowing manufacturers to determine the most appropriate temperatures for their own individual systems. However, EPA is establishing a lower limit of 5 °F above the maximum dew point of the exhaust mixture, instead of the maximum dew point as was proposed. The previously established maximum upper temperature of 250 °F remains in effect. Although these limits provide slightly less additional flexibility than was proposed, the Agency believes that they allow for a sufficiently wide range of temperatures. This revision is not intended to imply that the Agency no longer believes that the appropriate temperature range for most systems is 220–250 °F, but rather it is intended only to allow the manufacturers more flexibility. Manufacturers must demonstrate that their systems will prevent condensation from occurring, and will be allowed to do so using engineering analyses, such as dew point data from testing under some worst case conditions (e.g., with a large engine during a period of high ambient humidity).

EPA is also revising the regulations to allow heavy-duty engine manufacturers to use longer unheated ducts to transfer the exhaust from the engine to the dilution tunnel. The Agency will allow transfer ducts up to 32 feet in length, but will require that the maximum duct temperature not exceed 315 °C. EPA recommends that steps be taken to minimize the temperature increase in the transfer duct to reduce the possibility of the methanol and formaldehyde reacting on the walls of the transfer duct.

Today's rule also specifically allows heating and dehumidifying the dilution

air, with some minor restrictions. Allowing such pretreatment of the dilution air may help to eliminate some of the condensation problems associated with methanol-fueled vehicles, and may allow the use of lower system temperatures as discussed above. The restrictions limit the maximum temperature and affect how the dilution air flow rate is calculated.

#### 5. CVS and SHED Calibration and Retention Tests

##### Proposal

The regulations promulgated in 1989 required that, in addition to tests previously required for propane, tests also be performed to ensure that there are no losses of methanol in the CVS or SHED. The regulations specified injecting a known quantity of methanol or propane into the CVS or SHED, collecting a sample and comparing the amount calculated from the measured value to the amount injected. The regulations required, for methanol, that the measured value be within two percent of injected value. However, actual testing experience by both EPA and industry has shown that consistently obtaining results within two percent can be problematic given the current state of development of methanol test procedures. Therefore, EPA proposed to establish wider limits ( $\pm 6$  percent) for methanol recoveries during the calendar years 1992–1995. For SHED testing, these wider limits were to apply to both agreement between the amount injected and the initial measured amounts (recovery tests) and between the initial and final (after four hours) measured amounts (retention tests). EPA requested comments regarding whether it was sufficient to widen the tolerances through 1995, or if a longer period were required.

The Agency also proposed to require the use of a correction factor that would be derived from the four-hour retention test. This was to be a means of accounting for potential losses without increasing the testing burden.

##### Public Comments

AAMA supported permanently widening the tolerances for CVS and SHED recovery and retention tests for methanol to  $\pm 6$  percent. They stated in their comments that they “do not believe that a 2 percent limit will be achievable in the near future.” EPA recognizes that, at this time, complying with a 2 percent tolerance is not possible without an unreasonable test burden. This is due in large part to the imprecision of the GC analysis, which

AAMA estimated at  $\pm 5$  percent. This imprecision could be reduced by performing multiple GC analyses, although this would lead to a significant increase in costs. When the vehicles are tested for compliance with a carbon equivalence-based standard, however, the accuracy of the methanol measurement becomes less important. Since the test procedure determines the emissions of non-oxygenated HC by subtracting the methanol FID response from the total FID response, an undermeasurement of methanol will lead to an overmeasurement of HC, and vice versa. Thus the net impact of the accuracy of the methanol measurement on the accuracy of the calculated THCE emission rate is reduced. However, EPA continues to believe that the 2 percent tolerance will ultimately be achievable, and that this level of accuracy is appropriate. Therefore, the Agency will maintain this specification, but will allow manufacturers to request a waiver from the required 2 percent tolerance after 1995, as described below.

AAMA opposed the use of correction factors for SHED testing. They argued that correction factors are not necessary, and would be “inconsistent with previous test requirements.” EPA recognizes AAMA's concerns. More importantly, however, the Agency believes that the potential for losses can be addressed under the waiver provisions being established today (see Final Action section below). Therefore, EPA is not finalizing the proposed correction factor requirements.

##### Final Action

EPA is establishing a wider tolerance of  $\pm 6$  percent for methanol recovery and retention during the calendar years 1992–1995, as was proposed. After 1995, the Agency will allow manufacturers to request a waiver from the required tolerance (e.g.,  $\pm 2$  percent), provided that:

- (1) The Administrator determines that compliance with the specified tolerance is not practically feasible, and
- (2) 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, and

- (3) The manufacturer complies with higher tolerances (up to  $\pm 6$  percent for recoveries and  $\pm 8$  percent for retention), as specified by the Administrator.

In deciding whether to grant the waiver, and what the tolerances should be under the waiver, EPA will be

concerned primarily with the degree to which any imprecision and inaccuracy in the methanol sampling and measurement techniques would affect its ability to determine compliance with emission standards. More specifically, this means that the precision (repeatability) of methanol measurements should be as good as is practically feasible, and that there should be no losses in the system that would lead to a significant undermeasurement of methanol. The determination of practical feasibility will depend on the degree to which variability can be reduced and the costs associated with the reduction. EPA recognizes that the standard for precision that is "consistent with good laboratory practice" will change with time, and will use its own testing as the standard. That means that manufacturers will be required to have precision that, in the Administrator's judgement, is essentially as good as that of EPA.

#### 6. Fuels for Flame Ionization Detectors

##### Proposal

Flame ionization detectors measure hydrocarbons and other organics by ionizing the carbon atoms with a supplemental fuel source. At one time, the primary fuel was a mixture of hydrogen in nitrogen ( $H_2/N_2$ ), but now the more commonly used fuel is a mixture of hydrogen in helium ( $H_2/He$ ), which is thought to give a more accurate response. In the previous regulations, it was somewhat unclear what type of fuels were to be used with the heated flame ionization detectors (heated FID or HFID) required for methanol-fueled vehicle testing. Evaporative emissions testing and heavy-duty exhaust testing required the use of  $H_2/He$ , while the fuel for light-duty exhaust testing was previously unspecified. Since the light-duty fuel was unspecified, many testing facilities have used a mixture of hydrogen in nitrogen. To eliminate this confusion, the Agency proposed to clearly require that  $H_2/He$  fuel be used for all FIDs when testing methanol-fueled vehicles. Moreover, to provide consistent testing of both alternatively-fueled and conventionally-fueled vehicles, the Agency proposed to require the use of  $H_2/He$  fuel for all heated and unheated FIDs. The Agency also requested comments on whether revisions are needed to the FID calibration procedure as outlined in the CFR.

##### Public Comments

AAMA agreed with EPA's proposal to require that hydrogen/helium mixtures

be used as the fuel for all flame ionization detectors (FIDs). AAMA also recommended that EPA add a requirement to optimize the FID to make the response of methane (relative to propane) as close to one as possible. The Agency agrees that optimizing the FID to reduce variations in response factors is good engineering practice. However, EPA has not seen evidence that FIDs are currently being improperly calibrated, and thus does not believe that it is necessary to include such a provision in the regulations at this time. EPA will continue to consider this issue, and may propose further specifications for the calibration of FIDs at a later time.

##### Final Action

EPA is finalizing this revision as proposed, and will require the use of  $H_2/He$  fuel for all heated and unheated FIDs.

#### 7. Background Measurements

##### Proposal

The test procedures call for measurement of background concentrations of various gases, including methanol and formaldehyde, to be subtracted from the concentrations measured in the diluted exhaust. Previously, only a single sample was required for formaldehyde, while separate phase-by-phase samples were required for methanol. However, for the purpose of consistency, EPA proposed to also require only a single sample be collected to determine the methanol concentration in the dilution air. It was also noted that, since methanol levels in the dilution air will generally be very low, a single impinger is sufficient to measure the methanol concentration in the sample.

##### Public Comments

The comments received regarding the background measurements were generally supportive of the Agency's proposals. DDC requested that EPA clearly state in the regulations that background measurements are optional for manufacturers. EPA agrees, and has added such language.

##### Final Action

EPA is finalizing this revision as proposed, and is also adding regulatory language that states that background measurements are optional for manufacturers.

#### 8. Determination of Fuel Composition

##### Proposal

The regulations previously did not specify a procedure to determine the carbon:hydrogen:oxygen ratio for

methanol fuels and fuel mixtures, other than to state that the ratio was to be measured. However, if the methanol fuel and/or fuel mixtures are made from fuels for which the ratios are known (such as chemical grade methanol and Indolene), then the ratio for the resultant mixture can be calculated and no measurement is necessary. EPA proposed to revise the regulations to allow for calculation of the ratio for methanol fuels and fuel mixtures.

##### Public Comments

The comments received regarding the determination of fuel composition were supportive of the Agency's proposals.

##### Final Action

EPA is finalizing this revision as proposed.

#### 9. $NO_x$ Humidity Correction Factor

##### Proposal

The humidity of the air in a test area is known to have an effect on emissions of  $NO_x$ , and EPA has established a correction factor for  $NO_x$  test results. It became apparent that the correction factor established for heavy-duty methanol-fueled engines is erroneous. EPA proposed to correct this by applying the correction factor currently specified for gasoline-fueled engines to Otto-cycle methanol-fueled engines, and the one currently specified for petroleum-fueled diesel engines to methanol-fueled diesel engines, as was originally intended.

##### Public Comments

EPA received no comments regarding this issue.

##### Final Action

EPA is finalizing this revision as proposed.

#### 10. Heated Flame Ionization Detectors

##### Proposal

The regulations previously required that heated FIDs (HFIDs) be used when testing methanol-fueled vehicles. The reason for this requirement was that HFIDs provide a stable response for methanol more quickly than unheated FIDs. Some manufacturers have suggested, however, that in many cases the HFID is not necessary and that an unheated FID is adequate. EPA proposed to allow unheated FIDs to be used in place of heated FIDs for methanol-fueled vehicle testing.

##### Public Comments

The Agency received mixed comments in response to this proposed revision. AAMA supported the use of

unheated FIDs for methanol-fueled vehicle testing, though they indicated that they believe that it would be appropriate to require that each test lab provide data to demonstrate equivalence between their unheated FID and a heated FID, for their exhaust systems. The New York State Department of Environmental Conservation (NYDEC) commented that aromatic organics and large aliphatics can be lost to unheated surfaces in sampling systems. They recommended that heated FIDs should be used not only for testing methanol-fueled vehicles, but for testing petroleum-fueled vehicles as well. Based on these comments, and data from EPA testing (see Docket A-92-02), it is clear that unheated FIDs can be used for methanol testing in some systems, but that there is the potential for measurement problems in other systems. EPA will allow unheated FIDs to be used in place of heated FIDs for evaporative testing of methanol-fueled vehicles. The Agency will also allow the use of unheated FIDs for exhaust testing, where there appears to be a greater potential for measurement problems, but only after the manufacturer demonstrates equivalence with the heated FID for its system. EPA did not propose requiring heated FIDs for gasoline-fueled vehicle testing and has not yet received sufficient information that it is necessary.

#### Final Action

EPA will allow unheated FIDs to be used in place of heated FIDs for evaporative testing of methanol-fueled vehicle testing. The Agency will also allow the use of unheated FIDs for exhaust testing, provided that the manufacturer can demonstrate equivalence with the heated FID for its system.

#### 11. Gaseous Standards for Methanol and Formaldehyde

##### Proposal

Gaseous standards of many gases have been specified in the regulations and have been routinely used in calibration procedures; however, such standards were not allowed for methanol and formaldehyde. EPA proposed to allow the use of gaseous methanol standards for response factor calculation, with the requirement that the concentration of methanol in the standard gas not vary by more than two percent over its useful lifetime (i.e., from the time it is prepared until it is no longer used for testing).

#### Public Comments

AAMA supported EPA's proposal to allow the use of gaseous methanol standards for the determination of the FID response to methanol. However, they suggested that EPA widen the tolerance for stability to  $\pm 4$  percent (instead of  $\pm 2$  percent) to account for variability in the measurement of methanol. They also suggested that EPA allow bottles that exceed this tolerance to be renamed with the new concentration. The Agency recognizes that the variability associated with measuring methanol makes it possible that the measured concentration of methanol could be outside the  $\pm 2$  percent concentration, even though the true concentration had not changed by more than 2 percent. Therefore, EPA has added regulatory language that clarifies that the  $\pm 2$  percent tolerance is for a reasonable estimate of the true concentration, taking into account measurement variability, not necessarily a single measurement. The Agency envisions that manufacturers will use an average of multiple measurements to determine the concentration, and will make enough measurements so that the precision of the estimate is  $\pm 2$  percent. Also, EPA agrees that standards that change by more than 2 percent can be renamed with the new concentration, provided that the change is not greater than 10 percent.

#### Final Action

EPA will allow the use of gaseous methanol standards for response factor calculation, with the requirement that the concentration of methanol in the standard gas shall not vary by more than two percent, without being relabeled with the new concentration.

#### 12. Idle CO Testing

##### Proposal

In the 1989 FRM, EPA established idle CO emission standards for all methanol-fueled light-duty trucks and heavy-duty engines, including heavy-duty diesel engines. In the NPRM for this current rulemaking, EPA proposed to modify the testing provisions to allow for continuous analysis instead of bag sampling and analysis. This was done to be consistent with § 86.1310, which allows continuous CO analysis for transient testing of diesel cycle engines.

#### Public Comments

EPA received no comments regarding this issue.

#### Final Action

EPA is finalizing this revision as proposed.

In a related matter, EPA is correcting §§ 86.094-9 and 86.097-9 to clarify that the idle CO standards of those sections are applicable to gasoline-fueled, methanol-fueled, LPG-fueled and CNG-fueled light-duty trucks. The applicability of these standards to LPG-fueled and CNG-fueled light-duty trucks was specified in the Preamble of the FRM which established standards and test procedures for gaseous-fueled vehicles ( FR ), but the regulatory text of these sections was not revised to reflect this requirement.

#### 13. Direct Measurement of Non-Oxygenated Hydrocarbons

##### Proposal

Evaporative non-oxygenated hydrocarbon emissions from methanol-fueled vehicles have been measured by separately measuring total organic emissions and methanol emissions: the non-oxygenated hydrocarbon emissions are the difference between these two measurements. It had been suggested, however, that non-oxygenated hydrocarbons can be measured directly by installing water-filled impingers upstream of an FID calibrated on propane. The impingers would be expected to remove the methanol from the gas as it is bubbled through the water, but not the non-oxygenated hydrocarbons. The Agency proposed to revise the regulations to allow this option.

#### Public Comments

The comments received indicate that the technique which was proposed to measure non-oxygenated HC directly for methanol-fueled vehicles is not sufficiently accurate at this time.

#### Final Action

EPA is not finalizing this option in this action.

#### 14. FID Measurement of Methanol Emissions From M100 Vehicles

##### Proposal

Methanol emissions from M100 vehicles have been measured with an impinger system. The combined emissions of methanol and non-oxygenated HC have been measured by a FID and the non-oxygenated HC emissions have been determined by subtracting the methanol (after correcting for FID response) from the total. However, when the non-oxygenated HC emissions are small, there is a significant potential for errors. Because the amount of non-oxygenated HC emissions from M100 vehicles and engines is generally small, EPA proposed to allow measurement of the

total emissions with an FID calibrated on methanol, as has already been allowed through model year 1994.

#### Public Comments

AAMA supported this option to some extent, but felt that EPA should not use this option for its testing. At this time, EPA believes that the available information is not sufficient to support continuation of this option beyond the 1994 model year.

#### Final Action

EPA is not finalizing this option in this action.

#### 15. Collection of Methanol Samples

As noted above, methanol samples have been collected using impingers. EPA also proposed, however, allowing two alternative methods. The first was the allowance to measure methanol concentrations from SHED testing by direct GC analysis of the bag samples. The second alternative was the allowance of the use of cartridges, which are designed to collect methanol, for both exhaust and evaporative testing.

#### Public Comments

The comments received regarding the measurement of methanol by GC-bag analysis or from methanol cartridges do not support either of the proposed approaches at this time.

#### Final Action

EPA is not finalizing either approach in this action.

#### 16. Other Issues

AAMA indicated that the tolerance of  $\pm 0.5$  percent for the liquid methanol injection device used during CVS and SHED calibration may not be achievable at this time. EPA agrees, especially since manufacturers will still be required to comply with the recovery and retention tolerances specified by the Administrator. Thus, the Agency is allowing less precise methods to be used. This change will not effect the accuracy or precision of certification emissions tests.

AAMA requested that the Agency require the determination of the FID response to methanol only twice annually, instead of monthly. However, EPA believes that the response factor should be calculated each time the FID is recalibrated, on a monthly basis.

EPA is replacing the terms "Organic Material Hydrocarbon Equivalent" (OMHCE) and "Organic Material Non-Methane Hydrocarbon Equivalent" (OMNMHCE) with "Total Hydrocarbon Equivalent" (THCE) and "Non-Methane Hydrocarbon Equivalent" (NMHCE).

These new terms are simpler and are more obviously related to the comparable terms being used for petroleum-fueled vehicles (THC and NMHC). This change does not have any substantive effect on the certification process.

Finally, included among the regulatory revisions in this FRM are minor changes that allow the test procedures specified for measuring formaldehyde from methanol-fueled heavy-duty engines to be used to measure formaldehyde from other types of engines. These changes were originally proposed in the "Clean Fueled Fleets" NPRM (58 FR 32474, June 10, 1993), but were not finalized. The purpose of the changes is to provide a means of measuring formaldehyde from non-methanol fueled heavy-duty ULEV engines that have to comply with a separate formaldehyde standard. In general, the changes are nothing more than removing references such as "for methanol-fueled engines" that are associated with the formaldehyde measurement procedures, and replacing those references with "as applicable."

#### OMB Approval of Information Collection Requirements for CFV Emission Standards and Gaseous Fuels Rulemakings

EPA is also amending the table of currently approved information collection request (ICR) control numbers issued by OMB for various regulations. Today's amendment updates the table to accurately display those information requirements promulgated under Emission Standards for Clean-fuel Vehicles and Engines, Requirements for Clean-Fuel Vehicle Conversions, and California Pilot Test Program which appeared in the **Federal Register** on September 30, 1994 (59 FR 50042) and under Standards for Emissions From Natural Gas-Fueled, and Liquefied Petroleum Gas-Fueled Motor Vehicles and Motor Vehicle Engines, and Certification Procedures for Aftermarket Conversions which appeared in the **Federal Register** on September 21, 1994 (59 FR 48472). The affected regulations are codified at 40 CFR Parts 9, 85, 86, 88, and 600. EPA will continue to present OMB control numbers in a consolidated table format to be codified in 40 CFR part 9 of the Agency's regulations, and in each CFR volume containing EPA regulations. The table lists the section numbers with reporting and recordkeeping requirements, and the current OMB control numbers. This display of the OMB control numbers and its subsequent codification in the Code of Federal Regulations satisfies the requirements of the Paperwork

Reduction Act (44 U.S.C. 3501 *et seq.*) and OMB's implementing regulations at 5 CFR part 1320.

#### Environmental and Economic Impacts

This regulation is intended only to reduce the administrative and testing burden of certifying methanol-fueled vehicles. It does not affect the stringency of emission standards. Thus, it should have no impact on the environment.

This regulation does provide manufacturers some additional flexibility, and will result in minor economic benefits. These economic benefits, however, are expected to be small.

#### Statutory Authority

The statutory authority for this action is provided by sections 202(a) (1)-(2), 206, 301(a) of the Clean Air Act (42 U.S.C. 7521(a), 7525, and 7601(a)).

#### Administrative Designation and Regulatory Analysis

Under Executive Order 12866, EPA must judge whether a regulation is "significant" and, therefore, subject to OMB review and the requirements of the Executive Order. This regulation is not a "significant regulatory action" because the amendments make only minor and technical changes.

This Amendment to the final rule is not subject to the Office of Management and Budget's review under the Executive Order and no Regulatory Impact Analysis was prepared.

#### Reporting and Recordkeeping Requirements

The information collection requirements in this rule have been approved by the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* and have been assigned control number 2060-0104. An Information Collection Request document has been prepared by EPA (ICR No. 783.21) and a copy may be obtained from Sandy Farmer, Information Policy Branch; EPA; 401 M St., SW. (2136); Washington, DC 20460 or by calling (202) 260-2740.

Public reporting burden for this collection of information is estimated to have a negligible effect on the existing clearance which averages 15,900 hours per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing the collection of the information.

Send comments regarding the burden estimate or any other aspect of this collection of information, including



suggestions for reducing this burden to Chief, Information Policy Branch; EPA; 401 M St., SW. (2136); Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503, marked "Attention: Desk Officer for EPA."

All the information collection requirements for both the CFV Emission Standards and Gaseous Fuels Emission Standards rulemakings have been approved by the Office of Management and Budget under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. and have been assigned either control number 2060-0104 or 2060-0314.

**Regulatory Flexibility Act**

Under the Regulatory Flexibility Act, 5 U.S.C. 601 et seq., the Administrator of EPA is required to determine whether a regulation will have a significant economic impact on a substantial number of small entities and, if so, to perform a regulatory flexibility analysis. The technical amendments contained in this rulemaking will not increase the burden or cost of compliance for any segment of the automotive industry. Therefore, pursuant to 5 U.S.C. 605(b), I hereby certify that this rule will not have a significant economic impact on a substantial number of small entities.

**List of Subjects**

*40 CFR Part 9*

Reporting and recordkeeping requirements.

*40 CFR Part 86*

Environmental protection, Administrative practice and procedure, Air pollution control, Gasoline, Labeling, Motor vehicles, Motor vehicle pollution, Reporting and recordkeeping requirements.

Dated: April 28, 1995.

**Carol M. Browner,**  
*Administrator.*

For the reasons set forth in the preamble, parts 9 and 86 of title 40 of the Code of Federal Regulations are amended as follows:

**PART 9—[AMENDED]**

1. The authority citation for part 9 continues to read as follows:

**Authority:** 7 U.S.C. 135 et seq., 136-136y; 15 U.S.C. 2001, 2003, 2005, 2006, 2601-2671; 21 U.S.C. 331j, 346a, 348; 31 U.S.C. 9701; 33 U.S.C. 1251 et seq., 1311, 1313d, 1314, 1321, 1326, 1330, 1344, 1345 (d) and (e), 1361; E.O. 11735, 38 FR 21243, 3 CFR, 1971-1975 Comp. p. 973; 42 U.S.C. 241, 242b, 243, 246, 300f, 300g, 300g-1, 300g-2, 300g-3, 300g-4, 300g-5, 300g-6, 300j-1, 300j-2, 300j-3, 300j-

4, 300j-9, 1857 et seq., 6901-6992k, 7401-7671q, 7542, 9601-9657, 11023, 11048.

1a. Section 9.1 is amended in the table by adding in numerical order new entries under the center headings "Control of Air Pollution From Motor Vehicles and Motor Vehicle Engines," "Control of Air Pollution from New and In-Use Motor Vehicles and New and In-Use Motor Vehicle Engines: Certification and Test Procedures," "Clean-Fuel Vehicles" and "Fuel Economy of Motor Vehicles," to read as follows:

**§ 9.1 OMB approvals under the Paperwork Reduction Act.**

40 CFR citation	OMB control No.
* * *	* * *
<b>Control of Air Pollution From Motor Vehicles and Motor Vehicle Engines</b>	
85.503 .....	2060-0104
85.505 .....	2060-0104
* * *	* * *

**Control of Air Pollution From New and In-Use Motor Vehicles and New and In-Use Motor Vehicle Engines: Certification and Test Procedures**

* * *	* * *
86.094-24(a)(3)(iii) .....	2060-0314
* * *	* * *
86.098-28 .....	2060-0104
* * *	* * *
86.150-98 .....	2060-0104
* * *	* * *
86.513-94 .....	2060-0104
* * *	* * *
86.1344-94 .....	2060-0104
* * *	* * *

**Clean-Fuel Vehicles**

* * *	* * *
88.204-94(b)(1) .....	2060-0314
88.204-94(c) .....	2060-0314
* * *	* * *
88.306-94(b)(1) .....	2060-0314
88.306-94(b)(2) .....	2060-0314
88.306-94(b)(4) .....	2060-0314
88.306-94(c) .....	2060-0314
88.306-94(f) .....	2060-0314

40 CFR citation	OMB control No.
* * *	* * *
<b>Fuel Economy of Motor Vehicles</b>	
600.113-93 .....	2060-0104
* * *	* * *

**PART 86—CONTROL OF AIR POLLUTION FROM NEW AND IN-USE MOTOR VEHICLES AND NEW AND IN-USE MOTOR VEHICLE ENGINES: CERTIFICATION AND TEST PROCEDURES**

1b. The authority citation for part 86 continues to read as follows:

**Authority:** Secs 202, 203, 205, 206, 207, 208, 215, 216, 217 and 301(a), Clean Air Act, as amended (42 U.S.C. 7521, 7522, 7524, 7525, 7541, 7542, 7549, 7550, 7552 and 7601(a)).

2. Section 86.001-21 of Subpart A is amended by removing paragraphs (c) through (k) and adding paragraphs (c) through (l) to read as follows:

**§ 86.001-21 Application for certification.**

\* \* \* \* \*  
(c) through (j) [Reserved]. For guidance see § 86.094-21.  
(k) and (l) [Reserved]. For guidance see § 86.096-21.

3. Section 86.090-2 of Subpart A is amended by revising the definition of "Flexible fuel vehicle (or engine)", removing the definition of "Organic Material Hydrocarbon Equivalent" and adding the definitions of "Dedicated vehicle (or engine)" and "Total Hydrocarbon Equivalent" in alphabetical order to read as follows:

**§ 86.090-2 Definitions.**

\* \* \* \* \*  
*Dedicated vehicle (or engine)* means any motor vehicle (or motor vehicle engine) engineered and designed to be operated using a single fuel. Flexible fuel vehicles and multi-fuel vehicles are not dedicated vehicles.  
\* \* \* \* \*

*Flexible fuel vehicle (or engine)* means any motor vehicle (or motor vehicle engine) engineered and designed to be operated on a petroleum fuel, a methanol fuel, or any mixture of the two. Methanol-fueled vehicles that are only marginally functional when using gasoline (e.g., the engine has a drop in power output of more than 80 percent) are not flexible fuel vehicles.  
\* \* \* \* \*

*Total Hydrocarbon Equivalent* means the sum of the carbon mass emissions of non-oxygenated hydrocarbons, methanol, formaldehyde or other organic compounds that are separately measured, expressed as gasoline-fueled vehicle hydrocarbons. In the case of exhaust emissions, the hydrogen-to-carbon ratio of the equivalent hydrocarbon is 1.85:1. In the case of diurnal and hot soak emissions, the hydrogen-to-carbon ratios of the equivalent hydrocarbons are 2.33:1 and 2.2:1, respectively.

\* \* \* \* \*

4. Section 86.090-3 of Subpart A is amended by removing the entry for OMHCE in paragraph (b) and adding an entry for THCE in alphabetical order to read as follows:

**§ 86.090-3 Abbreviations.**

\* \* \* \* \*

(b) \* \* \*

THCE—Total Hydrocarbon Equivalent

\* \* \* \* \*

5. Section 86.094-2 of Subpart A is amended by adding the definition of "Non-Methane Hydrocarbon Equivalent" in alphabetical order to read as follows:

**§ 86.094-2 Definitions.**

\* \* \* \* \*

*Non-Methane Hydrocarbon Equivalent* means the sum of the carbon mass emissions of non-oxygenated non-methane hydrocarbons, methanol, formaldehyde, or other organic compounds that are separately measured, expressed as gasoline-fueled vehicle hydrocarbons. In the case of exhaust emissions, the hydrogen-to-carbon ratio of the equivalent hydrocarbon is 1.85:1. In the case of diurnal and hot soak emissions, the hydrogen-to-carbon ratios of the equivalent hydrocarbons are 2.33:1 and 2.2:1, respectively.

\* \* \* \* \*

6. Section 86.094-3 of Subpart A is amended in paragraph (b) by placing the entries in alphabetical order, removing the entry for OMNMHCE and adding an entry for NMHCE in alphabetical order to read as follows:

**§ 86.094-3 Abbreviations.**

\* \* \* \* \*

(b) \* \* \*

\* \* \* \* \*

NMHCE—Non-Methane Hydrocarbon Equivalent

\* \* \* \* \*

7. Section 86.094-9 of Subpart A is amended by revising paragraph (a)(1)(iii) to read as follows:

**§ 86.094-9 Emission standards for 1994 and later model year light-duty trucks.**

(a) \* \* \*

(1) \* \* \*

(iii) Exhaust emissions of carbon monoxide from 1994 and later model year light-duty trucks shall not exceed 0.50 percent of exhaust gas flow at curb idle at a useful life of 11 years or 120,000 miles, whichever first occurs (for Otto-cycle and methanol-natural gas- and liquefied petroleum gas-fueled diesel-cycle light-duty trucks only).

\* \* \* \* \*

8. Section 86.094-21 of Subpart A is amended by adding paragraph (j) to read as follows:

**§ 86.094-21 Application for certification.**

\* \* \* \* \*

(j) For methanol-fueled vehicles, the manufacturer shall specify:

(1) Whether the vehicle is a flexible fuel vehicle or a dedicated vehicle (manufacturers must obtain advance approval from the Administrator to classify methanol-fueled vehicles that can use gasoline as dedicated vehicles); and

(2) The fuel(s) (*i.e.*, the percent methanol) for which the vehicle was designed.

9. Section 86.096-21 of Subpart A is amended by redesignating paragraphs (j) and (k) as paragraphs (k) and (l), respectively, removing paragraphs (c) through (i), and adding paragraphs (c) through (j) to read as follows:

**§ 86.096-21 Application for certification.**

\* \* \* \* \*

(c) through (j) [Reserved]. For guidance see § 86.094-21.

\* \* \* \* \*

10. Section 86.097-9 of Subpart A is amended by revising paragraph (a)(1)(iii) to read as follows:

**§ 86.097-9 Emission standards for 1997 and later model year light-duty trucks.**

(a) \* \* \*

(1) \* \* \*

(iii) Exhaust emissions of carbon monoxide from 1997 and later model year light-duty trucks shall not exceed 0.50 percent of exhaust gas flow at curb idle at a useful life of 11 years or 120,000 miles, whichever first occurs (for Otto-cycle and methanol-natural gas- and liquefied petroleum gas-fueled diesel-cycle light-duty trucks only).

\* \* \* \* \*

11. Section 86.098-21 of Subpart A is amended by removing paragraphs (c) through (k) and adding paragraphs (c) through (l) to read as follows:

**§ 86.098-21 Application for certification.**

\* \* \* \* \*

(c) through (j) [Reserved]. For guidance see § 86.094-21.

(k) and (l) [Reserved]. For guidance see § 86.096-21.

12. Section 86.107-90 of Subpart B is amended by revising the introductory text of paragraph (a)(2)(i) and adding paragraph (a)(2)(iii) to read as follows:

**§ 86.107-90 Sampling and analytical system; evaporative emissions.**

(a) \* \* \*

(2) \* \* \* (i) For gasoline- and methanol-fueled vehicles a hydrocarbon analyzer utilizing the hydrogen flame ionization principle (FID) shall be used to monitor the atmosphere within the enclosure (a heated FID (HFID)(235° ±15°F (113 ±8°C)) is recommended for methanol-fueled vehicles). Instrument bypass flow may be returned to the enclosure. The FID shall have a response time to 90 percent of final reading of less than 1.5 seconds, and be capable of meeting performance requirements expressed as a function of Cstd: where Cstd is the specific enclosure hydrocarbon level, in ppm, corresponding to the evaporative emission standard:

\* \* \* \* \*

(iii) The methanol sampling system shall be designed such that, if a test vehicle emitted the maximum allowable level of methanol (based on all applicable standards) during any phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer, and such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection. The provisions of this paragraph apply to the design of sampling systems, not to individual tests.

\* \* \* \* \*

13. Section 86.107-96 of Subpart B is amended by revising paragraph (b)(1) and adding paragraph (b)(3) to read as follows:

**§ 86.107-96 Sampling and analytical systems; evaporative emissions.**

\* \* \* \* \*

(b) \* \* \*

(1) For gasoline fueled, natural gas-fueled, liquefied petroleum gas-fueled and methanol-fueled vehicles a hydrocarbon analyzer utilizing the hydrogen flame ionization principle (FID) shall be used to monitor the

atmosphere within the enclosure (a heated FID (HFID)(235° ±15°F (113 ±8°C)) is recommended for methanol-fueled vehicles). For natural gas-fueled vehicles, the FID may be calibrated using methane, or if calibrated using propane the FID response to methane shall be determined and applied to the FID hydrocarbon reading. Provided evaporative emission results are not effected, a probe may be used to detect or verify hydrocarbon sources during a running loss test. Instrument bypass flow may be returned to the enclosure. The FID shall have a response time to 90 percent of final reading of less than 1.5 seconds.

\* \* \* \* \*

(3) The methanol sampling system shall be designed such that, if a test vehicle emitted the maximum allowable level of methanol (based on all applicable standards) during any phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer, and such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection. The provisions of this paragraph apply to the design of

sampling systems, not to individual tests.

\* \* \* \* \*

14. Section 86.109-94 of Subpart B is amended by revising paragraphs (a)(2)(i) through (a)(2)(iv), text of paragraph (a)(3) preceding figures, text of paragraph (a)(4) preceding figure, paragraphs (a)(5), (b) introductory text, (b)(4), (b)(5), (b)(6), (c) introductory text, (c)(4), (c)(5), and (c)(6), and adding paragraphs (a)(6) and (d), and revising Figures B94-2 and B94-3 to read as follows:

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

(a) \* \* \*

(2) \* \* \*

(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.)

\* \* \* \* \*

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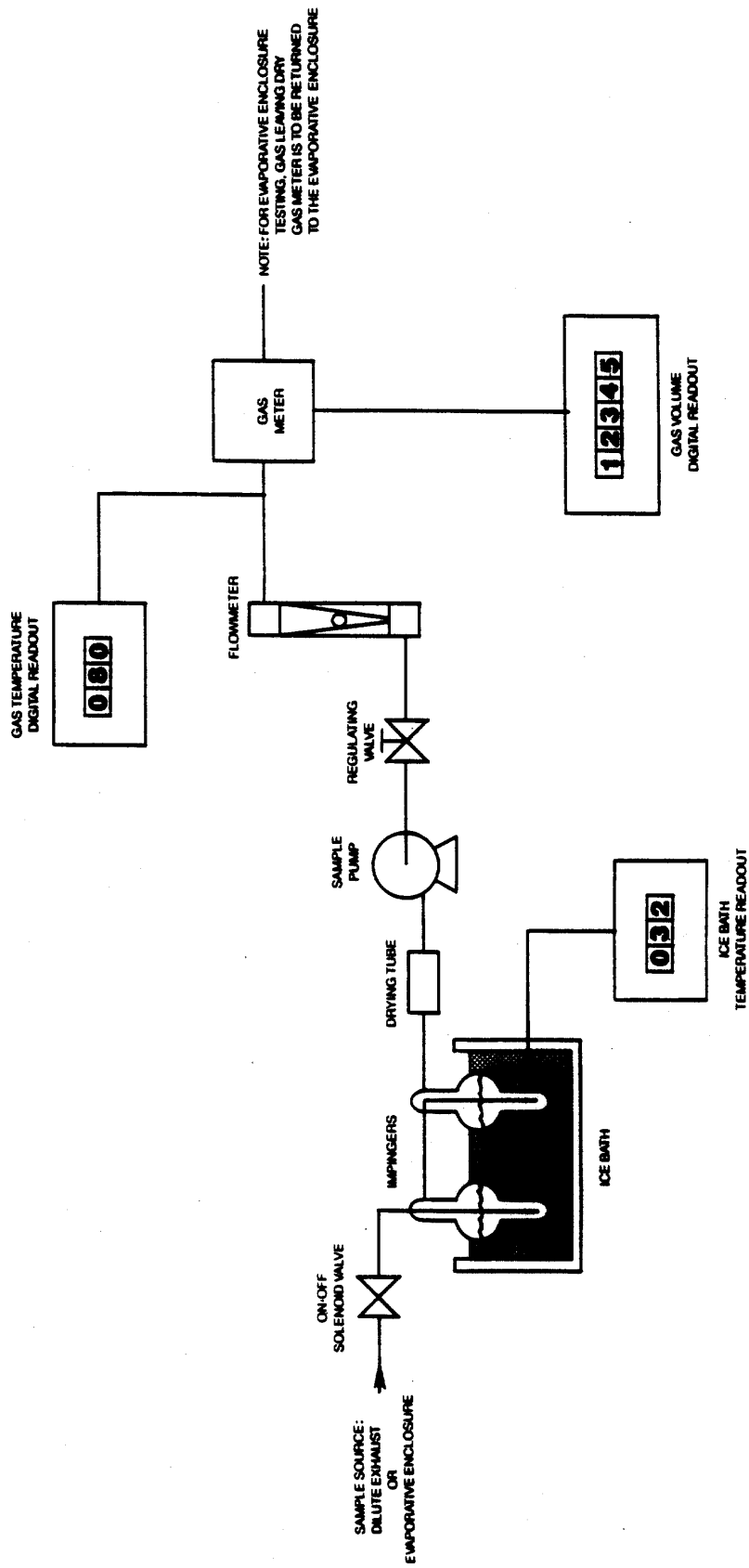


FIGURE B94-2 METHANOL SAMPLE COLLECTION FLOW SCHEMATIC

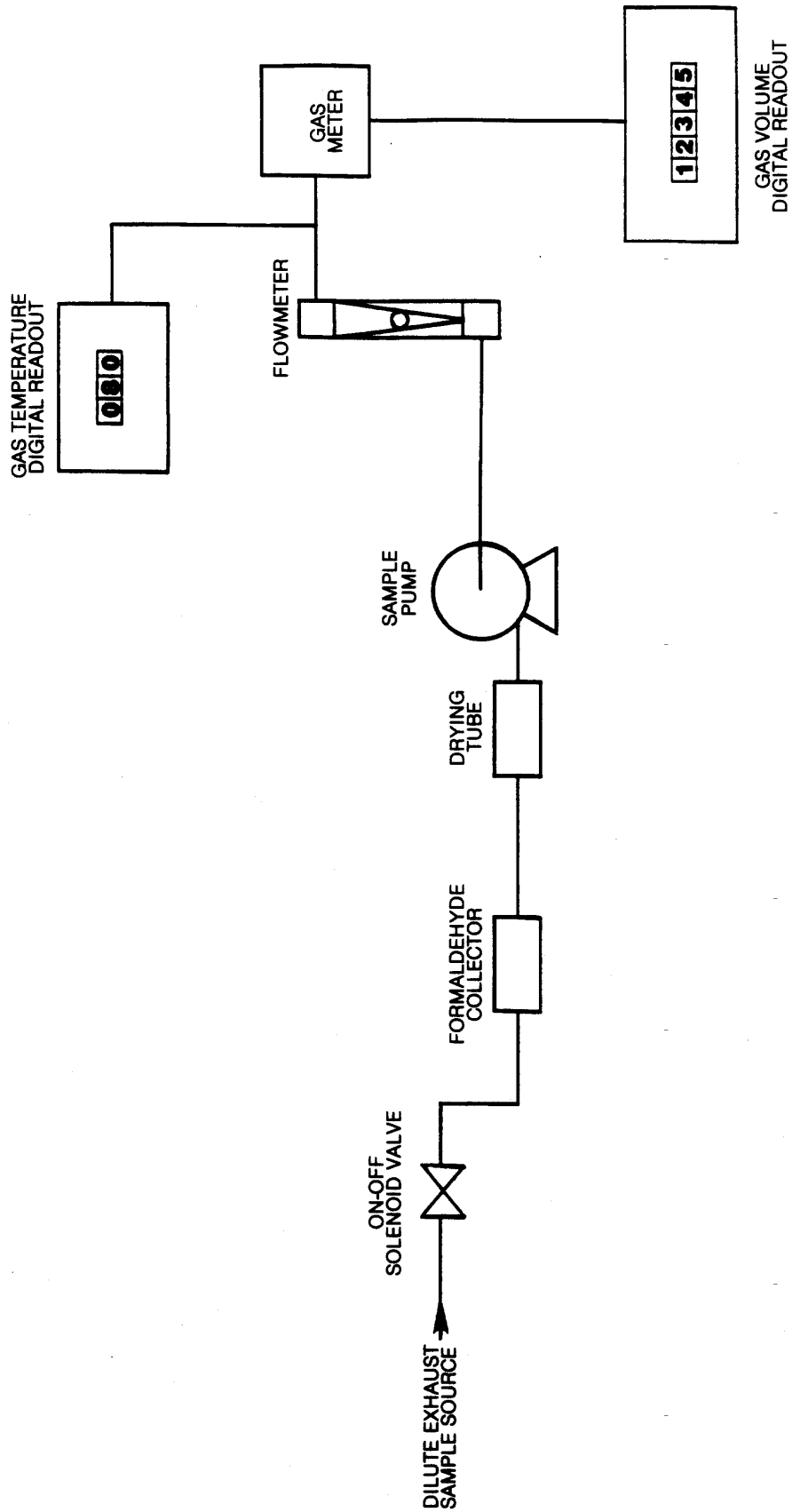


FIGURE B94-3 FORMALDEHYDE SAMPLE COLLECTION FLOW SCHEMATIC

(4) *Critical flow venturi.* The operation of the Critical Flow Venturi-Constant Volume Sampler (CFV-CVS) sample system, Figure B94-4, is based upon the principles of fluid dynamics associated with critical flow. Proportional sampling throughout temperature excursions is maintained by use of small 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 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). Care should be 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.)

\* \* \* \* \*

(5) *Electronic flow control.* The Critical Flow Venturi-Electronic Flow Control-Constant Volume Sampler (CFV-EFC-CVS) system is identical to the CFV-CVS system described in paragraphs (a)(4) and (c) of this section, except that it maintains proportional sampling for methanol and formaldehyde by measuring the CVS flow rate, and electronically controlling sample flow rates. 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).

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

(b) *Component description, PDP-CVS.* The PDP-CVS, Figure B94-1, consists of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling systems (see Figure B94-2 for methanol

sampling system and Figure B94-3 for formaldehyde sampling system) sampling lines which are heated to a temperature that is more than 5°F (3°C) above the maximum dew point of the sample, but below 250°F (121°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:

\* \* \* \* \*

(4) The flow capacity of the CVS shall be large enough to completely eliminate water condensation in the dilution and sampling systems. (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 and may be required for natural gas-fueled and liquefied petroleum gas-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.) (Copies may be obtained from U.S. Department of Commerce, NTIS, Springfield, Virginia 22161; order ± PB 84104702.) Dehumidifying the dilution air before entering the CVS is allowed. Heating the dilution air is also allowed, provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 250 °F.

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(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 the determination of methanol and 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. The systems shall also

comply with the following requirements that apply to the design of the systems, not to individual tests.

(i) The methanol system shall be designed such that, if a test vehicle emitted the maximum allowable level of methanol (based on all applicable standards) during the first phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer. Sampling systems for all phases shall be identical.

(ii) The formaldehyde system shall be designed such that, if a test vehicle emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of NMHCE (i.e., 0.05 g/mi for a 0.25 g/mi NMHCE standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, during the first phase of the test, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer. Sampling systems for all phases shall be identical.

(iii) The methanol and formaldehyde impinger systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection.

(c) *Component description, CFV-CVS.* The CFV-CVS sample system, Figure B94-4, consists of a dilution air filter and mixing assembly, a cyclone particulate separator, unheated sampling venturies for the bag samples, and for the methanol and formaldehyde samples from methanol-fueled vehicles, sample lines heated to a temperature that is more than 5°F (3°C) above the maximum dew point of the sample, but below 250°F (121°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:

\* \* \* \* \*

(4) The flow capacity of the CVS shall be large enough to completely eliminate water condensation in the dilution and sampling systems. (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 and may be required for natural gas-fueled and liquefied petroleum gas-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.) Dehumidifying the dilution air before entering the CVS is allowed. Heating the dilution air is also allowed, provided:

- (i) The air (or air plus exhaust gas) temperature does not exceed 250°F (121°C).
- (ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(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 the determination of methanol and 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 CVS. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests.

(i) The methanol system shall be designed such that, if a test vehicle emitted the maximum allowable level of methanol (based on all applicable standards) during the first phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer. Sampling systems for all phases shall be identical.

(ii) The formaldehyde system shall be designed such that, if a test vehicle emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of NMHCE (i.e., 0.05 g/mi for a 0.25 g/mi NMHCE standard), or the maximum formaldehyde level

allowed by a specific formaldehyde standard, whichever is less, during the first phase of the test, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer. Sampling systems for all phases shall be identical.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection.

(d) *Component description, CFV-EFC-CVS.* The CVS sample system is identical to the system described in paragraph (c) of this section, plus includes a means of electronically measuring the CVS flow rate, and electronic mass flow controllers for the methanol and formaldehyde sample lines. The EFC sample system shall conform to all of the requirements listed in paragraph (c), except that the methanol and formaldehyde samples must both be drawn from a static probe. It also must comply with the following additional requirements:

(1) The ratio of the CVS mass flow rate to the sample mass flow rate shall not deviate from the design ratio by more than ±5 percent. (The volumetric sample flow rate shall be varied inversely with the square root of the bulk stream temperature.)

(2) Flow meters to totalize sample volumes for methanol and/or formaldehyde samples shall meet the accuracy specifications of § 86.120. Total sample volumes may be obtained from the flow controllers, provided that the controllers meet the accuracy specifications of § 86.120.

15. Section 86.110-94 of Subpart B is amended by revising the text of paragraph (a)(1) preceding the figures, paragraphs (a)(5)(i) through (a)(5)(iii), (b) introductory text, (b)(1), (b)(2), (c), and (d), to read as follows:

**§ 86.110-94 Exhaust gas sampling system; diesel-cycle vehicles, and Otto-cycle vehicles requiring particulate emissions measurements.**

\* \* \* \* \*

(a) \* \* \*  
 (1) This sampling system requires the use of a PDP-CVS, CFV-CVS (or a CFV-EFC-CVS), sample system with heat exchanger connected to a dilution

tunnel. The heat exchanger is not required for the CFV-CVS or EFC-CFV-CVS if electronic flow controllers are used to maintain proportionality for the particulate sample. Figure B94-5 is a schematic drawing of the PDP system. Figure B94-6 is a schematic drawing of the CFV-CVS system. (Methanol-fueled Otto-cycle vehicles may be tested using this test equipment, without measuring particulate emissions.)

\* \* \* \* \*

(5) \* \* \*

(i) A tailpipe to dilution tunnel duct of unrestricted length maintained at a temperature above the dew point of the mixture, but below 250°F (121°C) through heating and cooling as 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 dew point of the mixture, but below 250°F (121°C) prior to the test and during breaks in testing (insulation may remain in place and or heating may occur during the testing provided the 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

\* \* \* \* \*

(b) *Component description—petroleum-fueled, natural gas-fueled and liquefied petroleum gas-fueled vehicles.* The components necessary for petroleum-fueled, natural gas-fueled and liquefied petroleum gas-fueled vehicle exhaust sampling shall meet the following requirements:

(1) The PDP-CVS, Figure B94-5, shall contain a proportional particulate sampling system, and shall conform to all of the requirements listed for the exhaust gas PDP-CVS (§ 86.109(b)), with one exception: a flow rate of sufficient volume is required to maintain the diluted exhaust stream, from which the particulate sample flow is taken, at a temperature of 125°F (52°C) or less.

(2) The CFV sample system, Figure B94-6, shall contain a proportional particulate sampling system, and shall conform to all of the requirements listed for the exhaust gas CFV sample system (§ 86.109(c)), except for the following:

(i) A flow rate of sufficient volume is required to maintain the diluted exhaust stream, from which the particulate sample flow is taken, at a temperature of 125°F (52°C) or less.

(ii) If a constant volume particulate sample is collected, a heat exchanger is required.

(iii) If a heat exchanger is used, the gas mixture temperature, measured at a point immediately ahead of the critical flow venturi, shall be within  $\pm 20^{\circ}\text{F}$  ( $11^{\circ}\text{C}$ ) 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  $\pm 20^{\circ}\text{F}$  ( $11^{\circ}\text{C}$ ) during the entire test. The temperature measuring system shall have an accuracy and precision of  $\pm 2^{\circ}\text{F}$  ( $1.1^{\circ}\text{C}$ ).

(iv) The cyclonic separator is optional.

\* \* \* \* \*

(c) *Component description—methanol-fueled vehicles.* The components necessary for methanol-fueled vehicle exhaust sampling shall meet the following requirements:

(1) The PDP-CVS, Figure B94-5, shall contain a proportional particulate sampling system, and shall conform to all of the requirements listed for the exhaust gas PDP-CVS (§ 86.109), with one exception: a flow rate of sufficient volume is required to maintain the diluted exhaust stream, from which the particulate sample flow is taken, at a temperature of  $125^{\circ}\text{F}$  ( $52^{\circ}\text{C}$ ) or less.

(2) The CFV-CVS sample system, Figure B94-6, shall contain a proportional particulate sampling system, and shall conform to all of the requirements listed for the exhaust gas CFV sample system (§ 86.109), except for the following:

(i) A flow rate of sufficient volume is required to maintain the diluted exhaust stream, from which the particulate sample flow is taken, at a temperature of  $125^{\circ}\text{F}$  ( $52^{\circ}\text{C}$ ) or less.

(ii) If a constant volume particulate sample is collected, a heat exchanger is required.

(iii) If a heat exchanger is used, the gas mixture temperature, measured at a point immediately ahead of the critical flow venturi, shall be within  $\pm 20^{\circ}\text{F}$  ( $11^{\circ}\text{C}$ ) 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  $\pm 20^{\circ}\text{F}$  ( $11^{\circ}\text{C}$ ) during the entire test. The temperature measuring system shall have an accuracy and precision of  $\pm 2^{\circ}\text{F}$  ( $1.1^{\circ}\text{C}$ ).

(iv) The cyclonic separator is optional.

(3) The EFC-CFV-CVS sample system shall conform to all of the requirements listed for the exhaust gas EFC sample system (§ 86.109) with three exceptions:

(i) A flow rate of sufficient volume is required to maintain the diluted exhaust stream, from which the particulate sample flow is taken, at a temperature of  $125^{\circ}\text{F}$  ( $52^{\circ}\text{C}$ ) or less.

(ii) A proportional particulate sample shall be collected using an electronic flow controller that meets the performance criteria listed in § 86.109 for methanol and formaldehyde EFC systems.

(iii) The cyclonic separator is optional.

(4) Losses of methanol due to condensation of water in the duct connecting the vehicle tail pipe to the dilution tunnel must be eliminated.

This may be accomplished by:

(i) The use of a duct of unrestricted length maintained at a temperature above the maximum dew point of the exhaust, but below  $250^{\circ}\text{F}$  ( $121^{\circ}\text{C}$ ), through heating and cooling as required; or

(ii) The use of 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  $250^{\circ}\text{F}$  ( $121^{\circ}\text{C}$ ), prior to the test and during breaks in testing (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.

(5) The vehicle exhaust shall be directed downstream at the point where it is introduced into the dilution tunnel.

(6) The dilution air shall be between  $68^{\circ}\text{F}$  ( $20^{\circ}\text{C}$ ) and  $86^{\circ}\text{F}$  ( $30^{\circ}\text{C}$ ) during the test (unless the requirements of § 86.109-94(b)(4) are also met).

(7) The dilution tunnel shall be:

(i) Sized to permit development of turbulent flow (Reynold's No.  $\gg 4000$ ) and complete mixing of the exhaust and dilution air between the mixing orifice and the particulate sample probe. It is recommended that uniform mixing be demonstrated by the user.

(ii) At least 8.0 inches (20.3 cm) in diameter.

(iii) Constructed of electrically conductive material which does not react with the exhaust components.

(iv) Grounded.

(8) The temperature of the diluted exhaust stream inside of the dilution tunnel shall be sufficient to prevent water condensation. However, the sample zone dilute exhaust temperature shall not exceed  $125^{\circ}\text{F}$  ( $52^{\circ}\text{C}$ ) at any time during the test.

(9) The particulate sample probe shall be:

(i) Installed facing upstream at a point where the dilution air and exhaust are

well mixed (i.e., near the tunnel centerline, approximately 10 tunnel diameters downstream from the point where the exhaust enters the dilution tunnel).

(ii) Sufficiently distant (radially) from the THC probe so as to be free from the influence of any wakes or eddies produced by the THC probe.

(iii) 0.5 inch (1.27 cm) minimum inside diameter.

(iv) The distance from the sampling tip to the filter holder shall be at least five probe diameters (for filters located inside the tunnel), but not more than 40.0 inches (102 cm) for filters located outside of the dilution tunnel.

(v) Free from sharp bends.

(vi) Configured so that a clean particulate filter (including back up filter) can be selected simultaneously with the selection of an empty gaseous emissions bag.

(10) The flow rate through the particulate probe shall be maintained to a constant value within  $\pm 5$  percent of the set flow rate.

(11) The particulate sample pump shall be located sufficiently distant from the dilution tunnel so that the inlet gas temperature is maintained at a constant temperature ( $\pm 5.0^{\circ}\text{F}$  ( $2.8^{\circ}\text{C}$ )).

(12) The gas meters or flow instrumentation shall be located sufficiently distant from the tunnel so that the inlet gas temperature remains constant ( $\pm 5.0^{\circ}\text{F}$  ( $2.8^{\circ}\text{C}$ )).

(13) The hydrocarbon probe shall be:

(i) Installed facing upstream at a point where the dilution air and exhaust are well mixed (i.e., approximately ten tunnel diameters downstream from the point where the exhaust enters the dilution tunnel).

(ii) Sufficiently distant (radially) from the particulate probe so as to be free from the influence of any wakes of eddies produced by the particulate probe.

(iii) Heated and insulated over the entire length to maintain a wall temperature more than  $5^{\circ}\text{F}$  ( $3^{\circ}\text{C}$ ) above the maximum dew point of the sample, but below  $250^{\circ}\text{F}$  ( $121^{\circ}\text{C}$ ).

(iv) 0.19 in. (0.48 cm) minimum inside diameter.

(14) It is intended that the THC probe be free from cold spots (i.e., free from cold spots where the probe wall temperature is less than  $5^{\circ}\text{F}$  ( $3^{\circ}\text{C}$ ) above the maximum dew point of the sample.) This will be determined by a temperature sensor located on a section of the probe wall outside of the dilution tunnel. The temperature sensor shall be insulated from any heating elements on the probe. The sensor shall have an accuracy and precision of  $\pm 2^{\circ}\text{F}$  ( $1.1^{\circ}\text{C}$ ).



(15) The dilute exhaust gas flowing in the hydrocarbon sample system shall be:

(i) At 235°F ± 15°F (113°C ± 8°C) immediately before the heated filter. This will be determined by a temperature sensor located immediately upstream of the filter. The sensor shall have an accuracy and precision of ± 2°F (1.1°C).

(ii) At 235° ± 15°F (113°C ± 8°C) immediately before the HFID. This will be determined by a temperature sensor located at the exit of the heated sample line. The sensor shall have an accuracy and precision of ± 2°F (1.1°C).

(16) It is intended that the dilute exhaust gas flowing in the hydrocarbon sample system between 220°F and 250°F (105°C and 121°C).

(17) For methanol-fueled vehicles, bag sampling procedures for the measurement of hydrocarbons as described in § 86.109 may be employed.

(d) [Reserved]. For guidance see § 86.110-90.

16. Section 86.113-94 of Subpart B is amended by revising paragraph (d) to read as follows:

**§ 86.113-94 Fuel specifications.**

\* \* \* \* \*

(d) *Mixtures of petroleum and methanol fuels for flexible fuel vehicles.*

(1) Mixtures of petroleum and methanol fuels used for exhaust and evaporative emission testing and service accumulation for flexible fuel vehicles shall consist of the appropriate petroleum fuels listed in either paragraph (a) or paragraph (b) of this section and a methanol fuel representative of the fuel expected to be found in use, as specified in paragraph (c) of this section, and shall be within the range of fuel mixtures for which the vehicle was designed, as reported in § 86.94-21(j). The Administrator may use any fuel or fuel mixture within this range for testing.

(2) The fuel mixtures used by the manufacturers shall be sufficient to demonstrate compliance over the full design range, and shall include:

- (i) For emission testing:
  - (A) The petroleum fuel specified in paragraph (a) or (b) of this section;
  - (B) A methanol fuel representative of the methanol fuel expected to be found in use, as specified in paragraph (c) of this section;
  - (C) A combination of the fuels specified in paragraphs (d)(2)(i)(A) and (d)(2)(i)(B) of this section at a composition which represents the highest Reid Vapor Pressure of in-use mixtures. This mixture shall contain between 9-13 percent methanol by volume.
- (ii) For service accumulation, the fuels specified in paragraphs (a) and (c)

of this section or, for diesel FFVs, paragraphs (b) and (c) of this section shall be used alternately. The fuels shall be alternated at mileage intervals not to exceed 5,000 miles. The fuels shall be alternated such that the cumulative volumes of both the methanol fuel and the petroleum fuel used shall be at least 25 percent of the total fuel volume.

(iii) Or, other combinations for testing or service accumulation which demonstrate compliance with the standards over the entire design range of the vehicle, provided that written approval is obtained from the Administrator prior to the start of testing.

(3) The specification range of the fuels to be used under this paragraph (d) shall be reported in accordance with § 86.094-21.

\* \* \* \* \*

17. Section 86.114-94 of Subpart B is amended by revising paragraphs (a)(2), (a)(5), (b), and (c), and adding paragraph (d) to read as follows:

**§ 86.114-94 Analytical gases.**

(a) \* \* \*

(2) Gases for the THC analyzer shall be:

- (i) Single blends of propane using air as the diluent; and
- (ii) Optionally, for response factor determination, single blends of methanol using air as the diluent.

\* \* \* \* \*

(5) Fuel for FIDs and HFIDs and the methane analyzer shall be a blend of 40 ±2 percent hydrogen with the balance being helium. The mixture shall contain less than one ppm equivalent carbon response. 98 to 100 percent hydrogen fuel may be used with advance approval by the Administrator.

\* \* \* \* \*

(b) Calibration gases (not including methanol) shall be traceable to within one percent of NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator.

(c) Span gases (not including methanol) shall be accurate to within two percent of true concentration, where true concentration refers to NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator.

(d) Methanol in air gases used for response factor determination shall:

- (1) Be traceable to within ±2 percent of NIST (formerly NBS) gas standards, or other standards which have been approved by the Administrator; and
- (2) Remain within ±2 percent of the labeled concentration. Demonstration of stability shall be based on a quarterly

measurement procedure with a precision of ±2 percent (two standard deviations), or other method approved by the Administrator. The measurement procedure may incorporate multiple measurements. If the true concentration of the gas changes by more than two percent, but less than ten percent, the gas may be relabeled with the new concentration.

18. Section 86.116-94 of Subpart B is amended by revising paragraphs (c)(1) and (c)(3), and adding paragraph (g) to read as follows:

**§ 86.116-94 Calibrations, frequency and overview.**

\* \* \* \* \*

(c) \* \* \*

(1) Calibrate the THC analyzers (both evaporative and exhaust instruments), methane analyzer, carbon dioxide analyzer, carbon monoxide analyzer, and oxides of nitrogen analyzer (certain analyzers may require more frequent calibration depending on particular equipment and uses).

\* \* \* \* \*

(3) Perform an organic gas retention and calibration on the evaporative emissions enclosure (see § 86.117-90(c)).

\* \* \* \* \*

(g) The Administrator, upon request, may waive the requirement to comply with the specified methanol recovery tolerance (e.g., ±2 percent in §§ 86.117-90 and 86.119-90), and/or the specified methanol retention tolerance (e.g., ±4 percent in § 86.117-90), and instead require compliance with higher tolerances (not to exceed ±6 percent for recoveries and ±8 for retention), provided that:

- (1) The Administrator determines that compliance with these specified tolerances is not practically feasible; and
- (2) 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.

19. Section 86.117-90 of Subpart B is amended by revising paragraphs (c) heading and introductory text, (c)(5), (c)(7), (c)(9), (d)(1), and (d)(2)(iii) to read as follows:

**§ 86.117-90 Evaporative emission enclosure calibrations.**

\* \* \* \* \*

(c) *Hydrocarbon and methanol (organic gas) retention check and calibration.* The hydrocarbon and methanol (if the enclosure is used for

methanol-fueled vehicles) retention check provides a check upon the calculated volume and also measures the leak rate. Prior to its introduction into service and at least monthly thereafter (the methanol check can be performed less frequently, provided it is performed at least twice annually) the enclosure leak rate shall be determined as follows:

\* \* \* \* \*

(5) Inject into the enclosure a known quantity of pure propane (4g is a convenient quantity) and a known quantity of pure methanol (4g is a convenient quantity) in gaseous form; i.e., at a temperature of at least 150–155 °F (65–68 °C). The propane and methanol may be measured by volume flow or by mass measurement. The method used to measure the propane

and methanol shall have an accuracy of ±0.5 percent of the measured value (less accurate methods may be used with the advanced approval of the Administrator). The methanol and propane tests do not need to be conducted simultaneously.

\* \* \* \* \*

(7) To verify the enclosure calibration, calculate the mass of propane and the mass of methanol using the measurements taken in steps (4) and (6) (see paragraph (d) of this section). This quantity must be within ±2 percent of that measured in step 5 above. (For 1991–1995 calendar years, the difference may exceed ±2 percent for methanol, provided it does not exceed ±8 percent for 1991 testing and ±6 percent for 1992–1995 testing.)

\* \* \* \* \*

(9) Calculate, using the equations in paragraph (d) of this section and the readings taken in step (8), the hydrocarbon and methanol mass. It may not differ by more than ±4 percent of the value in step (6). (For 1991–1995 calendar years, the difference may exceed ±4 percent for methanol, provided it does not exceed ±8 percent for 1991 testing and ±6 percent for 1992–1995 testing.)

(d) *Calculations.* (1) The calculation of net methanol and hydrocarbon mass change is used to determine enclosure background and leak rate. It is also used to check the enclosure volume measurements. The methanol mass change is calculated from the initial and final methanol samples, temperature and pressure according to the following equation:

$$M_{CH_3OH} = V_X \times \frac{T_{Ef}}{V_{Ef} \times T_{SHEDf}} (C_{MX1i} \times AV_{1f}) + (C_{MS2f} \times AV_{2f}) - \frac{T_{Ei}}{V_{Ei} \times T_{SHEDI}} (C_{MS1i} \times AV_{1i}) + (C_{MS1i} \times AV_{2i})$$

Where:

- (i)  $M_{CH_3OH}$  = Methanol mass change, µg.
- (ii) V = Enclosure volume, ft<sup>3</sup>, as measured in paragraph (b)(1) of this section.
- (iii) TE = Temperature of sample withdrawn, °R.
- (iv) T<sub>SHED</sub> = Temperature of SHED, °R.

- (v) VE = Volume of sample withdrawn, ft<sup>3</sup>.
- (vi) P<sub>B</sub> = Barometric pressure at time of sampling, in. Hg.
- (vii) C<sub>MS</sub> = GC concentration of test sample.
- (viii) AV = Volume of absorbing reagent in impinger (ml).

- (ix) i = Initial sample.
- (x) f = Final sample.
- (xi) 1 = First impinger.
- (xii) 2 = Second impinger.
- (2) \* \* \*
- (iii) C<sub>CH<sub>3</sub>OH</sub> = Methanol concentration as ppm carbon

$$= \frac{1.501 \times 10^{-3} \times T_E}{P_B \times V_E} [(C_{S1} \times AV_1) + (C_2 \times AV_2)]$$

\* \* \* \* \*

20. Section 86.117–96 of Subpart B is amended by revising paragraphs (c) heading and introductory text, (c)(1)(vii), (c)(1)(ix), (c)(1)(xii), (d)(1), and (d)(2)(iii) to read as follows:

**§ 86.117–96 Evaporative emission enclosure calibrations.**

\* \* \* \* \*

(c) *Hydrocarbon and methanol (organic) retention check and calibration.* The hydrocarbon and methanol (if the enclosure is used for methanol-fueled vehicles) retention check provides a check upon the calculated volume and also measures the leak rate. The enclosure leak rate shall be determined prior to its introduction into service, following any modifications or repairs to the enclosure that may affect the integrity of the

enclosure, and at least monthly thereafter. (The methanol check can be performed less frequently, provided it is performed at least twice annually.) If six consecutive monthly retention checks are successfully completed without corrective action, the enclosure leak rate may be determined quarterly thereafter as long as no corrective action is required.

- (1) \* \* \*
- (vii) Inject into the enclosure 2 to 6 grams of pure propane and 2 to 6 grams of pure methanol in gaseous form; i.e., at a temperature of at least 150 °F (65°C). The propane and methanol may be measured by volume flow or by mass measurement. The method used to measure the propane and methanol shall have an accuracy of ±0.2 percent of the measured value (less accurate methods may be used with the

advanced approval of the Administrator). The methanol and propane tests do not need to be conducted simultaneously.

\* \* \* \* \*

(ix) To verify the enclosure calibration, calculate the mass of propane and the mass of methanol using the measurements taken in paragraphs (c)(1)(vi) and (viii) of this section. See paragraph (d) of this section. This quantity must be within ±2 percent of that measured in paragraph (c)(1)(vii) of this section. (For 1991–1995 calendar years, the difference may exceed ±2 percent for methanol, provided it does not exceed ±6 percent.)

\* \* \* \* \*

(xii) At the completion of the 24-hour cycling period, analyze the enclosure atmosphere for hydrocarbon and

methanol content; determine the net withdrawn methanol (in the case of diurnal emission testing with fixed volume enclosures); record temperature and barometric pressure. These are the final readings for the hydrocarbon and methanol retention check. The final hydrocarbon and methanol mass, calculated in paragraph (d) of this

section, shall be within three percent of that determined in paragraph (c)(1)(viii) of this section. (For 1991–1995 calendar years, the difference may exceed ±3 percent for methanol, provided it does not exceed ±6 percent.)

\* \* \* \* \*

(d) *Calculations.* (1) The calculation of net methanol and hydrocarbon mass

change is used to determine enclosure background and leak rate. It is also used to check the enclosure volume measurements. The methanol mass change is calculated from the initial and final methanol samples, temperature and pressure according to the following equation:

$$M_{CH_3OH} = V_X \times \frac{T_{Ef}}{V_{Ef} \times T_{SHEDf}} (C_{MS1i} \times AV_{1f}) + (C_{MS2f} \times AV_{2f}) - \frac{T_{Ei}}{V_{Ei} \times T_{SHEDI}} (C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})$$

Where:

- (i)  $M_{CH_3OH}$  = Methanol mass change, µg.
- (ii) V = Enclosure volume, ft<sup>3</sup>, as measured in paragraph (b)(1) of this section.
- (iii)  $T_E$  = Temperature of sample withdrawn, °R.
- (iv)  $T_{SHED}$  = Temperature of SHED, °R.
- (v)  $V_E$  = Volume of sample withdrawn, ft<sup>3</sup>.
- (vi)  $P_B$  = Barometric pressure at time of sampling, in. Hg.
- (vii)  $C_{MS}$  = GC concentration of test sample.
- (viii) AV = Volume of absorbing reagent in impinger (ml).
- (ix) i = Initial sample.
- (x) f = Final sample.
- (xi) 1 = First impinger.
- (xii) 2 = Second impinger.
- (xiv)  $M_{CH_3OH, out}$  = mass of methanol exiting the enclosure, in the case of fixed volume enclosures for diurnal emission testing, µg.
- (xv)  $M_{CH_3OH, in}$  = mass of methanol exiting the enclosure, in the case of fixed volume enclosures for diurnal emission testing, µg.

(2) \* \* \*

(iii)  $C_{CH_3OH}$  = Methanol concentration as ppm carbon

$$= \frac{1.501 \times 10^{-3} \times T_E}{P_B \times V_E} [(C_{S1} \times AV_1) + (C_2 \times AV_2)]$$

\* \* \* \* \*  
21. Section 86.119–90 of Subpart B is amended by revising paragraphs (c)(1), (c)(4), and (c)(7) to read as follows:

**§ 86.119–90 CVS calibration.**

\* \* \* \* \*

(c) \* \* \*

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

\* \* \* \* \*

(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.

\* \* \* \* \*

(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.)

22. A new § 86.120–94 is being added to Subpart B to read as follows:

**§ 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:

(i) Mechanically adjust the instrument so that it agrees with the calibration measurement at the specified flow rates using the criteria of paragraph (a)(6) of this section; or

(ii) Develop a continuous best fit calibration curve for the instrument (as a function of the calibration device flow measurement) from the calibration points to determine corrected flow. The points on the calibration curve relative to the calibration device measurements must be within  $\pm 1.0$  percent of the maximum operating range of  $\pm 2.0$  percent of the point (whichever is smaller).

(b) Other systems. A bell prover may be used to calibrate the instrument if the

procedure outlined in ANSI B109.1-1973 is used. Prior approval by the Administrator is not required to use the bell prover.

23. Section 86.121-90 of Subpart B is amended by revising paragraphs (c) introductory text, (c)(1), and (c)(3)(iii) to read as follows:

**§ 86.121-90 Hydrocarbon analyzer calibration.**

\* \* \* \* \*

(c) *FID response factor to methanol.* When the FID analyzer is to be used for the analysis of hydrocarbon samples containing methanol, the methanol response factor of the analyzer shall be established. The methanol response

factor shall be determined at several concentrations in the range of concentrations in the exhaust sample, using either bag samples or gas bottles meeting the requirements of § 86.114.

(1) The bag sample of methanol for analysis in the FID, if used, shall be prepared using the apparatus shown in Figure B90-11. A known volume of methanol is injected, using a microliter syringe, into the heated mixing zone (250°F (121°C)) of the apparatus. The methanol is vaporized and swept into the sample bag with a known volume of zero grade air measured by a gas flow meter meeting the performance requirements of § 86.120.

BILLING CODE 6560-50-P

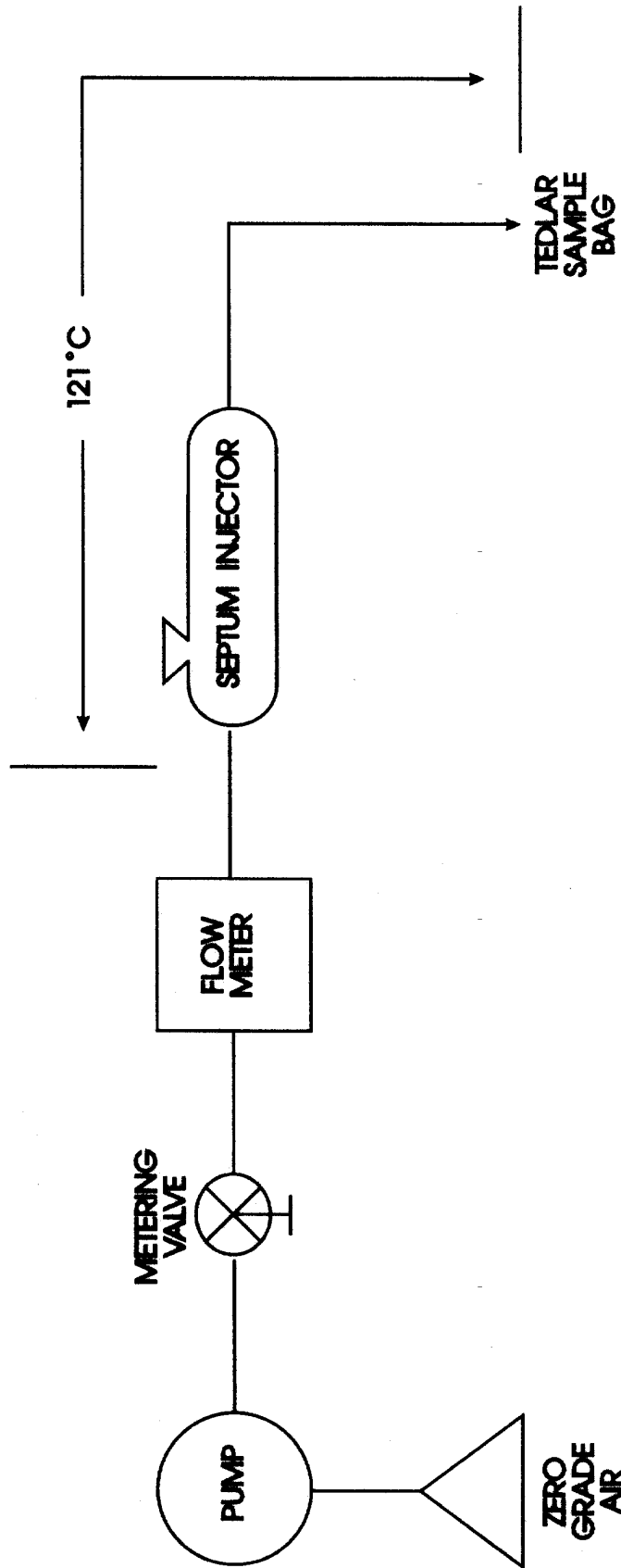


FIGURE B90-11 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

\* \* \* \* \*

(3) \* \* \*

(iii) SAMppm=methanol concentration in the sample bag, or gas bottle, in ppmC. SAMppm for sample bags

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. CH}_3\text{OH}}$$

Where:

\* \* \* \* \*

24. Section 86.123-78 of Subpart B is amended by adding paragraph (c) to read as follows:

**§ 86.123-78 Oxides of nitrogen analyzer calibration.**

\* \* \* \* \*

(c) When testing methanol-fueled vehicles, it may be necessary to clean the analyzer frequently to prevent interference with NO<sub>x</sub> measurements (see EPA/600/S3-88/040).

25. Section 86.127-94 of Subpart B is amended by adding paragraph (f) to read as follows:

**§ 86.127-94 Test procedures; overview.**

\* \* \* \* \*

(f) Background concentrations are measured for all species for which emissions measurements are made. For exhaust testing, this requires sampling and analysis of the dilution air. For evaporative testing, this requires measuring initial concentrations. (When testing methanol-fueled vehicles, manufacturers may choose not to measure background concentrations of methanol and/or formaldehyde, and then assume that the concentrations are zero during calculations.)

26. Section 86.127-96 of Subpart B is amended by adding paragraph (g) to read as follows:

**§ 86.127-96 Test procedures; overview.**

\* \* \* \* \*

(g) Background concentrations are measured for all species for which emissions measurements are made. For exhaust testing, this requires sampling and analysis of the dilution air. For evaporative testing, this requires measuring initial concentrations. (When testing methanol-fueled vehicles, manufacturers may choose not to measure background concentrations of methanol and/or formaldehyde, and then assume that the concentrations are zero during calculations.)

27. Section 86.137-90 of Subpart B is amended by revising paragraph (b)(20) to read as follows:

**§ 86.137-90 Dynamometer test run, gaseous and particulate emissions.**

\* \* \* \* \*

(b) \* \* \*

(20) As soon as possible, transfer the hot start "transient" exhaust and dilution air samples to the analytical system and process the samples according to § 86.140, obtaining a stabilized reading of the exhaust bag sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period. (If it is not possible to perform analysis on the methanol and formaldehyde samples, within 24 hours, the samples should be stored in a dark cold (4-10°C) environment until analysis. The samples should be analyzed within fourteen days.)

\* \* \* \* \*

28. Section 86.137-94 of Subpart B is amended by revising paragraphs (b)(4), (b)(6)(iii), (b)(6)(iv), and (b)(15), and removing the note following paragraph (b)(6)(iv) to read as follows:

**§ 86.137-94 Dynamometer test run, gaseous and particulate emissions.**

\* \* \* \* \*

(b) \* \* \*

(4) For methanol-fueled vehicles, with the sample selector valves in the "standby" position, insert fresh sample collection impingers into the methanol sample collection system, fresh impingers or a fresh cartridge into the formaldehyde sample collection system and fresh impingers (or a single cartridge for formaldehyde) into the dilution air sample collection systems for methanol and formaldehyde (background measurements of methanol and formaldehyde may be omitted and concentrations assumed to be zero for calculations in § 86.144).

\* \* \* \* \*

(6) \* \* \*

(iii) For methanol samples, the flow rates shall be set such that the system meets the design criteria of § 86.109 and § 86.110. For samples in which the concentration in the primary impinger exceeds 0.5 mg/l, it is recommended that the mass of methanol collected in the secondary impinger not exceed ten percent of the total mass collected. For samples in which the concentration in the primary impinger does not exceed 0.5 mg/l, analysis of the secondary impingers is not necessary.

(iv) For formaldehyde samples, the flow rates shall be set such that the system meets the design criteria of § 86.109 and § 86.110. For impinger samples in which the concentration of formaldehyde in the primary impinger exceeds 0.1 mg/l, it is recommended that the mass of formaldehyde collected

in the secondary impinger not exceed ten percent of the total mass collected. For samples in which the concentration in the primary impinger does not exceed 0.1 mg/l, analysis of the secondary impingers is not necessary.

\* \* \* \* \*

(15) Five seconds after the engine stops running, simultaneously turn off gas flow measuring device No. 2 and if applicable, turn off the hydrocarbon integrator No. 2, mark the hydrocarbon recorder chart, turn off the No. 2 particulate sample pump and close the valves isolating particulate filter No. 2, and position the sample selector valves to the "standby" position (and open the valves isolating particulate filter No. 1, if applicable). Record the measured roll or shaft revolutions (both gas meter or flow measurement instrumentation readings), and reset the counter. As soon as possible, transfer the "stabilized" exhaust and dilution air samples to the analytical system and process the samples according to § 86.140, obtaining a stabilized reading of the exhaust bag sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period. (If it is not possible to perform analysis on the methanol and formaldehyde samples within 24 hours, the samples should be stored in a dark cold (4-10°C) environment until analysis. The samples should be analyzed within fourteen days.) If applicable, carefully remove both pairs of particulate sample filters from their respective holders, and place each in a separate petri dish, and cover.

\* \* \* \* \*

29. Section 86.140-94 of Subpart B is amended by revising paragraphs (c) and (d) to read as follows:

**§ 86.140-94 Exhaust sample analysis.**

\* \* \* \* \*

(c) 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.

(d) For HCHO (methanol-fueled vehicles), introduce formaldehyde 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.

\* \* \* \* \*

30. Section 86.142-90 of Subpart B is amended by revising paragraphs (p)(1)

through (p)(7), and removing paragraph (p)(8), to read as follows:

**§ 86.142-90 Records required.**

\* \* \* \* \*

(p) \* \* \*

(1) Specification of the methanol-fuel or methanol-fuel mixtures used during the test.

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

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

(4) Volume of sample passed through the formaldehyde sampling system and the volume of DNPH solution used.

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

(6) The temperatures of the sample lines before the HFID and the impinger, the temperature of the exhaust transfer duct (as applicable), and the temperature of the control system of the heated hydrocarbon detector.

(7) A continuous measurement of the dew point of the raw and diluted exhaust. This requirement may be omitted if the temperatures of all heated

lines are kept above 220°F, or if the manufacturer performs an engineering analysis demonstrating that the temperature of the heated systems remains above the maximum dew point of the gas stream throughout the course of the test.

\* \* \* \* \*

31. Section 86.143-90 of Subpart B is amended by revising paragraphs (a)(1) and (a)(2)(iii) to read as follows:

**§ 86.143-90 Calculations; evaporative emissions.**

(a) \* \* \*

(1) For methanol:

$$M_{CH_3OH} = V_n X \times \frac{T_{Ef}}{(V_{Ef} \times T_{SHEDf})} \times [(C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f})] - \frac{T_{Ei}}{(V_{Ei} \times T_{SHEDI})} \times [(C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})]$$

Where:

(i)  $M_{CH_3OH}$  = Methanol mass change,  $\mu\text{g}$ .

(ii)  $V_n$  = Net enclosure volume,  $\text{ft}^3$ , as determined by subtracting 50  $\text{ft}^3$  (1.42  $\text{m}^3$ ) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50  $\text{ft}^3$ ) with advance approval by the Administrator: *Provided*, the

measured volume is determined and used for all vehicles tested by that manufacturer.

(iii)  $T_E$  = Temperature of sample withdrawn, °R.

(iv)  $V_E$  = Volume of sample withdrawn,  $\text{ft}^3$ .

(v)  $T_{SHED}$  = Temperature of SHED, °R

(vi)  $C_{MS}$  = GC concentration of sample,  $\mu\text{g}/\text{ml}$ .

(vii) AV = Volume of absorbing reagent in impinger.

(viii)  $P_B$  = Barometric pressure at time of sampling, in. Hg.

(ix) i = Initial sample.

(x) f = Final sample.

(xi) 1 = First impinger.

(xii) 2 = Second impinger.

(2) \* \* \*

(iii)  $C_{CH_3OH}$  = Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T}{P_B \times V_E} \times [(C_{S1} \times AV_1) + (C_{S2} \times AV_2)]$$

\* \* \* \* \*

32. Section 86.143-96 of Subpart B is amended by revising paragraphs (b)(1)(i) and (b)(1)(ii)(C) to read as follows:

**§ 86.143-96 Calculations; evaporative emissions.**

\* \* \* \* \*

(b) \* \* \*

(1) \* \* \*

(i) For methanol:

$$M_{CH_3OH} = V_n \times \frac{T_{Ef}}{(V_{Ef} \times T_{SHEDf})} \times [(C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f})] - \frac{T_{Ei}}{(V_{Ei} \times T_{SHEDI})} \times [(C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})] + (M_{CH_3OH,OUT} - M_{CH_3OH,\epsilon})$$

Where:

(A)  $M_{CH_3OH}$  = Methanol mass change,  $\mu\text{g}$ .

(B)  $V_n$  = Net enclosure volume,  $\text{ft}^3$ , as determined by subtracting 50  $\text{ft}^3$  (1.42  $\text{m}^3$ ) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of

the vehicle (instead of the nominal 50  $\text{ft}^3$ ) with advance approval by the Administrator: *Provided*, the measured volume is determined and used for all vehicles tested by that manufacturer.

(C)  $T_E$  = Temperature of sample withdrawn, °R.

(D)  $V_E$  = Volume of sample withdrawn,  $\text{ft}^3$ .

(E)  $T_{SHED}$  = Temperature of SHED, °R

(F)  $C_{MS}$  = GC concentration of sample,  $\mu\text{g}/\text{ml}$ .

(G) AV = Volume of absorbing reagent in impinger.

(H)  $P_B$  = Barometric pressure at time of sampling, in. Hg.

- (I) i = Initial sample.
- (J) f = Final sample.
- (K) 1 = First impinger.
- (L) 2 = Second impinger.
- (M)  $M_{CH_3OH, out}$  = mass of methanol exiting the enclosure, in the case of

- fixed-volume enclosures for diurnal emission testing,  $\mu\text{g}$ .
- (N)  $M_{CH_3OH, in}$  = mass of methanol entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing,  $\mu\text{g}$ .

- (ii) \* \* \*
- (C)  $C_{CH_3OH}$  = Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T}{P_B \times V_E} \times [(C_{S1} \times AV_1) + (C_{S2} \times AV_2)]$$

\* \* \* \* \*

33. Section 86.144-94 of Subpart B is amended by revising paragraphs (c)(5)(iv) through (c)(5)(xvi), (c)(7)(ii), and (e), and by removing paragraphs

(c)(5)(xvii) and (c)(5)(xviii), to read as follows:

- (c) \* \* \*
- (5) \* \* \*

**§ 86.144-94 Calculations; exhaust emissions.**

- (iv)(A)  $C_{CH_3OH_e}$  = Methanol concentration in the dilute exhaust, ppm.
- (B)  $C_{CH_3OH_e}$  =

$$\frac{3.813 \times 10^{-2} \times T_{EM} [(C_{S1} \times AV_{S1}) + (C_{S2} \times AV_{S2})]}{P_B \times V_{EM}}$$

- (v)(A)  $C_{CH_3OH_d}$  = Methanol concentration in the dilution air, ppm.
- (B)  $C_{CH_3OH_d}$  =

$$\frac{3.813 \times 10^{-2} \times T_{DM} [(C_{D1} \times AV_{D1}) + (C_{D2} \times AV_{D2})]}{P_B \times V_{DM}}$$

- (vi)  $T_{EM}$  = Temperature of methanol sample withdrawn from dilute exhaust, °R.
- (vii)  $T_{DM}$  = Temperature of methanol sample withdrawn from dilution air, °R.
- (viii)  $P_B$  = Barometric pressure during test, mm Hg.
- (ix)  $V_{EM}$  = Volume of methanol sample withdrawn from dilute exhaust,  $\text{ft}^3$ .
- (x)  $V_{DM}$  = Volume of methanol sample withdrawn from dilution air,  $\text{ft}^3$ .

- (xi)  $C_S$  = GC concentration of sample drawn from dilute exhaust,  $\mu\text{g}/\text{ml}$ .
- (xii)  $C_D$  = GC concentration of sample drawn from dilution air,  $\mu\text{g}/\text{ml}$ .
- (xiii)  $AV_S$  = Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml.
- (xiv)  $AV_D$  = Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml.

- (xv) 1 = first impinger.
- (xvi) 2 = second impinger.
- \* \* \* \* \*
- (7) \* \* \*

(ii) For methanol-fueled vehicles, where fuel composition is  $C_xH_yO_z$  as measured, or calculated, for the fuel used:

$$DF = \frac{(100) \frac{x}{x + y/2 + 3.76(x + y/2 - z/2)}}{CO_{2e} + (HC_e + CO_e + CH_3OH_e + HCHO_e) \times 10^{-4}}$$

\* \* \* \* \*

(e) For methanol-fueled vehicles with measured fuel composition of  $CH_{3.487}O_{0.763}$ , example calculation of exhaust emissions using positive displacement pump:

(1) For the "transient" phase of the cold start test assume the following:  $V_0=0.29344 \text{ ft}^3 \text{ rev}$ ;  $N=25,801$ ;  $R=37.5 \text{ pct}$ ;  $Ra=37.5 \text{ percent}$ ;  $P_B=725.42 \text{ mm Hg}$ ;  $P_d=22.02 \text{ mm Hg}$ ;  $P_4=70 \text{ mm Hg}$ ;  $T_p=570 \text{ deg R}$ ;  $FID HC_e=14.65 \text{ ppm}$ , carbon equivalent;  $r=0.788$ ;  $T_{EM}=527.67 \text{ deg R}$ ;

$V_{EM}=0.2818 \text{ ft}^3$ ;  $C_{S1}=7.101$ ;  $AV_{S1}=15.0 \text{ ml}$ ;  $C_{S2}=0.256$ ;  $AV_{S2}=15.0 \text{ ml}$ ;  $T_{DM}=527.67 \text{ deg R}$ ;  $V_{DM}=1.1389 \text{ ft}^3$ ;  $C_{D1}=0.439$ ;  $AV_{D1}=15.0 \text{ ml}$ ;  $C_{D2}=0.0$ ;  $AV_{D2}=15.0 \text{ ml}$ ;  $C_{FDE}=8.970 \mu\text{g}/\text{ml}$ ;  $V_{AE}=5.0 \text{ ml}$ ;  $Q=0.1429$ ;  $T_{EF}=527.67 \text{ deg R}$ ;  $V_{SE}=0.2857 \text{ ft}^3$ ;  $C_{FDA}=0.39 \mu\text{g}/\text{ml}$ ;  $V_{AA}=5.0 \text{ ml}$ ;  $T_{DF}=527.67 \text{ deg R}$ ;  $V_{SA}=1.1043 \text{ ft}^3$ ;  $NO_{Xe}=5.273 \text{ ppm}$ ;  $CO_{em}=98.8 \text{ ppm}$ ;  $CO_{2e}=0.469 \text{ pct}$ ;  $CH_{4e}=2.825 \text{ ppm}$ ;  $FID HC_d=2.771 \text{ ppm}$ ;  $NO_{Xd}=0.146 \text{ ppm}$ ;  $CO_{dm}=1.195 \text{ ppm}$ ;

$CO_{2d}=0.039 \text{ percent}$ ;  $CH_{4d}=2.019 \text{ ppm}$ ;  $Dct=3.583 \text{ miles}$ .

Then:

- (i)  $V_{mix}=(0.29344)(25,801)(725.42-70)(528)/(760)(570)=6048.1.0 \text{ ft}^3 \text{ per test phase}$ .
- (ii)  $H=(43.478)(37.5)(22.02)/[725.42-(22.02 \times 37.5/100)]=50 \text{ grains of water per pound of dry air}$ .
- (iii)  $K_H=1/[1-0.0047(50-75)]=0.8951$ .
- (iv)  $CO_e=[1-(0.01+0.005 \times 3.487) \times 0.469]$



- 0.000323(37.5)  
 ×98.8=96.332 ppm.

(v) CO<sub>d</sub>=(1-0.000323(37.5))×1.195=1.181 ppm. (vi)

$$C_{CH_3OHe} = \frac{(3.813 \times 10^{-2}) (527.67) [(7.101) (15.0) + (0.256) (15.0)]}{(725.42) (0.2818)} = 10.86 \text{ ppm}$$

(vii) HCe=14.65

(viii)

- (0.788)(10.86)=6.092.

$$DF = \frac{100 (1/[1+(3.487/2)+3.76(1+(3.487/4)-(0.763/2))])}{0.469+(6.092+96.332+10.86+0.664)(10^{-4})} = 24.939$$

$$C_{CH_3OH_d} = \frac{(3.813 \times 10^{-2}) (527.67) [(0.439) (15.0) + (0.0) (15.0)]}{(725.42) (1.1389)} = 0.16 \text{ ppm}$$

(x) CH<sub>3</sub>OH<sub>conc</sub>=10.86 - 0.16(1-1/24.939)=10.71 ppm.

(xii) HC<sub>conc</sub>=[14.65 - (0.788)(10.86)] - [2.771 - (0.788)(0.16)] (1-1/24.94)=3.553 ppm.

(xiii) HC<sub>mass</sub>=(6048.1)(16.33)(3.553/1,000,000)=0.35 grams per test phase.

(xi) CH<sub>3</sub>OH<sub>mass</sub>=6048.1×37.71×(10.71/1,000,000)=2.44 grams per test phase.

(xiv)

$$C_{HCHO_e} = \frac{4.069 \times 10^{-2} (8.970) (5.0) (0.1429) (527.67)}{(0.2857) (725.42)} = 0.664 \text{ ppm}$$

(xv)

$$C_{HCHO_d} = \frac{4.069 \times 10^{-2} (0.39) (5.0) (0.1429) (527.67)}{(1.1043) (725.42)} = 0.0075 \text{ ppm}$$

(xvi) HCHO<sub>conc</sub>=0.664-0.0075(1-1/24.939)=0.6568 ppm.

(xxiii) CO<sub>2conc</sub>=0.469-0.039(1-1/24.939)=0.432 percent.

(ii) NO<sub>xmass</sub>=0.979 grams per test phase.

(xvii) HCHO<sub>mass</sub>=(6048.1)(35.36)(0.6568/1,000,000)=0.1405 grams per test phase.

(xxiv) CO<sub>2mass</sub>=(6048.1)(51.85)(0.432/100)=1353 grams.

(iii) CO<sub>mass</sub>=0.365 grams per test phase.

(xviii) THCE=0.35+(13.8756/32.042)(2.44)+(13.8756/30.0262)(0.1405)=1.47 grams per test phase.

(xxv) CH<sub>4conc</sub>=2.825-2.019(1-1/24.939)=0.89 ppm.

(iv) CO<sub>2mass</sub>=1467 grams per test phase.

(xix) NO<sub>xconc</sub>=5.273 - (0.146)(1-1/24.939)=5.13 ppm.

(xxvi) NMHC<sub>conc</sub>=3.553 ppm - 0.89 ppm=2.67 ppm.

(v) D<sub>s</sub>=3.854 miles.

(xx) NO<sub>xmass</sub>=(6048.1)(54.16)(5.13/1,000,000)(0.8951)=1.505 grams per test phase.

(xxvii) NMHC<sub>mass</sub>=(6048.1)(16.33)(2.67/1,000,000)=0.263 grams per test phase.

(vi) NMHCE=0.113 grams per test phase.

(xxi) CO<sub>conc</sub>=96.332 - 1.181(1-1/24.939)=95.2 ppm.

(xxviii) NMHCE<sub>mass</sub>=0.263+(13.8756/32.042)(2.44)+(13.8756/30.0262)(0.1405)=1.39 grams per test phase.

(3) For the "transient" portion of the hot start test assume that similar calculations resulted in the following:

(xxii) CO<sub>mass</sub>=(6048.1)(32.97)(95.2/1,000,000)=18.98 grams per test phase.

(2) For the stabilized portion of the cold start test assume that similar calculations resulted in the following:  
 (i) THCE=0.143 grams per test phase.

(i) THCE=0.488 grams as carbon equivalent per test phase.

(ii) NO<sub>xmass</sub>=1.505 grams per test phase.

(iii) CO<sub>mass</sub>=3.696 grams per test phase.

(iv) CO<sub>2mass</sub>=1179 grams per test phase.

(v) D<sub>ht</sub>=3.577 miles.

(vi) NMHCE=0.426 grams per test phase.

(4) Weighted emission results:

(i)

$$THCE_{wm} = (0.43) \frac{(1.473+0.143)}{(3.583+3.854)} + (0.57) \frac{(0.488+0.143)}{(3.577+3.854)} = 0.142 \text{ grams as carbon equivalent per mile}$$

(ii)

$$\text{NOX}_{\text{wm}} = (0.43) \frac{(1.505 + 0.979)}{(3.583 + 3.854)} + (0.57) \frac{(1.505 + 0.979)}{(3.577 + 3.854)} = 0.334 \text{ grams per mile}$$

(iii)

$$\text{CO}_{\text{wm}} = (0.43) \frac{18.983 + 0.365}{(3.583 + 3.854)} + (0.57) \frac{(3.696 + 0.365)}{(3.577 + 3.854)} = 1.43 \text{ grams per mile}$$

(iv)

$$\text{CO2}_{\text{wm}} = (0.43) \frac{(1353 + 1467)}{(3.583 + 3.854)} + (0.57) \frac{(1179 + 1467)}{(3.577 + 3.854)} = 366 \text{ grams per mile}$$

(v)

$$\text{NMHCE}_{\text{wm}} = (0.43) \frac{(1.386 + 0.113)}{(3.583 + 3.854)} + (0.57) \frac{(0.426 + 0.113)}{(3.577 + 3.854)} = 0.128 \text{ grams per mile}$$

34. Section 86.509–90 of Subpart F is amended by revising paragraphs (a)(2)(i) through (a)(2)(iv), (a)(3), text of paragraph (a)(4) preceding the figure, paragraphs (b) introductory text, (b)(4), (b)(5), (b)(6), (c) introductory text, (c)(4) and (c)(5), (c)(6), and adding paragraphs (a)(5) and (d) to read as follows:

**§ 86.509–90 Exhaust gas sampling system.**

(a) \* \* \*

(2) \* \* \*

(i) Using a duct of unrestricted length maintained at a temperature above the maximum dew point of the exhaust, but below 121°C (250°F); 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 121°C (250°F), prior to the test and during any breaks in the test and uninsulated during the test (insulation may remain in place and/or heating may occur during testing provided maximum temperature is not exceeded); or

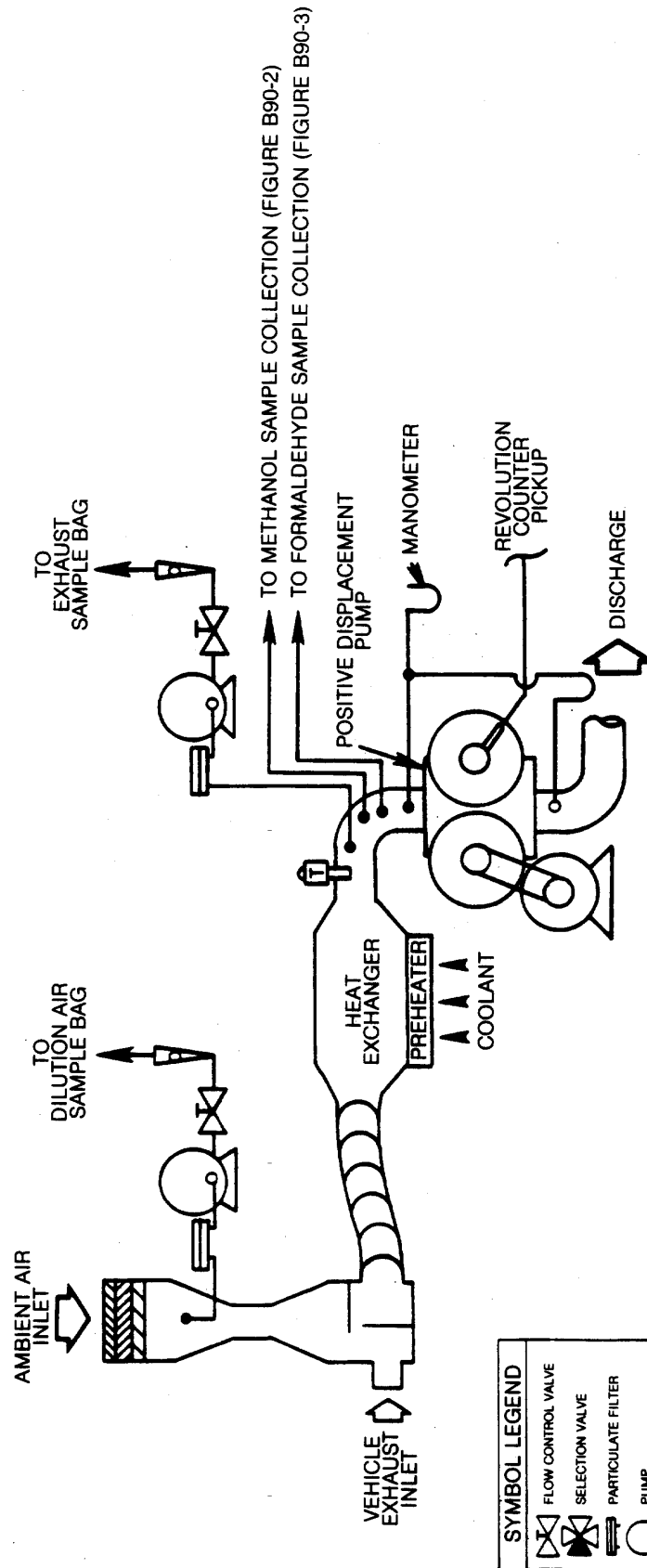
(iii) Using smooth wall duct less than five feet long with no required heating. A maximum of two short flexible connectors are allowed under this option; or

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

(3) *Positive displacement pump.* The Positive Displacement Pump-Constant Volume Sampler (PDP-CVS), Figure F90–1 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 are achieved by sampling at a constant flow rate. For methanol-fueled motorcycle sample lines for the methanol and formaldehyde samples are heated to prevent condensation. The temperature of the sample lines shall be more than 3 °C (5 °F) above the maximum dew point of the sample, but below 121 °C (250 °F). (Note: For 1990 through 1994 model year methanol-fueled motorcycles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.)

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SYMBOL LEGEND	
	FLOW CONTROL VALVE
	SELECTION VALVE
	PARTICULATE FILTER
	PUMP
	FLOWMETER
	PRESSURE GAUGE
	RECORDER
	TEMPERATURE SENSOR

FIGURE F90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)

(4) *Critical flow venturi.* The operation of the Critical Flow Venturi—Constant Volume Sampler (CFV—CVS) sample system, Figure F90–2, is based upon the principles of fluid dynamics associated with critical flow. Proportional sampling throughout temperature excursions is maintained by use of small CFVs in the sample lines, which respond to the varying temperatures in the same manner as the main CFV. For methanol-fueled motorcycles, the methanol and formaldehyde sample lines are heated to prevent condensation. The temperature of the sample lines shall be more than 3°C (5°F) above the maximum dew point of the sample, but below 121°C (250°F). Care must be taken to ensure that the CFVs of the sample probes are not heated since heating of the CFVs would cause loss of proportionality. (Note: For 1990 through 1994 model year methanol-fueled motorcycles, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.) Total flow per test is determined by continuously computing and integrating instantaneous flow. A low response time temperature sensor is necessary for accurate flow calculation.

(5) *Electronic Flow Control.* The Critical Flow Venturi—Electronic Flow Control—Constant Volume Sampler (CFV—EFC—CVS) system is identical to the CFV—CVS system described in paragraphs (a)(4) and (c) of this section, except that it maintains proportional sampling for methanol and formaldehyde by measuring the CVS flow rate, and electronically controlling sample flow rates. It is recommended that sample volumes be measured by separate flow meters. For methanol-fueled motorcycles, the samples lines for the methanol and formaldehyde samples are heated to prevent condensation. The temperature of the sample lines shall be more than 20 °F (11 °C) above the maximum dew point of the sample, but below 121 °C (250 °F).

(b) *Component description, PDP-CVS.* The PDP—CVS, Figure F90–1, consists of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling systems including, probes and sampling lines which, in the case of the methanol-fueled motorcycles, are heated to prevent condensation (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:

\* \* \* \* \*

(4) The location of the dilution air inlet shall be placed so as to use test-cell air for dilution and the flow capacity of the CVS shall be large enough to completely eliminate water condensation in the dilution and sampling systems. Control of water condensation with methanol-fueled vehicles is critical. Additional care may also be required to eliminate water condensation when testing natural gas and liquefied petroleum gas-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.) Dehumidifying the dilution air before entering the CVS is allowed. Heating the dilution air is also allowed, provided:

- (i) The air (or air plus exhaust gas) temperature does not exceed 121°C (250°F).
- (ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)
- (iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(5) Sample collection bags for dilution air and exhaust samples (hydrocarbons and carbon monoxide) 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 the determination of methanol and formaldehyde background (methanol-fueled motorcycles).

(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. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests:

- (i) The methanol system shall be designed such that if a test motorcycle continuously emitted the maximum allowable level of methanol (based on all applicable standards) the measured

concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer.

(ii) The formaldehyde system shall be designed such that if a test motorcycle continuously emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of THCE (i.e., 1.0 g/km for a 5.0 g/km standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection.

(c) *Component description, CFV—CVS.* The CFV—CVS sample system, Figure F90–2, consists of a dilution air filter and mixing assembly, a cyclone particulate separator, unheated sampling venturies for the bag samples, and for the methanol and formaldehyde samples from methanol-fueled vehicles, samples lines heated to prevent condensation 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:

\* \* \* \* \*

(4) The location of the dilution air inlet shall be placed so as to use test-cell air for dilution and the flow capacity of the CVS shall be large enough to completely eliminate water condensation in the dilution and sampling systems. Control of water condensation with methanol-fueled vehicles is critical. Additional care may also be required to eliminate water condensation when testing natural gas and liquefied petroleum gas-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.)

Dehumidifying the dilution air before entering the CVS is allowed. Heating the dilution air is also allowed, provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 250°F.

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(5) Sample collection bags for dilution air and exhaust samples (hydrocarbons and carbon monoxide) 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 the determination of methanol and formaldehyde background (methanol-fueled motorcycles).

(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 CVS. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests:

(i) The methanol system shall be designed such that if a test motorcycle continuously emitted the maximum allowable level of methanol (based on all applicable standards) the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer.

(ii) The formaldehyde system shall be designed such that if a test motorcycle continuously emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of THCE (i.e., 1.0 g/km for a 5.0 g/km standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples.

The remaining analyte shall be collected by the secondary impinger. This requirement does not apply to dilution air samples, since they do not require secondary impingers, or to samples in which the concentrations approach the limit of detection.

(d) *Component description, CFV-EFC- CVS.* The CVS sample system is identical to the system described in paragraph (c) of this section, plus includes a means of electronically measuring the CVS flow rate, and electronic mass flow controllers for the methanol and formaldehyde sample lines, and separate flow meters to totalize sample flow volumes (optional). The EFC sample system shall conform to all of the requirements listed in paragraph (c) of this section, except that the methanol and formaldehyde samples may both be drawn from a single static probe. It also must comply with the following additional requirements:

(1) The ratio of the CVS flow rate to the sample flow rate shall not deviate from the ratio at the start of the test by more than ±5 percent. (The volumetric sample flow rate shall be varied inversely with the square root of the bulk stream temperature.)

(2) Flow totalizers for methanol and/or formaldehyde samples shall have an accuracy of ±2 percent. Total sample volumes may be obtained from the flow controllers, with the advance approval of the administrator, provided that the controllers can be shown to have an accuracy of ±2 percent.

35. Section 86.513-94 of Subpart F is amended by revising paragraphs (c)(1) and (c)(2), and adding paragraph (c)(3) to read as follows:

**§ 86.513-94 Fuel and engine lubricant specifications.**

\* \* \* \* \*

(c) \* \* \* (1) mixtures of petroleum and methanol fuels used for exhaust and evaporative emission testing and service accumulation for flexible fuel motorcycles shall consist of the petroleum fuel listed in paragraph (a) of this section and the methanol fuel listed in paragraph (b), and shall be within the range of fuel mixtures for which the vehicle was designed, as reported in accordance with § 86.90-21. The Administrator may use any fuel or fuel mixture within this range for testing.

(2) The fuel mixtures used by the manufacturers shall be sufficient to demonstrate compliance over the full design range, and shall include:

(i) For emission testing,

(A) The petroleum fuel specified in paragraph (a) or (b),

(B) A methanol fuel representative of the methanol fuel expected to the found in use, as specified in paragraph (b),

(ii) For service accumulation, an alternating combination of the fuels specified in paragraphs (a) and (b) will be used to demonstrate the durability of the emission control systems based on good engineering judgement. The combination shall be selected such that the cumulative volumes of both the methanol fuel and the petroleum fuel used shall be at least twenty-five percent of the total fuel volume. The fuels shall be alternated at mileage intervals not to exceed 1,000 kilometers.

(3) The specification range of the fuels to be used under paragraph (c) of this section shall be reported in accordance with § 86.094-21.

\* \* \* \* \*

36. Section 86.514-78 of Subpart F is amended by revising paragraphs (a)(2) and (b), and adding paragraph (c) to read as follows:

**§ 86.514-78 Analytical gases.**

(a) \* \* \*

(2) Gases for the THC analyzer shall be:

(i) Single blends of propane using air as the diluent; and

(ii) Optionally, for response factor determination, single blends of methanol using air as the diluent.

\* \* \* \* \*

(b) Calibration gases (not including methanol) shall be known to within 2 percent of true values.

(c) Methanol in air gases used for response factor determination shall:

(1) Be traceable to within ±2 percent of NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator; and

(2) Remain within ±2 percent of the labeled concentration. Demonstration of stability shall be based on a quarterly measurement procedure with a precision of ±2 percent (two standard deviations), or other method approved by the Administrator. The measurement procedure may incorporate multiple measurements. If the true concentration of the gas changes by more than two percent, but less than ten percent, the gas may be relabeled with the new concentration.

37. Section 86.516-90 of Subpart F is amended by revising paragraph (c)(1) to read as follows:

**§ 86.516-90 Calibrations, frequency and overview.**

\* \* \* \* \*

(c) \* \* \*

(1) Calibrate the hydrocarbon analyzer, methane analyzer, carbon dioxide analyzer, carbon monoxide

analyzer, and oxides of nitrogen analyzer (certain analyzers may require more frequent calibration depending on particular equipment and uses).

\* \* \* \* \*

38. Section 86.519-90 of Subpart F is amended by revising paragraphs (d)(1), (d)(4), and (d)(7) to read as follows:

**§ 86.519-90 Constant volume sampler calibration.**

\* \* \* \* \*

(d) \* \* \*

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

\* \* \* \* \*

(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 5 minutes). This step does not need to be performed with each verification,

provided that it is performed at least twice annually.

\* \* \* \* \*

(7) The cause for any discrepancy greater than  $\pm 2$  percent must be found and corrected. The Administrator, upon request, may waive the requirement to comply with  $\pm 2$  percent methanol recovery tolerance, and instead require compliance with a higher tolerance (not to exceed  $\pm 6$  percent), provided that:

(i) The Administrator determines that compliance with the specified tolerance 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.

39. Section 86.521-90 of Subpart F is amended by revising paragraphs (d) introductory text, (d)(1), and (d)(3)(iii) to read as follows:

**§ 86.521-90 Hydrocarbon analyzer calibration.**

\* \* \* \* \*

(d) *FID response factor to methanol.* When the FID analyzer is to be used for the analysis of hydrocarbon samples containing methanol, the methanol response factor of the analyzer shall be established. The methanol response factor shall be determined at several concentrations in the range of concentrations in the exhaust sample, using either bag samples or gas bottles meeting the requirements of § 86.514.

(1) The bag sample, if used, of methanol for analysis in the FID shall be prepared using the apparatus shown in Figure F90-4. A known volume of methanol is injected, using a microliter syringe, into the heated mixing zone (250°F (121°C)) of the apparatus. The methanol is vaporized and swept into the sample bag with a known volume of zero grade air measured by a gas flow meter meeting the performance requirements of § 86.120.

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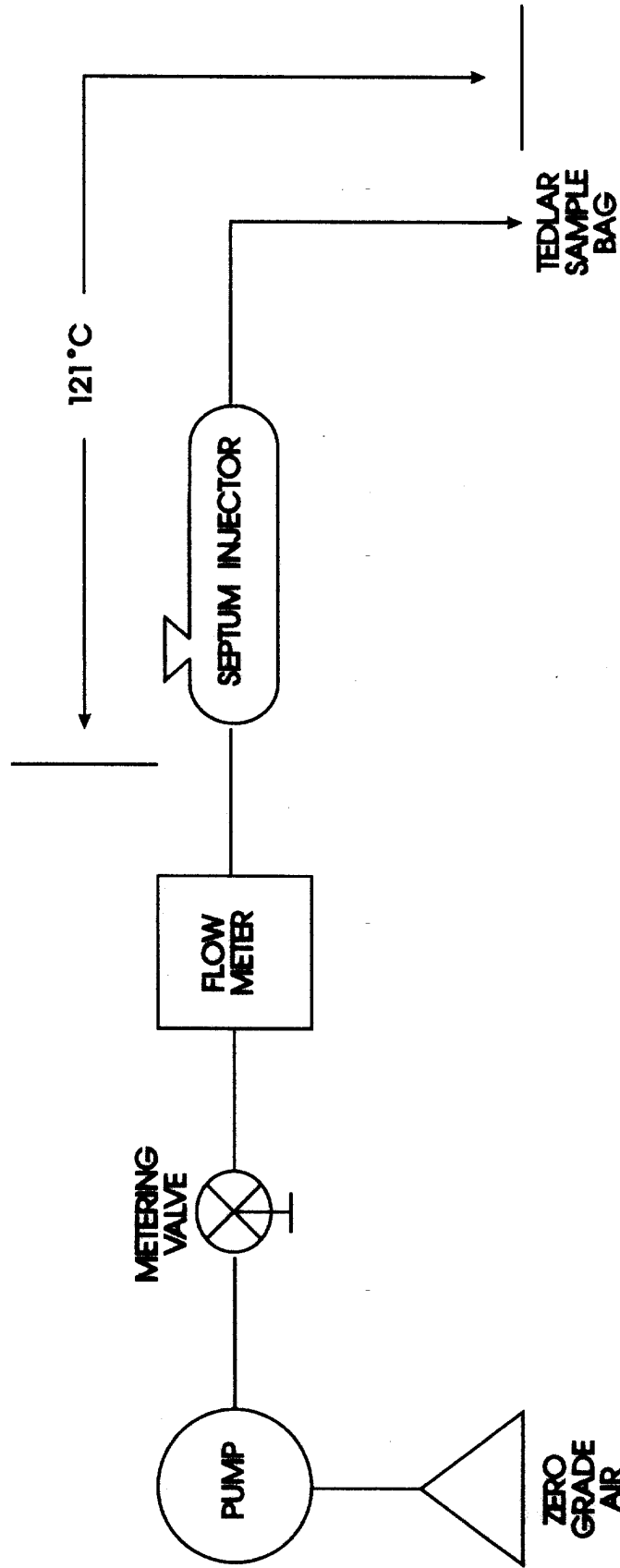


FIGURE F90-4 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

\* \* \* \* \*

(3) \* \* \*

(iii) SAM<sub>ppm</sub>=methanol concentration in the sample bag, or gas bottle, in ppmC. SAM<sub>ppm</sub> for sample bags:

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. CH}_3\text{OH}}$$

Where:

\* \* \* \* \*

40. Section 86.523-78 of Subpart F is amended by adding paragraph (c) to read as follows:

**§ 86.523-78 Oxides of nitrogen analyzer calibration.**

\* \* \* \* \*

(c) When testing methanol-fueled motorcycles, it may be necessary to clean the analyzer frequently to prevent interference with NO<sub>x</sub> measurements (see EPA/600/S3-88/040).

41. Section 86.527-90 of Subpart F is amended by adding paragraph (e) to read as follows:

**§ 86.527-90 Test procedures, overview.**

\* \* \* \* \*

(e) Background concentrations are measured for all species for which emissions measurements are made. For exhaust testing, this requires sampling and analysis of the dilution air. (When testing methanol-fueled motorcycles, manufacturers may choose not to measure background concentrations of methanol and/or formaldehyde, and then assume that the concentrations are zero during calculations.)

42. Section 86.537-90 of Subpart F is amended by revising paragraphs (b)(4), (b)(6)(iii), (b)(6)(iv), (b)(12), and (b)(14), and by removing the note following paragraph (b)(6)(iv) to read as follows:

**§ 86.537-90 Dynamometer test runs.**

\* \* \* \* \*

(b) \* \* \*

(4) For methanol-fueled vehicles, with the sample selector valves in the "standby" position, insert fresh sample collection impingers into the methanol sample collection system, fresh impingers or a fresh cartridge into the formaldehyde sample collection system and fresh impingers (or a single cartridge for formaldehyde) into the dilution air sample collection systems for methanol and formaldehyde (background measurements of methanol and formaldehyde may be omitted and concentrations assumed to be zero for calculations in § 86.544).

\* \* \* \* \*

(6) \* \* \*

(iii) For methanol samples, the flow rates shall be set such that the system

meets the design criteria of § 86.509. For samples in which the concentration in the primary impinger exceeds 0.5 mg/l, it is recommended that the mass of methanol collected in the secondary impinger not exceed ten percent of the total mass collected. For samples in which the concentration in the primary impinger does not exceed 0.5 mg/l, secondary impingers do not need to be analyzed.

(iv) For formaldehyde samples, the flow rates shall be set such that the system meets the design criteria of § 86.509. For impinger samples in which the concentration of formaldehyde in the primary impinger exceeds 0.1 mg/l, it is recommended that the mass of formaldehyde collected in the secondary impinger not exceed ten percent of the total mass collected. For samples in which the concentration in the primary impinger does not exceed 0.1 mg/l, secondary impingers do not need to be analyzed.

\* \* \* \* \*

(12) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously switch the sample flows from the "transient" bags and samples to "stabilized" bags and samples, switch off gas flow measuring device No. 1 and, start gas flow measuring device No. 2. Before the acceleration which is scheduled to occur at 510 seconds, record the measured roll or shaft revolutions and reset the counter or switch to a second counter. As soon as possible, transfer the "stabilized" exhaust and dilution air samples to the analytical system and process the samples according to § 86.540, obtaining a stabilized reading of the exhaust bag sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period. (If it is not possible to perform analysis on the methanol and formaldehyde samples within 24 hours, the samples should be stored in a dark cold (4-10°C) environment until analysis. The samples should be analyzed within fourteen days.)

\* \* \* \* \*

(14) Five seconds after the engine stops running, simultaneously turn off

gas flow measuring device No. 2 and position the sample selector valves to the "standby" position (and open the valves isolating particulate filter No. 1, if applicable). Record the measured roll or shaft revolutions (both gas meter or flow measurement instrumentation readings) and re-set the counter. As soon as possible, transfer the "stabilized" exhaust and dilution air samples to the analytical system and process the samples according to § 86.540, obtaining a stabilized reading of the exhaust bag sample on all analyzers within 20 minutes of the end of the sample collection phase of the test. Obtain methanol and formaldehyde sample analyses, if applicable, within 24 hours of the end of the sample period. (If it is not possible to perform analysis on the methanol and formaldehyde samples within 24 hours, the samples should be stored in a dark cold (4-10°C) environment until analysis. The samples should be analyzed within fourteen days.)

\* \* \* \* \*

43. Section 86.540-90 of Subpart F is amended by revising paragraphs (b) and (c) to read as follows:

**§ 86.540-90 Exhaust sample analysis.**

\* \* \* \* \*

(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.

44. Section 86.542-90 of Subpart F is amended by revising paragraph (p) to read as follows:

**§ 86.542-90 Records required.**

\* \* \* \* \*

(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).
- \* \* \* \* \*
- 45. Section 86.544-90 of Subpart F is amended by revising paragraphs (c)(5)(iv) through (c)(5)(xvi), and (c)(7)(ii), and removing paragraphs (c)(5)(xvii), (c)(5)(xviii), and (e) to read as follows:

**§ 86.544-90 Calculations; exhaust emissions.**  
 \* \* \* \* \*  
 (c) \* \* \*  
 (5) \* \* \*  
 (iv)(A)  $C_{CH_3OH_e}$ =Methanol concentration in the dilute exhaust, ppm.  
 (B)

$$C_{CH_3OH_e} = \frac{3.813 \times 10^{-2} \times T_{EM} [(C_{S1} \times AV_{S1}) + (C_{S2} \times AV_{S2})]}{P_B \times V_{EM}}$$

(v)(A)  $C_{CH_3OH_d}$ =Methanol concentration in the dilution air, ppm.

$$C_{CH_3OH_d} = \frac{3.813 \times 10^{-2} \times T_{DM} [(C_{D1} \times AV_{D1}) + (C_{D2} \times AV_{D2})]}{P_B \times V_{DM}}$$

- (B)
- (vi)  $T_{EM}$ =Temperature of methanol sample withdrawn from dilute exhaust, °R.
- (vii)  $T_{DM}$ =Temperature of methanol sample withdrawn from dilution air, °R.
- (viii)  $P_B$ =Barometric pressure during test, mm Hg.
- (ix)  $V_{EM}$ =Volume of methanol sample withdrawn from dilute exhaust, ft<sup>3</sup>.
- (x)  $V_{DM}$ =Volume of methanol sample withdrawn from dilution air, ft<sup>3</sup>.

- (xi)  $C_s$ =GC concentration of sample drawn from dilute exhaust, µg/ml.
- (xii)  $C_D$ =GC concentration of sample drawn from dilution air, µg/ml.
- (xiii)  $AV_s$ =Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml.
- (xiv)  $AV_D$ =Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml.

- (xv) 1=first impinger.
- (xvi) 2=second impinger.
- \* \* \* \* \*
- (7) \* \* \*
- (ii) For methanol-fueled, natural gas-fueled or liquefied petroleum gas-fueled motorcycles, where fuel composition is  $C_xH_yO_z$  as measured, or calculated, for the fuel used (for natural gas and liquefied petroleum gas-fuel, Z=0):

$$DF = \frac{(100) \frac{x}{(x + y/2 + 3.76)(x + y/2 - z/2)}}{CO_{2e} + (HC_e + CO_e + CH_3OH_e = HCHO_e) \times 10^{-4}}$$

\* \* \* \* \*  
 46. Section 86.1207-90 of Subpart M is amended by revising paragraphs (b)(1) introductory text and (c)(2), and adding paragraph (b)(3) to read as follows:

**§ 86.1207-90 Sampling and analytical system; evaporative emissions.**

- \* \* \* \* \*
- (b) \* \* \*
- (1) For gasoline and methanol-fueled vehicles a hydrocarbon analyzer utilizing the hydrogen flame ionization principle (FID) shall be used to monitor the atmosphere within the enclosure (a heated FID (HFID)(235°±15°F (113±8°C)) is recommended for methanol-fueled vehicles). Instrument bypass flow may be returned to the enclosure. The FID shall have a response time to 90 percent of final reading of less than 1.5 seconds,

and be capable of meeting performance requirements expressed as a function of Cstd: where Cstd is the specific enclosure hydrocarbon level, in ppm, corresponding to the evaporative emission standard:

- \* \* \* \* \*
- (3) The methanol sampling system described in paragraph (b)(2) of this section shall be designed such that, if a test vehicle emitted the maximum allowable level of methanol (based on all applicable standards) during any phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer, and such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be

collected by the secondary impinger. The provisions of this paragraph apply to the design of sampling systems, not to individual tests.

- (c) \* \* \*
- (2) For the methanol sample, permanent records shall be made of the following: the volumes of deionized water introduced into each impinger, the rate and time of sample collection and the chromatogram of the analyzed sample.

\* \* \* \* \*  
 47. Section 86.1207-96 of Subpart M is amended by revising paragraphs (b)(1) and (c)(2), and adding paragraph (b)(3) to read as follows:

**§ 86.1207-96 Sampling and analytical systems; evaporative emissions.**

\* \* \* \* \*

(b) \* \* \*

(1) For gasoline-, liquefied petroleum gas-, natural gas- and methanol-fueled vehicles a hydrocarbon analyzer utilizing the hydrogen flame ionization principle (FID) shall be used to monitor the atmosphere within the enclosure (a heated FID (HFID)(235 $\pm$ 15 $^{\circ}$ F (113 $\pm$ 8 $^{\circ}$ C)) is recommended for methanol-fueled vehicles). Provided evaporative emission results are not affected, a probe may be used to detect or verify hydrocarbon sources during a running loss test. Instrument bypass flow may be returned to the enclosure. The FID shall have a response time to 90 percent of final reading of less than 1.5 seconds.

\* \* \* \* \*

(3) The methanol sampling system described in paragraph (b)(2) of this section shall be designed such that, if a test vehicle emitted the maximum allowable level of methanol (based on all applicable standards) during any phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer, and such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. The provisions of this paragraph apply to the design of sampling systems, not to individual tests.

(c) \* \* \*

(2) For the methanol sample, permanent records shall be made of the following: the volumes of deionized water introduced into each impinger, the rate and time of sample collection and the chromatogram of the analyzed sample.

\* \* \* \* \*

48. Section 86.1213-94 is amended by revising paragraph (c) to read as follows:

**§ 86.1213-94 Fuel specifications.**

\* \* \* \* \*

(c) *Mixtures of petroleum and methanol fuels for flexible fuel vehicles.*

(1) Mixtures of petroleum and methanol fuels used for exhaust and evaporative emission testing and service accumulation for flexible fuel vehicles shall consist of the gasoline listed in paragraph (a) of this section and the methanol fuel listed in paragraph (b) of this section, and shall be within the range fuel mixtures for which the vehicle was designed as reported in accordance with § 86.94-21. The Administrator may use any fuel within this range for testing.

(2) The fuel mixtures used by the manufacturers shall be sufficient to demonstrate compliance over the full design range, and shall include:

(i) For emission testing:

(A) The petroleum fuel specified in paragraph (a) of this section;

(B) A methanol fuel representative of the methanol fuel expected to be found in use, as specified in paragraph (d) of this section; and

(C) A combination of the fuels specified in paragraphs (c)(2)(i)(A) and (B) of this section that represents the composition which results in the highest Reid Vapor Pressure for the mixture. The mixture shall contain between nine and thirteen percent methanol.

(ii) For service accumulation, an alternating combination of the fuels specified in paragraphs (a) and (b) of this section that, based on good engineering judgement, demonstrates the durability of the emission control system. The fuels may be used as a single mixture or alternated.

(iii) Or, other combinations for testing or service accumulation which demonstrate compliance with the standards over the entire design range of the vehicle, provided that written approval is obtained from the Administrator prior to the start of testing.

(3) The specification range of the fuels to be used under paragraph (c) of this section shall be reported in accordance with § 86.094-21.

\* \* \* \* \*

49. Section 86.1214-85 of Subpart M is amended by revising paragraphs (a)(1), (a)(2), (b) and (c) and adding paragraph (d) to read as follows:

**§ 86.1214-85 Analytical gases.**

(a) \* \* \*

(1) Gases for the hydrocarbon analyzer shall be:

(i) Single blends of propane using air as the diluent; and

(ii) Optionally, for response factor determination, single blends of methanol using air as the diluent.

(2) Fuel for the evaporative emission enclosure FID (or HFID for methanol-fueled vehicles) shall be a blend of 40  $\pm$ 2 percent hydrogen with the balance being helium. The mixture shall contain less than 1 ppm equivalent carbon response. 98 to 100 percent hydrogen fuel may be used with advance approval by the Administrator.

\* \* \* \* \*

(b) Calibration gases (not including methanol) shall be traceable to within one percent of NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator.

(c) Span gases (not including methanol) shall be accurate to within

two percent of true concentration, where true concentration refers to NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator.

(d) Methanol in air gases used for response factor determination shall:

(1) Be traceable to within  $\pm$ 2 percent of NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator; and

(2) Remain within  $\pm$ 2 percent of the labeled concentration. Demonstration of stability shall be based on a quarterly measurement procedure with a precision of  $\pm$ 2 percent (two standard deviations), or other method approved by the Administrator. The measurement procedure may incorporate multiple measurements. If the true concentration of the gas changes by more than two percent, but less than ten percent, the gas may be relabeled with the new concentration.

50. Section 86.1216-90 of Subpart M is amended by revising paragraphs (c)(1) and (c)(3), and adding paragraphs (d) and (e) to read as follows:

**§ 86.1216-90 Calibrations; frequency and overview.**

\* \* \* \* \*

(c) \* \* \*

(1) Calibrate the hydrocarbon analyzer (see § 86.1221). Certain analyzers may require more frequent calibration depending on particular equipment and uses.

\* \* \* \* \*

(3) Perform a hydrocarbon retention check and calibration on the evaporative emission enclosure (see § 86.1217).

(d) At least twice annually or after any maintenance perform a methanol retention check and calibration on the evaporative emission enclosure (see § 86.1217).

(e) Calibrate the methanol analyzer as often as required by the manufacturer or as necessary according to good practice.

51. Section 86.1217-90 of Subpart M is amended by revising paragraphs (c)(5), (c)(7) and (c)(9), (d)(1), (d)(2) introductory text and (d)(2)(i) through (d)(2)(iii) to read as follows:

**§ 86.1217-90 Evaporative emission enclosure calibrations.**

\* \* \* \* \*

(c) \* \* \*

(5) Inject into the enclosure a known quantity of pure propane (4g is a convenient quantity) and a known quantity of pure methanol (4g is a convenient quantity) in gaseous form; i.e., at a temperature of at least 150-155 $^{\circ}$ F (65-68 $^{\circ}$ C). The propane and methanol may be measured by volume flow or by mass measurement. The

method used to measure the propane and methanol shall have an accuracy of ±0.5 percent of the measured value. (Less accurate methods may be used with the advanced approval of the Administrator.) The methanol and propane tests do not need to be conducted simultaneously.

(7) To verify the enclosure calibration, calculate the mass of propane and the mass of methanol using the measurements taken in steps (4) and (6). See paragraph (d) of this section. This

quantity must be within ±2 percent of that measured in step 5 above. (For 1991–1995 calendar years, the difference may exceed ±2 percent for methanol, provided it does not exceed ±6 percent.)

(9) Calculate, using the equation in paragraph (d) of this section and the readings taken in step (8), the hydrocarbon and methanol mass. It may not differ by more than ±4 percent of the value in step (6). (For 1991–1995 calendar year methanol-fueled vehicles,

the difference may exceed ±4 percent for methanol, provided it does not exceed ±6 percent.)

(d) *Calculations.* (1) The calculation of net methanol and hydrocarbon mass change is used to determine enclosure background and leak rate. It is also used to check the enclosure volume measurements. The methanol mass change is calculated from the initial and final methanol samples, temperature and pressure according to the following equation:

$$M_{CH_3OH} = V \times \frac{T_{Ef}}{V_{Ef} \times T_{SHEDf}} \left[ (C_{MS1f} AV_{1f}) + (C_{MS2f} AV_{2f}) \right] - \frac{T_{Ei}}{V_{Ei} \times T_{SHEDI}} \left[ (C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i}) \right]$$

Where:

- (i)  $M_{CH_3OH}$  = Methanol mass change, µg.
- (ii)  $V$  = Enclosure volume, ft<sup>3</sup>, as measured in paragraph (b)(1) of this section.
- (iii)  $T_E$  = Temperature of sample withdrawn, °R.
- (iv)  $V_E$  = Volume of sample withdrawn, ft<sup>3</sup>.

- (v)  $P_B$  = Barometric pressure at time of sampling, in. Hg.
- (vi)  $C_{MS}$  = GC concentration of test sample.
- (vii)  $AV$  = Volume of absorbing reagent in impinger.
- (viii)  $i$  = Initial sample.
- (ix)  $f$  = Final sample.
- (x)  $1$  = First impinger.

(xi)  $2$  = Second impinger.

(2) The hydrocarbon mass change is calculated from the initial and final FID readings of hydrocarbon concentration, methanol concentration with FID response to methanol, temperature, and pressure according to the following equation:

$$M_{HC} = kV \times 10^{-4} \left( \frac{C_{HCf} - rC_{CH_3OHf}}{T_f} \right) \times P_{Bf} - \left( \frac{C_{HCi} - rC_{CH_3OHi}}{T_i} \right) \times P_{Bi}$$

Where:

- (i)  $M_{HC}$  = Hydrocarbon mass change, g.

- (ii)  $C_{HC}$  = FID hydrocarbon concentration as ppm carbon including FID response to methanol in the sample.

- (iii)  $C_{CH_3OH}$  = Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T_e}{P_B \times V_E} \times \left[ (C_{S1} \times AV_1) + (C_{S2} \times AV_2) \right]$$

\* \* \* \* \*

52. Section 86.1217–96 of Subpart M is amended by revising paragraphs (c)(1)(vii), (c)(1)(ix), (c)(1)(xii), (d)(1), (d)(2) introductory text, and (d)(2)(i) through (d)(2)(iii), and adding paragraph (c)(4) to read as follows:

**§ 86.1217–96 Evaporative emission enclosure calibrations.**

\* \* \* \* \*

(c) \* \* \*

(1) \* \* \*

(vii) Inject into the enclosure 2 to 6 grams of pure propane and 2 to 6 grams of pure methanol in gaseous form; i.e., at a temperature of at least 150°F (65°C). The propane and methanol may be measured by volume flow or by mass measurement. The method used to measure the propane and methanol shall have an accuracy and precision of

±0.2 percent of the measured value. (Less accurate methods may be used with advanced approval of the Administrator.) The methanol and propane tests do not need to be conducted simultaneously.

(ix) To verify the enclosure calibration, calculate the mass of propane and the mass of methanol using the measurements taken in paragraphs (c)(1)(vi) and (viii) of this section. See paragraph (d) of this section. This quantity must be within ±2 percent of that measured in paragraph (c)(1)(vii) of this section. (For calendar years through 1995, the difference may exceed ±2 percent for methanol, provided it does not exceed ±6 percent.)

(xii) At the completion of the 24-hour cycling period, analyze the enclosure

atmosphere for hydrocarbon and methanol content; determine the net withdrawn methanol (in the case of diurnal emission testing with fixed-volume enclosures); record temperature and barometric pressure. These are the final readings for the hydrocarbon and methanol retention check. The final hydrocarbon and methanol mass, calculated in paragraph (d) of this section, shall be within 3 percent of that determined in paragraph (c)(1)(viii) of this section. (For calendar years through 1995, the difference may exceed ±3 percent for methanol, provided it does not exceed ±6 percent.)

(4) The Administrator, upon request, may waive the requirement to comply with ±2 percent methanol recovery tolerance, and/or the ±3 percent retention tolerance and instead require

compliance with higher tolerances (not to exceed ±6 percent for recoveries and ±8 for retention), 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.

(d) *Calculations.* (1) The calculation of net methanol and hydrocarbon mass

change is used to determine enclosure background and leak rate. It is also used to check the enclosure volume measurements. The methanol mass change is calculated from the initial and final methanol samples, temperature and pressure according to the following equation:

$$M_{CH_3OH} = V \times \frac{T_{Ef}}{V_{Ef} \times T_{SHEDf}} \left[ (C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f}) \right] - \frac{T_{Ei}}{V_{Ei} \times T_{SHEDI}} \left[ (C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i}) \right]$$

Where:

- (i)  $M_{CH_3OH}$  = Methanol mass change, µg.
- (ii)  $V$  = Enclosure volume, ft<sup>3</sup>, as measured in paragraph (b)(1) of this section.
- (iii)  $T_E$  = Temperature of sample withdrawn, R.
- (iv)  $T_{SHED}$  = Temperature of enclosure, R.
- (v)  $V_E$  = Volume of sample withdrawn, ft<sup>3</sup>.

- (vi)  $P_B$  = Barometric pressure at time of sampling, in. Hg.
- (vii)  $C_{MS}$  = GC concentration of test sample.
- (viii)  $AV$  = Volume of absorbing reagent in impinger.
- (ix)  $i$  = Initial sample.
- (x)  $f$  = Final sample.
- (xi)  $1$  = First impinger.
- (xii)  $2$  = Second impinger.

(2) The hydrocarbon mass change is calculated from the initial and final FID readings of hydrocarbon concentration, methanol concentration with FID response to methanol, temperature, and pressure according to the following equation:

$$M_{HC} = kV \times 10^{-4} \frac{(C_{HCf} - rC_{CH_3OHf})}{T_f} \times P_{BF} - \frac{(C_{HCi} - rC_{CH_3OHi})}{T_i} \times P_{Bi}$$

Where:

(i)  $M_{HC}$  = Hydrocarbon mass change, g.

(ii)  $C_{HC}$  = FID hydrocarbon concentration as ppm carbon including FID response to methanol in the sample.

(iii)  $C_{CH_3OH}$  = Methanol concentration as ppm carbon

$$= \frac{1.501 \times 10^{-3} \times T_e}{P_B \times V_E} \times \left[ (C_{S1} \times AV_1) + (C_{S2} \times AV_2) \right]$$

\* \* \* \* \*

53. Section 86.1221-90 of Subpart M is amended by revising paragraphs (c) introductory text, (c)(1), and (c)(3)(iii) to read as follows:

**§ 86.1221-90 Hydrocarbon analyzer calibration.**

\* \* \* \* \*

(c) *FID response factor to methanol.*  
When the FID analyzer is to be used for

the analysis of hydrocarbon samples containing methanol, the methanol response factor of the analyzer shall be established. The methanol response factor shall be determined at several concentrations in the range of concentrations in the exhaust sample, using either bag samples or gas bottles meeting the requirements of § 86.114.

(1) The bag sample of methanol for analysis in the FID, if used, shall be

prepared using the apparatus shown in Figure M90-1. A known volume of methanol is injected, using a microliter syringe, into the heated mixing zone (250°F (121°C) of the apparatus. The methanol is vaporized and swept into the sample bag with a known volume of zero grade air measured by a gas flow meter with an accuracy of ±2 percent.

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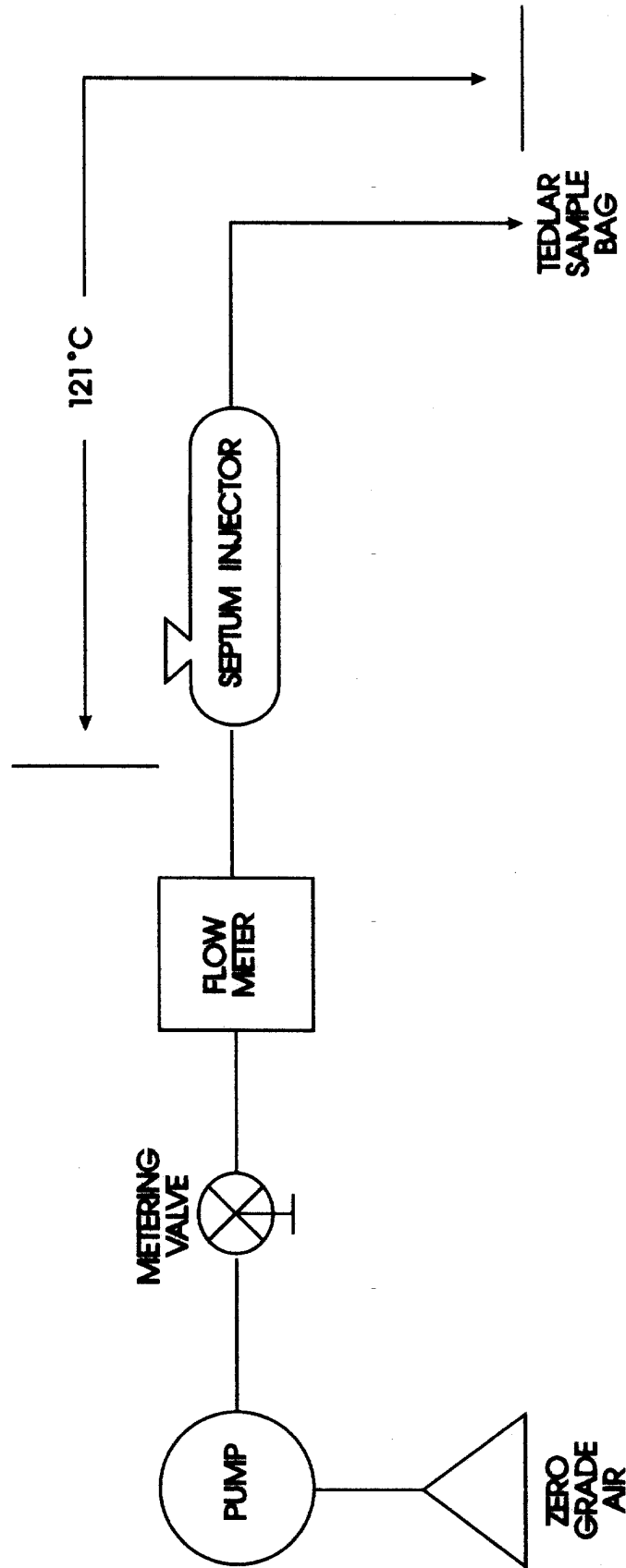


FIGURE M90-1 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

\* \* \* \* \*  
(3) \* \* \*

(iii) SAMppm=methanol concentration in the sample bag, or gas

bottle, in ppmC. SAMppm for sample bags:

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. CH}_3\text{OH}}$$

Where:

\* \* \* \* \*

54. Section 86.1227-90 of Subpart M is amended by adding paragraph (c) to read as follows:

**§ 86.1227-90 Test procedures; overview.**

\* \* \* \* \*

(c) Background concentrations are measured for all species for which emissions measurements are made. For evaporative testing, this requires measuring initial concentrations. (When testing methanol-fueled vehicles, manufacturers may choose not to measure background concentrations of methanol, and then assume that the concentrations are zero during calculations.)

55. Section 86.1227-96 of Subpart M is amended by adding paragraph (c) to read as follows:

**§ 86.1227-96 Test procedures; overview.**

\* \* \* \* \*

(c) Background concentrations are measured for all species for which emissions measurements are made. For evaporative testing, this requires measuring initial concentrations. (When testing methanol-fueled vehicles, manufacturers may choose not to measure background concentrations of methanol, and then assume that the concentrations are zero during calculations.)

56. Section 86.1242-90 of Subpart M is amended by revising paragraph (l)(2), and removing paragraph (l)(3) to read as follows:

**§ 86.1242-90 Records required.**

\* \* \* \* \*

(l) \* \* \*  
(2) The concentration of the GC analyses of the test samples (methanol).

\* \* \* \* \*

57. Section 86.1243-90 of Subpart M is amended by revising paragraphs (a) introductory text, (a)(1), (a)(2) introductory text, and (a)(2)(i) through (a)(2)(iii) to read as follows:

**§ 86.1243-90 Calculations; evaporative emissions.**

(a) The calculation of the net hydrocarbon, methanol and hydrocarbon plus methanol mass change in the enclosure is used to determine the diurnal and hot soak mass emissions. The mass changes are calculated from initial and final hydrocarbon and methanol concentrations in ppm carbon, initial and final enclosure ambient temperatures, initial and final barometric pressures, and net enclosure volume using the following equations:

(1) For methanol:

$$M_{\text{CH}_3\text{OH}} = V_n \times \frac{T_{\text{E}f}}{(V_E \times T_{\text{SHED}f})} \times [(C_{\text{MS1}f} \times AV_{1f}) + (C_{\text{MS2}f} \times AV_{2f})] - \frac{T_{\text{E}i}}{(V_E \times T_{\text{SHED}i})} \times [(C_{\text{MS1}i} \times AV_{1i}) + (C_{\text{MS2}i} \times AV_{2i})]$$

Where:

(i) M<sub>CH<sub>3</sub>OH</sub>=Methanol mass change, µg.

(ii) V<sub>n</sub>=Net enclosure volume, ft<sup>3</sup>, as determined by subtracting 50 ft<sup>3</sup> (1.42 m<sup>3</sup>) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50 ft<sup>3</sup>) with advance

approval by the Administrator: *Provided*, the measured volume is determined and used for all vehicles tested by that manufacturer.

- (iii) T<sub>E</sub>=Temperature of sample withdrawn, °R.
- (iv) V<sub>E</sub>=Volume of sample withdrawn, ft<sup>3</sup>.
- (v) T<sub>SHED</sub>=Temperature of SHED, °R

- (vi) P<sub>B</sub>=Barometric pressure at time of sampling, in. Hg.
- (vii) C<sub>MS</sub>=GC concentration of sample.
- (viii) AV=Volume of absorbing reagent in impinger.
- (ix) i=Initial sample.
- (x) f=Final sample.
- (xi) 1=First impinger.
- (xii) 2=Second impinger.
- (2) For hydrocarbons:

$$M_{\text{HC}} = (kV_n \times 10^{-4}) \frac{(C_{\text{HC}f} - rC_{\text{CH}_3\text{OH}f})P_{\text{B}f}}{T_f} - \frac{(C_{\text{HC}i} - rC_{\text{CH}_3\text{OH}i})P_{\text{B}i}}{T_i}$$

Where:

(i) M<sub>HC</sub>=Hydrocarbon mass change, g.

(ii) C<sub>HC</sub>=FID hydrocarbon concentration as ppm carbon including FID response to methanol in the sample.

(iii) C<sub>CH<sub>2</sub>OH</sub>=Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T}{P_B \times V_E} \times [(C_{S1} \times AV_1) + (C_{S2} \times AV_2)]$$

\* \* \* \* \*  
 58. Section 86.1243-96 of Subpart M is amended by revising paragraphs (b)(1)(i) and (b)(1)(ii)(C) to read as follows:

**§ 86.1243-96 Calculations; evaporative emissions.**  
 \* \* \* \* \*  
 (b) \* \* \*  
 (1) \* \* \*

Methanol emissions:

$$M_{CH_3OH} = V_n \times \frac{T_{Ef}}{V_E \times T_{SHEDf}} \times [(C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f})] - \frac{T_{Ei}}{(V_E \times T_{SHEDi})} \times [(C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})] + M_{CH_3OH,OUT} - M_{CH_3OH,\epsilon}$$

Where:

- (A)  $M_{CH_3OH}$ =Methanol mass change,  $\mu$ g.
- (B)  $V_{Fn}$ =Net enclosure volume,  $ft^3$ , as determined by subtracting 50  $ft^3$  (1.42  $m^3$ ) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50  $ft^3$ ) with advance approval by the Administrator: Provided, the measured volume is determined

- and used for all vehicles tested by that manufacturer.
- (C)  $T_E$ =Temperature of sample withdrawn,  $^{\circ}R$ .
- (D)  $V_E$ =Volume of sample withdrawn,  $ft^3$ .
- (E)  $T_{SHED}$ =Temperature of SHED,  $^{\circ}R$ .
- (F)  $AC_{MS}$ =GC concentration of sample.
- (G)  $AV$ =Volume of absorbing reagent in impinger.
- (H)  $P_B$ =Barometric pressure at time of sampling, in. Hg.
- (I)  $i$ =Initial sample.
- (J)  $f$ =Final sample.

- (K) 1=First impinger.
- (L) 2=Second impinger.
- (M)  $M_{CH_3OH,out}$ =mass of methanol exiting the enclosure, in the case of fixed volume enclosures for diurnal emission testing,  $\mu$ g.
- (N)  $M_{CH_3OH,in}$ =mass of methanol entering the enclosure, in the case of fixed volume enclosures for diurnal emission testing,  $\mu$ g.
- (ii) \* \* \*
- (C)  $C_{CH_3OH}$ =Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T}{P_B \times V_E} \times [(C_{S1} \times AV_1) + (C_{S2} \times AV_2)]$$

\* \* \* \* \*  
 59. Section 86.1309-90 of Subpart N is amended by revising paragraph (a)(2), text of paragraph (a)(3) preceding the figures, paragraphs (a)(4), (b) introductory text, (b)(4), (b)(5), (b)(6), (c) introductory text, (c)(4), (c)(5), and (c)(6), redesignating paragraphs (a)(5) and (a)(6) as paragraphs (a)(6) and (a)(7), adding paragraphs (a)(5) and (d), and revising Figures N90-2 and N90-3 to read as follows:

**§ 86.1309-90 Exhaust gas sampling system; Otto-cycle engines.**

(a) \* \* \*

(2) *Engine exhaust to CVS duct.* For methanol-fueled engines, reactions of the exhaust gases in the exhaust duct connected to the dilution tunnel (for the purposes of this paragraph, the exhaust duct excludes the length of pipe representative of the vehicle exhaust

pipe) shall be minimized. This may be accomplished by:  
 (i) Using a duct of unrestricted length maintained at a temperature below 599°F (315°C). (Cooling capabilities as required); or  
 (ii) Using a 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  
 (iii) Omitting the duct and performing the exhaust gas dilution function at the engine exhaust manifold, immediately after exhaust aftertreatment systems, or after a length of pipe representative of the vehicle exhaust pipe; or  
 (iv) Partial dilution of the exhaust gas prior to entering the dilution tunnel, which lowers the duct temperature below 599°F (315°C).  
 (3) *Positive displacement pump.* The Positive Displacement Pump Constant Volume Sampler (PDP-CVS), Figure

N90-1 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, the methanol sample (Figure N90-2), and the formaldehyde sample (Figure N90-3), as applicable are achieved by sampling at a constant flow rate. For methanol-fueled engines, the sample lines for the methanol and formaldehyde samples are heated to prevent condensation. (Note: For 1990 through 1994 model year methanol-fueled engines, methanol and formaldehyde sampling may be omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol.)

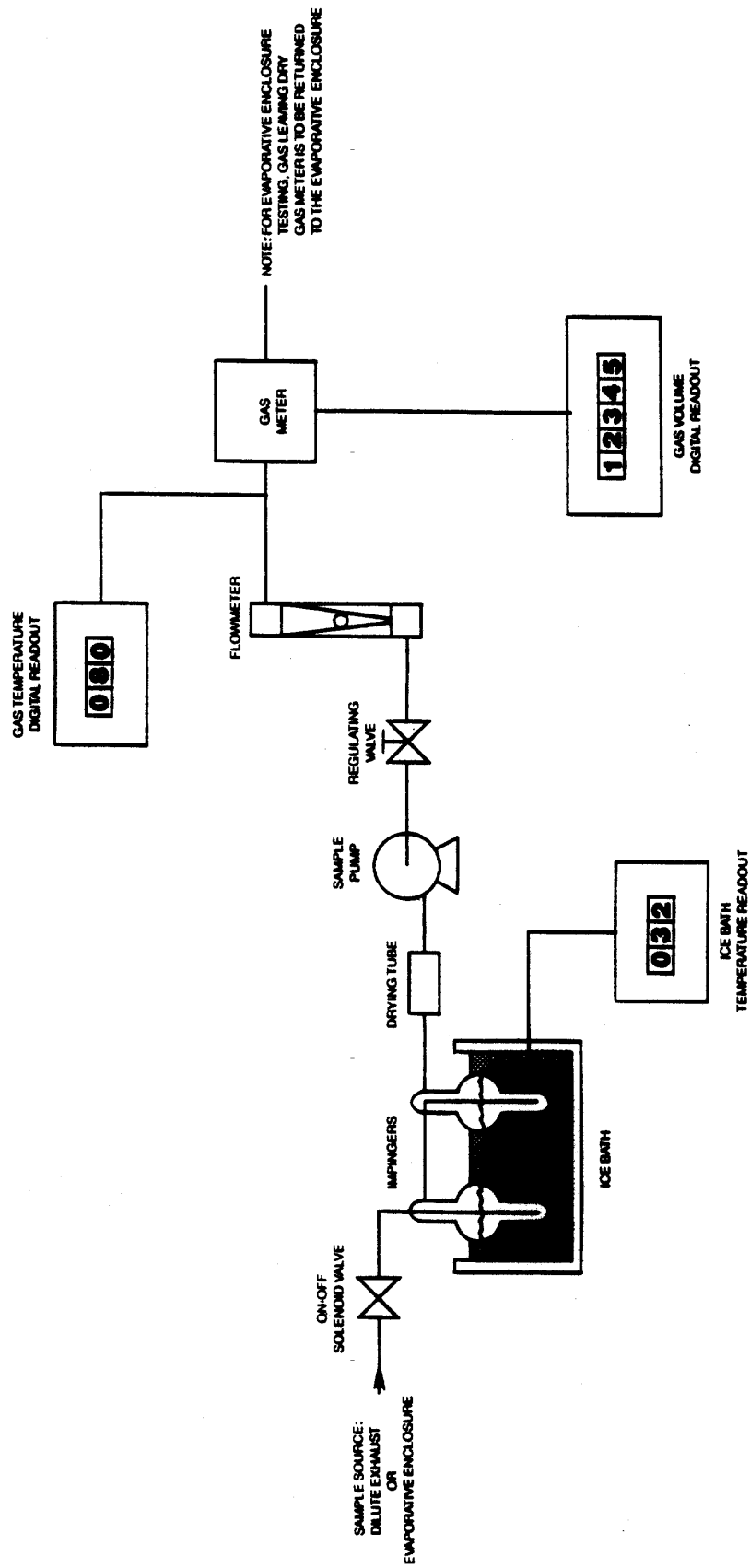


FIGURE N90-2 METHANOL SAMPLE COLLECTION FLOW SYSTEM



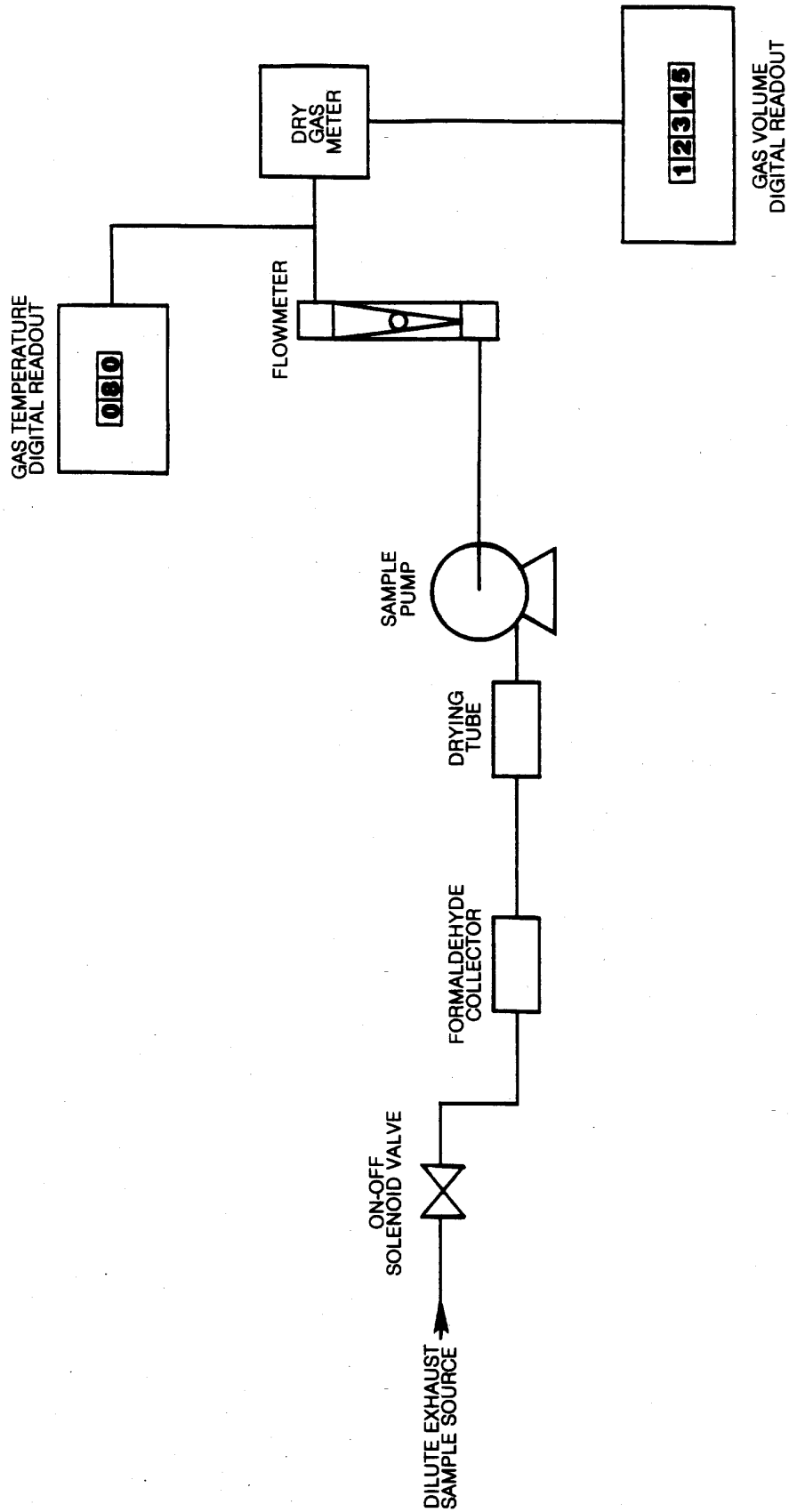


FIGURE N90-3 FORMALDEHYDE SAMPLE COLLECTION FLOW SCHEMATIC

(4) *Critical flow venturi*. The operation of the Critical Flow Venturi Constant Volume Sampler (CFV-CVS), Figure N90-4 is based upon the principles of fluid dynamics associated with critical flow. The CFV system is commonly called a constant volume system (CVS) even though the flow varies. It would be more proper to call the critical flow venturi (CFV) system a constant proportion sampling system since proportional sampling throughout temperature excursions is maintained by use of a small CFVs in the sample

lines. For engines requiring measurement of methanol and/or formaldehyde, 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 lines for the methanol and formaldehyde samples are heated to prevent condensation with care being taken to ensure that the CFVs of the sample probes are not heated. (Note: For 1990 through 1994 model year methanol-fueled engines, methanol and formaldehyde sampling may be

omitted provided the bag sample (hydrocarbons and methanol) is analyzed using a HFID calibrated with methanol. The variable mixture flow rate is maintained at choked flow, which 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.)

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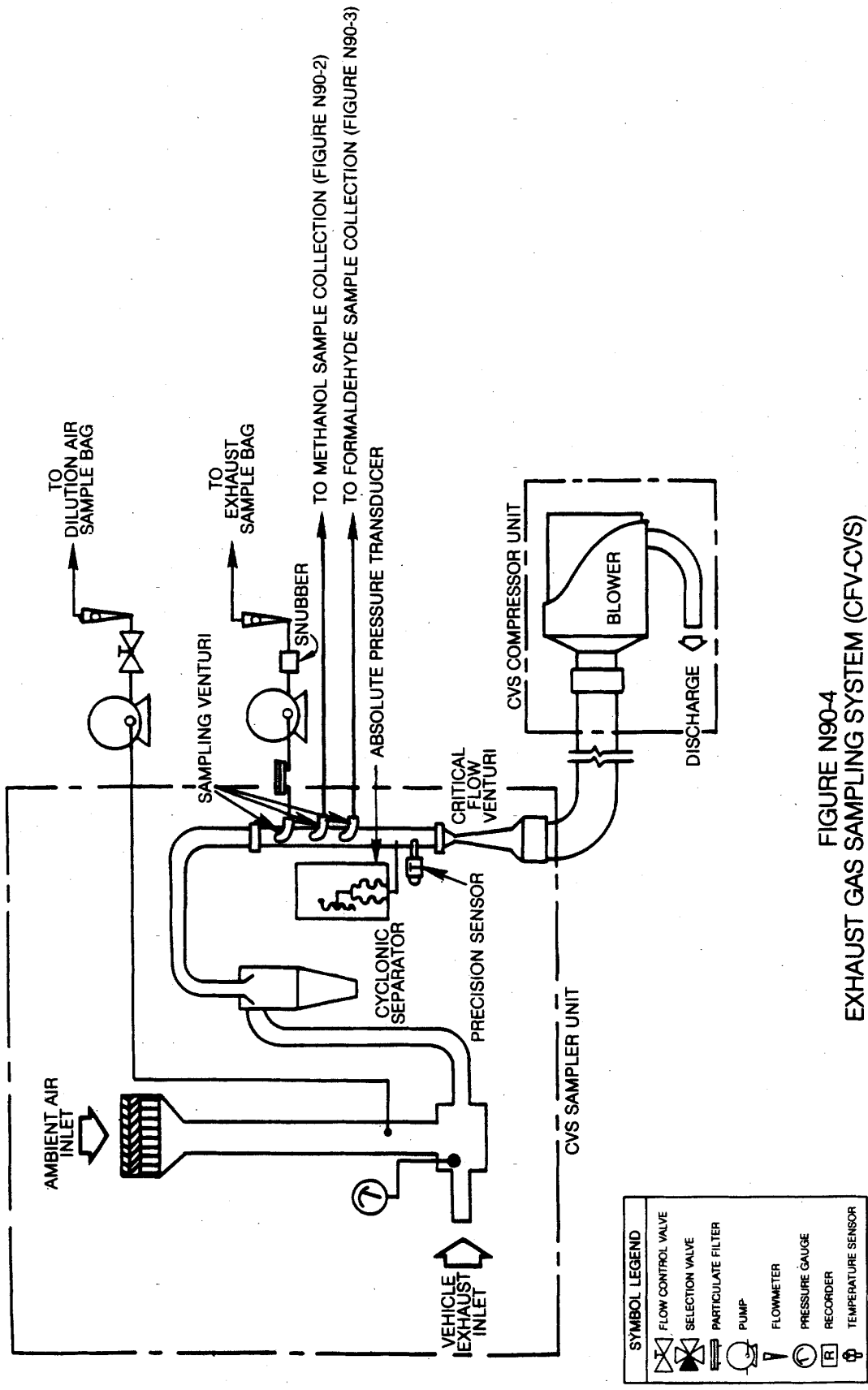


FIGURE N90-4  
EXHAUST GAS SAMPLING SYSTEM (CFV-CVS)

(5) *Electronic Flow Control.* The Electronic Flow Control Critical Flow Venturi Constant Volume Sampler (EFC-CFV-CVS) is identical to the CFV-CVS system, except that it uses electronic mass flow meters to maintain proportional sampling for methanol and formaldehyde. The flow rate of the exhaust plus dilution air and the sample flow rate are measured electronically. Proportionality is maintained by electronically controlled metering valves in the methanol and formaldehyde sample lines. Control of the valves is based on the electronic response of the flow meters. It is recommended that total flow sample volumes be measured by separate flow meters. For methanol-fueled engines, 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 sample lines for methanol and for formaldehyde may both draw samples from a single static probe. The lines for the methanol and formaldehyde samples are heated to prevent condensation.

\* \* \* \* \*

(b) *Component description, PDP-CVS.* The PDP-CVS, Figure N90-1, consists of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling systems (see Figure N90-2 for methanol sampling system and Figure N90-3 for formaldehyde sampling system) including sampling lines which are heated to prevent condensation in the case of the methanol-fueled engine, and associated valves, pressure and temperature sensors. The temperature of the sample lines shall be more than 5°F (3°C) above the maximum dew point of the mixture and less than 250°F (121°C). (It is recommended that they be maintained at 235±15°F (113±8°C)). 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. The PDP-CVS shall conform to the following requirements:

\* \* \* \* \*

(4) The flow capacity of the CVS shall be large enough to eliminate water condensation in the system. This is especially critical for methanol-fueled engines and may also be of concern with natural gas- and liquefied petroleum gas-fueled engines; see "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3-83-009. Dehumidifying the dilution air

before entering the CVS is allowed. Heating is also allowed, provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 250°F, or 125°F if particulate emissions are measured;

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.);

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(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 the determination of methanol and formaldehyde background (where applicable).

(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. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests:

(i) The methanol system shall be designed such that, if a test engine emitted the maximum allowable level of methanol (based on all applicable standards) during the first phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer.

(ii) The formaldehyde system shall be designed such that, if a test engine emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of THCE (i.e., 0.2 g/Bhp-hr for a 1.1 g/Bhp-hr THCE standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, during the first phase of the test, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected

by the secondary impinger. Sampling systems shall be identical for all phases.

(c) *Component description, CFV.* The CFV sample system, Figure N90-4, consists of a dilution air filter (optional) and mixing assembly, cyclone particulate separator (optional), unheated sampling venturies for the bag, methanol and formaldehyde samples, as applicable, heated sample lines to prevent condensation in the case of the methanol-fueled engine, critical flow venturi, and associated valves, pressure and temperature sensors. The temperature of the sample lines shall be more than 5°F (3°C) above the maximum dew point of the mixture and less than 250°F (121°C). (It is recommended that they be maintained at 235±15°F (113±8°C)). 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. The CFV sample system shall conform to the following requirements:

\* \* \* \* \*

(4) The flow capacity of the CVS shall be large enough to eliminate water condensation in the system. This is especially critical for methanol-fueled engines and may also be of concern with natural gas- and liquefied petroleum gas-fueled engines; see "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3-83-009. Dehumidifying the dilution air before entering the CVS is allowed. Heating is also allowed, provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 250°F, or 125°F if particulate emissions are measured.

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulated when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

(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 the determination of methanol and formaldehyde background (where applicable).

(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. The systems shall also comply with the following requirements that apply to the design of the systems, not to individual tests:

(i) The methanol system shall be designed such that, if a test engine emitted the maximum allowable level of methanol (based on all applicable standards) during the first phase of the test, the measured concentration in the primary impinger would exceed either 25 mg/l or a concentration equal to 25 times the limit of detection for the GC analyzer.

(ii) The formaldehyde system shall be designed such that, if a test engine emitted formaldehyde at a rate equal to twenty percent of the maximum allowable level of THCE (i.e., 0.2 g/Bhp-hr for a 1.1 g/Bhp-hr THCE standard), or the maximum formaldehyde level allowed by a specific formaldehyde standard, whichever is less, during the first phase of the test, the concentration of formaldehyde in the DNPH solution of the primary impinger, or solution resulting from the extraction of the DNPH cartridge, shall exceed either 2.5 mg/l or a concentration equal to 25 times the limit of detection for the HPLC analyzer.

(iii) The methanol and formaldehyde systems shall be designed such that the primary impinger collects at least 90 percent of the analyte in the samples. The remaining analyte shall be collected by the secondary impinger. Sampling systems shall be identical for all phases of the test.

(d) *Component description, EFC-CFV.* The EFC-CFV sample system, is identical to the CFV system described in paragraph (c) of this section, with the addition of electronic flow controllers, metering valves, separate flow meters to totalize sample flow volumes (optional), for methanol and formaldehyde samples. Both samples may be drawn from a single static probe. The EFC sample system shall conform to the following requirements:

- (1) All of the requirements of paragraph (c) of this section.
- (2) The ratio of sample flow to CVS flow must not vary by more  $\pm 5$  percent from the setpoint of the test.
- (3) The sample flow totalizers shall meet the accuracy specifications of § 86.1320. Total sample flow volumes may be obtained from the flow controllers, with advance approval of the Administrator, provided that they can be shown to meet the accuracy specifications of § 86.1320.

60. Section 86.1310-90 of Subpart N is amended by revising the section

heading, paragraph (a) introductory text, the text of paragraph (a)(1) preceding the figures, paragraphs (a)(4), (a)(5), (b)(1) introductory text, (b)(1)(i) introductory text, (b)(1)(ii), and (b)(1)(iii), to read as follows.

**§ 86.1310-90 Exhaust gas sampling and analytical system; diesel engines.**

(a) *General.* The exhaust gas sampling system described in this paragraph is designed to measure the true mass of both gaseous and particulate emissions in the exhaust of petroleum-fueled, natural gas-fueled, liquefied petroleum gas-fueled and methanol-fueled heavy-duty diesel engines. This system utilizes the CVS concept (described in § 86.1309) of measuring the combined mass emissions of HC, CH<sub>3</sub>OH and HCHO from methanol-fueled engines and CO, CO<sub>2</sub> and particulate from all fuel types. A continuously integrated system is required for THC (petroleum-fueled, natural gas-fueled, and liquefied petroleum gas-fueled engines) and NO<sub>x</sub> (all engines) measurement, and is allowed for all CO and CO<sub>2</sub> measurements plus the combined emissions of CH<sub>3</sub>OH, HCHO, and HC from methanol-fueled engines. Where applicable, separate sampling systems are required for methanol and for formaldehyde. The mass of gaseous emissions is determined from the sample concentration and total flow over the test period. The mass of particulate emissions is determined from a proportional mass sample collected on a filter and from the sample flow and total flow over the test period. As an option, the measurement of total fuel mass consumed over a cycle may be substituted for the exhaust measurement of CO<sub>2</sub>. General requirements are as follows:

(1) This sampling system requires the use of a PDP-CVS and a heat exchanger, a CFV-CVS (or an EFC-CFV-CVS) with either a heat exchanger or electronic flow compensation. Figure N90-5 is a schematic drawing of the PDP system. Figure N90-6 is a schematic drawing of the CFV-CVS system.

(4) For methanol-fueled engines, cooling or reaction of the exhaust gases in the exhaust duct connected to the dilution tunnel (for the purposes of this paragraph, the exhaust duct excludes the length of pipe representative of the vehicle exhaust pipe) shall be minimized. This may be accomplished by:

- (i) Using a duct of unrestricted length maintained at a temperature below 599°F (315°C). (Heating and possibly cooling capabilities as required); or

(ii) Using a 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

(iii) Omitting the duct and performing the exhaust gas dilution function at the engine exhaust manifold or immediately after exhaust aftertreatment systems, or after a length of pipe representative of the vehicle exhaust pipe; or

(iv) Partial dilution of the exhaust gas prior to entering the dilution tunnel, which lowers the duct temperature below 599°F (315°C).

(5) Heated sample lines are required for the methanol and formaldehyde samples (care must be taken to prevent heating of the sample probes unless compensation for varying flow rate is made). The sample collection lines shall be heated to a temperature more than 5°F (3°C) above the maximum dew point of the mixture, but below 250°F (121°C).

\* \* \* \* \*

(b) \* \* \*

(1) *Exhaust dilution system.* The PDP-CVS shall conform to all of the requirements listed for the exhaust gas PDP-CVS in § 86.1309(b). The CFV-CVS shall conform to all of the requirements listed for the exhaust gas CFV-CVS in § 86.1309(c). The EFC-CFV-CVS shall conform to all of the requirements listed for the exhaust gas EFC-CVS in § 86.1309(d). In addition, the CFV-CVS and EFC-CFV-CVS must conform to the following requirements:

(i) The flow capacity of the CVS must be sufficient to maintain the diluted exhaust stream at or below the temperatures required for the measurement of particulate and hydrocarbon emission noted below and at, or above, the temperatures where condensation of water in the exhaust gases could occur. This may be achieved by either of the following two methods:

\* \* \* \* \*

(ii) For the CFV-CVS or EFC-CFV-CVS, either a heat exchanger or electronic flow compensation (which also includes the particulate sample flows) is required (see Figure N90-6).

(iii) For the CFV-CVS or EFC-CFV-CVS when a heat exchanger is used, the gas mixture temperature, measured at a point immediately ahead of the critical flow venturi, shall be within  $\pm 20^\circ\text{F}$  ( $\pm 11^\circ\text{C}$ ) of the average operating temperature observed during the test with the simultaneous requirement that condensation does not occur. The temperature measuring system (sensors and readout) shall have an accuracy and precision of  $\pm 3.4^\circ\text{F}$  (1.9°C). For systems utilizing a flow compensator to maintain proportional sampling, the

requirement for maintaining constant temperature is not necessary.

\* \* \* \* \*

61. Section 86.1313-94 of Subpart N is amended by revising paragraph (d) to read as follows:

**§ 86.1313-94 Fuel Specifications.**

\* \* \* \* \*

(d) *Mixtures of petroleum and methanol fuels for flexible fuel vehicles.*

(1) Mixtures of petroleum and methanol fuels used for exhaust emission testing and service accumulation for flexible fuel vehicles shall consist of the methanol and petroleum fuels listed in paragraph (a) or (b) of this section, and shall be within the range of fuel mixtures for which the vehicle was designed, as reported in accordance with § 86.94-21. The Administrator may use any fuel mixture within this range for testing.

(2) The fuel mixtures used by the manufacturers shall be sufficient to demonstrate compliance over the full design range, and shall include:

(i) For emission testing:

(A) A petroleum fuel specified in paragraph (a) or paragraph (b) of this section;

(B) A methanol fuel representative of the methanol fuel expected to be found in use.

(ii) For service accumulation, an alternating combination of the fuels specified in paragraphs (a) or (b), and (c) of this section that, based on good engineering judgement, demonstrates the durability of the emissions control system. The combination shall be selected such that the cumulative volumes of both the methanol fuel and the petroleum fuel used shall be at least 25 percent of the total fuel volume. The fuels shall be or alternated at intervals not to exceed 500 hours.

(iii) Or, other combinations for testing and/or service accumulation which demonstrate compliance with the standards over the entire design range of the vehicle, provided that written approval is obtained from the Administrator prior to the start of testing.

(3) The specification range of the fuels to be used under this paragraph (d) shall be reported in accordance with § 86.094-21.

62. Section 86.1314-94 of Subpart N is amended by revising paragraphs (b), (e), (g)(2) and (g)(3), and adding paragraph (g)(4) to read as follows:

**§ 86.1314-94 Analytical gases.**

\* \* \* \* \*

(b) Gases for the hydrocarbon analyzer shall be:

(1) Single blends of propane using air as the diluent; and

(2) Optionally, for response factor determination, single blends of methanol using air as the diluent.

\* \* \* \* \*

(e) Fuel for FIDs and HFIDs and methane analyzers shall be a blend of 40 ±2 percent hydrogen with the balance being helium. The mixture shall contain less than 1 ppm equivalent carbon response. 98 to 100 percent hydrogen fuel may be used with advance approval by the Administrator.

\* \* \* \* \*

(g) \* \* \*

(2) Calibration gases (not including methanol) shall be traceable to within one percent of NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator.

(3) Span gases (not including methanol) shall be accurate to within two percent of true concentration, where true concentration refers to NIST (formerly NBS) gas standards, or other gas standards which have been approved by the Administrator.

(4) Methanol in air gases used for response factor determination shall:

(i) Be traceable to within ±2 percent of NIST (formerly NBS) gas standards, or other standards which have been approved by the Administrator; and

(ii) Remain within ±2 percent of the labeled concentration. Demonstration of stability shall be based on a quarterly measurement procedure with a precision of ±2 percent (two standard deviations), or other method approved by the Administrator. The measurement procedure may incorporate multiple measurements. If the true concentration of the gas changes by more than two percent, but less than ten percent, the gas may be relabeled with the new concentration.

\* \* \* \* \*

63. Section 86.1316-94 of Subpart N is amended by revising paragraph (b)(1) to read as follows:

**§ 86.1316-94 Calibrations; frequency and overview.**

(b) \* \* \*

(1) Calibrate the hydrocarbon analyzer, methane analyzer, carbon dioxide analyzer, carbon monoxide analyzer, and oxides of nitrogen analyzer (certain analyzers may require more frequent calibration depending on particular equipment and uses).

\* \* \* \* \*

64. Section 86.1319-90 of Subpart N is amended by revising paragraphs (e)(1), (e)(4), and (e)(7), and adding paragraph (e)(8) to read as follows:

**§ 86.1319-90 CVS calibration.**

\* \* \* \* \*

(e) \* \* \*

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

\* \* \* \* \*

(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.

\* \* \* \* \*

(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.

65. Section 86.1321-94 of Subpart N is amended by revising paragraphs (a)(3)(ii), (a)(3)(iii), (c) introductory text, (c)(1), and (c)(3)(iii), and adding Figure N94-10 at the end of paragraph (c)(1), and adding paragraph (a)(3)(iv) to read as follows:

**§ 86.1321-94 Hydrocarbon analyzer calibration.**

\* \* \* \* \*

(a) \* \* \*

(3) \* \* \*

(ii) The procedure listed in subpart D of this part, which is:

(A) If necessary, follow manufacturer's instructions for instrument start-up and basic operating adjustments.

(B) Set the oven temperature 5°C hotter than the required sample-line temperature. Allow at least one-half hour after the oven has reached

temperature for the system to equilibrate.

(C) Initial fuel flow adjustment. With the fuel and air-flow rates set at the manufacturer's recommendations, introduce a 350 ppmC ±75 ppmC span gas to the detector. Determine the response at a given fuel flow from the difference between the span-gas response and the zero-gas response. Incrementally adjust the fuel flow above and below the manufacturer's specification. Record and plot the span and zero response at these fuel flows. Adjust the fuel-flow rate to the rich side

of the curve. This is initial flow-rate setting and may not be the final optimized flow rate.

- (D) [Reserved]
- (E) Linearity check. For each range used, check linearity as follows:
  - (1) Zero the analyzer.
  - (2) Span the analyzer using a calibration gas that will provide a response of approximately 90 percent of full-scale concentration.
  - (3) Recheck the zero response. If it has changed more than 0.5 percent of full scale, repeat the steps in paragraphs (a)(3)(ii)(E) (1) and (2) of this section.

(4) Record the response of calibration gases having nominal concentrations of 30, 60, and 90 percent of full-scale concentration. It is permitted to use additional concentrations.

(5) Perform a linear least square regression on the data generated. Use an equation of the form  $y=mx$ , where  $x$  is the actual chart deflection and  $y$  is the concentration.

(6) Use the equation  $z=y/m$  to find the linear chart deflection ( $z$ ) for each calibration gas concentration ( $y$ ).

(7) Determine the linearity (%L) for each calibration gas by:

$$\text{Percent L} = \frac{(z - x)}{\text{Full - scale linear chart deflection}} \times 100$$

(8) The linearity criterion is met if the %L is less than ±2 percent for each data point generated. Below 40 ppmC the linearity criterion may be expanded to ±4 percent. For each emission test, a calibration curve of the form  $y=mx$  is to be used. The slope ( $m$ ) is defined for each range by the spanning process.

(9) If the %L for any point exceeds the specifications of the step in paragraph (a)(3)(ii)(E)(8) of this section, the air, fuel, and sample-flow rates may be varied.

(10) If the %L for any data point still exceeds the specifications, repair or replace the analyzer, FID fuel, burner air, or calibration bottles prior to testing. Repeat the procedures of this section

with the repaired or replaced equipment or gases.

(F) Optimized flow rates. The fuel-flow rate, air-flow rate and sample-flow rate are defined as "optimized" at this point.

(iii) The procedures specified by the manufacturer of the FID or HFID.

(iv) Alternative procedures may be used if approved in advance by the Administrator.

\* \* \* \* \*

(c) *FID response factor to methanol.* When the FID analyzer is to be used for the analysis of hydrocarbon samples containing methanol, the methanol response factor of the analyzer shall be established. The methanol response

factor shall be determined at several concentrations in the range of concentrations in the exhaust sample, using either bag samples or gas bottles meeting the requirements of § 86.1314.

(1) The bag sample of methanol for analysis in the FID, if used, shall be prepared using the apparatus shown in Figure N94-10. A known volume of methanol is injected, using a microliter syringe, into the heated mixing zone (250°F (121°C)) of the apparatus. The methanol is vaporized and swept into the sample bag with a known volume of zero grade air measured by a gas flow meter meeting the specifications of § 86.1320.

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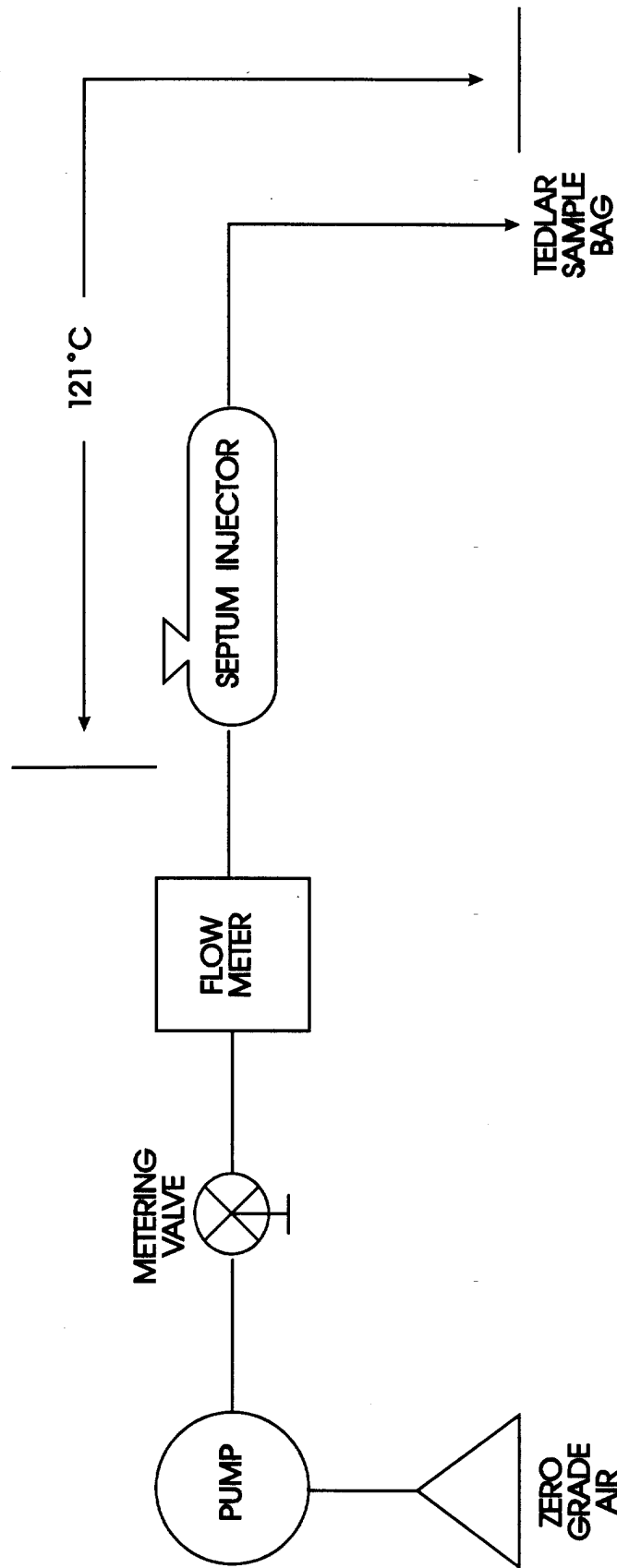


FIGURE N94-10 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX



\* \* \* \* \*

(3) SAM<sub>ppm</sub>=methanol concentration in the sample bag, or gas bottle, in ppmC. SAM<sub>ppm</sub> for sample bags:

$$\frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. CH}_3\text{OH}}$$

Where:

\* \* \* \* \*

66. Section 86.1323-84 of Subpart N is amended by adding paragraph (d) to read as follows:

**§ 86.1323-84 Oxides of nitrogen analyzer calibration.**

\* \* \* \* \*

(d) When testing methanol-fueled engines it may be necessary to clean the analyzer frequently to prevent interference with NO<sub>x</sub> measurements (see EPA/60/S3-88/040).

67. Section 86.1327-90 of Subpart N is amended by revising paragraph (a) to read as follows:

**§ 86.1327-90 Engine dynamometer test procedures; overview.**

(a) The engine dynamometer test procedure is designed to determine the brake specific emissions of hydrocarbons, nonmethane hydrocarbons carbon monoxide, oxides of nitrogen, particulate, methanol and formaldehyde, as applicable. The test procedure consists of a "cold" start test following either natural or forced cool-down periods described in §§ 86.1334 and 86.1335, respectively. A "hot" start test follows the "cold" start test after a hot soak of 20 minutes. The idle test of subpart P of this part may be run after the "hot" start test. The exhaust emissions are diluted with ambient air and a continuous proportional sample is collected for analysis during both the cold- and hot-start tests. The composite samples collected are analyzed either in bags or continuously for hydrocarbons (HC), methane (CH<sub>4</sub>—as applicable), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), and oxides of nitrogen (NO<sub>x</sub>), or in sample collection impingers for methanol (CH<sub>3</sub>OH) and sample collection impingers (or cartridges) for formaldehyde (HCHO). Measurement of CH<sub>3</sub>OH and HCHO may be omitted for 1990 through 1994 model year methanol-fueled engines when a FID calibrated on methanol is used. A bag or continuous sample of the dilution air is similarly analyzed for background levels of hydrocarbon, carbon monoxide, carbon dioxide, and oxides of nitrogen and, if appropriate, methane and/or methanol and/or formaldehyde. In addition, for diesel-cycle engines,

particulates are collected on fluorocarbon-coated glass fiber filters or fluorocarbon-based (membrane) filters, and the dilution air may be prefiltered.

\* \* \* \* \*

69. Section 86.1327-96 of Subpart N is amended by revising paragraph (a) to read as follows:

**§ 86.1327-96 Engine dynamometer test procedures; overview.**

(a) The engine dynamometer test procedure is designed to determine the brake specific emissions of hydrocarbons, nonmethane hydrocarbons, carbon monoxide, oxides of nitrogen, particulate, methanol and formaldehyde, as applicable. The test procedure consists of a "cold" start test following either natural or forced cool-down periods described in §§ 86.1334 and 86.1335, respectively. A "hot" start test follows the "cold" start test after a hot soak of 20 minutes. The idle test of subpart P of this part may be run after the "hot" start test. The exhaust emissions are diluted with ambient air and a continuous proportional sample is collected for analysis during both the cold- and hot-start tests. The composite samples collected are analyzed either in bags or continuously for hydrocarbons (HC), methane (CH<sub>4</sub>) carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), and oxides of nitrogen (NO<sub>x</sub>), or in sample collection impingers for methanol (CH<sub>3</sub>OH) and sample collection impingers (or cartridges) for formaldehyde (HCHO), as applicable. Measurement of CH<sub>3</sub>OH and HCHO may be omitted for 1990 through 1994 model year methanol-fueled engines when a FID calibrated on methanol is used. A bag or continuous sample of the dilution air is similarly analyzed for background levels of hydrocarbon, carbon monoxide, carbon dioxide, and oxides of nitrogen and, if appropriate, methane and/or methanol and/or formaldehyde. In addition, for diesel-cycle engines, particulates are collected on fluorocarbon-coated glass fiber filters or fluorocarbon-based (membrane) filters, and the dilution air may be prefiltered.

\* \* \* \* \*

69. Section 86.1330-90 of Subpart N is amended by revising paragraphs (b)(1) and (c) to read as follows:

**§ 86.1330-90 Test sequence; general requirements.**

\* \* \* \* \*

(b) \* \* \* (1) The temperature of the CVS dilution air shall be maintained at greater than 68°F (20°C) throughout the test sequence, except as permitted by § 86.1335-90. Heating of the dilution air above 86°F is allowed provided:

(i) The air (or air plus exhaust gas) temperature does not exceed 250°F, or 125°F if particulate emissions are measured.

(ii) Calculation of the CVS flow rate necessary to prevent water condensation is based on the lowest temperature encountered in the CVS prior to sampling. (It is recommended that the CVS system be insulation when heated dilution air is used.)

(iii) The dilution ratio is sufficiently high to prevent condensation in bag samples as they cool to room temperature.

\* \* \* \* \*

(c) No control of ambient air, engine intake or CVS dilution air humidity is required (dehumidification of the dilution air prior to entering the CVS is allowed).

\* \* \* \* \*

70. Section 86.1337-90 of Subpart N is amended by revising paragraphs (a)(3), (a)(13) and (a)(26) to read as follows:

**§ 86.1337-90 Engine dynamometer test run.**

(a) \* \* \*

(3) For methanol-fueled vehicles, install fresh methanol and formaldehyde impingers (or cartridges) in the exhaust and dilution air sample systems for methanol and formaldehyde. A single dilution air sample covering the total test period may be utilized for methanol and formaldehyde background. (Background measurements of methanol and formaldehyde may be omitted and concentrations assumed to be zero for calculations in § 86.1344.)

\* \* \* \* \*

(13) Immediately after the engine is turned off, turn off the engine cooling fan(s) if used, and the CVS blower (or disconnect the exhaust system from the CVS). As soon as possible, transfer the "cold start cycle" exhaust and dilution air bag samples to the analytical system and process the samples according to § 86.1340. A stabilized reading of the exhaust sample on all analyzers shall be obtained within 20 minutes of the end of the sample collection phase of the test. Analysis of the methanol and formaldehyde samples shall be obtained within 24 hours of the end of the sample collection period. (If it is not possible to perform the analysis within 24 hours, the samples should be stored in a cold (4-10 °C) dark environment until analysis can be performed. The samples should be analyzed within fourteen days.) For diesel engines tested for particulate, carefully remove the filter holder from the sample flow apparatus,

and remove each particulate sample filter from its holder and place each in a petri dish and cover.

\* \* \* \* \*

(26) As soon as possible, transfer the "hot start cycle" exhaust and dilution air bag samples to the analytical system and process the samples according to § 86.1340. A stabilized reading of the exhaust sample on all analyzers shall be obtained within 20 minutes of the end of the sample collection phase of the test. Analysis of the methanol and formaldehyde samples shall be obtained within 24 hours of the end of the sample collection period. (If it is not possible to perform them within 24 hours, the samples should be stored in a cold (approximately 4–10 °C) dark environment until analysis can be performed.) For diesel engines tested for particulate, carefully remove the assembled filter holder from the sample flow lines and remove each particulate sample filter from its holder and place each in a petri dish and cover as soon as possible. Within one hour after the end of the hot start phase of the test, transfer the four particulate filters to the weighing chamber for post-test conditioning.

\* \* \* \* \*

71. Section 86.1337–96 of Subpart N is amended by revising paragraphs (a)(3), (a)(13) and (a)(26) to read as follows:

**§ 86.1337–96 Engine dynamometer test run.**

(a) \* \* \*

(3) For methanol-fueled vehicles, install fresh methanol and formaldehyde impingers (or cartridges) in the exhaust and dilution air sample systems for methanol and formaldehyde. A single dilution air sample covering the total test period may be utilized for methanol and formaldehyde background. (Background measurements of methanol and formaldehyde may be omitted and concentrations assumed to be zero for calculations in § 86.1344.)

\* \* \* \* \*

(13) Immediately after the engine is turned off, turn off the engine cooling

fan(s) if used, and the CVS blower (or disconnect the exhaust system from the CVS). As soon as possible, transfer the "cold start cycle" exhaust and dilution air bag samples to the analytical system and process the samples according to § 86.1340. A stabilized reading of the exhaust sample on all analyzers shall be obtained within 20 minutes of the end of the sample collection phase of the test. Analysis of the methanol and formaldehyde samples shall be obtained within 24 hours of the end of the sample collection period. (If it is not possible to perform the analysis within 24 hours, the samples should be stored in a cold (4–10 °C) dark environment until analysis can be performed. The samples should be analyzed within 14 days.) For diesel engines tested for particulate, carefully remove the filter holder from the sample flow apparatus, and remove each particulate sample filter from its holder and place each in a petri dish and cover.

\* \* \* \* \*

(26) As soon as possible, transfer the "hot start cycle" exhaust and dilution air bag samples to the analytical system and process the samples according to § 86.1340. A stabilized reading of the exhaust sample on all analyzers shall be obtained within 20 minutes of the end of the sample collection phase of the test. Analysis of the methanol and formaldehyde samples shall be obtained within 24 hours of the end of the sample collection period. (If it is not possible to perform them within 24 hours, the samples should be stored in a cold (approximately 4–10 °C) dark environment until analysis can be performed.) For diesel engines tested for particulate, carefully remove the assembled filter holder from the sample flow lines and remove each particulate sample filter from its holder and place each in a petri dish and cover as soon as possible. Within 1 hour after the end of the hot start phase of the test, transfer the four particulate filters to the weighing chamber for post-test conditioning.

\* \* \* \* \*

72. Section 86.1340–90 of Subpart N is amended by revising paragraphs (g) and (h) to read as follows:

**§ 86.1340–90 Exhaust sample analysis.**

\* \* \* \* \*

(g) For CH<sub>3</sub>OH (where applicable), introduce test samples into the gas chromatograph and measure the concentration. This concentration is C<sub>MS</sub> in the calculations.

(h) For HCHO (where applicable), 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.

73. Section 86.1340–94 of Subpart N is amended by removing paragraphs (d)(8) through (h)(2) and adding paragraphs (d)(8) through (h) to read as follows:

**§ 86.1340–94 Exhaust sample analysis.**

\* \* \* \* \*

(d)(8) through (h) [Reserved]. For guidance see § 86.1340–90.

74. Section 86.1342–94 of Subpart N is amended by revising paragraphs (a)(1), (d)(3)(vi) through (d)(7)(ii), and (d)(8)(ii) to read as follows:

**§ 86.1342–94 Calculations; exhaust emissions.**

\* \* \* \* \*

(a) \* \* \*

(1) A<sub>WM</sub>=Weighted mass emission level (HC, CO, CO<sub>2</sub>, or NO<sub>x</sub>) in grams per brake horsepower-hour and, if appropriate, the weighted mass total hydrocarbon equivalent, formaldehyde, or non-methane hydrocarbon emission level in grams per brake horsepower-hour.

\* \* \* \* \*

(d) \* \* \*

(d)(3)(vi) through (d)(5)(iii)(B) [Reserved]. For guidance see § 86.1342–90.

(d)(5)(iv)(A) C<sub>CH<sub>3</sub>OH<sub>d</sub></sub>=Methanol concentration in the dilute exhaust, in ppm.

(B)

$$C_{CH_3OHd} = \frac{3.813 \times 10^{-2} \times T_{EM} [(C_{S1} \times AV_{S1}) + (C_{S2} \times AV_{S2})]}{P_B \times V_{EM}}$$

(v)(A) C<sub>CH<sub>3</sub>OH<sub>d</sub></sub>=Methanol concentration in the dilution air, in ppm (B)

$$C_{CH_3OHd} = \frac{3.813 \times 10^{-2} \times T_{DM} [(C_{D1} \times AV_{D1}) + (C_{D2} \times AV_{D2})]}{P_B \times V_{DM}}$$

- (vi) T<sub>EM</sub>=Temperature of methanol sample withdrawn from dilute exhaust, °R
- (vii) T<sub>DM</sub>=Temperature of methanol sample withdrawn from dilution air, °R
- (viii) P<sub>B</sub>=Barometric pressure during test, mm Hg.
- (ix) V<sub>EM</sub>=Volume of methanol sample withdrawn from dilute exhaust, ft<sup>3</sup>
- (x) V<sub>DM</sub>=Volume of methanol sample withdrawn from dilution air, ft<sup>3</sup>

- (xi) C<sub>S</sub>=GC concentration of sample drawn from dilute exhaust
- (xii) C<sub>D</sub>=GC concentration of sample drawn from dilution air
- (xiii) AV<sub>S</sub>=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml
- (xiv) AV<sub>D</sub>=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml

- (xv) 1=first impinger.
- (xvi) 2=second impinger.
- (d)(6)(i) through (d)(7)(i) [Reserved]. For guidance see § 86.1342-90.
- (d)(7)(ii) For methanol-fueled vehicles, where fuel composition is C<sub>x</sub>H<sub>y</sub>O<sub>z</sub> as measured, or calculated, for the fuel used:

$$DF = \frac{x}{(100)x + y / 2 = 3.76(x + y / 2 - z / 2)} \div CO_{2e} + (HC_e + CO_e + CH_3OH_e + HCHO_e)$$

- (d)(8)(i) \* \* \*
- (d)(8)(ii) For Otto-cycle engines: K<sub>H</sub>=1/[1-0.0047(H-75)] (or for SI units, K<sub>H</sub>=1/[1-0.0329(H-10.71)]).

75. Section 86.1344-94 of Subpart N is amended by revising paragraphs (e)(18) introductory text, (e)(18)(ii) through (e)(18)(vi), and removing paragraph (e)(18)(vii), to read as follows:

**§ 86.1344-94 Required information.**

- \* \* \* \* \*
- (e) \* \* \*
- (18) For engines requiring methanol and/or formaldehyde measurement (as applicable):
- \* \* \* \* \*
- (ii) The methanol concentration of the GC analyses of the test samples, µg/ml.
- (iii) Volume of sample passed through the formaldehyde sampling system.
- (iv) The formaldehyde concentration of the LC analysis of the test sample, µg/ml.
- (v) Specification of the methanol test fuel, or fuel mixtures, used during testing.

(vi) A continuous measurement of the dew point of the raw and diluted exhaust. This requirement may be omitted if the temperatures of all heated lines are kept above 220°F, or if the manufacturer performs an engineering analysis demonstrating that the temperature of the heated systems remains above the maximum dew point of the gas stream throughout the course of the test.

\* \* \* \* \*

76. The heading of subpart P is revised to read as follows:

**Subpart P—Emission Regulations for Otto-Cycle Heavy-Duty Engines, New Methanol-Fueled Natural Gas-Fueled, and Liquefied Petroleum Gas-Fueled Diesel-Cycle Heavy-Duty Engines, New Otto-Cycle Light-Duty Trucks, and New Methanol-Fueled Natural Gas-Fueled, and Liquefied Petroleum Gas-Fueled Diesel-Cycle Light-Duty Trucks; Idle Test Procedures**

77. Section 86.1501-94 of Subpart P is revised to read as follows:

**§ 86.1501-94 Scope; applicability.**

This subpart contains gaseous emission idle test procedures for light-duty trucks and heavy-duty engines for which idle CO standards apply. It applies to 1994 and later model years. The idle test procedures are optionally applicable to 1994 through 1996 model year natural gas-fueled and liquefied petroleum gas-fueled light-duty trucks and heavy-duty engines.

78. Section 86.1504-94 of Subpart P is amended by revising paragraph (c) to read as follows:

**§ 86.1504-94 Section numbering; construction.**

- \* \* \* \* \*
- (c) All provisions in this subpart apply to gasoline-fueled and methanol-fueled Otto-cycle heavy-duty engines, methanol-fueled Diesel-cycle heavy-duty engines, new Otto-cycle light-duty trucks, and liquefied petroleum gas-fueled, natural gas-fueled, and methanol-fueled diesel-cycle light-duty trucks.

79. Section 86.1505-94 of Subpart P is amended by revising paragraph (a) to read as follows:

**§ 86.1505-94 Introduction; structure of subpart.**

(a) This subpart describes the equipment and the procedures required to perform idle exhaust emission tests on heavy-duty engines and light-duty trucks. Subpart A of this part sets forth the testing requirements, reporting requirements and test intervals necessary to comply with EPA certification procedures.

\* \* \* \* \*

80. Section 86.1509-84 of Subpart P is amended by revising paragraph (c) to read as follows:

**§ 86.1509-84 Exhaust gas sampling system.**

\* \* \* \* \*

(c) A CVS sampling system with bag analysis as specified in § 86.1309 or § 86.109 or with continuous analysis as specified in § 86.1310 is permitted as applicable. The inclusion of an additional raw carbon dioxide (CO<sub>2</sub>) analyzer as specified in §§ 86.309-79 and 86.316-79 is required if the CVS system is used, in order to accurately determine the CVS dilution factor. The heated sample line specified in § 86.309-79 and § 86.310-79 for raw emission requirements is not required for the raw CO<sub>2</sub> measurement.

\* \* \* \* \*

81. Section 86.1511-84 of Subpart P is amended by revising paragraphs (a)(1) and (a)(8)(iii) to read as follows:

**§ 86.1511-84 Exhaust gas analysis system.**

(a) \* \* \*  
 (1) The analyzer used shall conform to the emission measurement accuracy provisions of § 86.1338.

\* \* \* \* \*

(8) \* \* \*  
 (iii) During variations of ±50 percent of nominal sample flow.

\* \* \* \* \*

82. Section 1514-84 of Subpart P is amended by adding paragraph (c) to read as follows:

**§ 86.1514-84 Analytical gases.**

\* \* \* \* \*

(c) If a CVS sampling system is used, the analytical gases specified in § 86.1314 shall be used.

83. Section 86.1537-84 of Subpart P is amended by revising paragraphs (d), (e)(1), (e)(2), and (e)(5) through (e)(7) to read as follows:

**§ 86.1537-84 Idle test run.**

\* \* \* \* \*

(d) Operate the warm engine at 2500 ±50 rpm, or rated torque speed for diesel-cycle engines, and zero load for a

minimum of 30 seconds and a maximum of 6 minutes.

(e) \* \* \*  
 (1) If bag samples are drawn, with the sample selector valves in the standby position connect evacuated sample collection bags to the dilute exhaust and dilution air sample collection systems.

(2) Start the CVS (if not already on), the sample pumps, integrators, and the raw CO<sub>2</sub> analyzer, as applicable. (The heat exchanger of the constant volume sampler, if used, shall be running at operating temperature before sampling begins.)

\* \* \* \* \*

(5) Begin raw and dilute sampling.

(6) For bag sampling, sample idle emissions long enough to obtain a sufficient bag sample, but in no case shorter than 60 seconds nor longer than 6 minutes. Follow the sampling and exhaust measurements requirements of § 86.340-79(e) for the conducting of the raw CO<sub>2</sub> measurement.

(7) As soon as possible, transfer the idle test exhaust and dilution air samples to the analytical system and process the samples according to § 86.1540-84. Obtain a stabilized reading of the exhaust sample on all

analyzers within 20 minutes of the end of the sample collection phase of the test.

\* \* \* \* \*

84. In Part 86, all references to "OMHCE" are revised to read "THCE", all references to "Organic Material Hydrocarbon Equivalent" are revised to read "Total Hydrocarbon Equivalent", all references to "Organic material hydrocarbon equivalent" are revised to read "Total hydrocarbon equivalent", all references to "organic material hydrocarbon equivalent" are revised to read "total hydrocarbon equivalent", all references to "OMNMHCE" are revised to read "NMHCE", all references to "Organic Material Non-Methane Hydrocarbon Equivalent" are revised to read "Non-Methane Hydrocarbon Equivalent", all references to "Organic material non-methane hydrocarbon equivalent" are revised to read "Non-methane hydrocarbon equivalent", all references to "organic material non-methane hydrocarbon equivalent" are revised to read "non-methane hydrocarbon equivalent".

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