and the amount for each customer are furnished. Others are permitted to submit tenders only for their own account.

3.5. Tenders for their own account will be received without deposit from commercial banks and other banking institutions; primary dealers, as defined above; Federally-insured savings and loan associations; States, and their political subdivisions or instrumentalities; public pension and retirement and other public funds; international organizations in which the United States holds membership; foreign central banks and foreign states; and Federal Reserve Banks. Tenders from all others must be accompanied by full payment for the amount of Notes applied for, or by a guarantee from a commercial bank or a primary dealer of 5 percent of the par amount applied for.

3.6. Immediately after the deadline for receipt of tenders, tenders will be opened, following by a public announcement of the amount and yield range of accepted bids. Subject to the reservations expressed in Section 4, noncompetitive tenders will be accepted in full, and then competitive tenders will be accepted, starting with those at the lowest yields, through successively higher yields to the extent required to attain the amount offered. Tenders at the highest accepted yield will be prorated if necessary. After the determination is made as to which tenders are accepted, an interest rate will be established, at a ⅛ of one percent increment, which results in an equivalent average accepted price close to 100.000 and a lowest accepted price above the original issue discount limit of 98.500. That stated rate of interest will be paid on all of the Notes. Based on such interest rate, the price on each competitive tender allotted will be determined and each successful competive bidder will be required to pay the price equivalent to the yield bid. Those submitting noncompetitive tenders will pay the price equivalent to the weighted average yield of accepted competitive tenders. Price calculations will be carried to three decimal places on the basis of price per hundred, e.g., 99.923, and the determinations of the Secretary of the Treasury shall be final. If the amount of noncompetitive tenders received would absorb all or most of the offering, competitive tenders will be accepted in an amount sufficient to provide a fair determination of the yield. Tenders received from Federal Reserve Banks will be accepted at the price equivalent to the weighted average yield of accepted competitive tenders.

3.7. Competitive bidders will be advised of the acceptance of their bids. Those submitting noncompetitive tenders will be notified only if the tender is not accepted in full, or when the price at the average yield is over par.

4. Reservations

4.1. The Secretary of the Treasury expressly reserves the right to accept or reject any or all tenders in whole or in part, to allot more or less than the amount of Notes specified in Section 1, and to make different percentage allotments to various classes of applicants when the Secretary considers it in the public interest. The Secretary's action under this Section is final.

5. Payment and Delivery

5.1. Settlement for the Notes allotted must be made at the Federal Reserve Bank or Branch or at the Bureau of the Public Debt, wherever the tender was submitted. Settlement on Notes allotted to institutional investors and to others whose tenders are accompanied by a guarantee as provided in Section 3.5. must be made or completed on or before Monday, April 17, 1989. Payment in full must accompany tenders submitted by all other investors. Payment must be in cash; in other funds immediately available to the Treasury; in Treasury bills, notes, or bonds maturing on or before the settlement date but which are not overdue as defined in the general regulations governing United States securities; or by check drawn to the order of the institution to which the tender was submitted, which must be received from institutional investors no later than Thursday, April 13, 1989. In addition, Treasury Tax and Loan Note Option Depositaries may make payment for the Notes allotted for their own accounts and for accounts of customers by credit to their Treasury Tax and Loan Note Accounts on or before Monday, April 17, 1989. When payment has been submitted with the tender and the purchase price of the Notes allotted is over par, settlement for the premium must be competed timely, as specified above. When payment has been submitted with the tender and the purchase price is under par, the discount will be remitted to the bidder.

5.2. In every case where full payment has not been completed on time, an amount of up to 5 percent of the par amount of Notes allotted shall, at the discretion of the Secretary of the Treasury, be forfeited to the United States.

5.3. Registered definitive securities tendered in payment for the Notes allotted and to be held in TREASURY DIRECT are not required to be assigned if the inscription on the registered definitive security is identical to the registration of the note being purchased. In any such case, the tender form used to place the Notes allotted in TREASURY DIRECT must be completed to show all the information required thereon, or the TREASURY DIRECT account number previously obtained.

6. General Provisions

6.1. As fiscal agents of the United States, Federal Reserve Banks are authorized, as directed by the Secretary of the Treasury, to receive tenders, to make allotments, to issue such notices as may be necessary, to receive payment for, and to issue, maintain, service, and make payment on the Notes.

6.2. The Secretary of the Treasury may, at any time, supplement or amend provisions of this circular if such supplements or amendments do not adversely affect existing rights of holders of the Notes. Public announcement of such changes will be promptly provided.

6.3. The Notes issued under this circular shall be obligations of the United States, and, therefore, the faith of the United States Government is pledged to pay, in legal tender, principal and interest on the Notes.

Gerald Murphy,

Fiscal Assistant Secretary.

[FR Doc. 89-8653 Filed 4-7-89; 8:45 am]

BILLING CODE 4810-40-M

Sunshine Act Meetings

Federal Register
Vol. 54, No. 68
Tuesday April 11 1989

This section of the FEDERAL REGISTER contains notices of meetings published under the "Government in the Sunshine Act" (Pub. L. 94-409) 5 U.S.C. 552b(e)(3).

BARRY GOLDWATER SCHOLARSHIP AND EXCELLENCE IN EDUCATION FOUNDATION

TIME AND DATE: 2:00 p.m., Tuesday, May 16, 1989.

PLACE: Russell Senate Office Building, Washington, DC 20510.

STATUS: The meeting will be closed to the public.

MATTERS TO BE CONSIDERED:

Report On Results Of Scholarship Review Panel

a. Discussion and consideration of scholarship candidates;
b. Selection of Goldwater Scholars.

CONTACT PERSON FOR MORE INFORMATION: Gerald J. Smith, Executive Secretary, Telephone: (202) 755–2312.

Gerald J. Smith,
Executive Secretary
[FR Doc. 89–8599 Filed 4–7–89; 2:45 pm]
BILLING CODE 4738–91–M

EQUAL EMPLOYMENT OPPORTUNITY COMMISSION

"FEDERAL REGISTER" CITATION OF PREVIOUS ANNOUNCEMENT: 54 FR 13453, Monday, April 3, 1989.

PREVIOUSLY ANNOUNCED TIME AND DATE OF MEETING: 2:00 P.M. (Eastern Time) Monday, April, 10, 1989.

CHANGE IN THE MEETING:

Closed Session

Agency Adjudication and Determination on Federal Agency Discrimination Complaint Appeals has been taken off the agenda.

CONTACT PERSON FOR MORE INFORAMTION: Frances M. Hart, Executive Officer, Executive Secretariat, (202) 634–6748.

Date: April 6, 1989.

Frances M. Hart,
Executive officer, Executive Secretariat.

This Notice issued April 6, 1989.

[FR Doc. 89–8582 Filed 4–6–89; 4:37 pm]
BILLING CODE 6750–06–M

FEDERAL ELECTION COMMISSION

Federal Register Number 89–8293.

PREVIOUSLY ANNOUNCED DATES & TIMES:

Tuesday, April 11, 1989, 10:00 A.M., Closed Session

Thursday, April 13, 1989, 10:00 A.M., Open Meeting

By direction of the Federal Election Commission, the Closed Session scheduled for Tuesday, April 11, 1989, is cancelled.

By direction of the Federal Election, the Open Meeting scheduled for Thursday, April 13, 1989, is cancelled.

PERSON TO CONTACT FOR INFORMATION: Mr. Fred Eiland, Information Officer, Telephone: 202–376–3155.

Marjorie W. Emmons,
Secretary of the Commission.
[FR Doc. 89–8667 Filed 4–7–89; 3:42 pm]
BILLING CODE 6715–01–M

NUCLEAR REGULATORY COMMISSION

DATE: Weeks of April 10, 17, 24, and May 1, 1989.

PLACE: Commissioners' Conference Room, 11555 Rockville Pike, Rockville, Maryland.

STATUS: Open and Closed.

MATTERS TO BE CONSIDERED:

Week of April 10

Thursday, April 13

9:30 a.m.—Briefing on Status of Implementation of Severe Accident Master Integration Plan (Public Meeting)
2:00 p.m.—Briefing on Implementation of Safety Goal Policy Statement (Public Meeting)
3:30 p.m.—Affirmation/Discussion and Vote (Public Meeting)
a. Effectiveness Review of Final Initial Decision

Week of April 17—Tentative

Monday, April 17

10:00 a.m.—Discussion of Shoreham Full Power Operating License (Public Meeting)
2:00 p.m.—Discussion/Possible Vote on Peach Bottom Restart (Public Meeting)

Thursday, April 20

2:00 p.m.—Briefing on Status of TMI–2 Cleanup Activities (Public Meeting)
3:30 p.m.—Affirmation/Discussion and Vote (Public Meeting) (if needed)

Week of April 24—Tentative

Tuesday, April 25

10:00 a.m.—Briefing on the Status of Generic Issues (Public Meeting)

Thursday, April 27

10:00 a.m.—Periodic Briefing by Advisory Committee on Nuclear Waste (ACNW) (Public Meeting)
3:30 p.m.—Affirmation/Discussion and Vote (Public Meeting) (if needed)

Week of May 1—Tentative

Tuesday, May 2

10:00 a.m.—Briefing on Severe Accident Research Plan (Public Meeting)
2:00 p.m.—Briefing on Results of Maintenance Team Inspections (Public Meeting)

Wednesday, May 3

10:00 a.m.—Briefing on the Status of NUREG–1150 (Public Meeting)
2:00 p.m.—Periodic Briefing by Advisory Committee on Reactor Safeguards (ACRS) (Public Meeting)
3:30 p.m.—Affirmation/Discussion and Vote (Public Meeting) (if needed)

ADDITIONAL INFORMATION: By a vote of 5–0 on April 6, 1989, the Commission determined pursuant to 5 U.S.C. 552b(e) and § 9.107(a) of the Commission's rules that Commission business required that "Briefing on Rancho Seco" (Public Meeting) scheduled for April 7, 1989, be held on less than one week's notice to the public.

Affirmation of "Rulemaking on Early Site Permits, Design Certifications, and Combined Licenses" (Public Meeting) rescheduled from April 6, 1989, to April 7, 1989.

Note.—Affirmation sessions are initially scheduled and announced to the public on a time-reserved basis. Supplementary notice is provided in accordance with the Sunshine Act as specific items are identified and added to the meeting agenda. If there is no specific subject listed for affirmation, this means that no item has as yet been identified as requiring any Commission vote on this date.

To verify the status of meetings call (recording)—(301) 492–0292.

CONTACT PERSON FOR MORE INFORMATION: William Hill (301) 492–1661.

E.C. Shelburne,
Office of the Secretary
April 6, 1989.

[FR Doc. 89–8649 Filed 4–7–89; 2:25 pm]
BILLING CODE 7590–01–M

SECURITIES AND EXCHANGE COMMISSION

"FEDERAL REGISTER" CITATION OF PREVIOUS ANNOUNCEMENT: [54 FR 13976 April 6, 1989].

STATUS: Closed meeting.

PLACE: 450 Fifth Street NW., Washington, DC.

DATE PREVIOUSLY ANNOUNCED: Monday, April 3, 1989

CHANGES IN THE MEETING: Additional meeting.

The following additional items will be considered at a closed meeting on Thursday, April 6, 1989, at 2:30 p.m.

Litigation matter.

Settlement of injunctive action.

Commissioner Cox, as duty officer, determined that Commission business required the above change.

At times changes in Commission priorities require alterations in the scheduling of meeting items. For further information and to ascertain what, if any, matters have been added, deleted or postponed, please contact: Holly Smith at (202) 272-2091

Jonathan G. Katz,

Secretary

April 4, 1989.

[FR Doc. 89-8611 Filed 4-7-89; 11:31 am]

BILLING CODE 8010-01-M

Corrections

Federal Register
Vol. 54, No. 68
Tuesday, April 11, 1989

This section of the FEDERAL REGISTER contains editorial corrections of previously published Presidential, Rule, Proposed Rule, and Notice documents. These corrections are prepared by the Office of the Federal Register. Agency prepared corrections are issued as signed documents and appear in the appropriate document categories elsewhere in the issue.

DEPARTMENT OF COMMERCE

International Trade Administration

Antidumping or Countervailing Duty Order, Finding, or Suspended Investigation; Opportunity To Request Administrative Review

Correction

In notice document 89-7686 appearing on page 13211 in the issue of Friday, March 31, 1989, make the following correction:

On page 13211, in the second column, in the table, under "Period", the third entry should read "01/01/88-12/31/88".

BILLING CODE 1505-01-D

NUCLEAR REGULATORY COMMISSION

[Docket No. 50-155]

Consumers Power Co., Consideration of Issuance of Amendment to Facility Operating License and Opportunity for Hearing

Correction

In notice document 89-7440 beginning on page 12976 in the issue of Wednesday, March 29, 1989, make the following correction:

On page 12976, in the second column, in the last paragraph, in the first line, "April 2, 1989" should read "April 28, 1989".

BILLING CODE 1505-01-D

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 71

[Airspace Docket No. 89-AWA-2]

Proposed Alteration of VOR Federal Airways

Correction

In proposed rule document 89-4964 beginning on page 9061 in the issue of Friday, March 3, 1989, make the following correction:

§ 71.123 [Corrected]

On page 9062, in the third column, under **V-126 [Amended]**, in the third line, "Watervill-42e" should read "Waterville".

BILLING CODE 1505-01-D

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 71 and 75

[Airspace Docket No. 89-AWA-3]

Proposed Alteration of VOR Federal Airways and Jet Routes; MI

Correction

In proposed rule document 89-4965 beginning on page 9063 in the issue of Friday, March 3, 1989, make the following correction:

§ 71.123 [Corrected]

On page 9064, in the first column, under **V-221 [Amended]**, in the eighth line, "260°" should read "261°"

BILLING CODE 1505-01-D

federal register

Tuesday
April 11, 1989

Part II

Environmental Protection Agency

40 CFR Part 86

Standards for Emissions From Methanol-Fueled Motor Vehicles and Motor Vehicle Engines; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 86

[AMS-FRL 3426-4]

Standards for Emissions From Methanol-Fueled Motor Vehicles and Motor Vehicle Engines

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Today's rule provides emission standards and test procedures for vehicles operating on methanol fuels. The evaporative and exhaust emission standards apply to all new motor vehicles: light-duty methanol vehicles (LDMVs), light-duty methanol trucks (LDMTs), heavy-duty methanol vehicles and engines (HDMVs, HDMEs), and methanol motorcycles. The regulations are effective beginning with the 1990 model year.

With few exceptions, exhaust standards identical to those applicable to current petroleum-fueled diesel engines are set for methanol-fueled diesel engines. Similarly, standards identical to those currently applicable to gasoline fueled vehicles are set for methanol-fueled Otto-cycle vehicles.

The carbon monoxide (CO), nitrogen oxides (NO_x), particulate, and smoke standards are numerically identical to those for current vehicles. Particulate and smoke standards, which currently apply only to petroleum-fueled diesel engines and vehicles (hereafter usually collectively referred to as vehicles), are set for methanol-fueled diesel vehicles. Idle CO standards apply to all methanol-fueled light-duty trucks and heavy-duty engines (Otto-cycle and diesel). Crankcase emissions are prohibited from all methanol vehicles and motorcycles. The new exhaust emission standards for non-oxygenated and oxygenated hydrocarbons (*i.e.*, organics) are intended to control carbon emissions from methanol vehicles to a level which is equivalent on a total carbon basis to that allowed from petroleum-fueled vehicles under their respective hydrocarbon (HC) standards. Evaporative organic emission standards are set for methanol vehicles regardless of engine type and are intended to limit carbon emissions to levels allowable for current gasoline vehicles. Particulate and NO_x emission averaging programs are established for every class of methanol vehicle where similar programs exist for current vehicles and are structured identically to those programs. No averaging is permitted across fuel types (*e.g.*, between methanol- and petroleum-fueled vehicles).

This action is being taken to remove the possibility that the absence of emission standards could hinder the development of methanol as a transportation fuel. The standards for methanol vehicles will provide a comparable degree of human health and environmental protection to that afforded by those applicable to current vehicles.

It should be noted that this rulemaking was developed prior to the enactment of the "Alternative Motor Fuels Act of 1988" (Pub. L. 100-494, October 14, 1988), which directs EPA to take specific actions necessary to include methanol-fueled vehicles in the Corporate Average Fuel Economy (CAFE) program beginning in 1992. These actions include the establishment of fuel economy test procedures. Since this rulemaking was at such an advanced level of review at the time that this Act was passed, including the necessary additional action would have severely delayed its promulgation. Therefore, the required action is not included here, and will be completed in a separate EPA regulation in the near future. All subsequent discussions of fuel economy and the CAFE program represent EPA's position prior to the "Alternative Motor Fuels Act of 1988."

DATES: This final rule is effective on June 12, 1989.

Note.—Under section 307(b)(1) of the Clean Air Act (hereafter referred to as "the Act"), EPA hereby finds that these regulations are of national applicability. Accordingly, judicial review of this action is available only by the filing of a petition for review in the United States Court of Appeals for the District of Columbia Circuit within 60 days of publication. Under section 307(b)(2) of the Act, the requirements which are the subject of today's notice may not be challenged later in judicial proceedings brought by EPA to enforce these requirements.

ADDRESS: Material relevant to this final rule is contained in Public Docket No. A-84-05. The docket is located at the U.S. Environmental Protection Agency, Central Docket Section, South Conference Center, Waterside Mall, 401 M Street, SW., Washington, DC 20460. The docket may be inspected between 8 a.m. and 3 p.m. on weekdays. A reasonable fee may be charged by EPA for photocopying. In addition, single copies of the Summary and Analysis of Comments document, which provides a basis for this final rulemaking, may be obtained by request from the contact person below. This document contains the Agency's response to the public comments received in regard to the Notice of Proposed Rulemaking (NPRM) and updates the technical analyses that were originally presented in the Regulatory Support Document (Docket Item III-A-3) published concurrently with the NPRM.

FOR FURTHER INFORMATION CONTACT: Mr. Charles Moulis, Emission Control Technology Division, U.S. Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, MI 48105, (313) 668-4229.

SUPPLEMENTARY INFORMATION:

I. Introduction

Since the early 1970's, the nation's need to reduce levels of air pollution and its dependence on imported petroleum has led to much research into alternative motor fuels. Methanol (CH_3OH) has emerged from this process as the leading candidate to replace gasoline when supplies of petroleum begin to tighten.[1] Methanol, currently made from natural gas and in the longer term producible from coal and other feedstocks, is more economical to produce and use than any other currently known liquid alternative to petroleum-based fuel. Methanol is an excellent, high octane, motor fuel. It has, in fact, been the fuel of the Indianapolis 500 race since the 1970's, in part because of its performance advantages over gasoline. It is clean burning, with significant potential advantages over petroleum fuels in terms of reactive HC, NO_x, CO, smoke, and particulate emissions. Moreover, prototype methanol vehicles have routinely demonstrated a 5 to 10 percent energy efficiency advantage over comparable gasoline-fueled engines, and equivalent efficiency to comparable diesel oil-fueled engines. Optimized vehicles have the potential for even more dramatic improvements. This increased efficiency would lead to reductions in vehicular CO_2 emissions. This is important given the impact of CO_2 on global warming (*i.e.*, the "greenhouse effect"). In order to assess the overall impact of methanol use on global warming, however, methanol production process technology and feedstock must also be taken into account, as well as effects on other greenhouse gases such as methane, nitrous oxide, CO and ozone. This issue is discussed in more detail in Section VI (Environmental Effects).

Significantly, the three largest U.S. automakers have all publicly supported methanol as the most desirable

[1] Fuel methanol, as discussed herein, which may contain percentages of hydrocarbon additives, is to be distinguished from methanol blends where a small amount of methanol (*e.g.*, 2-5 percent) is mixed with gasoline and sold as gasoline

candidate to replace petroleum, and test fleets of methanol vehicles have been operated in several locations around the country as well as internationally. These fleets involve vehicles produced by almost every major manufacturer in the world. The largest light-duty vehicle demonstrations have been in California, and have involved over 800 vehicles. Methanol transit bus programs exist in or are planned for San Francisco, Seattle, Los Angeles, Riverside, Jacksonville, New York City, Denver, and Phoenix, as well as Canada, Germany, New Zealand, and South Africa. Early programs have adequately demonstrated the viability of methanol vehicles and present the possibility that methanol vehicles could enter the marketplace in significant numbers in the relatively near future. Development of more advanced methanol vehicle technologies is now being pursued with the goal of optimizing vehicle driving performance, emissions, and efficiency. Additionally, vehicle technology which allows the use of methanol and gasoline in any combination is available and is undergoing testing. It has been suggested that such technology could help to ease a transition to methanol during a period when fuel methanol is not widely distributed.

Before methanol vehicles are sold in significant numbers, however, appropriate regulatory consideration must be given to the emissions from such vehicles. The current Federal Motor Vehicle Control Program (FMVCP) applies to gasoline-fueled and diesel vehicles and utilizes test procedures designed for petroleum fuels. However, section 202 of the Clean Air Act (CAA), 42 U.S.C. § 7521, authorizes EPA to control harmful emissions from all vehicles regardless of fuel type.

Methanol producers and vehicle manufacturers have been aware that certain emission standards and test procedures will apply to methanol vehicles, but have not known what the specific requirements would be. This uncertainty was a potential impediment to the development of methanol as a transportation fuel according to a report by the General Accounting Office [2] and, along with other issues, led to the formation of a cabinet level working group on alcohol fuels. (This group, headed by the Vice President, recently endorsed methanol usage as a cost effective long term air quality strategy.)

To eliminate this uncertainty, EPA initiated the development of suitable emission standards, test procedures, and associated regulations for all methanol motor vehicles: light-duty vehicles, light-duty trucks, heavy-duty vehicles, and motorcycles. On April 10, 1984, the Agency published an Advance Notice of Proposed Rulemaking (ANPRM) in the **Federal Register** (49 FR 14244). This notice set forth a preliminary approach to including methanol vehicles under the mobile source regulatory umbrella. Comments were requested from the public in a number of key areas in response to EPA's suggested approach. The ANPRM was followed by an informal workshop on May 30, 1984, to provide an opportunity for an exchange of views regarding the subjects raised in the notice.

After fully considering oral comments presented at the public workshop and written comments submitted in response to the ANPRM, the Agency published a Notice of Proposed Rulemaking (NPRM) in the **Federal Register** on August 29, 1986 (51 FR 30984). This notice further developed EPA's standard setting approach for methanol vehicles. In general, EPA proposed that standards identical to those already applicable to gasoline-fueled and diesel vehicles be set for methanol vehicles, depending on the engine type from which the methanol engine was derived.[3] Exceptions to this general rule were made only in areas where the emissions of methanol vehicles were expected to require control regardless of the combustion cycle utilized. Thus evaporative, idle, and crankcase emission standards were proposed for all methanol vehicles even though they currently apply to only one of the currently regulated vehicle types.

The Agency found this overall approach appropriate for several reasons. First, the otherwise applicable emission control requirements of the Act do not distinguish between vehicles operating on different fuels, and the legislative history of the Act indicates that Congress generally contemplated common emission standards for vehicles of different fuel types. Second, EPA previously took this approach in setting standards for diesel vehicles based on standards applicable to gasoline-fueled vehicles (for example, see 50 FR 10606). Third, this approach would provide equal environmental protection from vehicles of different fuel types, since the emissions of common pollutants would be controlled to the same levels. Fourth, methanol vehicles are expected to be similar in type, size, and function to their petroleum counterparts, so it would be equitable to require them to comply with the similar standards.

A public hearing was held on October 30, 1986, in Ann Arbor, Michigan at which oral comments on the NPRM were entertained. Written comments responding to the proposal were also received from 24 public and private parties.

Finally in a related action, on January 29, 1988 EPA published the "Guidance on Estimating Motor Vehicle Emission Reduction From the Use of Alternative Fuels and Fuel Blends" (technical report No. EPA–AA–TSS–PA–87–4). This document detailed Agency policy on the use of alternative fuels (including methanol) as an ozone reduction strategy. In this guidance, EPA found that the use of methanol fuel was a viable strategy for reducing ozone levels.

The remaining sections of this preamble describe EPA's resolution of the issues associated with the rulemaking. Section II describes today's action and summarizes the new requirements. Section III reviews the comments received on the NPRM and the Agency's analysis of those comments. Subsequent sections summarize the technical feasibility, leadtime requirements, environmental effects, and economic effects associated with the methanol standards.

II. Description of the Action

The following discussion describes each provision of the Final Rule. As already discussed, methanol-fueled vehicles will now be regulated along with petroleum fueled vehicles under the existing Federal Motor Vehicle Control Program (FMVCP). In this regard, it is important to note that because the design and function of methanol vehicles is very much like that of their petroleum counterparts, the methanol emission control requirements are comparable (in most cases identical) to those already in existence. This includes EPA's motor vehicle emission regulations governing certification, production line, and in-use requirements. Rather than presenting an exhaustive review of the entire FMVCP, this section contains a basic description of the methanol emission control requirements. The established regulations or protocols generally will be highlighted only where they differ for methanol vehicles. For additional information on the new or existing program requirements, the reader is referred to the accompanying

[2] The report entitled, "Removing Barriers to the Market Penetration of Methanol Fuels," is available for review in EPA Docket No. A–84–05.

[3] Currently, emission standards for gasoline-fueled vehicles apply to exhaust hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO_x), evaporative HC, and crankcase emissions. The standards for vehicles using diesel engines apply to exhaust HC, CO, NO_x, crankcase emissions, particulate, and smoke.

regulations appearing at the end of today's notice or Title 40, Part 86 of the Code of Federal Regulations, which this rulemaking hereby amends. Table 1 summarizes the numerical standards promulgated in today's action.

TABLE 1.— EMISSION STANDARDS FOR 1990 AND LATER MODEL YEAR METHANOL-FUELED VEHICLES AND ENGINES [1]

Vehicle class	Exhaust Standards [2]					Evaporative Organics [3] (g/test)
	Organics [3]	CO	NO_x	Particulate	Idle CO (% conc)	
LDV [4] Otto-cycle	0.41	3.4	1.0	N/A [5]	N/A	2.0
LDV [4] diesel	0.41	3.4	1.0	0.20	N/A	2.0
LDT_{16} Otto-cycle	0.80	10	1.2	N/A	0.50	2.0
	(1.0)	(14)	(1.2)		(0.50)	(2.6)
LDT_1 [6] diesel	0.80	10	1.2	0.26	0.50	2.0
	(1.0)	(14)	(1.2)		(0.50)	(2.6)
LDT_2 [7] Otto-cycle	0.80	10	1.7	N/A	0.50	2.0
	(1.0)	(14)	(1.7)		(0.50)	(2.6)
LDT_2 [7] diesel	0.80	10	1.7	0.26	0.50	2.0
	(1.0)	(14)	(1.7)		(0.50)	(2.6)
HDE [8] Otto-cycle	1 1	14.4	[10] 6.0	N/A	0.50	3.0
HDE [9] Otto-cycle	1.9	37 1	6.0	N/A	0.50	4.0
HDE [8] diesel	1.3	15.5	[10] 6.0	[11] 0.60	0.50	3.0
HDE [9] diesel	1.3	15.5	6.0	0.60	0.50	4.0
MC	5.0	12	N/A	N/A	N/A	N/A

[1] Standards in parentheses apply to vehicles sold in specified high-altitude counties. Crankcase emissions are prohibited for all classes of vehicles.
[2] LDV and LDT standards are in g/mi, HDE standards are in g/BHP-hr, and MC standards are in g/km, unless otherwise noted.
[3] Organics standards are expressed in petroleum-fueled vehicle hydrocarbon equivalents, as determined on a carbon mass basis.
[4] Standards apply at all altitudes.
[5] Not applicable.
[6] LDTs up to and including 3,750 lbs loaded vehicle weight (LVW).
[7] LDTs 3,751 lbs or greater LVW
[8] HDEs up to and including 14,000 lbs gross vehicle weight rating (GVWR).
[9] HDEs 14,001 lbs or greater GVWR.
[10] Beginning in 1991 model year, standard becomes 5.0 g/BHP-hr for all HDEs.
[11] Beginning in 1991 model year, standard becomes .25 g/BHP-hr for all HDEs except urban bus engines, which are subject to a 0.10 g/BHP-hr standard. In 1994, the standard becomes 0.10 g/BHP-hr for all HDEs.

A. Effective Date of the Methanol Standards

Today's notice promulgates the 1990 model year as the effective date for the various emission control requirements, representing a two-year delay from the proposed implementation date. EPA had expected to promulgate these standards with sufficient leadtime to permit their implementation by the 1988 model year, but the delay in this final action has necessitated a delay in the standards' effective date. EPA recognizes that the start of the 1990 model year is less than a year away. The Agency also believes that few methanol vehicles are likely to be produced in the 1990 model year, and that any that are will likely be for sale to states and municipalities seeking to improve their air quality. Under these unique circumstances, EPA finds it appropriate to make compliance with the standards for the 1990 model year optional. This approach will ensure that manufacturers have adequate leadtime to respond to the new regulations in an orderly manner, but at the same time provide states and localities with an opportunity to purchase methanol vehicles that comply with EPA standards in the 1990 model year. A more detailed discussion of the issues affecting the leadtime required to comply with today's action is provided in a subsequent discussion (see Section V, "Leadtime and the Effective Date of the Standards").

B. NO_x, CO, Particulate, Smoke, and Crankcase Emission Standards

The NO_x, CO, particulate, smoke, and crankcase emission standards are promulgated as originally proposed, with the exception of the 1990 model year effective date as noted above. In codifying standards for methanol vehicles, it was helpful to classify existing standards according to whether they were applicable to gasoline-fueled vehicles or diesel vehicles, and to extend this classification scheme to include methanol vehicles. Thus, the section of the regulations covering diesel vehicle standards now includes the provision of a methanol test fuel as well as appropriate test modifications necessary to accommodate the properties of methanol vehicle emissions. Similarly, the regulatory sections covering gasoline-fueled vehicles are broadened such that gasoline vehicles (whose thermodynamic characteristics approximate the theoretical Otto-cycle) and Otto-cycle methanol vehicles are grouped together under sections setting forth the standards and test procedures applicable generally to Otto-cycle vehicles.[4]

The NPRM relied on a nonsubstantively different organizational scheme to present the standards that are being finalized today. That document proposed generally applying the diesel vehicle standards to non-throttled methanol vehicles and the gasoline-fueled vehicle standards to throttled methanol vehicles.[5] The use or non-use of a throttle was found to be a good indicator of emissions and performance similarities between methanol vehicles and their petroleum-counterparts. The final rule, which classifies methanol vehicles as diesel or Otto-cycle vehicles, uses a different nomenclature to apply the same general principle. The change in approach is one of organizational convenience and simply lends clarity to the structure of the motor vehicle emission control regulations. The classification of a methanol vehicle as an Otto-cycle or diesel vehicle still depends on the use or non-use of a throttle in normal operation. The final rule also recognizes

[4] No diesel motorcycle standards exist because no such vehicles are mass produced for sale. Therefore, the gasoline motorcycle standards apply to all methanol motorcycles.

[5] For purposes of this rule, a throttle is a device used to control an engine's power output by limiting the amount of air entering the combustion chamber.

that in some future cases, this criterion may not be sufficient to adequately determine the classification of a vehicle. For example, a throttle may be used during only part of the operating cycle. In such cases, the Administrator may need to take into account other relevant factors, such as compression ratio, combustion characteristics, characteristics of the engine's operating thermodynamics, or intended in-use duty cycle. Therefore, unless otherwise specified, where the standards for petroleum vehicles differ by fuel type, the requirements for gasoline-fueled vehicles apply to methanol-fueled Otto-cycle vehicles, while those associated currently with diesel vehicles now apply to methanol-fueled diesel vehicles. More specifically, the exhaust CO standards for gasoline-fueled and diesel heavy-duty vehicles apply to methanol-fueled Otto-cycle and diesel vehicles, respectively. Similarly, the particulate and smoke standards, which apply to diesel vehicles only, are now applicable to methanol-fueled diesel vehicles.

As fully explained in a later section, there are two basic exceptions to the engine cycle-based applicability scheme as it relates to the pollutants discussed in this section. First, the idle CO standards, which apply to certain duty classes of gasoline vehicles, and set for *all* methanol vehicles of a corresponding class regardless of engine type. Second, the standards which currently prohibit crankcase emissions from all petroleum vehicles except non-naturally aspirated heavy-duty diesels, are now applicable to *all* methanol vehicles.

A waiver of the certification testing requirements for CO, particulate, or smoke emissions may be granted by the Administrator to any manufacturer demonstrating that, by virtue of a vehicle's design, the applicable standard would never be exceeded during the vehicle's useful service life. The waiver process is patterned after that associated with the CO standard for heavy-duty diesel vehicles. Manufacturers should be aware that receipt of a waiver of testing requirements in no way relieves the manufacturer of the responsibility to comply with emission standards in the certification process, during Selective Enforcement Audits, or in-use testing. Manufacturers should also be aware that receipt of a waiver in no way implies that EPA will not require emission testing for Selective Enforcement Audits or perform emission testing of in-use vehicles to determine compliance with the applicable standards.

Finally, manufacturers are allowed to determine compliance with the NO_x and particulate standards by averaging emissions within certain vehicle categories. Averaging programs are available for LDMVs, LDMTs, and HDMEs (except bus engines) in the case of particulates, and for LDMTs and HDMEs (including bus engines) in the case of NO_x. These are the same categories for which averaging is presently allowed for gasoline-fueled and diesel vehicles; restrictions relating to averaging between high and low altitude vehicles as well as 49-State and California vehicles will apply to methanol vehicles in the same fashion as for current vehicles. In a manner that is analogous to the separation made between the gasoline-fueled and diesel programs, averaging is prohibited between Otto-cycle and diesel methanol vehicles, and between methanol and petroleum-fueled vehicles.

C. Organic HC Emission Standards

Today's notice promulgates exhaust and evaporative HC standards for methanol vehicles which will generally limit the ozone producing potential of these vehicles to an amount no more than that of current vehicles. This is accomplished by limiting the amount of organic carbon emitted by methanol vehicles to that permitted from their petroleum counterparts. These carbon-limiting standards specifically account for non-oxygenated HC compounds as well as the oxygenated HC compounds of methanol and formaldehyde.[6] This approach results in standards for methanol vehicles that are equivalent to the existing HC standards for current vehicles and, for exhaust emissions, utilizes the same engine classification criteria (diesel or Otto-cycle) in distinguishing between methanol vehicle types as was used in applying CO, NO_x, particulate and smoke standards. Evaporative emission standards, similar in format, are applicable regardless of vehicle type.

The mathematical expression of the organics standards requires the measured masses of non-oxygenated HC, methanol, and formaldehyde to be converted to carbon, summed, expressed as gasoline hydrocarbon ($CH_{1.85}$) and compared to the numerical standard (*e.g.*, from Table 1, 0.41 g/mi for LDMV exhaust emissions). The specific format of this expression is provided in the regulations accompanying this notice.

D. Certification Test Fuel Specification

These regulations require that methanol-fueled vehicles be certified using a test fuel that is: 1) composed of 50 percent or more methanol by volume, and 2) is representative of commercially available fuels. This is similar to the approach currently used for specification of petroleum fuel for diesel vehicles. Representative in-use fuels cannot be determined, however, until the methanol fuel market develops. In the early years of methanol vehicle deployment, as the fuel market evolves, the manufacturer will be required to recommend the certification fuel and provide a justification for its belief that this fuel will be generally available and used in its vehicles. Final responsibility for specifying the test fuel will, however, remain with the Administrator. The Agency will continue to monitor developments in the fuel market and, in the longer run, act to specify representative fuels without requiring manufacturer participation in the process.

E. Test Procedures

Methanol-fueled vehicles are expected to be very similar to current vehicles in most respects. Therefore, the regulations being promulgated here generally apply the established certification and emission test protocols of 40 CFR Part 86 to methanol-fueled vehicles with only minor revisions as necessary to accommodate the unique functional aspects of methanol combustion technology. (For example, provision is made to ensure that the high water content of the products of methanol combustion does not interfere with accurate emissions sampling and analysis.)

The only area where major revisions were required involves the measurement of newly regulated pollutants. In order to ensure compliance with the organic standards being promulgated in this rulemaking, separate measurement of non-oxygenated HC, methanol, and formaldehyde is required. Although specific measurement procedures are provided in this rule (see the accompanying regulations for details), the Agency will allow alternative procedures provided that the manufacturer can demonstrate that they produce results equivalent to those obtainable from the procedures required here. These procedures are summarized in the following discussion.

The procedure for measuring non-oxygenated HC and methanol consists

[6] Technically, HC refers to compounds containing only hydrogen and carbon. By definition such compounds are non-oxygenated. In this rule, the term non-oxygenated HC is used, however, to distinguish the traditional hydrocarbon from the oxygenated components of methanol vehicle emissions.

of two steps. First, the methanol is collected by bubbling the exhaust or evaporative sample through water filled impingers. A gas chromatograph is then used to separate the methanol from the other constituents of the water/alcohol solution. The methanol is measured with a flame ionization detector (FID). Second, a combined measurement of the non-oxygenated HC and methanol in the sample is made using a heated FID calibrated on propane. The amount of non-oxygenated HC can then be determined by correcting the heated FID reading for methanol content. This requires an accurate determination of the device's response to pure methanol.

Formaldehyde measurements can be made using either of two similar procedures. The first involves bubbling the exhaust sample through impingers filled with 2,4-dinitrophenylhydrazine (DNPH) solution. The alternative procedure would replace the impingers with cartridges containing DNPH-impregnated silica gel. In either case, the products of the reaction between the aldehydes and the DNPH are separated using high pressure liquid chromatography. The amount of formaldehyde is then determined by an ultraviolet detector.

As an interim option, in order to give manufacturers flexibility in developing their methanol certification programs, EPA will allow manufacturers to use a simplified procedure for a five-year period from the date of initial effectiveness of these rules. This procedure involves a single measurement using a heated FID calibrated with methanol, with the result reported as $CH_{1.85}$. This would generally overmeasure HC, but undermeasure formaldehyde, with the net result being an organic measurement that would be somewhat higher than would have been obtained using the more detailed procedure. Vehicles certified using this procedure will also be liable for in-use compliance with the organics standards when this method is used.

As with other regulated pollutants, background measurements of each organic emission component are provided for in the test procedures.

F. Testing and Certification of Flexible Fuel Vehicles [7]

Under the regulations being promulgated in today's notice, vehicles that are designed to operate on gasoline, fuel methanol, or any mixture of these fuels must comply with the standards when tested on any fuel mixture which falls within the design range. As a matter of testing convenience, EPA will only require the manufacturer to test the vehicle on the mixture that is expected to produce the highest emissions. However, EPA does retain the right to perform testing using any fuel mixture that falls within the design range. The worst-case test fuel for each flexible fuel vehicle (FFV) will be recommended by the manufacturer, and approved by the EPA Administrator, at the time of certification, and may be different for exhaust and evaporative emission testing. (When any fuel except gasoline is used, the test procedure applicable to methanol vehicles will be adopted for these vehicles.) The manufacturer will continue to be liable for ensuring that any FFV so certified will comply with the applicable standards in customer service if tested on any reasonably available gasoline or methanol fuel, or any mixture of the fuels. Since this rule takes no action with respect to the Corporate Average Fuel Economy and Gas Guzzler Tax program requirements, FFVs will be treated as gasoline-fueled vehicles for the purposes of fuel economy testing and labeling (*i.e.*, tested on pure gasoline).

III. Public Participation

A number of interested parties commented on EPA's August 29, 1986 NPRM. The comments include written submittals to the rulemaking docket and those presented at the October 31, 1986 public hearing, which was held in Ann Arbor, Michigan. The Agency has fully considered these comments in developing today's final rule.

This section describes the major issues of the rulemaking, as reflected by the public comments. The discussion of each issue opens with a brief review of what was proposed. After this, a summary of the significant comments and EPA's analysis of the issue is provided. The reader is referred to the appropriate chapter of the Summary and Analysis of Comments document for the complete technical details of EPA's analysis. That document is available in the rulemaking docket. (For information on access to the docket, see the "**ADDRESSES**" section above.)

A. Scope of the Rulemaking

Summary of the Proposal. While there has been an interest in alternative fuels for many years, the development of methanol as a transportation fuel is reaching the point where mass production of methanol vehicles is a real possibility within the next decade. As noted previously, before a significant number of these vehicles could be sold, they would be required to comply with certain emission standards, as is the case for current petroleum-fueled vehicles. A primary purpose of expanding the scope of the Federal Motor Vehicle Control Program to cover methanol-fueled vehicles is to remove a potential impediment to the introduction of this technology by providing manufacturers with an understanding of the regulatory requirements which would be applicable to these vehicles. The Agency's overall regulatory approach in the proposed rule was to ensure that the standards applicable to methanol vehicles would be of comparable stringency to the standards applicable to petroleum fueled vehicles, and have environmental impacts no more adverse than current vehicles.

Summary of the Comments. The comments pertaining to the stated goals of the rulemaking either criticized the lack of standards for vehicles run on other alternative fuels, or addressed the stringency of the proposed emission control requirements for methanol vehicles. Regarding the breadth of the proposal, the State of New York commented that there is currently a substantial research effort aimed at developing a wide range of alcohol-based fuels from synthetic gas. It felt the rulemaking should be broadened to include all oxygenated fuels, avoiding the need to promulgate separate regulations in the future. CNG Services of Pittsburgh felt that emission standards should be promulgated for vehicles operated on natural gas. Brooklyn Union Gas felt EPA should put natural gas on a level playing field with methanol but did not actually suggest that standards be developed for natural gas vehicles.

A few manufacturers expressed the view that the rulemaking action should not inhibit progress through overly restrictive requirements. GM was the most outspoken in this regard, terming the proposed standards and test procedures "rigid and complex regulation." It also recommended an interim period of less stringent standards for methanol than for current vehicles to encourage further development. The Oxygenated Fuels Association and the Department of Energy (DOE) suggested interim standards to be revisited after several years. Several other commenters, such as Chevron, the National Automobile Dealers Association, and the Manufacturers of Emission Controls Association (MECA) were in basic agreement with EPA establishing methanol standards of comparable stringency, stating they would not be an impediment to methanol development.

[7] Flexible fuel vehicles are sometimes referred to as multi-fuel vehicles, dual-fuel vehicles, dual energy vehicles, or variable-fuel vehicles.

DOE and MECA both argued that while the proposed standards represent comparable stringency to gasoline vehicle regulations, more stringent standards could potentially be adopted in the future.

EPA Response to Comments. Regarding the inclusion of other alternative fuels in the present rulemaking, EPA notes that a consensus has not yet emerged as to whether the lack of emission standards for energy sources other than methanol is a potential hindrance to their development as motor vehicle fuels. Methanol, on the other hand, has been identified by the motor vehicle manufacturers, the Federal government, many state and local governments and various environmental groups as a desirable and feasible future transport fuel. The lack of standards for methanol vehicles was identified by a Cabinet-level group as an impediment to methanol's introduction. Since a similar degree of broad based interest in other alternative transportation fuels has not been demonstrated, limiting the present rulemaking to methanol is appropriate. Moreover, if the Agency did wish to expand the scope of this rule, specific proposals would first have to be issued for comment. Thus it would not be possible for EPA to finalize standards for alternative fuels other than methanol in this rulemaking. However, the Agency may act in the future to address other fuels.

In fact, the Agency believes that, having included methanol-fueled vehicles within the framework of previously existing standards, the inclusion of vehicles run on other fuels can be expeditious, as discussed forthwith. The Agency intends to use the diesel and Otto-cycle classification to the greatest extent practicable in applying the current exhaust emission standard setting approach to engines using alternative fuels. Where single constituent pollutants such as CO are concerned identical standards regardless of fuel type would likely apply. Multi-constituent pollutants such as unburned or partially combusted fuel may require special consideration, as in the case of methanol vehicles. It is the Agency's intent to control evaporative emissions of volatile fuels without regard for engine cycle, most likely using similar criteria as are deemed appropriate for the regulation of unburned or partially combusted fuel in exhaust emissions. The Agency would also need to take into consideration any unique aspects of new fuels and their combustion properties in determining whether to control previously unregulated pollutants (such as formaldehyde in the methanol vehicle case). Finally, test procedure modifications, as appropriate to ensure accurate measurement of all regulated pollutants, would need to be considered.

Such evenhanded treatment of different fuels would provide equitable environmental protection. It would also allow a more efficient operation of the free market in determining what engines are produced than would a policy of regulating differently the emissions resulting from the use of each new fuel. Furthermore, the use of a standard approach would expedite the process of including vehicles run on new fuels in the regulations, since it would not require returning to square one to derive appropriate standards. Thus, while the current rulemaking does not include any alternative fuel other than methanol within the purview of the emission control program, it does lay much of the groundwork necessary to include other fuels as it becomes apparent that they are potential market contenders. EPA will continue to monitor the progress of other alternative fuels, including their environmental benefits and likely market penetrations. Emission standards and test procedures for such fuels will be developed when warranted.

The preceding discussion regarding potential future fuels applies equally to potential future engine cycles. For example, a new Brayton cycle engine using petroleum fuel would be expected to meet the same single constituent pollutant standards as other engines, although special test procedures and additional emission standards might be necessary.

The Agency is in basic agreement with those commenters expressing concern that overly stringent regulation could hinder the development or sale of methanol vehicles, but disagrees that the proposed requirements would have this effect. As will be discussed in other sections of this document, the standards for methanol vehicles represent comparable stringency to those for current vehicles and should be achievable using similar technology. Such standards represent equitable technological treatment among the vehicle types. As will be discussed under the sections "Technical Feasibility" and "Economic Effects," the technical feasibility and cost of these standards are not issues; it is thus difficult to conclude that the rules as proposed would hinder the development of methanol vehicles, or that there is any basis to establish relaxed requirements as suggested by GM.[8] Also, the rules as finalized provide the greatest degree of certainty for developers of methanol vehicles. In response to those commenters suggesting that standards of greater stringency and by extension, environmental benefit, may be feasible in the future, EPA notes that any standard not specifically set by statute may be reconsidered in the future if warranted.

In summary, given the underlying rationale for today's rule, there is no justification to change either its scope or its control strategy at present. Future actions to expand the regulations could of course occur and would be considered on their merits, taking account of cost, feasibility, environmental need, and any other relevant factors.

B. Hydrocarbon Standards

1. Basis of the Ozone-Related Standards

Summary of the Proposal. As already mentioned, EPA clearly stated its intention in the NPRM to implement standards for methanol vehicles that are of comparable stringency and environmental benefit to those applicable to current petroleum-fueled vehicles. Accordingly, with regard to reactive organic emissions, the Agency wanted to ensure that methanol vehicles would produce no more tropospheric ozone than current vehicles. Achieving this goal, however, is somewhat complicated due to differences in the chemical composition of exhaust and evaporative organic emissions between methanol and current vehicles. The photochemically reactive organic emissions from petroleum-fueled vehicles are composed primarily of non-oxygenated HC. Methanol vehicles emit not only non-oxygenated HC, but also substantial quantities of oxygenated HC compounds with varying photochemical reactivities. In the exhaust, these latter compounds are principally unburned methanol and formaldehyde. For evaporative emissions, methanol is the principal oxygenated HC compound. Thus, equivalent amounts of gasoline and methanol vehicle emissions can be expected to have different tendencies to produce ozone, and EPA's proposal had to account for this.

The Agency proposed separate exhaust and evaporative emission

[8] As is discussed in subsequent sections of this notice, certain test procedure requirements have been simplified for an interim period. These allowances do not, however, represent a change in the overall approach to the rule, but rather are intended to allow manufacturers the opportunity to gain familiarity with new equipment and test protocols.

standards that would limit the total amount of organic carbon emitted from methanol vehicles to the amount that is permitted from current vehicles complying with their applicable HC standards. This standard-setting approach was chosen by EPA because, based on limited photochemical modeling results, the ozone producing potential of methanol vehicles complying with the carbon-based standards was generally expected to be similar or somewhat less than that of current vehicles.[9] (Such a finding is not unexpected, given that the photochemical oxidation process leading to ozone production is carbon dependent.) Additionally, these standards appeared to be achievable using control technology similar to that already used on current vehicles, so they were not anticipated to be a hindrance to the development of methanol vehicles nor to result in increased compliance costs as compared to current vehicles. This approach also had the appeal of extending the basis of the HC standards for existing vehicles to methanol vehicles in a manner apparently consistent with the basic philosophy embodied in the Clean Air Act, which focuses organic emission control primarily on ozone precursors. The carbon equivalence approach not only obviated the need to adjust the standard for or otherwise consider the mass of oxygen (which is not of itself a reactive agent) contained in methanol vehicle emissions, but also allowed the scientifically meaningful application (in terms of ozone potential) of the current numerical value of the standard to a new fuel.

As an alternative, EPA requested comments on a more empirical approach to setting standards. This approach would rely on the results of photochemical modeling to establish standards that would result in methanol vehicles having ozone potential equivalent to gasoline vehicles. In describing this alternative, the Agency noted the currently limited number of photochemical modeling studies upon which such standards would have to be based and indicated that significant uncertainties existed in translating modeling results into meaningful standards. Nonetheless, the Agency's preliminary analysis in the NPRM suggested standards of this type might be somewhat less stringent and less costly than the carbon-based standards.

[9] This modeling is described in detail in the Summary and Analysis of Comments document (docket item A-84-05-V-B) as well as the NPRM's Regulatory Support Document (docket item A-84-05-III-A-3).

The Agency also asked for comments regarding the need for separate formaldehyde exhaust standards to prevent excess emissions of this highly photochemically reactive compound from some methanol vehicles.

Summary of the Comments. No comments were received disputing EPA's preliminary finding in the NPRM that the proposed carbon-based standards would adequately limit the ozone producing potential of methanol vehicles relative to current vehicles. In fact, most commenters found EPA's proposed standards acceptable. The carbon-based standards were described as being scientifically reasonable, environmentally sound, and technologically feasible using control hardware similar to that used on current vehicles at a similar cost. Only two comments questioned the feasibility of complying with the carbon-based standards for exhaust emissions. Ford presented emission data showing that some prototype vehicles would be able to meet the photochemical modeling-based standards but not the proposed carbon-based standards. Ford did not argue that the carbon-based standards were infeasible but rather that the photochemical modeling-based standards were less stringent. GM presented data, based on limited testing of light-duty vehicles, which showed levels of organic emissions well below the carbon-based standards. Caterpillar stated that its prototype heavy-duty engine was expected to fail the standards by a factor of two due to high methanol emissions at light load conditions, but provided no test data to support this claim. No comments were received disputing the feasibility of the proposed evaporative emission standard.

Many of the commenters supporting the proposed carbon-based standards also believed insufficient information was available with which to develop acceptable photochemical modeling-based standards. Some stated that such a standard-setting approach would require more modeling studies than had been performed and that these studies might need to consider multi-day ozone episode effects. (Multi-day modeling is more complex than single day modeling and depends on a more detailed input data base.) Several commenters expressed serious reservations concerning the inherent difficulties and environmental risk associated with setting nationwide standards purporting to provide the same ozone protection from methanol-fueled vehicles as from petroleum-fueled vehicles. These reservations were based on the fact that photochemical modeling is capable of considering only a limited set of meteorological and pollutant inventory circumstances for a limited set of specific cities.

A few members of the automobile industry suggested that photochemically-equivalent standards could be adequately identified and should be adopted. Notably, Ford felt that sufficient modeling had already been performed to allow promulgation. Ford discussed its own analysis which modeled the impact of methanol use in 20 cities. GM stated that such standards could be developed based on multi-day modeling of six metropolitan areas.

The commenters supporting the photochemical modeling-based standards did so because they believed such standards would be less stringent and less expensive. As discussed previously, Ford submitted test data which show that the photochemical modeling-based standards discussed in the NPRM were easier to meet than the carbon-based standards. None of the commenters, however, submitted data that could be used to develop a quantitative estimate of any economic benefit that might result from adopting standards based on photochemical modeling. GM specifically stated that it was unable to make an estimate in this regard.

Several commenters felt that separate formaldehyde standards should be adopted to ensure adequate control of this highly photochemically reactive compound. Specifically, the California Air Resources Board (CARB) suggested separate formaldehyde standards for the various classes of vehicles that would limit this pollutant to the levels of current vehicles. Two commenters questioned the present feasibility of separate formaldehyde standards, while others felt there was insufficient data upon which to base such a requirement.

EPA Response to Comments. The Agency has reviewed the environmental adequacy and technical feasibility (including a consideration of stringency relative to current gasoline-fueled vehicle standards) of the proposed carbon-based organics standards in light of information provided by the various commenters, as well as additional information obtained by EPA. Turning first to the issue of environmental adequacy of the standards, the reanalysis included Ford's newly available modeling results for 20 cities along with new fleet-average emission factors for methanol vehicles developed from an expanded emission factor data base The results indicate that methanol vehicles produced in compliance with

the carbon-based standards would have about 54 to 95 percent of the ozone-producing potential of current gasoline vehicles (depending on the city and study under consideration). Therefore, the Agency agrees with the commenters that this standard-setting approach is sufficient to prevent a degradation in ambient ozone air quality levels from occurring as a result of methanol vehicle operation.

Turning next to the question of technical feasibility, there were no comments opposing EPA's finding in the NPRM that the proposed carbon-based *evaporative* emission standards were achievable using currently available control technology, so the feasibility of this requirement is not an issue. Regarding the proposed carbon-based *exhaust* standards, however, several remarks were received concerning the ability of prototype vehicles to meet those standards using currently available control technology.

In evaluating these comments, EPA believes it is important to recognize that they are based on the results of prototype vehicle development programs. The goals of these programs were not aimed at compliance with emission standards specifically designed for methanol vehicles. Even though Ford's comments indicate only a limited amount of development work was done to reduce methanol vehicle emissions, the data presented by Ford show that the majority of prototype vehicles could meet the proposed exhaust standards at the low to moderate mileage accumulation levels attained by the test vehicles. Further, when vehicles that did not meet the proposed CO and NO_x standards—which Ford did not argue are infeasible—are excluded from Ford's data, all of their vehicles emit at levels below the carbon-based organics standard. GM's data are somewhat less useful since there is no indication of CO or NO_x levels. The data do, nevertheless, support the feasibility of the organic standards. Numerous other comments were also received supporting the technical feasibility of meeting the proposed exhaust standards using currently available technology. Insufficient information on the emission-related goals of Caterpillar's prototype development program was provided to assess whether or not that company's claim that its engines presently emit organics in excess of the proposed standards means that the standard itself is infeasible.

On the whole, considering relevant data and comments on the feasibility of the carbon-based standards for both light- and heavy-duty vehicles, EPA finds no basis to alter its earlier conclusion that the proposed carbon-based exhaust and evaporative emission standards are attainable using emission control technology similar to that used on current vehicles at similar costs.

The Agency also studied the environmental adequacy and feasibility of photochemical modeling-derived standards. In evaluating this approach to standard setting, two important questions must be considered: first, can adequate photochemical-modeling based standards be derived, and second, from environmental and cost perspectives, do these standards necessarily represent a superior standard-setting approach?

In order to assess the appropriateness of standards derived from photochemical modeling, it is necessary to examine the quality of the available modeling studies themselves, and the amount of modeling data available. In addition, to date only a limited number of modeling studies have been performed. Of these, EPA finds only three that have value for the purposes of developing standards. Two of the studies were performed by Systems Applications, Inc. (SAI), and modeled the effect of methanol fuel substitution on ozone levels in Los Angeles and Philadelphia.[10] [11] Both SAI studies have similar methodologies. Each evaluated methanol's impact over one day periods. Each employed an "airshed" model (three dimensional, citywide modeling grid) to define the trajectory of the single air parcel which, in the base case (no methanol use), developed the maximum one-hour ozone concentration. Each employed the less complex "trajectory" model, focusing on the previously identified air parcel, to evaluate subsequent scenarios with various levels of methanol substitution. Finally, each expended substantial effort to develop city-specific input data, including emissions and meteorological information.

The third study was performed by Ford and discussed in its comments to the NPRM. The study evaluated single day ozone episodes for 20 non-attainment areas outside California (including Philadelphia) using a trajectory model only. Simplified, linear trajectories were assumed, and default emissions speciation factors, identical in all cities, were applied. These simplifications limit the representativeness of the results for any particular city. Additionally, Ford's modeling, by design broad in scope, was limited in depth to only four runs per city.

Unfortunately, as discussed in the Summary and Analysis of Comments, all the studies are deficient to varying degrees. Review of the available information shows that although the current studies are very useful in estimating the potential impact of methanol vehicles they are inadequate for the purpose of promulgating photochemical modeling-based standards.

Of course, many of the limitations could be addressed by further modeling, as suggested by GM. But sufficient modeling would likely take years to complete (precluding application to this rulemaking). EPA therefore considered whether it might be possible to use the currently available data by accounting in some fashion for the uncertainty associated with it. As will be shown, however, the benefit of photochemically-derived standards over carbon-based standards remains unclear based on this analysis. The uncertainty in this regard follows from a consideration of the method EPA would need to use to set environmentally acceptable requirements.

The mathematical expressions used to derive photochemically equivalent exhaust and evaporative standards Include factors to account for the relative photochemical reactivities of methanol and formaldehyde when compared to the non-oxygenated HC emitted from current vehicles. Relative reactivity as a concept implies that organic compounds can be characterized as having a given amount of ozone potential relative to the "typical" (or "average") organic emission. This ozone potential is quantified as the amount of ozone produced by a given pollutant relative to that produced by the same amount of the average hydrocarbon mixture. The Summary and Analysis of Comments document provides a detailed discussion of the modeling technique used to quantify these relative reactivities. Relative reactivity values are then used in the mathematical formulation of the standard to weight each pollutant according to its ozone producing potential. Attaining the goal of equivalent ozone potential, therefore, involves choosing the relative reactivities for methanol and formaldehyde so that no area experiences a change in ozone air quality from methanol vehicles.

[10] G.Z. Whitten, H. Hogo, Systems Applications, Inc. "Impact of Methanol on Smog: A Preliminary Estimate," Publication No. 83044, February 1983.

[11] G.Z. Whitten, N. Yankow, T.C. Myers, Systems Applications, Inc., "Photochemical Modeling of Methanol-Use Scenarios in Philadelphia," Publication No. EPA 460/3-86-001, 1986.

Three approaches were identified for choosing these relative reactivities. The first approach uses the average relative reactivities for methanol and formaldehyde from all of the photochemical modeling studies. Consideration of this first approach showed that attaining exactly equivalent ozone potential for methanol vehicles is not feasible, given differences in local air chemistry. Thus, the other approaches considered involved worst case assumptions to ensure that no area would suffer a degradation in air quality due to their use.

The second approach uses the relative reactivities of the worst-case city in the modeling data base. The problem with this approach is that the worst-case city would almost certainly change with time. This would occur because the ratio of methanol reactivity to formaldehyde reactivity is different for each location, making ozone production dependent on the relative mixture of methanol and formaldehyde emissions from methanol vehicles. Over a period of time the emission characteristics of methanol vehicles (*i.e.*, the ratio of methanol to formaldehyde emissions) will likely vary due to changes in fleet mix or vehicle technology. The end result is that the standards would need to be revised in the future to ensure adequate environmental protection.

The third approach uses the highest relative reactivity for each pollutant from the modeling studies regardless of city. With this method, the ozone-producing potential of methanol vehicles in any city would not exceed that for current vehicles. This approach addresses the chief deficiency of the previous two approaches because no area would be expected to experience an increase in ozone and some protection is afforded from future ozone increases due to changes in the methanol vehicle fleet.

While none of the three approaches is ideal, the final method would do the most to ensure that there is not an increase in ozone levels due to methanol vehicle use. (An example of the mathematical formulation of the standard as derived using this final method is given in the Summary and Analysis of Comments.)

Now that a methodology for deriving photochemical modeling-based standards has been identified, the current modeling studies and methanol emissions data base can be used to explore the potential benefit of such standards compared to the carbon-based standards. When the expected ratios of *exhaust* organics from methanol vehicles are applied to the formulas for the carbon-based and photochemical modeling-based standards, the result is that the two alternatives appear to allow roughly the same amount of total carbon to be emitted, with the photochemical modeling-based standards being slightly more stringent for the average vehicle in EPA's methanol vehicle emission factor data base. The fact that the carbon-based standards appear less stringent differs from EPA's earlier tentative conclusion presented in the NPRM, which was that, based on the single modeling study then available, modeling-based standards would be the least stringent alternative. It is also at odds with the views expressed by several of the commenters who favored the modeling-based approach, believing it would be less stringent.

As mentioned in the earlier discussion of the feasibility of the carbon-based standards, Ford did present exhaust emission data for 17 vehicles. This can be used to demonstrate the small difference between carbon-based and photochemical modeling-based standards. When those vehicles that did not meet the proposed CO and NO_x standards are excluded from the data base, the remaining eight vehicles all met the carbon-based standards. All eight met the sample photochemical modeling-based standards given in the NPRM. Seven of the eight met the new standards, derived using the more recent modeling results. Thus, Ford's data do not show that modeling-based standards are less stringent in the case of exhaust emissions. Rather, they tend to support EPA's assertion that the opposite is true. They also show that for catalyst-equipped vehicles, achieving the CO standard may be the primary technological determinant for meeting either of the alternative exhaust organics standards.

Evaluating the relative stringency of the *evaporative* emission standards is much more straightforward. These emissions do not contain formaldehyde and the photoreactivity of methanol compared to the emissions from current vehicles is low. The net result is that evaporative standards based on photochemical modeling will always be less stringent than carbon-based standards. To place this in perspective, the currently available information indicates that methanol vehicles certified to photochemical modeling-based standards could emit about 25 percent more total carbon than under carbon-based standards. This situation could result in smaller evaporative control canisters and a lower cost of controlling evaporative emissions from methanol vehicles. Unfortunately, no comments were received upon which an estimate of the savings associated with the less stringent approach could be based. This analysis does not account for the fact that the low volatility of methanol acts to decrease evaporative emissions. Thus, while the modeling-based standards may allow more total carbon to be emitted, it is not obvious that this represents a meaningful relaxation in the stringency of the standards.

Overall, the available information indicates that photochemically-derived exhaust standards may be slightly more stringent relative to the proposed carbon-based approach. It is presently unclear, however, if this small increase in stringency would result in any difference in the cost of compliance. Conversely, the photochemically-based evaporative standards may be less stringent, but whether there is any economic benefit to this difference is also unknown. When the exhaust and evaporative standards are viewed together and the uncertainties in the analysis are considered, the Agency believes the two standard-setting approaches can be regarded as yielding comparable environmental protection, with generally similar total compliance costs. GM's inability to make an estimate of any difference in regard to the cost of compliance under these approaches supports this argument, especially considering that the difference between the two approaches GM was comparing was much greater than when the updated modeling studies are the basis for reactivity-based standards.

In summary, the Agency's analysis of the proposed carbon-based standards shows they are sufficient to prevent any increase in ambient ozone levels from the use of methanol vehicles, and that they should be achievable using emission control technology similar to that used on current vehicles. The analysis also leads to the conclusion that there is no obvious advantage to implementing standards based on photochemical modeling, especially in light of the inherent analytical difficulties associated with such a standard-setting approach. The Agency has decided, therefore, to promulgate standards as proposed, based on a carbon equivalence to existing HC standards, rather than to pursue the modeling-based alternative.

It should be noted that, under the standards being promulgated today, most areas which adopt a methanol fuel program will experience the equivalent of a decrease in ozone precursors. For example, EPA estimates the equivalent

HC reductions for light-duty methanol vehicles meeting today's standards to be:[12]

34 percent for exhaust HC.

71 percent for evaporative HC (when compared to a 11.5 psi gasoline).

32 percent for evaporative HC (when compared to a 9.0 psi gasoline).

Tne Agency will continue to recognize these credits for states which incorporate an alternative fuels methanol program into their SIPs. Furthermore, a state may, at its option, model the ozone forming potential of an alternative fuels strategy, and adopt different HC reduction figures as appropriate.

In response to the comments regarding the need for separate formaldehyde standards for ozone control, EPA agrees that this pollutant deserves special consideration because of its high photochemical reactivity. The Agency's review of this issue, using the previously discussed photochemical modeling studies and methanol emissions data base, indicates that the fleet-average methanol vehicle certified to the carbon-based standards will have 54 to 95 percent of the ozone forming potential relative to current vehicles. These results indicate that a separate ozone-related standard for formaldehyde is not needed, since the carbon-based standards will most likely limit average formaldehyde emissions to acceptable levels. Therefore, EPA disagrees with the commenters that a separate formaldehyde standard is presently needed. As noted elsewhere, EPA will test production vehicles for formaldehyde emissions; if the Agency finds that formaldehyde emissions on average exceed the levels current data suggests, EPA will reconsider establishing separate formaldehyde standards. Since methanol vehicles will not become numerous enough to affect air quality until well into the next decade, there will be time for EPA to establish separate standards if they prove necessary. [The possibility of a separate standard to protect against the direct health effects of formaldehyde exposure is discussed in Section III.B.3, "Separate Health Effects-Based Standards."]

2. Optional Combined Exhaust and Evaporative Standards

Review of the Proposal. Although not specifically proposed, EPA discussed the possibility of creating optional combined exhaust and evaporative organic emissions standards that would allow increases in evaporative emissions to be offset by reductions in exhaust emissions. This trading scheme was considered in the belief that it might have some benefit in providing manufacturers with the flexibility to decide the most cost-effective approach to controlling a vehicle's total organic emissions. Allowing manufacturers to trade reduced evaporative emissions for increased exhaust emissions was not being considered since the evaporative standards were designed to essentially eliminate the fuel component of any HC emissions measured in evaporative testing. Thus, allowing manufacturers to trade non-fuel emissions for increased exhaust emissions could result in "gaming" of a combined standard, with associated negative environmental effects. Despite the potential benefits of the trading scheme, however, EPA noted several difficulties associated with such standards. In this regard, comments were specifically requested on the environmental risks that might accompany the alternative standards as well as methods for establishing an equivalency between exhaust and evaporative organic emissions. Comments were also requested concerning the expected size and associated value of any increase in evaporative emissions that this alternative would precipitate.

Summary of the Comments. Most of the comments concerning the optional combined organics standards came from the automotive industry. The manufacturers of heavy-duty engines argued that such standards would not provide a benefit to their segment of the industry. They pointed out that heavy-duty engines and vehicles are generally manufactured by different companies (*i.e.*, the industry is non-integrated), making the use of any combined certification approach a remote possibility. In fact, the heavy-duty engine manufacturers felt combined standards would actually create an unnecessary administrative burden.

The concept received mixed reactions from the light-duty motor vehicle manufacturers. Toyota opposed the option claiming it would actually increase the number of evaporative tests per vehicle family. The majority of the commenters, however, expressed moderate interest in combined standards, but no manufacturer submitted information concerning the expected amounts of the offsets which might occur or the value of the option. Ford and GM suggested it could be possible to establish the equivalency between exhaust and evaporative emissions and maintain adequate environmental protection, but neither offered a specific methodology for accomplishing this.

Finally, a single commenter from the oil industry, Chevron, opposed the concept, stating that the establishment of an environmentally benign equivalence between evaporative and exhaust emissions would be difficult based on the information currently available.

EPA Response to Comments. The Agency notes that support for the concept of combined standards was not enthusiastic. The heavy-duty engine industry commenters and one major light-duty manufacturer opposed the concept. It is not obvious, however, that implementation of such a program would cause any significant administrative burden for non-integrated heavy-duty engine manufacturers, since they are in fact currently responsible for evaporative certification. Additionally, as far as they or any manufacturer of heavy-duty or light-duty vehicles is concerned, since the program would be optional, no manufacturer who would be harmed by its use need adopt it.

Only a few light-duty manufacturers supported combined standards, and none addressed the fundamental uncertainties associated with the approach, as expressed in the NPRM. One of the Agency's primary concerns centers on whether the alternative standards have any value to manufacturers. EPA's skepticism in this area is related to the nature of the evaporative emission standards and the type of technology which is used to control these emissions. As explained in the proposal, the present evaporative standards were designed to essentially eliminate emissions from fuel-related sources. For example, the light-duty vehicle standard of 2.0 grams HC per test was implemented to account for background sources of HC (*e.g.*, interior materials and lubricants), to accommodate some degree of test-to-test variability, and to provide some compliance cushion. Hence, the standards require essentially the complete elimination of fuel-related emissions.

Present evaporative emission control systems function by routing gasoline vapors from the vehicle's fuel tank and engine to a charcoal-filled canister where they are stored. When the engine is started, the vapors are purged from the canister, routed to the engine, and burned as fuel. If the canister becomes saturated with evaporated gasoline, the excess vapors are vented directly to the atmosphere, causing the emissions from such a vehicle to increase substantially.

[12] From EPA-AA-TSS-PA-87-4.

The interaction between this characteristic of the requisite control hardware and the nature of the evaporative standards which are designed to allow no fuel emissions means that either a vehicle's control system will capture essentially all fuel-related emissions, or it will generally fail the emissions test dramatically. This "all or nothing" situation makes it very difficult to design a vehicle to emit only a little excess evaporated fuel, which is the likely emission control strategy that would need to be followed to take full advantage of combined standards. The data on evaporative emissions for methanol-fueled vehicles are much more limited than those for gasoline-fueled vehicles. Nevertheless, the fundamental characteristics of the evaporative control system are expected to be similar regardless of fuel type, and these same uncertainties would apply to either vehicle type as well. For this reason, EPA questions the practical value of such an optional program for methanol vehicles. No manufacturer provided any information which might allay the Agency's uncertainty in this regard.

An even more fundamental concern to the Agency involves the method used to determine the environmental equivalency between evaporative and exhaust emissions. The method presented as an example in the NPRM attempted to convert evaporative emissions, as measured in grams HC per test, to an exhaust equivalent expressed in grams per mile. Because in-use evaporative emissions are a strong function of driving patterns, the conversion process involves the use of assumptions regarding important driving-related parameters. Among these are the number of miles driven per day and the number of vehicle trips per day. While average values can be derived for the relevant driving-related parameters, it is not clear that they would correctly weight the different driving habits. Thus, an accurate assessment of all typical driving patterns and their associated emissions effects would be necessary in order to convert evaporative emissions test data to in-use emission factors. This situation is further complicated in that in-use exhaust and evaporative emissions are affected differently by local climate, with the result that an equivalence established under FTP test conditions is less accurate for other conditions. Given the limited amount of information now available, EPA concludes (in agreement with Chevron) that the available information is insufficient to establish an environmentally benign equivalence between exhaust and evaporative emissions.

To summarize and conclude, the Agency's analysis of optional combined exhaust and evaporative standards for methanol vehicles shows that such an alternative is of dubious value to the regulated industry. The analysis also shows that deriving an equivalence between exhaust and evaporative emissions would be extremely difficult based upon currently available information. Commenters presented no data which could have been used to resolve these uncertainties, making it difficult to proceed with the program. Furthermore, since the goal of this rulemaking is to establish a level playing field for methanol vehicles, it would not be appropriate, especially in light of these uncertainties, to provide special options for methanol vehicles. Therefore, the Agency is taking no action with regard to optional combined exhaust and evaporative emission standards as part of today's final rule.

3. Separate Health Effects-Based Standards

Summary of the Proposal. In the NPRM, EPA noted that direct exposure to methanol and formaldehyde emissions from methanol vehicles could pose a public health risk due to acute toxic or, in the case of formaldehyde, carcinogenic health effects. Further, the question of whether this risk would be adequately addressed by the proposed ozone-related standards was evaluated in order to investigate the need for separate health-based standards for methanol and formaldehyde. The discussion below concerns EPA's analysis of these issues at the time of the proposal; EPA's current analysis is described in the "EPA Response to Comments" section.

The Agency's analysis of potentially acute toxic effects initially focused on identifying ambient concentrations for each pollutant above which adverse effects might be anticipated for normal individuals in the population at large. These concentrations were specifically chosen in the context of the short, perhaps repetitive exposures generally expected to be associated with motor vehicles. The resulting levels of concern were then used as an analytic tool to evaluate a variety of exposure scenarios to assess the potential public health risk. See the Regulatory Support Document (docket item #A-84-05-III-A-3) for details related to the selection of these levels of concern. These levels were not intended to be cutoff points for regulatory action; clearly, determining the need for regulatory action requires consideration of other factors such as the potential frequency, length, and avoidability of exposures to high concentrations of methanol and formaldehyde and the Agency's legal authority to establish standards addressing such exposures Thus these levels of concern were intended to serve as warning flags, which draw attention to scenarios where there is a potential for significant health risks for the public.

The analysis indicated that the proposed carbon-based standards should be sufficient to prevent toxic concentrations in all scenarios evaluated except those relating to formaldehyde exposure in the personal parking garage. Additionally, methanol and formaldehyde concentrations were predicted to approach levels of toxic concern in the personal and public parking garages, respectively. Even in these exposure scenarios, the view stated in the proposal was that the anticipated acute effects were expected to be reversible and minor in nature (*i.e.*, slight irritation of the eyes for the case of formaldehyde; increase in urine levels for methanol). The personal garage scenario in which formaldehyde concentrations were of concern involved an improperly maintained vehicle, starved and left to warm up for five minutes. The concentration approaching the level of concern would be experienced between the time the driver returned to his or her garage and when he or she drove away. Since the biological effects experienced were thought to be limited to annoyances like eye irritation or for sensitive individuals respiratory tract irritation, or would be accompanied by unpleasant odor, the proposal stated that the driver would have incentive to avoid the exposure by removing the vehicle from the garage prior to warm-up or by repairing the vehicle. Just as with CO emissions from current vehicles, EPA found in the proposal that it would be reasonable to expect owners to assume primary responsibility for avoiding an obviously unsafe practice like idling a vehicle in a garage. Also, it was uncertain whether a standard would have any benefit in this scenario, since standards apply to well maintained vehicles. As a result, no standard was deemed necessary.[13]

[13] In this scenario, as well as in the public parking garage scenario, methanol from malfunctioning vehicles at idle was found to approach the level of concern, but in each case the margin between predicted concentrations and the level of concern was greater than for formaldehyde. Thus formaldehyde was seen as the limiting factor and the analysis concentrated on the need for its control.

The scenario in which formaldehyde in the public parking garage approached the level of concern required complete market penetration of methanol vehicles and a very poorly ventilated garage. The parking garage scenario of concern also included the extreme conditions that all of the vehicles would be started and allowed to idle within a short period of time, and that 25 percent would have severely malfunctioning emission control systems. The Agency decided against regulatory action based on the low probability of the assumed conditions occurring simultaneously and the uncertainties in the emission factor data base.

The scenario involving exposure to evaporate methanol emissions in the personal garage concerns a hot vehicle sitting in a completely sealed garage with no ventilation and with the evaporative emissions control canister disconnected. Again, this scenario is only a potential problem when the owner remains in the garage for an extended period. Even in this case, the concentration was predicted only to approach the level of concern. Since at the level of concern, based on accepted scientific understanding, the health effects experienced were expected to be minor and reversible and since an emission standard would do little to control emissions when the evaporative control canister is disconnected, no standard was deemed necessary.

The concerns regarding potential carcinogenic health effects focused on exposures to ambient concentrations of formaldehyde, a chemical that had been found to cause cancer in laboratory animals. The Agency's analysis of this issue in the proposal showed there were considerable uncertainties pertaining mainly to formaldehyde's carcinogenic potential in humans and the carcinogenic risk posed by methanol vehicles relative to that posed by other sources, including existing mobile sources. The low expected initial market penetrations of methanol vehicles would provide time to resolve the present uncertainties without undue risk to public health. Therefore, the Agency deferred action on cancer-related standards for methanol vehicles until the relative contribution of all sources in the ambient environment to the carcinogenic risk of this pollutant was better understood.

Summary of the Comments. The NPRM drew a wide range of comments covering almost every aspect of EPA's health effects assessment. A few commenters expressed the concern that EPA had relied on a very limited emissions data base in deciding not to propose separate health-based standards. One cited an EPA statement in the proposal about the difficulties of translating the limited amount of test data into reliable in-use emission factors. The American Gas Association expressed the strongest opinion in this area, citing limitations in the formaldehyde emissions data base as one reason that no methanol vehicle standards should be promulgated at this time.

Several comments addressed EPA's level of concern (chosen for scenarios lasting less than 15 minutes, which may be repeated) for formaldehyde and methanol. Several organizations felt that EPA's 0.50 milligram per cubic meter (mg/m^3) level of concern for formaldehyde was inadequate to protect the public health. Findings from the National Research Council were cited which indicated that sensitive individuals will encounter eye irritation at formaldehyde levels as low as 0.05 ppm (1ppm = 1.16 mg/m^3 at 70 °F) and in the presence of other pollutants at levels as low as 0.01 ppm. It also stated that 10 to 12 percent of the population has no threshold below which effects do not occur. No comments were received specifically opposing the 260 mg/m^3 (1 ppm = 1.24 mg/m^3) level of concern for methanol.

General Motors (GM) supported both levels of concern, stating that the level of concern for methanol should prevent unsafe levels of this substance and its metabolites from accumulating in the blood of exposed persons. It also concurred with the Agency that any health effects at the level of concern for formaldehyde would be minor and reversible.

The automotive industry in general as well as the DOE agreed with EPA that the proposed carbon-based standards should adequately protect the public from exposures to toxic levels of methanol and formaldehyde. The California Air Resources Board argued that where predicted concentrations approximate or exceed the level of concern, as is the case for garages, regulatory action is warranted.

The commenters also addressed the carcinogenic risk associated with ambient concentrations of formaldehyde. Several comments were received in this regard opposing EPA's position, which was that no separate standards specifically for methanol vehicles are warranted now but that the complexities of the issue warrant further study. The California Air Resources Board stated that according to EPA's cancer risk assessment guidelines, formaldehyde would be considered a probable human carcinogen based on the available animal test results. It went on to suggest specific standards that would limit formaldehyde from methanol vehicles to the levels of current vehicles. (These standards were also discussed in Section III.B.1, with reference to formaldehyde's photochemical reactivity.)

On the other hand, Chrysler and GM were unconvinced of formaldehyde's carcinogenic risk and opposed consideration of standards to protect against it. These manufacturers cited a recent study of industrial workers by the National Cancer Institute, which they claimed showed no excess cancer mortality due to formaldehyde exposure. GM agreed with EPA that there is adequate time to further investigate the cancer risks of formaldehyde before methanol vehicles enter the fleet in large enough numbers to be a special concern.

EPA Response to Comments—Adequacy of Emissions Data. One of the most fundamental issues raised in the comments pertains to EPA's use of limited emission factor data and the resulting reliability of the health effects assessment. This topic was discussed in the proposal, and EPA concluded that the existing data appeared sufficient to adequately characterize methanol vehicle emissions for the purposes of the NPRM but that improvements in the data base would be desirable in several key areas.

New emissions data has become available since the proposal was published. The methanol vehicle emissions data base presently contains test results for 14 models of prototype and first generation vehicles from 15 different studies.[14] A substantial amount of information regarding city and highway-cycle exhaust emissions as well as evaporative emissions, and to a lesser extent cold start idle emissions, has also been added to the information base. These recent additions have improved EPA's ability to project in-use emissions and have been used to reassess the need for separate health-based standards. Further improvements in the data base would still be useful, especially as regards cold idle emissions. As mentioned later in this notice, EPA will collect more emission data as methanol fueled vehicles are

[14] This database is discussed in detail in Gold, Michael, and Moulis, Charles, "Emission Factor Database for Prototype Light-Duty Methanol Vehicles," SAE Paper 872055, and updated in "Effects of Emission Standards on Methanol Vehicle Related Ozone, formaldehyde, and Methanol Exposure," by the same authors, Air Pollution Control Association Paper 88-41.4.

developed and will revisit this analysis as the information warrants.

The new data differ most substantively from the old in the areas of idle and evaporative emissions. The data base now contains some actual cold start idle data for methanol vehicles. The data range from 8–122 mg/min for formaldehyde and 0.85–4.85 g/min for methanol over a five minute averaging period. The emissions of formaldehyde and methanol used in the NPRM analysis (0.04–2.03 mg/min formaldehyde and 0.002–0.043 g/min methanol) were *estimated* using data from warmed-up vehicles. While the new data are an improvement over the old, the idle emissions data base for methanol vehicles is still limited. Only two models, the Ford Escort and the Toyota Carina, have been evaluated. As will be discussed in the section on exposure scenarios below, the Escort technology, which establishes the upper limit of the range on formaldehyde emissions, is unrepresentative of technologies that will ultimately be marketed. The Carina, which is more optimized with respect to emission control technology and which establishes the lower limit of the range, has been tested only at room temperature, which is not a worst case condition. Furthermore, idle methanol emissions for the Carina were not measured. EPA believes that, in the absence of emission standards to limit idle emissions (other than the FTP organics standards, which will likely have some limiting effect on idle emissions), the range given by these vehicles should be interpreted as a set of possible emission levels. It will not be possible to determine more accurately what actual idle emissions will be until the methanol vehicles that will ultimately be marketed become available for testing. (As will be noted in the conclusion to this section, EPA intends to obtain data in this regard as soon as is practicable.)

Formaldehyde data for gasoline and diesel vehicles and carbon monoxide data for all technologies are useful in placing the anticipated health effects of formaldehyde emissions from methanol vehicles into perspective. Recent formaldehyde data for gasoline vehicles (previously estimated to emit at a rate of 1.1 mg/min) have extended the range of data upward to 20 mg/min for low mileage, well maintained, catalyzed vehicles. A range of up to 76 mg/min has been measured for pre-catalyst gasoline vehicles. Testing of a single low mileage diesel vehicle showed formaldehyde emissions of up to 24.3 mg/min. Carbon monoxide emissions data for methanol and gasoline vehicles are also available and will be discussed later.

Hot soak evaporative emission data were also very limited at the time of the NPRM. The new data indicate that worst case hot soak emissions of methanol should in fact be less than were previously thought (2.0 g/hr instead of 3.0 g/hr).

The reader is referred to the Summary and Analysis of Comments document for a more detailed presentation of the emission data discussed here.

Toxicity of Formaldehyde (Non-Cancer). The arguments presented by the commenters opposing the level of concern for formaldehyde were previously addressed in the NPRM, and no new information was submitted for the Agency's consideration. To briefly reiterate the Agency's analysis of this issue, the acute effects noted in clinical studies with formaldehyde concentrations below the level of concern (0.50 mg/m^3) are expected to be non-serious and reversible for most of the population with the caveats listed below (see the Regulatory Support Document for details). Furthermore, these findings may be conservative for the vast majority of the population, because the clinical exposures were usually of greater duration than the relatively brief exposures (less than 15 minutes), at or approaching this level, expected to be associated with methanol vehicle-related formaldehyde. In reaching this conclusion, the Agency notes that there is a wide variability in the responses of individuals to various levels of formaldehyde. Thus irritant effects, if any are experienced, may first occur for some individuals at levels above or below 0.50 mg/m^3. The Agency does not wish to imply that exposures to concentrations below the level of concern are always acceptable; however, the Agency believes that effects will generally be minor at this level for the vast majority of the population. In the absence of new information to the contrary, the Agency believes its original conclusions remain valid and finds no reason at present to alter the previously identified level of concern for formaldehyde.

Acute effects at levels above the level of concern would generally be limited to eye and respiratory tract irritation of concentration-related severity. It is noted that research data do indicate that an inurement to irritant effects tends to occur after several minutes of exposure. Evidence suggests that pulmonary effects could also occur, resulting in temporarily reduced lung function. Those with existing respiratory problems, asthmatics for example, may experience more adverse effects. Notably, the National Research Council analysis cited by the commenters attempted to quantify the sensitive population fraction based on general allergic tendencies not reaction to formaldehyde in particular.

It has been suggested that exposure to formaldehyde at irritant levels (*i.e.*, above the level of concern) may cause individuals to become hypersensitive to formaldehyde. Individuals sensitized in this fashion would later exhibit allergic (*e.g.*, asthmatic) reactions when exposed to low concentrations of formaldehyde. While such a relationship has been suspected, there is no definitive evidence for allergic sensitization to inhaled formaldehyde.

Evidence suggests that repeated exposure to formaldehyde at irritant levels (*i.e.*, above the level of concern) for short durations may result in some cumulative health impacts, such as permanently reduced lung function. This suggestion is appropriately characterized as speculative at present, since it is not based on the study of formaldehyde exposures of the sort described here. Rather, it is based on formaldehyde's effects in long term, lower concentration, residential and occupational exposures, and on irritant mechanisms associated with other toxins.

The Agency also discussed the possibility that a small portion of the population may have no threshold below which effects do not occur. For example, as commenters pointed out, studies indicate that a portion of the population may experience eye irritation at concentrations as low as 0.01 ppm (1 ppm 1.16 = mg/m^3 at 70°F). However, these studies are typically based upon occupational exposure, and not the repetitive brief excursions above background concentrations anticipated due to mobile sources. It is also not known how large such a group might be.

The preceeding discussion is not meant to imply that the Agency believes that current ambient formaldehyde concentrations are acceptable, nor does it intend to imply that sensitive individuals do not need to be protected. Rather, any program to prevent such low level exposures would require much broader control measures than simply regulating methanol vehicles. To address the question of low level ambient concentrations of formaldehyde, an Agency-wide task force on formaldehyde has been created. This task force will investigate the need and means available for control of ambient formaldehyde concentrations. This investigation will include current

mobile sources, which are contributors to background formaldehyde concentrations.

Toxicity of Methanol. Even though no comments were received opposing 260 mg/m³ as the level of concern for methanol, a recent assessment has become available which supports the appropriateness of this choice (see the Regulatory Support Document for details of this choice). The Health Effects Institute (HEI) [15] recently conducted an extensive review of the potential health effects of methanol exposure and assessed the implications with regard to methanol vehicles.[16] Its general findings included the view that EPA's proposed actions in this rule are currently appropriate. Among HEI's specific conclusions was that the most serious human health effect related to methanol exposure is ocular toxicity due to formate metabolism. A 15-minute exposure at 200 mg/m³ methanol, under the mobile source-related scenarios evaluated by EPA, would result in a worst case formate body burden many times lower than levels associated with ocular toxicity in humans. However, a firm conclusion regarding chronic exposure cannot be drawn, and alternative mechanisms of methanol toxicity may be associated with other health effects. The HEI report calls for research in these areas. HEI concluded that the available peer reviewed literature produced no evidence on which to base a conclusion that exposure to levels of methanol vapor associated with normal use of methanol as a vehicular fuel would result in adverse health effects. Therefore, the Agency believes this report does not alter the earlier decision to rely upon a level of 260 mg/m³ as an appropriate focus for concern regarding short duration (15 minutes or so) exposure to methanol.

The Agency wishes to call attention, however, to the results of three recent studies involving laboratory exposure of animals to methanol. In one, pregnant rats were exposed to 6,550, 13,300, and 26,600 mg/m³ of methanol for 7 hours per day on gestation days 1–19 (only days 7–19 at the high dose).[17] At the two higher concentrations, fetal weights were significantly reduced and an exposure-related number of skeletal and visceral malformations were observed (although the increase was not statistically significant at 13,300 mg/m³). The lowest concentration was not teratogenic. In another study, mature male rats were exposed for 8 hours per day for 1–6 weeks to methanol at 260, 2,600, and 13,000 mg/m³ methanol.[18] Statistically significant decreased levels of circulating free testosterone were noted in the populations exposed at the two lower levels. Increases in circulating luteinizing hormone were noted in the population exposed at the highest level. Finally, pregnant rats ingested 2.5 g of methanol per kg of bodyweight for one of two 3-day periods during gestation.[19] A number of physiological and behavioral parameters among the rat pups were evaluated. Two parameters showed differences among exposed pups from controls. First, increased latency to suckling behavior 24 hours after birth was noted. Second, exposed pups experienced decreased ability to locate their home nest materials on day 10 after birth. These studies are seen as potentially significant with regard to human exposure to methanol; however, they were not conducted to address the type of exposure concerns noted here (i.e., occasional exposures, lasting less than 15 minutes, to methanol concentrations near the level of concern (260 mg/m³)). These studies focused on exposures lasting from several hours to days, with concentrations usually much higher than the public would be expected to be exposed to. Thus it is not possible to resolve this issue at this time.

Research needs to be done to verify and extend these early results, to better characterize dose-response relationships for pertinent health endpoints at low atmospheric concentrations and under varying exposure durations, and to attempt extrapolation of the animal-based data to human beings before prescriptive or prophylactic action is taken with regard to methanol vehicles. It would also be useful to examine human populations epidemiologically for similar health effects. Research may also be needed to address methanol's potential neurotoxicity. In addition, since it is not known whether the formate metabolite of methanol is solely responsible for the reproductive and developmental toxicity of methanol observed in the animal studies, other mechanisms of methanol toxicity need to be considered as well. This will facilitate improved assessment of potential risks associated with projected human levels of exposure. The Agency in fact, currently plans to pursue some of these issues.

Exposure Scenarios. EPA's analysis translated levels of concern into conclusions regarding the need for standards via a series of exposure models which convert emission factors into predicted ambient concentrations. In general, exposures in these scenarios were expected to last no more than 15 minutes, and they could be repetitive. As noted previously, the Agency has updated this analysis with an improved emission data base to help address the concerns that several commenters had in this regard. With a few exceptions, the new analysis is in substantial agreement with the old one. It is discussed in more detail in the Summary and Analysis of Comments. However, as noted before, the new data base differs most substantively in the areas of idle and evaporative emissions. These new data continue to highlight idle emissions in garages as a possible concern, and they remove the personal garage hot soak scenario from the list of potentially hazardous situations.

A substantive change in the analytic approach from that discussed in the proposal is related to the exposure model used for the public parking garage. The previous analysis focused on a model that was based on an actual underground garage, which was poorly ventilated. However, this model is no longer considered representative, since pollutant concentrations inside the actual garage were so high that it had to be completely reventilated. Additionally, in comparing actually measured CO concentrations in the garage upon which the severe scenario was based to reasonable emission rates from the gasoline-fueled vehicles in existence at the time of the measurements, EPA finds that the model may have been overpredicting formaldehyde and CO concentrations by a substantial margin. Therefore, the current analysis is focused on a model of a more typical garage. The model predicts the maximum concentrations that would occur under congested traffic conditions, in which the garage is emptied in a short period of time, such as after a concert. Individuals would be exposed to the highest predicted concentrations in the garage for about four minutes, and to concentrations that are 28 percent as high for another four minutes. For comparison, the concentrations predicted for the severe

[15] HEI is an independent research organization jointly funded by EPA and the automotive industry.

[16] "Automotive Methanol Vapors and Human Health: An Evaluation of Existing Scientific Information and Issues for Future Research," Health Effects Institute, May 1987.

[17] Nelson, B.K., et al., "Teratological Assessment of Methanol and Ethanol at High Inhalation Levels in Rats," Fund. Apply. Toxicol. 5:727–736, 1985.

[18] Cameron, A.M., et al., "Circulating Concentrations of Testosterone, Luteinizing Hormone, and Follicle Stimulating Hormone in Male Rats After Inhalation of Methanol," Arch. Toxicol., Supply. 7:441–443, 1984.

[19] Infurna, R. and Weiss, B., "Neonatal Behavioral Toxicity in Rats Following Prenatal Exposure to Methanol," Teratology, 33:259–265, 1986.

model, which was previously the focus of EPA's analysis, would be about four times the maximum predicted concentrations of the typical model.

EPA's modeling predicts maximum concentrations of 0.25 to 1.0 mg/m³ formaldehyde for the typical parking garage scenario assuming respectively that the lowest and highest emitting methanol vehicle models in the available data base comprise 30 percent of the total gasoline plus methanol market. The predicted concentration for the same scenario with only gasoline vehicles would be from 0.25 mg/m³ (assuming average in-use emissions based on low mileage catalyst gasoline vehicles) to 1.05 mg/m³ (assuming emissions for an older technology, non-catalyst vehicle). Therefore, assuming 30 percent conversion of the fleet to methanol vehicles with high emissions, acute health effects experienced would be similar to those experienced prior to the advent of catalyst technology for gasoline vehicles, and for most of the population would be limited to temporary and mild irritation of the eyes. Asthmatics or others with existing respiratory problems may experience more severe effects of exposure at these levels.

The severe personal garage scenario is predicted to have concentrations ranging from 0.5 mg/m³ for the lowest emitting methanol vehicle to 16.3 mg/m³ for the highest after idling in a garage with the door open for five minutes (longer idling times would result in higher concentrations, as would operating with the garage door closed). Concentrations of formaldehyde resulting from idling a gasoline vehicle for five minutes in a personal garage are predicted to be from 0.6–2.7 mg/m³ for catalyst vehicles to 10.0 mg/m³ for a non-catalyst vehicle. Acute health effects at the highest predicted levels for methanol or gasoline vehicles would be severe irritation of the eyes, nose and throat for most normal individuals with possible pulmonary function effects. At the lower levels, irritation would likely be slight. Again, the wide variability in human response to formaldehyde is noted. Population subgroups may experience stronger irritation at the lower levels, and asthmatics could suffer attacks at levels intermediate to the predicted range for the personal garage.

For methanol emissions due to cold idling, EPA's modeling predicts concentrations as high as 44 mg/m³ for the typical parking garage scenario with 30 percent penetration, and 650 mg/m³ for the severe personal garage scenario. The body burden of formate due to 15 minutes of methanol exposure at 650 mg/m³ is still expected to be many times lower than doses of acute clinical significance for ocular toxicity.

With the exception of methanol in the public garage scenario, the concentrations noted above significantly exceed the levels of concern for short (less than 15 minutes) exposures to formaldehyde (0.50 mg/m³) and methanol (260 mg/m³). Whether some form of regulatory action is warranted to protect against health risks in garage-related scenarios depends on a consideration of several important factors.

With regard to the public parking garage scenario, predicted concentrations in typical garages due to methanol vehicles at 30 percent fleet penetration range from levels similar to those experienced today with gasoline vehicles to levels similar to those experienced in the years prior to catalyst technology. (This comparison is given for illustrative purposes only; it is not intended as a finding on the acceptability of current concentrations.) The uncertainties in this analysis are considerable. First, the methanol vehicles from which the highest emissions data were obtained did not meet the proposed carbon-based standard for organic emissions. Over the city driving cycle these 1983 carbureted Ford Escorts emitted at roughly two or three times the allowable level. These vehicles can be considered "gross" emitters and clearly are not representative of vehicles that will ultimately be certified to emission standards. This follows from a consideration of the technology used in the early carbureted Escorts. They are prototype vehicles, representing a minimal design change from the gasoline configuration. Little or no emission control technology specific to methanol vehicles was utilized. Much more recent data for a Toyota Carina, tested at room temperature, were at a level more like that of gasoline vehicles. The formaldehyde emission level of this vehicle is 8.0 mg/min, which is approximately five times lower than that of the worst case Escort at room temperature. Unfortunately cold temperature formaldehyde data and methanol data (at any temperature) are not available for this vehicle. This prevents using it to assess worst case exposures. Nevertheless, the Agency anticipates reductions from the early Escort levels at low temperatures as well. The Carina represents a first step towards an emission control system optimized toward methanol vehicles. The catalyst composition, size, and mounting location were chosen with methanol vehicle emissions in mind. It is expected that continued development effort will work to reduce idle formaldehyde and methanol emissions further. At this point, it would be appropriate to characterize the lower portion of the range of available emission data as being the more probable.

Next, the cold idle emission rates used in the exposure model were estimated based on a ratio of in-use emissions to certification levels (2.2 for the public garage scenario). This ratio, or emissions offset, applied to each vehicle's measured emission factor, is derived from tests of gasoline-fueled engines operating under FTP conditions. It is not obvious that cold idle emissions from methanol engines would have similar characteristics. In addition, it is worth noting that these offsets are designed to be applied to the emissions level of a vehicle that just meets its standard. As noted previously, the worst case vehicle, upon which the present analysis relied, emitted organics at levels 2–3 times above the proposed standards already. Applying this additional offset makes the predicted concentrations very conservatively high. Additionally, validation data for the typical garage were not available, so that the accuracy of the model could not be determined. These arguments are explored in greater detail in the Summary and Analysis of Comments document.

The uncertainties discussed in this analysis demonstrate that more investigation into cold idle emissions and exposure modeling is necessary before accurate conclusions can be drawn regarding public health risks from methanol vehicles in public parking garages. It would appear very unlikely, however, that methanol vehicles would pose an unacceptable risk in any public garage at the low market penetrations expected in the near future given the relatively mild impacts which the model predicts. The Agency believes this provides adequate time to resolve the present analytical uncertainties, and to reexamine the issue with adequate data.

The concern with idling in a personal garage is somewhat different, since the existence of any toxic effects requires only one vehicle, and thus is not dependent on methanol vehicle market penetration. It is noted that formaldehyde emissions for the vehicle associated with the 650 mg/m³ methanol concentration were so high that concentrations would exceed the level of concern for formaldehyde by a factor much greater than that for methanol;

while the predicted concentrations of methanol could potentially be of concern, formaldehyde is seen as the more serious concern in this analysis, and as such is the focus of the discussion.

EPA notes that many of the uncertainties (emission factors, validity of the modeling) in the analysis of the public parking garage are also applicable to the personal garage scenario. Thus, just as with the public garage analysis, it is not possible to accurately predict the impact of methanol vehicles at this time, and the predicted concentrations should therefore be considered only preliminary indicators. Table 2 shows predicted concentrations for several technologies.

TABLE 2.—PREDICTED CONCENTRATIONS OF FORMALDEHYDE IN PERSONAL GARAGES

Vehicle	Predicted formaldehyde
Methanol Escort (20 °F) (Early Model).	8–16 mg/m³.
Methanol Carina (78 °F)	0.5–1.1 mg/m³.
Catalyst Gasoline Vehicle (20 °F).	1.3–2.7 mg/m³.
Non-Catalyst Gasoline Vehicle (70 °F).	5–10 mg/m³.
Diesel (20 °F)	1.6–3.3 mg/m³.

This table presents concentrations associated with the highest emitting vehicles available for each technology. The catalyst gasoline and diesel vehicles were well maintained, low mileage vehicles. The non-catalyst gasoline vehicle was a high mileage 1971 vehicle. The upper estimates include a safety factor of 2.0 to account for potential in-use deterioration and other analytical uncertainties. It can be seen that all technologies are capable of emitting sufficient formaldehyde to cause concentrations above the level of concern inside a garage. As noted before, for normal individuals these concentrations would result in various levels of irritation, ranging from slight, perhaps negligible, up to very strong, with the possibility of pulmonary function effects (*i.e.*, reduced lung function). Sensitive individuals may experience stronger irritation at the lower levels. Intermediate concentrations could trigger asthmatic attacks for asthmatics. While these possible effects are clearly significant, EPA continues to believe that current emissions data and the health evaluation are too uncertain to permit an accurate assessment of the potential problem

Additional study of the issue is necessary to resolve outstanding questions. In any event, EPA does not have legal authority under the Clean Air Act to promulgate emission standards to limit formaldehyde or methanol exposures in garages. The Clean Air Act authorizes EPA to regulate only "air pollutants," which the Act defines as substances released to the "ambient air." EPA's longstanding interpretation of "ambient air" is air outside of structures as distinguished from indoor air. The Agency thus lacks adequate authority under the Act to promulgate emission standards to prevent exposures to air pollutants within garages or other structures. However, if the Agency finds that such exposures result in an unacceptable public health risk, then it will consider whether it has authority under other statutes to take regulatory action.

To determine whether methanol will pose an indoor air pollution problem of which the public should be warned, EPA intends to collect idle methanol and formaldehyde data for new vehicles (as they are developed) in the course of its own research, to obtain similar data from manufacturers, to investigate the accuracy of the models, to evaluate the potential for reductions in cold start emissions, and to evaluate health effects data with the intent of establishing a more certain threshold level of concern. EPA has programs in all these areas underway or in the planning phases. EPA expects that manufacturers will continue to warn consumers (via owner's manuals, for example) about the potential hazards of idling vehicles in enclosed places, even open garages. While such warnings have historically been associated with avoiding exposure to high levels of CO, EPA recommends that they also be used to warn the public to avoid situations that could result in high formaldehyde levels.

In addition to collecting more data through its research efforts, EPA will also collect formaldehyde and methanol emissions data on methanol-fueled vehicles undergoing certification testing at EPA facilities. The Agency also will work with manufacturers to collect and analyze other data on formaldehyde and methanol emissions from methanol-fueled vehicles. EPA will promptly make publicly available any new data on formaldehyde and methanol emissions from production methanol fueled vehicles. Further EPA action could include seeking from manufacturers reports on their emissions data and warning labels on methanol vehicles in order to alert sensitive individuals to potential hazards or the conducting of a public education campaign with the same goal.

Formaldehyde Carcinogenicity. The last area of concern raised by the commenters pertains to whether a separate formaldehyde standard is needed to prevent an increase in cancer risk due to increased ambient concentrations of this pollutant. The California Air Resources Board was correct in stating that formaldehyde would be classified as a probable human carcinogen under EPA's guidelines for carcinogen risk assessment. Indeed, the Agency has formally made this classification.[20]

Included in the body of evidence considered in this determination was the National Cancer Institute study cited by Chrysler and GM. Contrary to the commenters' position, however, EPA found that this study did show an excess of some types of cancer among workers exposed to formaldehyde, and the Agency argued that the study favored a finding that formaldehyde should be regarded as a probable carcinogen in humans.

In response to the commenters' recommendation of a separate cancer-related standard, EPA believes that such a standard may not be required, that sufficient data are not now available to make this decision, and that the expected slow rate of introduction of these vehicles allows time for the necessary analysis to be done. Any subsequent standard should be based on quantitative information indicating that methanol vehicles meeting the carbon-based standards will substantially increase ambient formaldehyde levels. No commenter provided evidence to this effect, and the Agency's review of the available information suggests that such will not necessarily be the case. While the data do show that methanol vehicles have the potential to emit substantially more formaldehyde than current vehicles, it is not clear that methanol vehicles will result in significant increases in overall formaldehyde exposure. Ambient formaldehyde levels not only depend on the amount of this pollutant directly emitted into the atmosphere, but also on the amount that is formed in the atmosphere by the photochemical reaction of other organic pollutants. How much ambient formaldehyde is photochemically produced has been estimated to be from

[20] "Assessment or Health Risks to Garment Workers and Certain Home Residents From Exposure to Formaldehyde," EPA Office of Pesticides and Toxic Substances, Final Draft, March 1987

about 60 to 90 percent of the total.[21] Hence, the formaldehyde that is directly emitted from methanol vehicles would not proportionately affect ambient concentrations. Limited modeling data, as discussed in the Summary and Analysis of Comments, bear this point out. Also, the overall reactivity of current vehicle emissions has been found to generally exceed that of methanol vehicle emissions, so it is probable that current vehicles result in more secondary formaldehyde.

Summary. At this time the Agency is not promulgating separate standards to specifically control emissions of formaldehyde to the ambient air. The foregoing analysis indicated that the methanol vehicles that will ultimately be marketed might emit methanol and formaldehyde at levels high enough to cause concern in public and private garages. The Agency has concluded, however, that the presently available emissions data for prototype vehicles and the models used in the garage scenarios are of uncertain value and that it does not have the legal authority to set standards to prevent such indoor exposures. With regard to formaldehyde's carcinogenic potential, sufficient data are not available to indicate that methanol vehicles will substantially impact ambient formaldehyde levels. EPA's analysis also revealed that formaldehyde emissions from petroleum fueled vehicles can be significant; therefore action to selectively address formaldehyde from methanol vehicles may not necessarily be appropriate. Sufficient time remains to address the outstanding uncertainties before methanol vehicles enter the fleet in significant quantities. EPA is committed to resolving these uncertainties. The Agency has already begun gathering data and performing the scientific studies that will be required in order to make regulatory decisions. As part of this effort, an Agency-wide task force has been created to assess issues related to ambient formaldehyde exposure and to recommend control options as appropriate. Other studies, noted elsewhere in this discussion, will also be carried out. If future evidence shows an unacceptable health risk, action consistent with EPA's statutory authority will be taken. Options that could be considered would include public education and warning labels on vehicles.

[21] "Source Assessment of Formaldehyde Emissions," Radian Corporation, September 3, 1985.

C. Standards for NOx, CO, Particulate, Smoke, and Crankcase Emissions

Review of the Proposal. The Agency proposed that where numerically identical standards currently apply to petroleum vehicles regardless of engine type (*i.e.*, gasoline-fueled or diesel), the same standards should be adopted for the respective class of methanol vehicles. This was the case for the existing NOx standards and most of the CO standards (see Table 1).

Where the present emission standards differ by engine type (particulate, smoke, and heavy-duty vehicle CO), the Agency generally proposed that the respective control requirements should apply to methanol vehicles exhibiting emission characteristics similar to their petroleum counterparts. To determine the applicability of the standards, EPA found that methanol engine types could be best classified based on the method used to control the engine's power output (*i.e.*, the use or non-use of a throttle mechanism in the intake system to regulate the quantity of air allowed into the combustion chamber) as the primary indicator of engine cycle. More specifically, the emission characteristics of methanol engines that are throttled in normal operation were expected to be similar to those of throttled petroleum (*i.e.*, Otto-cycle, or gasoline-fueled) engines. Similarly, methanol engines not using a throttle during normal operation would be more like non-throttled petroleum (*i.e.*, diesel) engines. Using this approach, EPA proposed to apply the CO standards for gasoline-fueled and diesel heavy duty engines to their methanol-fueled counterparts, using the throttle criterion as the basis of classification. Also, the particulate and smoke standards which apply only to diesel vehicles were proposed for non-throttled (diesel) methanol vehicles.

There were two instances where this approach was not followed. First, the idle CO standards that are applicable to certain gasoline vehicles were proposed for *all* corresponding classes of methanol vehicles. The Agency expanded this requirement to include vehicles that otherwise would be classified as being non-throttled, primarily because one such prototype methanol engine utilized a throttling device during idle. This could result in fuel/air mixtures under idle conditions that were sufficiently rich to cause CO emissions in excess of the standards applicable to throttled methanol engines. Second, standards that presently prohibit crankcase emissions from all petroleum engines, except heavy-duty diesels using turbochargers or blowers for air induction (*i.e.*, non-naturally aspirated engines), were proposed for *all* methanol engines. The Agency extended this requirement to non-naturally aspirated, non-throttled methanol engines because of the environmental concern over the nature of crankcase emissions and because there appeared to be no question of the feasibility of the requirement.

In the NPRM, EPA noted that while the proposed CO, NO_x, particulate, and smoke standards currently appeared justified, there were significant uncertainties as to whether controls would ultimately prove necessary in every instance. (For example, most non-throttled engines should have little difficulty complying with the idle CO requirements.) The Agency proposed to deal with this possibility by providing for a waiver of the certification testing requirement for any manufacturer demonstrating that the applicable standard would never be exceeded during the vehicle's useful life. This is presently done with the CO standard for heavy-duty diesel engines in order to reduce the manufacturers' regulatory burden. A waiver of certification test requirements is not, however, to be construed as a waiver of liability to comply with the existing standard or to avoid end of line or in-use test requirements.

Summary of the Comments. Most of the comments on the proposed CO and NOx standards supported the proposed requirements. The only opposing comment came from MAN Nutzfahreuge Gmbh (MAN) and pertained to the potential impact of the NOx standards for non-throttled methanol engines and methanol engines without turbochargers and intercoolers. MAN argued that the proposed standards (*e.g.*, 6.0 grams per brake horsepower-hour for 1990, 5.0 grams per brake horsepower-hour beginning in 1991) would adversely affect fuel economy and delay the acceptance of methanol engines.

Ford was the only commenter opposing the proposed approach for setting the idle CO standards. It stated that such standards were unnecessary for methanol vehicles not using a throttle at idle, and that such a requirement placed a burden on the manufacturer to either needlessly certify the vehicle or apply for a waiver.

Regarding the proposed particulate and smoke emission standards, Mercedes-Benz Truck Company disagreed with EPA's engine classification scheme for determining the applicability of the requirements. It argued that the presence of a throttle is irrelevant to a methanol engine's soot forming potential. The important

criterion was described as the kind of lubricating oil used by an engine during the combustion process. In this regard, the commenter suggested that EPA should focus on two-stroke engines, which use more oil than four-stroke engines, because both throttled and non-throttled versions of such engines may emit excessive particulate. No data were submitted to substantiate the commenter's claim, however.

GM's comments indicated that some form of catalytic exhaust aftertreatment may be required for heavy-duty engines burning neat (100 percent) methanol to comply with the most stringent particulate standards (0.10 grams per brake horsepower-hour beginning in 1991, for bus engines, and 1994 for all other HDMEs). GM was less certain about how vehicles operating on a methanol/gasoline mixture would perform but indicated that this fuel mixture could result in increased potential for particulate emissions.

The proposed control of crankcase emissions from non-naturally aspirated, non-throttled heavy-duty methanol engines drew negative comments from several parties. The commenters argued that crankcase controls are not currently required for petroleum-fueled non-naturally aspirated heavy-duty diesel engines, because their crankcase emissions are insignificant compared to the associated cost of control. As the primary support for this position, the manufacturers referred to two EPA analyses performed in the late 1970s and early 1980s that concluded such a requirement for these diesel engines was not cost effective. The commenters argued implicitly that the cost of controlling non-naturally aspirated, non-throttled methanol engines would be the same as that for their petroleum-fueled diesel counterparts because of similar emissions characteristics and requisite control technology. A turbocharged engine, for example, would require a pump to route the crankcase gas either into the exhaust in front of a catalyst, or into the intake manifold after the turbocharger. The manufacturers felt that these pumps would be prohibitively expensive, and that routing the gases directly into the turbocharger (which would not require a pump) would result in fouling due to oil mist, causing maintenance problems. The commenters presented no emissions or cost data for either petroleum- or methanol-fueled engines with which the previous studies could be updated or extended to methanol engines.

The few comments specifically addressing the proposed availability of waivers from the CO, NO_x, particulate, and smoke standards were positive. Caterpillar and the Engine Manufacturers Association (EMA) commented that smoke emissions should be very low from all methanol engines, so waivers from the testing requirements should be allowed for this pollutant. Ford's comment, noted in the discussion on idle CO standards, implied that this manufacturer was concerned that the waiver application process would be burdensome, but did not address the question of whether the availability of waivers would be a desirable regulatory outcome.

EPA Response to Comments

NO_x standards. In response to MAN's comment that NO_x standards for methanol vehicles should not necessarily be identical to those for petroleum vehicles, where they apply regardless of fuel type, EPA finds no reason to create special benefits for certain methanol vehicles by decreasing the stringency of the applicable NO_x requirement. First, the goal of the rulemaking is to apply comparable emission control requirements to all vehicles. Second, the combustion temperatures associated with methanol fuel are less than those for petroleum fuels. These lower temperatures should inherently limit the NO_x produced by methanol vehicles to lower concentrations than for their petroleum counterparts. As a result, the methanol-fueled diesel vehicles, as well as engines lacking turbochargers and intercoolers, cited by MAN should be able to comply with any NO_x control requirements at least as easily as their petroleum counterparts. Therefore, EPA disagrees with MAN that methanol vehicles would be adversely affected by the promulgation of equivalent NO_x standards.

Idle CO. The Ford comment questioning the need to implement idle CO standards for engines without a throttle has some merit. Nevertheless, in this instance, the Agency believes it is particularly important to recognize that methanol represents an emerging technology, and that there is no historical data base with which to accurately characterize the emissions performance of all methanol engine designs. In the absence of more definitive information, EPA continues to believe it is prudent to apply the standards as proposed, even for the case cited by the commenter. This approach also seems especially appropriate at this time, if manufacturers are allowed to apply for waivers of the certification testing requirements when a vehicle is expected to always emit below the level of the applicable standard.

In this regard, EPA disagrees with Ford's implication that the waiver application process represents a significant burden to the manufacturer. Applications for similar waivers are now easily and routinely processed for the diesel CO standard, and waiver requirements for methanol standards are not expected to be substantially different. The Agency also notes that other commenters supported the proposed waiver provision. Therefore, providing for a waiver of the testing requirements under the prescribed conditions appears to be a viable approach for dealing with the current uncertainties regarding the emission characteristics of some methanol vehicles, while at the same time reducing the manufacturers, regulatory burden where possible. The uncertainty about idle CO levels from potential methanol engine technologies along with the availability of testing waivers make it reasonable for EPA to promulgate the idle CO standard as proposed.

Particulate and Smoke. Regarding the proposed throttle-based classification scheme for determining the applicability of the particulate and smoke standards, the Agency agrees with Mercedes-Benz that the combustion of lubricating oil contributes to particulate formation. In the broadest sense, therefore, EPA's regulations ought to account for the particulate formation potential of two-stroke engines, which tend to consume larger quantities of lube oil regardless of whether or not they are throttled in nature. The Agency notes, however, that there is no apparent effort underway to develop or commercialize a two-stroke throttled methanol engine. Thus promulgation of standards applicable to such an engine would be premature at present.

Additionally, Mercedes-Benz's focus only on lubricating oil fails to acknowledge other primary determinants of particulate formation during the combustion process. Particulates are generally produced in localized fuel-rich areas of the combustion chamber. In diesel engines, power is controlled by varying the amount of fuel, while the volume of air inducted into the cylinder is essentially unaffected. Also, the fuel is usually sprayed directly into the combustion chamber. These characteristics of diesel engines can result in a heterogeneous fuel/air mixture within the cylinder due to droplet formation or charge stratification. The-fuel rich areas of such a mixture often fail to burn completely, resulting in the formation of particulate matter. In Otto-cycle engines, power is controlled by metering both fuel and air.

This results in a fairly uniform fuel/air mixture in the cylinder. Such a mixture burns more completely and inherently produces relatively low particulate emissions. The Agency relied upon this fundamental distinction between the two types of engines in proposing the engine classification scheme for methanol vehicles.

Particulate nucleation is also thought to be dependent on the presence of hydrocarbon chains in the combustion mixture. Thus methanol combustion by itself ought to have little particulate formation potential. The presence of excess lube oil in the combustion chamber, as Mercedes-Benz points out, would increase that potential. GM correctly points out another potential source of hydrocarbon chains in the fuel by noting that gasoline may be used as a blendstock. Finally, EPA notes that other additives may also be present to provide desirable fuel combustion or safety-related properties. Thus the Agency continues to find that, in the absence of empirical data to the contrary, the lack of a throttle in diesel engines gives rise to combustion conditions that, combined with appropriate fuel or oil properties, may potentially result in excess particulate emissions. EPA continues to believe, therefore, that the throttle criterion, as a determinant of engine type and thus the applicability of smoke and particulate emissions standards, is reasonable and appropriate. At the same time, the Agency recognizes that this criterion may not in all cases be sufficient by itself to classify methanol engines as diesels. For example, some engines are throttled only under certain operating conditions, but may still emit significant quantities of particulate. Thus flexibility is being given to the Administrator in resolving any ambiguities, as described earlier, in engine classification.

The final comment on the proposed application of the particulate standards for heavy-duty methanol vehicles addressed the stringency of the requirement. GM indicated that catalytic exhaust aftertreatment could be needed to ensure compliance with at least the most stringent standard of 0.10 grams per mile for buses beginning in 1991 and for other heavy-duty vehicles beginning in 1994. The Agency does not view this as an issue in the feasibility of the standards. Catalytic converters similar to the type referred to by GM have been used on the vast majority of gasoline vehicles for many years, and the cost of this hardware is less than the particulate trap oxidizers that many petroleum-fueled heavy-duty diesels will require in the future to comply with the standards. Testing by several manufacturers, GM included, indicates that the application of catalytic aftertreatment technology to methanol engines presents no technical difficulties beyond optimization of the catalytic ingredients and hardware layout. Therefore, EPA finds the particulate standards for heavy-duty methanol vehicles to be a reasonable emission control requirement.

Crankcase Controls. The last separate area of comment pertains to the prohibition against crankcase emissions from non-throttled heavy-duty methanol engines using turbochargers or blowers for air induction. The Agency finds the previous EPA analyses of diesel engines cited by the commenters are not applicable to methanol-fueled engines for two primary reasons. First, methanol-fueled diesel engines are expected to have lower particulate emissions than petroleum-fueled diesels. The resulting crankcase gases should therefore be cleaner and easier to filter, mitigating the concern with respect to turbocharger fouling. Because of these low levels of particulates, it may be more appropriate to compare crankcase emissions from methanol engines to crankcase emissions from gasoline-fueled engines, which have been routinely routed through turbochargers for years. Therefore, it is likely that control costs of non-naturally aspirated, methanol-fueled diesel engines would be more like those of turbocharged gasoline-fueled engines.

Second, the earlier analysis is outdated and represents a worst-case cost effectiveness for diesels. Since the time the analysis was done, two manufacturers (Daimler-Benz and Isuzu) have begun voluntarily controlling crankcase emissions from turbocharged diesel engines by routing the emissions through an oil separator and into the turbocharger. Actual control costs for the Daimler Benz engine are lower than EPA's previous estimate (see the Summary and Analysis of Comments for more detail). Admittedly, this cost information is for one engine model and may not be representative of costs for heavy-duty engines in general. However, it seems likely that current costs would on average be lower than those EPA estimated in the earlier analysis. Thus, even if the comparison between the emission characteristics of petroleum-fueled and methanol-fueled diesel engines were valid, the older heavy-duty diesel engine analysis would still not be applicable to methanol-fueled diesel engines. For these reasons, the Agency rejects the commenters' contention that controlling crankcase emissions from non-naturally aspirated, non-throttled heavy-duty methanol engines is prohibitively expensive.

Summary. The Agency's review of the CO, NO_x, particulate, and smoke exhaust emission standards shows that methanol vehicles should have no unique difficulty complying with the proposed requirements. In fact, compliance with the applicable NO_x and particulate standards may be easier for methanol vehicles than for their petroleum counterparts. Regarding the availability of waivers to eliminate the testing requirements for vehicles with emissions that are always expected to remain below the applicable standard, EPA continues to find this a reasonable approach for reducing a manufacturer's regulatory burden without jeopardizing environmental protection. A review of the throttle-based classification scheme for determining the applicability of the particulate and smoke standards shows it is in general a reasonable method for differentiating between the types of methanol engines likely to exceed these standards if otherwise left uncontrolled. Allowance for the consideration of other engine characteristics in addition to the use or non-use of a throttle will avoid ambiguities which may develop as a result of any hybrid engine technology. Finally, the prohibition against crankcase emissions from all methanol vehicles appears feasible and reasonable. Therefore, EPA concludes that the various standards should be promulgated as originally proposed.

D. Emissions Averaging Programs

Review of the Proposal. In the ANPRM, the Agency originally discussed allowing manufacturers to include methanol vehicles in their determination of compliance with the diesel particulate averaging standards. This consideration was predicated on the fact that the high efficiencies of methanol vehicles could result in their being in direct competition with petroleum-fueled diesel vehicles (*i.e.*, the sale of a methanol vehicle would preempt the purchase of its petroleum-fueled diesel equivalent). If this occurred, and manufacturers were allowed to count methanol vehicles toward compliance with the particulate standards, the inherently low particulate emissions from these vehicles would allow a diesel manufacturer to avoid the use of costly emission control technology, such as trap oxidizers, on some of its petroleum-fueled diesel vehicles. The result would be an incentive to develop methanol-technology with no detrimental effect on ambient particulate levels.

In the NPRM, however, the Agency noted that the degree to which methanol and petroleum-fueled diesel vehicles would be direct competitors was impossible to predict, due to the uncertainties associated with the relative economics of future methanol and petroleum vehicles. If methanol vehicles also competed with gasoline-fueled vehicles to any significant degree and averaging were allowed, diesel particulate emissions could increase substantially. For this reason, EPA did not propose to include methanol vehicles in determining compliance with the diesel particulate standards, but rather requested public comment on the possible design and desirability of such a program.

The Agency did propose creating for methanol vehicles separate particulate and NO_x averaging programs that were comparable to those already in existence for various groups of gasoline-fueled and diesel vehicles. This regulatory approach gives a manufacturer added flexibility in designing its overall compliance strategy with the applicable standards. The proposal suggested prohibiting averaging between throttled and non-throttled methanol engines within the same group (*i.e.*, light-duty trucks). This latter provision is analogous to the separate gasoline-fueled and diesel averaging programs.

Summary of the Comments. Three manufacturers commented on allowing particulate averaging between fuel types. Caterpillar and Cummins generally criticized such a program from two perspectives. First, they agreed with EPA that it was impossible to predict the degree of future competition between methanol- and petroleum-fueled diesel vehicles. As noted above, this could substantially increase diesel particulate levels. Second, the manufacturers were concerned about the potential anti-competitive effects of such a program. Caterpillar argued that averaging between fuel types would at least initially provide an unfair advantage to manufacturers of smaller urban-oriented engines, because the demand for such engines would mirror the fact that during a transition to methanol, methanol should be more readily available in urban areas. Cummins argued that inter-fuel averaging would create adverse inequities for manufacturers who do not produce methanol engines, if a competitor's petroleum-fueled diesel engine could avoid more expensive control technology (*e.g.*, a trap oxidizer) as a consequence of producing methanol vehicles for use in the averaging program.

Qualified support for the inter-fuel particulate averaging scheme came from GM. It felt that direct competition between methanol-fueled vehicles and petroleum-fueled diesel vehicles could be predicted to occur for urban bus sales. GM specifically suggested that averaging across fuel types for bus engines would allow areas without particulate problems to purchase less expensive, higher emitting, petroleum-fueled diesel buses, while areas with particulate problems could be required to purchase methanol buses or buses with trap oxidizers in order to receive operating subsidies from the Federal government. They also stated that because of the stringency of the 1991 urban bus standard, a substantial number of methanol buses would have to be produced to provide averaging credits sufficient to allow production of a single petroleum-fueled bus without a particulate trap.

No comments were received on the proposed particulate and NO_x averaging programs for methanol vehicles only.

EPA Response to Comments. The position of both Caterpillar and Cummins that allowing averaging between the fuel types could somehow benefit manufacturers that produce methanol engines or small urban engines may be valid. However, it is not necessarily true that providing regulatory flexibility, which might be more advantageous for some manufacturers than others, would be anti-competitive. Further, the limited information supplied by the commenters failed to reasonably demonstrate whether any adverse, anti-competitive effects would actually occur.

The Agency continues to find the real issue pertaining to a combined averaging program concerns the potential effects on air quality. The Agency's preliminary analyses in this regard were narrow in scope and were unable to demonstrate that allowing averaging between methanol- and petroleum-fueled diesel vehicles could be environmentally benign. The analysis did not consider the alternative of only allowing methanol-fueled diesel engines to participate in averaging programs with diesels (and restricting the inclusion of methanol-fueled Otto-cycle engines). Since the NPRM was published, the Agency has reevaluated its approach to regulating all heavy-duty engines, including methanol-diesels. The Agency believes it may be possible to design an integrated program allowing cross-fuel averaging in some cases as well as some form of banking and trading of emission credits among manufacturers. Such a program could have benefits for the regulated industry without undue adverse environmental impact, and therefore EPA has decided to pursue the issue through a regulatory action. Since this action is broader in scope than just the question of averaging between methanol-fueled and petroleum-fueled diesels, the present rulemaking is an inappropriate vehicle for further consideration of it. The Agency therefore defers analysis of comments received in this regard. GM's comments concerning the special case of buses are relevant to this broader program and will be considered as the future action is developed.

No substantive comments were received regarding the proposal to create separate particulate and NO_x averaging programs similar to those already in existence for various groups cf gasoline-fueled and diesel vehicles. The Agency views this as constituting acceptance of the goal of this rulemaking action, to create emission control requirements for methanol vehicles that are comparable to the requirements for their petroleum counterparts. Therefore, particulate and NO_x averaging standards are being promulgated, including the prohibition of averaging emissions between Otto-cycle and diesel methanol engines, as well as other constraints identical to those for the current gasoline-fueled and diesel averaging programs.

E. Fuel Economy Requirements

Summary of the Proposal. The Energy Policy and Conservation Act authorizes the Department of Transportation (DOT), under 15 U.S.C. 2001(5), to determine that liquid or gaseous fuels other than gasoline and diesel oil should be included in the Corporate Average Fuel Economy (CAFE) and fuel economy labeling programs, if such inclusion would be consistent with the need of the nation to ccnserve energy. Similarly, Section 201 of the Energy Tax Act of 1978, 26 U.S.C. 4064 *et seq.*, authorizes the Secretary of the Treasury (after consultation with the Secretary of Transportation) to include in the Gas Guzzler Tax program vehicles fueled with any product of petroleum or natural gas, if such inclusion is consistent with the need of the nation to conserve energy. Since methanol is a liquid fuel and is currently produced mainly from natural gas, it could conceivably be included in the fuel economy programs established by either statute. Both of these statutes give EPA the responsibility for determining the amount of an alternative fuel which is

equivalent to a gallon of gasoline. The resulting gasoline-equivalent fuel economy of vehicles operating on alternative energy sources would then be used for the purposes of CAFE or the Gas Guzzler Tax, as appropriate.

In the NPRM, it was noted that neither DOT nor the Treasury had decided to include methanol in their respective programs. The Agency found that this made the establishment of a fuel equivalency factor (FEF) for methanol premature. Therefore, no such factor or associated labeling requirements were proposed.

Summary of the Comments. Several commenters expressed support for the inclusion of methanol in the CAFE and Gas Guzzler programs, stating that such action could speed the development of methanol vehicles. Most of these commenters also indicated a preference for one or another approach which could be used to determine the FEF. The California Air Resources Board stated that action by EPA would not create an incentive unless DOT and the Treasury also acted, but felt that no action by EPA would be a potential impediment to methanol development. Nissan felt that establishing an FEF now would promote research and development of methanol vehicles. Finally, the National Automobile Dealers Association encouraged EPA to pursue dialogue with DOT and the Treasury concerning methanol fuel equivalency.

EPA Response to Comments. The Agency agrees that it would be desirable for manufacturers to know exactly how methanol vehicles may ultimately be treated with respect to CAFE and the Gas Guzzler Tax. However, EPA believes that adopting an FEF for methanol at the present time would do little, if anything, to significantly reduce the present uncertainty, since DOT and the Treasury have not yet acted (and may not act) to include methanol in their respective programs. Also, it is not at all obvious that the establishment of this factor would by itself prompt a regulatory decision regarding the ultimate inclusion of methanol within the provisions of CAFE or the Gas Guzzler Tax. Moreover, if DOT or the Treasury decided to include methanol in their programs, their reasons for doing so may suggest that EPA should take a particular approach to establishing the FEFs. Lacking any real benefit to action, the Agency concludes that it is best to delay establishing an FEF for methanol. Therefore, the Agency has not addressed this issue in today's action. If and when methanol is included in the CAFE or Gas Guzzler programs, EPA will initiate action to establish an FEF. In response to NADA's suggestion, EPA remains open to pursuing a dialogue with DOT and the Treasury on this topic, as appropriate.

F. Emission Test Procedures

1. Test Fuel Specifications

Review of the Proposal. EPA proposed that methanol fuel used in emissions testing be representative of commercially available methanol fuel. This was necessary to ensure that test emissions would be representative of those associated with vehicle operation in the the real world. Recognizing that methanol-fueled vehicles were at an early stage of development and that, as a result, manufacturers' fuel specifications for those vehicles that will ultimately be marketed have not been determined, EPA chose not to propose a detailed specification for methanol test fuel at the present time other than to require that the fuel contain at least 50 percent methanol by volume.

Summary of the Comments. Many commenters (California Air Resources Board, Chrysler, Department of Energy, Ford, Manufacturers of Emission Controls Association, Oxygenated Fuels Association, Nissan, and Toyota) stated that EPA should establish a fuel specification as part of the rulemaking. A fuel specification would provide vehicle and engine manufacturers with a basis for making engineering decisions on fuel system and engine design. Vehicle design parameters are dependent on fuel specification, and it was felt that a range of 50 percent through 100 percent methanol is too broad to allow this process to take place. Specifying a fuel would also provide fuel suppliers with a clear design target and prevent proliferation of fuel specifications.

Several commenters suggested that EPA should select either M85 (85 percent methanol/15 percent gasoline) or M100 (pure methanol) as the certification fuel. Reasons given in favor of M85 related to driveability, startability, flame luminosity, and fuel tank vapor concentration concerns. Also, this formulation is a common one specified for use in prototype research vehicles. M100 was suggested as an appropriate fuel for use in compression ignition engines.

Other commenters (GM, Chevron, Engine Manufacturers Association, and Volkswagen) felt that the manufacturers should specify the test fuel, at least in the short term, to ensure that only the fuel for which the vehicle is designed would be used. Volkswagen pointed out that flexibility in the choice of a test fuel would facilitate research and continued development of the optimum vehicle and fuel combination. GM added that M85 and M100 are distinctly different fuels from the perspective of vehicle design and should not be viewed as different grades of methanol fuel.

The State of New York asked how, under EPA's proposals, a representative fuel would be chosen. More specifically, New York asked what fuel properties would be considered and what tolerances would be used to specify the fuel.

EPA Response to Comments. EPA concurs with those commenters who feel that it would be desirable to specify a fuel at the present time. Provision of a fuel specification now could force a degree of standardization within the vehicle and fuel industries which would be difficult to otherwise presently obtain. The Agency's primary concern in regard to a methanol test fuel, however, is to ensure that emission testing be representative of real world conditions. Since a methanol fuel market does not yet exist, it is not possible for the Agency to select a representative test fuel. Further, there would be problems associated with selection of a fuel specification before a market for methanol vehicles and fuel is established. The manufacturers would tend to optimize vehicles' emissions performance around the specified fuel. GM's comment that M85 and M100 are different fuels, not just different grades of methanol, is a useful one in this regard, and demonstrates how important the choice of a test fuel is. From emissions and performance perspectives, use of one of these fuels or the other can be expected to result in significantly different vehicle designs. Thus, an EPA specification provided now could have the effect of deterring vehicle optimization around a fuel which might be superior for technical, environmental, and/or economic reasons. Even if EPA were to proceed with establishing a test fuel at present, such action would not necessarily impact decisions made by fuel suppliers, who are not bound to market a fuel simply because EPA specifies it for purposes of environmental testing.

The desires of many of the commenters to have EPA specify one particular fuel or another notwithstanding, the development of the in-use fuel market should remain the concern of vehicle manufacturers and fuel suppliers. As long as vehicles are able to comply with emission standards when tested on the fuels that are eventually marketed, and as long as no other overriding environmental concern

not addressed by the emission standards accompanies use of those fuels, the Agency should remain neutral concerning the development of in-use fuels.

It is recognized that in the initial sales years of methanol vehicles, the fuel market may be more uncertain than after some degree of market equilibrium and vehicle and fuel standardization is reached. In this regard, those comments suggesting that EPA adopt the manufacturers' suggested test fuel are particularly useful. In the early phases of a transition to methanol, the manufacturers can be expected to have carefully considered the nature of the anticipated fuel market and incorporated their understanding of it into their vehicle design planning. The Agency in fact intends to take advantage of this knowledge by requiring that manufacturers recommend a test fuel for their certification vehicles and provide a justification as to why that fuel can be expected to be generally available and used in their vehicles. Final authority for specifying the fuel will, however, remain with the Administrator. In the longer run, as the fuel market solidifies, the Agency will be able to act to specify representative test fuels without this required input.

In response to New York's question regarding the details of any future specification, EPA will focus its consideration of potential test fuels on fuel properties that can be expected to affect emissions. Specifics in this regard will be provided at the time of the future action.

2. Emissions Measurement Procedures

Review of the Proposal. Only those aspects of the proposal receiving substantive comment are summarized here. Since most of the procedures proposed for methanol vehicle testing are identical to those already in use, comments received related mainly to procedures proposed to measure newly regulated pollutants. Organic emissions from methanol-fueled engines and vehicles consist primarily of a mixture of non-oxygenated hydrocarbons, methanol, and formaldehyde. EPA proposed requiring measurement of each of these organic materials. The Agency noted that a flame ionization detector (FID), the instrument presently used for measurement of petroleum-fueled vehicle hydrocarbons, can be used to correctly measure either hydrocarbon emissions or methanol emissions separately. It cannot, however, accurately measure both simultaneously, because it is less sensitive to methanol. EPA also noted in the proposal that a FID has a very low (approaching zero) response to formaldehyde. As a result, more detailed procedures would be required to measure methanol vehicle organic emissions than petroleum-fueled vehicle HC.

Very briefly, the procedures proposed were as follows. For methanol, the procedure was to dissolve the methanol in water and to separate the methanol from the solvent using a gas chromatograph (GC) followed by heated FID measurement. For hydrocarbons, the procedure consisted of the collection of dilute bag samples, measurement of the hydrocarbons plus methanol with a heated FID calibrated on propane, followed by subtraction of the methanol fraction. The heated FID is required for this measurement due to its quicker response and its ability to prevent condensation in the sample lines. This analysis would need to account for the heated FID's response factor to methanol. For formaldehyde, the procedure employed the collection of formaldehyde from the exhaust sample by reaction with 2,4-dinitrophenylhydrazine (DNPH), either in impingers containing the reagent solution or in DNPH-impregnated silica gel cartridges. This would be followed by analysis with a high pressure liquid chromatograph and an ultraviolet detector.

EPA proposed that background samples of methanol and formaldehyde be collected for each phase (bag) of the test procedure, exactly as is required for other regulated pollutants. Analysis of these background samples would employ the same procedures as were described for the analyses of the exhaust emissions samples.

To prevent adsorption or condensation and the associated loss of exhaust gas constituents (in particular, methanol and formaldehyde), it was proposed that the duct connecting the vehicle tailpipe to the constant volume sampler and, in the case of heavy-duty methanol-fueled engines, the duct connecting the engine to the dilution tunnel, be heated to 235°±15 °F (113°±8 °C).

Summary of the Comments. Several of the commenters felt that more cost effective procedures than those proposed for measuring organic emissions would be desirable. These commenters supported avoiding both the proposed methanol and formaldehyde measurement procedures by use of a FID to characterize total organics, even though, as was noted, this procedure would be less accurate than the proposed approach. One commenter, EMA, suggested this approach be used at least on an interim basis until methanol vehicles achieve significant market penetration. Several manufacturers supported using the FID procedure currently used for petroleum-fueled vehicles, and applying correction factors to the results to account for the different response of the FID to methanol vehicle emissions. Others supported a similar option, with the difference being that the FID would be calibrated on methanol. GM further suggested that any correction factors also account for reactivity differences among the organics.

The Department of Energy (DOE) similarly supported the use of a FID calibrated on methanol, but did not support the use of correction factors. DOE felt that the HC overmeasurement accompanying such a procedure would provide a margin of safety with respect to ozone control.

Reasons given for suggesting these alternative procedures were: (1) They require less analytic equipment than the proposed procedures; (2) they would be less expensive than the proposed methods; and (3) they would allow continuous in-line measurement of the emissions, whereas the methanol and formaldehyde procedures, as proposed, would not.

GM suggested that an unheated FID be allowed for measurement of evaporative HC plus methanol emissions. GM felt that since there is not enough water vapor to cause condensation in the evaporative testing system, there is no need to heat the FID.

GM felt that some methanol loss may be associated with condensation on the walls of unheated sample bags employed in the exhaust HC plus methanol analysis, and that the use of a continuous heated FID analysis would give the correct results.

Toyota requested that the measurement of background formaldehyde levels be made optional because of inherently low background levels and the complexity of the analytical procedures.

Caterpillar and Toyota felt that the requirement that the exhaust ducting be heated was complicated and unnecessary. Toyota suggested a simplified approach that would allow the elimination of the heating requirement for short ducts or turning the heater off once the duct is preheated to EPA's specified temperature.

Finally, commenters raised questions regarding the use of other specific procedures which might produce equivalent results to those that would be

obtained if the proposed procedures were used.

EPA Response to Comments. Since one of EPA's goals in this rulemaking was to establish regulations that would ensure that methanol vehicles would not have any detrimental effect on air quality, the Agency is not willing to allow any simplified procedures which could potentially undermeasure total organic emissions. Based on an analysis presented in the Summary and Analysis of Comments, EPA concluded that only the simplification suggested by DOE could reasonably be expected to not undermeasure total organic emissions. EPA's data continue to show that the overmeasurement of HC that would result from this method would be greater than the undermeasurement of formaldehyde. Thus, the total would be conservatively high. Any attempt to correct this total via use of empirically derived coefficients, as several commenters requested, would risk sacrificing the margin of safety. Use of correction factors was therefore rejected by EPA. EPA has decided to allow use of the simplified procedure suggested by DOE, which provides an adequate margin of safety, on an interim basis.

Because the purpose of allowing the use of this simplified procedure would be to reduce testing costs and to provide manufacturers with more flexibility during the development of a methanol-fueled vehicle fleet, there needs to be a reasonable limit to the period of time wherein the simplified procedure can be used. It was decided that a five-year period from the effective date of these regulations would be sufficiently long to allow initial development of a methanol fleet.

EPA continues to believe that the long term requirement for the measurement of methanol and formaldehyde is necessary, because of the toxic and reactive nature of these pollutants. During the period when the use of the simplified measurement procedure is allowed, EPA expects to monitor the organic material composition of the emissions from methanol-fueled engines and vehicles. This monitoring would be performed to enhance the Agency's knowledge of methanol-fueled vehicle emissions and the potential for health effects. The Agency expects that manufacturers would collect similar data and make it available to EPA, as they have for other mobile source issues under the provisions of section 202(a)(4) of the Clean Air Act. The manufacturers currently provide much useful information under this section, and future information would logically include test results for methanol and formaldehyde emissions.

Any manufacturer choosing the simplified method for a particular vehicle must understand that EPA will also use the method, and that all future testing of that vehicle for in-use compliance will also make use of it. This is to ensure that manufacturers do not make multiple attempts at compliance, first with the simplified (more conservative) method and perhaps later with the more accurate one. Also, requiring that in-use compliance testing make use of the same method of testing as was used during certification ensures consistency in the data.

Use of a heated FID is being required for evaporative as well as exhaust testing because of its quicker response to methanol as well as its ability to prevent condensation. Since the time available to draw a sample in evaporative testing is short, a quick FID response is essential for an accurate reading. Thus the Agency is promulgating this requirement as proposed.

The concern raised by GM about condensation-related losses in bags may be valid. However, lacking sufficient data with which to quantify the significance of GM's comment, the proposed sample collection procedure will be retained. This concern will be investigated in detail and, if warranted, the sample collection procedure will be modified at a future date. Manufacturers are forewarned that in the meantime, if good laboratory practice demands that steps be taken to avoid condensation in bags, they should take those steps as a matter of prudence.

Toyota is correct in stating that the background formaldehyde measurement could be simplified. However, it is not correct to suggest that measurement is not necessary at all. Such an approach could lead to problems in compliance determinations (vehicles could be failed inadvertently) and lab-to-lab correlation testing. As an option, however, EPA will allow collection of a single formaldehyde background sample for each test (instead of one sample for each phase), covering the total test period. This simplification will significantly reduce the labor and equipment demands of each test.

EPA finds that several simplifying options in regard to its requirement to heat the exhaust duct are also warranted. First, heating will not be required for ducts that are less than five feet long, and are constructed from smooth wall tubing. Second, when this configuration is impractical, EPA will allow the use of smooth wall ducts up to 12 feet long, as suggested by Toyota, without requiring heating during testing, provided that the duct is heated to 235°±15 °F (113°±8 °C) prior to the start of testing and during any periods of the test when the engine is off. Heating of the duct will be required during the test, if the total length of the duct exceeds 12 feet. It should be noted that whenever the duct is heated, regardless of duct length, it will be necessary to ensure that the temperature of the duct wall does not exceed 250 °F (121 °C). As a final alternative, the exhaust duct may be essentially eliminated by moving the mixing point of the dilution air and exhaust gases to a point immediately adjacent to the vehicle tailpipe or engine exhaust.

Several commenters were concerned that EPA's proposed procedures might preclude their ability to utilize other measurement techniques that might produce equally accurate results. EPA stated in the NPRM that it wishes to encourage the continued development of measurement procedures for methanol vehicles. The promulgation of the procedures discussed above is not intended to prevent manufacturers from utilizing any other methods they consider to be superior, so long as they can demonstrate to EPA the methods' equivalency to the specified procedures.

3. Requirements for Flexible Fuel Vehicles

Summary of the Proposal. The Agency proposed that, because flexible fuel vehicles (FFVs) are designed to operate on gasoline, methanol, or any mixture of these fuels, they should comply with the emission standards (when tested using the methanol vehicle test procedures) when tested on any mixture of the fuels which they could conceivably consume in-use. Comments were specifically requested on the appropriateness of the requirement.

Summary of the Comments. No commenter argued against EPA's philosophy that FFVs should comply with the applicable emission standards when tested on fuels used in customer service. Most of the commenters were concerned, however, that EPA's proposed approach to certifying FFVs would require tests on a range of certification fuels and that this would be burdensome and unnecessarily complicated.

To avoid this, the commenters suggested a variety of alternatives, such as specifying either methanol or gasoline as the test fuel for each vehicle at the time of certification. Ford argued that testing on intermediate mixtures was unnecessary, because owners

would habitually use only one of the fuels. Chrysler felt that FFVs should be tested on *both* methanol and gasoline to ensure that the vehicles are not optimized for only one of the extremes. GM, however, suggested that testing initially should be required on gasoline only, since it will be the predominant fuel choice in the near future. Chevron pointed out that a methanol-gasoline mixture is often more volatile than either methanol or gasoline separately. Consequently, evaporative emissions will be greatest on a mixed fuel. It felt that this possibility should be addressed by testing on intermediate mixtures as well as methanol and gasoline. The Department of Energy felt that EPA should simply specify a worst case fuel mixture at the time of testing.

Finally, Ford was concerned about how FFVs would be treated with respect to fuel economy and labeling.

EPA Response to Comments. The statement that FFVs were expected to comply with standards using any possible in-use fuel was not meant to imply that testing would be required on a wide variety of different fuels. The Agency agrees with the commenters that this would create an unnecessary testing burden which could hinder the development of methanol vehicles. Rather, EPA believes that this goal can be achieved with a reasonable degree of confidence during the certification process by restricting certification tests to fuels that are most likely to produce high emissions. The importance of correctly identifying such fuels is underscored by Chrysler's comment that the emissions performance of a vehicle will likely be optimized for the certification test fuel.

In evaluating the alternatives suggested by the commenters, the Agency finds that testing on methanol or gasoline will not necessarily ensure worst-case emissions for certification purposes, nor would requiring separate tests with both fuels. As noted by Chevron, a mixture of methanol and gasoline can be significantly more volatile and result in higher emissions than either gasoline or methanol. EPA rejects Ford's contention that such mixtures are unlikely in customer service. There is no assurance that owners will habitually refuel with either methanol or gasoline. This would be especially true in a competitive fuel market, when consumers would be expected to exhibit the greatest interest in flexible fuel vehicles.

Overall the Agency is in at least partial agreement with the comments suggesting the designation of a single test fuel at the time of emissions certification. Two exceptions to this general approach appear necessary, however, to ensure an effective program. First, to ensure environmental protection, separate fuels *may* be required for evaporative and exhaust testing and mileage accumulation. Second, the manufacturer should recommend a specification, for Administrator approval, of the test fuels most likely to produce the highest emissions. This is appropriate because the manufacturers generally will be most familiar with the specific emission characteristics of each vehicle. It also provides manufacturers with some degree of added certainty and flexibility concerning the certification requirements. These specifications would be made at the time of application for certification.

The Agency wants to stress that selection of a certification test fuel does not remove the manufacturer's liability for complying with the applicable standards when tested on other fuels. For example, EPA's in-use compliance testing of FFVs may be conducted using methanol, gasoline, or any mixture of these fuels found to be in customer service.

The issue of methanol's inclusion in the CAFE and Gas Guzzler programs is discussed in detail in a separate section. As is noted there, methanol is currently not a part of either program. Thus, the Agency finds that it is appropriate to treat FFVs strictly as gasoline vehicles for the purposes of CAFE and the Gas Guzzler Tax. This will necessitate testing on gasoline to determine the vehicle's fuel economy. With respect to labeling, since methanol is not included in the CAFE program and no methodology for calculating the fuel economy of methanol vehicles was proposed, placing a methanol fuel economy number on the label would be inappropriate.

IV. Technical Feasibility

In the NPRM, the Agency noted that the exhaust pollutants subject to control by the proposed standards are either similar or identical to those presently regulated from current vehicles and engines. Further, emission levels are such that the stringency of the new standards is comparable to that of existing standards for gasoline-fueled and diesel vehicles. This allows essentially the same emission control technology employed by petroleum vehicles to be applied to methanol vehicles. Numerous comments supported this point of view. Exhaust emission testing of prototype vehicles, along with a consideration of control technology that is emerging to address new standards applicable to petroleum-fueled vehicles showed that the methanol vehicle exhaust standards are achievable with available or expected controls. In fact, most of the standards were achievable even before vehicles were optimized for methanol use (see Section III.B.1, for example).

Several comments were received which relate to the feasibility of the exhaust organics standards. Caterpillar claimed that carbon-based organics standards would not be achievable for its current heavy-duty engine. As discussed earlier in this document (see Section III. B.1, entitled "Basis of the Ozone-Related Standards"), the comment was insufficiently supported by data or by information on the emission-related goals of Caterpillar's engine program. Recent testing of another heavy-duty engine, this one by Detroit Diesel Allison (DDA), without a catalyst demonstrated that the CO, particulate, and NO_x standards were readily achieved.[22] The organic emission standard was not met by this engine, but with the planned development of advanced fuel injectors or if necessary the addition of catalytic aftertreatment, compliance is now expected.

Ford presented data (also discussed in Section III.B.1) which showed that carbon-based standards were achievable, at least at the low to moderate mileage levels for which data were available. Ford's comments also indicated that little development work had been done to optimize the exhaust emission control systems of these vehicles. GM also presented data which demonstrated that exhaust organics are emitted from light-duty vehicles at levels below the standards. Thus the Agency is confident that the carbon-based standards are feasible for both heavy-duty and light-duty vehicles.

No commenter questioned the feasibility of compliance with any other exhaust emission standard (CO, NO_x, particulate, or smoke). EPA concludes, therefore, that they are feasible.

EPA indicated in the NPRM that while some development effort may be required to achieve the evaporative standards, the control technology would be virtually identical to the current technology and thus should pose no significant technological challenges Ford agreed with the Agency and stated that the standards appeared feasible. No commenter argued that they were not. EPA concludes that the evaporative standards are feasible.

[22] Unpublished DDA test data. Available in the public docket for review.

Compliance with the prohibition against crankcase emissions is not expected to be difficult for any methanol vehicle. The requisite technology is currently used on all gasoline-fueled vehicles and on naturally aspirated diesels. Commenters did not argue that the standards for methanol engines would be infeasible. They did feel however that applying controls to non-naturally aspirated, methanol-fueled diesel engines would be prohibitively expensive, as is the case, they claimed, for non-naturally aspirated petroleum-fueled diesels today. Crankcase emissions from methanol-fueled engines, for reasons described elsewhere in this document (see Section III.C), should be easier to control than are diesel crankcase emissions. This fact, along with the voluntary application of crankcase controls on non-naturally aspirated heavy-duty petroleum-fueled diesels manufactured by Daimler-Benz and Isuzu, indicates that such technology is also feasible for non-naturally aspirated heavy-duty methanol engines.

V. Leadtime and the Effective Date of the Standards

The NPRM originally proposed an effective date of 1988 for these standards. Delays in the rulemaking process necessitated that this date be moved back. The earliest feasible date of applicability, as discussed below, is 1990. Hence the standards are effective as of that model year. The amount of leadtime now available is similar to that which would have been allowed had EPA maintained its original rulemaking schedule.

The only comment received in regard to the leadtime question was from EMA, which claimed that heavy-duty methanol engines should be allowed four years of leadtime for new HC, CO, and NOx standards. EMA's logic is faulty, however, since the statutory provision it refers to is in section 202(a)(3) of the Act. That section's specific requirement and legislative history make clear that Congress drafted the section with petroleum-fueled vehicles in mind. EPA thus believes that vehicles run on alternative fuels are appropriately regulated under sections 202(a)(1) and 202(a)(2), which, as noted in the NPRM, "shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period." EPA notes that were the section EMA cites applicable, the Agency would not be required to provide specific leadtimes for all standards (*e.g.*, particulates), and it might in some cases have to set standards more stringent than those applicable to petroleum-fueled vehicles, if such standards were feasible for methanol-fueled vehicles on a technology-forcing basis. However, for reasons discussed earlier, EPA believes that methanol-fueled vehicle emission standards should be comparable to their petroleum-fueled vehicle counterparts, and that sections 202(a) (1) and (2) if the Act permitted this approach. The leadtime question therefore relates to technical considerations, not rigid statutory requirements.

From a technical perspective, leadtime is primarily a function of how rapidly manufacturers can respond in an orderly manner to the new emission control requirements. As discussed in greater detail earlier, the Agency fully expects all methanol vehicles to be able to comply with the proposed standards using the same basic technology now being applied to gasoline-fueled and diesel vehicles. Thus, the only leadtime necessary is that for the development of specific applications, procurement of componentry, and certification. (Leadtime for developing methanol emission testing procedures and facilities will be minimal, given their overall similarity to current test protocols and given the interim relaxation of some of the potentially more troublesome requirements of the emission measurement protocols.) This process can proceed as fast as the development of other, non-emissions related equipment specific to methanol-fueled vehicles, and could, in EPA's technical judgment, be completed as early as the 1991 model year, and perhaps in the case of a small number of engine families, as early as the 1990 model year.

Also important in choosing the effective date of the emission standards is when methanol vehicles will reach the market in significant numbers. The Agency believes that some methanol vehicles could be produced for public sale as early as 1990 and mass-produced in the early 1990's based on the present state of development. EPA recognizes that the most likely driving force for the introduction of methanol vehicles in the 1990 model year would be from states and municipalities seeking to improve their air quality. Under such a scenario, they may desire to purchase vehicles certified to comply with the standards promulgated here. To provide for this, the standards are established for the 1990 model year. However, to ensure that manufacturers have sufficient leadtime, compliance with the standards will be optional for the 1990 model year, and mandatory for 1991 and later model years. Parties wishing to purchase vehicles meeting these standards in 1990 can do so simply by requiring it as a condition of purchase. EPA is confident that this approach will have no adverse impact on the environment, since the number of vehicles potentially involved is extremely small.

VI. Environmental Effects

Since methanol vehicles will displace petroleum-fueled vehicles, the environmental impact of today's standards will depend on a comparison of emissions from methanol-fueled vehicles to the emissions of petroleum-fueled vehicles. Making direct comparisons is, however, problematic. First, it is unknown which models of methanol vehicles will be marketed. Second, only limited testing has been done to compare emissions between similar petroleum-fueled and methanol-fueled vehicles.

In fact, the data which attempt to make such a comparison are inconclusive; sometimes emissions are less for methanol vehicles, sometimes not. The primary reason for this is that early methanol vehicle programs have been inconsistent with respect to emission control system design goals. The limited amount of development pursued to date, made apparent in comments by Ford (which has produced more methanol vehicles than any other company), makes a comparison for these models less relevant than if the vehicles had been optimized for methanol use.

The environmental impact of methanol vehicles can be estimated more precisely by examining some of the technological considerations of this rule than by trying to evaluate the limited and somewhat confounding data that are available

First, light-duty, methanol-fueled Otto-cycle vehicles are expected to utilize similar emission control technology to that used on existing gasoline-fueled vehicles (Section III.B.1). As a result, and given that the emission standards for CO and NO_x will be identical to those applicable to gasoline-fueled vehicles, Otto-cycle methanol-fueled vehicles will have similar emission levels of these pollutants. Using similar logic, the emission standards for methanol-fueled vehicle organics are equivalent (on a carbon basis) to the HC standards for gasoline fueled vehicles, and thus roughly equivalent amounts of organic carbon emissions for methanol- and gasoline-fueled vehicles can be anticipated It is important to note that

while the foregoing discussion compared organic emissions from methanol-fueled vehicles to HC emissions from gasoline-fueled vehicles, the relative abilities of those emissions to produce ozone may differ. EPA's analysis indicates that in general, when equal amounts of these two pollutant classifications (compared on a carbon basis) are emitted, the ozone produced from the methanol-fueled vehicle emissions will be somewhat less than that produced by the gasoline-fueled vehicle emissions Thus, the standards being promulgated today should generally limit the amount of ozone produced by methanol-fueled vehicles relative to that resulting from gasoline-fueled vehicles. Most cities may experience a minor benefit in this regard, but no city is currently projected to suffer a degradation.

These conclusions were derived based on data for light-duty vehicles. Similar conclusions can be drawn as regards motorcycles and heavy-duty Otto-cycle engines (when compared to their gasoline-fueled counterparts), since control technologies will be similar to those applicable to light-duty vehicles.

Second, with respect to diesel vehicles, CO and organic carbon emissions would be expected to correspond roughly between methanol- and petroleum-fueled vehicles because of similar engine operation fundamentals and similar control requirements and technologies. The available information shows, however, that methanol offers substantial benefits in the areas of NO_x, particulate, and smoke. This results not from any increased stringency of control requirements but rather by virtue of methanol's unique characteristics as a fuel when combusted in a diesel engine. Therefore, depending on the extent to which petroleum fueled diesel engines and vehicles are displaced by methanol-fueled engines and vehicles, the standards being promulgated today will have a positive environmental effect.

Thus, today's emission standards should, with exceptions as noted below, result in methanol vehicles having an equal or somewhat less adverse impact on the environment for regulated pollutants, depending on the vehicle type (Otto-cycle or diesel) and pollutant. The exceptions to this are methanol and formaldehyde. While emissions of these pollutants, as discussed below, will increase due to methanol vehicles, they are regulated under a combined carbon-based organics standard, and levels of organic carbon from methanol vehicles are not expected to increase.

There is some potential public health concern regarding the methanol and formaldehyde emissions from methanol vehicles due to their acute toxic effects. As part of this rulemaking, the Agency assessed the public health risk associated with the toxicological properties of these pollutants by evaluating several public and private exposure scenarios. The results of this study suggest that the only area of potential near-term concern involves the idling of cold methanol vehicles in personal parking garages. Under this exposure scenario, the concentration of formaldehyde was estimated to be significantly greater than the level at which the vast majority of the population would first notice the irritant effects of this pollutant. Methanol concentrations were projected to exceed their levels of concern, but the available data do not allow a conclusion that adverse effects in humans would be anticipated at the predicted concentrations. (For a more detailed discussion of methanol health effects see the discussion labeled "Toxicity of Methanol," in Section III.B.2.)

It is noted that while these results are important, there are many uncertainties about the quality of the emission factor data and the validity of the exposure model used in the assessment. More importantly, the irritant effects of formaldehyde under such exposure conditions would likely discourage owners from idling methanol vehicles inside of their garages, particularly since such precautions would also prevent exposure to concentrations of carbon monoxide which could cause much more severe acute health effects (including nausea, severe headaches, brain damage, and even death). EPA believes that it is appropriate for the owner to assume responsibility for avoiding obviously adverse and voluntary exposures such as idling inside of a personal garage. In this regard, methanol-fueled vehicles are no different from petroleum-fueled vehicles, which have similar emissions of CO as methanol vehicles, and for which idling inside garages is recognized as a dangerous practice. Furthermore, current vehicles can also emit enough formaldehyde to cause formaldehyde concentrations inside a garage to significantly exceed the level of concern. EPA will continue to investigate the potential for unacceptable exposures in parking garages and other exposure settings as additional information becomes available. The Agency also notes the need for additional scientific study to determine the effects of repeated exposures to low levels of methanol, especially with regard to effects observed in well conducted animal studies as discussed earlier. Appropriate action, to the extent statutorily authorized, will then be initiated if necessary. (Section III.B.3 contains a more detailed discussion of this topic.)

Formaldehyde is also a suspected human carcinogen. If methanol vehicles enter the market in significant numbers, typical ambient concentrations might increase, because these vehicles emit more formaldehyde than current vehicles. If so, any formaldehyde-related cancer risk could also increase. The uncertain extent to which formaldehyde is created in the atmosphere through photochemical reactions of other organic pollutants emitted from both stationary and mobile sources, however, provides a confounding effect in the analysis. This makes it difficult to judge the likely effect of methanol vehicles on ambient formaldehyde levels relative to that of other sources, including current vehicles. Given the present uncertainties and the fact that it will be a long time before methanol vehicles could comprise a large enough fraction of the fleet to significantly affect ambient formaldehyde concentrations, EPA intends to pursue its current study of formaldehyde-related emissions from all major sources before taking any regulatory action with regard to this pollutant. (Section III.B.3 contains a more detailed discussion of this topic.)

In a related matter, benzene and other carcinogens and toxic pollutants which result from direct emissions and incomplete combustion of current motor fuels are expected to exhibit a general decrease as methanol vehicle use increases.

Methanol vehicles could have an impact on global warming (i.e., the "greenhouse effect") as well. While increased combustion efficiency may result in lower carbon dioxide (CO_2) emissions from methanol-fueled vehicles compared with petroleum-fueled vehicles, the overall impact of a shift to methanol-fueled vehicles on global warming is uncertain. The analysis of the impact must include the effect of not only emissions from the vehicles, but also emissions from methanol production. While CO_2 is the single largest contributor to the greenhouse effect, other greenhouse gases such as carbon monoxide, nitrous oxide and methane must also be considered. Additionally, if large scale methanol use were to result in significant decreases in tropospheric ozone concentrations on a global scale, a partial offset to the greenhouse warming would occur. Present modeling is, however, unable to estimate the degree to which replacement of gasoline by methanol in

motor vehicles would affect overall global tropospheric ozone levels.

The amounts of these greenhouse gases emitted vary depending upon how methanol is produced. Assuming energy prices that are roughly in the range of current prices and current technology, fuel for a methanol vehicle system would likely be derived from natural gas. In this case, a shift to methanol vehicles would have little or no effect upon global warming.

In the long-term, the implications of using methanol as a transportation fuel are difficult to predict. Should petroleum and natural gas prices rise substantially, it is probable that methanol would be produced from coal. Assuming vehicle miles traveled and other factors remain constant and assuming current process technology, a methanol-fueled system using methanol derived from coal could result in as much as a doubling of the motor vehicle contribution to the greenhouse effect relative to the contribution of current petroleum fuels. This increase, however, is not an inherent result of methanol production, rather it is a result of utilization of coal as a feedstock. Under some circumstances which make the use of coal as a motor fuel feedstock a viable economic alternative, the relevant comparison might not be between coal-based methanol and petroleum-based gasoline, but rather between coal-based methanol and coal-based gasoline. When economics encourages the production of motor fuel from coal, given current production processes and costs and methanol's potentially higher combustion efficiency, methanol production and use could have significant advantages over production and use of gasoline from coal. The overall range of global warming effects, however, would depend upon a wide range of factors, such as vehicle fuel economy and driving patterns, which would likely be different in a scenario in which production of transportation fuels from coal was economic. For example, total miles traveled and total fuel combusted would likely decrease due to conservation associated with higher prices. (This would likely occur equally for gasoline or methanol vehicles.) Therefore, the full impact on the greenhouse effect of a coal-derived methanol transportation system is difficult to accurately predict.

Finally, with higher petroleum prices it may become economically feasible to produce methanol from biomass. If this is done in a renewable fashion, there would be no net increase in carbon dioxide emissions. If the production process employed adequate control over methane emissions, use of methanol from biomass could substantially reduce the transportation sector's contribution to global warming

It is concluded that today's standards will result in levels of most regulated emissions similar to those for current vehicles they will displace. Exceptions include methanol and formaldehyde emissions which will increase, and smoke, particulate, and NO_x emissions, which relative to current diesel engine levels will decrease. Also, replacement of petroleum-fueled vehicles with methanol-fueled-vehicles could result in decreases in ozone levels in some areas and will result in decreased emissions of unregulated toxins such as benzene and other fuel-related pollutants. Methanol vehicles could also have an effect on global warming, which could be positive or negative, depending on production processes. Overall, the environmental impact of methanol vehicles is expected to be positive.

VII. Economic Effects

The Agency expects the standards to be attainable using emission control technology which is similar to that already in existence for petroleum vehicles. Given this, as well as several other considerations to be discussed below, the cost of emission controls for methanol vehicles generally should be similar to or less than that for the majority of current vehicles.

In a few instances it appears possible that the application of present technology to methanol vehicles may be somewhat less costly. Most gasoline vehicles require a three-way (oxidation/reduction) catalyst to achieve the applicable standards. With several caveats, it is possible to conclude that the majority of Otto-cycle methanol vehicles will also utilize this type of control technology. First, research is presently being conducted to determine whether it may be possible to eliminate the reduction part of the catalyst without risking exceedance of the NO_x standard. This would result in significant cost advantages. Methanol's lower combustion temperatures and resulting lower engine-out NO_x emissions make this a possibility. Second, it is also possible that methanol's simple chemical structure will allow the use of less expensive oxidative materials in an optimized catalyst bed. Only Chrysler argued that the carbon-based exhaust organics standards would be more expensive than existing HC standards. Chrysler presented no data whatever with which to substantiate this claim. In light of this and in the absence of other similar comments, the Agency rejects Chrysler's argument.

With regard to evaporative emissions, it is expected that carbon-containing canisters, identical in construction and function to those on gasoline fueled vehicles will be used as the control technology. It is expected that these canisters will be sized (and hence costed) similarly to those for gasoline-fueled vehicles or perhaps smaller, given methanol's lower volatility, and hence lower vapor generating capacity. No commenter argued that the evaporative standards would increase the cost of compliance for methanol-fueled vehicles when compared to gasoline-fueled vehicles.

With two notable exceptions, methanol-fueled diesel vehicles will likely require similar control technology to that used on current diesel vehicles. Many petroleum-fueled diesel vehicles will require a trap-oxidizer to achieve the stringent diesel particulate standards for urban buses and all heavy-duty vehicles beginning in the 1991 and 1994 model years, respectively. Some heavy-duty methanol-fueled diesel vehicles may require an oxidation catalyst in the worst case to attain the same standards. Oxidation catalysts are expected to be significantly less expensive than particulate trap-oxidizers. Therefore, compliance with the applicable particulate standards for methanol-fueled vehicles should be less costly than for petroleum-fueled vehicles. On the other hand, since evaporative standards do not now apply to petroleum-fueled diesel vehicles, their application to methanol-fueled diesel vehicles represents an increased cost. It is possible to reason, however, that this will be offset by the lower cost of complying with particulate standards for these vehicles.

Overall, methanol vehicles will have generally similar control technologies as current vehicles. With the exception that today's standards will require evaporative control on more vehicles than are controlled currently, every identified potential cost differential between methanol and current vehicles would work to make control for methanol vehicles less expensive relative to current vehicles. Overall, therefore, it is possible to conclude that the economic impact of these standards will be neutral or slightly favorable to methanol vehicles.

Statutory Authority:

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

Administrative Designation

Under Executive Order 12291, EPA must judge whether a regulation is "major" and, therefore, subject to the requirement that a Regulatory Impact Analysis be prepared This regulation is being developed primarily to remove any emissions-related regulatory uncertainties that may act as a barrier to the development of methanol as a transportation fuel. It will not impose costs for methanol vehicles that are significantly different from those for vehicles which are already in production, and will not adversely affect competition, productivity, investment, employment, or innovation. This regulation, therefore, is not major and does not require a Regulatory Impact Analysis.

This regulation was submitted to the Office of Management and Budget (OMB) for review as required by Executive Order 12291. Any written comments from OMB and any EPA response to those comments are in the public docket for this rulemaking.

Reporting and Record Keeping Requirements

The information collection requirements contained in this final rule have been approved by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1980, 44 U.S.C. 2501 et seq., and have been assigned OMB Control Number 2060–0104. The public reporting burden for this collection of information is estimated to vary from 2 to 2000 hours per response, with an average of 115 hours per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The burden for submissions pertaining to methanol-fueled vehicles will be slightly lower as a result of this action. The decrease, however is not significant on average.

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, PM–223, U.S. Environmental Protection Agency, 401 M Street, SW., 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."

Impact on Small Entities

Section 605 of the Regulatory Flexibility Act, 5 U.S.C. 601 et seq., requires that the Administrator certify that these regulations would not have a significant impact on a substantial number of small entities. I certify that this regulation does not have such an effect because it primarily affects only manufacturers of motor vehicles and motor vehicle engines, a group which does not contain a substantial number of small entities.

List of Subjects in 40 CFR Part 86

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

Date: February 22, 1989.

William K. Reilly,

Administrator.

TABLE OF CHANGES MADE TO VARIOUS SUBPARTS

Section	Change	Reason
1. Part 86 Authority	Addition of citations	Incorporate all authority citations.
2. Table of Contents	Addition of 1990 MY sections	Incorporation of methanol fuel into the regulations.
3. § 86.090–1	Addition of section 86.090–1	Do.
4. § 86.090–2	Addition of section 86.090–2	Do.
5. § 86.090–3	Addition of section 86.090–3	Do.
6. § 86.090–5	Addition of section 86.090–5	Do.
7. § 86.090–8	Addition of section 86.090–8	Do.
8. § 86.090–9, (a)(1), (b), (d), (e) and (g)(2)	Modify language to include methanol	Do.
9. § 86.090–10, Title, (a)(1), (a)(3), (b) and (c)	Change "gasoline-fueled" to "Otto-cycle" in title, and add emission standards for methanol fuel.	Do.
10. § 86.091–10, Title, (a)(1), (a)(3), (b) and (c)	Change "gasoline-fueled" to Otto-cycle" in title, add emission standards for methanol fuel.	Do.
11. § 86.090–11, (a)(1), (b)(1), (b)(3), (b)(4) and (c)	Add emission standards for methanol fuel	Do.
12. § 86.091–11, (a)(1), (b)(1), (b)(3), (b)(4) and (c)	Add emission standards for methanol fuel	Do.
13. § 86.094–11, (a)(1), (b)(1), (b)(3), (b)(4) and (c)	.....do.	Do.
14. § 86.090–14	Addition of section 86.090–14	Do.
15. § 86.090–21	Addition of section 86.090–21	Do.
16. § 86.091–21, (a), (b)(4)(ii), (b)(4)(iii)(B)(*2*), (b)(5)(i)(A), (b)(5)(i)(C), (b)(6)(i), (b)(6)(ii), (b)(6)(iii)(B)(*3*) and (e).	Modify language to incorporate methanol fuel	Do.
17. § 86.090–22	Addition of section 86.090–22	Do.
18. § 86.090–23	Addition of section 86.090–23	Do.
19. § 86.091–23, (b)(1)(ii), (b)(2), (b)(3), (b)(4), (c)(1), (e)(1), (f) and (f)(1).	Modify language to incorporate methanol fuel	Do.
20. § 86.090–24	Addition of section 86.090–24	Do.
21. § 86.090–25, (b)(3), (d)(1)(ii), (e)(2), (3) and (h)	Modify language to include methanol	Do.
22. § 86.090–26	Addition of section 86.090–26	Do.
23. § 86.090–27	Addition of section 86.090–27	Do.
24. § 86.090–28	Addition of section 86.090–28	Do.
25. § 86.091–28, (a)(4)(i), (a)(4)(i)(C), (a)(4)(ii)(B), (b)(2), (b)(3), (b)(4), (b)(8), (c)(2), (c)(4), (c)(7), (d)(1) and (d)(2).	Modify language to incorporate methanol fuel	Do.
26. § 86.090–29	Addition of section 86.090–29	Do.
27. § 86.091–29, (a)(3)(i), (b)(3)(i) and (c)(1)	Modify language to incorporate methanol fuel	Do.
28. § 86.090–30	Addition of section 86.090–30	Do.
29. § 86.091–30, (a)(1)(ii), (a)(3)(i), (a)(3)(ii), (a)(9), (b)(1), (b)(3), (b)(4), (b)(4)(ii)(A), (b)(4)(iii), (b)(4)(iv) and (d).	Modify language to incorporate methanol fuel	Do.
30. § 86.090–35	Addition of Section 86.090–35	Do.
31. § 86.091–35, (a), (a)(1)(iii)(C), (a)(1)(iii)(D), (a)(2)(iii)(D), (a)(3)(iii)(F), (a)(3)(iii)(G), (a)(3)(iii)(J), (a)(3)(iii)(K), (a)(4)(i), (a)(4)(iii)(E), (c)(1), (g)(1) and (h).	Modify language to incorporate methanol fuel	Do.
32. § 86.104, (b)	Modify language to incorporate methanol fuel	Do.

TABLE OF CHANGES MADE TO VARIOUS SUBPARTS—Continued

Section	Change	Reason
33. § 86.105, (a)	.....do.	Do.
34. § 86.106-90	Addition of section 86.106-90	Do.
35. § 86.107-90	Addition of section 86.107-90	Do.
36. § 86.109-90	Addition of section 86.109-90	Do.
37. § 86.110-90	Addition of section 86.110-90	Do.
38. § 86.111-90	Addition of section 86.111-90	Do.
39. § 86.113-90	Modify language to incorporate methanol fuel	Do.
40. § 86.116-90	Addition of section 86.116-90	Do.
41. § 86.117-90	Addition of section 86.117-90	Do.
42. § 86.119-90	Addition of section 86.119-90	Do.
43. § 86.121-90	Addition of section 86.121-90	Do.
44. § 86.126-90	Addition of section 86.126-90	Do.
45. § 86.127-90	Addition of section 86.127-90	Do.
46. § 86.131-90	Addition of section 86.131-90	Do.
47. § 86.132-90	Addition of section 86.132-90	Do.
48. § 86.133-90	Addition of section 86.133-90	Do.
49. § 86.135-90	Addition of section 86.135-90	Do.
50. § 86.136-90	Addition of section 86.136-90	Do.
51. § 86.137-90	Addition of section 86.137-90	Do.
52. § 86.138-90	Addition of section 86.138-90	Do.
53. § 86.139-90	Addition of section 86.139-90	Do.
54. § 86.140-90	Addition of section 86.140-90	Do.
55. § 86.142-90	Addition of section 86.142-90	Do.
56. § 86.143-90	Addition of section 86.143-90	Do.
57. § 86.144-90	Addition of section 86.144-90	Do.
58. § 86.401-90	Addition of section 86.401-90	Do.
59. § 86.410-90	Addition of section 86.410-90	Do.
60. § 86.509-90	Addition of section 86.509-90	Do.
61. § 86.511-90	Addition of section 86.511-90	Do.
62. § 86.513-90, (c), (d), (e), (f), (g), (h)	Modify language to incorporate methanol fuel	Do.
63. § 86.516-90	Addition of section 86.516-90	Do.
64. § 86.519-90	Addition of section 86.519-90	Do.
65. § 86.521-90	Addition of section 86.521-90	Do.
66. § 86.526-90	Addition of section 86.526-90	Do.
67. § 86.527-90	Addition of section 86.527-90	Do.
68. § 86.535-90	Addition of section 86.535-90	Do.
69. § 86.537-90	Addition of section 86.537-90	Do.
70. § 86.540-90	Addition of section 86.540-90	Do.
71. § 86.542-90	Addition of section 86.542-90	Do.
72. § 86.544-90	Addition of section 86.544-90	Do.
73. § 86.608-90	Addition of section 86.608-90	Do.
74. Subpart I, Title	Change "Diesel-Fueled" to "Diesel" in title	Do.
75. § 86.884-1	Modify language to incorporate methanol fuel	Do.
76. § 86.884-5(b)	.....do.	Do.
77. § 86.884-6	.....do.	Do.
78. Subpart K, Title	Remove "Gasoline-Fueled" and "Diesel" from title	Do.
79. § 86.1001-84	Remove fuel types	Do.
80. § 86.1003-90	Addition of section 86.1003-90	Do.
81. § 86.1005-90	Addition of section 86.1005-90	Do.
82. § 86.1008-90	Addition of section 86.1008-90	Do.
83. Subpart M, Title	Add methanol fuel to title	Do.
84. § 86.1201-90	Addition of section 86.1201-90	Do.
85. § 86.1205-90	Addition of section 86.1205-90	Do.
86. § 86.1206-90	Addition of section 86.1206-90	Do.
87. § 86.1207-90	Addition of section 86.1207-90	Do.
88. § 86.1213-90(a), (c), (d), (e), (f)	Modify language to incorporate methanol fuel	Do.
89. § 86.1216-90	Addition of section 86.1216-90	Do.
90. § 86.1217-90	Addition of section 86.1217-90	Do.
91. § 86.1221-90	Addition of section 86.1221-90	Do.
92. § 86.1227-90	Addition of section 86.1227-90	Do.
93. § 86.1231-90	Addition of section 86.1231-90	Do.
94. § 86.1232-90	Addition of section 86.1232-90	Do.
95. § 86.1233-90	Addition of section 86.1233-90	Do.
96. § 86.1238-90	Addition of section 86.1238-90	Do.
97. § 86.1242-90	Addition of section 86.1242-90	Do.
98. § 86.1243-90	Addition of section 86.1243-90	Do.
99. Subpart N, Title	Change "Diesel-Fueled" to "Diesel" in Title	Do.
100. § 86.1301-90	Addition of section 86.1301-90	Do.
101. § 86.1304-90	Addition of section 86.1304-90	Do.
102. § 86.1305-90	Addition of section 86.1305-90	Do.
103. § 86.1306-90	Addition of section 86.1306-90	Do.
104. § 86.1309-90	Addition of section 86.1309-90	Do.
105. § 86.1310-90	Addition of section 86.1310-90	Do.
106. § 86.1311-90	Addition of section 86.1311-90	Do.
107. § 86.1313-90	Addition of section 86.1313-90	Do.
108. § 86.1316-90	Addition of section 86.1316-90	Do.
109. § 86.1319-90	Addition of section 86.1319-90	Do.
110. § 86.1320-90	Addition of section 86.1320-90	Do.
111. § 86.1321-90	Addition of section 86.1321-90	Do.
112. § 86.1326-90	Addition of section 86.1326-90	Do.

TABLE OF CHANGES MADE TO VARIOUS SUBPARTS—Continued

Section	Change	Reason
113. § 86.1327-90	Addition of section 86.1327-90	Do.
114. § 86.1330-90	Addition of section 86.1330-90	Do.
115. § 86.1332-90	Addition of section 86.1332-90	Do.
116. § 86.1333-90	Addition of section 86.1333-90	Do.
117. § 86.1335-90	Addition of section 86.1335-90	Do.
118. § 86.1337-90	Addition of section 86.1337-90	Do.
119. § 86.1339-90	Addition of section 86.1339-90	Do.
120. § 86.1340-90	Addition of section 86.1340-90	Do.
121. § 86.1341-90	Addition of section 86.1341-90	Do.
122. § 86.1342-90	Addition of section 86.1342-90	Do.
123. § 86.1343-90, Title	Remove diesels only	Do.
124. § 86.1344-90	Addition of section 86.1344-90	Do.
125. Subpart P, Title	Addition of methanol fuel to title	Do.
126. § 86.1501-90	Addition of section 86.1501-90	Do.
127. § 86.1504-90	Addition of section 86.1504-90	Do.
128. § 86.1505-90	Addition of section 86.1505-90	Do.
129. § 86.1506-90	Addition of section 86.1506-90	Do.
130. Appendix I (f)(1) and (f)(3)	Change gasoline-fueled to Otto-cycle	Do.
131. § 86.091-2 Introductory text	Change 86.088-2 to 86.090-2	Continuation of 1990 definitions.
132. § 86.091-9 (a)(1), (b), (d)(e) and (g)(2)	Modify to include methanol	Do.

For the reasons set forth in the Preamble, Part 86 of Title 40 of the *Code of Federal Regulations* is revised, as set forth below:

1. The authority citation for Part 86 is revised to read as follows:

Authority: Secs. 202, 203, 206, 207, 208, 215, 301(a), of the Clean Air Act as Amended; 42 U.S.C. 7521, 7522, 7524, 7525, 7541, 7542, 7549, 7550 and 7601(a).

2. The Table of Contents of Part 86 is revised, to read as follows:

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

Subpart A—General Provisions for Emission Regulations for 1977 and Later Model Year New Light-Duty Vehicles, Light-Duty Trucks, and Heavy-Duty Engines, and for 1985 and Later Model Year New Gasoline-Fueled and Methanol-Fueled Heavy-Duty Vehicles

Sec.
86.078–3 Abbreviations.
86.078–6 Hearings on certification.
86.078–7 Maintenance of records; submittal of information; right of entry.
86.079–31 Separate certification.
86.079–32 Addition of a vehicle or engine after certification.
86.079–33 Changes to a vehicle or engine covered by certification.
86.079–36 Submission of vehicle identification numbers.
86.079–39 Submission of maintenance instructions.
86.080–12 Alternative certification procedures.
86.081–8 Emissions standards for 1981 light-duty vehicles.
86.082–2 Definitions.
86.082–8 Emission standards for 1982 and later light-duty vehicles.
86.082–14 Small-volume manufacturer certification procedures.
86.082–34 Alternative procedure for notification of additions and changes.
86.083–30 Certification.
86.084–2 Definitions.
86.084–4 Section numbering; construction.
86.084–5 General standards; increase in emissions; unsafe conditions.
86.084–14 Small-volume manufacturers certification procedures.
86.084–15 Emission standards for 1984 model year heavy passenger cars.
86.084–26 Mileage and service accumulation; emission measurements.
86.084–40 Automatic expiration of reporting and recordkeeping requirements.
86.085–1 General applicability.
86.085–2 Definitions.
86.085–8 Emission standards for 1985 and later model year light-duty vehicles.
86.085–9 Emission standards for 1985 and later model year light-duty trucks.
86.085–10 Emission standards for 1985 and later model year gasoline-fueled heavy-duty engines and vehicles.
86.085–11 Emission standards for 1985 and later model year diesel heavy-duty engines.
86.085–13 Alternative durability program.
86.085–20 Incomplete vehicles, classification.
86.085–21 Application for certification.
86.085–22 Approval of application for certification; test fleet selections; determinations of parameters subject to adjustment for certification and Selective Enforcement Audit, adequacy of limits, and physically adjustable ranges.
86.085–23 Required data.
86.085–24 Test vehicles and engines.
86.085–25 Maintenance.
86.085–27 Special test procedures.
86.085–28 Compliance with emission standards.
86.085–29 Testing by the Administrator.
86.085–30 Certification.
86.085–35 Labeling.
86.085–37 Production vehicles and engines.
86.085–38 Maintenance instructions.
86.087–8 Emission standards for 1987 light-duty vehicles.
86.087–9 Emission standards for 1987 and later model year light-duty trucks.
86.087–10 Emission standards for 1987 and later model year gasoline-fueled heavy-duty engines and vehicles.
86.087–21 Application for certification.
86.087–23 Required data.
86.087–25 Maintenance.
86.087–28 Compliance with emission standards.
86.087–29 Testing by the Administrator.
86.087–30 Certification.
86.087–35 Labeling.
86.087–38 Maintenance instructions.
86.088–2 Definitions.
86.088–9 Emission standards for 1988 and later model year light-duty trucks.
86.088–10 Emission standards for 1988 and later model year gasoline-fueled heavy-duty engines and vehicles.
86.088–11 Emission standards for 1988 and later model year diesel heavy-duty engines.
86.088–21 Application for certification.
86.088–23 Required data.
86.088–25 Maintenance.
86.088–28 Compliance with emission standards.
86.088–29 Testing by the Administrator.
86.088–30 Certification.
86.088–35 Labeling.
86.090–1 General applicability.
86.090–2 Definitions.
86.090–3 Abbreviations.
86.090–5 General standards; increase in emissions; unsafe conditions.
86.090–8 Emission standards for 1990 and later model year light-duty vehicles.
86.090–9 Emission standards for 1990 and later model year light-duty trucks.
86.090–10 Emission standards for 1990 and later model year Otto-cycle heavy-duty engines and vehicles.
86.090–11 Emission standards for 1990 and later model year diesel heavy-duty engines and vehicles.

Sec.
86.090–14 Small-volume manufacturer certification procedures.
86.090–21 Application for certification.
86.090–22 Approval of application for certification; test fleet selections; determinations of parameters subject to adjustment for certification and selective enforcement audit, adequacy of limits, and physically adjustable ranges.
86.090–23 Required data.
86.090–24 Test vehicles and engines.
86.090–25 Maintenance.
86.090–26 Mileage and service accumulation; emission measurements.
86.090–27 Special test procedures.
86.090–28 Compliance with emission standards.
86.090–29 Testing by the Administrator.
86.090–30 Certification.
86.090–35 Labeling.
86.091–2 Definitions.
86.091–9 Emission standards for 1991 and later model year light-duty trucks.
86.091–10 Emission standards for 1991 and later model year Otto-cycle heavy-duty engines and vehicles.
86.091–11 Emission standards for 1991 and later model year diesel heavy-duty engines and vehicles.
86.091–21 Application for certification.
86.091–23 Required data.
86.091–28 Compliance with emission standards.
86.091–29 Testing by the Administrator.
86.091–30 Certification.
86.091–35 Labeling.
86.094–11 Emission standards for 1994 and later model year diesel heavy-duty engines and vehicles.

Subpart B—Emission Regulations for 1977 and Later Model Year New Light-Duty Vehicles and New Light-Duty Trucks; Test Procedures.

86.101 General applicability.
86.102 Definitions.
86.103 Abbreviations.
86.104 Section numbering; construction.
86.105 Introduction; structure of subpart.
86.106–82 Equipment required; overview.
86.106–90 Equipment required; overview.
86.107–78 Sampling and analytical system; evaporative emissions.
86.107–90 Sampling and analytical system; evaporative emissions.
86.108–79 Dynamometer.
86.109–82 Exhaust gas sampling system; gasoline-fueled vehicles.
86.109–90 Exhaust gas sampling system; Otto-cycle vehicles.
86.110–82 Exhaust gas sampling system; diesel vehicles.
86.110–90 Exhaust gas sampling system; diesel vehicles.
86.111–82 Exhaust gas analytical system.
86.111–90 Exhaust gas analytical system.
86.112–82 Weighing chamber (or room) and microgram balance specifications.
86.113–82 Fuel specifications.
86.113–86 Fuel specifications.
86.113–90 Fuel specifications.
86.114–79 Analytical gases.
86.115–78 EPA urban dynamometer driving cycles.
86.116–82 Calibrations, frequency and overview.
86.116–90 Calibrations, frequency and overview.
86.117–78 Evaporative emission enclosure calibrations.
86.117–90 Evaporative emission enclosure calibrations.
86.118–78 Dynamometer calibration.
86.119–78 CVS calibration.
86.119–90 CVS calibration.
86.120–82 Gas meter or flow instrumentation calibration; particulate measurement.
86.121–82 Hydrocarbon analyzer calibration.
86.121–90 Hydrocarbon analyzer calibration.
86.122–78 Carbon monoxide analyzer calibration.
86.123–78 Oxides of nitrogen analyzer calibration.
86.124–78 Carbon dioxide analyzer calibration.
86.126–78 Calibration of other equipment.
86.126–90 Calibration of other equipment.
86.127–82 Test procedures; overview.
86.127–90 Test procedures; overview.
86.128–79 Transmissions.
86.129–80 Road load power, test weight, and inertia weight class determination.
86.130–78 Test sequence; general requirements.
86.131–78 Vehicle preparation.
86.131–90 Vehicle preparation.
86.132–82 Vehicle preconditioning.
86.132–90 Vehicle preconditioning.
86.133–78 Diurnal breathing loss test.
86.133–90 Diurnal breathing loss test.
86.134–78 [Reserved]
86.135–82 Dynamometer procedure.
86.135–90 Dynamometer procedure
86.136–82 Engine starting and restarting.
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3. A new § 86.090–1 is added to Subpart A to read as follows:

§ 86.090–1 General applicability.

(a) The provisions of this subpart apply to: 1990 and later model year new Otto-cycle and diesel light-duty vehicles; 1990 and later model year new Otto-cycle and diesel light-duty trucks; and, 1990 and later model year new Otto-cycle and diesel heavy-duty engines.

(b) *Optional applicability.* A manufacturer may request to certify any heavy-duty vehicle of 10,000 pounds Gross Vehicle Weight Rating or less to the light-duty truck provisions. Heavy-duty engine or vehicle provisions do not apply to such a vehicle.

(c) [Reserved]

(d) *Alternative Durability Program.* For 1990 and later model year light-duty vehicles and light-duty trucks, a manufacturer may elect to participate in the Alternative Durability Program. This optional program provides an alternative method of determining exhaust emission control system durability. The general procedures and a description of the programs are contained in § 86.085–13 and specific provisions on test vehicles and compliance procedures are contained in § 86.085–24 and § 86.088–28 respectively.

(e) *Small-Volume Manufacturers.* Special certification procedures are available for any manufacturer whose projected combined U.S. sales of light-duty vehicles, light-duty trucks, and heavy-duty engines in its product line are fewer than 10,000 units for the model year in which the manufacturer seeks certification. In order to certify its product line under these optional procedures, the small-volume manufacturer must first obtain the Administrator's approval. Vehicles produced at facilities leased, operated, controlled, supervised, or is ten percent or greater part owned by the manufacturer shall be counted in calculating the total sales of the manufacturer. The small-volume manufacturer's certification procedures are described in § 86.090–14.

(f) *Optional Procedures for Determining Exhaust Opacity.* (1) The provisions of Subpart I apply to tests which are performed by the Administrator, and optionally, by the manufacturer.

(2) Measurement procedures, other than that described in Subpart I, may be used by the manufacturer provided the manufacturer satisfies the requirements of § 86.090–23(f).

(3) When a manufacturer chooses to use an alternative measurement procedure it has the responsibility to determine whether the results obtained by the procedure will correlate with the results which would be obtained from the measurement procedure in Subpart I. Consequently, the Administrator will not routinely approve or disapprove any alternative opacity measurement procedure or any associated correlation data which the manufacturer elects to use to satisfy the data requirements of Subpart I.

(4) If a confirmatory test(s) is performed and the results indicate there is a systematic problem suggesting that the data generated under an optional alternative measurement procedure do not adequately correlate with Subpart I data, EPA may require that all certificates of conformity not already issued be based on data from Subpart I procedures.

4. A new § 86.090–2 is added to Subpart A to read as follows:

§ 86.090–2 Definitions.

The definitions in § 86.088–2 remain effective. The definitions in this section apply beginning with the 1990 model year.

"Composite particulate standard," for a manufacturer which elects to average light-duty vehicles and light-duty trucks together in either the petroleum-fueled or methanol-fueled light-duty particulate averaging program, means that standard calculated using the following equation and rounded to the nearest one-hundredth (0.01) of a gram per mile:

$$\frac{(PROD_{LDV})(STD_{LDV}) + (PROD_{LDT})(STD_{LDT})}{(PROD_{LDV}) + (PROD_{LDT})} = \text{Manufacturer composite particulate standard}$$

Where:

$PROD_{LDV}$ represents the manufacturer's total petroleum-fueled diesel or methanol-fueled diesel light-duty vehicle production for those engine families being included in the appropriate average for a given model year.

STD_{LDV} represents the light-duty vehicle particulate standard.

$PROD_{LDT}$ represents the manufacturer's total petroleum-fueled diesel or methanol-fueled diesel light-duty truck production for those engine families being included in the appropriate average for a given model year.

STD_{LDT} represents the light-duty truck particulate standard.

"Diesel" means type of engine with operating characteristics significantly similar to the theoretical Diesel combustion cycle. The non-use of a throttle during normal operation is indicative of a diesel engine.

"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 mixtures of the two.

"Methanol-fueled" means any motor vehicle or motor vehicle engine that is engineered and designed to be operated using methanol fuel (*i.e.*, a fuel that

contains at least 50 percent methanol (CH_3OH) by volume) as fuel. Flexible fuel vehicles are methanol-fueled vehicles.

"Non-oxygenated hydrocarbon" means organic emissions measured by a flame ionization detector excluding methanol.

"Organic Material Hydrocarbon Equivalent" means the sum of the carbon mass contributions of non-oxygenated hydrocarbons, methanol and formaldehyde as contained in a gas sample, 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.

"Otto-cycle" means type of engine with operating characteristics significantly similar to the theoretical Otto combustion cycle. The use of a throttle during normal operation is indicative of an Otto-cycle engine.

"Primary intended service class" means:

(a) The primary service application group for which a heavy-duty diesel engine is designed and marketed, as determined by the manufacturer. The primary intended service classes are designated as light, medium, and heavy heavy-duty diesel engines. The determination is based on factors such as vehicle GVW, vehicle usage and operating patterns, other vehicle design characteristics, engine horsepower, and other engine design and operating characteristics.

(1) Light heavy-duty diesel engines usually are non-sleeved and not designed for rebuild; their rated horsepower generally ranges from 70 to 170. Vehicle body types in this group might include any heavy-duty vehicle built for a light-duty truck chassis, van trucks, multi-stop vans, recreational vehicles, and some single axle straight trucks. Typical applications would include personal transportation, light-load commercial hauling and delivery, passenger service, agriculture, and construction. The GVWR of these vehicles is normally less than 19,500 lbs.

(2) Medium heavy-duty diesel engines may be sleeved or non-sleeved and may be designed for rebuild. Rated horsepower generally ranges from 170 to 250. Vehicle body types in this group would typically include school buses, tandem axle straight trucks, city tractors, and a variety of special purpose vehicles such as small dump trucks, and trash compactor trucks. Typical applications would include commercial short haul and intra-city delivery and pickup. Engines in this group are normally used in vehicles whose GVWR varies from 19,500–33,0000 lbs.

(3) Heavy heavy-duty diesel engines are sleeved and designed for multiple rebuilds. Their rated horsepower generally exceeds 250. Vehicles in this group are normally tractors, trucks, and buses used in inter-city, long-haul applications. These vehicles normally exceed 33,000 lbs GVWR.

"Throttle" means a device used to control an engines power output by limiting the amount of air entering the combustion chamber.

"Useful life" means:

(a) For light-duty vehicles a period of use of 5 years or 50,000 miles, whichever first occurs.

(b) For a light-duty truck engine family, a period of use of 11 years or 120,000 miles, whichever occurs first.

(c) For an Otto-cycle heavy-duty engine family, a period of use of 8 years of 110,000 miles, whichever first occurs.

(d) For a diesel heavy-duty engine family:

(1) For light heavy-duty diesel engines, period of use of 8 years or 110,000 miles, whichever first occurs.

(2) For medium heavy-duty diesel engines, a period of use of 8 years or 185,000 miles, whichever first occurs.

(3) For heavy heavy-duty diesel engines, a period of use of 8 years or 290,000 miles, whichever first occurs.

(e) As an option for both light-duty truck and heavy-duty engine families, an alternative useful life period assigned by the Administrator under the provisions of paragraph (f) of § 86.090–21.

(f) The useful-life period for purposes of the emissions defect warranty and emissions performance warranty shall be a period of 5 years/50,000 miles whichever first occurs, for light-duty trucks Otto-cycle heavy-duty engines and light heavy-duty diesel engines. For all other heavy-duty diesel engines the aforementioned period is 5 years/100,000 miles, whichever first occurs. However, in no case may this period be less than the manufacturer's basic mechanical warranty period for the engine family.

5. A new § 86.090–3 is added to Subpart A to read as follows:

§ 86.090–3 Abbreviations.

(a) The abbreviations in § 86.078–3 remain effective. The abbreviations in this section apply beginning with the 1990 model year.

(b) The abbreviations in this section apply to this subpart, and also to Subparts B, E, F, M, N, and P of this part, and have the following meanings:

DNPH—2,4-dinitrophenylhydrazine.

GC—Gas chromatograph.

HPLC—High-pressure liquid chromatography.

MeOH—Methanol (CH_3OH).

OMHCE—Organic Material Hydroarbon Equivalent.

UV—Ultraviolet.

6. A new § 86.090–5 is added to Subpart A to read as follows:

§ 86.090–5 General standards; increase in emissions; unsafe conditions.

(a)(1) Every new motor vehicle (or new motor vehicle engine) manufactured for sale, sold, offered for sale, introduced, or delivered for introduction to commerce, or imported into the United States for sale or resale which is subject to any of the standards prescribed in this subpart shall be covered by a certificate of conformity issued pursuant to §§ 86.090–21, 86.090–22, 86.090–23, 86.090–29, 86.090–30, 86.079–31, 86.079–32, 86.079–33, and 86.082–34.

(2) No heavy-duty vehicle manufacturer shall take any of the actions specified in section 203(a)(1) of the Act with respect to any Otto-cycle or diesel heavy-duty vehicle which uses an engine which has not been certified as meeting applicable standards.

(b)(1) Any system installed on or incorporated in a new motor vehicle (or new motor vehicle engine) to enable such vehicle (or engine) to conform to standards imposed by this subpart.

(i) Shall not in its operation or function cause the emission into the ambient air of any noxious or toxic substance that would not be emitted in the operation of such vehicle (or engine) without such system, except as specifically permitted by regulation; and

(ii) Shall not in its operation, function or malfunction result in any unsafe condition endangering the motor vehicle, its occupants, or persons or property in close proximity to the vehicle.

(2) In establishing the physically adjustable range of each adjustable parameter on a new motor vehicle (or new motor vehicle engine), the manufacturer shall ensure that, taking into consideration the production tolerances, safe vehicle driveability characteristics are available within that range, as required by section 202(a)(4) of the Clean Air Act.

(3) Every manufacturer of new motor vehicles (or new motor vehicle engines) subject to any of the standards imposed by this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicles (or motor vehicle engines) in accordance with good

engineering practice to ascertain that such test vehicles (or test engines) will meet the requirements of this section for the useful life of the vehicle (or engine).

7. A new § 86.090–8 is added to Subpart A to read as follows:

§ 86.090–8 Emission standards for 1990 and later model year light-duty vehicles.

(a)(1) Exhaust emissions from 1990 and later model year light-duty vehicles shall not exceed (compliance with these standards is optional for 1990 model year methanol-fueled vehicles):

(i)(A) *Hydrocarbons (for petroleum-fueled Otto-cycle and diesel vehicles).* 0.41 gram per vehicle mile (0.26 gram per vehicle kilometer).

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled Otto-cycle and diesel vehicles).* 0.41 gram per vehicle mile (0.26 gram per vehicle kilometer).

(ii) *Carbon monoxide.* 3.4 grams per vehicle mile (2.1 grams per vehicle kilometer).

(iii) *Oxides of nitrogen.* 1.0 gram per vehicle mile (0.63 gram per vehicle kilometer).

(iv) *Particulate (for diesel vehicles only).*

(A) 0.20 gram per vehicle mile (0.12 gram per vehicle kilometer).

(B) A manufacturer may elect to include all or some of its diesel light-duty vehicle engine families in the appropriate particulate averaging program (petroleum or methanol), provided that vehicles produced for sale in California or in designated high-altitude areas may be averaged only within each of these areas. Averaging is not permitted between fuel types. If the manufacturer elects to average light-duty vehicles and light-duty trucks together in the appropriate particulate averaging program, its composite particulate standard applies to the combined set of light-duty vehicles and light-duty trucks included in the average and is calculated as defined in § 86.090–2.

(2) The standards set forth in paragraph (a)(1) of this section refer to the exhaust emitted over a driving schedule as set forth in Subpart B of this part and measured and calculated in accordance with those procedures.

(b) Fuel evaporative emissions from 1990 and later model year light-duty vehicles shall not exceed (compliance with these standards is optional for 1990 model year methanol-fueled engines):

(1) *Hydrocarbons (for gasoline-fueled vehicles).* 2.0 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for methanol-fueled vehicles).* 2.0 grams carbon per test.

(3) The standards set forth in paragraphs (b) (1) and (2) of this section refers to a composite sample of the fuel evaporative emissions collected under the conditions set forth in Subpart B of this part and measured in accordance with those procedures.

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any 1990 and later model year Otto-cycle or methanol-fueled diesel light-duty vehicle.

(d) through (f) [Reserved]

(g) Any 1990 and later model year light-duty vehicle that a manufacturer wishes to certify for sale shall meet the emission standards under both low- and high-altitude conditions as specified in § 86.082–2, except as provided in paragraphs (h) and (i) of this section. Vehicles shall meet emission standards under both low- and high-altitude conditions without manual adjustments or modifications. Any emission control device used to meet emission standards under high-altitude conditions shall initially actuate (automatically) no higher than 4,000 feet above sea level.

(h) The manufacturer may exempt 1990 and later model year vehicles from compliance at high altitude with the emission standards set forth in paragraphs (a) and (b) of this section if the vehicles are not intended for sale at high altitude and if the requirements of paragraphs (h) (1) and (2) of this section are met.

(1) A vehicle configuration shall only be considered eligible for exemption under paragraph (h) of this section if the requirements of either paragraph (h) (1) (i), (ii), (iii), or (iv) of this section are met.

(i) Its design parameters (displacement-to-weight ratio (D/W) and engine speed-to-vehicle-speed ratio (N/V)) fall within the exempted range for that manufacturer for that year. The exempted range is determined according to the following procedure:

(A) The manufacturer shall graphically display the D/W and N/V data of all vehicle configurations it will offer for the model year in question. The axis of the abscissa shall be D/W (where (D) is the engine displacement expressed in cubic centimeters and (W) is the equivalent vehicle test weight expressed in pounds), and the axis of the ordinate shall be N/V (where (N) is the crankshaft speed expressed in revolutions per minute and (V) is the vehicle speed expressed in miles per hour). At the manufacturer's option, either the 1:1 transmission gear ratio or the lowest numerical gear ratio available in the transmission will be used to determine N/V. The gear selection must be the same for all N/V data points on the manufacturer's graph. For each transmission/axle ratio combination, only the lowest N/V value shall be used in the graphical display.

(B) The product line is then defined by the equation, $N/V = C(D/W)^{-0.9}$, where the constant, C, is determined by the requirement that all the vehicle data points either fall on the line or lie to the upper right of the line as displayed on the graphs.

(C) The exemption line is then defined by the equation, $N/V = C(0.84\ D/W)^{-0.9}$, where the constant, C is the same as that found in paragraph (h)(1)(i)(B) of this section.

(D) The exempted range includes all values of N/V and D/W which simultaneously fall to the lower left of the exemption line as drawn on the graph.

(ii) Its design parameters fall within the alternate exempted range for that manufacturer that year. The alternate exempted range is determined by substituting rated horsepower (hp) for displacement (D) in the exemption procedure described in paragraph (h)(1)(i) of this section and by using the product line $N/V = C(hp/W)^{-0.9}$.

(A) Rated horsepower shall be determined by using the Society of Automotive Engineers Test Procedure J 1349, or any subsequent version of that test procedure. Any of the horsepower determinants within that test procedure may be used, as long as it is used consistently throughout the manufacturer's product line in any model year.

(B) No exemptions will be allowed under paragraph (h)(1)(ii) of this section to any manufacturer that has exempted vehicle configurations as set forth in paragraph (h)(1)(i) of this section.

(iii) Its acceleration time (the time it takes a vehicle to accelerate from 0 miles per hour to a speed not less than 40 miles per hour and not greater than 50 miles per hour) under high-altitude conditions is greater than the largest acceleration time under low-altitude conditions for that manufacturer for that year. The procedure to be followed in making this determination is:

(A) The manufacturer shall list the vehicle configuration and acceleration time under low-altitude conditions of that vehicle configuration which has the highest acceleration time under low-altitude conditions of all the vehicle configurations it will offer for the model year in question. The manufacturer shall also submit a description of the methodology used to make this determination.

(B) The manufacturer shall then list the vehicle configurations and

acceleration times under high-altitude conditions of all those vehicle configurations which have higher acceleration times under high-altitude conditions than the highest acceleration time at low altitude identified in paragraph (h)(1)(iii)(A) of this section.

(iv) In lieu of performing the test procedure of paragraphs (h)(1)(iii) (A) and (B) of this section, its acceleration time can be estimated based on the manufacturer's engineering evaluation, in accordance with good engineering practice, to meet the exemption criteria of paragraph (h)(1)(iii) of this section.

(2) A vehicle shall only be considered eligible for exemption under this paragraph if at least one configuration of its model type (and transmission configuration in the case of vehicles equipped with manual transmissions, excluding differences due to the presence of overdrive) is certified to meet emission standards under high-altitude conditions as specified in paragraph (a) through (g) of this section. The Certificate of Conformity (the Certificate) covering any exempted configuration(s) will also apply to the corresponding non-exempt configuration(s) required under this subparagraph. As a condition to the exemption, any suspension, revocation, voiding, or withdrawal of the Certificate as it applies to a non-exempt configuration for any reason will result in a suspension of the Certificate as it applies to the corresponding exempted configuration(s) of that model type, unless there is at least one other corresponding non-exempt configuration of the same model type still covered by the Certificate. The suspension of the Certificate as it applies to the exempted configuration(s) will be terminated when any one of the following occurs:

(i) Another corresponding non-exempt configuration(s) receive(s) coverage under the Certificate; or

(ii) Suspension of the Certificate as it applies to the corresponding non-exempt configuration(s) is terminated; or

(iii) The Agency's action(s), with respect to suspension, revocation, voiding or withdrawal of the Certificate as it applies to the corresponding non-exempt configuration(s), is reversed.

(3) The sale of a vehicle for principal use at a designated high-altitude location that has been exempted as set forth in paragraph (h) of this section will be considered a violation of Section 203(a)(1) of the Clean Air Act.

(i)(1) The manufacturers may exempt 1990 and later model year vehicles from compliance at low altitude with the emission standards set forth in paragraphs (a) and (b) of this section if the vehicles:

(i) Are not intended for sale at low altitude; and

(ii) Are equipped with a unique, high-altitude axle ratio (rear-wheel drive vehicles) or a unique, high-altitude drivetrain (front-wheel drive vehicles) with a higher N/V ratio than other configurations of that model type which are certified in compliance with the emission standards of paragraphs (a) and (b) of this section under low-altitude conditions.

(2) The sale of a vehicle for principal use at low altitude that has been exempted as set forth in paragraph (h)(1) of this section will be considered a violation of section 203(a)(1) of the Clean Air Act.

8. Section 86.090–9 of Subpart A is amended by revising paragraphs (a)(1), (b), (d), (e), and (g)(2), to read as follows:

§ 86.090–9 Emission standards for 1990 and later model year light-duty trucks.

(a)(1) The standards set forth in paragraphs (a) through (c) of this section shall apply to light-duty trucks sold for principal use at other than a designated high-altitude location. Exhaust emissions from 1990 and later model year light-duty trucks shall not exceed (compliance with these standards is optional for 1990 model year methanol-fueled vehicles):

(i)(A) *Hydrocarbons (for petroleum-fueled Otto-cycle and diesel light-duty trucks).* 0.80 gram per vehicle mile (0.50 gram per vehicle kilometer).

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled Otto-cycle and diesel light-duty trucks).* 0.80 gram per vehicle mile (0.50 gram per vehicle kilometer).

(ii) *Carbon monoxide.* (A) 10 grams per vehicle mile (6.2 grams per vehicle kilometer).

(B) 0.50 percent of exhaust gas flow at curb idle (for Otto-cycle and methanol-fueled diesel light-duty trucks only).

(iii) *Oxides of nitrogen.* (A) For light-duty trucks up to and including 3,750 lbs loaded vehicle weight, 1.2 grams per vehicle mile (0.75 gram per vehicle kilometer).

(B) For light-duty trucks greater loaded vehicle weight, 1.7 grams per vehicle mile (1.1 grams per vehicle kilometer).

(C) A manufacturer may elect to include all or some of its light-duty truck engine families in the NO_x averaging program, provided that trucks produced for sale in California or in designated high-altitude areas may be averaged only within each of those areas. Petroleum-fueled and methanol-fueled engine families may not be averaged together. Otto-cycle and diesel engines families also may not be averaged together. If the manufacturer elects to participate in the NO_x averaging program, individual family NO_x emission limits may not exceed 2.3 grams per mile. If the manufacturer elects to average together NO_x emissions of light-duty trucks subject to the standards of paragraphs (a)(1)(iii)(A) and (a)(1)(iii)(B) of this section, its composite NO_x standard applies to the combined fleets of light-duty trucks up to and including, and over, 3,750 lbs loaded vehicle weight included in the average and is calculated as defined in § 86.088–2.

(iv) *Particulate (for diesel light-duty trucks only).* (A) For light-duty trucks up to and including 3,750 lbs. loaded vehicle weight, 0.26 gram per vehicle mile (0.16 gram per vehicle kilometer).

(B) For light-duty trucks 3,751 lbs and greater loaded vehicle weight, 0.45 gram per vehicle mile (0.28 gram per vehicle kilometer).

(C) A manufacturer may elect to include all or some of its diesel light-duty truck engine families subject to the standard of paragraph (a)(1)(w)(A) of this section in the appropriate particulate averaging program (petroleum or methanol), provided that trucks produced for sale in California or in designated high-altitude areas may be averaged only within each of those areas. Averaging is not permitted between fuel types. If the manufacturer elects to average both light-duty trucks subject to the standard of paragraph (a)(1)(w)(A) of this section and light-duty vehicles together in the appropriate particulate averaging program, its composite particulate standard applies to the combined set of light-duty vehicles and light-duty trucks included in the average and is calculated as defined in § 86.088–2.

* * * * *

(b) Fuel evaporative emissions from 1990 and later model year light-duty trucks shall not exceed (compliance with these standards is optional for 1990 model year methanol-fueled vehicles):

(1) *Hydrocarbons (for gasoline-fueled light-duty trucks).* 2.0 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for methanol-fueled light-duty trucks).* 2.0 grams per test.

(3) The standards set forth in paragraphs (b) (1) and (2) of this section refer to a composite sample of the fuel evaporative emissions collected under the conditions set forth in Subpart B of this part and measured in accordance with those procedures.

* * * * *

(d)(1) Model year 1990 and later light-duty trucks sold for principal use at a

designated high-altitude location shall be capable of meeting the following exhaust emission standards when tested under high-altitude conditions:

(i)(A) *Hydrocarbons (for petroleum-fueled Otto-cycle and diesel light-duty trucks).* 1.0 grams per vehicle mile (0.62 grams per vehicle kilometer).

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled Otto-cycle and diesel light-duty trucks).* 1.0 gram per vehicle mile (0.62 gram per vehicle kilometer).

(ii) *Carbon Monoxide.* (A) 14 grams per vehicle mile (8.7 grams per vehicle kilometer).

(B) 0.50 percent of exhaust gas flow at curb idle (for Otto-cycle and methanol-fueled diesel light-duty trucks only).

(iii) *Oxides of Nitrogen.* (A) For light-duty trucks up to and including 3,750 lbs loaded vehicle weight, 1.2 grams per vehicle mile (0.75 grams per vehicle kilometer).

(B) For light-duty trucks 3,751 lbs and greater loaded vehicle weight, 1.7 grams per vehicle mile (1.1 grams per vehicle kilometer).

(iv) *Particulate (for diesel light-duty trucks only).* For light-duty trucks up to and including 3,750 lbs loaded vehicle weight, 0.26 gram per vehicle mile (0.16 gram per vehicle kilometer).

(2) The standards set forth in paragraph (d)(1)(i), (d)(1)(ii)(A), (d)(1)(iii), and (d)(1)(iv) of this section refer to the exhaust emitted over a driving schedule as set forth in Subpart B of this part and measured and calculated in accordance with those procedures. The standard set forth in paragraph (d)(1)(ii)(B) of this section refers to the exhaust emitted at curb idle and measured and calculated in accordance with the procedures set forth in Subpart P of this part.

(e) Fuel evaporative emissions from 1990 and later model year light-duty trucks sold for principal use at a designated high-altitude location, when tested under high-altitude conditions, shall not exceed:

(1) *Hydrocarbons (for gasoline-fueled light-duty trucks).* 2.6 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for methanol-fueled light-duty trucks).* 2.6 grams per test.

(3) The standards set forth in paragraphs (e) (1) and (2) of this section refer to a composite sample of the fuel evaporative emissions collected under the conditions set forth in Subpart B of this part and measured in accordance with those procedures.

* * * * *

(g) * * *

(2) The manufacturer may exempt 1990 and later model year vehicles from compliance with the high-altitude emission standards set forth in paragraphs (d) and (e) of this section if the vehicles are not intended for sale at high altitude and if the following requirements are met. A vehicle configuration shall only be considered eligible for exemption if the requirements of either paragraph (g)(2)(i), (ii), (iii), or (iv) of this section are met.

* * * * *

9. Section 86.090–10 of Subpart A is amended by revising the title and paragraphs (a)(1), (a)(3), (b) and (c), to read as follows:

§ 86.090–10 Emission standards for 1990 and later model year Otto-cycle heavy-duty engines and vehicles.

(a)(1) Exhaust emissions from new 1990 and later model year Otto-cycle engines shall not exceed (compliance with these standards is optional for 1990 model year methanol-fueled engines):

(i) For *gasoline-fueled Otto-cycle engines* intended for use in all vehicles except as provided in paragraph (a)(3) of this paragraph,

(A) *Hydrocarbons.* 1.1 grams per brake horsepower-hour (0.41 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon monoxide.* (*1*) 14.4 grams per brake horsepower-hour (5.36 grams per megajoule), as measured under transient operating conditions.

(*2*) *For gasoline-fueled Otto-cycle heavy-duty engines utilizing aftertreatment technology.* 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* 6.0 grams per brake horsepower-hour (2.2 grams per megajoule), as measured under transient operating conditions.

(ii) For *gasoline-fueled Otto-cycle engines* intended for use only in vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs,

(A) *Hydrocarbons.* 1.9 grams per brake horsepower-hour (0.71 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon Monoxide.* (*1*) 37.1 grams per brake horsepower-hour (13.8 grams per megajoule), as measured under transient operating conditions.

(*2*) *For gasoline-fueled Otto-cycle heavy-duty engines utilizing aftertreatment technology.* 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* 6.0 grams per brake horsepower-hour (2.2 grams per megajoule), as measured under transient operating conditions.

(iii) For *methanol-fueled Otto-cycle heavy-duty engines* intended for use in all vehicles, except as provided in paragraph (a)(3) of this paragraph.

(A) *Organic Material Hydrocarbon Equivalent.* 1.1 gram per brake horsepower-hour (0.41 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon monoxide.* (*1*) 14.4 grams per brake horsepower-hour (5.36 grams per megajoule), as measured under transient operating conditions.

(*2*) 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* 6.0 grams per brake horsepower-hour (2.2 grams per megajoule), as measured under transient operating conditions.

(iv) For *methanol-fueled Otto-cycle heavy-duty engines* intended for use only in vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs.

(A) *Organic Material Hydrocarbon Equivalent.* 1.9 grams per brake horsepower-hour (0.71 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon monoxide.* (*1*) 37.1 grams per brake horsepower-hour (13.8 grams per megajoule), as measured under transient operating conditions.

(*2*) 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* 6.0 grams per brake horsepower-hour (2.2 grams per megajoule), as measured under transient operating conditions.

* * * * *

(3)(i) A manufacturer may certify one or more gasoline-fueled Otto-cycle heavy-duty engine configurations intended for use in all vehicles to the emission standards set forth in paragraph (a)(1)(ii) of this section: *Provided,* that the total model year sales of such configuration(s) being certified to the emission standards in paragraph (a)(1)(ii) of this section represent no more than 5 percent of total model year sales of all gasoline-fueled Otto-cycle heavy-duty engines intended for use in vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds by the manufacturer.

(ii) A manufacturer may certify one or more methanol-fueled Otto-cycle heavy-duty engine configurations intended for use in all vehicles to the emission standards set forth in paragraph (a)(l)(iv) of this section: *Provided,* that the total model year sales of such configuration(s) being certified to the emission standards in paragraph (a)(1)(iv) of this section represent no more than 5 percent of total model year sales of all methanol-fueled Otto-cycle heavy-duty engines intended for use in vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds by the manufacturer.

(iii) The configurations certified to the emission standards of paragraphs (a)(1)(ii) and (iv) of this section under the provisions of paragraphs (a)(3)(i) and (ii) of this section shall still be required to meet the evaporative emission standards set forth in paragraphs (b)(1)(i) (b)(2)(i) and (b)(3)(i) of this section.

(b) *Evaporative emissions* from 1990 and later model year heavy-duty vehicles shall not exceed (compliance with these standards is optional for 1990 model year methanol-fueled engines):

(1) *Hydrocarbons (for vehicles equipped with gasoline-fueled engines).* (i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for vehicles equipped with methanol-fueled engines).* (i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(3)(i) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraphs (b)(1) and (b)(2) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in Subpart M and measured in accordance with those procedures.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs, the standards set forth in paragraphs (b)(1)(ii) and (b)(2)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in § 86.090–23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1990 or later model year Otto-cycle heavy-duty engine.

* * * * *

10. Section 86.091–10 of Subpart A is amended by revising the title of the section and paragraphs (a)(1), (a)(3), (b), and (c), to read as follows:

§ 86.091–10 Emission standards for 1991 and later model year Otto-cycle heavy-duty engines and vehicles.

(a)(1) Exhaust emissions from new 1991 and later model year Otto-cycle heavy-duty engines shall not exceed:

(i) For *gasoline-fueled Otto-cycle engines* intended for use in all vehicles except as provided in paragraph (a)(3) of this paragraph,

(A) *Hydrocarbons.* 1.1 grams per brake horsepower-hour (0.41 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon monoxide.* (*1*) 14.4 grams per brake horsepower-hour (5.36 grams per megajoule), as measured under transient operating conditions.

(*2*) *For gasoline-fueled Otto-cycle heavy-duty engines utilizing aftertreatment technology.* 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* (*1*) 5.0 grams per brake horsepower-hour (1.9 grams per megajoule), as measured under transient operating conditions.

(*2*) A manufacturer may elect to include some or all of its gasoline-fueled Otto-cycle heavy-duty engine families in the heavy-duty engine NO_x averaging program, provided that engines produced for sale in California or in 49-state areas may be averaged only within each of those areas. Averaging is limited to within fuel types (gasoline and methanol). If the manufacturer elects to participate in the NO_x averaging program, individual family NO_x emission limits may not exceed 6.0 grams per brake horsepower-hour (2.2 grams per megajoule).

(ii) For *gasoline-fueled Otto-cycle engines* intended for use only in vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs.

(A) *Hydrocarbons.* 1.9 grams per brake horsepower-hour (0.71 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon Monoxide.* (*1*) 37.1 grams per brake horsepower-hour (13.8 grams per megajoule), as measured under transient operating conditions.

(*2*) *For gasoline-fueled Otto-cycle heavy-duty engines utilizing aftertreatment technology.* 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* (*1*) 5.0 grams per brake horsepower-hour (1.9 grams per megajoule), as measured under transient operating conditions.

(*2*) A manufacturer may elect to include some or all of its gasoline-fueled Otto-cycle heavy-duty engine families in the heavy-duty engine NO_x averaging program, as described in paragraph (a)(1)(i)(C)(*2*) of this section.

(iii) For *methanol-fueled Otto-cycle heavy-duty engines* intended for use in all vehicles, except as provided in paragraph (a)(3) of this section.

(A) *Organic Material Hydrocarbon Equivalent.* 1.1 gram per brake horsepower-hour (0.41 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon monoxide.* (*1*) 14.4 grams per brake horsepower-hour (5.36 grams per megajoule), as measured under transient operating conditions.

(*2*) 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* (*1*) 5.0 grams per brake horsepower-hour (1.9 grams per megajoule), as measured under transient operating conditions.

(*2*) A manufacturer may elect to include some or all of its methanol-fueled Otto-cycle engine families in the heavy-duty NO_x averaging program, as described in paragraph (a)(1)(i)(C)(*2*) of this section.

(iv) For *methanol-fueled Otto-cycle heavy-duty engines* intended for use only in vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs.

(A) *Organic Material Hydrocarbon Equivalent.* 1.9 grams per brake horsepower-hour (0.71 gram per megajoule), as measured under transient operating conditions.

(B) *Carbon monoxide.* (*1*) 37.1 grams per brake horsepower-hour (13.8 grams per megajoule), as measured under transient operating conditions.

(*2*) 0.50 percent of exhaust gas flow at curb idle.

(C) *Oxides of nitrogen.* (*1*) 5.0 grams per brake horsepower-hour (1.9 grams per megajoule), as measured under transient operating conditions.

(*2*) A manufacturer may elect to include some or all of its methanol-fueled Otto-cycle heavy-duty engine families in the heavy-duty NO_x averaging program, as described in paragraph (a)(1)(i)(C)(*2*) of this section.

(2) * * *

(3)(i) A manufacturer may certify one or more gasoline-fueled Otto-cycle heavy-duty engine configurations intended for use in all vehicles to the emission standards set forth in paragraph (a)(1)(ii) of this section: *Provided,* that the total model year sales of such configuration(s) being certified to the emission standards in paragraph (a)(1)(ii) of this section represent no more than 5 percent of total model year sales of all gasoline-fueled Otto-cycle heavy-duty engines intended for use in vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds by the manufacturer.

(ii) A manufacturer may certify one or more methanol-fueled Otto-cycle heavy-duty engine configurations intended for use in all vehicles to the emission standards set forth in paragraph (a)(1)(iv) of this section: *Provided,* that the total model year sales of such configuration(s) being certified to the emission standards in paragraph a(1)(iv) of this section represent no more than 5 percent of total model year sales of all methanol-fueled Otto-cycle heavy-duty

engines intended for use in vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds by the manufacturer.

(iii) The configurations certified to the emission standards of paragraphs (a)(1)(ii) and (iv) of this section under the provisions of paragraphs (a)(3)(i) and (ii) of this section shall still be required to meet the evaporative emission standards set forth in paragraphs (b)(1)(i), (b)(2)(i) and (b)(3)(i) of this section.

(b) *Evaporative emissions* from 1991 and later model year heavy-duty vehicles shall not exceed:

(1) *Hydrocarbons (for vehicles equipped with gasoline-fueled engines).* (i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for vehicles equipped with methanol-fueled engines).*

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(3)(i) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraphs (b)(1) and (b)(2) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in Subpart M and measured in accordance with those procedures.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs., the standards set forth in paragraphs (b)(1)(ii) and (b)(2)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in § 86.091–23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1991 or later model year Otto-cycle heavy-duty engine.

* * * * *

11. Section 86.090–11 of Subpart A is amended by revising paragraphs (a)(1) and (c) and adding new paragraphs (b)(3) and (b)(4), to read as follows:

§ 86.090–11 Emission standards for 1990 and later model year diesel heavy-duty engines and vehicles.

(a)(1) Exhaust emissions from new 1990 and later model year diesel heavy-duty engines shall not exceed the following:

(i)(A) *Hydrocarbons (for petroleum-fueled diesel engines).* 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled diesel engines).* 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(ii) *Carbon monoxide.* (A) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(B) 0.50 percent of exhaust gas flow at curb idle (methanol-fueled diesel only).

(iii) *Oxides of nitrogen.* 6.0 grams per brake horsepower-hour (2.2 grams per megajoule), as measured under transient operating conditions.

(iv) *Particulate.* For diesel engines, 0.60 gram per brake horsepower-hour (0.22 gram per megajoule), as measured under transient operating conditions.

(b) * * *

(3) *Evaporative emissions* (total of non-oxygenated hydrocarbons plus methanol) from 1990 and later model year heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed:

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs., 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs., 4.0 grams per test.

(4)(i) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs., the standards set forth in paragraph (b)(3) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in Subpart M and measured in accordance with those procedures.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs., the standard set forth in paragraph (b)(3)(ii) of this section refers to the manufacturers' engineering design evaluation using good engineering practice (a statement of which is required in § 86.090–23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1990 or later model year methanol-fueled diesel, or any naturally-aspirated diesel heavy-duty engine. For petroleum-fueled diesel engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

* * * * *

12. Section 86.091–11 of Subpart A is amended by revising paragraphs (a)(1) and (c), and adding new paragraphs (b)(3) and (b)(4), to read as follows:

§ 86.091–11 Emission standards for 1991 and later model year diesel heavy-duty engines and vehicles.

(a)(1) Exhaust emissions from new 1991 and later model year diesel heavy-duty engines shall not exceed the following:

(i)(A) *Hydrocarbons (for petroleum-fueled diesel engines).* 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled diesel engines).* 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(ii) *Carbon monoxide.* (A) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(B) 0.50 percent of exhaust gas flow at curb idle (methanol-fueled diesel only).

(iii) *Oxides of nitrogen.* (A) 5.0 grams per brake horsepower-hour (1.9 grams per megajoule), as measured under transient operating conditions.

(B) A manufacturer may elect to include some or all of its diesel heavy-duty engine families in the heavy-duty NO_x averaging program, provided that engines produced for sale in California or in 49 state areas may be averaged only within each of those areas. Averaging is limited to within fuel types (petroleum or methanol). Averaging is limited to engines within a given primary service class as defined in § 86.085–2. Averaging across primary service classes is not permitted. If the manufacturer elects to participate in the NO_x averaging program, individual family NO_x emission limits may not exceed 6.0 grams per brake horsepower-hour (2.2 grams per megajoule).

(iv) *Particulate.* (A) For diesel engines to be used in urban buses, 0.10 grams per brake horsepower-hour (0.037 gram per megajoule), as measured under transient operating conditions.

(B) For all other diesel engines only, 0.25 gram per brake horsepower-hour (0.093 gram per megajoule), as measured under transient operating conditions.

(C) A manufacturer may elect to include all or some of its diesel heavy-duty engine families, exclusive of engines to be used in urban buses, in the appropriate heavy-duty particulate averaging program (petroleum or methanol), provided that engines produced for sale in California or in 49-state areas may be averaged only within each of those areas. Averaging is not permitted between fuel types. Engines for use in urban buses may not be included in either heavy-duty particulate

averaging program. Averaging is limited to engines within a given primary service class as defined in § 86.085–2. Averaging across primary service classes is not permitted. If the manufacturer elects to participate in either averaging program, individual family particulate limits may not exceed 0.60 gram per brake horsepower-hour (0.22 gram per megajoule).

* * * * *

(b) * * *

(3) *Evaporative emissions* (total of non-oxygenated hydrocarbons plus methanol) from 1991 and later model year heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed:

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(4)(i) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraph (b)(3) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in Subpart M and measured in accordance with those procedures.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs, the standard set forth in paragraph (b)(3)(ii) of this section refers to the manufacturers, engineering design evaluation using good engineering practice (a statement of which is required in § 86.091–23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1991 or later model year methanol-fueled diesel, or any naturally-aspirated diesel heavy-duty engine. For petroleum fueled engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

* * * * *

13. Section 86.094–11 of Subpart A is amended by revising paragraphs (a)(1) and (c), and adding new paragraphs (b)(3) and (b)(4) to read as follows:

§ 86.094–11 Emission standards for 1994 and later model year diesel heavy-duty engines and vehicles.

(a)(1) Exhaust emissions from new 1994 and later model year diesel heavy-duty engines shall not exceed the following:

(i)(A) *Hydrocarbons (for petroleum-fueled diesel engines).* 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled diesel engines).* 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(ii) *Carbon monoxide.* (A) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(B) 0.50 percent of exhaust gas flow at curb idle (methanol-fueled diesel only).

(iii) *Oxides of nitrogen.* [Reserved]

(iv) *Particulate.* (A) 0.10 grams per brake horsepower-hour (0.037 gram per megajoule), as measured under transient operating conditions.

(B) A manufacturer may elect to include all or some of its diesel heavy-duty engine families, exclusive of engines to be used in urban buses, in the appropriate heavy-duty particulate averaging program (petroleum or methanol), provided that engines produced for sale in California or in 49-state areas may be averaged only within each of those areas. Averaging is not permitted between fuel types. Engines for use in urban buses may not be included in either heavy-duty particulate averaging program. Averaging is limited to engines within a given primary service class as defined in § 86.085–2. Averaging across primary service classes is not permitted. If the manufacturer elects to participate in either averaging program, individual family particulate limits may not exceed 0.60 grams per brake horsepower-hour (0.22 gram per megajoule).

* * * * *

(b) * * *

(3) *Evaporative emissions* (total of non-oxygenated hydrocarbons plus methanol) from 1994 and later model year heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed:

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(4)(i) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraph (b)(3) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in Subpart M and measured in accordance with those procedures.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs, the standard set forth in paragraph (b)(3)(ii) of this section refers to the manufacturers, engineering design evaluation using good engineering practice (a statement of which is required in § 86.091 23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1994 or later model year methanol-fueled diesel, or any naturally-aspirated diesel heavy-duty engine. For petroleum-fueled engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

* * * * *

14. A new § 86.090–14 is added to Subpart A to read as follows:

§ 86.090–14 Small-volume manufacturers certification procedures.

(a) The small-volume manufacturers certification procedures described in paragraphs (b) and (c) of this section are optional. Small-volume manufacturers may use these optional procedures to demonstrate compliance with the general standards and specific emission requirements contained in this subpart.

(b)(1) The optional small-volume manufacturers certification procedures apply to light-duty vehicles, light-duty trucks, and heavy-duty engines produced by manufacturers with U.S. sales (for the model year in which certification is sought) of fewer than 10,000 units (light-duty vehicles, light-duty trucks, and heavy-duty engines combined).

(2) For the purpose of determining the applicability of paragraph (b)(1) of this section, where there is more than one importer or distributor of vehicles and/or engines manufactured by the same person, the sales the Administrator shall use shall be the aggregate of the projected or actual sales of those vehicles and/or engines by all of the importers and distributors.

(c) Small-volume manufacturers shall demonstrate compliance with the applicable sections of this subpart as follows:

(1) Sections 86.090–1, 86.088–2, 86.090–3, 86.084–4, 86.090–5, 86.078–6, 86.078–7, and 86.090–8 through 86.090–11 are applicable.

(2) Section 86.080–12 is not applicable.

(3) Sections 86.085–13, 86.090–14, 86.084–15, and 86.085–20 are applicable.

(4) Small-volume manufacturers shall include in its records all of the information that EPA requires in § 86.090–21. This information will be considered part of the manufacturer's application for certification. However, the manufacturer is not required to submit the information to the Administrator unless the Administrator requests it.

(5) Section 86.085–22 is applicable except as noted below.

(i) Small-volume light-duty vehicle and light-duty truck manufacturers may

satisfy the requirements of paragraph (e) of § 86.085–22 by including a statement of compliance on adjustable parameters in the application for certification. In the statement of compliance the manufacturer shall state that the limits, stops, seals, or other means used to inhibit adjustment have been designed to accomplish their intended purpose based on good engineering practice and past experience. If the vehicle parameter is adjustable the vehicle must meet emission standards with the parameter set any place within the adjustable range [reference § 86.090–21).

(ii) Paragraphs (a), (b), (c), and (d) of § 86.085–22 are not applicable.

(6) Section 86.090–23 is applicable.

(7) Section 86.085–24 is applicable except as noted below.

(i) Small-volume manufacturers may satisfy the requirements of paragraphs (b) and (c) of § 86.085–24 by:

(A) Selecting emission-data test vehicles (engines) by the worst case emissions criteria as follows:

(*1*) *Light-duty vehicles and light-duty trucks.* The test vehicle shall be selected based on the following criteria: The manufacturer shall select the heaviest (including options) vehicle within the family. Then within that vehicle it shall select, in the order listed, the largest frontal area, largest displacement, the highest numerical axle ratio with the largest tire offered in the engine family, and the maximum fuel flow calibration.

(*2*) *Heavy-duty Otto-cycle engines.* The manufacturer shall select the worst case emission-data engine first based on the largest displacement within the engine family. Then within the largest displacement the manufacturer shall select, in the order listed, highest fuel flow at the speed of maximum rated torque, the engine with the most advance spark timing, no EGR or lowest EGR flow, and no air pump or lowest actual flow air pump.

(*3*) *Heavy-duty diesel engines.* The manufacturer shall select in each engine family the worst case emission data engine based on the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed.

(B) Testing light-duty vehicle or light-duty truck emission-data vehicles at any service accumulation distance less than 6,436 kilometers (4,000 miles) or heavy-duty engine emission-data engines at any service accumulation time less than 125 hours.

(C) Using assigned deterioration factors that the Administrator determines and prescribes. However, the manufacturer may, at its option, accumulate miles (hours) on a durability-data vehicle (engine) and complete emission tests for the purpose of establishing its own deterioration factor.

(ii) Paragraphs (d) and (e) of § 86.085–24 are not applicable.

(8) Section 86.090–25 is applicable to durability-data light-duty vehicles, light-duty trucks, and heavy-duty engines if the manufacturer does not use assigned deterioration factors.

(9) Sections 86.084–26 and 86.085–27 are not applicable.

(10) Sections 86.090–28 and 86.090–29 are applicable.

(11)(i) Section 86.090–30 of this subpart is applicable, except for paragraphs (a)(2) and (b) of that section. In the place of these paragraphs, small-volume manufacturers shall comply with paragraphs (c)(11) (ii) through (v) of this section.

(ii) Small-volume manufacturers shall submit an application for certification containing the following:

(A) The names, addresses, and telephone numbers of the persons the manufacturer authorizes to communicate with us.

(B) A brief description of the vehicles (or engines) covered by the certificate (the manufacturers' sales data book or advertising, including specifications, may satisfy this requirement for most manufacturers). The description shall include, as a minimum, the following items as applicable:

(*1*) Engine families and vehicle (or engine) configurations.

(*2*) Vehicle or engine models to be listed on the certificate of conformity.

(*3*) The test weight and horsepower setting for each vehicle or engine configuration.

(*4*) Projected sales.

(*5*) Combustion cycle.

(*6*) Cooling mechanism.

(*7*) Number of cylinders.

(*8*) Displacement.

(*9*) Fuel system type.

(*10*) Number of catalytic converters, volume, and composition.

(*11*) Method of air aspiration.

(*12*) Thermal reactor characteristics.

(*13*) Suppliers' and/or manufacturer's name and model number of any emission-related items identified in paragraphs (c)(11)(ii)(B) (*1*) through (*12*) of this section, if purchased from a supplier or manufacturer who uses the items in its own certified vehicles(s) or engine(s).

(*14*) A list of emission component part numbers.

(*15*) Drawings, calibration curves, and descriptions of emission related components, including those components regulated under paragraph (e) of § 86.085–22, and schematics of hoses and other devices connecting these components.

(*16*) Vehicle adjustments or modifications necessary for light duty trucks to assure that they conform to high altitude standards.

(*17*) A description of the light-duty vehicles and light-duty trucks that are exempted from either the low- or high-altitude emission standards, as applicable.

(C) The results of all emission tests the manufacturer performs to demonstrate compliance with the applicable standards.

(D)(*1*) The following statement signed by the authorized representative of the manufacturer: "The vehicles (or engines) described herein have been tested in accordance with [list of the applicable Subparts A, B, D, I, N, or P] of Part 86, Title 40, United States Code of Federal Regulations, and on the basis of those tests are in conformance with that subpart. All of the data and records required by that subpart are on file and are available for inspection by the EPA Administrator. We project the total U.S. sales of vehicles (engines) subject to this subpart to be fewer than 10,000 units."

(*2*) A statement as required by and contained in paragraph (c)(5) of § 86.090–14 signed by the authorized representative of the manufacturer.

(*3*) A statement that the vehicles or engines described in the manufacturers application for certification are not equipped with auxiliary emission control devices which can be classified as a defeat device as defined in § 86.084–2.

(*4*) A statement of compliance with section 206(a)(3) of the Clean Air Act.

(*5*) A statement that, based on the manufacturer's engineering evaluation and/or emission testing, the light-duty vehicles comply with emission standards at high altitude unless exempt under paragraph (h) of § 86.090–8.

(*6*) A statement that, based on the manufacturers engineering evaluation and/or emission testing, the light-duty trucks sold for principle use at designated high-altitude locations comply with the high-altitude emission requirements and that all other light-duty trucks are at least capable of being modified to meet high altitude standards unless exempt under paragraph (g)(2) of § 86.090–9.

(iii) If the manufacturer meets requirements of this subpart, the Administrator will issue a certificate of conformity for the vehicles described in the application for certification.

(iv) The certificate will be issued for such a period not to exceed one model year as the Administrator may

determine and upon such terms as he may deem necessary to assure that any vehicle or engine covered by the certificate will meet the requirements of the Act and of this subpart.

(v)(A) If, after a review of the statements and descriptions submitted by the manufacturer, the Administrator determines that the manufacturer has not met the applicable requirements, the Administrator shall notify the manufacturer in writing, setting forth the basis for his determination. The manufacturer may request a hearing on the Administrator's determination.

(B) If the manufacturer does not request a hearing or present the required information the Administrator will deny certification.

(12) Sections 86.079–31 and 86.079–32 are not applicable

(13) Under § 86.079–33, small-volume manufacturers are covered by the following:

(i) Small-volume manufacturers may make production changes (running changes) without receiving the Administrator's prior approval. The manufacturer shall assure (by conducting emission tests as it deems necessary) that the affected vehicles (engines) remain in compliance with the requirements of this part.

(ii) The manufacturer shall notify the Administrator within seven days after implementing any production related change (running change) that would affect vehicle emissions. This notification shall include any changes to the information required under paragraph (c)(11)(ii) of this section. The manufacturer shall also amend as necessary its records required under paragraph (c)(4) of this section to conform with the production design change.

(14) Section 86.082–34 is not applicable.

(15) Sections 86.090–35, 86.079–36, 86.082–37, 86.087–38, and 86.084–39 are applicable.

15. A new § 86.090–21 is added to Subpart A to read as follows:

§ 86.090–21 Application for certification.

(a) A separate application for a certificate of conformity shall be made for each set of standards (or family emission limits, as appropriate) and each class of new motor vehicles or new motor vehicle engines. Such application shall be made to the Administrator by the manufacturer and shall be updated and corrected by amendment.

(b) The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

(1)(i) Identification and description of the vehicles (or engines) covered by the application and a description of their engine (vehicles only), emission control system and fuel system components. This shall include a detailed description of each auxiliary emission control device (AECD) to be installed in or on any certification test vehicle (or certification test engine).

(ii)(A) The manufacturer shall provide to the Administrator in the application for certification:

(*1*) A list of those parameters which are physically capable of being adjusted (including those adjustable parameters for which access is difficult) and that, if adjusted to settings other than the manufacturer's recommended setting, may affect emissions;

(*2*) A specification of the manufacturer's intended physically adjustable range of each such parameter, and the production tolerances of the limits or stops used to establish the physically adjustable range;

(*3*) A description of the limits or stops used to establish the manufacturer's intended physically adjustable range of each adjustable parameter, or any other means used to inhibit adjustment;

(*4*) The nominal or recommended setting, and the associated production tolerances, for each such parameter.

(B) The manufacturer may provide, in the application for certification, information relating to why certain parameters are not expected to be adjusted in actual use and to why the physical limits or stops used to establish the physically adjustable range of each parameter, or any other means used to inhibit adjustment, are expected to be effective in preventing adjustment of parameters on in-use vehicles to settings outside the manufacturer's intended physically adjustable ranges. This may include results of any tests to determine the difficulty of gaining access to an adjustment or exceeding a limit as intended or recommended by the manufacturer.

(C) The Administrator may require to be provided detailed drawings and descriptions of the various emission related components, and/or hardware samples of such components, for the purpose of making his determination of which vehicle or engine parameter will be subject to adjustment for new certification and Selective Enforcement Audit testing and of the physically adjustable range for each such vehicle or engine parameter.

(2) Projected U.S. sales data sufficient to enable the Administrator to select a test fleet representative of the vehicles (or engines) for which certification is requested. The sales data shall also include the altitude of intended sale for light-duty trucks.

(3) A description of the test equipment and fuel proposed to be used.

(4)(i) For light-duty vehicles and light duty trucks, a description of the test procedures to be used to establish the evaporative emission deterioration factors required to be determined and supplied in § 86.090–23(b)(2).

(ii) For heavy duty vehicles equipped with gasoline-fueled or methanol-fueled engines, the Administrator does not assume that each evaporative emission family-evaporative emission control system combination will deteriorate in a unique manner during the useful life of the vehicle. The manufacturer shall therefore identify those evaporative emission deterioration factors which shall be applied to the various evaporative emission family-evaporative emission control system combinations which are expected to exhibit similar deterioration characteristics during the useful life of the vehicle.

(iii)(A) A description of the test procedures to be used to establish the durability data or the exhaust emission deterioration factors required to be determined and supplied in § 86.088–23(b)(1).

(B)(*1*) For engine families provided an alternative useful-life period under paragraph (f) of this section, a statement of that alternative period and a brief synopsis of the justification.

(*2*) For heavy-duty diesel engine families, a statement of the primary intended service class (light, medium, or heavy) and an explanation as to why that service class was selected. Each diesel engine family shall be certified under one primary intended service class only. After reviewing the guidance in § 86.085–2, the class shall be determined on the basis of which class best represents the majority of the sales of that engine family.

(C)(*1*) A statement of recommended maintenance and procedures necessary to assure that the vehicles (or engines) covered by a certificate of conformity in operation conform to the regulations, and a description of the program for training of personnel for such maintenance, and the equipment required.

(*2*) A description of vehicle adjustments or modifications necessary, if any, to assure that light-duty vehicles and light-duty trucks covered by a certificate of conformity conform to the regulations while being operated at any altitude locations, and a statement of

the altitude at which the adjustments or modifications apply.

(D) At the option of the manufacturer, the proposed composition of the emission-data test fleet or (where applicable) the durability-data test fleet.

(5)(i)(A) If the manufacturer elects to participate in the particulate averaging program for diesel light-duty vehicles and/or diesel light-duty trucks, the application must list the family particulate emission limit and the projected U.S. production volume of the family for the model year.

(B) The manufacturer shall choose the level of the family particulate emission limits, accurate to one-hundredth of a gram per mile.

(C) The manufacturer may at any time during production elect to change the level of any family diesel particulate emission limit(s) by submitting the new limit(s) to the Administrator and by demonstrating compliance with the limit(s) as described in § 86.085–2 and § 86.088–28(b)(5)(i).

(ii)(A) If the manufacturer elects to participate in the NO_x averaging program for light-duty trucks, the application must list the family NO_x emission limit and the projected U.S. production volume of the family for the model year.

(B) The manufacturer shall choose the level of the family NOx emission limits, accurate to one-tenth of a gram per mile.

(C) The manufacturer may at any time during production elect to change the level of any family NO_x emission limit(s) by submitting the new limits to the Administrator and by demonstrating compliance with the limit(s) as described in § 86.088–2 and § 86.088–28(b)(5)(ii).

(6)(i) For Otto-cycle heavy-duty engines, the application must state whether the engine family is being certified for use in all vehicles regardless of their Gross Vehicle Weight Rating (see § 86.088–10 (a)(1)(i) and (a)(3)(i)), or, only for use in vehicles with a Gross Vehicle Weight Rating greater than 14,000 pounds.

(ii) If the engine family is being certified for use in all vehicles and, is being certified to the emission standards applicable to Otto-cycle heavy-duty engines for use only in vehicles with a Gross Vehicle Weight Rating over 14,000 pounds under the provisions of paragraph (a)(3) of § 86.088–10, then the application must also attest that the engine family, together with all other engine families being certified under the provisions of paragraph (a)(3) of § 86.088–10, represent no more than 5 percent of model year sales of the manufacturer of all Otto-cycle heavy duty engines for use in vehicles with Gross Vehicle Weight Ratings of up to 14,000 pounds.

(iii)(A) A description of the test procedures to be used to establish the durability data or the exhaust emission deterioration factors required to be determined and supplied in § 86.088–23(b)(1).

(B)(*1*) A statement of the useful life of use of each light-duty truck engine family and heavy-duty engine family.

(*2*) For engine families provided an alternative useful life period under paragraph (f) of this section, a statement of that alternative period and a brief synopsis of the justification.

(*3*) For heavy-duty diesel engine families, a statement of the primary intended service class (light, medium, or heavy) and an explanation as to why that service class was selected. Each diesel engine family shall be certified under one primary intended service class only. After reviewing the guidance in § 86.085–2, the class shall be determined on the basis of which class best represents the majority of the sales of that engine family.

(7) For each light-duty vehicle engine family, a statement of recommended maintenance and procedures necessary to assure that the vehicles (or engines) covered by a certificate of conformity in operation conform to the regulations, and a description of the program for training of personnel for such maintenance and the equipment required.

(8) For each light-duty vehicle engine family, the proposed composition of the emission-data test fleet and the durability-data test fleet.

(c) Complete copies of the application and of any amendments thereto, and all notifications under § 86.079–32, § 86.079–33, and § 86.082–84 shall be submitted in such multiple copies as the Administrator may require.

(d) Incomplete light-duty trucks shall have a maximum completed curb weight and maximum completed frontal area specified by the manufacturer.

(e) For vehicles equipped with gasoline-fueled or methanol-fueled heavy-duty engines, the manufacturer shall specify a maximum nominal fuel tank capacity for each evaporative emission family-evaporative emission control system combination.

(f) Light-duty truck and heavy-duty engine manufacturers who believe that the useful life periods of § 86.085–2 are significantly unrepresentative for one or more engine families (either too long or too short), may petition the Administrator to provide an alternative useful-life period. This petition must include the full rationale behind the request together with any supporting data and other evidence. Based on this or other information the Administrator may assign an alternative useful-life period. Any petition should be submitted in a timely manner, to allow adequate time for a thorough evaluation.

16. Section 86.091–21 of Subpart A is amended by revising paragraphs (a), (b)(4)(i), (b)(4)(ii), (b)(5)(ii), (b)(6)(i)(A), (b)(6)(i)(C), (b)(7)(i), (b)(7)(ii), (e) and (f), to read as follows:

§ 86.091–21 Application for certification.

(a) A separate application for a certificate of conformity shall be made for each set of standards (or family emission limits, as appropriate) and each class of new motor vehicles or new motor vehicle engines. Such application shall be made to the Administrator by the manufacturer and shall be updated and corrected by amendment.

(b) * * *

(4)(i) For light-duty vehicles and light-duty trucks, a description of the test procedures to be used to establish the evaporative emission deterioration factors required to be determined and supplied in § 86.091–23(b)(2).

(ii) For heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines, the Administrator does not assume that each evaporative emission family-evaporative emission control system combination will deteriorate in a unique manner during the useful life of the vehicle. The manufacturer shall therefore identify those evaporative emission deterioration factors which shall be applied to the various evaporative emission family-evaporative emission control system combinations which are expected to exhibit similar deterioration characteristics during the useful life of the vehicle.

* * * * *

(5) * * *

(ii) For heavy-duty diesel engine families, a statement of the primary intended service class (light, medium, or heavy) and an explanation as to why that service class was selected. Each diesel engine family shall be certified under one primary intended service class only. After reviewing the guidance in § 86.090–2, the class shall be determined on the basis of which class best represents the majority of the sales of that engine family.

* * * * *

(6)(i)(A) If the manufacturer elects to participate in the particulate averaging program for diesel light-duty vehicles and/or diesel light-duty trucks, or the particulate averaging program for heavy-duty diesel engines, the application must list the family

particulate emission limit and the projected U.S. production volume of the family for the model year.

(B) * * *

(C) The manufacturer may at any time during production elect to change the level of any family particulate emission limit(s) by submitting the new limit(s) to the Administrator and by demonstrating compliance with the limit(s) as described in § 86.090–2 and § 86.091–28(b)(5)(i).

* * * * *

(7)(i) For Otto-cycle heavy-duty engines, the application must state whether the engine family is being certified for use in all vehicles regardless of their Gross Vehicle Weight Rating (see § 86.091–10 (a)(1)(i) and (a)(3)(i)), or, only for use in vehicles with a Gross Vehicle Weight Rating greater than 14,000 pounds.

(ii) If the engine family is being certified for use in all vehicles and, is being certified to the emission standards applicable to Otto-cycle engines for use only in vehicles with a Gross Vehicle Weight Rating over 14,000 pounds under the provisions of paragraph (a)(3) of § 86.091–10, then the application must also attest that the engine family, together with all other engine families being certified under the provisions of paragraph (a)(3) of § 86.091–10, represent no more than 5 percent of model year sales of the manufacturer of all Otto-cycle heavy-duty engines for use in vehicles with Gross Vehicle Weight Ratings of up to 14,000 pounds.

* * * * *

(e) For vehicles equipped with gasoline-fueled or methanol-fueled heavy-duty engines, the manufacturer shall specify a maximum nominal fuel tank capacity for each evaporative emission family-evaporative emission control system combination.

(f) Light-duty truck and heavy-duty engine manufacturers who believe that the useful life periods of § 86.090–2 are significantly unrepresentative for one or more engine families (either too long or too short), may petition the Administrator to provide an alternative useful-life period. This petition must include the full rationale behind the request together with any supporting data and other evidence. Based on this or other information the Administrator may assign an alternative useful-life period. Any petition should be submitted in a timely manner, to allow adequate time for a thorough evaluation.

17. A new § 86.090–22 is added to Subpart A, to read as follows:

§ 86.090–22 Approval of application for certification; test fleet selections; determinations of parameters subject to adjustment for certification and Selective Enforcement Audit, adequacy of limits, and physically adjustable ranges.

(a) After a review of the application for certification and any other information which the Administrator may require, the Administrator may approve the application and select a test fleet in accordance with § 86.090–24.

(b) The Administrator may disapprove in whole or in part an application for certification for reasons including incompleteness, inaccuracy, inappropriate proposed mileage (or service) accumulation procedures, test equipment, or fuel, and incorporation of defeat devices in vehicles (or on engines) described by the application.

(c) Where any part of an application is rejected, the Administrator shall notify the manufacturer in writing and set forth the reasons for such rejection. Within 30 days following receipt of such notification, the manufacturer may request a hearing on the Administrator's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Administrator's determinations, and data in support of such objections. If, after the review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 86.078–6 with respect to such issue.

(d)(1) The Administrator does not approve the test procedures for establishing the evaporative emission deterioration factors for light-duty vehicles and light-duty trucks. The manufacturer shall submit the procedures as required in § 86.090–21(b)(4)(i) prior to the Administrator's selection of the test fleet under § 86.090–24(b)(1) and if such procedures will involve testing of durability-data vehicles selected by the Administrator or elected by the manufacturer under § 86.090–24(c)(1), prior to initiation of such testing.

(2) *Light-duty trucks and heavy-duty engines only.* The Administrator does not approve the test procedures for establishing exhaust emission deterioration factors. The manufacturer shall submit these procedures and determinations as required in § 86.090–21(b)(4)(iii) prior to determining the deterioration factors.

(3) *Heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines only.* The Administrator does not approve the test procedures for establishing the evaporative emission deterioration factors. The test procedure will conform to the requirements in § 86.090–23(b)(3).

(e) When the Administrator selects emission-data vehicles for the test fleet, he will at the same time determine those vehicle or engine parameters which will be subject to adjustment for certification, Selective Enforcement Audit and Production Compliance Audit testing, the adequacy of the limits, stops, seals, or other means used to inhibit adjustment, and the resulting physically adjustable ranges for each such parameter and notify the manufacturer of his determinations.

(1)(i) Except as noted in paragraph (e)(1)(iv) of this section, the Administrator may determine to be subject to adjustment the idle fuel-air mixture parameter on Otto-cycle vehicles (or engines) (carbureted or fuel-injected); the choke valve action parameter(s) on carbureted, Otto-cycle vehicles (or engines); or any parameter on any vehicle (or engine) (Otto-cycle or diesel) which is physically capable of being adjusted, may significantly affect emissions, and was not present on the manufacturer's vehicles (or engines) in the previous model year in the same form and function.

(ii) The Administrator may, in addition, determine to be subject to adjustment any other parameters on any vehicle or engine which is physically capable of being adjusted and which may significantly affect emissions. However, the Administrator may do so only if he has previously notified the manufacturer that he might do so and has found, at the time he gave this notice, that the intervening period would be adequate to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period. In no event will this notification be given later than September 1 of the calendar year two years prior to the model year.

(iii) In determining the parameters subject to adjustment the Administrator will consider the likelihood that, for each of the parameters listed in paragraphs (e)(1)(i) and (e)(1)(ii) of this section, settings other than the manufacturer's recommended setting will occur on in-use vehicles (or engines). In determining likelihood, the Administrator may consider such factors as, but not limited to, information contained in the preliminary application, surveillance information from similar in-use vehicles (or engines), the difficulty and cost of gaining access

to an adjustment, damage to the vehicle (or engine) if an attempt is made to gain such access and the need to replace parts following such attempt, and the effect of settings other than the manufacturer's recommended setting on vehicle (or engine) performance characteristics including emission characteristics.

(iv) Manual chokes of heavy-duty engines only will not be considered a parameter subject to adjustment under the parameter adjustment requirements.

(2)(i) The Administrator shall determine a parameter to be adequately inaccessible or sealed if:

(A) In the case of an idle mixture screw, the screw is recessed within the carburetor casting and sealed with lead, thermosetting plastic, or an inverted elliptical spacer or sheared off after adjustment at the factory, and the inaccessibility is such that the screw cannot be accessed and/or adjusted with simple tools in one-half hour or for $20 (1978 dollars) or less.

(B) In the case of a choke bimetal spring, the plate covering the bimetal spring is riveted or welded in place, or held in place with nonreversible screws.

(C) In the case of a parameter which may be adjusted by elongating or bending adjustable members (e.g., the choke vacuum break), the elongation of the adjustable member is limited by design or, in the case of a bendable member, the member is constructed of a material which when bent would return to its original shape after the force is removed (plastic or spring steel materials).

(D) In the case of any parameter, the manufacturer demonstrates that adjusting the parameter to settings other than the manufacturer's recommended setting takes more than one-half hour or costs more than $20 (1978 dollars).

(ii) The Administrator shall determine a physical limit or stop to be an adequate restraint on adjustability if:

(A) In the case of a threaded adjustment, the threads are terminated, pinned or crimped so as to prevent additional travel without breakage or need for repairs which take more than one-half hour or cost more than $20 (1978 dollars).

(B) The adjustment is ineffective at the end of the limits of travel regardless of additional forces or torques applied to the adjustment.

(C) The manufacturer demonstrates that travel or rotation limits cannot be exceeded with the use of simple and inexpensive tools (screwdriver, pliers, open-end or box wrenches, etc.) without incurring significant and costly damage to the vehicle (or engine) or control system or without taking more than one-half hour or costing more than $20 (1978 dollars).

(iii) If manufacturer service manuals or bulletins describe routine procedures for gaining access to a parameter or for removing or exceeding a physical limit, stop, seal or other means used to inhibit adjustment, or if surveillance data indicate that gaining access, removing, or exceeding is likely, paragraphs (e)(2)(i) and (e)(2)(ii) of this section shall not apply for that parameter.

(iv) In determining the adequacy of a physical limit, stop, seal, or other means used to inhibit adjustment of a parameter not covered by paragraph (e)(2)(i) or (e)(2)(ii) of this section, the Administrator will consider the likelihood that it will be circumvented, removed, or exceeded on in-use vehicles. In determining likelihood, the Administrator may consider such factors as, but not limited to, information contained in the preliminary application; surveillance information from similar in-use vehicles (or engines); the difficulty and cost of circumventing, removing, or exceeding the limit, stop, seal, or other means; damage to the vehicle (or engine) if an attempt is made to circumvent, remove, or exceed it and the need to replace parts following such attempt; and the effect of settings beyond the limit, stop, seal, or other means on vehicle (or engine) performance characteristics other than emission characteristics.

(3) The Administrator shall determine two physically adjustable ranges for each parameter subject to adjustment:

(i)(A) In the case of a parameter determined to be adequately inaccessible or sealed, the Administrator may include within the physically adjustable range applicable to testing under this subpart (certification testing) all settings within the production tolerance associated with the nominal setting for that parameter, as specified by the manufacturer in the preliminary application for certification.

(B) In the case of other parameters, the Administrator shall include within this range all settings within physical limits or stops determined to be adequate restraints on adjustability. The Administrator may also include the production tolerances on the location of these limits or stops when determining the physically adjustable range.

(ii)(A) In the case of a parameter determined to be adequately inaccessible or sealed, the Administrator shall include within the physically adjustable range applicable to testing under Subpart G or K (Selective Enforcement Audit and Production Compliance Audit) only the actual settings to which the parameter is adjusted during production.

(B) In the case of other parameters, the Administrator shall include within this range all settings within physical limits or stops determined to be adequate restraints on adjustability, as they are actually located on the test vehicle (or engine).

(f)(1) If the manufacturer submits the information specified in § 86.090–21(b)(1)(ii) in advance of its full preliminary application for certification, the Administrator shall review the information and make the determinations required in paragraph (e) of this section within 90 days of the manufacturer's submittal.

(2) The 90-day decision period is exclusive of the elapsed time during which EPA may request additional information from manufacturers regarding an adjustable parameter and the receipt of the manufacturers' response(s).

(g) Within 30 days following receipt of notification of the Administrator's determinations made under paragraph (e) of this section, the manufacturer may request a hearing on the Administrator's determinations. The request shall be in writing, signed by an authorized representative of the manufacturer, and shall include a statement specifying the manufacturer's objections to the Administrator's determinations, and data in support of such objections. If, after review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 86.078–6 with respect to such issue.

18. A new § 86.090–23 is added to Subpart A to read as follows:

§ 86.090–23 Required data.

(a) The manufacturer shall perform the tests required by the applicable test procedures, and submit to the Administrator the following information: *Provided, however,* that if requested by the manufacturer, the Administrator may waive any requirement of this section for testing of vehicles (or engines) for which emission data are available or will be made available under the provisions of § 86.090–29.

(b)(1)(i) Exhaust emission durability data on such light-duty vehicles tested in accordance with applicable test procedures and in such numbers as specified, which will show the performance of the systems installed on or incorporated in the vehicle for extended mileage, as well as a record of

all pertinent maintenance performed on the test vehicles.

(ii) Exhaust emission deterioration factors for light-duty trucks and heavy-duty engines, and all test data that are derived from the testing described under § 86.090–21(b)(4)(iii)(A), as well as a record of all pertinent maintenance. Such testing shall be designed and conducted in accordance with good engineering practice to assure that the engines covered by a certificate issued under § 86.090–30 will meet the emission standards (or family emission limits, as appropriate) in § 86.090–9, § 86.090–10, or § 86.090–11 as appropriate, in actual use for the useful life of the engine.

(2) For light-duty vehicles and light-duty trucks, evaporative emission deterioration factors for each evaporative emission family-evaporative emission control system combination and all test data that are derived from testing described under § 86.090–21(b)(4)(i) designed and conducted in accordance with good engineering practice to assure that the vehicles covered by a certificate issued under § 86.090–30 will meet the evaporative emission standards in § 86.090–8 or § 86.090–9, as appropriate, for the useful life of the vehicle.

(3) For heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines, evaporative emission deterioration factors for each evaporative emission family-evaporative emission control system combination identified in accordance with § 86.090–21(b)(4)(ii). Furthermore, a statement that the test procedure(s) used to derive the deterioration factors includes, but need not be limited to, a consideration of the ambient effects of ozone and temperature fluctuations, and the service accumulation effects of vibration, time, and vapor saturation and purge cycling. The deterioration factor test procedure shall be designed and conducted in accordance with good engineering practice to assure that the vehicles covered by a certificate issued under § 86.090–30 will meet the evaporative emission standards in § 86.090–10 and § 86.090–11 in actual use for the useful life of the engine. Furthermore, a statement that a description of the test procedure, as well as all data, analyses and evaluations, is available to the Administrator upon request.

(4)(i) For heavy-duty vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs. and equipped with gasoline-fueled or methanol-fueled engines, a written statement to the Administrator certifying that the manufacturer's vehicles meet the standards of § 86.090–10 or § 86.090–11 (as applicable) as determined by the provisions of § 86.090–28. Furthermore, a written statement to the Administrator that all data, analyses, test procedures, evaluations, and other documents, on which the above statement is based, are available to the Administrator upon request.

(ii) For heavy-duty vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs. and equipped with gasoline-fueled or methanol-fueled engines, a written statement to the Administrator certifying that the manufacturer's evaporative emission control systems are designed, using good engineering practice, to meet the standards of § 86.090–10 or § 86.090–11 (as applicable) as determined by the provisions of § 86.090–28. Furthermore, a written statement to the Administrator that all data, analyses, test procedures, evaluations, and other documents, on which the above statement is based, are available to the Administrator upon request.

(c) Emission data. (1) Emission data, including in the case of methanol fuel, methanol, formaldehyde and organic material hydrocarbon equivalent on such vehicles tested in accordance with applicable test procedures and in such numbers as specified. These data shall include zero-mile data, if generated and emission data generated for certification as required under § 86.090–26(a)(3)(i) or § 86.090–26(a)(3)(ii). In lieu of providing emission data on idle CO emissions, smoke emissions or particulate emissions from methanol-fueled diesel certification vehicles the Administrator may, on request of the manufacturer, allow the manufacturer to demonstrate (on the basis of previous emission tests, development tests, or other information) that the engine will conform with the applicable emission standards of § 86.090–8 or § 86.090–9.

(2) Certification engines. (i) Emission data on such engines tested in accordance with applicable emission test procedures of this subpart and in such numbers as specified. These data shall include zero-hour data, if generated, and emission data generated for certification as required under § 86.090–26(c)(4). In lieu of providing emission data on idle CO emissions, smoke emissions or particulate emissions from methanol-fueled diesel certification vehicles, or on CO emissions from petroleum-fueled or methanol-fueled diesel certification engines the Administrator may, on request of the manufacturer, allow the manufacturer to demonstrate (on the basis of previous emission tests, development tests, or other information) that the engine will conform with the applicable emission standards of § 86.090–11.

(ii) For heavy-duty diesel engines, a manufacturer may submit hot-start data only, in accordance with Subpart N, when making application for certification. However, for conformity SEA and recall testing by the Agency, both the cold-start and hot-start test data, as specified in Subpart N, will be included in the official results.

(d) A statement that the vehicles (or engines) for which certification is requested conform to the requirements in § 86.090–5(b), and that the descriptions of tests performed to ascertain compliance with the general standards in § 86.090–5(b), and the data derived from such tests, are available to the Administrator upon request.

(e)(1) A statement that the test vehicles (or test engines) with respect to which data are submitted to demonstrate compliance with the applicable standards (or family emission limits, as appropriate) of this subpart are in all material respects as described in the manufacturer's application for certification, have been tested in accordance with the applicable test procedures utilizing the fuels and equipment described in the application for certification and that on the basis of such tests the vehicles (or engines) conform to the requirements of this part. If such statements cannot be made with respect to any vehicle (or engine) tested, the vehicle (or engine) shall be identified, and all pertinent data relating thereto shall be supplied to the Administrator. If, on the basis of the data supplied and any additional data as required by the Administrator, the Administrator determines that the test vehicles (or test engine) was not as described in the application for certification or was not tested in accordance with the applicable test procedures utilizing the fuels and equipment as described in the application for certification, the Administrator may make the determination that the vehicle (or engine) does not meet the applicable standards (or family emission limits, as appropriate). The provisions of § 86.090–30(b) shall then be followed.

(2) For evaporative emission durability, or light-duty truck or heavy-duty engine exhaust emission durability, a statement of compliance with paragraph (b)(1)(ii), (b)(2), or (b)(3) of this section, as applicable.

(f) Additionally, manufacturers participating in the particulate averaging program for diesel light-duty vehicles and diesel light-duty trucks shall submit:

(1) In the application for certification, a statement that the vehicles for which certification is requested will not, to the best of the manufacturer's belief, when included in the manufacturer's production-weighted average emission level, cause the applicable particulate standard(s) to be exceeded.

(2) No longer than 90 days after the end of a given model year of production of engine families included in the diesel particulate averaging program, the number of vehicles produced in each engine family at each certified family diesel particulate emission limit, along with the resulting production-weighted average particulate emission level.

(g) Additionally, manufacturers participating in the NO_x averaging program for light-duty trucks shall submit:

(1) In the application for certification, a statement that the vehicles for which certification is requested will not, to the best of the manufacturer's belief, when included in the manufacturer's production-weighted average emission level, cause the applicable NO_x standard(s) to be exceeded.

(2) No longer than 90 days after the end of a given model year of production of engine families included in the light-duty truck NO_x averaging program, the number of vehicles produced in each engine family at each certified family NO_x emission limit, along with the resulting production-weighted average NO_x emission level.

19. Section 86.091–23 of Subpart A is amended by revising paragraphs (b)(1)(ii), (b)(2), (b)(3), (b)(4), (c), (e)(1), (f) introductory text and (f)(2), to read as follows:

§ 86.091–23 Required data.

* * * * *

(b)(1) * * *

(ii) Exhaust emission deterioration factors for light-duty trucks and heavy-duty engines, and all test data that are derived from the testing described under § 86.091–21(b)(4)(iii)(A), as well as a record of all pertinent maintenance. Such testing shall be designed and conducted in accordance with good engineering practice to assure that the engines covered by a certificate issued under § 86.091–30 will meet the emission standards (or family emission limits, as appropriate) in § 86.091–9, § 86.091–10, or § 86.091–11 as appropriate, in actual use for the useful life of the engine.

(2) For light-duty vehicles and light-duty trucks, evaporative emission deterioration factors for each evaporative emission family-evaporative emission control system combination and all test data that are derived from testing described under § 86.091–21(b)(4)(i) designed and conducted in accordance with good engineering practice to assure that the vehicles covered by a certificate issued under § 86.091–30 will meet the evaporative emission standards in § 86.091–8 or § 86.091–9, as appropriate, for the useful life of the vehicle.

(3) For heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines, evaporative emission deterioration factors for each evaporative emission family-evaporative emission control system combination identified in accordance with § 86.091–21(b)(4)(ii). Furthermore, a statement that the test procedure(s) used to derive the deterioration factors includes, but need not be limited to, a consideration of the ambient effects of ozone and temperature fluctuations, and the service accumulation effects of vibration, time, and vapor saturation and purge cycling. The deterioration factor test procedure shall be designed and conducted in accordance with good engineering practice to assure that the vehicles covered by a certificate issued under § 86.091–30 will meet the evaporative emission standards in § 86.091–10 and § 86.091–11 in actual use for the useful life of the engine. Furthermore, a statement that a description of the test procedure, as well as all data, analyses and evaluations, is available to the Administrator upon request.

(4)(i) For heavy-duty vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs and equipped with gasoline-fueled or methanol-fueled engines, a written statement to the Administrator certifying that the manufacturer's vehicles meet the standards of § 86.091–10 or § 86.091–11 (as applicable) as determined by the provisions of § 86.091–28. Furthermore, a written statement to the Administrator that all data, analyses, test procedures, evaluations, and other documents, on which the above statement is based, are available to the Administrator upon request.

(ii) For heavy-duty vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs and equipped with gasoline-fueled or methanol-fueled engines, a written statement to the Administrator certifying that the manufacturer's evaporative emission control systems are designed, using good engineering practice, to meet the standards of § 86.091–10 or § 86.091–11 (as applicable) as determined by the provisions of § 86.091–28. Furthermore, a written statement to the Administrator that all data, analyses, test procedures, evaluations, and other documents, on which the above statement is based, are available to the Administrator upon request.

(c) *Emission data.* (1) Emission data, including in the case of methanol fuel, methanol, formaldehyde and organic material hydrocarbon equivalent on such vehicles tested in accordance with applicable test procedures and in such numbers as specified. These data shall include zero-mile data, if generated and emission data generated for certification as required under § 86.090–26(a)(3)(i) or § 86.090–26(a)(3)(ii). In lieu of providing emission data on idle CO emissions, smoke emissions or particulate emissions from methanol-fueled diesel certification vehicles the Administrator may, on request of the manufacturer, allow the manufacturer to demonstrate (on the basis of previous emission tests, development tests, or other information) that the engine will conform with the applicable emission standards of § 86.090–8 or § 86.090–9.

(2) Certification engines. (i) Emission data on such engines tested in accordance with applicable emission test procedures of this subpart and in such numbers as specified. These data shall include zero-hour data, if generated, and emission data generated for certification as required under § 86.090–26(c)(4). In lieu of providing emission data on idle CO emissions or particulate emissions from methanol-fueled diesel certification engines, or on CO emissions from petroleum-fueled or methanol-fueled diesel certification engines the Administrator may, on request of the manufacturer, allow the manufacturer to demonstrate (on the basis of previous emission tests, development tests, or other information) that the engine will conform with the applicable emission standards of § 86.091–11.

* * * * *

(e)(1) A statement that the test vehicles (or test engines) with respect to which data are submitted to demonstrate compliance with the applicable standards (or family emission limits, as appropriate) of this subpart are in all material respects as described in the manufacturer's application for certification, have been tested in accordance with the applicable test procedures utilizing the fuels and equipment described in the application for certification and that on the basis of such tests the vehicles (or engines) conform to the requirements of this part. If such statements cannot be made with respect to any vehicle (or engine) tested, the vehicle (or engine) shall be identified, and all pertinent data relating thereto shall be supplied to the Administrator. If, on the basis of the

data supplied and any additional data as required by the Administrator, the Administrator determines that the test vehicles (or test engine) was not as described in the application for certification or was not tested in accordance with the applicable test procedures utilizing the fuels and equipment as described in the application for certification, the Administrator may make the determination that the vehicle (or engine) does not meet the applicable standards (or family emission limits, as appropriate). The provisions of § 86.091–30(b) shall then be followed.

* * * * *

(f) Additionally, manufacturers participating in any of the diesel particulate averaging programs shall submit:

* * * * *

(2) No longer than 90 days after the end of a given model year of production of engine families included in one of the diesel particulate averaging programs, the number of vehicles (or engines) produced in each engine family at each certified family diesel particulate emission limit, along with the resulting production-weighted average particulate emission level.

* * * * *

20. A new § 86.090–24 is added to Subpart A to read as follows:

§ 86.090–24 Test vehicles and engines.

(a)(1) The vehicles or engines covered by an application for certification will be divided into groupings of engines which are expected to have similar emission characteristics throughout their useful life. Each group of engines with similar emission characteristics shall be defined as a separate engine family.

(2) To be classed in the same engine family, engines must be identical in all the following respects:

(i) The cylinder bore center-to-center dimensions.

(ii) [Reserved]

(iii) [Reserved]

(iv) The cylinder block configuration (air cooled or water cooled; L–6, 90° V–8, etc.).

(v) The location of the intake and exhaust valves (or ports).

(vi) The method of air aspiration.

(vii) The combustion cycle.

(viii) Catalytic converter characteristics.

(ix) Thermal reactor characteristics.

(x) Type of air inlet cooler (*e.g.*, intercoolers and after-coolers) for diesel heavy-duty engines.

(3)(i) Engines identical in all the respects listed in paragraph (a)(2) of this section may be further divided into different engine families if the Administrator determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of the following features of each engine:

(A) The bore and stroke.

(B) The surface-to-volume ratio of the nominally dimensioned cylinder at the top dead center positions.

(C) The intake manifold induction port size and configuration.

(D) The exhaust manifold port size and configuration.

(E) The intake and exhaust valve sizes.

(F) The fuel system.

(G) The camshaft timing and ignition or injection timing characteristics.

(ii) Light-duty trucks and heavy-duty engines produced in different model years and distinguishable in the respects listed in paragraph (a)(2) of this section shall be treated as belonging to a single engine family if the Administrator requires it, after determining that the engines may be expected to have similar emission deterioration characteristics.

(4) Where engines are of a type which cannot be divided into engine families based upon the criteria listed in paragraphs (a)(2) and (a)(3) of this section, the Administrator will establish families for those engines based upon those features most related to their emission characteristics. Engines that are eligible to be included in the same engine family based on the criteria in paragraphs (a)(2) and (a)(3)(i) of this section may be further divided into different engine families if the manufacturer determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of the following features of each engine:

(i) The dimension from the center line of the crankshaft to the center line of the camshaft.

(ii) The dimension from the center line of the crankshaft to the top of the cylinder block head face.

(iii) The size of the intake and exhaust valves (or ports).

(5) Gasoline-fueled and methanol-fueled light-duty vehicles and light-duty trucks covered by an application for certification will be divided into groupings which are expected to have similar evaporative emission characteristics throughout their useful life. Each group of vehicles with similar evaporative emission characteristics shall be defined as a separate evaporative emission family.

(6) For gasoline-fueled or methanol-fueled light-duty vehicles and light-duty trucks to be classed in the same evaporative emission family, vehicles must be similar with respect to:

(i) Type of vapor storage device (*e.g.*, canister, air cleaner, crankcase).

(ii) Basic canister design.

(iii) Fuel system.

(7) Where vehicles are of a type which cannot be divided into evaporative emission families based on the criteria listed above, the Administrator will establish families for those vehicles based upon the features most related to their evaporative emission characteristics.

(8)(i) If the manufacturer elects to participate in the Alternative Durability Program, the engine families covered by an application for certification shall be grouped based upon similar engine design and emission control system characteristics. Each of these groups shall constitute a separate engine family group.

(ii) To be classed in the same engine family group, engine families must contain engines identical in all of the following respects:

(A) The combustion cycle.

(B) The cylinder block configuration (air-cooled or water-cooled; L–6, V–8, rotary, etc.).

(C) Displacement (engines of different displacement within 50 cubic inches or 15 percent of the largest displacement and contained within a multidisplacement engine family will be included in the same engine family group).

(D) Catalytic converter usage and basic type (noncatalyst, oxidation catalyst only, three-way catalyst equipped).

(9) Engine families identical in all respects listed in paragraph (a)(8) of this section may be further divided into different engine family groups if the Administrator determines that they are expected to have significantly different exhaust emission control system deterioration characteristics.

(10) A manufacturer may request the Administrator to include in an engine family group, engine families in addition to those grouped under the provisions of paragraph (a)(8) of this section. This request must be accompanied by information the manufacturer believes supports the inclusion of these additional engine families.

(11) A manufacturer may combine into a single engine family group those light-duty vehicle and light-duty truck engine families which otherwise meet the requirements of paragraphs (a)(8) through (a)(10) of this section.

(12) The vehicles covered by an application for certification equipped with gasoline-fueled or methanol-fueled

heavy-duty engines will be divided into groupings of vehicles on the basis of physical features which are expected to affect evaporative emissions. Each group of vehicles with similar features shall be defined as a separate evaporative emission family.

(13) For vehicles equipped with gasoline-fueled or methanol-fueled heavy-duty engines to be classed in the same evaporative emission family, vehicles must be identical with respect to:

(i) Method of fuel/air metering (*i.e.*, carburetion versus fuel injection).

(ii) Carburetor bowl fuel volume, within a 10 cc range.

(14) For vehicles equipped with gasoline-fueled or methanol-fueled heavy-duty engines to be classed in the same evaporative emission control system, vehicles must be identical with respect to:

(i) Method of vapor storage.

(ii) Method of carburetor sealing.

(iii) Method of air cleaner sealing.

(iv) Vapor storage working capacity, within a 20 g range.

(v) Number of storage devices.

(vi) Method of purging stored vapors.

(vii) Method of venting the carburetor during both engine off and engine operation.

(viii) Liquid fuel hose material.

(ix) Vapor storage material.

(15) Where vehicles equipped with gasoline-fueled or methanol-fueled heavy-duty engines are types which cannot be divided into evaporative emission family-control system combinations based on the criteria listed above, the Administrator will establish evaporative emission family-control system combinations for those vehicles based on features most related to their evaporative emission characteristics.

(b) *Emission data.*

(1) *Emission-data vehicles.* Paragraph (b)(1) of this section applies to light-duty vehicle and light-duty truck emission-data vehicles.

(i) Vehicles will be chosen to be operated and tested for emission data based upon engine family groupings. Within each engine family, one test vehicle will be selected based on the following criteria: The Administrator shall select the vehicle with the heaviest equivalent test weight (including options) within the family. Then within that vehicle the Administrator shall select, in the order listed, the highest road-load power, largest displacement, the transmission with the highest numerical final gear ratio (including overdrive), the highest numerical axle ratio offered in that engine family and the maximum fuel flow calibration.

(ii) The Administrator shall select one additional test vehicle from within each engine family. The vehicle selected shall be the vehicle expected to exhibit the highest emissions of those vehicles remaining in the engine family. If all vehicles within the engine family are similar the Administrator may waive the requirements of this paragraph.

(iii) Within an engine family and exhaust emission control system, the manufacturer may alter any emission-data vehicle (or other vehicles such as including current or previous model year emission-data vehicles, fuel economy data vehicles, and development vehicles provided they meet emission-data vehicles, protocol) to represent more than one selection under paragraphs (b)(1) (i), (ii), (iv), or (vii) of this section.

(iv) If the vehicles selected in accordance with paragraphs (b)(1) (i) and (ii) of this section do not represent each engine-system combination, then one vehicle of each engine-system combination not represented will be selected by the Administrator. The vehicle selected shall be the vehicle expected to exhibit the highest emissions of those vehicles remaining in the engine family.

(v) For high-altitude exhaust emission compliance for each engine family, the manufacturer shall follow one of the following procedures:

(A) The manufacturer will select for testing under high-altitude conditions the vehicle expected to exhibit the highest emissions from the nonexempt vehicles selected in accordance with § 86.090–24(b)(1) (ii), (iii), and (iv) of this section or,

(B) In lieu of testing vehicles according to paragraph (b)(1)(v)(A) of this section, a manufacturer may provide a statement in its application for certification that, based on the manufacturer's engineering evaluation of such high-altitude emission testing as the manufacturer deems appropriate,

(*1*) That all light-duty vehicles not exempt under § 86.090–8(h) comply with the emission standards at high-altitude, and

(*2*) That light-duty trucks sold for principal use at designated high-altitude locations comply with the high-altitude emission requirements, and that all light-duty trucks sold at low-altitude, which are not exempt under § 86.090–9(g)(2), are capable of being modified to meet high-altitude standards.

(vi) If 90 percent or more of the engine family sales will be in California, a manufacturer may substitute emission-data vehicles selected by the California Air Resources Board criteria for the selections specified in paragraphs (b)(1) (i), (ii), and (iv) of this section.

(vii)(A) Vehicles of each evaporative emission family will be divided into evaporative emission control systems.

(B) The Administrator will select the vehicle expected to exhibit the highest evaporative emissions, from within each evaporative family to be certified, from among the vehicles represented by the exhaust emission-data selections for the engine family, unless evaporative testing has already been completed on the vehicle expected to exhibit the highest evaporative emissions for the evaporative family as part of another engine family's testing.

(C) If the vehicles selected in accordance with paragraph (b)(1)(vii)(B) of this section do not represent each evaporative emission control system then the Administrator will select the highest expected evaporative emission vehicle from within the unrepresented evaporative system.

(viii) For high-altitude evaporative emission compliance for each evaporative emission family, the manufacturer shall follow one of the following procedures:

(A) The manufacturer will select for testing under high-altitude conditions the one nonexempt vehicle previously selected under paragraphs (b)(1)(vii) (B) or (C) of this section which is expected to have the highest level of evaporative emissions when operated at high altitude or

(B) In lieu of testing vehicles according to paragraph (b)(1)(viii)(A) of this section, a manufacturer may provide a statement in its application for certification that based on the manufacturer's engineering evaluation of such high-altitude emission testing as the manufacturer deems appropriate,

(*1*) That all light-duty vehicles not exempt under § 86.090–8(h) comply with the emission standards at high altitude and

(*2*) That light-duty trucks sold for principal use at designated high-altitude locations comply with the high-altitude emission requirements, and that all light-duty trucks sold at low altitude, which are not exempt under § 86.090–9(g)(2), are capable of being modified to meet high-altitude standards.

(ix) Vehicles selected under paragraph (b)(1)(v)(A) of this section may be used to satisfy the requirements of (b)(1)(viii)(A) of this section.

(x) *Light-duty trucks only:* (A) The manufacturer may reconfigure any of the low-altitude emission-data vehicles to represent the vehicle configuration required to be tested at high altitude.

(B) The manufacturer is not required to test the reconfigured vehicle at low altitude.

(2) *Otto-cycle heavy-duty emission-data engines.* Paragraph (b)(2) of this section applies to Otto-cycle heavy-duty engines.

(i) [Reserved]

(ii) [Reserved]

(iii) The Administrator shall select a maximum of two engines within each engine family based upon features indicating that they may have the highest emission levels of the engines in the engine family as follows:

(A) The Administrator shall select one emission-data engine first based on the largest displacement within the engine family. Then within the largest displacement the Administrator shall select, in the order listed, highest fuel flow at the speed of maximum rated torque, the engine with the most advanced spark timing, no EGR or lowest EGR flow, and no air pump or lowest actual flow air pump.

(B) The Administrator shall select one additional engine, from within each engine family. The engine selected shall be the engine expected to exhibit the highest emissions of those engines remaining in the engine family. If all engines within the engine family are similar the Administrator may waive the requirements of this paragraph.

(iv) If the engines selected in accordance with paragraphs (b)(2) (ii) and (iii) of this section do not represent each engine displacement-exhaust emission control system combination, then one engine of each engine displacement-exhaust emission control system combination not represented shall be selected by the Administrator.

(v) Within an engine family/displacement/control system, the manufacturer may alter any emission-data engine (or other engine including current or previous model year emission-data vehicles and development engines provided they meet the emission-data engines protocol) to represent more than one selection under paragraphs (b)(2)(iii) of this section.

(3) *Diesel heavy-duty emission-data engines.* Paragraph (b)(3) of this section applies to diesel heavy-duty emission-data vehicles.

(i) Engines will be chosen to be run for emission data based upon engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Engines of each engine family will be divided into groups based upon their exhaust emission control systems. One engine of each engine system combination shall be run for smoke emission data (diesel engines only) and gaseous emission data. Either the complete gaseous emission test or the complete smoke test may be conducted first. Within each combination, the engine that features the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed, will usually be selected. If there are military engines with higher fuel rates than other engines in the same engine system combinations, then one military engine shall also be selected. The engine with the highest fuel feed per stroke will usually be selected.

(iii) The Administrator may select a maximum of one additional engine within each engine-system combination based upon features indicating that it may have the highest emission levels of the engines of that combination. In selecting this engine, the Administrator will consider such features as the injection system, fuel system, compression ratio, rated speed, rated horsepower, peak torque speed, and peak torque.

(iv) Within an engine family control system combination, the manufacturer may alter any emission-data engine (or other engine including current or previous model year emission-data vehicles and development engines provided they meet the emission-data engines' protocol) to represent more than one selection under paragraphs (b)(3) (ii) and (iii) of this section.

(c) *Durability data.* (1) *Light-duty vehicle durability-data vehicles.* Paragraph (c)(1) of this section applies to light-duty vehicle durability-data vehicles.

(i) A durability-data vehicle will be selected by the Administrator to represent each engine-system combination. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with that control-system combination in that engine family and will be designated by the Administrator as to transmission type, fuel system, inertia weight class, and test weight.

(ii) A manufacturer may elect to operate and test additional vehicles to represent any engine-system combination. The additional vehicles must be of the same engine displacement, transmission type, fuel system and inertia weight class as the vehicle selected for that engine-system combination in accordance with the provisions of paragraph (c)(1)(i) of this section. Notice of an intent to operate and test additional vehicles shall be given to the Administrator no later than 30 days following notification of the test fleet selection.

(2) *Light-duty trucks.* Paragraph (c)(2) of this section applies to vehicles, engines, subsystems, or components used to establish exhaust emission deterioration factors for light-duty trucks.

(i) The manufacturer shall select the vehicles, engines, subsystems, or components to be used to determine exhaust emission deterioration factors for each engine-family control system combination. Whether vehicles, engines, subsystems, or components are used, they shall be selected so that their emissions deterioration characteristics may be expected to represent those of in-use vehicles, based on good engineering judgment.

(ii) [Reserved]

(3) *Heavy-duty engines.* Paragraph (c)(3) of this section applies to engines, subsystems, or components used to establish exhaust emission deterioration factors for heavy-duty engines.

(i) The manufacturer shall select the engines, subsystems, or components to be used to determine exhaust emission deterioration factors for each engine-family control system combination. Whether engines, subsystems, or components are used, they shall be selected so that their emissions deterioration characteristics may be expected to represent those of in-use engines, based on good engineering judgment.

(ii) [Reserved]

(d) For purposes of testing under § 86.084–26 (a)(9) or (b)(11), the Administrator may require additional emission-data vehicles (or emission-data engines) and durability-data vehicles (light-duty vehicles only) identical in all material respects to vehicles (or engines) selected in accordance with paragraphs (b) and (c) of this section, *provided* that the number of vehicles (or engines) selected shall not increase the size of either the emission-data fleet or the durability-data fleet by more than 20 percent or one vehicle (or engine), whichever is greater.

(e)(1) Any manufacturer whose projected sales for the model year in which certification is sought is less than:

(i) 2,000 Otto-cycle light-duty vehicles, or

(ii) 2,000 diesel light-duty vehicles, or

(iii) 2,000 Otto-cycle light-duty trucks, or

(iv) 2,000 diesel light-duty trucks, or

(v) 2,000 Otto-cycle heavy-duty engines, or

(vi) 2,000 diesel heavy-duty engines,

may request a reduction in the number of test vehicles (or engines) determined in accordance with the foregoing provisions of this section. The Administrator may agree to such lesser number as he determines would meet the objectives of this procedure.

(2) Any manufacturer may request to certify engine families with combined total sales of fewer than 10,000 light-duty vehicles, light-duty trucks, and heavy-duty engines utilizing assigned deterioration factors prescribed by the Administrator. The assigned deterioration factors shall be applied only to entire engine families.

(f) In lieu of testing an emission-data or durability-data vehicle (or engine) selected under paragraph (b) or (c) of this section, and submitting data therefore, a manufacturer may, with the prior written approval of the Administrator, submit exhaust emission data and/or fuel evaporative emission data, as applicable on a similar vehicle (or engine) for which certification has previously been obtained or for which all applicable data required under § 86.090–23 has previously been submitted.

(g)(1) This paragraph applies to light-duty vehicles and light-duty trucks, but does not apply to the production vehicles selected under paragraph (h) of this section.

(2)(i) Where it is expected that more than 33 percent of a carline, within an engine-system combination will be equipped with an item (whether that item is standard equipment or an option), the full estimated weight of that item shall be included in the curb weight computation for each vehicle available with that option in that carline, within that engine-system combination.

(ii) Where it is expected that 33 percent or less of the carline, within an engine-system, will be equipped with an item of (whether that item is standard equipment or an option), no weight for that item will be added in computing curb weight for any vehicle in that carline, within that engine-system combination, unless that item is standard equipment on the vehicle.

(iii) In the case of mutually exclusive options, only the weight of the heavier option will be added in computing curb weight.

(iv) Optional equipment weighing less than 3 pounds per item need not be considered.

(3)(i) Where it is expected that more than 33 percent of a carline, within an engine-system combination will be equipped with an item of (whether that item is standard equipment or an option) that can reasonably be expected to influence emissions, then such items shall actually be installed (unless excluded under paragraph (g)(3)(ii) of this section) on all emission data and durability data vehicles of that carline, within that engine-system combination, on which the items are intended to be offered in production. Items that can reasonably be expected to influence emissions are: air conditioning, power steering, power brakes and other items determined by the Administrator.

(ii) If the manufacturer determines by test data or engineering evaluation that the actual installation of the optional equipment required by paragraph (g)(3)(i) of this section does not affect the emissions or fuel economy values, the optional equipment need not be installed on the test vehicle.

(iii) The weight of the options shall be included in the design curb weight and also be represented in the weight of the test vehicles.

(iv) The engineering evaluation, including any test data, used to support the deletion of optional equipment from test vehicles, shall be maintained by the manufacturer and shall be made available to the Administrator upon request.

(4) Where it is expected that 33 percent or less of a carline, within an engine system combination will be equipped with an item of (whether that item is standard equipment or an option) that can reasonably be expected to influence emissions, that item shall not be installed on any emission data or durability data vehicles of that carline, within that engine-system combination, unless that item is standard equipment on the vehicle.

(h) Alternative Durability Program durability-data vehicles. This section applies to light-duty vehicle and light-duty truck durability-data vehicles selected under the Alternative Durability Program described in § 86.085–13.

(1) In order to update the durability data to be used to determine a deterioration factor for each engine family group, the Administrator will select durability-data vehicles from the manufacturer's production line. Production vehicles will be selected from each model year's production for those vehicles certified using the Alternative Durability Program procedures.

(i) The Administrator shall select the production durability-data vehicle designs from the designs that the manufacturer offers for sale. For each model year and for each engine family group, the Administrator may select production durability-data vehicle designs of equal number to the number of engine families within the engine family group, up to a maximum of three vehicles.

(ii) The production durability-data vehicles representing the designs selected in paragraph (h)(1)(i) of this section will be randomly selected from the manufacturer's production. The Administrator will make these random selections unless the manufacturer (with prior approval of the Administrator) elects to make the random selections.

(iii) The manufacturer may select additional production durability-data vehicle designs from within the engine family group. The production durability-data vehicles representing these designs shall be randomly selected from the manufacturer s production in accordance with paragraph (h)(l)(ii) of this section.

(iv) For each production durability-data vehicle selected under paragraph (h)(1) of this section, the manufacturer shall provide to the Administrator (before the vehicle is tested or begins service accumulation) the vehicle identification number. Before the vehicle begins service accumulation the manufacturer shall also provide the Administrator with a description of the durability-data vehicle as specified by the Administrator.

(v) In lieu of testing a production durability-data vehicle selected under paragraph (h)(1) of this section, and submitting data therefrom, a manufacturer may, with the prior written approval of the Administrator, submit exhaust emission data from a production vehicle of the same configuration for which all applicable data has previously been submitted.

(2) If, within an existing engine family group, a manufacturer requests to certify vehicles of a new design, engine family, emission control system, or with any other durability-related design difference, the Administrator will determine if the existing engine family group deterioration factor is appropriate for the new design. If the Administrator cannot make this determination or deems the deterioration factor not appropriate, the Administrator shall select preproduction durability-data vehicles under the provisions of paragraph (c) of this section. If vehicles are then certified using the new design, the Administrator may select production vehicles with the new design under the provisions of paragraph (h)(1) of this section.

(3) If a manufacturer reguests to certify vehicles of a new design that the Administrator determines are a new engine family group, the Administrator shall select preproduction durability data vehicles under the provisions of paragraph (c) of this section. If vehicles are then certified using the new design, the Administrator may select production vehicles of that design under the provisions of paragraph (h)(1) of this section.

21. Section 86.090–25 of Subpart A is amended by revising paragraphs (b)(3), (d)(1)(ii), (e) (2) and (3), and (h) to read as follows:

§ 86.090–25 Maintenance.

* * * * *

(b) * * *

(3) For Otto-cycle light-duty vehicles, light-duty trucks and heavy duty engines, emission-related maintenance in addition to, or at shorter intervals than, the following will not be accepted as technologically necessary, except as provided in paragraph (b)(7) of this section.

(i)(A) The cleaning or replacement of light-duty vehicle or light-duty truck spark plugs at 30,000 miles of use and at 30,000 mile intervals thereafter.

(B) The cleaning or replacement of Otto-cycle heavy duty engine spark plugs at 25,000 miles (or 750 hours) of use and at 25,000 mile intervals (or 750-hour) intervals thereafter, for engines certified for use with unleaded fuel only.

* * * * *

(d) * * *

(1) * * *

(ii) Readjustment of an Otto-cycle vehicle cold-start enrichment system may be performed if there is a problem of stalling.

* * * * *

(e) * * *

(2) Maintenance on light-duty truck emission-data vehicles selected under § 86.090–24(b)(1) (v) or (vii), and permitted to be tested for purposes of § 86.090–23(c)(1)(ii) under the provisions of § 86.090–24(b)(2), may be performed in conjunction with emission control system modifications at the low-mileage test point, and shall be performed in accordance with the maintenance instructions to be provided to the ultimate purchaser required under § 86.087–38.

(3) Maintenance on those light-duty truck emission-data vehicles selected under 86.090–24(b)(1)(v) which are not capable of being modified in the field for the purpose of complying with emissions standards at an altitude other than that intended by the original design, may be performed in conjunction with the emission control system modifications at the low-mileage test point, and shall be approved in advance by the Administrator.

* * * * *

(h) All test data, maintenance reports, and required engineering reports shall be compiled and provided to the Administrator in accordance with § 86.090–23.

22. A new § 86.090–26 is added to Subpart A to read as follows:

§ 86.090–26 Mileage and service accumulation; emission requirements.

(a)(1) Paragraph (a) of this section applies to light-duty vehicles.

(2) The procedure for mileage accumulation will be the Durability Driving Schedule as specified in Appendix IV to this part. A modified procedure may also be used if approved in advance by the Administrator. Except with the advance approval of the Administrator, all vehicles will accumulate mileage at a measured curb weight which is within 100 pounds of the estimated curb weight. If the loaded vehicle weight is within 100 pounds of being included in the next higher inertia weight class as specified in § 86.129, the manufacturer may elect to conduct the respective emission tests at higher loaded vehicle weight.

(3) *Emission-data vehicles.* Unless otherwise provided for in § 86.090–23(a), emission-data vehicles shall be operated and tested as follows:

(i) *Otto-cycle.* (A) The manufacturer shall determine, for engine family, the mileage at which the engine-system combination is stabilized for emission-data testing. The manufacturer shall maintain, and provide to the Administrator if requested, a record of the rationale used in making this determination. The manufacturer may elect to accumulate 4,000 miles on each test vehicle within an engine family without making a determination. Any vehicle used to represent emission-data vehicle selections under § 86.090–24(b)(1) shall be equipped with an engine and emission control system that has accumulated at least the mileage determined under this paragraph. Fuel economy data generated from certification vehicles selected in accordance with § 86.090–24(b)(1) with engine-system combinations that have accumulated more than 10,000 kilometers (6,200 miles) shall be factored in accordance with § 600.006–82(c). Complete exhaust and evaporative (if required) emission tests shall be conducted for each emission-data vehicle selection under § 86.090–24(b)(1). The Administrator may determine under § 86.090–24(f) that no testing is required.

(B) Emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1) (v) or (viii) shall be conducted at the mileage at which the engine system combination is stabilized for emission testing under high-altitude conditions.

(C) Exhaust and evaporative emissions tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1) (i), (ii), (iii), (iv), or (vii)(B) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing under low-altitude conditions.

(D) For each engine family, the manufacturer will either select one vehicle previously selected under § 86.090–24(b)(1) (i) through (iv) to be tested under high-altitude conditions or provide a statement in accordance with § 86.090–24(b)(1)(v). Vehicles shall meet emission standards under both low- and high-altitude conditions without manual adjustments or modifications. In addition, any emission control device used to conform with the emission standards under high-altitude conditions shall initially actuate (automatically) no higher than 4,000 feet above sea level.

(ii) *Diesel.* (A) The manufacturer shall determine, for each engine family, the mileage at which the engine-system combination is stabilized for emission-data testing. The manufacturer shall maintain, and provide to the Administrator if requested, a record of the rationale used in making this determination. The manufacturer may elect to accumulate 4,000 miles on each test vehicle within an engine family without making a determination. Any vehicle used to represent emission-data vehicle selections under § 86.090–24(b)(1) shall be equipped with an engine and emission control system that has accumulated at least the mileage determined under this paragraph. Fuel economy data generated from certification vehicles selected in accordance with § 86.090–24(b)(1) with engine-system combinations that have accumulated more than 10,000 kilometers (6,200 miles) shall be factored in accordance with § 600.006–82(c). Complete exhaust emission tests shall be conducted for each emission-data vehicle selection under § 86.090–24(b)(1). The Administrator may determine under § 86.090–24(f) that no testing is required.

(B) Emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1)(v) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing under low-altitude conditions.

(C) Exhaust and evaporative emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1) (i) through (iv) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing under low-altitude conditions.

(D) For each engine family, the manufacturer will either select one vehicle previously selected under § 86.090–24(b)(1) (i) through (iv) to be tested under high-altitude conditions or provide a statement in accordance with

§ 86.090–24(b)(1)(v). Vehicles shall meet emission standards under both low- and high-altitude conditions without manual adjustments or modifications. In addition, any emission control device used to conform with the emission standards under high-altitude conditions shall initially actuate (automatically) no higher than 4,000 feet above sea level.

(4)(i) *Durability data vehicles.* (A) Unless otherwise provided for in § 86.090–23(a), each durability-data vehicle shall be driven, with all emission control systems installed and operating, for 50,000 miles or such lesser distance as the Administrator may agree to as meeting the objective of this procedure.

(B) Complete exhaust emission tests shall be made at test point mileage intervals that the manufacturer determines.

(C) At a minimum, two complete exhaust emission tests shall be made. The first test shall be made at a distance not greater than 6,250 miles. The last shall be made at 50,000 miles.

(D) The mileage interval between test points must be of equal length except for the interval between zero miles and the first test, and any interval before or after testing conducted in conjunction with vehicle maintenance as specified in § 86.090–25(g)(2).

(ii) The manufacturer may, at its option, alter the durability-data vehicle at the selected test point to represent emission-data vehicle(s) within the same engine/system combination and perform emission tests on the altered vehicle. Upon completion of emission testing, the manufacturer may return the test vehicle to the durability-data vehicle configuration prior to the continuation of mileage accumulation.

(5)(i) All tests required by this subpart on emission-data vehicles shall be conducted at a mileage equal to or greater than the mileage the manufacturer determines under paragraph (a)(3) of this section.

(ii) All tests required by this subpart on durability-data vehicles shall be conducted within 250 miles of each of the test points.

(6)(i)(A) The manufacturer may conduct multiple tests at any test point at which the data are intended to be used in the deterioration factor. At each test point where multiple tests are conducted, the test results from all valid tests shall be averaged to determine the data point to be used in the deterioration factor calculation, except under paragraph (a)(6)(i)(B) of this section. The test results from emission tests performed before maintenance affecting emissions shall not be averaged with test results after the maintenance.

(B) The manufacturer is not required to average multiple tests if the manufacturer conducts no more than three tests at each test point and if the number of tests at each test point is equal. All test points must be treated the same for all exhaust pollutants.

(ii) The results of all emission testing shall be supplied to the Administrator. The manufacturer shall furnish to the Administrator explanation for voiding any test. The Administrator will determine if voiding the test was appropriate based upon the explanation given by the manufacturer for the voided test. Tests between test points may be conducted as required by the Administrator. Data from all tests (including voided tests) may be submitted weekly to the Administrator, but shall be air posted or delivered to the Administrator within 7 days after completion of the test. In addition, all test data shall be compiled and provided to the Administrator in accordance with § 86.090–23. Where the Administrator conducts a test on a durability-data vehicle at a prescribed test point, the results of that test will be used in the calculation of the deterioration factor.

(iii) The results of all emission tests shall be rounded, in accordance with ASTM E 29–67, to the number of decimal places contained in the applicable emission standard expressed to one additional significant figure.

(7) Whenever a manufacturer intends to operate and test a vehicle which may be used for emission or durability data, the manufacturer shall retain in its records all information concerning all emissions tests and maintenance, including vehicle alterations to represent other vehicle selections. For emission-data vehicles, this information shall be submitted, including the vehicle description and specification information required by the Administrator, to the Administrator following the emission-data test. For durability-data vehicles, this information shall be submitted following the 5,000-mile test.

(8) Once a manufacturer submits the information required in paragraphs (a)(7) of this section for a durability-data vehicle, the manufacturer shall continue to run the vehicle to 50,000 miles, and the data from the vehicle will be used in the calculations under § 86.090–28. Discontinuation of a durability-data vehicle shall be allowed only with the consent of the Administrator.

(9)(i) The Administrator may elect to operate and test any test vehicle during all or any part of the mileage accumulation and testing procedure. In such cases, the manufacturer shall provide the vehicle(s) to the Administrator with all information necessary to conduct this testing.

(ii) The test procedures in §§ 86.106 through 86.145 will be followed by the Administrator. The Administrator will test the vehicles at each test point. Maintenance may be performed by the manufacturer under such conditions as the Administrator may prescribe.

(iii) The data developed by the Administrator for the engine-system combination shall be combined with any applicable data supplied by the manufacturer on other vehicles of that combination to determine the applicable deterioration factors for the combination. In the case of a significant discrepancy between data developed by the Administrator and that submitted by the manufacturer, the Administrator's data shall be used in the determination of deterioration factors.

(10) Emission testing of any type with respect to any certification vehicle other than that specified in this part is not allowed except as such testing may be specifically authorized by the Administrator.

(11) This section does not apply to testing conducted to meet the requirements of § 86.090–23(b)(2).

(b)(1) Paragraph (b) of this section applies to light-duty trucks.

(2) There are three types of mileage or service accumulation applicable to light-duty trucks:

(i) Mileage or service accumulation on vehicles, engines, subsystems, or components selected by the manufacturer under § 86.090–24(c)(2)(i). The manufacturer determines the form and extent of this mileage or service accumulation, consistent with good engineering practice, and describes it in the application for certification.

(ii) Mileage accumulation of the duration selected by the manufacturer on emission-data vehicles selected under § 86.090–24(b)(1). The procedure for mileage accumulation will be the Durability Driving Schedule as specified in Appendix IV to this part. A modified procedure may also be used if approved in advance by the Administrator. Except with the advance approval of the Administrator, all vehicles will accumulate mileage at a measured curb weight which is within 100 pounds of the estimated curb weight. If the loaded vehicle weight is within 100 pounds of being included in the next higher inertia weight class as specified in § 86.129, the manufacturer may elect to conduct the respective emission tests at the test weight corresponding to the higher loaded vehicle weight.

(iii) Service or mileage accumulation which may be part of the test

procedures used by the manufacturer to establish evaporative emission deterioration factors.

(3) Exhaust emission deterioration factors will be determined on the basis of the mileage or service accumulation described in paragraph (b)(2)(i) of this section and related testing, according to the manufacturer's procedures.

(4) Each emission-data vehicle shall be operated and tested as follows:

(i) *Otto-cycle.* (A) The manufacturer shall determine, for each engine family, the mileage at which the engine-system combination is stabilized for emission-data testing. The manufacturer shall maintain, and provide to the Administrator if requested, a record of the rationale used in making this determination. The manufacturer may elect to accumulate 4,000 miles on each test vehicle within an engine family without making a determination. Any vehicle used to represent emission-data vehicle selections under § 86.090–24(b)(1) shall be equipped with an engine and emission control system that has accumulated at least the mileage determined under this paragraph. Fuel economy data generated from certification vehicles selected in accordance with § 86.090–24(b)(1) with engine-system combinations that have accumulated more than 10,000 kilometers (6,200 miles) shall be factored in accordance with § 600.006–82(c). Complete exhaust emission tests shall be conducted for each emission-data vehicle selection under § 86.090–24(b)(1). The Administrator may determine under § 86.090–24(f) that no testing is required.

(B) Emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1) (v) or (viii) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing or at 6,436 kilometers (4,000-miles) under high-altitude conditions.

(C) Exhaust and evaporative emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1) (ii), (iii), (iv)(A), or (vii)(B) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing or at the 6,436-kilometer (4,000-mile) test point under low-altitude conditions.

(D) If the manufacturer recommends adjustments or modifications in order to conform to emission standards at high altitude, such adjustments or modifications shall be made to the test vehicle selected under § 86.090–24(b)(1) (v) and (viii) (in accordance with the instructions to be provided to the ultimate purchaser) before being tested under high-altitude conditions.

(ii) *Diesel.* (A) The manufacturer shall determine, for each engine family, the mileage at which the engine-system combination is stabilized for emission-data testing. The manufacturer shall maintain, and provide to the Administrator if requested, a record of the rationale used in making this determination. The manufacturer may elect to accumulate 4,000 miles on each test vehicle within an engine family without making a determination. Any vehicle used to represent emission-data vehicle selections under § 86.090–24(b)(1) shall be equipped with an engine and emission control system that has accumulated at least the mileage determined under this paragraph. Fuel economy data generated from certification vehicles selected in accordance with § 86.090–24(b)(1) with engine-system combinations that have accumulated more than 10,000 kilometers (6,200 miles) shall be factored in accordance with § 600.006–82(c). Complete exhaust emission tests shall be conducted for each emission-data vehicle selection under § 86.090–24(b)(1). The Administrator may determine under § 86.090–24(f) that no testing is required.

(B) Emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1)(v) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing or at the 6,436-kilometer (4,000-mile) test point under low-altitude conditions.

(C) Exhaust and evaporative emission tests for emission-data vehicle(s) selected for testing under § 86.090–24(b)(1) (ii), (iii), and (iv) shall be conducted at the mileage at which the engine-system combination is stabilized for emission testing or at the 6,436-kilometer (4,000-mile) test point under low-altitude conditions.

(D) If the manufacturer recommends adjustments or modifications in order to conform to emission standards at high altitude, such adjustments or modifications shall be made to the test vehicle selected under § 86.090–24(b)(1) (v) and (viii) (in accordance with the instructions to be provided to the ultimate purchaser) before being tested under high-altitude conditions.

(iii) [Reserved]

(iv) All tests required by this subpart on emission-data vehicles shall be conducted at a mileage equal to or greater than the mileage the manufacturer determines under paragraph (b)(4) of this section.

(c)(1) Paragraph (c) of this section applies to heavy-duty engines.

(2) There are two types of service accumulation applicable to heavy-duty engines:

(i) Service accumulation on engines, subsystems, or components selected by the manufacturer under § 86.088–24(c)(3)(i). The manufacturer determines the form and extent of this service accumulation, consistent with good engineering practice, and describes it in the application for certification.

(ii) Dynamometer service accumulation on emission-data engines selected under § 86.090–24(b) (2) or (3). The manufacturer determines the engine operating schedule to be used for dynamometer service accumulation, consistent with good engineering practice. A single engine operating schedule shall be used for all engines in an engine family-control system combination. Operating schedules may be different for different combinations.

(3) Exhaust emission deterioration factors will be determined on the basis of the service accumulation described in paragraph (b)(2)(i) of this section and related testing, according to the manufacturer's procedures.

(4) The manufacturer shall determine, for each engine family, the number of hours at which the engine system combination is stabilized for emission-data testing. The manufacturer shall maintain, and provide to the Administrator if requested a record of the rationale used in making this determination. The manufacturer may elect to accumulate 125 hours on each test engine within an engine family without making a determination. Any engine used to represent emission-data engine selections under § 86.090–24(b)(2) shall be equipped with an engine system combination that has accumulated at least the number of hours determined under this paragraph. Complete exhaust emission tests shall be conducted for each emission-data engine selection under § 86.090–24(b)(2). Evaporative emission controls need not be connected provided normal operating conditions are maintained in the engine induction system. The Administrator may determine under § 86.090–24(f) that no testing is required.

(d)(1) Paragraph (d) of this section applies to both light-duty trucks and heavy-duty engines.

(2)(i) The results of all emission testing shall be supplied to the Administrator. The manufacturer shall furnish to the Administrator explanation for voiding any test. The Administrator will determine if voiding the test was appropriate based upon the explanation given by the manufacturer for the voided test. Tests between test points may be conducted as required by the Administrator. Data from all tests (including voided tests) may be

submitted weekly to the Administrator, but shall be air posted or delivered to the Administrator within 7 days after completion of the tests. In addition, all test data shall be compiled and provided to the Administrator in accordance with § 86.090–23. Where the Administrator conducts a test on a durability-data vehicle at a prescribed test point, the results of that test will be used in the calculation of the deterioration factor.

(ii) The results of all emission tests shall be recorded and reported to the Administrator. These test results shall be rounded, in accordance with ASTM E 29–67, to the number of decimal places contained in the applicable emission standard expressed to one additional significant figure.

(3) Whenever a manufacturer intends to operate and test a vehicle (or engine) which may be used for emission data, the manufacturer shall retain in its records all information concerning all emissions tests and maintenance, including vehicle (or engine) alterations to represent other vehicle (or engine) selections. This information shall be submitted, including the vehicle (or engine) description and specification information required by the Administrator, to the Administrator following the emission-data test.

(4) [Reserved]

(5) [Reserved]

(6) Emission testing of any type with respect to any certification vehicle or engine other than that specified in this subpart is not allowed except as such testing may be specifically authorized by the Administrator.

23. A new § 86.090–27 is added to Subpart A, to read as follows:

§ 86.090–27 Special test procedures.

(a) The Administrator may, on the basis of written application by a manufacturer, prescribe test procedures, other than those set forth in this part, for any light-duty vehicle, light-duty truck, heavy-duty engine, or heavy-duty vehicle which the Administrator determines is not susceptible to satisfactory testing by the procedures set forth in this part.

(b) If the manufacturer does not submit a written application for use of special test procedures but the Administrator determines that a light-duty vehicle, light-duty truck, heavy-duty engine, or heavy-duty vehicle is not susceptible to satisfactory testing by the procedures set forth in this part, the Administrator shall notify the manufacturer in writing and set forth the reasons for such rejection in accordance with the provisions of § 86.090–22(c).

24. A new § 86.090–28 is added to Subpart A, to read as follows:

§ 86.090–28 Compliance with emission standards.

(a)(1) Paragraph (a) of this section applies to light-duty vehicles.

(2) The applicable exhaust and evaporative emission standards (and family particulate emission limits, as appropriate) of this subpart apply to the emissions of vehicles for their useful life.

(3) Since it is expected that emission control efficiency will change with mileage accumulation on the vehicle, the emission level of a vehicle which has accumulated 50,000 miles will be used as the basis for determining compliance with the standards (or family particulate emission limit, as appropriate).

(4) The procedure for determining compliance of a new motor vehicle with exhaust emission standards (or family particulate emission limit, as appropriate) is as follows, except where specified by paragraph (a)(7) of this section for the Alternative Durability Program:

(i) Separate emission deterioration factors shall be determined from the exhaust emission results of the durability data vehicle(s) for each engine-system combination. A separate factor shall be established for exhaust HC, exhaust OMHCE (methanol-fueled vehicles) exhaust CO, exhaust NO_x, and exhaust particulate (diesel vehicles) for each engine-system combination. A separate evaporative emission deterioration factor shall be determined for each evaporative emission family-evaporative emission control system combination from the testing conducted by the manufacturer (gasoline-fueled and methanol-fueled vehicles only).

(A) The applicable results to be used unless excluded by paragraph (a)(4)(i)(A)(*4*) of this section in determining the exhaust emission deterioration factors for each engine-system combination shall be:

(*1*) All valid exhaust emission data from the tests required under § 86.088–26(a)(4) except the zero-mile tests. This shall include the official test results, as determined in § 86.090–29 for all tests conducted on all durability-data vehicles of the combination selected under § 86.090–24(c) (including all vehicles elected to be operated by the manufacturer under § 86.090–24(c)(1)(ii)).

(*2*) All exhaust emission data from the tests conducted before and after the scheduled maintenance provided in § 86.088–25.

(*3*) All exhaust emission data from tests required by maintenance approved under § 86.088–25, in those cases where the Administrator conditioned his approval for the performance of such maintenance on the inclusion of such data in the deterioration factor calculation.

(*4*) The manufacturer has the option of applying an outlier test point procedure to completed durability data within its certification testing program for a given model year. The outlier procedure will be specified by the Administrator. For any pollutant, durability-data test points that are identified as outliers shall not be included in the determination of deterioration factors if the manufacturer has elected this option. The manufacturer shall specify to the Administrator before the certification of the first engine family for that model year, if it intends to use the outlier procedure. The manufacturer may not change procedures after the first engine family of the model year is certified. Where the manufacturer chooses to apply both the outlier procedure and averaging (as allowed under § 86.088–26(a)(6)(*i*) to the same data set, the outlier procedure shall be completed prior to applying the averaging procedure.

(B) All applicable exhaust emission results shall be plotted as a function of the mileage on the system, rounded to the nearest mile, and the best fit straight lines, fitted by the method of least squares, shall be drawn through all these data points. The data will be acceptable for use in the calculation of the deterioration factor only if the interpolated 4,000-mile and 50,000-mile points on this line are within the low-altitude standards provided in § 86.090–8. Exceptions to this where data are still acceptable are when a best fit straight line crosses an applicable standard but no data points exceeded the standard, or the best fit straight line crosses an applicable standard with a negative slope (the 4,000-mile interpolated point is higher than the 50,000-mile interpolated point) but the 50,000-mile actual data point is below the standard A multiplicative exhaust emission deterioration factor shall be calculated for each engine-system combination as follows:

Factor = Exhaust emissions interpolated to 50,000 miles divided by exhaust emissions interpolated to 4,000 miles.

These interpolated values shall be carried out to a minimum of four places to the right of the decimal point before dividing one by the other to determine the deterioration factor. The results shall be rounded to three places to the right of the decimal point in accordance with ASTM E 29–67.

(C) An evaporative emissions deterioration factor (gasoline-fueled and

methanol-fueled vehicles only) shall be determined from the testing conducted as described in § 86.090–21(b)(4)(i), for each evaporative emission family-evaporative emission control system combination to indicate the evaporative emission level at 50,000 miles relative to the evaporative emission level at 4,000 miles as follows:

Factor = Evaporative emission level at 50,000 miles minus the evaporative emission level at 4,000 miles.

The factor shall be established to a minimum of two places to the right of the decimal.

(ii)(A) The official exhaust emission test results for each emission-data vehicle at the selected test point shall be multiplied by the appropriate deterioration factor: *Provided,* that if a deterioration factor as computed in paragraph (a)(4)(i)(B) of this section is less than one, that deterioration factor shall be one for the purposes of this paragraph.

(B) The official evaporative emission test results (gasoline-fueled and methanol-fueled vehicles only) for each evaporative emission-data vehicle at the selected test point shall be adjusted by addition of the appropriate deterioration factor: *Provided,* that if a deterioration factor as computed in paragraph (a)(4)(i)(C) of this section is less than zero, that deterioration factor shall be zero for the purposes of this paragraph.

(iii) The emissions to compare with the standard (or the family particulate emission limit, as appropriate) shall be the adjusted emissions of paragraphs (a)(4)(ii) (A) and (B) of this section for each emission-data vehicle. Before any emission value is compared with the standard (or the family particulate emission limit, as appropriate), it shall be rounded, in accordance with ASTM E 29–67, to two significant figures. The rounded emission values may not exceed the standard (or the family particulate emission limit, as appropriate).

(iv) Every test vehicle of an engine family must comply with the exhaust emission standards (or the family particulate emission limit, as appropriate), as determined in paragraph (a)(4)(iii) of this section, before any vehicle in that family may be certified.

(v) Every test vehicle of an evaporative emission family must comply with the evaporative emission standard, as determined in paragraph (a)(4)(iii) of this section, before any vehicle in that family may be certified.

(5) If a manufacturer chooses to change the level of any family particulate emission limit(s) in the particulate averaging program, compliance with the new limit(s) must be based upon existing certification data.

(6) If a manufacturer chooses to participate in the diesel particulate averaging program, the production-weighted average of the family particulate emission limits of all affected engine families must comply with the particulate standard in § 86.090–8(a)(1)(iv), or the composite particulate standard defined in § 86.088–2, as appropriate, at the end of the production year.

(7) The procedure to determine the compliance of new motor vehicles in the Alternative Durability Program (described in § 86.085–13) is the same as described in paragraphs (a)(4)(iii) through (a)(4)(v) of this section. For the engine families that are included in the Alternative Durability Program, the exhaust emission deterioration factors used to determine compliance shall be those that the Administrator has approved under § 86.085–13(c). The evaporative emission deterioration factor for each evaporative emission family shall be determined and applied according to paragraph (a)(4) of this section. The procedures to determine the minimum exhaust emissions deterioration factors required under § 86.085–13(d) are as follows:

(i) Separate deterioration factors shall be determined from the exhaust emission results of the durability-data vehicles for each engine family group. A separate factor shall be established for exhaust HC, exhaust CO, and exhaust NO_x for each engine family group. The evaporative emission deterioration factor for each evaporative family will be determined and applied in accordance with paragraph (a)(4) of this section.

(ii) The deterioration factors for each engine family group shall be determined by the Administrator using historical durability data from as many as three previous model years. These data will consist of deterioration factors generated by durability-data vehicles representing certified engine families and of deterioration factors from vehicles selected under § 86.090–24(h). The Administrator shall determine how these data will be combined for each engine family group.

(A) The test results to be used in the calculation of each deterioration factor to be combined for each engine family group shall be those test results specified in paragraph (a)(4)(i)(A) of this section.

(B) For each durability-data vehicle selected under § 86.090–24(h), all applicable exhaust emissions results shall be plotted as a function of the mileage on the system rounded to the nearest mile, and the best fit straight lines, fitted by method of least squares, shall be drawn through all these data points. The exhaust deterioration factor for each durability-data vehicle shall be calculated as specified in paragraph (a)(4)(i)(B) of this section.

(C) *Line crossing.* For the purposes of paragraph (a)(5) of this section, line crossing occurs when either of the interpolated 4,000- and 50,000-mile points of the best fit straight line exceeds the applicable emission standard and at least one applicable data point exceeds the standard.

(*1*) The Administrator will not accept for certification line-crossing data from preproduction durability-data vehicles selected under § 86.090–24(c), § 86.090–24 (h)(2), or (h)(3).

(*2*) The Administrator will not accept for certification line-crossing data from production durability-data vehicles selected under § 86.090–24(h)(1) unless the 4,000-mile test result multiplied by the engine family group deterioration factor does not exceed the applicable emission standards. The deterioration factors used for this purpose shall be those that were used in the certification of the production vehicle. Manufacturers may calculate this product immediately after the 4,000-mile test of the vehicle. If the product exceeds the applicable standards, the manufacturer may, with the approval of the Administrator, discontinue the vehicle and substitute a new vehicle. The manufacturer may continue the original vehicle, but the data will not be acceptable if line crossing occurs.

(b)(1) Paragraph (b) of this section applies to light-duty trucks.

(2) The exhaust and evaporative emission standards (and family emission limits, as appropriate) of § 86.090–9 apply to the emissions of vehicles for their useful life.

(3) Since emission control efficiency generally decreases with the accumulation of mileage on the vehicle, deterioration factors will be used in combination with emission-data vehicle test results as the basis for determining compliance with the standards (or family emission limits, as appropriate).

(4)(i) Paragraph (b)(4) of this section describes the procedure for determining compliance of a new vehicle with exhaust emission standards (or family emission limits, as appropriate), based on deterioration factors supplied by the manufacturers, except where specified by paragraph (b)(5) of this section for the Alternative Durability Program.

(ii) Separate exhaust emission deterioration factors, determined from tests of vehicles, engines, subsystems, or components conducted by the manufacturer, shall be supplied for each engine-system combination. Separate factors shall be established for transient HC, CO, and NO_x, idle CO (vehicles equipped with Otto-cycle or methanol-fueled diesel engines only), and exhaust particulate (diesel vehicles only).

(iii) For transient HC, OMHCE (methanol-fueled vehicles), CO, and NO_x, idle CO (vehicles equipped with Otto-cycle or methanol-fueled diesel engines only), and exhaust particulate (diesel vehicles), the official exhaust emission results for each emission-data vehicle at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph.

(iv) The emission values to compare with the standards (or family emission limits, as appropriate) shall be the adjusted emission values of paragraph (b)(4)(iii) of this section, rounded to the same number of significant figures as contained in the applicable standard in accordance with ASTM E 29–67, for each emission-data engine.

(5)(i) Paragraph (b)(5)(i) of this section applies only to manufacturers electing to participate in the particulate averaging program.

(A) If a manufacturer chooses to change the level of any family particulate emission limit(s), compliance with the new limit(s) must be based upon existing certification data.

(B) The production-weighted average of the family particulate emission limits of all applicable engine families, rounded to two significant figures in accordance with ASTM E 29–67, must comply with the particulate standards in § 86.090–9(a)(1)(iv) or (d)(1)(iv), or the composite particulate standard defined in § 86.085–2, as appropriate, at the end of the product year.

(ii) Paragraph (b)(5)(ii) of this section applies only to manufacturers electing to participate in the NO_x averaging program.

(A) If a manufacturer chooses to change the level of any family NO_x emission limit(s), compliance with the new limit(s) must be based upon existing certification data.

(B) The production-weighted average of the family NO_x emission limits of all applicable engine families, rounded to two significant figures in accordance with ASTM E 29–67, must comply with the NO_x emission standards of § 86.090–9(a)(1)(iii) (A) or (B), or of § 86.090–9(d)(1)(iii) (A) or (B), or the composite NO_x standard as defined in § 86.088–2, at the end of the product year.

(6) The procedure to determine the compliance of new motor vehicles in the Alternative Durability Program (described in § 86.085–13) is the same as described in paragraphs (b)(4)(iv), (b)(7)(iv) and (b)(8) of this section. For the engine families that are included in the Alternative Durability Program, the exhaust emission deterioration factors used to determine compliance shall be those that the Administrator has approved under § 86.085–13(c). The evaporative emission deterioration factor for each evaporative emission family shall be determined and applied according to paragraph (b)(7) of this section. The procedures to determine the minimum exhaust emissions deterioration factors required under § 86.085–13(d) are as follows:

(i) Separate deterioration factors shall be determined from the exhaust emission results of the durability-data vehicles for each engine family group. A separate factor shall be established for exhaust HC, exhaust CO, and exhaust NO_x for each engine family group. The evaporative emission deterioration factor for each evaporative family will be determined and applied in accordance with paragraph (b)(6) of this section.

(ii) The deterioration factors for each engine family group shall be determined by the Administrator using historical durability data from as many as three previous model years. These data will consist of deterioration factors generated by durability-data vehicles representing certified engine families and of deterioration factors from vehicles selected under § 86.090–24(h). The Administrator shall determine how these data will be combined for each engine family group.

(A) The test results to be used in the calculations of each deterioration factor to be combined for each engine family group shall be those test results specified in paragraph (a)(4)(i)(A) of this section.

(B) For each durability-data vehicle selected under § 86.090–24(h), all applicable exhaust emission results shall be plotted as a function of the mileage on the system rounded to the nearest mile, and the best fit straight lines, fitted by the method of least squares, shall be drawn through all these data points. The exhaust deterioration factor for each durability-data vehicle shall be calculated as specified in paragraph (a)(4)(i)(B) of this section.

(C) *Line crossing.* For the purposes of paragraph (b)(5) of this section, line crossing occurs when either of the interpolated 4,000- and 120,000-mile points of the best fit straight line exceeds the applicable emission standard and at least one applicable data point exceeds the standard.

(*1*) The Administrator will not accept for certification line-crossing data from preproduction durability-data vehicles selected under § 86.090–24(c)(1), or § 86.090–24 (h)(2) or (h)(3).

(*2*) The Administrator will not accept for certification line-crossing data from production durability-data vehicles selected under § 86.090–24(h)(1) unless the 4,000-mile test result multiplied by the engine family group deterioration factor does not exceed the applicable emission standard. The deterioration factors used for this purpose shall be those that were used in the certification of the production vehicle. Manufacturers may calculate this product immediately after the 4,000-mile test of the vehicle. If the product exceeds the applicable standard, the manufacturer may, with the approval of the Administrator, discontinue the vehicle and substitute a new vehicle. The manufacturer may continue the original vehicle, but the data will not be acceptable if line crossing occurs.

(7)(i) Paragraph (b)(7) of this section describes the procedure for determining compliance of a new vehicle with fuel evaporative emission standards. The procedure described here shall be used for all vehicles in all model years.

(ii) The manufacturer shall determine, based on testing described in § 86.090–21(b)(4)(i), and supply an evaporative emission deterioration factor for each evaporative emission family-evaporative emission control system combination. The factor shall be calculated by subtracting the emission level at the selected test point from the emission level at the useful life point.

(iii) The official evaporative emission test results for each evaporative emission-data vehicle at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(iv) The emission value to compare with the standards shall be the adjusted emission value of paragraph (b)(7)(iii) of this section rounded to two significant figures in accordance with ASTM E 29–67 for each evaporative emission-data vehicle.

(8) Every test vehicle of an engine family must comply with all applicable standards (and family emission limits, as appropriate), as determined in

paragraphs (b)(4)(iv) and (b)(7)(iv) of this section, before any vehicle in that family will be certified.

(c)(1) Paragraph (c) of this section applies to heavy-duty engines.

(2) The exhaust emission standards for Otto cycle engines in § 86.090–10 or for diesel engines in § 86.090–11 apply to the emissions of engines for their useful life.

(3) Since emission control efficiency generally decreases with the accumulation of service on the engine, deterioration factors will be used in combination with emission-data engine test results as the basis for determining compliance with the standards.

(4)(i) Paragraph (c)(4) of this section describes the procedure for determining compliance of an engine with emission standards (or family emission limits, as appropriate), based on deterioration factors supplied by the manufacturer.

(ii) Separate exhaust emission deterioration factors, determined from tests of engines, subsystems, or components conducted by the manufacturer, shall be supplied for each engine-system combination. For Otto-cycle engines, separate factors shall be established for transient HC (OMHCE for methanol-fueled vehicles), CO, and NO_x; and idle CO, for those engines utilizing aftertreatment technology (*e.g.*, catalytic converters). For diesel engines, separate factors shall be established for transient HC (OMHCE for methanol-fueled engines), CO, NO_x, and exhaust particulate. For diesel smoke testing, separate factors shall also be established for the acceleration mode (designated as "A"), the lugging mode (designated as "B"), and peak opacity (designated as "C").

(iii)(A) Paragraph (c)(4)(iii)(A) of this section applies to Otto-cycle heavy-duty engines.

(*1*) *Otto-cycle heavy-duty engines not utilizing aftertreatment technology (e.g., catalytic converters).* For transient HC (OMHCE), CO, and NO_x, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(*2*) *Otto-cycle heavy-duty engines utilizing aftertreatment technology (e.g., catalytic converters).* For transient HC (OMHCE), CO, and NO_x, and for idle CO, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph.

(B) Paragraph (c)(4)(iii)(B) of this section applies to diesel heavy-duty engines.

(*1*) *Diesel heavy-duty engines not utilizing aftertreatment technology (e.g., particulate traps).* For transient HC (OMHCE), CO, NO_x, and exhaust particulate, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(*2*) *Diesel heavy-duty engines utilizing aftertreatment technology (e.g., particulate traps).* For transient HC (OMHCE), CO, NO_x, and exhaust particulate, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph.

(*3*) Diesel heavy duty engines only. For acceleration smoke ("A"), lugging smoke ("B"), and peak smoke ("C"), the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(iv) The emission values to compare with the standards (or family emission limits, as appropriate) shall be the adjusted emission values of paragraph (c)(4)(iii) of this section, rounded to the same number of significant figures as contained in the applicable standard in accordance with ASTM E 29 67, for each emission data engine.

(5) [Reserved].

(6) [Reserved].

(7) Every test engine of an engine family must comply with all applicable standards (or family emission limits, as appropriate), as determined in paragraph (c)(4)(iv) of this section, before any engine in that family will be certified.

(d)(1) Paragraph (d) of this section applies to heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines.

(2) The applicable evaporative emission standard in § 86.090–10 or § 86.090–11 applies to the emissions of vehicles for their useful life.

(3)(i) For vehicles with a GVWR of up to 26,000 pounds, because it is expected that emission control efficiency will change during the useful life of the vehicle, an evaporative emission deterioration factor shall be determined from the testing described in § 86.090–23(b)(3) for each evaporative emission family-evaporative emission control system combination to indicate the evaporative emission control system deterioration during the useful life of the vehicle (minimum 50,000 miles). The factor shall be established to a minimum of two places to the right of the decimal.

(ii) For vehicles with a GVWR of greater than 26,000 pounds, because it is expected that emission control efficiency will change during the useful life of the vehicle, each manufacturer's statement as required in § 86.090–23(b)(4)(ii) shall include, in accordance with good engineering practice, consideration of control system deterioration.

(4) The evaporative emission test results, if any, shall be adjusted by the addition of the appropriate deterioration factor: *Provided,* that if the deterioration factor as computed in paragraph (d)(3) of this section is less than zero, that deterioration factor shall be zero for the purposes of this paragraph.

(5) The emission level to compare with the standard shall be the adjusted emission level of paragraph (d)(4) of this section. Before any emission value is compared with the standard, it shall be rounded, in accordance with ASTM E 29–67, to two significant figures. The rounded emission values may not exceed the standard.

(6) Every test vehicle of an evaporative emission family must comply with the evaporative emission standard, as determined in paragraph (d)(5) of this section, before any vehicle in that family may be certified.

25. Section 86.091–28 is amended by revising paragraphs (a)(4)(i) introductory text, (a)(4)(i)(C), (a)(4)(ii)(B), (b)(2), (b)(3), (b)(4), (b)(8), (c)(2), (c)(4), (c)(7), (d)(1), and (d)(2), to read as follows:

§ 86.091–28 Compliance with emission standards.

(a) * * *

(4) * * *

(i) Separate emission deterioration factors shall be determined from the exhaust emission results of the durability-data vehicle(s) for each engine-system combination. A separate factor shall be established for exhaust HC, exhaust OMHCE (methanol-fueled vehicles) exhaust CO, exhaust NO_x, and exhaust particulate (diesel vehicles) for each engine-system combination. A

separate evaporative emission deterioration factor shall be determined for each evaporative emission family-evaporative emission control system combination from the testing conducted by the manufacturer (gasoline-fueled and methanol-fueled vehicles only).

* * * * *

(C) An evaporative emissions deterioration factor (gasoline-fueled and methanol-fueled vehicles only) shall be determined from the testing conducted as described in § 86.090–21(b)(4)(i), for each evaporative emission family-evaporative emission control system combination to indicate the evaporative emission level at 50,000 miles relative to the evaporative emission level at 4,000 miles as follows:

Factor = Evaporative emission level at 50,000 miles minus the evaporative emission level at 4,000 miles.

The factor shall be established to a minimum of two places to the right of the decimal.

(ii) * * *

(B) The official evaporative emission test results (gasoline-fueled and methanol-fueled vehicles only) for each evaporative emission-data vehicle at the selected test point shall be adjusted by addition of the appropriate deterioration factor: *Provided,* that if a deterioration factor as computed in paragraph (a)(4)(i)(C) of this section is less than zero, that deterioration factor shall be zero for the purposes of this paragraph.

* * * * *

(b) * * *

(2) The exhaust and evaporative emission standards (and family emission limits, as appropriate) of § 86.091–9 apply to the emissions of vehicles for their useful life.

(3) Since emission control efficiency generally decreases with the accumulation of mileage on the vehicle, deterioration factors will be used in combination with emission-data vehicle test results as the basis for determining compliance with the standards (or family emission limits, as appropriate).

(4)(i) Paragraph (b)(4) of this section describes the procedure for determining compliance of a new vehicle with exhaust emission standards (or family emission limits, as appropriate), based on deterioration factors supplied by the manufacturers, except where specified by paragraph (b)(5) of this section for the Alternative Durability Program.

(ii) Separate exhaust emission deterioration factors, determined from tests of vehicles, engines, subsystems, or components conducted by the manufacturer, shall be supplied for each engine-system combination. Separate factors shall be established for transient HC (OMHCE for methanol-fuel), CO, and NO_x, idle CO (vehicles equipped with Otto-cycle or methanol-fueled diesel engines only), and exhaust particulate (diesel vehicles only).

(iii) For transient HC (OMHCE for methanol-fuel), CO, and NO_x, idle CO (vehicles equipped with Otto-cycle or methanol-fueled diesel engines only), and exhaust particulate (diesel vehicles), the official exhaust emission results for each emission-data vehicle at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph.

(iv) The emission values to compare with the standards (or family emission limits, as appropriate) shall be the adjusted emission values of paragraph (b)(4)(iii) of this section rounded to two significant figures in accordance with ASTM E 29–67 for each emission-data engine.

* * * * *

(8) Every test vehicle of an engine family must comply with all applicable standards (and family emission limits, as appropriate), as determined in paragraphs (b)(4)(iv) and (b)(7)(iv) of this section, before any vehicle in that family will be certified.

(c) * * *

* * * * *

(2) The exhaust emission standards (or family emission limits, as appropriate) for Otto-cycle engines in § 86.090–10 or for diesel engines in § 86.091–11 apply to the emissions of engines for their useful life.

* * * * *

(4)(i) Paragraph (c)(4) of this section describes the procedure for determining compliance of an engine with emission standards (or family emission limits, as appropriate), based on deterioration factors supplied by the manufacturer.

(ii) Separate exhaust emission deterioration factors, determined from tests of engines, subsystems, or components conducted by the manufacturer, shall be supplied for each engine-system combination. For Otto-cycle engines, separate factors shall be established for transient HC (OMHCE), CO, and NO_x; and idle CO, for those engines utilizing aftertreatment technology (*e.g.,* catalytic converters). For diesel engines, separate factors shall be established for transient HC (OMHCE), CO, NO_x, and exhaust particulate. For diesel smoke testing, separate factors shall also be established for the acceleration mode (designated as "A"), the lugging mode (designated as "B"), and peak opacity (designated as "C").

(iii)(A) Paragraph (c)(4)(iii)(A) of this section applies to Otto-cycle heavy-duty engines.

(*1*) *Otto-cycle heavy-duty engines not utilizing aftertreatment technology (e.g., catalytic converters).* For transient HC (OMHCE), CO, and NO_x, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(*2*) *Otto-cycle heavy-duty engines utilizing aftertreatment technology (e.g., catalytic converters).* For transient HC (OMHCE), CO, and NO_x, and for idle CO, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph.

(B) Paragraph (c)(4)(iii)(B) of this section applies to diesel heavy-duty engines.

(*1*) *Diesel heavy-duty engines not utilizing aftertreatment technology (e.g., particulate traps).* For transient HC (OMHCE), CO, NO_x, and exhaust particulate, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph.

(*2*) *Diesel heavy-duty engines utilizing aftertreatment technology (e.g., particulate traps).* For transient HC (OMHCE), CO, NO_x, and exhaust particulate, the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph.

(*3*) *Diesel heavy-duty engines only.* For acceleration smoke ("A"), lugging smoke ("B"), and peak smoke ("C"), the official exhaust emission results for each emission-data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is less than zero, it shall

be zero for the purposes of this paragraph.

(iv) The emission values to compare with the standards (or family emission limits, as appropriate) shall be the adjusted emission values of paragraph (c)(4)(iii) of this section, rounded to the same number of significant figures as contained in the applicable standard in accordance with ASTM E 29–67, for each emission-data engine.

* * * * *

(7) Every test engine of an engine family must comply with all applicable standards (or family emission limits, as appropriate), as determined in paragraph (c)(4)(iv) of this section, before any engine in that family will be certified.

(d)(1) Paragraph (d) of this section applies to heavy-duty vehicles equipped with gasoline-fueled or methanol-fueled engines.

(2) The applicable evaporative emission standard in § 86.091–10 or § 86.091–11 applies to the emissions of vehicles for their useful life.

* * * * *

26. A new § 86.090–29 is added to Subpart A, to read as follows:

§ 86.090–29 Testing by the Administrator.

(a)(1) Paragraph (a) of this section applies to light-duty vehicles and light-duty trucks.

(2) The Administrator may require that any one or more of the test vehicles be submitted to him, at such place or places as he may designate, for the purposes of conducting emissions tests. The Administrator may specify that he will conduct such testing at the manufacturer's facility, in which case instrumentation and equipment specified by the Administrator shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(3)(i) Whenever the Administrator conducts a test on a test vehicle, the results of that test shall, unless subsequently invalidated by the Administrator, comprise the official data for the vehicle at the prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards (or family emission limits, as appropriate).

(ii) Whenever the Administrator does not conduct a test on a test vehicle at a test point, the manufacturer's test data will be accepted as the official data for that point: *Provided*, that if the Administrator makes a determination based on testing under paragraph (a)(2) of this section, that there is a lack of correlation between the manufacturer's test equipment and the test equipment used by the Administrator, no manufacturer's test data will be accepted for purposes of certification until the reasons for the lack of correlation are determined and the validity of the data is established by the manufacturer, and *further provided*, that if the Administrator has reasonable basis to believe that any test data submitted by the manufacturer is not accurate or has been obtained in violation of any provisions of this part, the Administrator may refuse to accept that data as the official data pending retesting or submission of further information. If the manufacturer conducts more than one test on a vehicle, as authorized under § 86.088–26 (a)(3)(i)(A) or (b)(4)(i)(A), the data from the last test in that series of tests on that vehicle will constitute the official data.

(iii)(A)(*1*) The Administrator may adjust or cause to be adjusted any adjustable parameter of an emission data vehicle or engine which the Administrator has determined to be subject to adjustment for certification and Selective Enforcement Audit testing in accordance with § 86.090–22(e)(1), to any setting within the physically adjustable range of that parameter, as determined by the Administrator in accordance with § 86.090–22(e)(3)(i) prior to the performance of any tests to determine whether such vehicle or engine conforms to applicable emission standards, including tests performed by the manufacturer under § 86.090–23(c)(1). However, if the idle speed parameter is one which the Administrator has determined to be subject to adjustment, the Administrator shall not adjust it to a setting which causes a higher engine idle speed than would have been possible within the physically adjustable range of the idle speed parameter on the engine before it accumulated any dynamometer service, all other parameters being identically adjusted for the purpose of the comparison. The Administrator, in making or specifying such adjustments, will consider the effect of the deviation from the manufacturer's recommended setting on emissions performance characteristics as well as the likelihood that similar settings will occur on in-use light-duty vehicles or light-duty trucks. In determining likelihood, the Administrator will consider factors such as, but not limited to, the effect of the adjustment on vehicle performance characteristics and surveillance information from similar in-use vehicles.

(*2*) For those vehicles or engine parameters which the Administrator has not determined to be subject to adjustment during certification and Selective Enforcement Audit testing in accordance with § 86.090–22(e)(1), the emission-data vehicle presented to the Administrator for testing shall be calibrated within the production tolerances applicable to the manufacturer's specifications to be shown on the vehicle label (see § 86.090–35 (a)(1)(iii)(D) or (a)(2)(iii)(D)) as specified in the application for certification. If the Administrator determines that a vehicle is not within such tolerances, the vehicle will be adjusted, at the facility designated by the Administrator, prior to the test and an engineering report shall be submitted to the Administrator describing the corrective action taken. Based on the engineering report, the Administrator will determine if the vehicle will be used as an emission-data vehicle.

(B) If the Administrator determines that the test data developed on an emission-data vehicle under paragraph (a)(3)(i) of this section would cause that vehicle to fail due to excessive 4,000-mile emissions or by application of the appropriate deterioration factor, then the following procedure shall be observed:

(*1*) The manufacturer may request a retest. Before the retest, those vehicle or engine parameters which the Administrator has not determined to be subject to adjustment for certification and Selective Enforcement Audit testing in accordance with § 86.090–22(e)(1) may be readjusted to manufacturer's specification, if these adjustments were made incorrectly prior to the first test. The Administrator may adjust or cause to be adjusted any parameter which the Administrator has determined to be subject to adjustment to any setting within the physically adjustable range of that parameter, as determined by the Administrator in accordance with § 86.090–22(e)(3)(i). Other maintenance or repairs may be performed in accordance with § 86.088–25. All work on the vehicle shall be done at such location and under such conditions as the Administrator may prescribe.

(*2*) The vehicle will be retested by the Administrator and the results of this test shall comprise the official data for the emission-data vehicle.

(iv) If sufficient durability data are not available at the time of any emission test conducted under paragraph (a)(2) of this section to enable the Administrator to determine whether an emission-data vehicle would fail, the manufacturer may request a retest in accordance with the provisions of paragraphs (a)(3)(iii)(A) and (B) of this section. If the

manufacturer does not promptly make such request, he shall be deemed to have waived the right to a retest. A request for retest must be made before the manufacturer removes the vehicle from the test premises.

(b)(1) Paragraph (b) of this section applies to heavy-duty engines.

(2) The Administrator may require that any one or more of the test engines be submitted to him, at such place or places as he may designate, for the purpose of conducting emissions tests. The Administrator may specify that he will conduct such testing at the manufacturers facility, in which case instrumentation and equipment specified by the Administrator shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(3)(i) Whenever the Administrator conducts a test on a test engine the results of that test, unless subsequently invalidated by the Administrator, shall comprise the official data for the engine at that prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards (or family emission limits, as appropriate).

(ii) Whenever the Administrator does not conduct a test on a test engine at a test point, the manufacturer's test data will be accepted as the official data for that test point: *Provided,* that if the Administrator makes a determination based on testing under paragraph (b)(2) of this section, that there is a lack of correlation between the manufacturer's test equipment and the test equipment used by the Administrator, no manufacturer's test data will be accepted for purposes of certification until the reasons for the lack of correlation are determined and the validity of the data is established by the manufacturer, *and further provided,* that if the Administrator has reasonable basis to believe that any test data submitted by the manufacturer is not accurate or has been obtained in violation of any provision of this part, the Administrator may refuse to accept that data as the official data pending retesting or submission of further information.

(iii)(A)(*1*) The Administrator may adjust or cause to be adjusted any adjustable parameter of an emission-data engine which the Administrator has determined to be subject to adjustment for certification testing in accordance with § 86.090–22(e)(1), to any setting within the physically adjustable range of that parameter, as determined by the Administrator in accordance with § 86.090–22(e)(3)(i), prior to the performance of any tests to determine whether such engine conforms to applicable emission standards, including tests performed by the manufacturer under § 86.090–23(c)(2). The Administrator, in making or specifying such adjustments, may consider the effect of the deviation from the manufacturer's recommended setting on emissions performance characteristics as well as the likelihood that similar settings will occur on in-use heavy-duty engines. In determining likelihood, the Administrator may consider factors such as, but not limited to, the effect of the adjustment on engine performance characteristics and surveillance information from similar in-use engines.

(*2*) For those engine parameters which the Administrator has not determined to be subject to adjustment for certification testing in accordance with § 86.090–22(e)(1), the emission-data engine presented to the Administrator for testing shall be calibrated within the production tolerances applicable to the manufacturer specifications to be shown on the engine label (see § 86.090–35(a)(3)(iii)) as specified in the application for certification. If the Administrator determines that an engine is not within such tolerances, the engine shall be adjusted at the facility designated by the Administrator prior to the test and an engineering report shall be submitted to the Administrator describing the corrective action taken. Based on the engineering report, the Administrator will determine if the engine shall be used as an emission-data engine.

(B) If the Administrator determines that the test data developed under paragraph (b)(3)(iii)(A) of this section would cause the emission-data engine to fail due to excessive 125-hour emission values or by the application of the appropriate deterioration factor, then the following procedure shall be observed:

(*1*) The manufacturer may request a retest. Before the retest, those engine parameters which the Administrator has not determined to be subject to adjustment for certification testing in accordance with § 86.090–22(e)(1) may be readjusted to the manufacturer's specifications, if these adjustments were made incorrectly prior to the first test. The Administrator may adjust or cause to be adjusted any parameter which the Administrator has determined to be subject to adjustment in accordance with § 86.090–22(e)(3)(i). However, if the idle speed parameter is one which the Administrator has determined to be subject to adjustment, the Administrator shall not adjust it to a setting which causes a higher engine idle speed than would have been possible within the physically adjustable range of the idle speed parameter on the engine before if accumulated any dynamometer service, all other parameters being identically adjusted for the purpose of the comparison. Other maintenance or repairs may be performed in accordance with § 86.088–25. All work on the vehicle shall be done at such location and under such conditions as the Administrator may prescribe.

(*2*) The engine will be retested by the Administrator and the results of this test shall comprise the official data for the emission-data engine.

(iv) If sufficient durability data are not available at the time of any emission test conducted under paragraph (b)(2) of this section to enable the Administrator to determine whether an emission-data engine would fail, the manufacturer may request a retest in accordance with the provisions of paragraph (b)(3)(iii)(B) (*1*) and (*2*) of this section. If the manufacturer does not promptly make such request, he shall be deemed to have waived the right to a retest. A request for retest must be made before the manufacturer removes the engine from the test premises.

(c)(1) Paragraph (c) of this section applies to gasoline-fueled and methanol-fueled heavy-duty vehicles.

(2) The Administrator may require that any one or more of the evaporative emission family-system combinations included in the manufacturer's statement(s) of compliance be installed on an appropriate vehicle and such vehicle be submitted to him, at such place or places as he may designate, for the purpose of conducting emissions tests. The Administrator may specify that he will conduct such testing at the manufacturer's facility, in which case instrumentation and equipment specified by the Administrator shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(3)(i) Whenever the Administrator conducts a test on an evaporative emission family-system combination the results of that test, unless subsequently invalidated by the Administrator, shall comprise the official data for the evaporative emission family-system combination and the manufacturer's data, analyses, etc., shall not be used in determining compliance with emission standards.

(ii) Whenever the Administrator does not conduct a test on an evaporative emission family-system combination, the manufacturer's test data will be accepted as the official data: *Provided*, that if the Administrator makes a determination, based on testing under paragraph (c)(2) of this section, that there is a lack of correlation between the manufacturer's test equipment and the test equipment used by the Administrator, no manufacturer's test data will be accepted for purposes of certification until the reasons for the lack of correlation are determined and the validity of the data is established by the manufacturer, *and further provided*, that if the Administrator has reasonable basis to believe that any test data, analyses, or other information submitted by the manufacturer is not accurate or has been obtained in violation of any provision of this part, the Administrator may refuse to accept those data, analyses, etc., as the official data pending retesting or submission of further information.

27. Section 86.091–29 of Subpart A is amended by revising paragraphs (a)(3)(i), (b)(3)(i), and (c)(1), to read as follows:

§ 86.091–29 Testing by the Administrator.

(a) * * *

(3)(i) Whenever the Administrator conducts a test on a test vehicle, the results of that test shall, unless subsequently invalidated by the Administrator, ccmprise the official data for the vehicle at the prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards (or family emission limits, as appropriate).

* * * * *

(b) * * *

(3)(i) Whenever the Administrator conducts a test on a test engine the results of that test, unless subsequently invalidated by the Administrator, shall comprise the official data for the engine at that prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards (or family emission limits, as appropriate).

* * * * *

(c)(1) Paragraph (c) of this section applies to gasoline-fueled and methanol-fueled heavy-duty vehicles.

* * * * *

28. A new section 86.090–30 is added to Subpart A, to read as follows:

§ 86.090–30 Certification.

(a)(1)(i) If, after a review of the test reports and data submitted by the manufacturer, data derived from any inspection carried out under § 86.078–7(c), and any other pertinent data or information, the Administrator determines that a test vehicle(s) (or test engine(s)) meet(s) the requirements of the Act and of this subpart, he will issue a certificate of conformity with respect to such vehicle(s) (or engine(s)) except in cases covered by paragraphs (a)(1)(ii) and (c) of this section.

(ii) Gasoline-fueled and methanol-fueled heavy-duty vehicles. If, after a review of the statement(s) of compliance submitted by the manufacturer under § 86.090–23(b)(4) and any other pertinent data or information, the Administrator determines that the requirements of the Act and this subpart have been met, he will issue one certificate of conformity per manufacturer with respect to the evaporative emission family(s) covered by such statement(s) except in cases covered by paragraph (c) of this section.

(2) Such certificate will be issued for such period not to exceed one model year as the Administrator may determine and upon such terms as he may deem necessary or appropriate to assure that any new motor vehicle (or new motor vehicle engine) covered by the certificate will meet the requirements of the Act and of this part.

(3)(i) One such certificate will be issued for each engine family. For gasoline-fueled and methanol-fueled light-duty vehicles and light-duty trucks, one such certificate will be issued for each engine family evaporative emission family combination.

(A) *Light-duty vehicles.* Each certificate will certify compliance with no more than one set of standards (or family emission limits, as appropriate).

(B) *Light-duty trucks.* Each certificate will certify compliance with no more than one set of standards (or family emission limits, as appropriate), except for low-altitude standards and high-altitude standards. The certificate shall state that it covers vehicles sold or delivered to an ultimate purchaser for principal use at a designated high-altitude location only if the vehicle conforms in all material respects to the design specifications that apply to those vehicles described in the application for certification at high altitude.

(ii) For gasoline-fueled and methanol-fueled heavy-duty vehicles, one such certificate will be issued for each manufacturer and will certify compliance for those vehicles previously identified in that manufacturer's statement(s) of compliance as required in § 86.090–23(b)(4) (i) and (ii).

(iii) For diesel light-duty vehicles and light-duty trucks included in the particulate averaging program, the manufacturer may at any time during production elect to change the level of any family particulate emission limit by demonstrating compliance with the new limit as described in §§ 86.090–28(a)(6) and 86.090–28(b)(5)(i). New certificates issued under this paragraph will be applicable only for vehicles produced subsequent to the date of issuance.

(iv) For light-duty trucks included in the NO_x averaging program, the manufacturer may at any time during production elect to change the level of any family NO_x emission limit by demonstrating compliance with the new limit as described in § 86.090–28(b)(5)(ii). New certificates issued under this paragraph will be applicable only for vehicles produced subsequent to the day of issue.

(4)(i) The adjustment or modification of any light-duty truck in accordance with instructions provided by the manufacturer for the altitude where the vehicle is principally used will not be considered a violation of section 203(a)(3) of the Clean Air Act.

(ii) A violation of section 203(a)(1) of the Clean Air Act occurs when a manufacturer sells or delivers to an ultimate purchaser any light-duty vehicle or light-duty truck, subject to the regulations under the Act, under any of the conditions specified in the remainder of this paragraph.

(A) When a light-duty vehicle or light-duty truck is not configured to meet high-altitude requirements:

(*1*) At a designated high-altitude location, unless such manufacturer has reason to believe that such vehicle will not be sold to an ultimate purchaser for principal use at a designated high-altitude location; or

(*2*) At a location other than a designated high-altitude location, when such manufacturer has reason to believe that such motor vehicle will be sold to an ultimate purchaser for principal use at a designated high-altitude location.

(B) When a light-duty vehicle is not configured to meet low-altitude requirements, as provided in § 86.087–8(i):

(*1*) At a designated low-altitude location, unless such manufacturer has reason to believe that such vehicle will not be sold to an ultimate purchaser for principal use at a designated low-altitude location; or

(*2*) At a location other than a designated low-altitude location, when such manufacturer has reason to believe

that such motor vehicle will be sold to an ultimate purchaser for principal use at a designated low-altitude location.

(iii) A manufacturer shall be deemed to have reason to believe that a light-duty vehicle that has been exempted from compliance with emission standards at high altitude, or a light-duty truck which is not configured to meet high-altitude requirements, will not be sold to an ultimate purchaser for principal use at a designated high-altitude location if the manufacturer has informed its dealers and field representatives about the terms of these high-altitude regulations, has not caused the improper sale itself, and has taken reasonable action which shall include, but not be limited to, either paragraph (a)(4)(iii) (A) or (B), and (a)(4)(iii)(C) of this section:

(A) Requiring dealers in designated high-altitude locations to submit written statements to the manufacturer signed by the ultimate purchaser that a vehicle which is not configured to meet high-altitude requirements will not be used principally at a designated high-altitude location; requiring dealers in counties contiguous to designated high-altitude locations to submit written statements to the manufacturer, signed by the ultimate purchaser who represents to the dealer in the normal course of business that he or she resides in a designated high-altitude location, that a vehicle which is not configured to meet high-altitude requirements will not be used principally at a designated high-altitude location; and for each sale or delivery of fleets of ten or more such vehicles in a high-altitude location or in counties contiguous to high-altitude locations, requiring either the selling dealer or the delivering dealer to submit written statements to the manufacturer, signed by the ultimate purchaser who represents to the dealer in the normal course of business that he or she resides in a designated high-altitude location, that a vehicle which is not configured to meet high-altitude requirements will not be used principally at a designated high-altitude location. In addition, the manufacturer will make available to EPA, upon reasonable written request (but not more frequently than quarterly, unless EPA has demonstrated that it has substantial reason to believe that an improperly configured vehicle has been sold), sales, warranty, or other information pertaining to sales of vehicles by the dealers described above maintained by the manufacturer in the normal course of business relating to the altitude configuration of vehicles and the locations of ultimate purchasers; or

(B) Implementing a system which monitors factory orders of low-altitude vehicles by high-altitude dealers, or through other means, identifies dealers that may have sold or delivered a vehicle not configured to meet the high-altitude requirements to an ultimate purchaser for principal use at a designated high-altitude location; and making such information available to EPA upon reasonable written request (but not more frequently than quarterly, unless EPA has demonstrated that it has substantial reason to believe that an improperly configured vehicle has been sold); and

(C) Within a reasonable time after receiving written notice from EPA or a state or local government agency that a dealer may have improperly sold or delivered a vehicle not configured to meet the high-altitude requirements to an ultimate purchaser residing in a designated high-altitude location, or based on information obtained pursuant to paragraph (a)(4)(iii) of this section that a dealer may have improperly sold or delivered a significant number of such vehicles to ultimate purchasers so residing, reminding the dealer in writing of the requirements of these regulations, and, where appropriate, warning the dealer that sale by the dealer of vehicles not configured to meet high-altitude requirements may be contrary to the terms of its franchise agreement with the manufacturer and the dealer certification requirements of § 85.2108 of this chapter.

(iv) A manufacturer shall be deemed to have reason to believe that a light-duty vehicle which has been exempted from compliance with emission standards at low-altitude, as provided in § 86.090 8(i), will not be sold to an ultimate purchaser for principal use at a designated low-altitude location if the manufacturer has informed its dealers and field representatives about the terms of these high-altitude regulations, has not caused the improper sale itself, and has taken reasonable action which shall include, but not be limited to, either paragraph (a)(4)(iv) (A) or (B), and (a)(4)(iv)(C) of this section:

(A) Requiring dealers in designated low-altitude locations to submit written statements to the manufacturer signed by the ultimate purchaser that a vehicle which is not configured to met low-altitude requirements will not be used principally at a designated low-altitude location; requiring dealers in counties contiguous to designated low-altitude locations to submit written statements to the manufacturer, signed by the ultimate purchaser who represents to the dealer in the normal course of business that he or she resides in a designated low-altitude location, that a vehicle which is not configured to meet low-altitude requirements will not be used principally at a designated low-altitude location; and for each sale or delivery of fleets of ten or more such vehicles in a low-altitude location or in counties contiguous to low-altitude locations, requiring either the selling dealer or the delivering dealer to submit written statements to the manufacturer, signed by the ultimate purchaser who represents to the dealer in the normal course of business that he or she resides in a designated low-altitude location, that a vehicle which is not configured to meet low-altitude requirements will not be used principally at a designated low-altitude location. In addition, the manufacturer will make available to EPA, upon reasonable written request (but not more frequently than quarterly, unless EPA has demonstrated that it has substantial reason to believe that an improperly configured vehicle has been sold), sales, warranty, or other information pertaining to sales of vehicles by the dealers described above maintained by the manufacturer in the normal course of business relating to the altitude configuration of vehicles and the locations of ultimate purchasers; or

(B) Implementing a system which monitors factory orders of high-altitude vehicles by low-altitude dealers, or through other means, identifies dealers that may have sold or delivered a vehicle not configured to meet the low-altitude requirements to an ultimate purchaser for principal use at a designated low-altitude location; and making such information available to EPA upon reasonable written request (but not more frequently than quarterly, unless EPA has demonstrated that it has substantial reason to believe that an improperly configured vehicle has been sold); and

(C) Within a reasonable time after receiving written notice from EPA or a state or local government agency that a dealer may have improperly sold or delivered a vehicle not configured to meet the low-altitude requirements to an ultimate purchaser residing in a designated low-altitude location, or based on information obtained pursuant to paragraph (a)(4)(iv) of this section that a dealer may have improperly sold or delivered a significant number of such vehicles to ultimate purchasers so residing, reminding the dealer in writing of the requirements of these regulations, and where appropriate, warning the dealer that sale by the dealer of vehicles not configured to meet low-altitude requirements may be contrary to the

terms of its franchise agreement with the manufacturer and the dealer certification requirements of § 85.2108 of this chapter.

(5)(i) For the purpose of paragraph (a) of this section, a "designated high-altitude location" is any county which has substantially all of its area located above 1,219 meters (4,000 feet) and:

(A) Requested an extension past the attainment date of December 31, 1982, for compliance with either the National Ambient Air Quality Standards for carbon monoxide or ozone, as indicated in Part 52 (Approval and Promulgation of Implementation Plans) of this title; or

(B) Is the same state as a county designated as a high-altitude location according to paragraph (a)(5)(i)(A) of this section.

(ii) The designated high-altitude locations defined in paragraph (a)(5)(i) of this section are listed below:

State of Colorado

Adams	Kit Carson
Alamosa	Lake
Arapahoe	La Plata
Archuleta	Larimer
Boulder	Las Animas
Chaffee	Lincoln
Cheyenne	Mesa
Clear Creek	Mineral
Conejos	Moffat
Costilla	Montezuma
Crowley	Montrose
Custer	Morgan
Delta	Otero
Denver	Ouray
Dolores	Park
Douglas	Pitkin
Eagle	Pueblo
Elbert	Rio Blanco
El Paso	Rio Grande
Fremont	Routt
Garfield	Saguache
Gilpin	San Juan
Grand	San Miguel
Gunnison	Summit
Hinsdale	Teller
Huerfano	Washington
Jackson	Weld
Jefferson	

State of Nevada

Carson City	Lyon
Douglas	Mineral
Elko	Nye
Esmeralda	Pershing
Eureka	Storey
Humboldt	Washoe
Lander	White Pine
Lincoln	

State of New Mexico

Bernalillo	McKinley
Catron	Santa Fe
Colfax	Otero
Curry	Rio Arriba
Sandoval	Roosevelt
De Baca	Sandoval
Grant	San Juan
Mora	San Miguel
Guadalupe	Sierra
Harding	Socorro
Hidalgo	Taos
Lincoln	Torrance
Los Alamos	Union
Luna	Valencia

State of Utah

Beaver	Morgan
Box Elder	Piute
Cache	Rich
Carbon	Salt Lake
Daggett	San Juan
Davis	Sanpete
Duchesne	Sevier
Emery	Summit
Garfield	Tooele
Grand	Uintah
Iron	Utah
Juab	Wasatch
Kane	Wayne
Millard	Weber

(iii) For the purpose of paragraph (a) of this section, a "designated low-altitude location" is any county which has substantially all of its area located below 1,219 meters (4,000 feet).

(iv) The designated low-altitude locations so defined include all counties in the United States which are not listed in either paragraph (a)(5)(ii) of this section or in the list below:

State of Arizona

Apache	Navajo
Cochise	Yavapai
Coconino	

State of Idaho

Bannock	Franklin
Bear Lake	Fremont
Bingham	Jefferson
Blaine	Lemhi
Bonneville	Madison
Butte	Minidoka
Camas	Oneida
Caribou	Power
Cassia	Teton
Clark	Valley
Custer	

State of Montana

Beaverhead	Meagher
Deer Lodge	Park
Gallatin	Powell
Jefferson	Silver Bow
Judith Basin	Wheatland
Madison	

State of Nebraska

Banner	Kimball
Cheyenne	Sioux

State of Oregon

Harney	Lake
Klamath	

State of Texas

Jeff Davis	Parmer
Hudspeth	

State of Wyoming

Albany	Natrona
Campbell	Niobrara
Carbon	Park
Converse	Platte
Fremont	Sublette
Goshen	Sweetwater
Hot Springs	Teton
Johnson	Uinta
Laramie	Washakie
Lincoln	Weston

(6) Catalyst-equipped vehicles, otherwise covered by a certificate, which are driven outside the United States, Canada, and Mexico will be presumed to have been operated on leaded gasoline resulting in deactivation of the catalysts. If these vehicles are imported or offered for importation without retrofit of the catalyst, they will be considered not to be within the coverage of the certificate unless included in a catalyst control program operated by a manufacturer or a United States Government agency and approved by the Administrator.

(7) For incomplete light-duty trucks, a certificate covers only those new motor vehicles which, when completed by having the primary load-carrying device or container attached, conform to the maximum curb weight and frontal area limitations described in the application for certification as required in § 86.090–21(d).

(8) For heavy-duty engines, a certificate covers only those new motor vehicle engines installed in heavy-duty vehicles which conform to the minimum gross vehicle weight rating, curb weight, or frontal area limitations for heavy-duty vehicles described in § 86.082–2.

(9) For incomplete gasoline-fueled and methanol-fueled heavy-duty vehicles a certificate covers only those new motor vehicles which, when completed, conform to the nominal maximum fuel tank capacity limitations as described in the application for certification as required in § 86.090–21(e).

(10) For diesel light-duty vehicles and diesel light-duty truck families which are included in a particulate averaging program, the manufacturer's production-weighted average of the particulate emission limits of all engine families in a participating class or classes shall not exceed the applicable diesel particulate standard, or the composite particulate standard defined in § 86.090–2, as appropriate, at the end of the model year, as determined in accordance with 40 CFR Part 86. The certificate shall be void *ab initio* for those vehicles causing any exceedance of the particulate standard.

(11) For light-duty truck families which are included in the NO_x averaging program, the manufacturer's production weighted average of the NO_x emission limits of all such engine families shall not exceed the applicable light-duty truck NO_x standard, or the composite NO_x standard defined in § 86.088–2, as appropriate, at the end of the model year, as determined in accordance with 40 CFR Part 86. The certificate shall be void *ab initio* for those vehicles causing any exceedance of the NO_x standard.

(b)(1) The Administrator will determine whether a vehicle (or engine) covered by the application complies

with applicable standards (or family emission limits, as appropriate) by observing the following relationships:

(i) *Light-duty vehicles.* (A) The durability-data vehicle(s) selected under § 86.090–24(c)(1)(i) shall represent all vehicles of the same engine-system combination.

(B) The emission-data vehicle(s) selected under § 86.090–24(b)(1) (ii) through (iv) shall represent all vehicles of the same engine-system combination as applicable.

(C) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(vii) (A) and (B) shall represent all vehicles of the same evaporative control system within the evaporative family.

(ii) *Light-duty trucks.* (A) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(ii), shall represent all vehicles of the same engine-system combination as applicable.

(B) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(vii) (A) and (B) shall represent all vehicles of the same evaporative control system within the evaporative family.

(C) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(v) shall represent all vehicles of the same engine-system combination as applicable.

(D) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(viii) shall represent all vehicles of the same evaporative control system within the evaporative emission family, as applicable.

(iii) *Heavy duty engines.* (A) An Otto-cycle emission-data test engine selected under § 86.090–24(b)(2)(iv) shall represent all engines in the same family of the same engine displacement-exhaust emission control system combination.

(B) An Otto-cycle emission-data test engine selected under § 86.090–24(b)(2)(iii) shall represent all engines in the same engine family of the same engine displacement-exhaust emission control system combination.

(C) A diesel emission-data test engine selected under § 86.090–24(b)(3)(ii) shall represent all engines in the same engine system combination.

(D) A diesel emission-data test engine selected under § 86.090–24(b)(3)(iii) shall represent all engines of that emission control system at the rated fuel delivery of the test engine.

(iv) *Gasoline-fueled and methanol-fueled heavy-duty vehicles.* A statement of compliance submitted under § 86.090–23(b)(4) (i) or (ii) shall represent all vehicles in the same evaporative emission family-evaporative emission control system combination.

(2) The Administrator will proceed as in paragraph (a) of this section with respect to the vehicles (or engines) belonging to an engine family or engine combination (as applicable), all of which comply with all applicable standards (or family emission limits, as appropriate).

(3) If, after a review of the test reports and data submitted by the manufacturer, data derived from any additional testing conducted pursuant to § 86.090–29, data or information derived from any inspection carried out under § 86.078–7(c) or any other pertinent data or information, the Administrator determines that one or more test vehicles (or test engines) of the certification test fleet do not meet applicable standards (or family emission limits, as appropriate), he will notify the manufacturer in writing, setting forth the basis for his determination. Within 30 days following receipt of the notification, the manufacturer may request a hearing on the Administrator's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Administrator's determination and data in support of such objections. If, after a review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 86.078–6 with respect to such issue.

(4) For light-duty vehicles and light-duty trucks the manufacturer may, at its option, proceed with any of the following alternatives with respect to an emission-data vehicle determined not in compliance with all applicable standards (or family emission limits, as appropriate) for which it was tested:

(i) Request a hearing under § 86.078–6; or

(ii) Remove the vehicle configuration (or evaporative vehicle configuration as applicable) which failed, from his application;

(A) If the failed vehicle was tested for compliance with exhaust emission standards (or family emission limits, as appropriate) only: The Administrator may select, in place of the failed vehicle, in accordance with the selection criteria employed in selecting the failed vehicle, a new emission-data vehicle to be tested for exhaust emission compliance only.

(B) If the failed vehicle was tested for compliance with both exhaust and evaporative emission standards: The Administrator may select, in place of the failed vehicle, in accordance with the selection criteria employed in selecting the failed vehicle, a new emission-data vehicle which will be tested for compliance with both exhaust and evaporative emission standards. If one vehicle cannot be selected in accordance with the selection criteria employed in selecting the failed vehicle, then two vehicles may be selected (*i.e.*, one vehicle to satisfy the exhaust emission vehicle selection criteria and one vehicle to satisfy the evaporative emission vehicle selection criteria). The vehicle selected to satisfy the exhaust emission vehicle selection criteria will be tested for compliance with exhaust emission standards only. The vehicle selected to satisfy the evaporative emission vehicle selection criteria will be tested for compliance with both exhaust and evaporative emission standards; or

(iii) Remove the vehicle configuration (or evaporative vehicle configuration, as applicable) which failed from the application and add a vehicle configuration(s) (or evaporative vehicle configuration(s), as applicable) not previously listed. The Administrator may require, if applicable, that the failed vehicle be modified to the new engine code (or evaporative emission code, as applicable) and demonstrate by testing that it meets applicable standards (or family emission limits, as appropriate) for which it was originally tested. In addition, the Administrator may select, in accordance with the vehicle selection criteria given in § 86.090–24(b), a new emission-data vehicle or vehicles. The vehicles selected to satisfy the exhaust emission vehicle selection criteria will be tested for compliance with exhaust emission standards (or family emission limits, as appropriate) only. The vehicles selected to satisfy the evaporative emission vehicle selection criteria will be tested for compliance with both exhaust and evaporative emission standards (or family emission limits, as appropriate); or

(iv) Correct a component or system malfunction and show that with a correctly functioning system or component the failed vehicle meets applicable standards (or family emission limits, as appropriate) for which it was originally tested. The Administrator may require a new emission-data vehicle, of identical vehicle configuration (or evaporative vehicle configuration, as applicable) to the failed vehicle, to be operated and tested for compliance with the applicable standards (or family emission limits, as appropriate) for which the failed vehicle was originally tested.

(5) For heavy-duty engines the manufacturer may, at his option, proceed with any of the following alternatives with respect to any engine

family represented by a test engine(s) determined not in compliance with applicable standards:

(i) Request a hearing under § 86.078–6; or

(ii) Delete from the application for certification the engines represented by the failing test engine. (Engines so deleted may be included in a later request for certification under § 86.079–32.) The Administrator may then select in place of each failing engine an alternative engine chosen in accordance with selection criteria employed in selecting the engine that failed; or

(iii) Modify the test engine and demonstrate by testing that it meets applicable standards. Another engine which is in all material respects the same as the first engine, as modified, may then be operated and tested in accordance with applicable test procedures.

(6) If the manufacturer does not request a hearing or present the required data under paragraph (b)(4) or (b)(5) of this section (as applicable), the Administrator will deny certification.

(c)(1) Notwithstanding the fact that any certification vehicle(s) (or certification engine(s)) may comply with other provisions of this subpart, the Administrator may withhold or deny the issuance of a certificate of conformity (or suspend or revoke any such certificate which has been issued) with respect to any such vehicle(s) or engine(s)) if:

(i) The manufacturer submits false or incomplete information in his application for certification thereof;

(ii) The manufacturer renders inaccurate any test data which he submits pertaining thereto or otherwise circumvents the intent of the Act, or of this part with respect to such vehicle (or engine);

(iii) Any EPA Enforcement Officer is denied access on the terms specified in § 86.078–7(c) to any facility or portion thereof which contains any of the following:

(A) The vehicle (or engine);

(B) Any components used or considered for use in its modification or buildup into a certification vehicle (or certification engine);

(C) Any production vehicle (or production engine) which is or will be claimed by the manufacturer to be covered by the certificate;

(D) Any step in the construction of a vehicle (or engine) described in paragraph (c)(iii)(C) of this section;

(E) Any records, documents, reports, or histories required by this part to be kept concerning any of the above;

(iv) Any EPA Enforcement Officer is denied "reasonable assistance" (as defined in § 86.078–7(c)) in examining any of the items listed in paragraph (c)(1)(iii) of this section.

(2) The sanctions of withholding, denying, revoking, or suspending of a certificate may be imposed for the reasons in paragraph (c)(1) (i), (ii), (iii), or (iv) of this section only when the infraction is substantial.

(3) In any case in which a manufacturer knowingly submits false or inaccurate information or knowingly renders inaccurate or invalid any test data or commits any other fraudulent acts and such acts contribute substantially to the Administrator's decision to issue a certificate of conformity, the Administrator may deem such certificate void *ab initio*.

(4) In any case in which certification of a vehicle (or engine) is proposed to be withheld, denied, revoked, or suspended under paragraph (c)(1) (iii) or (iv) of this section, and in which the Administrator has presented to the manufacturer involved, reasonable evidence that a violation of § 86.078–7(c) in fact occurred, the manufacturer, if he wishes to contend that, even though the violation occurred, the vehicle (or engine) in question was not involved in the violation to a degree that would warrant withholding, denial, revocation, or suspension of certification under either paragraph (c)(1) (iii) or (iv) of this section, shall have the burden of establishing that contention to the satisfaction of the Administrator.

(5) Any revocation or suspension of certification under paragraph (c)(1) of this section shall:

(i) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.078–6 hereof.

(ii) Extend no further than to forbid the introduction into commerce of vehicles (or engines) previously covered by the certification which are still in the hands of the manufacturer, except in cases of such fraud or other misconduct as makes the certification invalid *ab initio*.

(6) The manufacturer may request in the form and manner specified in paragraph (b)(3) of this section that any determination made by the Administrator under paragraph (c)(1) of this section to withhold or deny certification be reviewed in a hearing conducted in accordance with § 86.078–6. If the Administrator finds, after a review of the request and supporting data, that the request raises a substantial factual issue, he will grant the request with respect to such issue.

(d)(1) *For light duty vehicles.* Notwithstanding the fact that any vehicle configuration or engine family may be covered by a valid outstanding certificate of conformity, the Administrator may suspend such outstanding certificate of conformity in whole or in part with respect to such vehicle configuration or engine family if:

(i) The manufacturer refuses to comply with the provisions of a test order issued by the Administrator pursuant to § 86.603; or

(ii) The manufacturer refuses to comply with any of the requirements of § 86.603; or

(iii) The manufacturer submits false or incomplete information in any report or information provided pursuant to the requirements of § 86.609; or

(iv) The manufacturer renders inaccurate any test data which he submits pursuant to § 86.609; or

(v) Any EPA Enforcement Officer is denied the opportunity to conduct activities related to entry and access as authorized in § 86.606 of this part and in a warrant or court order presented to the manufacturer or the party in charge of a facility in question; or

(vi) EPA Enforcement Officers are unable to conduct activities related to entry and access or to obtain "reasonable assistance" as authorized in § 86.606 of this part because a manufacturer has located its facility in a foreign jurisdiction where local law prohibits those activities; or

(vii) The manufacturer refuses to or in fact does not comply with § 86.604(a), 86.605, 86.607, 86.608, or 86.610.

(2) The sanction of suspending a certificate may not be imposed for the reasons in paragraph (d)(1) (i), (ii), or (vii) of this section where the refusal is caused by conditions and circumstances outside the control of the manufacturer which render it impossible to comply with those requirements.

(3) The sanction of suspending a certificate may be imposed for the reasons in paragraph (d)(1) (iii), (iv), or (v) of this section only when the infraction is substantial.

(4) In any case in which a manufacturer knowingly submitted false or inaccurate information or knowingly rendered inaccurate any test data or committed any other fraudulent acts, and such acts contributed substantially to the Administrator's original decision not to suspend or revoke a certificate of conformity in whole or in part, the Administrator may deem such certificate void from the date of such fraudulent act.

(5) In any case in which certification of a vehicle is proposed to be suspended under paragraph (d)(1)(v) of this section and in which the Administrator has

presented to the manufacturer involved reasonable evidence that a violation of § 86.606 in fact occurred, if the manufacturer wishes to content that, although the violation occurred, the vehicle configuration or engine family in question was not involved in the violation to a degree that would warrant suspension of certification under paragraph (d)(1)(v) of this section, the manufacturer shall have the burden of establishing the contention to the satisfaction of the Administrator.

(6) Any suspension of certification under paragraph (d)(1) of this section shall:

(i) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.614; and

(ii) Not apply to vehicles no longer in the hands of the manufacturer.

(7) Any voiding of a certificate of conformity under paragraph (d)(4) of this section will be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.614.

(e) *For light-duty trucks and heavy-duty engines.* (1) Notwithstanding the fact that any vehicle configuration or engine family may be covered by a valid outstanding certificate of conformity, the Administrator may suspend such outstanding certificate of conformity in whole or in part with respect to such vehicle or engine configuration or engine family if:

(i) The manufacturer refuses to comply with the provisions of a test order issued by the Administrator pursuant to § 86.1003; or

(ii) The manufacturer refuses to comply with any of the requirements of § 86.1003; or

(iii) The manufacturer submits false or incomplete information in any report or information provided pursuant to the requirements of § 86.1009; or

(iv) The manufacturer renders inaccurate any test data submitted pursuant to § 86.1009; or

(v) Any EPA Enforcement Officer is denied the opportunity to conduct activities related to entry and access as authorized in § 86.1006 of this part and in a warrant or court order presented to the manufacturer or the party in charge of a facility in question; or

(vi) EPA Enforcement Officers are unable to conduct activities related to entry and access as authorized in § 86.1006 of this part because a manufacturer has located a facility in a foreign jurisdiction where local law prohibits those activities; or

(vii) The manufacturer refuses to or in fact does not comply with the requirements of §§ 86.1004(a), 86.1005, 86.1007, 86.1008, 86.1010, 86.1011, or 86.1013.

(2) The sanction of suspending a certificate may not be imposed for the reasons in paragraphs (e)(1) (i), (ii), or (vii) of this section where such refusal or denial is caused by conditions and circumstances outside the control of the manufacturer which renders it impossible to comply with those requirements. Such conditions and circumstances shall include, but are not limited to, any uncontrollable factors which result in the temporary unavailability of equipment and personnel needed to conduct the required tests, such as equipment breakdown or failure or illness of personnel, but shall not include failure of the manufacturers to adequately plan for and provide the equipment and personnel needed to conduct tests. The manufacturer will bear the burden of establishing the presence of the conditions and circumstances required by this paragraph.

(3) The sanction of suspending a certificate may be imposed for the reasons outlined in paragraph (e)(1) (iii), (iv), or (v) of this section only when the infraction is substantial.

(4) In any case in which a manufacturer knowingly submitted false or inaccurate information or knowingly rendered inaccurate any test data or committed any other fraudulent acts, and such acts contributed substantially to the Administrator's original decision not to suspend or revoke a certificate of conformity in whole or in part, the Administrator may deem such certificate void from the date of such fraudulent act.

(5) In any case in which certification of a light-duty truck or heavy-duty engine is proposed to be suspended under paragraph (e)(1)(v) of this section and in which the Administrator has presented to the manufacturer involved reasonable evidence that a violation of § 86.1006 in fact occurred, if the manufacturer wishes to contend that, although the violation occurred, the vehicle or engine configuration or engine family in question was not involved in the violation to a degree that would warrant suspension of certification under paragraph (e)(1)(v) of this section, he shall have the burden of establishing that contention to the satisfaction of the Administrator.

(6) Any suspension of certification under paragraph (e)(1) of this section shall:

(i) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.1014, and

(ii) Not apply to vehicles or engines no longer in the hands of the manufacturer.

(7) Any voiding of a certificate of conformity under paragraph (e)(4) of this section shall be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.1014.

29. Section 86.091–30 of Subpart A is amended by revising paragraphs (a)(1)(ii), (a)(3)(i), (a)(3)(ii), (a)(9), (b)(1), (b)(3), (b)(4) introductory text, (b)(4)(ii)(A), (b)(4)(iii), (b)(4)(iv), (d)(1) through (d)(6) and adding (d)(7) to read as follows:

§ 86.091–30 Certification.

(a) * * *

(1) * * *

(ii) *Gasoline-fueled and methanol-fueled heavy-duty vehicles.* If, after a review of the statement(s) of compliance submitted by the manufacturer under § 86.091–23(b)(4) and any other pertinent data or information, the Administrator determines that the requirements of the Act and this subpart have been met, he will issue one certificate of conformity per manufacturer with respect to the evaporative emission family(s) covered by such statement(s) except in cases covered by paragraph (c) of this section.

* * * * *

(3)(i) One such certificate will be issued for each engine family. For gasoline-fueled and methanol fueled light-duty vehicles and light-duty trucks, one such certificate will be issued for each engine family evaporative emission family combination.

(A) Light-duty vehicles. Each certificate will certify compliance with no more than one set of standards (or family emission limits, as appropriate).

(B) Light-duty trucks. Each certificate will certify compliance with no more than one set of standards (or family emission limits, as appropriate), except for low-altitude standards and high altitude standards. The certificate shall state that it covers vehicles sold or delivered to an ultimate purchaser for principal use at a designated high-altitude location only if the vehicle conforms in all material respects to the design specifications that apply to those vehicles described in the application for certification at high altitude.

(ii) For gasoline-fueled and methanol fueled heavy- duty vehicles, one such certificate will be issued for each manufacturer and will certify compliance for those vehicles previously identified in that manufacturer's

statement(s) of compliance as required in § 86.091–23(b)(4) (i) and (ii).

* * * * *

(9) For incomplete gasoline-fueled and methanol-fueled heavy-duty vehicles a certificate covers only those new motor vehicles which, when completed, conform to the nominal maximum fuel tank capacity limitations as described in the application for certification as required in § 86.091–21(e).

* * * * *

(b)(1) The Administrator will determine whether a vehicle (or engine) covered by the application complies with applicable standards (or family emission limits, as appropriate) by observing the following relationships:

(i) Light-duty vehicles. (A) The durability data vehicle(s) selected under § 86.090–24(c)(1)(i) shall represent all vehicles of the same engine system combination.

(B) The emission data vehicle(s) selected under § 86.090–24(b)(1) (ii) through (iv) shall represent all vehicles of the same engine-system combination as applicable.

(C) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(vii) (A) and (B) shall represent all vehicles of the same evaporative control system within the evaporative family.

(ii) *Light-duty trucks.* (A) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(ii), shall represent all vehicles of the same engine-system combination as applicable.

(B) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(vii) (A) and (B) shall represent all vehicles of the same evaporative control system within the evaporative family.

(C) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(v) shall represent all vehicles of the same engine-system combination as applicable.

(D) The emission-data vehicle(s) selected under § 86.090–24(b)(1)(viii) shall represent all vehicles of the same evaporative control system within the evaporative emission family, as applicable.

(iii) Heavy-duty engines. (A) An Otto-cycle emission-data test engine selected under § 86.090–24(b)(2)(iv) shall represent all engines in the same family of the same engine displacement-exhaust emission control system combination.

(B) An Otto-cycle emission-data test engine selected under § 86.090–24(b)(2)(iii) shall represent all engines in the same engine family of the same engine displacement-exhaust emission control system combination.

(C) A diesel emission data test engine selected under § 86.090–24(b)(3)(ii) shall represent all engines in the same engine-system combination.

(D) A diesel emission-data test engine selected under § 86.090–24(b)(3)(iii) shall represent all engines of that emission control system at the rated fuel delivery of the test engine.

(iv) Gasoline-fueled and methanol-fueled heavy-duty vehicles. A statement of compliance submitted under § 86.091–23(b)(4) (i) or (ii) shall represent all vehicles in the same evaporative emission family-evaporative emission control system combination.

* * * * *

(3) If, after a review of the test reports and data submitted by the manufacturer, data derived from any additional testing conducted pursuant to § 86.091–29, data or information derived from any inspection carried out under § 86.078–7(c) or any other pertinent data or information, the Administrator determines that one or more test vehicles (or test engines) of the certification test fleet do not meet applicable standards (or family emission limits, as appropriate), he will notify the manufacturer in writing, setting forth the basis for his determination. Within 30 days following receipt of the notification, the manufacturer may request a hearing on the Administrator's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Administrator's determination and data in support of such objections. If, after a review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 86.078–6 with respect to such issue.

(4) For light-duty vehicles and light-duty trucks the manufacturer may, at its option, proceed with any of the following alternatives with respect to an emission-data vehicle determined not in compliance with all applicable standards (or family emission limits, as appropriate) for which it was tested:

* * * * *

(ii) * * *

(A) If the failed vehicle was tested for compliance with exhaust emission standards (or family emission limits, as appropriate) only: The Administrator may select, in place of the failed vehicle, in accordance with the selection criteria employed in selecting the failed vehicle, a new emission-data vehicle to be tested for exhaust emission compliance only.

* * * * *

(iii) Remove the vehicle configuration (or evaporative vehicle configuration, as applicable) which failed from the application and add a vehicle configuration(s) (or evaporative vehicle configuration(s), as applicable) not previously listed. The Administrator may require, if applicable, that the failed vehicle be modified to the new engine code (or evaporative emission code, as applicable) and demonstrate by testing that it meets applicable standards (or family emission limits, as appropriate) for which it was originally tested. In addition, the Administrator may select, in accordance with the vehicle selection criteria given in § 86.090–24(b), a new emission-data vehicle or vehicles. The vehicles selected to satisfy the exhaust emission vehicle selection criteria will be tested for compliance with exhaust emission standards (or family emission limits, as appropriate) only. The vehicles selected to satisfy the evaporative emission vehicle selection criteria will be tested for compliance with both exhaust and evaporative emission standards (or family emission limits, as appropriate); or

(iv) Correct a component or system malfunction and show that with a correctly functioning system or component the failed vehicle meets applicable standards (or family emission limits, as appropriate) for which it was originally tested. The Administrator may require a new emission-data vehicle, of identical vehicle configuration (or evaporative vehicle configuration, as applicable) to the failed vehicle, to be operated and tested for compliance with the applicable standards (or family emission limits, as appropriate) for which the failed vehicle was originally tested.

* * * * *

(d) * * *

(1) * * *

(v) Any EPA Enforcement Officer is denied the opportunity to conduct activities related to entry and access as authorized in § 86.606 of this part and in a warrant or court order presented to the manufacturer or the party in charge of a facility in question; or

(vi) EPA Enforcement Officers are unable to conduct activities related to entry and access or to obtain "reasonable assistance" as authorized in § 86.606 of this part because a manufacturer has located its facility in a foreign jurisdiction where local law prohibits those activities; or

(vii) The manufacturer refuses to or in fact does not comply with §§ 86.604(a), 86.605, 86.607, 86.608, or 86.610.

(2) The sanction of suspending a certificate may not be imposed for the

reasons in paragraph (d)(1)(i), (ii), or (vii) of this section where the refusal is caused by conditions and circumstances outside the control of the manufacturer which render it impossible to comply with those requirements.

(3) The sanction of suspending a certificate may be imposed for the reasons in paragraph (d)(1)(iii), (iv), or (v) of this section only when the infraction is substantial.

* * * * *

(5) In any case in which certification of a vehicle is proposed to be suspended under paragraph (d)(1)(v) of this section and in which the Administrator has presented to the manufacturer involved reasonable evidence that a violation of § 86.606 in fact occurred, if the manufacturer wishes to contend that, although the violation occurred, the vehicle configuration or engine family in question was not involved in the violation to a degree that would warrant suspension of certification under paragraph (d)(1)(v) of this section, the manufacturer shall have the burden of establishing the contention to the satisfaction of the Administrator.

(6) * * *

(i) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.614; and

* * * * *

(7) Any voiding of a certificate of conformity under paragraph (d)(4) of this section will be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.614.

* * * * *

30. A new § 86.090–35 is added to Subpart A, to read as follows:

§ 86.090–35 Labeling.

(a) The manufacturer of any motor vehicle (or motor vehicle engine) subject to the applicable emission standards (and family emission limits, as appropriate) of this subpart, shall, at the time of manufacture, affix a permanent legible label, of the type and in the manner described below, containing the information hereinafter provided, to all production models of such vehicles (or engines) available for sale to the public and covered by a certificate of conformity under § 86.090–30(a).

(1) Light-duty vehicles. (i) A permanent, legible label shall be affixed in a readily visible position in the engine compartment.

(ii) The label shall be affixed by the vehicle manufacturer who has been issued the certificate of conformity for such vehicle in such a manner that it cannot be removed without destroying or defacing the label. The label shall not be affixed to any equipment which is easily detached from such vehicle.

(iii) The label shall contain the following information lettered in the English language in block letters and numerals, which shall be of a color that contrasts with the background of the label:

(A) The label heading: Vehicles Emission Control Information;

(B) Full corporate name and trademark of manufacturer;

(C) Engine displacement (in cubic inches), engine family identification and evaporative family identification;

(D) Engine tune-up specifications and adjustments, as recommended by the manufacturer in accordance with the applicable emission standards (or family emission limits, as appropriate), including but not limited to idle speed(s), ignition timing, the idle air-fuel mixture setting procedure and value (*e.g.*, idle CO, idle air-fuel ratio, idle speed drop), high idle speed, initial injection timing, and valve lash (as applicable), as well as other parameters deemed necessary by the manufacturer. These specifications should indicate the proper transmission position during tune-up and what accessories (*e.g.*, air conditioner), if any, should be in operation;

(E) An unconditional statement of compliance with the appropriate model year U.S. Environmental Protection Agency regulations which apply to light duty vehicles;

(F) For vehicles which are part of the diesel particulate averaging program, the family particulate emission limit to which the vehicle is certified;

(G) For vehicles that have been exempted from compliance with the emission standard at high altitude, as specified in § 86.087–8(h);

(*1*) A highlighted statement (*e.g.*, underscored or boldface letters) that the vehicle is certified to applicable emission standards at low altitude only;

(*2*) A statement that the vehicle's unsatisfactory performance under high-altitude conditions makes it unsuitable for principal use at high altitude, and

(*3*) A statement that the emission performance warranty provisions of 40 CRF Part 85, Subpart V do not apply when the vehicle is tested at high altitude, and

(H) For vehicles that have been exempted from compliance with the emission standards at low altitude, as specified in § 86.087–8(i),

(*1*) A highlighted statement (*e.g.*, underscored or boldface letters) that the vehicle is certified to applicable emission standards at high altitude only, and

(*2*) A statement that the emission performance warranty provisions of 40 CFR Part 85, Subpart V do not apply when the vehicle is tested at low altitude.

(2) Light-duty trucks. (i) A legible, permanent label shall be affixed in a readily visible position in the engine compartment.

(ii) The label shall be affixed by the vehicle manufacturer who has been issued the certificate of conformity for such vehicle, in such a manner that it cannot be removed without destroying or defacing the label. The label shall not be affixed to any equipment which is easily detached from such vehicle.

(iii) The label shall contain the following information lettered in the English language in block letters and numerals, which shall be of a color that contrasts with the background of the label.

(A) The label heading: Important Vehicle Information;

(B) Full corporate name and trademark of manufacturer;

(C) Engine displacement (in cubic inches) and engine family identification;

(D) Engine tune-up specifications and adjustments, as recommended by the manufacturer in accordance with the applicable emission standards (or family emission limits, as appropriate), including but not limited to idle speed(s), ignition timing, the idle air-fuel mixture setting procedure and value (*e.g.*, idle CO, idle air-fuel ratio, idle speed drop), high idle speed, initial injection timing, and valve lash (as applicable), as well as other parameters deemed necessary by the manufacturer. These specifications should indicate the proper transmission position during tune-up and what accessories (*e.g.*, air conditioner), if any, should be in operation. If adjustments or modifications to the vehicle are necessary to insure compliance with emission standards (or family emission limits, as appropriate) at either high or low altitude, the manufacturer shall either include the instructions for such adjustments on the label, or indicate on the label where instructions for such adjustments may be found. The label shall indicate whether the engine tune-up or adjustment specifications are applicable to high altitude, low altitude or both;

(E) The prominent statement: "This vehicle conforms to U.S. EPA regulations applicable to 19 Model Year New Light-Duty Trucks."

(F) If the manufacturer is provided an alternate useful-life period under the

provisions of § 86.090–21(f), the prominent statement: "This vehicle has been certified to meet U.S. EPA standards for a useful-life period of ____ years or ____ miles of operation, whichever occurs first. This vehicle's actual life may vary depending on its service application." The manufacturer may alter this statement only to express the assigned alternate useful life in terms other than years of miles (*e.g.*, hours, or miles only);

(G) A statement, if applicable, that the adjustments or modifications indicated on the label are necessary to ensure emission control compliance at the altitude specified;

(H) A statement, if applicable, that the high-altitude vehicle was designated or modified for principal use at high altitude. This statement must be affixed by the manufacturer at the time of assembly or by any dealer who performs the high altitude modification or adjustment prior to sale to an ultimate purchaser;

(I) For vehicles that have been exempted from compliance with the high-altitude emission standards, as specified in § 86.090–9(g)(2),

(*1*) A highlighted statement (*e.g.*, underscored or boldface letters) that the vehicle is certified to applicable emission standards at low altitude only,

(*2*) A statement that the vehicle's unsatisfactory performance under high-altitude conditions makes it unsuitable for principal use at high altitude, and

(*3*) A statement that the emission performance warranty provisions of 40 CFR Part 85, Subpart I do not apply when the vehicle is tested at high altitude; and

(J) For vehicles which are included in the diesel particulate averaging program, the family particulate emission limit to which the vehicle is certified.

(K) For vehicles which are included in the light-duty truck NO_x averaging program, the family NO_x emission limit to which the vehicle is certified.

(3) *Heavy-duty engines.* (i) A permanent legible label shall be affixed to the engine in a position in which it will be readily visible after installation in the vehicle.

(ii) The label shall be attached to an engine part necessary for normal engine operation and not normally requiring replacement during engine life.

(iii) The label shall contain the following information lettered in the English language in block letters and numerals which shall be of a color that contrasts with the background of the label:

(A) The label heading: Important Engine Information;

(B) Full corporate name and trademark of manufacturer;

(C) Engine displacement (in cubic inches) and engine family and model designations;

(D) Date of engine manufacture (month and year). The manufacturer may, in lieu of including the date of manufacture on the engine label, maintain a record of the engine manufacture dates. The manufacturer shall provide the date of manufacture records to the Administrator upon request;

(E) Engine specifications and adjustments as recommended by the manufacturer. These specifications should indicate the proper transmission position during tuneup and what accessories (*e.g.*, air conditioner), if any, should be in operation;

(F) For Otto-cycle engines the label should include the idle speed, ignition timing, and the idle air fuel mixture setting procedure and value (*e.g.*, idle CO, idle air-fuel ratio, idle speed drop), and valve lash;

(G) For diesel engines the label should include the advertised hp at rpm, fuel rate at advertised hp in mm^3/stroke, valve lash, initial injection timing, and idle speed;

(H) The prominent statement: "This engine conforms to U.S. EPA regulations applicable to 19____ Model Year New Heavy-Duty Engines."

(I) If the manufacturer is provided with an alternate useful-life period under the provisions of § 86.090–21(f), the prominent statement: "This engine has been certified to meet U.S. EPA standards for a useful-life period of ____ miles or ____ hours of operation, whichever occurs first. This engine's actual life may vary depending on its service application." The manufacturer may alter this statement only to express the assigned alternate useful life in terms other than miles or hours (*e.g.*, years, or hours only);

(J) *For diesel engines.* The prominent statement: "This engine has a primary intended service application as a _____-heavy-duty engine." (The primary intended service applications are light, medium, and heavy, as defined in § 86.085–2);

(K) *For Otto-cycle engines.* One of the following statements, as applicable:

(*1*) For engines certified to the emission standards under § 86.090–10(a)(1)(i) or § 86.090–10(a)(1)(iii), the statement: "This engine is certified for use in all heavy-duty vehicles."

(*2*) For gasoline-fueled engines certified under the provisions of § 86.090–10(a)(3)(i), the statement: "This engine is certified for use in all heavy-duty vehicles under the special provision of 40 CFR 86.090–10(a)(3)(i)."

(*3*) For engines certified to the emission standards of § 86.090–10(a)(1)(ii) or § 86.090–10(a)(1)(iv), the statement: "This engine is certified for use only in heavy-duty vehicles with a gross vehicle weight rating above 14,000 lbs."

(iv) The label may be made up of one or more pieces: *Provided*, that all pieces are permanently attached to the same engine or vehicle part as applicable.

(4)(i) *Gasoline-fueled and methanol-fueled heavy-duty vehicles.* A permanent, legible label shall be affixed in a readily visible position in the engine compartment. If such vehicles do not have an engine compartment, the label required in paragraphs (a)(4) and (g)(1) of this section shall be affixed in a readily visible position on the operator's enclosure or on the engine.

(ii) The label shall be affixed by the vehicle manufacturer who has been issued the certificate of conformity for such vehicle, in such a manner that it cannot be removed without destroying or defacing the label. The label shall not be affixed to any equipment which is easily detached from such vehicle.

(iii) The label shall contain the following information lettered in the English language in block letters and numerals, which shall be of a color that contrasts with the background of the label:

(A) The label heading: Vehicles Emission Control Information;

(B) Full corporate name and trademark of manufacturer;

(C) Evaporative family identification;

(D) The maximum nominal fuel tank capacity (in gallons) for which the evaporative control system is certified; and

(E) One of the following, as appropriate:

(*1*) An unconditional statement of compliance with the appropriate model year U.S. Environmental Protection Agency regulations which apply to gasoline-fueled heavy-duty vehicles.

(*2*) An unconditional statement of compliance with the appropriate model year U.S. Environmental Protection Agency regulations which apply to methanol-fueled heavy-duty vehicles.

(b) The provisions of this section shall not prevent a manufacturer from also reciting on the label that such vehicle (or engine) conforms to any applicable state emission standards for new motor vehicles (or new motor vehicle engines) or any other information that such manufacturer deems necessary for, or useful to, the proper operation and

satisfactory maintenance of the vehicle (or engine).

(c)(1) The manufacturer of any light-duty vehicle or light-duty truck subject to the emission standards (or family emission limits, as appropriate) of this subpart shall, in addition and subsequent to setting forth those statements on the label required by the Department of Transportation (DOT) pursuant to 49 CFR 567.4, set forth on the DOT label or on an additional label located in proximity to the DOT label and affixed as described in 40 CFR 567.4(b), the following information in the English language, lettered in block letters and numerals not less than three thirty-seconds of an inch high, of a color that contrasts with the background of the label:

(i) The Heading: "Vehicle Emission Control Information."

(ii)(A) *For light duty vehicles,* the statement: "This Vehicle Conforms to U.S. EPA Regulations Applicable to 19__ Model Year New Motor Vehicles."

(B) *For light-duty trucks. (1)* The statement: "This vehicle conforms to U.S. EPA Regulations Applicable to 19__ Model Year New Light-Duty Trucks."

(*2*) If the manufacturer is provided an alternate useful-life period under the provisions of § 86.090–21(f), the prominent statement: "This vehicle has been certified to meet U.S. EPA standards for a useful-life period of __ years or ____ miles of operation, whichever occurs first. This vehicle's actual life may vary depending on its service application." The manufacturer may alter this statement only to express the assigned alternate useful life in terms other than years or miles (*e.g.*, hours, or miles only).

(iii) One of the following statements, as applicable, in letters and numerals not less than six thirty-seconds of an inch high and of a color that contrasts with the background of the label:

(A) For all vehicles certified as non-catalyst- equipped: "NON-CATALYST."

(B) For all vehicles certified as catalyst-equipped which are included in a manufacturer's catalyst control program for which approval has been given by the Administrator: "CATALYST-APPROVED FOR IMPORT."

(C) For all vehicles certified as catalyst-equipped which are not included in a manufacturer's catalyst control program for which prior approval has been given by the Administrator: "CATALYST."

(2) In lieu of selecting either of the labeling options of paragraph (c)(1) of this section, the manufacturer may add the information required by paragraph (c)(1)(iii) of this section to the label required by paragraph (a) of this section. The required information will be set forth in the manner prescribed by paragraph (c)(1)(iii) of this section.

(d) Incomplete light-duty trucks or incomplete heavy-duty vehicles optionally certified as light-duty trucks shall have the following prominent statement printed on the label required by paragraph (a)(2) of this section in lieu of the statement required by paragraph (a)(2)(iii)(E) of this section: "This vehicle conforms to U.S. EPA regulations applicable to 19— Model Year New Light-Duty Trucks when completed at a maximum curb weight of ____ pounds or at a maximum gross vehicle weight rating of ____ pounds or with a maximum frontal area of ____ square feet."

(e) Incomplete heavy duty vehicles having a gross vehicle weight rating of 8,500 pounds or less shall have one of the following statements printed on the label required by paragraph (a)(3) of this section in lieu of the statement required by paragraph (a)(3)(iii)(H) of this section: "This engine conforms to U.S. EPA regulations applicable to 19— Model Year New Heavy-Duty Engines when installed in a vehicle completed at a curb weight of more than 6,000 pounds or with a frontal area of greater than 45 square feet."

(f) The manufacturer of any incomplete light-duty vehicle or light-duty truck shall notify the purchaser of such vehicle of any curb weight, frontal areas, or gross vehicle weight rating limitations affecting the emission certificate applicable to that vehicle. This notification shall be transmitted in a manner consistent with National Highway Traffic Safety Administration Safety notification requirements published in 49 CFR Part 568.

(g)(1)(i) Incomplete gasoline-fueled heavy-duty vehicles shall have the following prominent statement printed on the label required in paragraph (a)(4) of this section: "[Manufacturer's corporate name] has determined that this vehicle conforms to U.S. EPA regulations applicable to 19— Model Year New Gasoline-Fueled Heavy-Duty Vehicles when completed with a nominal fuel tank capacity not to exceed ____ gallons. Persons wishing to add fuel tank capacity beyond the above maximum must submit a written statement to the Administrator that the hydrocarbon storage system has been upgraded according to the requirements of 40 CFR 86.090–35(g)(2)."

(ii) Incomplete methanol-fueled heavy-duty vehicles shall have the following prominent statement printed on the label required in paragraph (a)(4) of this section: "(Manufacturer's corporate name) has determined that this vehicle conforms to U.S. EPA regulations applicable to 19— Model Year New Methanol-Fueled Heavy-Duty Vehicles when completed with a nominal fuel tank capacity not to exceed ____ gallons. Persons wishing to add fuel tank capacity beyond the above maximum must submit a written statement to the Administrator that the hydrocarbon storage system has been upgraded according to the requirements of 40 CFR 86.090–35(g)(2)."

(2) Persons wishing to add fuel tank capacity beyond the maximum specified on the label required in paragraph (g)(1) of this section shall:

(i) Increase the amount of fuel tank vapor storage material according to the following function:

$$Cap_f = Cap_i \left(\frac{\text{T. Vol.}}{\text{Max. Vol.}} \right)$$

Where:

Cap_f = final amount of fuel tank vapor storage material, grams.

Cap_i = initial amount of fuel tank vapor storage material, grams.

T. Vol. = total fuel tank volume of completed vehicle, gallons.

Max. Vol. = maximum fuel tank volume as specified on the label required in paragraph (g)(1) of this section, gallons.

(ii) Use, if applicable, hosing for fuel vapor routing which is at least as impermeable to hydrocarbon vapors as that used by the primary manufacturer.

(iii) Use vapor storage material with the same absorptive characteristics as that used by the primary manufacturer.

(iv) Connect, if applicable, any new hydrocarbon storage device to the existing hydrocarbon storage device in series such that the original hydrocarbon storage device is situated between the fuel tank and the new hydrocarbon storage device. The original hydrocarbon storage device shall be sealed such that vapors cannot reach the atmosphere. The elevation of the original hydrocarbon storage device shall be equal to or lower than the new hydrocarbon storage device.

(v) Submit a written statement to the Administrator that paragraphs (g)(2)(i) through (g)(2)(iv) of this section have been complied with.

(3) If applicable, the Administrator will send a return letter verifying the receipt of the written statement required in paragraph (g)(2)(v) of this section.

(h)(1) Light-duty trucks and heavy duty engines for which nonconformance penalties are to be paid in accordance with § 86.1113–87(b) shall have the following information printed on the label required in paragraph (a) of this

section or on a separate permanent legible label in the English language and located in proximity to the label required in paragraph (a) of this section. The manufacturer shall begin labeling production engines or vehicles within 10 days after the completion of the PCA.

(i) The statement: "The manufacturer of this engine/vehicle will pay a penalty to be allowed to introduce it into commerce at an emission level higher than the applicable emission standard. The compliance level (or new emission standard) for this engine/vehicle is _____." (The manufacturer shall insert the applicable pollutant and compliance level calculated in accordance with § 86.1112–87(a).)

(2) If a manufacturer introduces an engine or vehicle into commerce prior to the compliance level determination of § 86.1112–87(a), it shall provide the engine or vehicle owner with a label as described above to be affixed in a location in proximity to the label required in paragraph (a) of this section within 30 days of the completion of the PCA.

31. Section 86.091–35 of Subpart A is amended by revising paragraphs (a) introductory text, (a)(1)(iii) (C) and (D), (a)(2)(iii)(D), (a)(3)(iii) (F) and (G), (a)(3)(iii) (J) and (K), (a)(4)(i), (a)(4)(iii)(E), (c)(1), (g)(1), and adding paragraph (h) to read as follows:

§ 86.091–35 Labeling.

(a) The manufacturer of any motor vehicle (or motor vehicle engine) subject to the applicable emission standards (and family emission limits, as appropriate) of this subpart, shall, at the time of manufacture, affix a permanent legible label, of the type and in the manner described below, containing the information hereinafter provided, to all production models of such vehicles (or engines) available for sale to the public and covered by a certificate of conformity under § 86.091–30(a).

(1) * * *

(iii) * * *

(C) Engine displacement (in cubic inches), engine family identification and evaporative family identification;

(D) Engine tune-up specifications and adjustments, as recommended by the manufacturer in accordance with the applicable emission standards (or family emission limits, as appropriate), including but not limited to idle speed(s), ignition timing, the idle air-fuel mixture setting procedure and value (*e.g.*, idle CO, idle air-fuel ratio, idle speed drop), high idle speed, initial injection timing, and valve lash (as applicable), as well as other parameters deemed necessary by the manufacturer. These specifications should indicate the proper transmission position during tune-up and what accessories (*e.g.*, air conditioner), if any, should be in operation;

* * * * *

(2) * * *

(iii) * * *

(D) Engine tune-up specifications and adjustments, as recommended by the manufacturer in accordance with the applicable emission standards (or family emission limits, as appropriate), including but not limited to idle speed(s), ignition timing, the idle air-fuel mixture setting procedure and value (*e.g.*, idle CO, idle air-fuel ratio, idle speed drop), high idle speed, initial injection timing, and valve lash (as applicable), as well as other parameters deemed necessary by the manufacturer. These specifications should indicate the proper transmission position during tune-up and what accessories (*e.g.*, air conditioner), if any, should be in operation. If adjustments or modifications to the vehicle are necessary to insure compliance with emission standards (or family emission limits, as appropriate) at either high or low altitude, the manufacturer shall either include the instructions for such adjustments on the label, or indicate on the label where instructions for such adjustments may be found. The label shall indicate whether the engine tune-up or adjustment specifications are applicable to high altitude, low altitude or both;

* * * * *

(3) * * *

(iii) * * *

(F) For Otto-cycle engines the label should include the idle speed, ignition timing, and the idle air-fuel mixture setting procedure and value (*e.g.*, idle CO, idle air-fuel ratio, idle speed drop), and valve lash;

(G) For diesel engines the label should include the advertised hp at rpm, fuel rate at advertised hp in mm^3/stroke, valve lash, initial injection timing, and idle speed;

* * * * *

(J) *For diesel engines.* The prominent statement: "This engine has a primary intended service application as a _____-heavy-duty engine." (The primary intended service applications are light, medium, and heavy, as defined in § 86.085–2);

(K) *For Otto-cycle engines.* One of the following statements, as applicable:

(*1*) For engines certified to the emission standards of § 86.091–10(a)(1)(i) or § 86.091–10(a)(1)(iii), the statement: "This engine is certified for use in all heavy-duty vehicles."

(*2*) For gasoline-fueled engines certified under the provisions of § 86.091–10(a)(3)(i), the statement: "This engine is certified for use in all heavy-duty vehicles under the special provision of 40 CFR 86.091–10(a)(3)(i)."

(*3*) For engines certified to the emission standards of § 86.091–10(a)(1)(ii) or § 86.091–10(a)(1)(iv), the statement: "This engine is certified for use only in heavy-duty vehicles with a gross vehicle weight rating above 14,000 lbs."

* * * * *

(4)(i) *Gasoline-fueled and methanol-fueled heavy-duty vehicles.* A permanent, legible label shall be affixed in a readily visible position in the engine compartment. If such vehicles do not have an engine compartment, the label required in paragraphs (a)(4) and (g)(1) of this section shall be affixed in a readily visible position on the operator's enclosure or on the engine.

* * * * *

(iii) * * *

(E) One of the following, as appropriate:

(*1*) An unconditional statement of compliance with the appropriate model year U.S. Environmental Protection Agency regulations which apply to gasoline-fueled heavy-duty vehicles.

(*2*) An unconditional statement of compliance with the appropriate model year U.S. Environmental Protection Agency regulations which apply to methanol-fueled heavy-duty vehicles.

* * * * *

(c)(1) The manufacturer of any light-duty vehicle or light-duty truck subject to the emission standards (or family emission limits, as appropriate) of this subpart shall, in addition and subsequent to setting forth those statements on the label required by the Department of Transportation (DOT) pursuant to 49 CFR 567.4, set forth on the DOT label or on an additional label located in proximity to the DOT label and affixed as described in 40 CFR 567.4(b), the following information in the English language, lettered in block letters and numerals not less than three thirty-seconds of an inch high, of a color that contrasts with the background of the label:

* * * * *

(g)(1)(i) Incomplete gasoline-fueled heavy-duty vehicles shall have the following prominent statement printed on the label required in paragraph (a)(4) of this section: "(Manufacturer's corporate name) has determined that this vehicle conforms to U.S. EPA regulations applicable to 19__ Model Year New Gasoline-Fueled Heavy-Duty

Vehicles when completed with a nominal fuel tank capacity not to exceed ___ gallons. Persons wishing to add fuel tank capacity beyond the above maximum must submit a written statement to the Administrator that the hydrocarbon storage system has been upgraded according to the requirements of 40 CFR 86.091–35(g)(2)."

(ii) Incomplete methanol-fueled heavy-duty vehicles shall have the following prominent statement printed on the label required in paragraph (a)(4) of this section: "(Manufacturer's corporate name) has determined that this vehicle conforms to U.S. EPA regulations applicable to 19__ Model Year New Methanol-Fueled Heavy-Duty Vehicles when completed with a nominal fuel tank capacity not to exceed ___ gallons. Persons wishing to add fuel tank capacity beyond the above maximum must submit a written statement to the Administrator that the hydrocarbon storage system has been upgraded according to the requirements of 40 CFR 86.091–35(g)(2)."

* * * * *

(h)(1) Light-duty trucks and heavy-duty engines for which nonconformance penalties are to be paid in accordance with § 86.1113–87(b) shall have the following information printed on the label required in paragraph (a) of this section or on a separate permanent legible label in the English language and located in proximity to the label required in paragraph (a) of this section. The manufacturer shall begin labeling production engines or vehicles within 10 days after the completion of the PCA.

(i) The statement: "The manufacturer of this engine/vehicle will pay a penalty to be allowed to introduce it into commerce at an emission level higher than the applicable emission standard. The compliance level (or new emission standard) for this engine/vehicle is _____." (The manufacturer shall insert the applicable pollutant and compliance level calculated in accordance with § 86.1112–87(a).)

(2) If a manufacturer introduces an engine or vehicle into commerce prior to the compliance level determination of § 86.1112–87(a), it shall provide the engine or vehicle owner with a label as described above to be affixed in a location in proximity to the label required in paragraph (a) of this section within 30 days of the completion of the PCA.

32. Section 86.104 of Subpart B is amended by revising paragraph (b), to read as follows:

§ 86.104 Section numbering; construction.

* * * * *

(b) Unless indicated otherwise, all provisions in this subpart apply to petroleum-fueled and methanol-fueled vehicles.

33. Section 86.105 of Subpart B is amended by revising paragraph (a), to read as follows:

§ 86.105 Introduction; structure of subpart.

(a) This subpart describes the equipment required and the procedures to follow in order to perform gaseous exhaust, diesel particulate, and evaporative emission tests on light-duty vehicles and light-duty trucks. Subpart A sets forth testing requirements and test intervals necessary to comply with EPA certification procedures.

* * * * *

34. A new § 86.106–90 is added to Subpart B, to read as follows:

§ 86.106–90 Equipment required; overview.

(a) This subpart contains procedures for exhaust emissions tests on petroleum-fueled, and methanol-fueled light-duty vehicles and light-duty trucks, and for evaporative emission tests on gasoline-fueled and methanol-fueled light-duty vehicles and light-duty trucks. Certain items of equipment are not necessary for a particular test, *e.g.*, evaporative enclosure when testing diesel vehicles. Alternate sampling systems may be used if shown to yield equivalent results, and if approved in advance by the Administrator. Equipment required and specifications are as follows:

(1) *Evaporative emission tests, gasoline-fueled and methanol-fueled vehicles.* The evaporative emission test is closely related to and connected with the exhaust emission test. All vehicles tested for evaporative emissions must be tested for exhaust emissions. Further, unless the evaporative emission test is waived by the Administrator under § 86.090–26, all gasoline-fueled and methanol-fueled vehicles must undergo both tests. (Diesel vehicles are excluded from the evaporative emission standard.) Section 86.107 specifies the necessary equipment.

(2) *Exhaust emission tests.* All vehicles subject to this subpart are tested for exhaust emissions. The exhaust from Otto-cycle vehicles is tested for gaseous emissions only, using the CVS concept (§ 86.109). The exhaust from diesel vehicles is tested for both gaseous and particulate emissions. Petroleum-fueled diesel vehicle testing also utilizes the CVS concept of measuring emissions, but requires that a PDP–CVS or CFV with heat exchanger be used, and that it be connected to a dilution tunnel in order to sample particulate emissions (§ 86.110). The exhaust from methanol-fueled diesel vehicles is tested for both gaseous and particulate emissions using the CVS concept (either PDP CVS or CFV as specified in § 86.109 or PDP–CVS or CFV with heat exchanger as specified in § 86.110 may be used) and is connected to a dilution tunnel to sample particulate emissions (§ 86.110) (This equipment may be used with methanol-fueled Otto-cycle vehicles, however, particulates are not measured). All gasoline-fueled and methanol-fueled vehicles are either tested for evaporative emissions or undergo a diurnal heat build. Petroleum-fueled diesel vehicles are excluded from this requirement. Equipment necessary and specifications appear in §§ 86.108 through 86.114.

(3) *Fuel, analytical gas, and driving schedule specifications.* Fuel specifications for exhaust and evaporative emissions testing and for mileage accumulation for petroleum-fueled and methanol-fueled vehicles are specified in § 86.113. Analytical gases are specified in § 86.114. The EPA Urban Dynamometer Driving Schedule (UDDS) for use in petroleum-fueled and methanol-fueled exhaust emissions tests is specified in § 86.115 and Appendix I.

35. A new § 86.107–90 is added to Subpart B, to read as follows:

§ 86.107–90 Sampling and analytical system; evaporative emissions.

(a) Component description (evaporative emissions sampling system). The following components will be used in evaporative emissions sampling systems for testing under this subpart.

(1) *Evaporative emission measurement enclosure.* The enclosure shall be readily sealable, rectangular in shape, with space for personnel access to all sides of the vehicle. When sealed, the enclosure shall be gas tight in accordance with § 86.117. Interior surfaces must be impermeable and non-reactive to hydrocarbons and to methanol (if the enclosure is used for methanol-fueled vehicles). One surface should be of flexible, impermeable and non-reactive material to allow for minor volume changes, resulting from temperature changes. Wall design should promote maximum dissipation of heat, and if artificial cooling is used, interior surface temperatures shall not be less than 68°F (20°C).

(2) *Evaporative emission hydrocarbon and methanol analyzers.* (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 required 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:

(A) Stability of the analyzer shall be better than 0.01 Cstd ppm at zero and span over a 15-minute period on all ranges used.

(B) Repeatability of the analyzer, expressed as one standard deviation, shall be better than 0.005 Cstd ppm on all ranges used.

(ii) For methanol-fueled vehicles, a methanol sampling and analyzing system is required in addition to the FID analyzer. The methanol sampling equipment shall consist of impingers for collecting the methanol sample and appropriate equipment for drawing the sample through the impingers. The analytical equipment shall consist of a gas chromatograph equipped with a flame ionization detector. (NOTE: For 1990 through 1994 model year methanol-fueled vehicles, a HFID calibrated on methanol may be used in place of the HFID, calibrated on propane plus the methanol impingers and associated analytical equipment).

(3) *Evaporative emission hydrocarbon and methanol data recording system.* (i) The electrical output of the FID used for measuring hydrocarbons (or hydrocarbons plus methanol as appropriate) shall be recorded at least at the initiation and termination of each diurnal or hot soak. The recording may be by means of a strip chart potentiometric recorder, by use of an on-line computer system or other suitable means. In any case, the recording system must have operational characteristics (signal to noise ratio, speed of response, *etc.*) equivalent to or better than those of the signal source being recorded, and must provide a permanent record of results. The record shall show a positive indication of the initiation and completion of each diurnal or hot soak along with the time elapsed between initiation and completion of each soak.

(ii) 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, the volumes of each sample introduced into the gas chromatograph, the flow rate of carrier gas through the column, the column temperature, and the chromatogram of the analyzed sample.

(4) *Tank fuel heating system.* The tank fuel heating system shall consist of a heat source and a temperature controller. A typical heat source is a 2000 W heating pad. Other sources may be used as required by circumstances. The temperature controller may be manual, such as a variable voltage transformer, or may be automated. The heating system must not cause hot spots on the tank wetted surface which could cause local overheating of the fuel. Heat must not be applied to the vapor in the tank above the liquid fuel. The temperature controller must be capable of controlling the fuel tank temperature during the diurnal soak to within ±3°F (±1.7°C) of the following equation:

$F = T_o + (0.4)t$.

or *For SI units:*

$C = T_o + (2/9)t$.

Where:

F=Temperature in °F.

C=Temperature in °C.

t=Time since start of test in minutes.

T_o=initial temperature in °F (or in °C for SI units).

(5) *Temperature recording system.* Strip chart recorder(s) or automatic data processor shall be used to record enclosure ambient and vehicle fuel tank temperature during the evaporative emissions test. The temperature recorder or data processor shall record each temperature at least once every minute. The recording system shall be capable of resolving time to ±15s and capable of resolving temperature to ±0.75°F (±0.42°C). The temperature recording system (recorder and sensor) shall have an accuracy of ±3°F (±1.7°C). The recorder (data processor) shall have a time accuracy of ±15s and a precision of ±15s. Two ambient temperature sensors, connected to provide one average output, shall be located in the enclosure. These sensors shall be located at the approximate vertical centerline of each side wall extending 4 inches (nominally) into the enclosure at a height of 3±0.5 ft (0.9±0.2m). The vehicle fuel tank temperature sensor shall be located in the fuel tank so as to measure the temperature of the prescribed test fuel at the approximate mid-volume of the fuel. Manufacturers shall arrange that vehicles furnished for testing at Federal certification facilities be equipped with iron-constantan Type J thermocouples for measurement of fuel tank temperature.

(6) *Purge blower.* One or more portable or fixed blowers shall be used to purge the enclosure. The blowers shall have sufficient flow capacity to reduce the enclosure hydrocarbon and/or methanol concentration from the test level to the ambient level between tests. Actual flow capacity will depend upon the time available between tests.

(7) *Mixing blower.* One or more small blowers or fans with a total capacity of 200 to 1000 cfm shall be used to mix the contents of the enclosure during evaporative emission testing. No portion of the air stream shall be directed toward the vehicle. Maintenance of uniform concentrations throughout the enclosure is important to the accuracy of the test.

36. A new § 86.109–90 is added to Subpart B, to read as follows:

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

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

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

(i) Using a duct of unrestricted length maintained at 235°±15°F (113°±8°C), heating and possible cooling capabilities are required; or

(ii) Using a short duct (up to 12 feet long) constructed of smooth wall pipe with a minimum of flexible sections, maintained at 235°±15°F (113°±8°C) prior to the test and during the 10 minute hot soak segment and uninsulated during the test (insulation may remain in place and/or heating may occur during testing provided maximum temperature is not exceeded); or

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

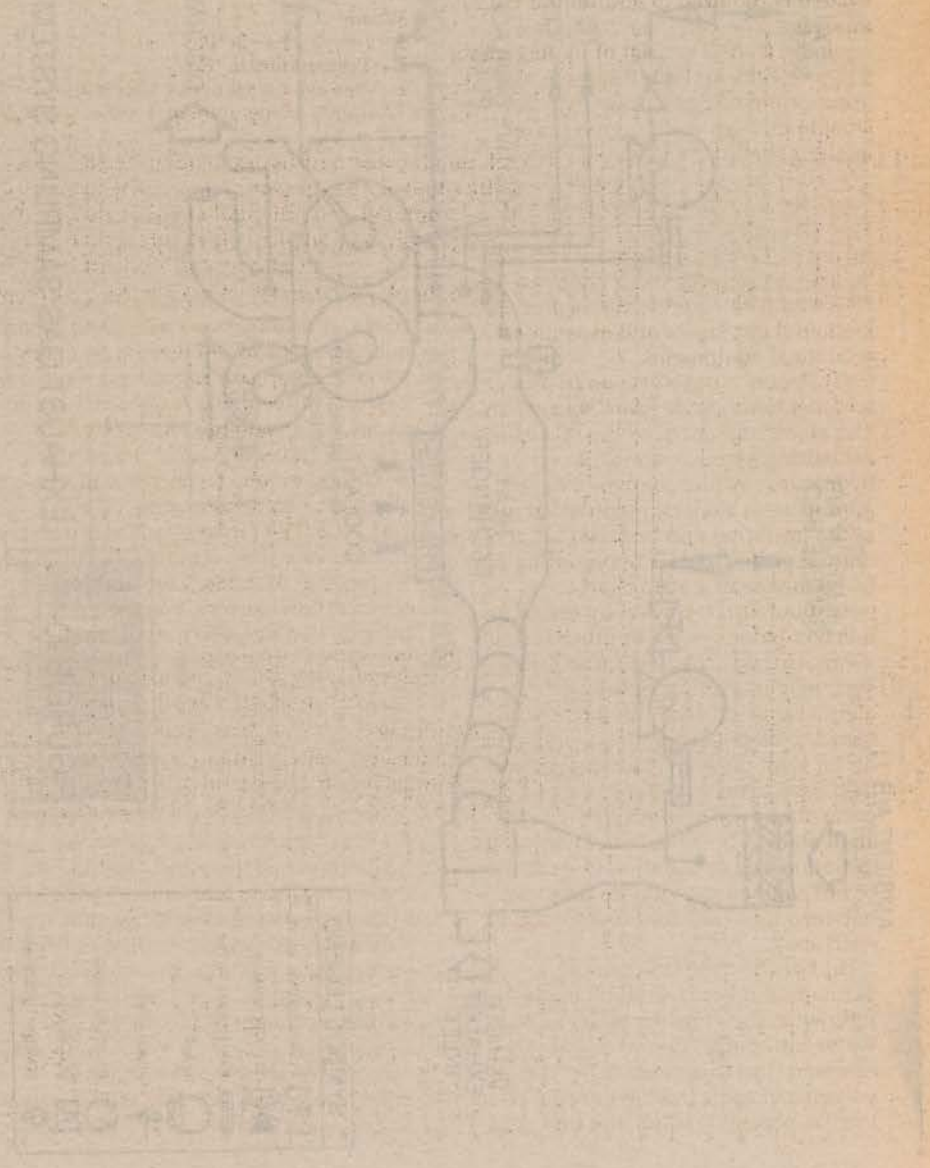
(iv) Omitting the duct and performing the exhaust gas dilution function at the vehicle tailpipe exit.

(3) *Positive displacement pump.* The Positive Displacement Pump-Constant Volume Sampler (PDP–CVS), Figure B90–1 satisfies the first condition by metering at a constant temperature and pressure through the pump. The total

volume is measured by counting the revolutions made by the calibrated positive displacement pump. The proportional samples for the bag sample, and for methanol-fueled vehicles, the methanol sample (Figure B90–2) and the formaldehyde sample (Figure B90–3), are achieved by sampling at a constant flow rate. For methanol-fueled vehicles, the sample lines for the methanol and formaldehyde samples are heated to 235°±15°F (113°±8°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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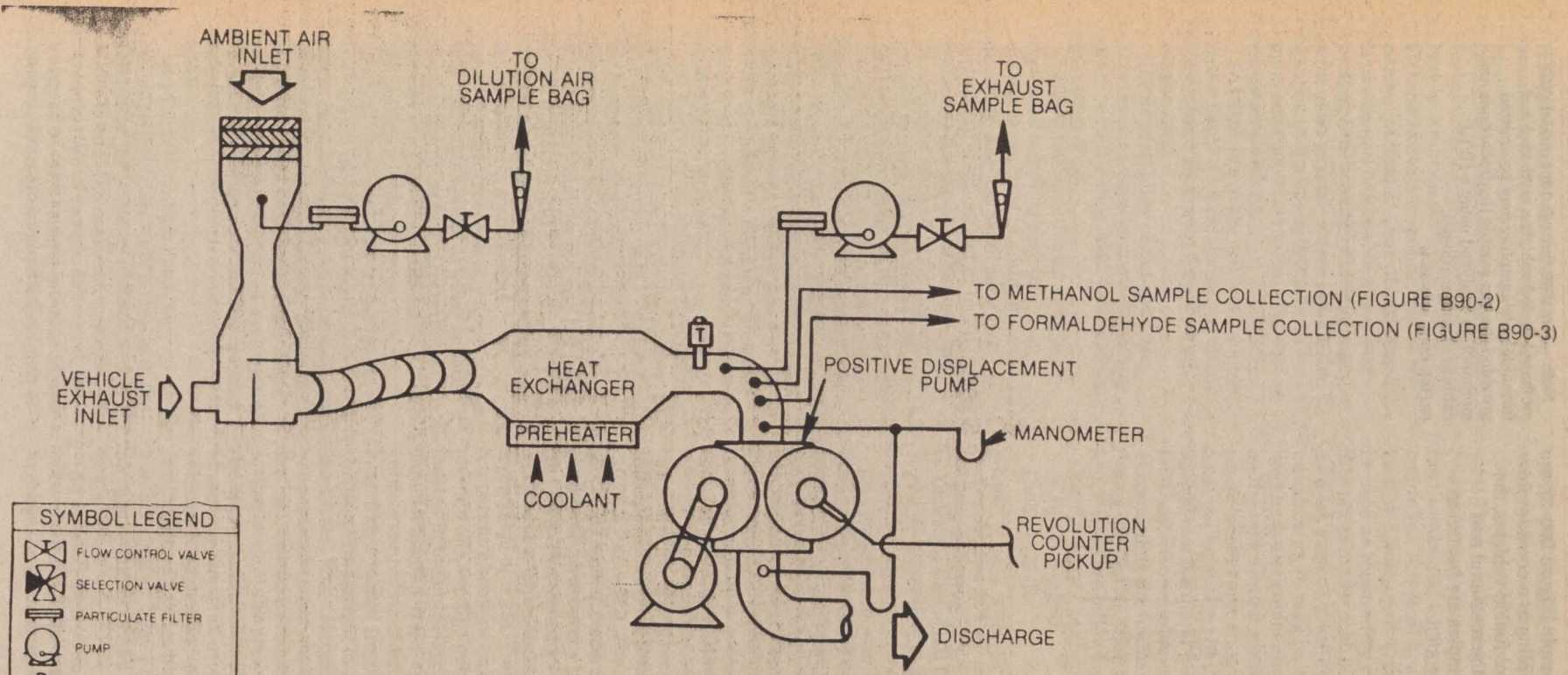


FIGURE B90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)

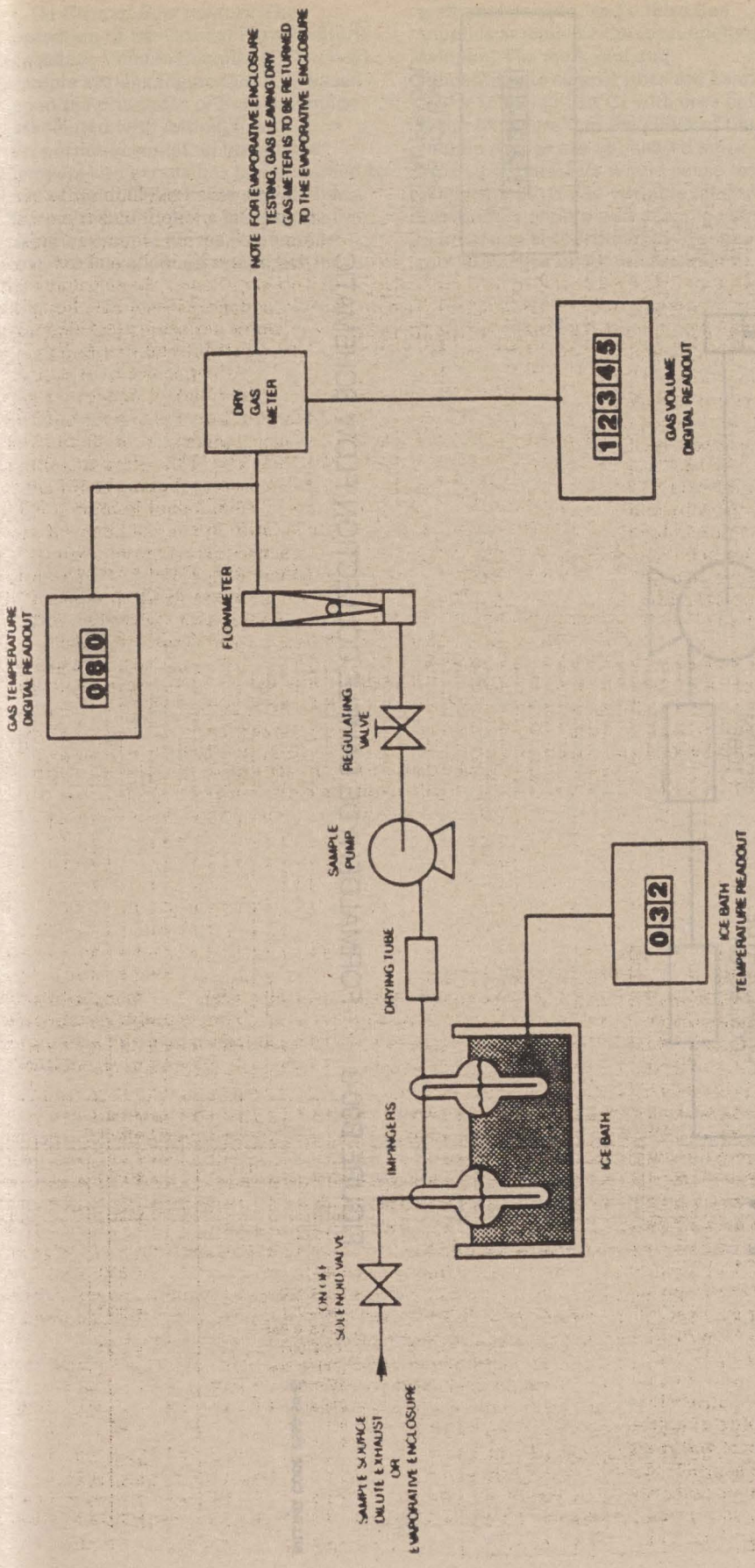


FIGURE B¼-2 METHANOL SAMPLE COLLECTION FLOW SCHEMATIC

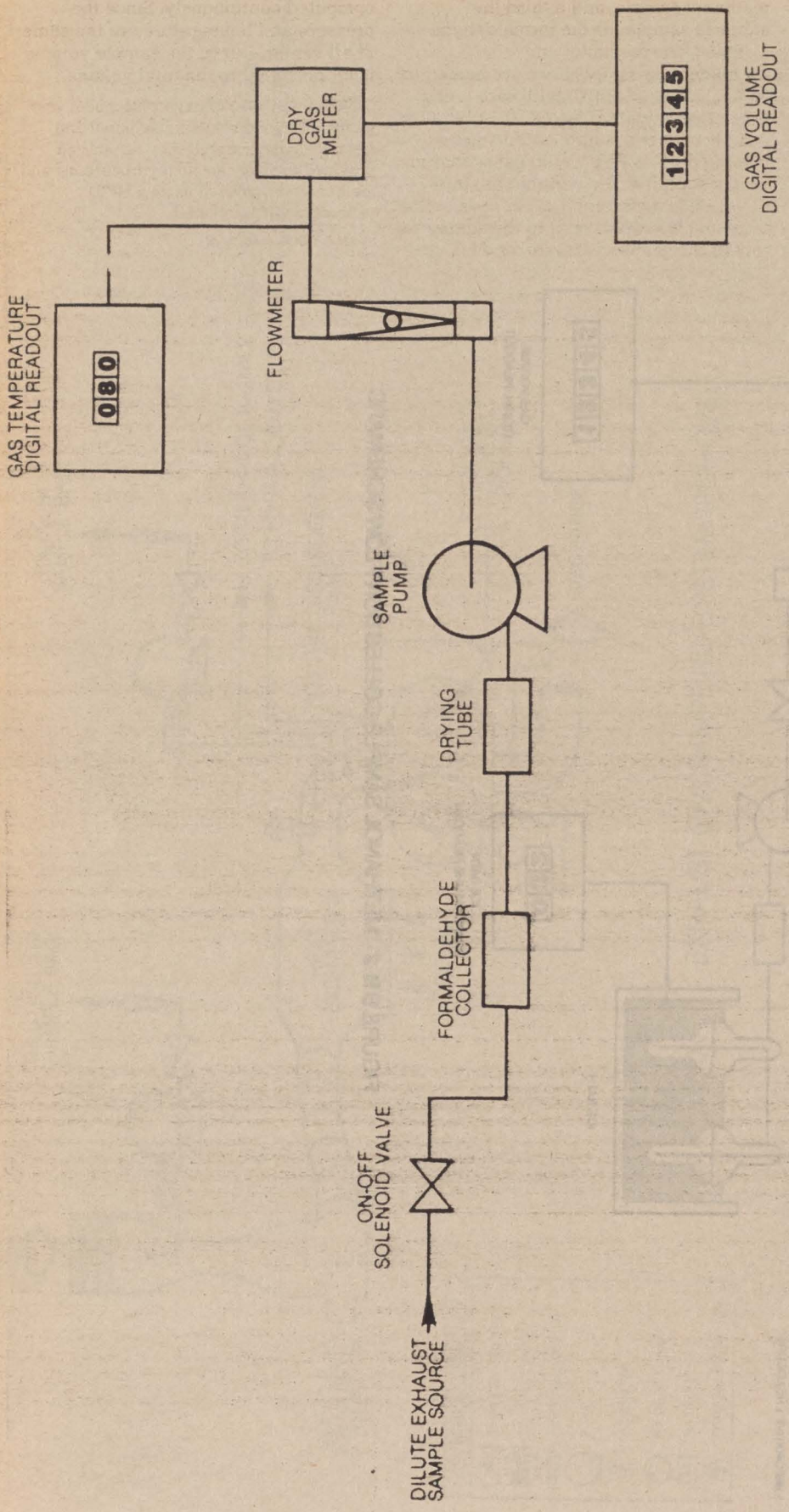


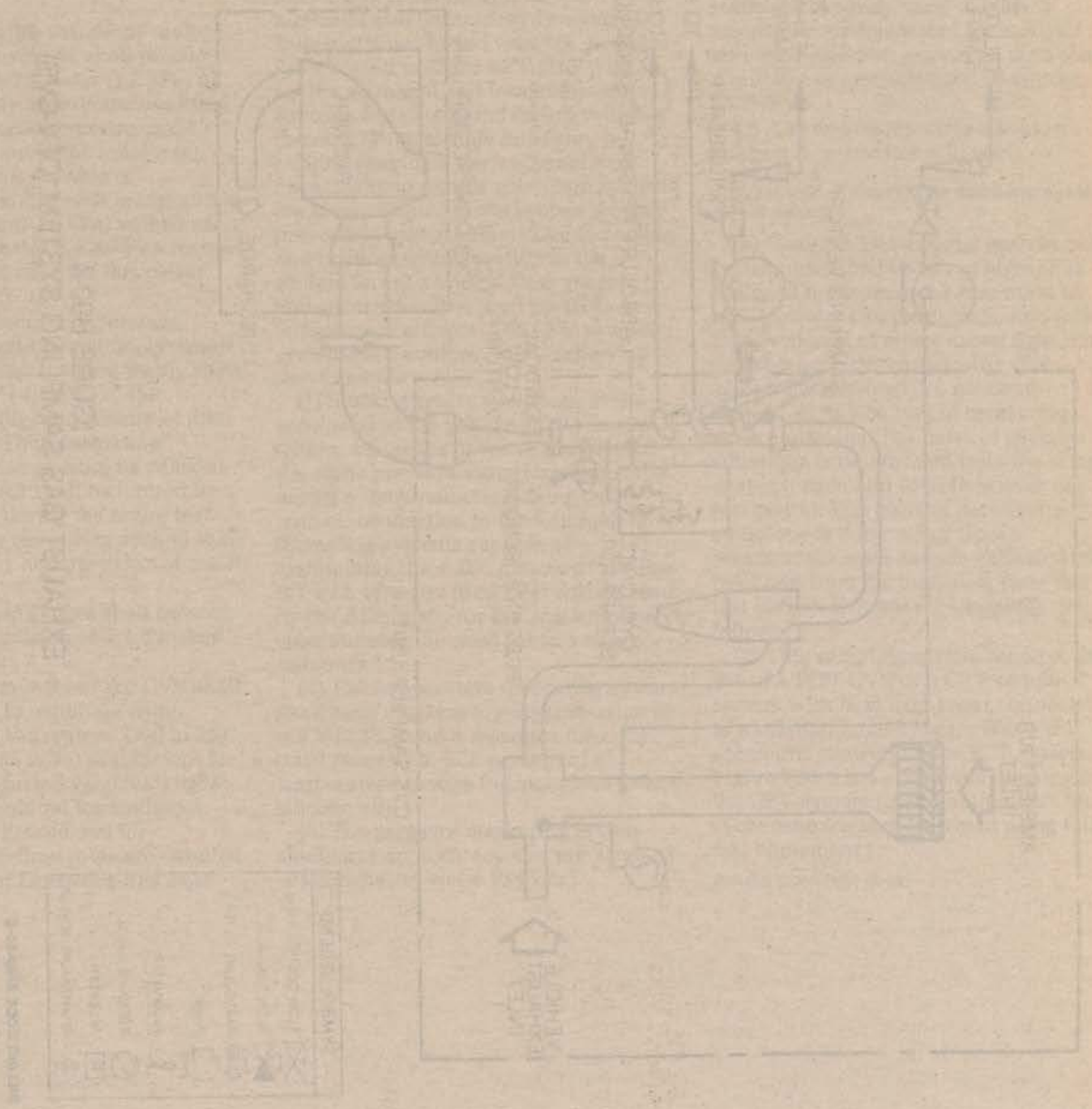
FIGURE B90-3 FORMALDEHYDE SAMPLE COLLECTION FLOW SCHEMATIC

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(4) *Critical flow venturi.* The operation of the Critical Flow Venturi—Constant Volume Sampler (CFV–CVS) sample system, Figure B90–4, is based upon the principles of fluid dynamics associated with critical flow. Proportional sampling throughout temperature excursions is maintained by use of small CFVs in the sample lines (for methanol-fueled vehicles, one line supplies sample for the bag sample, another line supplies sample for the methanol sample, and a third line supplies sample for the formaldehyde sample.) The methanol and formaldehyde sample lines are heated to 235°±15°F (113°±8°C) with care being taken to ensure that the CFVs of the sample probes are not heated since heating of the CFVs would cause loss of proportionality. The variable mixture flow rate is maintained at sonic velocity, is inversely proportional to the square root of the gas temperature, and is computed continuously. Since the pressure and temperature are the same at all venturi inlets, the sample volume is proportional to the total volume.

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

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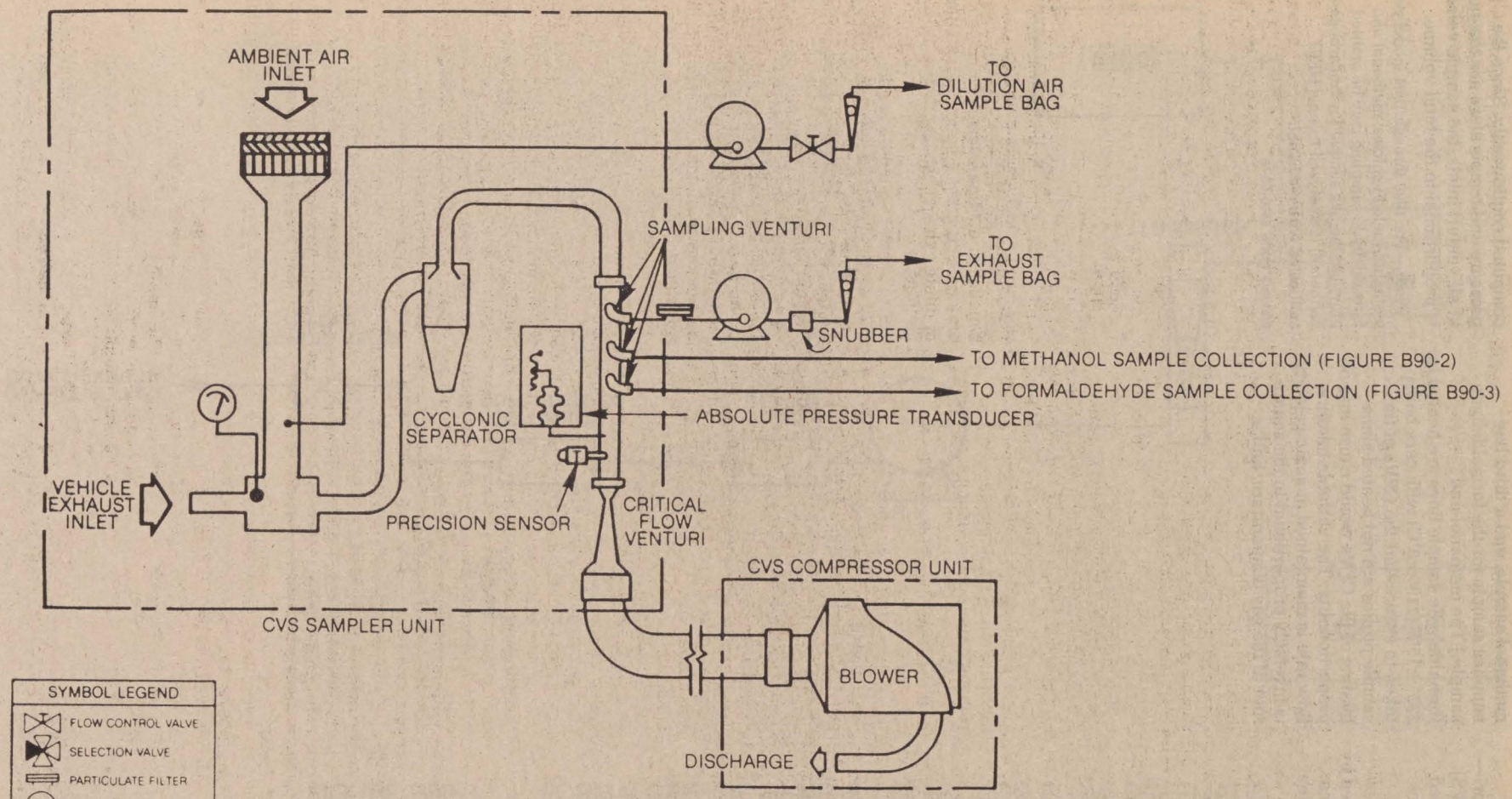


FIGURE B90-4
EXHAUST GAS SAMPLING SYSTEM (CFV-CVS)

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

(b) *Component description, PDP–CVS.* The PDP–CVS, Figure B90–1, consists of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling systems (see Figure B90–2 for methanol sampling system and Figure B90–3 for formaldehyde sampling system) sampling lines which are heated to 235°±15°F (113°±8°C) in the case of the methanol-fueled vehicles (heating of the sample lines may be omitted, provided the methanol and formaldehyde sample collection systems are close coupled to the probes thereby preventing loss of sample due to cooling and resulting condensation in the sample lines), and associated valves, pressure and temperature sensors. The PDP–CVS shall conform to the following requirements:

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

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

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

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

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

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

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

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

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

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

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

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

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

37. A new § 86.110–90 is added to Subpart B, to read as follows:

§ 86.110–90 Exhaust gas sampling system; diesel vehicles.

(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 either diesel light-duty vehicles and light-duty trucks. This system utilizes the CVS concept (described in § 86.109) of measuring mass emissions. 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 total flow over the test period. General requirements are as follows:

(1) This sampling system requires the use of a PDP–CVS or a CFV sample system with heat exchanger connected to a dilution tunnel. Figure B90–5 is a schematic drawing of the PDP system. Figure B90–6 is a schematic drawing of the CFV system (methanol-fueled Otto-cycle vehicles may be tested using this test equipment.)

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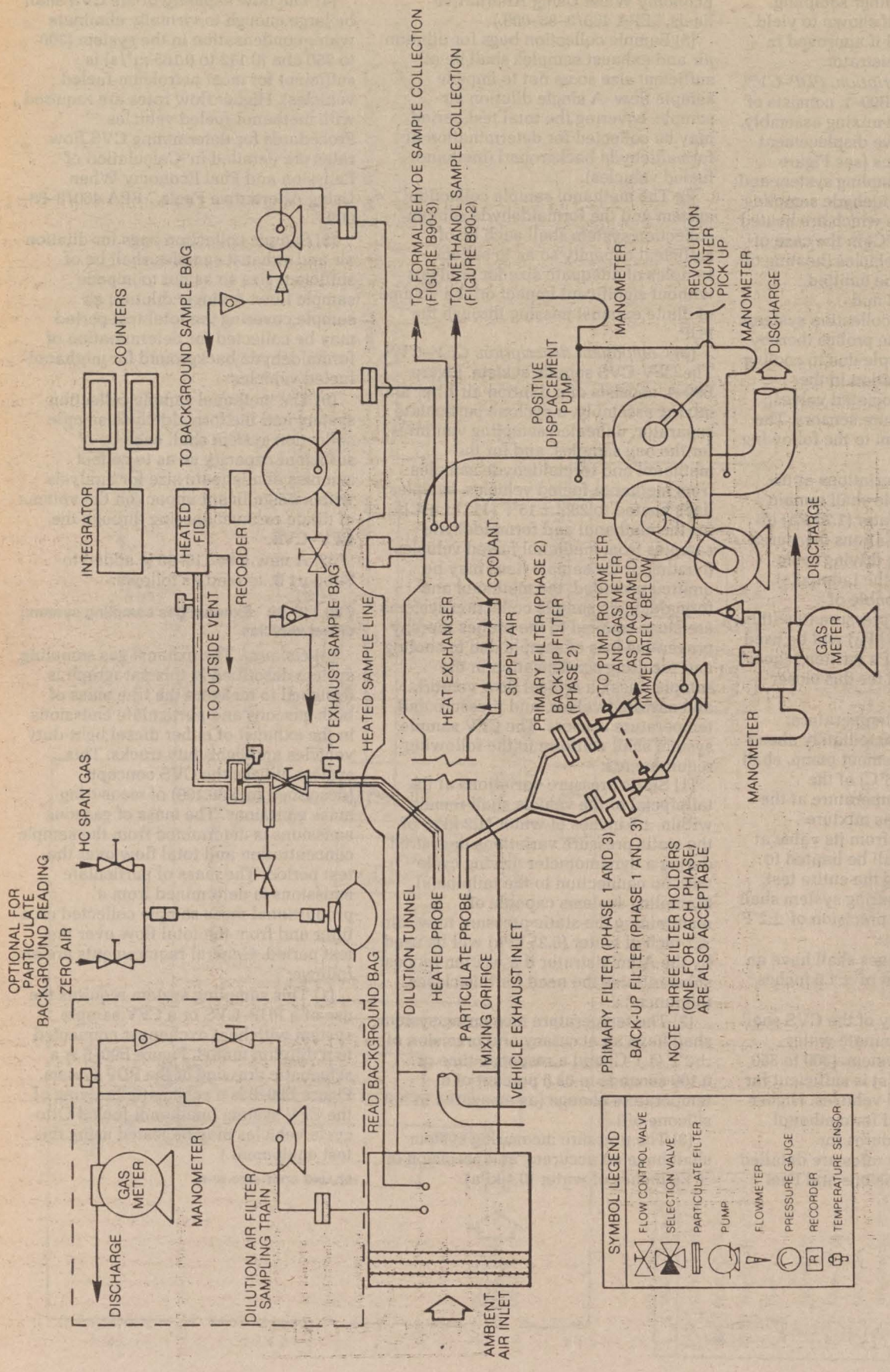


FIGURE B90-5
GASEOUS AND PARTICULATE EMISSIONS SAMPLING SYSTEM (PDP-CVS)

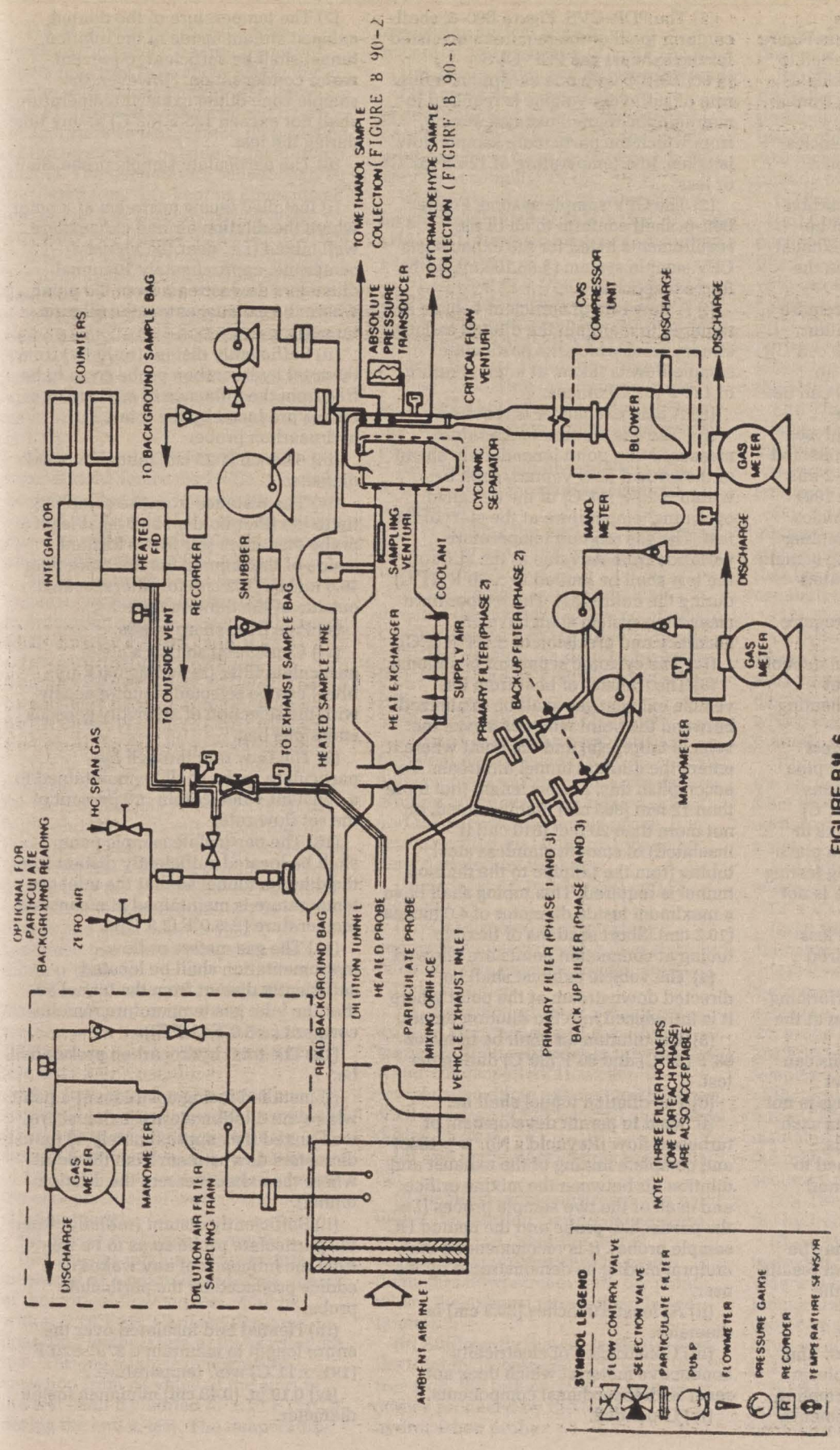


FIGURE B90-6

GASEOUS AND PARTICULATE EMISSIONS SAMPLING SYSTEM (CFV-CVS)

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(2) Bag, HFID, and particulate sampling capabilities as shown in Figure B90–5 (or Figure B90–6) are required to provide both gaseous and particulate emissions sampling capabilities from a single system.

(3) Petroleum-fueled diesel vehicles require a heated flame ionization detector (HFID) (375°±20°F (191°±11°C)) sample for hydrocarbon analysis. The HFID sample must be taken directly from the diluted exhaust stream through a heated probe in the dilution tunnel.

(4) Methanol-fueled vehicles require the use of a heated flame ionization detector (HFID) (235°±15°F (113°±8°C)) for hydrocarbon analysis. With an HFID, the hydrocarbon analysis can be made on the bag sample and the methanol and formaldehyde analyses are performed on the samples collected for these purposes (Figures B90–2 and B90–3). NOTE: For 1990 through 1994 model year methanol-fueled vehicles, methanol and formaldehyde sampling may be omitted provided the bag sample is analyzed using a HFID calibrated with methanol.

(5) Methanol-fueled vehicles require either:

(i) A tailpipe to dilution tunnel duct of unrestricted length maintained at 235°±15°F (113°±8°C) through heating and cooling as required; or

(ii) Using short duct (up to 12 feet long) constructed of smooth wall pipe with a minimum of flexible sections maintained at 235°±15°F (113°±°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 a smooth wall duct less than five feet long with no required heating, or

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

(6) Since various configurations can produce equivalent results, exact conformance with these drawings is not required. Additional components such as instruments, valves, solenoids, pumps, and switches may be used to provide additional information and coordinate the functions of the component systems.

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

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

(1) The PDP–CVS, Figure B90–5, 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 B90–6, shall conform to all of the requirements listed for the exhaust gas CFV sample system (§ 86.109(c)), with four 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°F (52°C) or less.

(ii) A heat exchanger is required.

(iii) The gas mixture temperature, measured at a point immediately ahead of the critical flow venturi, shall be within ±20°F (11°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 ±20°F (11°C) during the entire test. The temperature measuring system shall have an accuracy and precision of ±2°F (1.1°C).

(iv) The cyclonic separator is optional.

(3) The transfer of heat from the vehicle exhaust gas shall be minimized between the point where it leaves the vehicle tailpipe(s) and the point where it enters the dilution tunnel airstream. To accomplish this, a short length (not more than 12 feet (365 cm) if uninsulated, or not more than 20 feet (610 cm) if insulated) of smooth stainless steel tubing from the tailpipe to the dilution tunnel is required. This tubing shall have a maximum inside diameter of 4.0 inches (10.2 cm). Short sections of flexible tubing at connection points are allowed.

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

(5) The dilution air shall be between 68°F (20°C) and 86°F (30°C) during the test.

(6) The dilution tunnel shall be:

(i) Sized to permit development of turbulent flow (Reynold's No. >>4000) and complete mixing of the exhaust and dilution air between the mixing orifice and each of the two sample probes (*i.e.*, the particulate probe and the heated HC 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.

(7) 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°F (52°C) at any time during the test.

(8) 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 total hydrocarbon probe so as to be free from the influence of any wakes or eddies produced by the total hydrocarbon 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 5 probe diameters (for filters located inside of 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.

(9) The flow rate through the particulate probe shall be maintained to a constant value within ±5 percent of the set flow rate.

(10) 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 (±5.0°F (2.8°C)).

(11) The gas meters or flow instrumentation shall be located sufficiently distant from the tunnel so that the inlet gas temperature remains constant (±5.0°F (2.8°C)).

(12) The total hydrocarbon probe shall be:

(i) Installed facing upstream at a point where the dilution air and exhaust are well mixed (*i.e.*, approximately 10 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 or eddies produced by the particulate probe.

(iii) Heated and insulated over the entire length to maintain a 375°±20°F (191°±11°C) *wall* temperature.

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

(13) It is intended that the total hydrocarbon probe be free from cold spots (*i.e.*, free from spots where the probe *wall* temperature is less than 355°F). 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 ±2°F (1.1°C).

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

(i) At 375°F±10°F (191°C±6°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 375°F±10°F (191°C±6°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).

(15) It is intended that the dilute exhaust gas flowing in the total hydrocarbon sample system be between 365°F and 385°F (185°C and 197°C).

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

(1) The PDP–CVS, Figure B90–5 shall conform to all of the requirements listed for the exhaust gas PDP–CVS (§ 86.109 (a)(3) and (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 and shall prevent the condensation of water vapor in the dilution tunnel.

(2) The CFV sample system, Figure B90–6 shall conform to all of the requirements listed for the exhaust gas CFV sample system (§ 86.109 (a)(4) and (c)), with four 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°F (52°C) or less and shall prevent the condensation of water vapor in the dilution tunnel.

(ii) A heat exchanger is required.

(iii) The gas mixture temperature, measured at a point immediately ahead of the critical flow venturi, shall be within ±20°F (11°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 ±20°F (11°C) during the entire test. The temperature measuring system shall have an accuracy and precision of ±2°F (1.1°C).

(iv) The cyclonic separator is optional.

(3) Losses of methanol due to condensation of water in the duct connecting the vehicle tail pipe to the dilation tunnel must be minimized. This may be accomplished by:

(i) The use of a duct of unrestricted length maintained at 235°±15°F (113°±8°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 235°±15°F (113°±8°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 a smooth wall duct less than five feet long with no required heating, or

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

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

(5) The dilution air shall be between 68°F (20°C) and 86°F (30°C) during the test.

(6) The dilution tunnel shall be:

(i) Sized to permit development of turbulent flow (Reynold's No. $>>4000$) 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.

(7) 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°F (52°C) at any time during the test.

(8) 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 total hydrocarbon probe so as to be free from the influence of any wakes or eddies produced by the total hydrocarbon 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 5 probe diameters (for filters located inside of 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.

(9) The flow rate through the particulate probe shall be maintained to a constant value within ±5 percent of the set flow rate.

(10) 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 (±5.0°F (2.8°C)).

(11) The gas meters or flow instrumentation shall be located sufficiently distant from the tunnel so that the inlet gas temperature remains constant (±5.0°F (2.8°C)).

(12) The hydrocarbon probe shall be:

(i) Installed facing upstream at a point where the dilution air and exhaust are well mixed (*i.e.*, approximately 10 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 or eddies produced by the particulate probe.

(iii) Heated and insulated over the entire length to maintain a 235°±15°F (113°±8°C) *wall* temperature.

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

(13) It is intended that the total hydrocarbon probe be free from cold spots (*i.e.*, free from cold spots where the probe *wall* temperature is less than 220°F.) 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 ±2°F (1.1°C).

(14) 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°F±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).

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

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

(d) Filters, particulate sampling.

(1) Filter acceptance criteria. Valid diesel particulate net filter weights shall be accepted according to the following criteria:

(i) During each phase of the UDDS, dilute exhaust will be simultaneously sampled by paired primary test and back-up test filters.

(ii) The back-up filter holder shall be located 3 to 4 inches downstream of the primary filter holder.

(iii) The net weight of particulate material collected on each primary test filter and each back-up test filter shall be determined by the procedure outlined in § 86.139.

(iv) A ratio of net weights will be determined by the following formula:

$$\text{Ratio of net weights} = \frac{(\text{Mass Particulate})_{\text{primary filter}}}{(\text{Mass Particulate})_{\text{primary filter}} + (\text{Mass Particulate})_{\text{back-up filter}}}$$

(v) If the ratio is greater than 0.95, then particulate emissions calculations are based on the net weight of the primary filter only.

(vi) If the ratio is less than 0.95, then particulate emissions calculations are based on the combined net weights of the back-up test filter and the primary test filter.

(2) The particulate filter must have a minimum 47 mm diameter (37 mm stain area). Larger diameter filters are also acceptable. (Larger diameter filters may be desirable in order to reduce the pressure drop across the filter when testing vehicles which produce large amounts of particulate.)

(3) The recommended minimum loading on the primary 47 mm filter is 0.5 milligrams. Equivalent loadings (i.e., mass/stain area) are recommended for larger filters.

(4) Fluorocarbon coated glass fiber filters or fluorocarbon-based (membrane) filters are required for particulate collection.

38. A new § 86.111–90 is added to Subpart B, to read as follows:

§ 86.111–90 Exhaust gas analytical system.

(a) *Schematic drawings.* Figure B90–7 is a schematic drawing of the exhaust gas analytical system for analysis of hydrocarbons (HC) (hydrocarbons plus methanol in the case of methanol-fueled vehicles), carbon monoxide (CO), carbon dioxide (CO_2), and oxides of nitrogen (NOx). The schematic diagram of the hydrocarbon analysis train for diesel vehicles (and for hydrocarbons plus methanol for methanol-fueled diesel vehicles if continuous HFID analysis is employed) is shown as part of Figure B90–5 (or Figure B90–6). Since various configurations can produce accurate results, exact conformance with either drawing is not required. Additional components such as instruments, valves, solenoids, pumps and switches may be used to provide additional information and coordinate the functions of the component systems.

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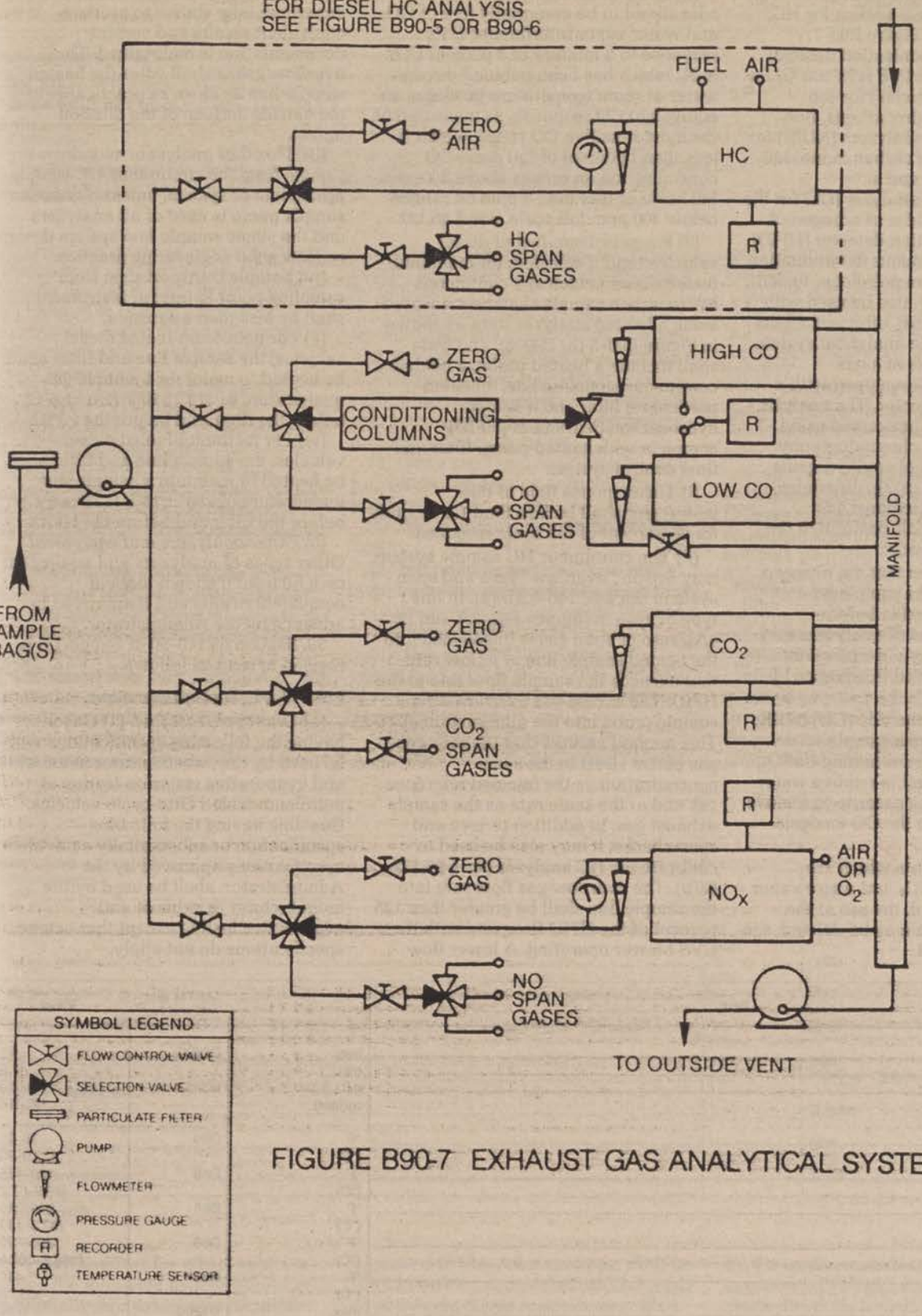


FIGURE B90-7 EXHAUST GAS ANALYTICAL SYSTEM

(b) *Major component description.* The exhaust gas analytical system for HC, CO, CO_2, and NOx, Figure B90–7, consists of a flame ionization detector (FID) (heated, 235°±15°F (113°±8°C) for methanol-fueled vehicles) for the determination of hydrocarbons, non-dispersive infrared analyzers (NDIR) for the determination of carbon monoxide and carbon dioxide and a chemiluminescence analyzer (CL) for the determination of oxides of nitrogen. A heated flame ionization detector (HFID) is used for the continuous determination of hydrocarbons from petroleum-fueled diesel vehicles (may also be used with methanol-fueled diesel vehicles), Figure B90–5 (or B90–6). The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

(1) The CL requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(2) The carbon monoxide (CO) NDIR analyzer may require a sample conditioning column containing $CaSO_4$, or indicating silica gel to remove water vapor and containing ascarite to remove carbon dioxide from the CO analysis stream.

(i) If CO instruments which are essentially free of CO_2 and water vapor interference are used, the use of the conditioning column may be deleted, see §§ 86.122 and 86.144.

(ii) A CO instrument will be considered to be essentially free of CO_2 and water vapor interference if its response to a mixture of 3 percent CO_2 in N_2 which has been bubbled through water at room temperature produces an equivalent CO response, as measured on the most sensitive CO range, which is less than 1 percent of full scale CO concentration on ranges above 300 ppm full scale or less than 3 ppm on ranges below 300 ppm full scale, see § 86.122.

(3) For petroleum-fueled diesel vehicles (and if selected, for methanol-fueled diesel vehicles) a continuous hydrocarbon sample shall be measured using a heated analyzer train as shown in Figure B90–5 (or B90–6). The train shall include a heated probe, a heated continuous sampling line, a heated particulate filter and a heated hydrocarbon instrument (HFID) complete with heated pump, filter and flow control system.

(i) The response time of this instrument shall be less than 1.5 seconds for 90 percent of full scale response.

(ii) The continuous HC sample system may use an "overflow" zero and span system; see § 86.140–82(b)(4). In this type of system (figures B82–3A and B82–4A), zero or span gas is introduced into the heated sample line at a flow rate that exceeds the sample flow rate to the HFID. The excess gas overflows the sample probe into the dilution tunnel. This method assures that the reference gas enters HFID in the same concentration as the injected reference gas and at the same rate as the sample exhaust gas. In addition to zero and span checks, it may also be used to calibrate the HC analyzer per § 86.121–82(b). The overflow gas flow rate into the sample line shall be greater than 125 percent of the HFID flow rate with the CVS blower operating. A lower flow rate may be used if it has been experimentally shown to produce equivalent results and current documentation is maintained. The overflow gases shall enter the heated sample line as close as practicable to the outside surface of the dilution tunnel.

(iii) No other analyzers may draw a sample from the continuous HC sample probe, line or system, unless a common sample pump is used of all analyzers and the single sample line system design reflects good engineering practice.

(iv) Sample transport time from sampling point to inlet of instrument shall be less than 4 seconds.

(v) For petroleum-fueled diesel vehicles, the sample line and filter shall be heated to maintain a sample gas temperature of 375°±10°F (191°±6°C) before the filter and before the HFID.

(vi) For methanol-fueled diesel vehicles, the sample line and filter shall be heated to maintain a sample gas temperature of 235°±15°F (113°±8°C) before the filter and before the HFID.

(c) *Other analyzers and equipment.* Other types of analyzers and equipment may be used if shown to yield equivalent results and if approved in advance by the Administrator.

39. Section 86.113–90 of Subpart B is revised to read as follows:

§ 86.113–90 Fuel specifications.

(a) *Otto-cycle test fuel.* (1) Gasoline having the following specifications will be used by the Administrator in exhaust and evaporative emission testing of petroleum fueled Otto-cycle vehicles. Gasoline having the following specification or substantially equivalent specifications approved by the Administrator, shall be used by the manufacturer in exhaust and evaporative testing except that octane specifications do not apply.

Item		ASTM test method No.	Value
Octane, research	min.	D2699	93
Sensitivity	min.		7.5
Lead (organic)	g/U.S.gal.	D3237	[1]0.050
	(g/liter)		[1](0.013)
Distillation range:			
IBP [2]	°F	D86	75–95
	(°C)		(23.9–35)
10 pct. point	°F	D86	120–135
	(°C)		(48.9–57.2)
50 pct. point	°F	D86	200–230
	(°C)		(93.3–110)
90 pct. point	°F	D86	300–325
	(°C)		(148.9–162.8)
EP (max.)	°F	D86	415
	(°C)		(212.8)
Sulfur, weight pct.	max.	D1266	0.10
Phosphorus, max	g/U.S. gal.	D3231	0.005
	(g/liter)		(0.0013)
RVP [3,4]	psi	D3231	8.7–9.2
	(kPa)		(60.0–63.4)

Item		ASTM test method No.	Value
Hydrocarbon composition:			
Olefins	max. pct.	D1319	10
Aromatics	max. pct.	D1319	35
Saturates		D1319	[5]

[1] Maximum.
[2] For testing at altitudes above 1,219 m (4,000 ft) the specified range is 75°–105 °F (23.9°–40.6 °C).
[3] For testing which is unrelated to evaporative emission control, the specified range is 8.0–9.2 psi (55.2–63.4 kPa).
[4] For testing at altitudes above 1,219 m (4,000 ft) the specified range is 7.9–9.2 psi (54.5–63.4 kPa).
[5] Remainder

(2) Unleaded gasoline representative of commercial gasoline which will be generally available through retail outlets shall be used in service accumulation for petroleum-fueled Otto-cycle vehicles. Leaded gasoline will not be used in service accumulation.

(i) The octane rating of the gasoline used shall be no higher than 1.0 Research octane number above the minimum recommended by the manufacturer and have a minimum sensitivity of 7.5 octane numbers, where sensitivity is defined as the Research octane number minus the Motor octane number.

(ii) The Reid Vapor Pressure of the gasoline used shall be characteristic of the motor fuel used during the season in which the service accumulation takes place.

(3) Methanol fuel used for exhaust and evaporative emission testing and in service accumulation of methanol-fueled Otto-cycle vehicles shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol by volume.

(i) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (a)(3) of this section.

(ii) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(4) Other methanol fuels may be used for testing and service accumulation provided:

(i) They are commercially available, and

(ii) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(iii) Use of a fuel listed under paragraph (a)(3) of this section would have a detrimental effect on emissions or durability, and

(iv) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(5) The specification range of the fuels to be used under paragraphs (a)(2), (a)(3), and (a)(4) of this section shall be reported in accordance with § 86.090–21(b)(3).

(b) *Diesel test fuel.* (1) The petroleum fuels employed for testing diesel vehicles shall be clean and bright, with pour and cloud points adequate for operability. The petroleum fuel may contain nonmetallic additives as follows: cetane improver, metal deactivator, antioxidant, dehazer, antirust, pour depressant, dye, dispersant and biocide.

(2) Petroleum fuel for diesel vehicles meeting the following specifications, or substantially equivalent specifications approved by the Administrator, shall be used in exhaust emission testing. The grade of petroleum fuel recommended by the engine manufacturer, commercially designated as "Type 2–D" grade diesel, shall be used.

Item		ASTM test method No.	Type 2–D
Cetane number		D613	42–50
Distillation range:			
IBP	°F	D86	340–400
	(°C)		(171.1–204.4)
10 pct. point	°F	D86	400–460
	(°C)		(204.4–237.8)
50 pct. point	°F	D86	470–540
	(°C)		(243.3–282.2)
90 pct. point	°F	D86	550–610
	(°C)		(287.8–321.1)
EP	°F	D86	580–660
	(°C)		(304.4–348.9)
Gravity	°API	D287	33–37
Total sulfur	pct.	D129, or D2622	0.2–0.5
Hydrocarbon composition:			
Aromatics, min.	pct.	D1319	27
Paraffins, naphthenes, olefins			[1]
Flashpoint, min.	°F	D93	130
	(°C)		(54.4)
Viscosity, centistokes		D445	2.0–3.2

[1] Remainder

(3) Petroleum fuel for diesel vehicles meeting the following specifications, or substantially equivalent specifications approved by the Administrator, shall be used in service accumulation. The grade of petroleum diesel fuel recommended by the engine manufacturer, commercially designated as "Type 2–D" grade diesel fuel, shall be used.

Item		ASTM test method No.	Type 2-D
Cetane number		D613	38–58
Distillation range:			
90 pct. point	°F	D86	430–630
	(°C)		(221.1–332.2)
Gravity	°API	D287	30–42
Total sulfur	min., pct.	D129 or D2622	0.20
Flashpoint, min.	°F	D93	130
	(°C)		(54.4)
Viscosity	centistokes	D455	1.5–4.5

(4) Methanol fuel used for exhaust and evaporative emission testing and in service accumulation of methanol-fueled diesel vehicles shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol by volume.

(i) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (b)(4) of this section.

(ii) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(5) Other fuels may be used for testing and service accumulation provided:

(i) They are commercially available, and

(ii) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(iii) Use of a fuel listed under paragraphs (b)(2) and (b)(3) or (b)(4) of this section would have a detrimental effect on emissions or durability, and

(iv) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(6) The specification range of the fuels to be used under paragraphs (b)(2), (b)(3), (b)(4), and (b)(5) of this section shall be reported in accordance with § 86.090–21(b)(3).

(c) Fuels not meeting the specifications set forth in this section may be used only with the advance approval of the Administrator.

(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 be within the range of fuel mixtures for which the vehicle was designed.

(2) Manufacturer testing and service accumulation may be performed using only those mixtures (mixtures may be different for exhaust testing, evaporative testing, and service accumulation) expected to result in the highest emissions, provided:

(i) The fuels which constitute the mixture will be used in customer service, and

(ii) Information, acceptable to the Administrator, is provided by the manufacturer to show that the designated fuel mixtures would result in the highest emissions, and

(iii) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(3) The specification range of the fuels to be used under paragraph (d)(1) of this section shall be reported in accordance with § 86.090–21(b)(3).

40. A new § 86.116–90 is added to Subpart B, to read as follows:

§ 86.116–90 Calibrations, frequency and overview.

(a) Calibrations shall be performed as specified in § 86.117 through § 86.126.

(b) At least yearly or after any maintenance which could alter background emission levels, evaporative enclosure background emission measurements shall be performed.

(c) At least monthly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

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

(2) Calibrate the dynamometer. If the dynamometer receives a weekly performance check (and remains within calibration) the monthly calibration need not be performed.

(3) Perform a hydrocarbon and methanol (if methanol fuel is used) retention check and calibration on the evaporative emission enclosure.

(4) Calibrate the gas meters or flow instrumentation used for providing total flow measurement for particulate sampling.

(d) At least weekly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

(1) Check the oxides of nitrogen converter efficiency, and

(2) Perform a CVS system verification.

(3) Run a performance check on the dynamometer. This check may be omitted if the dynamometer has been calibrated within the preceeding month.

(e) The CVS positive displacement pump or Critical Flow Venturi shall be calibrated following initial installation, major maintenance, or as necessary when indicated by the CVS system verification (described in § 86.119).

(f) Sample conditioning columns, if used in the CO analyzer train, should be checked at a frequency consistent with observed column life or when the indicator of the column packing begins to show deterioration.

41. A new § 86.117–90 is added to Subpart B, to read as follows:

§ 86.117–90 Evaporative emission enclosure calibrations.

The calibration of the evaporative emission enclosure consists of three parts: Initial and periodic determination of enclosure background emissions (hydrocarbons and methanol); initial determination of enclosure internal volume; and periodic hydrocarbon and methanol retention check and calibration. Methanol measurements may be omitted when methanol-fueled vehicles will not be tested in the evaporative enclosure.

(a) *Initial and periodic determination of enclosure background emissions.* Prior to its introduction into service, annually thereafter, and after any repair which can affect the enclosure background emissions, the enclosure shall be checked to determine that it does not contain materials which will themselves emit hydrocarbons or methanol. *Proceed as follows:

*Note: When methanol as well as hydrocarbons are present in the evaporative enclosure, the HFID hydrocarbon concentration measurement includes the partial response of the HFID to methanol plus the hydrocarbons. Determination of the HFID response to methanol, § 86.121, prior to its

being placed in service is required for the determination of hydrocarbons.

(1) Zero and span (calibrate if required) the hydrocarbon analyzer.

(2) Purge the enclosure until a stable background hydrocarbon reading is obtained.

(3) Turn on the mixing blower (if not already on).

(4) Seal enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HCi}, C_{CH_3OHi}, and P_{Bi}, T_i, for the enclosure background determination.

(5) Allow the enclosure to stand undisturbed without sampling for four hours.

(6) Measure the hydrocarbon concentration on the same FID and the methanol level. These are the final concentrations, C_{HCf} and C_{CH_3OHf}. Also measure final temperature and barometric pressure.

(7) Calculate the mass change of methanol, hydrocarbons, and hydrocarbons plus methanol in the enclosure according to the equations in paragraph (d) of this section. The enclosure background emissions (hydrocarbons plus methanol) shall not be greater than 0.4g for the 4 hours.

(b) *Initial determination of enclosure internal volume.* Prior to its introduction into service the enclosure internal volume shall be determined by the following procedure:

(1) Carefully measure the internal length, width and height of the enclosure, accounting for irregularities (such as braces) and calculate the internal volume.

(2) Perform an enclosure calibration check according to paragraphs (c) (1) through (7) of this section.

(3) If the calculated mass does not agree within 2 percent of the injected propane mass, then corrective action is required.

(c) *Hydrocarbon and methanol 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 enclosure leak rate shall be determined as follows:

(1) Zero and span (calibrate if required) the hydrocarbon analyzer.

(2) Purge the enclosure until a stable background hydrocarbon reading is obtained.

(3) Turn on the mixing blower (if not already on).

(4) Seal enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HCi}, C_{CH_3OHi}, T_i and P_{Bi} for the enclosure calibration.

(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 and precision of ±0.5 percent of the measured value.

(6) After a minimum of 5 minutes of mixing, analyze the enclosure atmosphere for hydrocarbon and methanol content, also record temperature and pressure. These measurements are the final readings for the enclosure calibration as well as the initial readings for the retention check.

(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.

(8) Allow the enclosure to remain sealed for a minimum of 4 hours, analyze the enclosure atmosphere for hydrocarbon and methanol content; record temperature and barometric pressure. These are the final readings for the hydrocarbon and methanol retention check.

(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).

(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:

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

Where:

(i) M_{CH_3OH} = Methanol mass change, μg.

(ii) V = Enclosure volume, ft^3, as measured in paragraph (b)(1) of this section.

(iii) C_{MR} = Concentration of methanol in standard sample for calibration of GC, μg/ml.

(iv) A_{MR} = GC peak area of standard sample.

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

(vi) T_{SHED} = Temperature of SHED, °R.

(vii) V_E = Volume of sample withdrawn, ft^3.

(viii) P_B=Barometric pressure at time of sampling, in. Hg.
(ix) A_{MS}=GC peak area of test sample.
(x) AV=Volume of absorbing reagent in impinger (ml).
(xi) i=Initial sample.
(xii) f=Final sample.
(xiii) 1=First impinger
(xiv) 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:

$$M_{HC}=kV\times10^{-4}\left(\frac{(C_{HCf}-rC_{CH_3OHf})\times P_{Bf}}{T_f}-\frac{(C_{HCi}-rC_{CH_3OHi})\times P_{Bi}}{T_i}\right)$$

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

$$=\left(\frac{1.501\times10^{-3}C_{MR}\times T_E}{A_{MR}\times P_B\times V_E}\right)[(A_{S1}\times AV_1)+(A_{S2}\times AV_2)]$$

(iv) V=Enclosure volume ft^3 (m^3), as measured in paragraph (b)(1) of this section.
(v) r=FID response factor to methanol.
(vi) P_B=Barometric pressure, in. Hg. (kPa).
(vii) T=Enclosure ambient temperature, °R(°K).
(viii) i=Indicates initial reading.
(ix) f=Indicates final reading.
(x)(A) k=3.05.
(B) *For SI units*, k=17.60.

Note:—Hydrocarbon concentration is stated in ppm carbon, that is, ppm propane × 3. Expressions in parentheses are for SI units.

42. A new § 86.119–90 is added to Subpart B, to read as follows:

§ 86.119–90 CVS calibration.

The CVS is calibrated using an accurate flowmeter and restrictor valve. Measurements of various parameters are made and related to flow through the unit. Procedures used by EPA for both PDP and CFV are outlined below. Other procedures yielding equivalent results may be used if approved in advance by the Administrator. After the calibration curve has been obtained, verification of the entire system can be performed by injecting a known mass of gas into the system and comparing the mass indicated by the system to the true mass injected. An indicated error does not necessarily mean that the calibration is wrong, since other factors can influence the accuracy of the system, *e.g.*, analyzer calibration. A verification procedure is found in paragraph (c) of this section.

(a) *PDP calibrations.* (1) The following calibration procedure outlines the equipment, the test configuration, and the various parameters which must be measured to establish the flow rate of the CVS pump. All the parameters related to the pump are simultaneously measured with the parameters related to a flowmeter which is connected in series with the pump. The calculated flow rate ft^3/min (at pump inlet absolute pressure and temperature) can then be plotted versus a correlation function which is the value on a specific combination of pump parameters. The linear equation which relates the pump flow and the correlation function is then determined. In the event that a CVS has a multiple speed drive, a calibration for each range used must be performed.

(2) This calibration procedure is based on the measurement of the absolute values of the pump and flowmeter parameters that relate the flow rate at each point. Three conditions must be maintained to assure the accuracy and integrity of the calibration curve. First, the pump pressures should be measured at taps on the pump rather than at the external piping on the pump inlet and outlet. Pressure taps that are mounted at the top center and bottom center of the pump drive headplate are exposed to the actual pump cavity pressures, and therefore reflect the absolute pressure differentials. Secondly, temperature stability must be maintained during the calibration. The laminar flowmeter is sensitive to inlet temperature oscillations which cause the data points to be scattered. Gradual changes (±2°F (1.1°C)) in temperature are acceptable as long as they occur over a period of several minutes. Finally, all connections between the flowmeter and the CVS pump must be absolutely void of any leakage.

(3) During an exhaust emission test the measurement of these same pump parameters enables the user to calculate the flow rate from the calibration equation.

(4) Connect a system as shown in Figure B90–8. Although particular types of equipment are shown, other configurations that yield equivalent results may be used if approved in advance by the Administrator. For the system indicated, the following data with given accuracy are required:

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Tolerances
Barometric pressure (corrected)	P_B	in. Hg (kPa)	±0.01 in. Hg (±0.034 kPa)
Ambient temperature	T_A	°F(°C)	±0.5°F (±0.28°C)
Air temperature into LFE	ETI	°F(°C)	±0.25°F (±0.14°C)
Pressure depression upstream of LFE	EPI	in. H_2O (kPa)	±0.05 in. H_{20} (±0.012 kPa)
Pressure drop across the LFE matrix	EDP	in. H_2O (kPa)	±0.005 in. H_2O (±0.001 kPa)
Air temperature at CVS pump inlet	PTI	°F(°C)	±0.5°F (±0.3°C)
Pressure depression at CVS pump inlet	PPI	in. fluid (kPa)	±0.05 in. fluid (±0.022 kPa)

CALIBRATION DATA MEASUREMENTS—Continued

Parameter	Symbol	Units	Tolerances
Specific gravity of manometer fluid (1.75 oil)	Sp. Gr.		
Pressure head at CVS pump outlet	PPO	in. fluid (kPa)	±0.05 in. fluid (±0.022 kPa)
Air temperature at CVS pump outlet (optional)	PTO	°F(°C)	±0.5°F (±0.28°C)
Pump revolutions during test period	N	Revs	±1 Rev.
Elapsed time for test period	t	sec	±0.05 sec.

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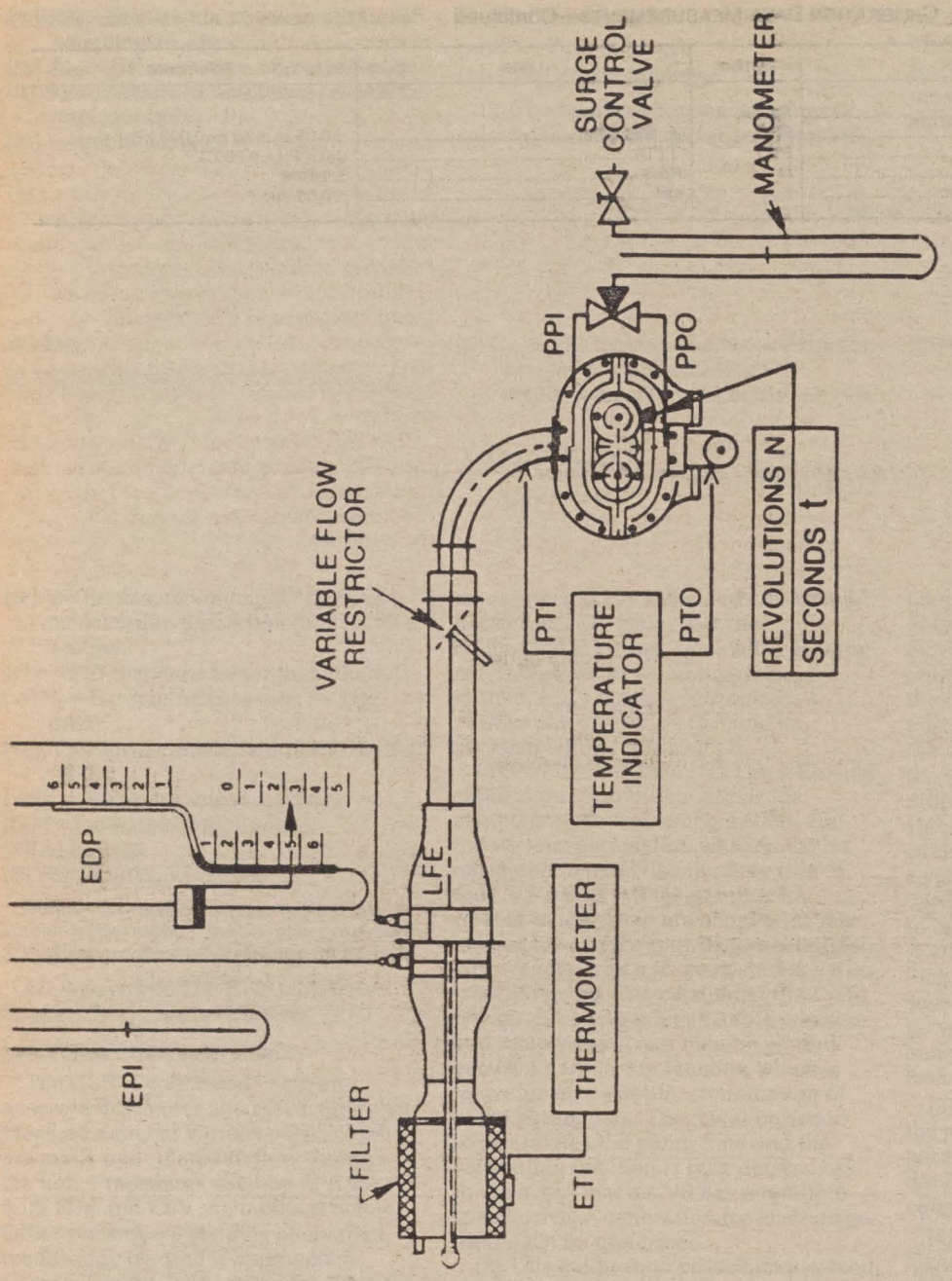


FIGURE B90-8 PDP-CVS CALIBRATION CONFIGURATION

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(5) After the system has been connected as shown in Figure B90–8, set the variable restrictor in the wide open position and run the CVS pump for 20 minutes. Record the calibration data.

(6) Reset the restrictor valve to a more restricted condition in an increment of pump inlet depression (about 4 in. H_2O (1.0 kPa) that will yield a minimum of six data points for the total calibration. Allow the system to stabilize for 3 minutes and repeat the data acquisition.

(7) Data analysis:

(i) The air flow rate, Q_s, at each test point is calculated in standard cubic feet per minute from the flowmeter data using the manufacturer's prescribed method.

(ii) The air flow rate is then converted to pump flow, V_o, in cubic feet per revolution at absolute pump inlet temperature and pressure:

$$V_o = (Q_s/n) \times (T_p/528) \times (29.92/P_p)$$

Where:

(A) V_o = Pump flow ft^3/rev (m^3/rev) at T_p, P_p.

(B) Q_s = Meter air flow rate in standard cubic feet per minute, standard conditions are 68 °F, 29.92 in. Hg (20 °C, 101.3 kPa).

(C) n = Pump speed in revolutions per minute.

(D)(*1*) T_p = Pump inlet temperature, °R(°K) = PTI + 460.

(*2*) *For SI units*, T_p = PTI + 273.

(E)(*1*) P_p = Absolute pump inlet pressure, in. Hg. (kPa) = P_B − PPI (SP.GR./13.57).

(*2*) *For SI units*, $P_p = P_B - PPI$.

Where:

(F) P_B = barometric pressure, in. Hg. (kPa).

(G) PPI = Pump inlet depression, in. fluid (kPa).

(H) SP.GR. = Specific gravity of manometer fluid relative to water.

(iii) The correlation function at each test point is then calculated from the calibration data:

$$X_o = \frac{1}{n}\sqrt{\frac{\Delta P_p}{P_e}}$$

Where:

(A) X_o = correlation function.

(B) ΔP_p = the pressure differential from pump inlet to pump outlet, in. Hg (kPa) = $P_e - P_p$.

(C)(*1*) P_e = Absolute pump outlet pressure, in Hg, (kPa) = $_{PB}$ + PPO (SP.GR./13.57].

(*2*) *For SI units*, $P_e = P_B + PPO$.

Where:

(D) PPO = Pressure head at pump outlet, in. fluid (kPa).

(iv) A linear least squares fit is performed to generate the calibration equations which have the forms:

$$V_o = D_o - M(X_o)$$
$$n = A - B(\Delta P_p)$$

D_o, M, A, and B are the slope-intercept constants describing lines.

(8) A CVS system that has multiple speeds should be calibrated on each speed used. The calibration curves generated for the ranges will be approximately parallel and the intercept values, D_o, will increase as the pump flow range decreases.

(9) If the calibration has been performed carefully, the calculated values from the equation will be within ±0.50 percent of the measured value of V_o. Values of M will vary from one pump to another, but values of D_o for pumps of the same make, model, and range should agree within ±3 percent of each other. Particulate influx from use will cause the pump slip to decrease as reflected by lower values for M. Calibrations should be performed at pump start-up and after major maintenance to assure the stability of the pump slip rate. Analysis of mass injection data will also reflect pump slip stability.

(b) *CFV calibration.* (1) Calibration of the CFV is based upon the flow equation for a critical venturi. Gas flow is a function of inlet pressure and temperature:

$$Q_s = \frac{K_v P}{\sqrt{T}}$$

Where:

(i) Q_s = Flow.

(ii) K_v = Calibration coefficient.

(iii) P = Absolute pressure.

(iv) T = Absolute temperature.

The calibration procedure described below establishes the value of the calibration coefficient at measured values of pressure, temperature and air flow.

(2) The manufacturer's recommended procedure shall be followed for calibrating electronic portions of the CFV.

(3) Measurements necessary for flow calibration are as follows:

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Tolerances
Barometric pressure (corrected)	P_B	in. Hg (kPa)	±0.01 in. Hg (±0.034 kPa).
Air temperature, into flowmeter	ETI	°F(°C)	±0.25 °F(±0.14 °C).
Pressure depression upstream of LFE	EPI	in. H_2O (kPa)	±0.05 in. H_2O (±0.0l2 kPa).
Pressure drop across LFE matrix	EDP	in. H_2O (kPa)	±0.005 in. H_2O (±0.001 kPa).
Air flow	Q_s	ft^3/min (m^3/min)	±0.5%.
CFV inlet depression	PPI	in. fluid (kPa)	±0.05 in. fluid (±0.022 kPa).
Temperature at venturi inlet	T_v	°F(°C)	±0.5 °F (±0.28 °C.
Specific gravity of manometer fluid (1.75 oil)	Sp. Gr.		

(4) Set up equipment as shown in Figure B90–9 and check for leaks. Any leaks between the flow measuring device and the critical flow venturi will seriously affect the accuracy of the calibration.

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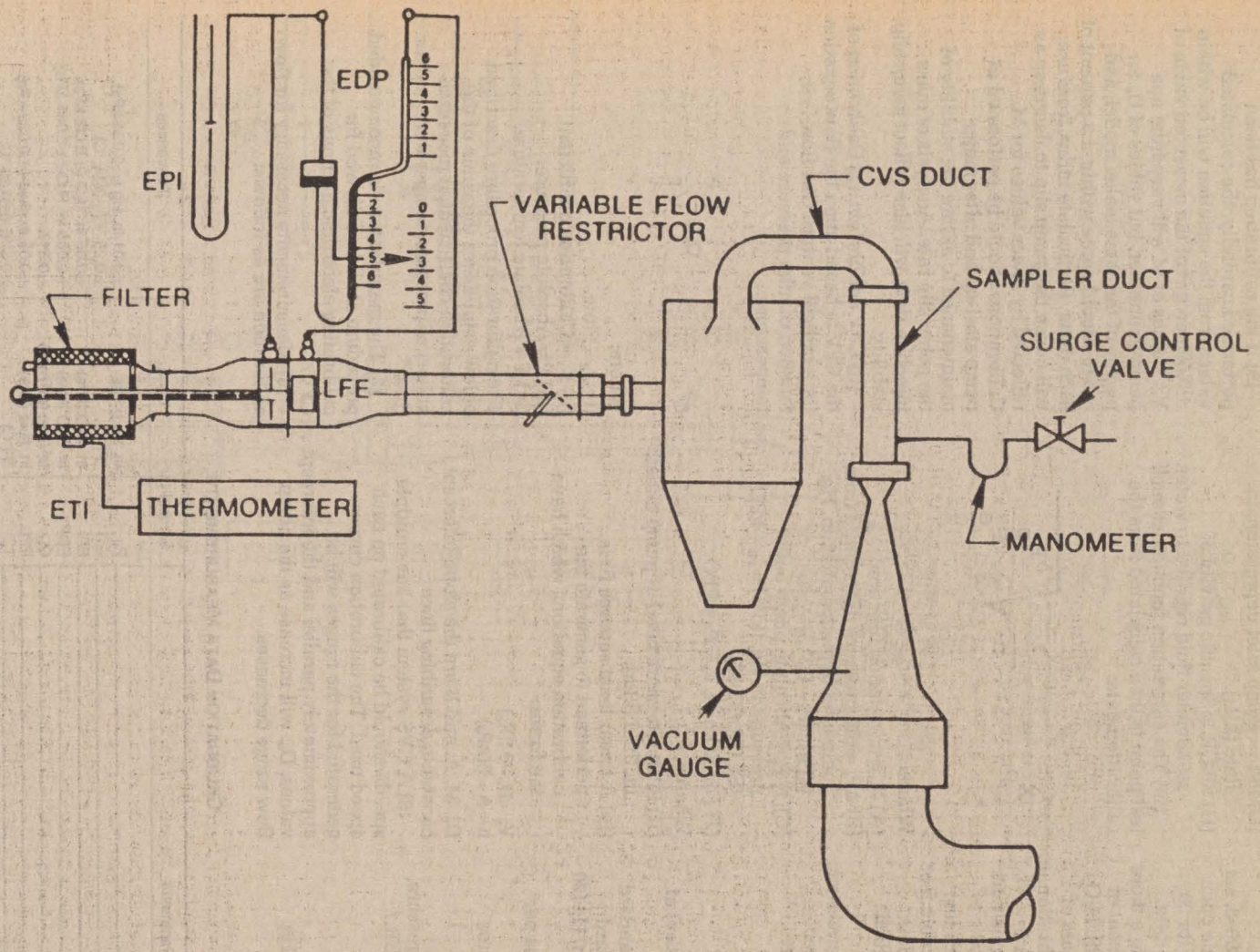


FIGURE B90-9 CFV-CVS CALIBRATION CONFIGURATION

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(5) Set the variable flow restrictor to the open position, start the blower, and allow the system to stabilize. Record data from all instruments.

(6) Vary the flow restrictor and make at least 8 readings across the critical flow range of the venturi.

(7) *Data analysis:* The data recorded during the calibration are to be used in the following calculations:

(i) The air flow rate, Q_s, at each test point is calculated in standard cubic feet per minute from the flow meter data using the manufacturer's prescribed method.

(ii) Calculate values of the calibration coefficient for each test point:

$$K_v = \frac{Q_s\sqrt{T_v}}{P_v}$$

Where:

(A) Q_s = Flow rate in standard cubic feet per minute, standard conditions are 68 °F 29.92 in. Hg (20 °C, 101.3 kPa).

(B) T_v = Temperature at venturi inlet, °R(°K).

(C)(*1*) P_v = Pressure at venturi inlet, mm Hg (kPa) = P_B − PPI (SP.GR./13.57).

(*2*) *For SI units,* $P_v = P_B - PPI$.

Where:

(D) PPI = Venturi inlet pressure depression, in. fluid (kPa).

(E) SP.GR. = Specific gravity of manometer fluid, relative to water.

(iii) Plot K_v as a function of venturi inlet pressure. For sonic flow K_v will have a relatively constant value. As pressure decreases (vacuum increases), the venturi becomes unchoked and K_v decreases. See Figure B90–10.

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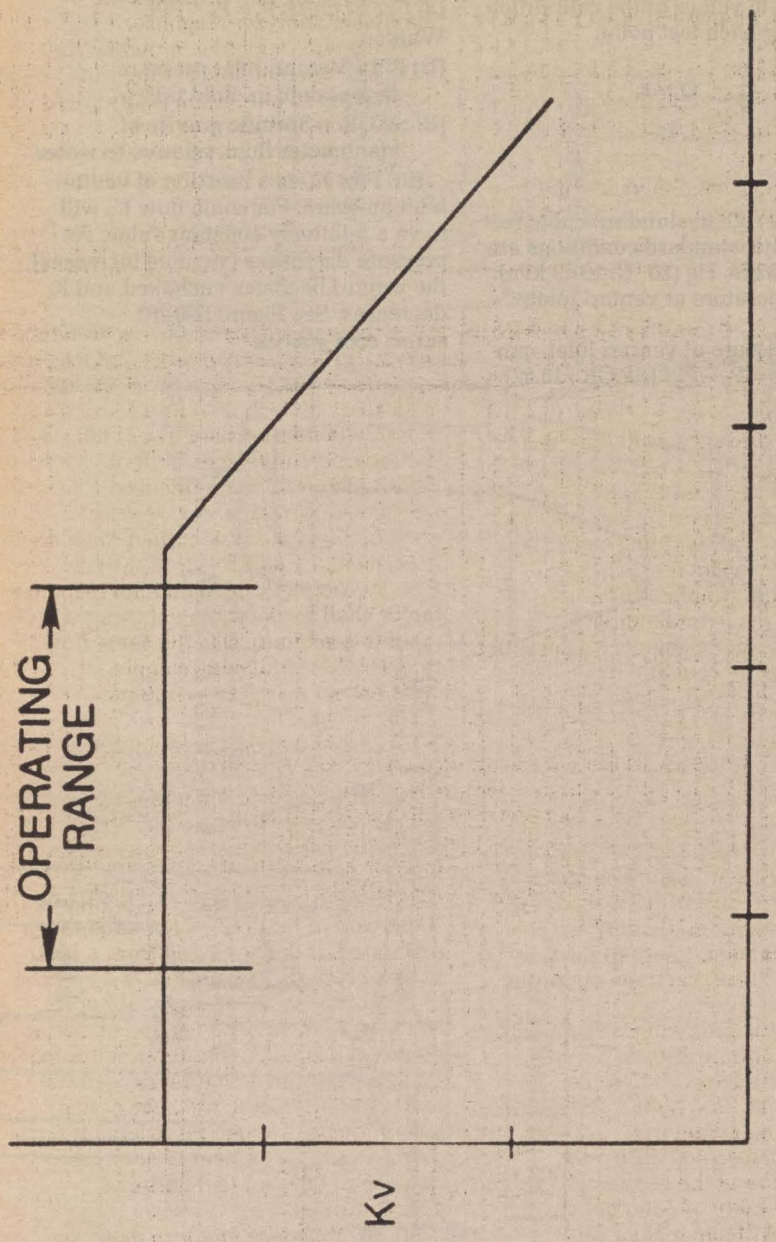


FIGURE B90-10 SONIC FLOW CHOKING

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(iv) For a minimum of 8 points in the critical region calculate an average K_v and the standard deviation.

(v) If the standard deviation exceeds 0.3 percent of the average K_v take corrective action.

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

(1) Obtain a small cylinder that has been charged with pure propane or carbon monoxide gas (CAUTION—carbon monoxide is poisonous). Obtain another small cylinder which has been charged with pure methanol if the system will be used for methanol-fueled vehicle testing. Since this cylinder will be heated to 150–155°F, care must be taken to ensure that the liquid volume of methanol placed in the cylinder does not exceed approximately one-half of the total volume of the cylinder.

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

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

(4) Following the completion of step (3) above, continue to operate the CVS in the normal manner and release a quantity of pure methanol into the system during the sampling period (approximately 5 minutes).

(5) The calculations of § 86.144 are performed in the normal way, except in the case of propane. The density of propane (17.30 g/ft³/carbon atom (0.6109 kg/m³/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of carbon monoxide, the density of 32.97 g/ft³ (1.164 kg/m³) is used. In the case of methanol, the density of 37.71 g/ft³ (1.332 kg/m³) is used.

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

(7) The cause for any discrepancy greater than ±2 percent must be found and corrected.

43. A new § 86.121–90 is added to Subpart B, to read as follows:

§ 86.121–90 Hydrocarbon analyzer calibration.

The hydrocarbon analyzers shall receive the following initial and periodic calibration. The HFID used with petroleum-fueled diesel vehicles shall be operated at a temperature of 375 °F±10 °F (191 °±6 °C). The HFID used with methanol-fueled vehicles shall be operated at 235 °±15 °F (113±8 °C).

(a) *Initial and periodic optimization of detector response.* Prior to its introduction into service and at least annually thereafter, the FID and HFID hydrocarbon analyzers shall be adjusted for optimum hydrocarbon response. Alternate methods yielding equivalent results may be used, if approved in advance by the Administrator.

(1) Follow the manufacturer's instructions or good engineering practice for instrument startup and basic operating adjustment using the appropriate FID fuel and zero-grade air.

(2) Optimize on the most common operating range. Introduce into the analyzer a propane in air mixture (methanol in air mixture for methanol-fueled vehicles when optional methanol calibrated HFID procedure is used during the 1990 through 1994 model year) with a propane (or methanol) concentration equal to approximately 90 percent of the most common operating range.

(3) One of the following is required for FID or HFID optimization:

(i) For all FIDs and HFIDs, the procedures specified by the applicable FID or HFID manufacturer.

(ii) For Beckman 400 FIDs only, implementation of the recommendations outlined in Society of Automotive Engineers (SAE) paper No. 770141, "Optimization of Flame Ionization Detector for Determination of Hydrocarbons in Diluted Automobile Exhaust"; author, Glenn D. Reschke.

(iii) For HFIDs only, the following peaking procedure. (A) With the fuel and air flow rates set in the manufacturer's recommendations, determine the analyzer response 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 the span and zero response at these fuel flows. A plot of the difference between the span and zero response versus the fuel flow will be similar to the one shown in Fig. B87–11. Adjust the fuel-flow rate to the highest setting that produces the maximum analyzer response.

(B) To determine the optimum air flow, use the fuel flow setting determined in paragraph (a)(3)(iii)(A) of this section and vary air flow.

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

(4) To determine the optimum air flow, use the FID fuel flow setting determined above and vary air flow.

(5) After the optimum flow rates have been determined, record them for future reference.

(b) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter the FID or HFID hydrocarbon analyzers shall be calibrated on all normally used instrument ranges, and, if testing methanol vehicles under the procedure described in § 86.107–90(a)(2)(ii) or § S6.110–90(a)(4), the methanol response factor shall be determined (paragraph (c) of this section). Use the same flow rate as when analyzing sample.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero-grade air.

(3) Calibrate on each normally used operating range with propane in air calibration gases (methanol in air as appropriate) having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. For each range calibrated, if the deviation from a least squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

(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.

(1) The bag sample of methanol for analysis in the FID 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 dry gas meter.

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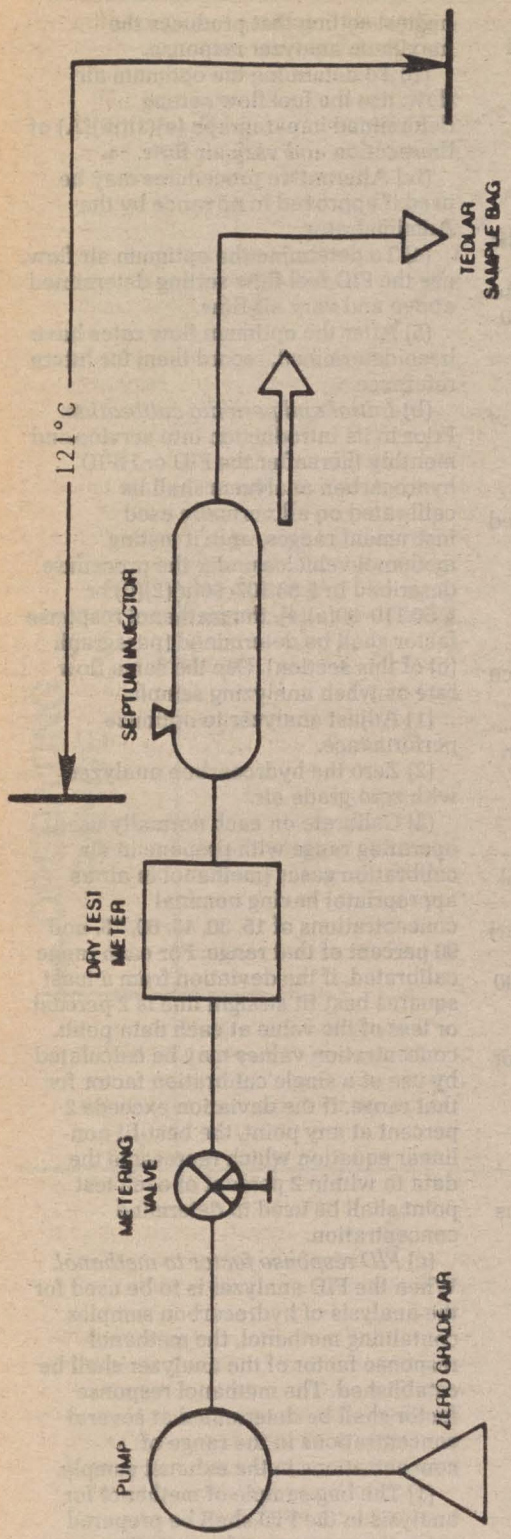


FIGURE B90-11 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

BILLING CODE 6560-50-C

(2) The bag sample is analyzed using the FID.

(3) The FID response factor, r, is calculated as follows:

$r = FIDppm/SAMppm$

Where:

(i) r = FID response factor.

(ii) FIDppm = FID reading in ppmC.

(iii) SAMppm = methanol concentration in the sample bag in ppmC

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. } CH_3OH}$$

Where:

(iv) 0.02406 = Volume of one mole at 29.92 in. Hg and 68 °F, m^3.

(v) Fuel injected = Volume of methanol injected, ml.

(vi) Fuel density = Density of methanol, 0.7914 g/ml.

(vii) Air volume = Volume of zero grade air, m^3.

(viii) Mol. Wt. CH_3OH = 32.04.

44. A new § 86.126–90 is added to Subpart B, to read as follows:

§ 86.126–90 Calibration of other equipment.

Other test equipment used for testing shall be calibrated as often as required by the manufacturer or as necessary according to good practice. Specific equipment requiring calibration are the gas chromatograph and flame ionization detector used in measuring methanol and the high pressure liquid chromatograph (HPLC) and ultraviolet detector for measuring formaldehyde.

45. A new § 86.127–90 is added to Subpart B, to read as follows:

§ 86.127–90 Test procedures; overview.

The procedures described in this and subsequent sections are used to determine the conformity of vehicles with the standards set forth in Subpart A for light-duty vehicles and light-duty trucks.

(a) The overall test consists of prescribed sequences of fueling, parking and operating conditions. Vehicles are tested for any or all of the following emissions:

(1) Gaseous exhaust HC, CO, NO_x, CO_2 (for petroleum-fueled vehicles), plus CH_3OH and HCHO for methanol-fueled vehicles (measurement of CH_3OH and HCHO may be omitted for 1990 through 1994 model year methanol-fueled vehicles provided a HFID calibrated on methanol is used for measuring HC plus CH_3OH).

(2) Particulates (diesel vehicles).

(3) Evaporative HC (for gasoline-fueled and methanol-fueled vehicles) and CH_3OH (for methanol-fueled vehicles). A separate CH_3OH measurement may be omitted for 1990 through 1994 model year methanol-fueled vehicles provided a HFID calibrated on methanol is used for measuring HC plus CH_3OH.

The evaporative portion of the test procedure occurs before and after the exhaust emission test, and in some cases, during the exhaust emission test.

(b) The Otto-cycle exhaust emission test is designed to determine gaseous hydrocarbon, carbon monoxide, carbon dioxide, and oxides of nitrogen mass emissions from gasoline-fueled and methanol-fueled vehicles as well as methanol and formaldehyde from methanol-fueled Otto-cycle vehicles while simulating an average trip in an urban area of 7.5 miles (12.1 kilometers). The test consists of engine startups and vehicle operation on a chassis dynamometer, through a specified driving schedule. A proportional part of the diluted exhaust is collected continuously for subsequent analysis, using a constant volume (variable dilution) sampler or critical flow venturi sampler.

(c) The diesel exhaust emission test is designed to determine particulate and gaseous mass emissions during a test similar to the test in § 86.127(b). For petroleum-fueled vehicles, diluted exhaust is continuously analyzed for total hydrocarbons using a heated sample line and analyzer. The other gaseous emissions, CO, CO_2 and NO_x are collected continuously for analysis as in § 86.127(b). For methanol-fueled vehicles, hydrocarbons, methanol, formaldehyde, CO, CO_2, and NO_x are collected continuously for analysis as in § 86.127(b). Hydrocarbons, methanol and formaldehyde are collected using heated sample lines, and a heated FID is used for hydrocarbons analyses. Simultaneous with the gaseous exhaust collection and analysis, particulates from a proportional part of the diluted exhaust are collected continuously on a filter. The mass of particulate is determined by the procedure described in § 86.139. This testing requires a dilution tunnel as well as the constant volume sampler.

(d) The evaporative emission test (gasoline-fueled vehicles and methanol-fueled vehicles) is designed to determine hydrocarbon and methanol evaporative emissions as a consequence of diurnal temperature fluctuation, urban driving, and hot soaks during parking. It is associated with a series of events representative of a motor vehicle's operation, which result in hydrocarbon and/or methanol vapor losses. The test procedure is designed to measure:

(1) Diurnal breathing losses resulting from daily temperature changes, measured by the enclosure technique;

(2) Running losses from suspected sources (if indicated by engineering analysis or vehicle inspection) resulting from a simulated trip on a chassis dynamometer, measured by carbon traps; and

(3) Hot soak losses, which result when the vehicle is parked and the hot engine is turned off, measured by the enclosure technique.

(e) Except in cases of component malfunction or failure, all emission control systems installed on or incorporated in a new motor vehicle shall be functioning during all procedures in this subpart. Maintenance to correct component malfunction or failure shall be authorized in accordance with § 86.088–25.

46. A new § 86.131–90 is added to Subpart B, to read as follows:

§ 86.131–90 Vehicle preparation.

(a) For gasoline-fueled and methanol-fueled vehicles prepare the fuel tank(s) for recording the temperature of the prescribed test fuel at the approximate mid-volume of the fuel.

(b) Provide additional fittings and adapters, as required, to accommodate a fuel drain at the lowest point possible in the tank(s) as installed on the vehicle.

47. A new § 86.132–90 is added to Subpart B, to read as follows:

§ 86.132–90 Vehicle preconditioning.

(a) The vehicle shall be moved to the test area and the following operations performed:

(1) The fuel tank(s) shall be drained through the provided fuel tank(s) drain(s) and filled to the prescribed "tank fuel volume" with the specified test fuel, § 86.113. For the above operations the evaporative emission control system shall neither be abnormally purged nor abnormally loaded.

(2) Within one hour of being fueled the vehicle shall be placed, either by being driven or pushed, on a dynamometer and operated through one Urban Dynamometer Driving Schedule test procedure, see § 86.115 and Appendix I. A test vehicle may not be used to set dynamometer horsepower.

(3) For those unusual circumstances where additional preconditioning is desired by the manufacturer, such preconditioning may be allowed with the advance approval of the Administrator.

(4) The Administrator may also choose to conduct or require the conduct of additional preconditioning to insure

that the evaporative emission control system is stabilized in the case of gasoline-fueled and methanol-fueled vehicles, or to insure that the exhaust system is stabilized in the case of petroleum-fueled and methanol-fueled diesel vehicles.

(i) *Gasoline-fueled and methanol-fueled vehicles.* (A) The additional preconditioning shall consist of an initial one hour minimum soak and, one, two, or three driving cycles of the UDDS, as described in (a)(2) of this section, each followed by a soak of at least one hour with engine off, engine compartment cover closed and cooling fan off.

(B) The vehicle may be driven off the dynamometer following each UDDS for the soak period.

(ii) *Petroleum-fueled diesel vehicles.* The preconditioning shall consist of either of the following:

(A) The additional preconditioning described in paragraph (a)(4)(i) of this section; or

(B) For abnormally treated vehicles, as defined in § 86.085–2, two Highway Fuel Economy Driving Schedules, found in Part 600 Appendix I, run in immediate succession, with the road load power set at twice the value obtained from § 86.129–80.

(b) Within five minutes of completion of preconditioning, the vehicle shall be driven off the dynamometer and parked. The vehicle shall be stored for not less than 12 hours nor for more than 36 hours prior to the cold start exhaust test. (Gasoline-fueled and methanol-fueled vehicles undergo a one-hour diurnal heat build prior to the cold start exhaust test. A wait of up to one hour is permitted between the end of the diurnal heat build and the beginning of the cold start exhaust test. See § 86.130 and Figure B79–5.)

(c) Vehicles to be tested for evaporative emissions shall be processed in accordance with procedures in §§ 86.133 through 86.138. Vehicles to be tested for exhaust emissions only shall be processed according to § 86.133 through § 86.137.

48. A new § 86.133–90 is added to Subpart B, to read as follows:

§ 86.133–90 Diurnal breathing loss test.

(a)(1) Following vehicle preparation and vehicle preconditioning procedures described in §§ 86.131 and 86.132 the test vehicle shall be allowed to soak for a period of not less than 12 or more than 36 hours prior to the exhaust emission test. The diurnal test shall start not less than 10 or more than 35 hours after the end of the preconditioning procedure. The start of the exhaust test shall follow the end of the diurnal test within one hour.

(2) Gasoline-fueled and methanol-fueled vehicles to be tested for exhaust emissions only shall undergo the diurnal heat build. Since no evaporative measurements are necessary, an evaporative enclosure is not required.

(b) The evaporative emission enclosure shall be purged for several minutes immediately prior to the test.

Note: If at any time the concentration of hydrocarbons, of methanol or of methanol and hydrocarbons exceeds 15,000 ppm C the enclosure should be immediately purged. The concentration provides a 4:1 safety factor of hydrocarbons and methanol against the lean flammability limit.

(c) The FID (or HFID) hydrocarbon analyzer shall be zeroed and spanned immediately prior to the test.

(d) Impingers charged with known volumes of pure deionized water shall be placed in the methanol sampling system (methanol-fueled vehicles only).

(e) If not already on, evaporative enclosure mixing fan shall be turned on at this time.

(f) Immediately prior to the diurnal breathing loss test, the fuel tank(s) of the prepared vehicle shall be drained and recharged with the specified test fuel, § 86.113, to the prescribed "tank fuel volume," defined in § 86.078–2. The temperature of the fuel prior to its delivery to the fuel tank shall be between 45° and 60 °F (7.2 °C and 16 °C). The fuel tank cap(s) is not installed until the diurnal heat build begins.

(g) The test vehicle, with the engine shut off, shall be moved into the evaporative emission enclosure, the test vehicle windows and luggage compartment(s) shall be opened, the fuel tank temperature sensor shall be connected to the temperature recording system, and, if required, the heat source shall be properly positioned with respect to the fuel tank(s) and/or connected to the temperature controller.

(h) The temperature recording system shall be started.

(i) The fuel may be artificially heated to the starting diurnal temperature.

(j) When the fuel temperature recording system reaches at least 58 °F (14 °C), immediately:

(1) Install fuel tank cap(s).

(2) Turn off purge blowers, if not already off at this time.

(3) Close and seal enclosure doors.

(k) When the fuel temperature recording system reaches 60°±2 °F (16°±1.1 °C), immediately:

(1) Analyze enclosure atmosphere for hydrocarbons and record. This is the initial (time=0 minutes) hydrocarbon concentration, C_{HCi}, § 86.143.

(2) Simultaneously with initiation of the hydrocarbon analysis, initiate collection of the methanol sample by drawing a sample from the enclosure through the sampling system for four minutes. This is the initial methanol measurement from which methanol concentration C_{CH3OHi} and mass are calculated. Remove impingers and replace with freshly charged clean impingers which will be used to collect the final methanol sample.

(3) Start diurnal heat build and record time. This commences the 60±2 minute test period.

(l) The fuel shall be heated in such a way that its temperature change conforms to the following function to within ±3 °F [±1.6 °C]:

(1) $F=T_o+0.4t$.

(2) For SI units, $C=T_o+(2/9)t$.

Where:

(3) F=fuel temperature, °F.

(4) C=fuel temperature, °C.

(5) t=time since beginning of test, minutes.

(6) T_o=initial temperature.

After 60±2 minutes of heating, the fuel temperature rise shall be 24°±1 °F (13.4 °C±0.5 °C).

(m) The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the end of the diurnal test.

(n) The end of the diurnal breathing loss test occurs 60±2 minutes after the heat build begins, paragraph (j)(2). Analyze the enclosure atmosphere for hydrocarbons and record. This is the final (time=60 minutes) hydrocarbon concentration, C_{HCf}, § 86.143. The time (or elapsed time) of this analysis shall be recorded.

(o) Simultaneously with the start of the hydrocarbon analysis, initiate collection of the methanol sample. Sample for 4.0±0.5 minutes. This is the final methanol sample.

(p) *Alternate method for methanol sampling.* Since sample times of longer than four minutes may be necessary in order to collect an adequate and representative sample of methanol at the end of a test (when SHED concentrations are usually increasing rapidly), it may be necessary to rapidly collect the methanol sample in a bag and then bubble the bag sample through the impingers at the specified flow rate. The time elapsed between collection of the bag sample and flowing through the impingers should be minimized in order to prevent any losses. This alternative must be adopted if the four minute sample period is inadequate to collect a sample of sufficient concentration to allow accurate GC analysis.

(q) Once the final methanol sample has been collected, the heat source shall be turned off and the enclosure doors unsealed and opened.

(r) The heat source shall be moved away from the vehicle, if required, and/or disconnected from the temperature controller, the fuel tank temperature sensor shall be disconnected from the temperature recording system, the test vehicle windows and luggage compartments may be closed and the test vehicle, with the engine shut off, shall be removed from the evaporative emission enclosure.

(s) For vehicles with multiple tanks, the largest tank shall be designated as the primary tank and shall be heated in accordance with the procedures described in paragraph (1) of this section. All other tanks shall be designated as auxiliary tanks and shall undergo a similar heat build such that the fuel temperature shall be within 3°F (1.6°C) of the primary tank.

49. A new § 86.135–90 is added to Subpart B, to read as follows:

§ 86.135–90 Dynamometer procedure.

(a) *Overview*—(1) *Gasoline-fueled and methanol-fueled Otto-cycle vehicles.* The dynamometer run consists of two tests, a "cold" start test after a minimum 12-hour and a maximum 36-hour soak according to the provisions of §§ 86.132 and 86.133, and a "hot" start test following the "cold" start test by 10 minutes. Engine startup (with all accessories turned off), operation over the UDDS and engine shutdown make a complete cold start test. Engine startup and operation over the first 505 seconds of the driving schedule complete the hot start test. The exhaust emissions are diluted with ambient air and a continuously proportional sample is collected for analysis during each phase. The composite samples collected in bags are analyzed for hydrocarbon, carbon monoxide, carbon dioxide, and oxides of nitrogen. A parallel sample of the dilution air is similarly analyzed for hydrocarbon, carbon monoxide, carbon dioxide, and oxides of nitrogen. Methanol and formaldehyde samples (exhaust and dilution air) are collected and analyzed for methanol-fueled vehicles (a single dilution air formaldehyde sample covering the total time of the test may be collected in place of three individual samples). Methanol and formaldehyde samples may be omitted for 1990 through 1994 model years when a FID calibrated on methanol is used.

(2) *Petroleum-fueled and methanol-fueled diesel vehicles.* The dynamometer run consists of two tests, a "cold" start test after a minimum 12-hour and a maximum 36-hour soak according to the provisions of §§ 86.132 and 86.133, and a "hot" start test following the "cold" start by 10 minutes. Engine startup (with all accessories turned off), operation over the UDDS, and engine shutdown make a complete cold start test. Engine startup and operation over the first 505 seconds of the driving schedule complete the hot start test. The exhaust emissions are diluted with ambient air in the dilution tunnel as shown in Figure B90–5 and Figure B90–6. Six particulate samples are collected on filters for weighing; the first sample plus back-up is collected during the first 505 seconds of the cold start test; the second sample plus back-up is collected during the remainder of the cold start test (including shutdown); the third sample plus back-up is collected during the hot start test. Continuous proportional samples of gaseous emissions are collected for analysis during each test phase. For petroleum-fueled vehicles, the composite samples collected in bags are analyzed for carbon monoxide, carbon dioxide, and oxides of nitrogen. Hydrocarbons from petroleum-fueled vehicles are sampled and analyzed continuously according to the provisions of § 86.110. Parallel samples of the dilution air are similarly analyzed for hydrocarbon, carbon monoxide, carbon dioxide, and oxides of nitrogen. For methanol-fueled vehicles, bag samples are collected and analyzed for hydrocarbons, carbon monoxide, carbon dioxide, and oxides of nitrogen. Methanol and formaldehyde samples are taken for both exhaust emissions and dilution air (a single dilution air formaldehyde sample, covering the total test period may be collected). Methanol and formaldehyde samples may be omitted for 1990 through 1994 model years when an FID calibrated on methanol is used. Parallel bag samples of dilution air are analyzed for hydrocarbons, carbon monoxide, carbon dioxide, and oxides of nitrogen.

(b) During dynamometer operation, a fixed speed cooling fan shall be positioned so as to direct cooling air to the vehicle in an appropriate manner with the engine compartment cover open. In the case of vehicles with front engine compartments, the fan shall be squarely positioned within 12 inches (30.5 centimeters) of the vehicle. In the case of vehicles with rear engine compartments (or if special designs make the above impractical), the cooling fan shall be placed in a position to provide sufficient air to maintain vehicle cooling. The fan capacity shall normally not exceed 5300 cfm (2.50 m^3/s). If, however, the manufacturer can show that during field operation the vehicle receives additional cooling, and that such additional cooling is needed to provide a representative test, the fan capacity may be increased or additional fans used if approved in advance by the Administrator.

(c) The vehicle speed as measured from the dynamometer rolls shall be used. A speed *vs.* time recording, as evidence of dynamometer test validity, shall be supplied on request of the Administrator.

(d) Practice runs over the prescribed driving schedule may be performed at test point, provided an emission sample is not taken, for the purpose of finding the minimum throttle action to maintain the proper speed-time relationship, or to permit sampling system adjustment.

Note: When using two-roll dynamometers a truer speed-time trace may be obtained by minimizing the rocking of the vehicle in the rolls; the rocking of the vehicle changes the tire rolling radius on each roll. This rocking may be minimized by restraining the vehicle horizontally (or nearly so) by using a cable and winch.

(e) The drive wheel tires may be inflated up to a gauge pressure of 45 psi (310 kPa) in order to prevent tire damage. The drive wheel tire pressure shall be reported with the test results.

(f) If the dynamometer has not been operated during the 2-hour period immediately preceding the test, it shall be warmed up for 15 minutes by operating at 30 mph (48 kph) using a non-test vehicle or as recommended by the dynamometer manufacturer.

(g) If the dynamometer horsepower must be adjusted manually, it shall be set within 1 hour prior to the exhaust emissions test phase. The test vehicle shall not be used to make this adjustment. Dynamometers using automatic control of preselectable power settings may be set anytime prior to the beginning of the emissions test.

(h) The driving distance, as measured by counting the number of dynamometer roll or shaft revolutions, shall be determined for the transient cold start, stabilized cold start, and transient hot start phases of the test. The revolutions shall be measured on the same roll or shaft used for measuring the vehicle's speed.

(i) Four-wheel drive vehicles will be tested in a two-wheel drive mode of operation. Full-time four-wheel drive vehicles will have one set of drive wheels temporarily disengaged by the vehicle manufacturer. Four-wheel drive vehicles which can be manually shifted to a two-wheel mode will be tested in the normal on-highway two-wheel drive mode of operation.

50. A new § 86.136–90 is added to Subpart B, to read as follows:

§ 86.136–90 Engine starting and restarting.

(a) *Gasoline-fueled and methanol-fueled Otto-cycle vehicles.* Paragraph (a) of this section applies to gasoline-fueled and methanol-fueled Otto-cycle vehicles.

(1) The engine shall be started according to the manufacturer's recommended starting procedures in the owner's manual. The initial 20-second idle period shall begin when the engine starts.

(2) *Choke operation:* (i) Vehicles equipped with automatic chokes shall be operated according to the manufacturer's operating instructions in the owner's manual, including choke setting and "kick-down" from cold fast idle.

(ii) Vehicles equipped with manual chokes shall be operated according to the manufacturer's operating instructions in the owner's manual.

(3) The transmission shall be placed in gear 15 seconds after the engine is started. If necessary, braking may be employed to keep the drive wheels from turning.

(4) The operator may use the choke, accelerator pedal, *etc.*, where necessary to keep the engine running.

(5) If the manufacturer's operating instructions in the owner's manual do not specify a warm engine starting procedure, the engine (automatic and manual-choke engines) shall be started by depressing the accelerator pedal about half way and cranking the engine until it starts.

(b) *Petroleum-fueled and methanol-fueled diesel vehicles.* The engine shall be started according to the manufacturer's recommended starting procedures in the owner's manual. The initial 20-second idle period shall begin when the engine starts. The transmission shall be placed in gear 15 seconds after the engine is started. If necessary, braking may be employed to keep the drive wheels from turning.

(c) If the vehicle does not start after 10 seconds of cranking, cranking shall cease and the reason for failure to start shall be determined. The gas flow measuring device on the constant volume sampler (usually a revolution counter) or CFV (and the hydrocarbon integrator and particulate sampling system when testing petroleum-fueled diesel vehicles and the particulate sampling system when testing methanol-fueled diesel vehicles, *see* § 86.137 Dynamometer test runs) shall be turned off and the sampler selector valves, including the methanol sampler, placed in the "standby" position during this diagnostic period. In addition, either the CVS should be turned off, or the exhaust tube disconnected from the tailpipe during the diagnostic period. If failure to start is an operational error, the vehicle shall be rescheduled for testing from a cold start.

(1) If a failure to start occurs during the cold portion of the test and is caused by a vehicle malfunction, corrective action of less than 30 minutes duration may be taken (according to § 86.088–25), and the test continued. All sampling system(s) shall be reactivated at the same time cranking begins. When the engine starts, the driving schedule timing sequence shall begin. If failure to start is caused by vehicle malfunction and the vehicle cannot be started, the test shall be voided, the vehicle removed from the dynamometer, and corrective action may be taken according to § 86.088–25. The reason for the malfunction (if determined) and the corrective action taken shall be reported to the Administrator.

(2) If a failure to start occurs during the hot start portion of the test and is caused by vehicle malfunction, the vehicle must be started within one minute of key on. All sampling system(s) shall be reactivated at the same time cranking begins. When the engine starts, the driving schedule timing sequence shall begin. If the vehicle cannot be started within one minute of key on, the test shall be voided, the vehicle removed from the dynamometer, corrective action taken (according to § 86.088–25), and the vehicle rescheduled for testing. The reason for the malfunction (if determined) and the corrective action taken shall be reported to the Administrator.

(d) If the engine "false starts" the operator shall repeat the recommended starting procedure (such as resetting the choke, *etc.*).

(e) *Stalling:* (1) If the engine stalls during an idle period, the engine shall be restarted immediately and the test continued. If the engine cannot be started soon enough to allow the vehicle to follow the next acceleration as prescribed, the driving schedule indicator shall be stopped. When the vehicle restarts, the driving schedule indicator shall be reactivated.

(2) If the engine stalls during some operating mode other than idle, the driving schedule indicator shall be stopped, the vehicle shall then be restarted and accelerated to the speed required at that point in the driving schedule and the test continued. During acceleration to this point, shifting shall be performed in accordance with § 86.128.

(3) If the vehicle will not restart within one minute, the test shall be voided, the vehicle removed from the dynamometer, corrective action taken, and the vehicle rescheduled for test. The reason for the malfunction (if determined) and the corrective action taken shall be reported to the Administrator.

51. A new § 86.137–90 is added to Subpart B, to read as follows:

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

(a) *General*— (1) *Gasoline-fueled and methanol- fueled Otto-cycle vehicles.* The vehicle shall be allowed to stand with the engine turned off for a period of not less than 12 hours or more than 36 hours before the cold start exhaust emission test. The cold start exhaust test shall follow the diurnal breathing loss test by not more than one hour. The vehicle shall be stored prior to the emission test in such a manner that precipitation (*e.g.*, rain or dew) does not occur on the vehicle. The complete dynamometer test consists of a cold start drive of 7.5 miles (12.1 km) and simulates a hot start drive of 7.5 miles (12.1 km). The vehicle is allowed to stand on the dynamometer during the 10 minute time period between the cold and hot start tests. The cold start test is divided into two periods. The first period, representing the cold start "transient" phase, terminates at the end of the deceleration which is scheduled to occur at 505 seconds of the driving schedule. The second period, representing the "stabilized" phase, consists of the remainder of the driving schedule including engine shutdown. The hot start test, similarly, consists of two periods. The first period, representing the hot start "transient" phase, terminates at the same point in driving schedule as the first period of the cold start test. The second period of the hot start test, "stabilized" phase, is assumed to be identical to the second period of the cold start test. Therefore, the hot start test terminates after the first period (505 seconds) is run.

(2) *Petroleum-fueled and methanol-fueled diesel vehicles.* The vehicle shall be allowed to stand with the engine turned off for a period of not less than 12 hours or more than 36 hours before the cold start exhaust emission test. The vehicle shall be stored prior to the emission test in such a manner that precipitation (*e.g.*, rain or dew) does not occur on the vehicle. The complete dynamometer test consists of a cold start drive of 7.5 miles (12.1 km), and simulates a hot start drive of 7.5 miles (12.1 km). The vehicle is allowed to stand on the dynamometer during the 10

minute time period between the cold and hot start tests. The cold start test is divided into two periods. The first period, representing the cold start "transient" phase, terminates at the end of the deceleration which is scheduled to occur at 505 seconds of the driving schedule. The second period, representing the "stabilized" phase, consists of the remainder of the driving schedule including engine shutdown. The hot start test, similarly, consists of two periods. The first period, representing the start of the "transient" phase, terminates at the same point in the driving schedule as the first period of the cold start test. The second period of the hot start test, "stabilized" phase, is assumed to be identical to the second period of the cold start test. Therefore, the hot start test terminates after the first period (505 seconds) is run.

(b) The following steps shall be taken for each test:

(1) Place drive wheels of vehicle on dynamometer without starting engine.

(2) Open the vehicle engine compartment cover and position the cooling fan.

(3) For all vehicles, with the sample selector valves in the "standby" position, connect evacuated sample collection bags to the dilute exhaust and dilution air sample collection systems.

(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, the formaldehyde sample collection system and fresh impingers (or capsules for formaldehyde) into the dilution air sample collection systems for methanol and formaldehyde (may be omitted for 1990 through 1994 model years).

(5) Start the CVS (if not already on), the sample pumps (except the diesel particulate sample pump, if applicable), the temperature recorder, the vehicle cooling fan, and the heated hydrocarbon analysis recorder (diesels only). (The heat exchanger of the constant volume sampler, if used, petroleum-fueled diesel hydrocarbon analyzer continuous sample line and filter, methanol-fueled vehicle hydrocarbon, methanol and formaldehyde sample lines, if applicable, should be preheated to their respective operating temperatures before the test begins.)

(6) Adjust the sample flow rates to the desired flow rate and set the gas flow measuring devices to zero.

(i) For gaseous bag samples (except hydrocarbon samples), the minimum flow rate is 0.17 cfm (0.08 l/sec).

(ii) For hydrocarbon samples, the minimum FID (or HFID in the case of diesel- and methanol-fueled Otto-cycle vehicles) flow rate is 0.066 cfm (0.031 l/sec).

(iii) For methanol samples, the minimum flow rate is 0.14 cfm (0.067 l/sec).

(iv) For formaldehyde samples, the minimum flow rate is 0.036 cfm (0.017 l/s) with capsule collector and 0.14 cfm (0.067 l/s) with impinger.

Note: CFV sample flow rate is fixed by the venturi design.

(7) Attach the exhaust tube to the vehicle tailpipe(s).

(8) Carefully install a particulate sample filter into each of the filter holders for diesel vehicle tests. The filters must be handled only with forceps or tongs. Rough or abrasive filter handling will result in erroneous weight determination.

(9) Start the gas flow measuring device, position the sample selector valves to direct the sample flow into the "transient" exhaust sample bag, the "transient" methanol exhaust sample, the "transient" formaldehyde exhaust sample, the "transient" dilution air sample bag, the "transient" methanol dilution air sample and the "transient" formaldehyde dilution air sample (turn on the petroleum-fueled diesel hydrocarbon analyzer system integrator, mark the recorder chart, start particulate sample pump No. 1, and record both gas meter or flow measurement instrument readings, if applicable), turn the key on, and start cranking the engine.

(10) Fifteen seconds after the engine starts, place the transmission in gear.

(11) Twenty seconds after the engine starts, begin the initial vehicle acceleration of the driving schedule.

(12) Operate the vehicle according to the Urban Dynamometer Driving Schedule (§ 86.115).

Note: During diesel vehicle testing, adjust the flow rate through the particulate sample probe to maintain a constant value within ±5 percent of the set flow rate. Record the average temperature and pressure at the gas meter or flow instrument inlet. If the set flow rate cannot be maintained because of high particulate loading on the filter, the test shall be terminated. The test shall be rerun using a lower flow rate, or larger diameter filter, or both.

(13) 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 the "stabilized" bags and samples, switch off gas flow measuring device No. 1, switch off the No. 1 petroleum-fueled diesel hydrocarbon integrator and the No. 1 particulate sample pump, mark the petroleum-fueled diesel hydrocarbon recorder chart, and close valves isolating particulate filter No. 1, if applicable, and start gas flow measuring device No. 2, and start the petroleum-fueled diesel hydrocarbon integrator No. 2 and the No. 2 particulate sample pump and open valves isolating particulate filter No. 2, if applicable. 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 "transient" exhaust and dilution air samples to the analytical system and process the samples according to § 86.140 obtaining a stabilized reading of the bag exhaust 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 collection phase of the test.

(14) Turn the engine off 2 seconds after the end of the last deceleration (at 1,369 seconds).

(15) Five seconds after the engine stops running, simultaneously turn off gas flow measuring device No. 2 and if applicable, turn off the petroleum-fueled diesel 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 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 § 86.140, 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 applicable, carefully remove both pairs of particulate sample filters from their respective holders, and place each in a separate petri dish, and cover.

(16) Immediately after the end of the sample period, turn off the cooling fan and close the engine compartment cover.

(17) Turn off the CVS or disconnect the exhaust tube from the tailpipe(s) of the vehicle.

(18) Repeat the steps in paragraphs (b)(2) through (b)(2) of this section for the hot start test, except only two evacuated sample bags, two methanol

sample impingers, two formaldehyde sample impingers, and one pair of particulate sample filters, as appropriate, are required. The step in paragraph (b)(9) of this section shall begin between 9 and 11 minutes after the end of the sample period for the cold start test.

(19) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously turn off gas flow measuring device No. 1 (and the petroleum-fueled diesel hydrocarbon integrator No. 1, mark the petroleum-fueled diesel hydrocarbon recorder chart and turn off the No. 1 particulate sample pump, if applicable) and position the sample selector valve to the "standby" position. (Engine shutdown is not part of the hot start test sample period.) Record the measured roll or shaft revolutions (and the No. 1 gas meter reading or flow measurement instrument). (Carefully remove the third pair of particulate sample filters from its holder and place in a clean petri dish and cover, if applicable.)

(20) As soon as possible, transfer the hot start "transient" exhaust and dilution air bag samples to the analytical system and process the samples according to § 86.140 obtaining a stabilized reading of the bag exhaust 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 (~0 °C) environment until analysis).

(21) As soon as possible, and in no case longer than one hour after the end of the hot start phase of the test, transfer the six particulate filters to the weighing chamber for post-test conditioning, if applicable.

(22) Disconnect the exhaust tube from the vehicle tailpipe(s) and drive the vehicle from dynamometer.

(23) The CVS or CFV may be turned off, if desired.

(24) Vehicles to be tested for evaporative emissions will proceed according to § 86.138. For all others this completes the test sequence.

52. A new § 86.138–90 is added to Subpart B, to read as follows:

§ 86.138–90 Hot-soak test.

The hot-soak evaporative emission test shall be conducted immediately following the hot transient exhaust emission test.

(a) Prior to the completion of the hot-start transient exhaust emission sampling period, the evaporative emission enclosure shall be purged for several minutes.

(b) The FID (or HFID) hydrocarbon analyzer shall be zeroed and spanned immediately prior to the test.

(c) Fresh impingers shall be installed in the methanol sample collection system immediately prior to the start of the test, if applicable.

(d) If not already on, the evaporative enclosure mixing fan shall be turned on at this time.

(e) Upon completion of the hot transient exhaust emission sampling period, the vehicle engine compartment cover shall be closed, the cooling fan shall be moved, the vehicle shall be disconnected from the dynamometer and exhaust sampling system, and then driven at minimum throttle to the vehicle entrance of the enclosure.

(f) The vehicle's engine must be stopped before any part of the vehicle enters the enclosure. The vehicle may be pushed or coasted into the enclosure.

(g) The test vehicle windows and luggage compartments shall be opened, if not already open.

(h) The temperature recording system shall be started and the time of engine shut off shall be noted on the evaporative emission hydrocarbon recording system.

(i) The enclosure doors shall be closed and sealed within two minutes of engine shutdown and within seven minutes after the end of the exhaust test.

(j) The 60±0.5 minute hot soak begins when the enclosure doors are sealed. The enclosure atmosphere shall be analyzed for hydrocarbon and recorded. This is initial (time=0 minutes) hydrocarbon concentration, C_{HCi}, for use in calculating evaporative losses, see § 86.143. The "zero" time methanol sample shall be collected starting at the same time as the hydrocarbon analysis is started. Sampling should continue for four minutes.

(k) The test vehicle shall be permitted to soak for a period of one hour in the enclosure.

(l) The FID (or HFID) hydrocarbon analyzer shall be zeroed and spanned immediately prior to the end of the test.

(m) Fresh impingers shall be installed in the methanol collection system immediately prior to the end of the test, if applicable.

(n) At the end of the 60±0.5 minute test period, again analyze the enclosure atmosphere for hydrocarbons and methanol, as described in § 86.138–90(j), and record time. These analyses provide the final (time=60 minutes) hydrocarbon concentration, C_{HCf}, and the final methanol level for use in calculating evaporative losses, see § 86.143. This operation completes the evaporative emission measurement procedure.

(o) *Alternate method for methanol sampling.* Since sample times of longer than four minutes may be necessary in order to collect an adequate and representative sample of methanol at the end of a test (when SHED concentrations are usually increasing rapidly), it may be necessary to rapidly collect the methanol sample in a bag and then bubble the bag sample through the impingers at the specified flow rate. The time elapsed between collection of the bag sample and flowing through the impingers should be minimized in order to prevent any losses. This alternative must be adopted if the four minute sample period is inadequate to collect a sample of sufficient concentration to allow accurate GC analysis.

53. A new § 86.139–90 is added to Subpart B, to read as follows:

§ 86.139–90 Particulate filter handling and weighing.

(a) At least 8 hours, but not more than 56 hours before the test, place each filter in an open, but protected, petri dish and place in the weighing chamber which meets the humidity and temperature specifications of § 86.112.

(b) At the end of the 8 to 56 hour stabilization period, weigh the filter on a balance having a precision of one microgram. Record this weight. This reading is the tare weight.

(c) The filter shall then be stored in a covered petri dish which shall remain in the weighing chamber until needed for testing.

(d)(1) If the filter is not used within one hour of its removal from the weighing chamber, it shall be reweighed.

(2) The one hour limit may be replaced by an eight-hour limit if one or both of the following conditions are met:

(i) A stabilized filter is placed and kept in a sealed filter holder assembly with the ends plugged, or

(ii) A stabilized filter is placed in a sealed filter holder assembly, which is then immediately placed in a sample line through which there is no flow.

(e) After the test, and after the sample filter is returned to the weighing room, condition it for at least 1 hour but not more than 56 hours. Then weigh a second time. This latter reading is the gross weight of the filter. Record this weight.

(f) The net weight (P_e) is the gross weight minus the tare weight.

Note: Should the sample on the filter contact the petri dish or any other surface, the test is void and must be rerun.

54. A new § 86.140–90 is added to Subpart B, to read as follows:

§ 86.140–90 Exhaust sample analysis.

The following sequence of operations shall be performed in conjunction with each series of measurements:

(a) For CO, CO_2, NOx, and for Otto-cycle and methanol-fueled diesel vehicle HC:

(1) Zero the analyzers and obtain a stable zero reading. Recheck after tests.

(2) Introduce span gases and set instrument gains. In order to avoid errors, span and calibrate at the same flow rates used to analyze the test sample. Span gases should have concentrations equal to 75 to 100 percent of full scale. If gain has shifted significantly on the analyzers, check the calibrations. Show actual concentrations on chart.

(3) Check zeroes; repeat the procedure in paragraphs (1) and (2) of this section if required.

(4) Check flow rates and pressures.

(5) Measure HC, CO, CO_2, and NOx concentrations of samples.

(6) Check zero and span points. If difference is greater than 2 percent of full scale, repeat the procedure in paragraphs (a) (1) through (5) of this section.

(b) For petroleum-fueled diesel vehicle HC:

(1) Zero HFID analyzer and obtain a stable zero reading.

(2) Introduce span gas and set instrument gains. Span gas should have concentration equal to 75 to 100 percent of full scale.

(3) Check zero as in (b)(1) of this section.

(4) Introduction of zero and span gas into the analyzer can be accomplished by either of the following methods:

(i) Close heated valve in HC sample (see Figures B90–5 or B90–6), and allow gases to enter HFID. Extreme care should be taken not to introduce gases under high pressure.

(ii) Connect zero and span line directly to HC sample probe and introduce gases at a flow rate greater than 125 percent of the HFID flow rate with the CVS blower operating (see Figures B90–5 or B90–6). Excess flow must be allowed to exit probe inlet.

Note: In order to minimize errors, HFID flow rate and pressure during zero and span (and background bag reading) must be exactly the same as that used during testing.

(5) Continuously record (integrate electronically if desired) dilute hydrocarbon emissions levels during test. Background samples are collected in sample bags and analyzed as in paragraphs (b)(4) (i) or (ii) of this section.

(6) Check zero and span as in paragraphs (b)(1) through (b)(4) (i) or (ii) of this section. If difference is greater than 2 percent of full scale, void test and check for HC "hangup" or electronic drift in analyzer.

(c) For CH_3OH (methanol-fueled vehicles):

(1) Introduce a reference sample of methanol (the concentration of methanol in deionized water is known and is C_{MR} in the calculations) into the gas chromatograph and measure the area of the response peak This reference sample peak area is A_{MR} in the calculations.

(2) Introduce test samples into the gas chromatograph and measure the area of the response peak. This peak area is A_{MS} in the calculations.

(d) For HCHO (methanol-fueled vehicles): (1) Introduce a reference sample of formaldehyde (the concentration of formaldehyde as a dinitrophenylhydrazine derivative in acetonitrile is known (C_{FR})) into the high pressure liquid chromatograph (HPLC) and measure the area of the response peak. This reference sample peak area is A_{FR} in the calculations.

(2) Introduce test samples into the high pressure liquid chromatograph and measure the area of the responses peak. This peak area is A_{FS} in the calculations.

55. A new § 86.142–90 is added to Subpart B, to read as follows:

§ 86.142–90 Records required.

The following information shall be recorded with respect to each test:

(a) Test number.

(b) System or device tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument operated.

(e) Driver or operator.

(f) Vehicle: ID number, manufacturer, model year, standards, engine family, evaporative emissions family, basic engine description (including displacement, number of cylinders, turbocharger used, and catalyst usage), fuel system (including number of carburetors, number of carburetor barrels, fuel injection type and fuel tank(s) capacity and location), engine code, gross vehicle weight rating, inertia weight class, actual curb weight at zero miles, actual road load at 50 mph (80 kph), transmission configuration, axle ratio, car line, system miles, idle rpm, and drive wheel tire pressure, as applicable.

(g) Indicated road load power absorption at 50 mph (80 kph) and dynamometer serial number. As an alternative to recording the dynamometer serial number, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided the test cell records show the pertinent information.

(h) All pertinent instrument information such as tuning—gain—serial number—detector number—range. As an alternative a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided test cell calibration records show the pertinent instrument information.

(i) Recorder charts: Identify zero, span, exhaust gas, and dilution air sample traces.

(j) Test cell barometric pressure, ambient temperature, and humidity.

Note: A central laboratory barometer may be used: *Provided*, that individual test cell barometric pressures are shown to be within ±0.1 percent of the barometric pressure at the central barometer location.

(k) Fuel temperatures, as prescribed.

(l) Pressure of the mixture of exhaust and dilution air entering the CVS metering device (or pressure drop across the CFV), the pressure increase across the device, and the temperature at the inlet. The temperature may be recorded continuously or digitally to determine temperature variations.

(m) The number of revolutions of the positive displacement pump accumulated during each test phase while exhaust samples are being collected. The number of standard cubic feet metered by a critical flow venturi during each test phase would be the equivalent record for a CFV.

(n) The humidity of the dilution air.

Note: If conditioning columns are not used (see §§ 86.122 and 86.144) this measurement can be deleted. If the conditioning columns are used and the dilution air is taken from the test cell, the ambient humidity can be used for this measurement.

(o) The temperature of the gas flowing in the heated sample line before the heated filter, and also before the HFID, and the temperature of the control system of the heated hydrocarbon detector (for petroleum-fueled diesel vehicles only).

(p) The driving distance for each of the three phases of the test, calculated from the measured roll or shaft revolutions.

(q) *Additional required records for petroleum-fueled and methanol-fueled diesel vehicles.* (1) Pressure and temperature of the dilute exhaust mixture (and background air if sampled) at the inlet to the gas meter used for particulate sampling.

(2) The temperature of the dilute exhaust mixture inside the dilution

tunnel near the inlet of the particulate probe.

(3) Gas meter or flow measurement instrumentation readings at the start of each sample period and at the end of each sample period.

(4) The stabilized pre-test weight and post-test weight of each particulate sample and back-up filter.

(5) Continuous temperature and humidity recording of the ambient air in which the particulate filters were stabilized.

(r) *Additional required records for methanol-fueled vehicles.* (1) Specification of the methanol-fuel 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 methanol concentration in the reference sample and the peak area from the GC analysis of the reference sample.

(4) The peak area of the GC analyses of the test samples (methanol).

(5) Volume of sample passed through the formaldehyde sampling system.

(6) The formaldehyde concentration in the reference sample and the peak area from the HPLC analysis of the reference sample.

(7) The peak area of the HPLC analysis of the test sample (formaldehyde).

(8) The temperature of the sample lines before the HFID and the impingers, and the temperature of the control system of the heated hydrocarbon detector.

56. A new § 86.143–90 is added to Subpart B, to read as follows:

§ 86.143–90 Calculations; evaporative emissions.

(a) The calculation of the net hydrocarbon, methanol and hydrocarbon plus methanol (organic material hydrocarbon equivalent) 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:

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

Where:

(i) M_{CH_3OH} = Methanol mass change, μg.

(ii) V_n = Net enclosure volume, ft³, as determined by subtracting 50 ft³ (1.42 m³) (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 ft³) with advance approval by the Administrator; *Provided,* the measured volume is determined and used for all vehicles tested by that manufacturer.

(iii) C_{MR} = Concentration of methanol in standard sample for calibration of GC, μg/ml.

(iv) A_{MR} = GC peak area of standard sample.

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

(vi) V_E = Volume of sample withdrawn, ft³.

(vii) T_{SHED} = Temperature of SHED, °R.

(viii) A_{MS} = GC peak area of sample.

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

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

(xi) i = Initial sample.

(xii) f = Final sample.

(xiii) 1 = First impinger.

(xiv) 2 = Second impinger.

(2) For hydrocarbons:

$$M_{HC} = (kV_n \times 10^{-4}) \left[\frac{(C_{HCf} - rC_{CH_3OH})P_{Bf}}{T_f} - \frac{(C_{HCi} - rC_{CH_3OH})P_{Bi}}{T_i}\right]$$

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.

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

(iv) V_n = Net enclosure volume ft^3 (m^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.

(v) r = FID response factor to methanol.

(vi) P_B = Barometric pressure, in Hg (kPa).

(vii) T = Enclosure temperature, °R(°K).

(viii) i = initial reading.

(ix) f = final reading.

(x) 1 = First impinger.

(xi) 2 = Second impinger.

(xii)(A) k = 0.208 (12 + H/C).

(B) *For SI units,* k = 1.2 (12 + H/C).

Where:

(xiii) H/C = hydrogen-carbon ratio.

(A) H/C = 2.33 for diurnal emissions.

(B) H/C = 2.2 for hot soak emissions.

(3) For total evaporative emissions:

Total Evaporative Emissions = Total Diurnal Emissions + Total Hot Soak Emissions

$$= (M_{HC} + \frac{14.3594}{32.042} \times 10^6 M_{CH_3OH}) + (M_{HC} + \frac{14.2284}{32.042} \times 10^6 M_{CH_3OH}), g$$

(b) The final reported results shall be computed by summing the individual evaporative emission results determined for the diurnal breathing-loss test, running-loss test and the hot-soak test.

57. A new § 86.144–90 is added to Subpart B, to read as follows:

§ 86.144–90 Calculations; exhaust emissions.

The final reported test results shall be computed by use of the following formula:

(a) For light-duty vehicles and light duty trucks:

$$Y_{wm} = 0.43 \left(\frac{Y_{ct} + Y_s}{D_{ct} + D_s} \right) + 0.57 \left(\frac{Y_{ht} + Y_s}{D_{ht} + D_s} \right)$$

Where:

(1) Y_{wm} = Weighted mass emissions of each pollutant, *i.e.,* HC, CO, NOx or CO_2, in grams per vehicle mile and if appropriate, the weighted organic material hydrocarbon equivalent mass in grams per vehicle mile.

(2) Y_{ct} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

(3) Y_{ht} = Mass emissions as calculated from the "transient" phase of the hot start test, in grams per test phase.

(4) Y_s = Mass emissions as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

(5) D_{ct} = The measured driving distance from the "transient" phase of the cold start test, in miles.

(6) D_{ht} = The measured distance from the "transient" phase of the hot start test, in miles.

(7) D_s = The measured driving distance from the "stabilized" phase of the cold start test, in miles.

(b) The mass of each pollutant for each phase of both the cold start test and the hot start test is determined from the following:

(1) Hydrocarbon mass:

$HC_{mass} = V_{mix} \times Density_{HC} \times (HC_{conc}/1{,}000{,}000)$

(2) Oxides of nitrogen mass:

$NO_{xmass} = V_{mix} \times Density_{NO2} \times K_H \times (NO_{xconc}/1{,}000{,}000)$

(3) Carbon monoxide mass:

$CO_{mass} = V_{mix} \times Density_{CO} \times (CO_{conc}/1{,}000{,}000)$

(4) Carbon dioxide mass:

$CO_{2mass} = V_{mix} \times Density_{CO2} \times (CO_{2conc}/100)$

(5) Methanol mass:

$CH_3OH_{mass} = V_{mix} \times Density_{CH_3OH} \times (CH_3OH_{conc}/1{,}000{,}000)$

(6) Formaldehyde mass:

$HCHO_{mass} = V_{mix} \times Density_{HCHO} \times (HCHO_{conc}/1{,}000{,}000)$

(7) Organic material hydrocarbon equivalent mass:

(i) OMHCE =

$$HC_{Mass} + \frac{13.8756}{32.042} (CH_3OH_{mass}) + \frac{13.8756}{30.0262} (HCHO_{mass})$$

(c) Meaning of symbols:

(1)(i) HC_{mass} = Hydrocarbon emissions, in grams per test phase.

(ii) $Density_{HC}$ = Density of hydrocarbons is 16.33 g/ft^3 (0.5768 kg/m^3), assuming an average carbon to hydrogen ratio of 1:1.85, at 68°F (20°C) and 760 mm Hg (101.3 kPa) pressure.

(iii)(A) HC_{conc} = Hydrocarbon concentration of the dilute exhaust sample corrected for background, in ppm carbon equivalent, *i.e.,* equivalent propane × 3.

(B) $HC_{conc} = HC_e - HC_d(1 - 1/DF)$.

Where:

(iv)(A) HC_e = Hydrocarbon concentration of the dilute exhaust sample or, for diesel (or methanol-fueled vehicles, if selected), average

hydrocarbon concentration of the dilute exhaust sample as calculated from the integrated HC traces, in ppm carbon equivalent.

(B) HC_e = FID $HC_e - (r)C_{CH_3OH_e}$

(v) FID HC_e = Concentration of hydrocarbon plus methanol in dilute exhaust as measured by the FID, ppm carbon equivalent.

(vi) r = FID response to methanol.

(vii) $C_{CH_3OH_e}$ = Concentration of methanol in dilute exhaust as determined from the dilute exhaust methanol sample in ppm carbon. For vehicles not fueled with methanol, $C_{CH_3OH_e}$ equals zero.

(viii)(A) HC_d = Hydrocarbon concentration of the dilution air as measured, in ppm carbon equivalent.

(B) HC_d = FID $HC_d - (r)C_{CH_3OH_d}$

(ix) FID HC_d = Concentration of hydrocarbon plus methanol in dilution air as measured by the FID, ppm carbon equivalent.

(x) $C_{CH_3OH_d}$ = Concentration of methanol in dilution air as determined from dilution air methanol sample in ppm carbon. For vehicles not fueled with methanol, $C_{CH_3OH_d}$ equal zero.

(2)(i) NOx_{mass} = Oxides of nitrogen emissions, in grams per test phase.

(ii) $Density_{NO_2}$ = Density of oxides of nitrogen is 54.16 g/ft³ (1.913 kg/m³) assuming they are in the form of nitrogen dioxide, at 68°F (20°C) and 760 mm Hg (101.3kPa) pressure.

(iii)(A) NOx_{conc} = Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, in ppm.

(B) $NOx_{conc} = NOx_e - NOx_d[1 - (1/DF)]$.

Where:

(iv) NOx_e = Oxides of nitrogen concentration of the dilute exhaust sample as measured, in ppm.

(v) NOx_d = Oxides of nitrogen concentration of the dilution air as measured, in ppm.

(3)(i) CO_{mass} = Carbon monoxide emissions, in grams per test phase.

(ii) $Density_{co}$ = Density of carbon monoxide is 32.97 g/ft³ (1.164 kg/m³), at 68°F (20°C) and 760 mm Hg (101.3 kPa) pressure.

(iii)(A) CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, in ppm.

(B) $CO_{conc} = CO_e - CO_d[1 - (1/DF)]$.

Where:

(iv)(A) CO_e = Carbon monoxide concentration of the dilute exhaust volume corrected for water vapor and carbon dioxide extraction, in ppm.

(B) $CO_e = (1 - 0.01925CO_{2_e} - 0.000323R)CO_{em}$ for petroleum fuel with hydrogen to carbon ratio of 1.85:1.

(C) $CO_e = [1 - (0.01 + 0.005HCR)CO_{2_e} - 0.000323R]CO_{em}$ for methanol fuel, where HCR is hydrogen-to-carbon ratio as measured for the fuel used.

(v) CO_{em} = Carbon monoxide concentration of the dilute exhaust sample as measured, in ppm.

(vi) CO_{2_e} = Carbon dioxide concentration of the dilute exhaust sample, in percent.

(vii) R = Relative humidity of the dilution air, in percent (see § 86.142(n)).

(viii)(A) CO_d = Carbon monoxide concentration of the dilution air corrected for water vapor extraction, in ppm.

(B) $CO_d = (1 - 0.000323R)CO_{dm}$.

Where:

(ix) CO_{dm} = Carbon monoxide concentration of the dilution air sample as measured, in ppm.

Note: If a CO instrument which meets the criteria specified in § 86.111 is used and the conditioninq column has been deleted, CO_{em} must be substituted directly for CO_e and CO_{dm} must be substituted directly for CO_d.

(4)(i) $CO_{2_{mass}}$ = Carbon dioxide emissions, in grams per test phase.

(ii) Density CO_2 = Density of carbon dioxide is 51.81 g/ft³ (1.830 kg/m³), at 68°F (20°C) and 760 mm Hg (101.3 kPa) pressure.

(iii)(A) $CO_{2_{conc}}$ = Carbon dioxide concentration of the dilute exhaust sample corrected for background, in percent.

(B) $CO_{2_{conc}} = C0_{2_e} - CO_{2_d}(1 - (1/DF))$.

Where:

(iv) CO_{2_d} = Carbon dioxide concentration of the dilution air as measured, in percent.

(5)(i) CH_3OH_{mass} = Methanol emissions corrected for background, in grams per test phase.

(ii) $Density_{CH_3OH}$ = Density of methanol is 37.71 g/ft³ (1.332 kg/m³), at 68°F (20°C) and 760 mmHg (101.3kPa) pressure.

(iii)(A) CH_3OH_{conc} = Methanol concentration of the dilute exhaust corrected for background, ppm.

(B) $CH_3OH_{conc} = C = {}_{CH_3OH_e} - C_{CH_3OH_d}(1 - (1/DF))$

Where:

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

$$\text{(B)}\quad C_{CH_3OH_e} = \frac{3.813 \times 10^{-2} \times C_{CH_3OH_R} \times T_{EM}[(A_{S1} \times AV_{S1}) + (A_{S2} \times AV_{S2})]}{A_{CH_3OH_R} \times P_B \times V_{EM}}$$

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

$$\text{(B)}\quad C_{CH_3OH_d} = \frac{3.813 \times 10^{-2} \times C_{CH_3OH_R} \times T_{DM}[(A_{D1} \times AV_{D1}) + (A_{D2} \times AV_{D2})]}{A_{CH_3OH_R} \times P_B \times V_{DM}}$$

(vi) $C_{CH_3OH_R}$ = Concentration of methanol in standard sample for calibration of GC, μg/ml.

(vii) $A_{CH_3OH_R}$ = GC peak area of standard sample.

(viii) T_{EM} = Temperature of methanol sample withdrawn from dilute exhaust, °R.

(ix) T_{DM}=Temperature of methanol sample withdrawn from dilution air, °R.

(x) P_B=Barometric pressure during test, mm Hg.

(xi) V_{EM}=Volume of methanol sample withdrawn from dilute exhaust, ft³.

(xii) V_{DM}=Volume of methanol sample withdrawn from dilution air, ft³.

(xiii) A_S=GC peak area of sample drawn from dilute exhaust.

(xiv) A_D=GC peak area of sample drawn from dilution air.

(xv) AV_S=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml.

(xvi) AV_D=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml.

(xvii) 1=first impinger.

(xviii) 2=second impinger.

(6)(i) $HCHO_{mass}$=Formaldehyde emissions corrected for background, in grams per test phase.

$$\text{(B) } C_{HCHOe} = \frac{4.069\times10^{-2}\times C_{FDE}\times V_{AE}\times Q\times T_{EF}}{V_{SE}\times P_B}$$

(v)(A) C_{HCHOd}=Formaldehyde concentration in dilution air in ppm.

$$\text{(B) } C_{HCHOd} = \frac{4.069\times10^{-2}\times C_{FDA}\times V_{AA}\times Q\times T_{DF}}{V_{SA}\times P_B}$$

(vi) C_{FDE}=Concentration of DNPH derivative of formaldehyde from dilute exhaust sample in sampling solution, μg/ml.

(vii) V_{AE}=Volume of sampling solution for dilute exhaust formaldehyde sample, ml.

(viii)(A) Q=Ratio of molecular weights of formaldehyde to its DNPH derivative.

(B) Q=0.1429.

(ix) T_{EF}=Temperature of formaldehyde sample withdrawn from dilute exhaust, °R.

(x) V_{SE}=Volume of formaldehyde sample withdrawn from dilute exhaust, ft³.

(xi) P_B=Barometric pressure during test, mm Hg.

(xii) C_{FDA}=Concentration of DNPH derivative of formaldehyde from dilution air sample in sampling solution, μg/ml.

(xiii) V_{AA}=Volume of sampling solution for dilution air formaldehyde sample, ml.

(xiv) T_{DF}=Temperature of formaldehyde sample withdrawn from dilution air, °R.

(xv) V_{SA}=Volume of formaldehyde sample withdrawn from dilution air, ft³.

(7)(i) $DF=13.4/[CO_{2e}+(HC_e+CO_e)\,10^{-4}]$ for petroleum-fueled vehicles.

$$\text{(ii)}\quad DF = \frac{100 \times \left(\frac{x}{x + y/2 + 3.76(x + y/4 - z/2)}\right)}{CO_{2e} + (HC_e + CO_e + C_{CH3OH_e})\,10^{-4}}$$

for methanol-fueled vehicles where fuel composition is $C_xH_yO_z$ as measured for the fuel used.

(iii)(A) K_H=Humidity correction factor.

(B) $K_H=1/[1-0.0047(H-75)]$.

(C) *For SI units*, $K_H=1/[1-0.0329(H-10.71)]$.

Where:

(iv)(A) H=Absolute humidity in grains (grams) of water per pound (kilogram) of dry air.

(B) $H=[(43.478)R_a\times P_d]/[P_B-(P_d\times R_a/100)]$.

(C) *For SI units*, $H=[(6.211)R_a\times P_d]/[P_B-(P_d\times R_a/100)]$.

(v) R_a=Relative humidity of the ambient air, percent.

(vi) P_d=Saturated vapor pressure, mm Hg (kPa) at the ambient dry bulb temperature.

(vii) P_B=Barometric pressure, mm Hg (kPa),

(viii)(A) V_{mix}=Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions (528 °R (293 °K) and 760 mm Hg (101.3 kPa)).

(B) For PDP–CVS, V_{mix} is:

$$V_{mix} = \frac{V_0\times N\times(P_B-P_1)\times 528}{760\times T_P}$$

(C) *For SI units*,

$$V_{mix} = \frac{V_0\times N\times(P_B-P_1)\times 293}{101.3\times T_P}$$

Where:

(ix) V_o=Volume of gas pumped by the positive displacement pump, in cubic feet (m³) per revolution. This volume is

(ii) $Density_{HCHO}$=Density of formaldehyde is 35.36 g/ft³ (1.249 kg/m³), at 68 °F (20 °C) and 760 mmHg (101.3 kPa) pressure.

(iii)(A) $HCHO_{conc}$=Formaldehyde concentration of the dilute exhaust corrected for background, in ppm.

(B) $HCHO_{conc}=C_{HCHOe}-C_{HCHOd}\,(1-(1/DF))$

Where:

(iv)(A) C_{HCHOe}=Formaldehyde concentration in dilute exhaust, in ppm.

dependent on the pressure differential across the positive displacement pump.

(x) N=Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

(xi) P_B=Barometric pressure, mm Hg (kPa).

(xii) P_4=Pressure depression below atmospheric measured at the inlet to the positive displacement pump, in mm Hg (kPa) (during an idle mode).

(xiii) T_p=Average temperature of dilute exhaust entering positive displacement pump during test, °R(°K).

(d) For petroleum-fueled vehicles, example calculation of mass values of exhaust emissions using positive displacement pump:

(1) For the "transient" phase of the cold start test assume the following:

V_o=0.29344 ft³/rev; N=10,485; R=48.0 pct; R_a=48.2 percent; P_B=762 mm Hg; P_d=22.225 mm Hg; P_4=70 mm Hg; T_p=570 °R; HC_e=105.8 ppm, carbon equivalent; NO_{xe}=11.2 ppm; CO_{em}=306.6 ppm; CO_{2e}=1.43 percent; HC_d=12.1 ppm; NO_{xd}=0.8 ppm; CO_{dm}=15.3 ppm; CO_{2d}=0.032 percent; D_{ct}=3.598 miles.

Then:

(i) $V_{mix}=(0.29344)(10{,}485)(762-70)(528)/(760)(570)=2595.0$ ft³ per test phase.

$$\text{(ii) } H=\frac{(43.478)(48.2)(22.225)}{762-(22.225)(48.2/100)}$$

=62 grains of water per pound of dry air.

(iii) $K_H=1/[1-0.0047(62-75)]=0.9424$

(iv) $CO_e=[1-0.01925(1.43)-0.000323(48)](306.6)=293.4$ ppm.

(v) $CO_d=[1-0.000323(48)](15.3)=15.1$ ppm.

(vi) $DF=13.4/[1.43+10^{-4}(105.8+293.4)]=9.116$.

(vii) $HC_{conc}=105.8-12.1(1-1/9.116)=95.03$ ppm.

(viii) $HC_{mass}=(2595)(16.33)(95.03/1{,}000{,}000)=4.027$ grams per test phase.

(ix) $NOx_{conc}=11.2-0.8(1-1/9.116)=10.49$ ppm.

(x) $NOx_{mass}=(2595)(54.16)(10.49/1{,}000{,}000)(0.9424)=1.389$ grams per test phase.

(xi) $CO_{conc}=293.4-15.1(1-1/9.116)=280.0$ ppm.

(xii) $CO_{mass}=(2595)(32.97)(280/1{,}000{,}000)=23.96$ grams per test phase.

(xiii) $CO_{2conc}=1.43-0.032(1-1/9.116)=1.402$ percent.

(xiv) $CO_{2mass}=(2595.0)(51.85)(1.402/100)=1886$ grams per test phase.

(2) For the stabilized portion of the cold start test assume that similar calculations resulted in the following:

(i) $HC_{mass}=0.62$ grams per test phase.

(ii) $NOx_{mass}=1.27$ grams per test phase.

(iii) $CO_{mass}=5.98$ grams per test phase.

(iv) $CO_{2mass}=2346$ grams per test phase.

(v) $D_s=3.902$ miles.

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

(i) $HC_{mass}=0.51$ gram per test phase.

(ii) $NOx_{mass}=1.38$ grams per test phase.

(iii) $CO_{mass}=5.01$ grams per test phase.

(iv) $CO_{2mass}=1758$ grams per test phase.

(v) $D_{ht}=3.598$ miles.

(4) Weighted mass emission results:

(i) $HC_{wm}=0.43[(4.027+0.62)/(3.598+3.902)]+0.57[(0.51+0.62)/(3.598+3.902)]=0.352$ grams per vehicle mile.

(ii) $NO_{xwm}=0.43[(1.389+1.27)/(3.598+3.902)]+0.57[(1.38+1.27)/(3.598+3.902)]=0.354$ grams per vehicle mile.

(iii) $CO_{wm}=0.43[(23.96+5.98)/(3.598+3.902)]+0.57[(5.01+5.98)/(3.598+3.902)]=2.55$ grams per vehicle mile.

(iv) $CO_{2wm}=0.43[(1886+2346)/(3.598+3.902)+0.57[(1758+2346)/(3.598+3.902)]=555$ grams per vehicle mile.

(e) For methanol-fueled vehicle with measured fuel composition of $CH_{3.14}O_{0.6}$ example calculation of exhaust emissions using positive displacement pump:

(1) For the "transient" phase of the cold start test assume the following:

V_o=0.29344 ft³/rev; N=10,485; R=48.0 pct; R_a=48.2 percent; P_B=762 mm Hg; P_d=22.225 mm Hg; P_4=70 mm Hg; T_p 570 °R; FID HC_e=81.6 ppm, carbon equivalent; r=0.75; C_{CH3OHR}=71 ug/ml; T_{EM}=567 °R; A_{CH3OHR}=3660; V_{EM} 1.18 ft³; A_{S1}=4460; AV_{s1}= 25.2 ml; A_{s2}=360; AV_{s2}=24.9 ml; T_{DM}=532 °R; V_{DM}=1.17 ft³; A_{D1}=110; AV_{D1}=25.0 ml; A_{D2}= 10; AV_{D2}=25.1 ml; C_{FDE}=20 ug/ml; V_{AE}=5.0 ml; Q=0.1429; T_{EF}=569 °R; V_{SE}=0.30 ft³; C_{FDA}= 1 ug/ml; V_{AA}=5.0 ml; T_{DF}=532 °R; V_{SA}=0.31 ft³; NOx_e=11.2 ppm; CO_{em}=306.6 ppm; CO_{2e}=1.43 pct; FID HC_d=12.1 ppm; NOx_d=0.8 ppm; CO_{dm}=15.3 ppm; CO_{2d}=0.032 percent; D_{ct}=3.598 miles.

Then:

(i) $V_{mix}=(0.29344)(10{,}485)(762-70)(528)/(760)(570)=2595.0$ ft³ per test phase.

(ii) $H=(43.478)(48.2)(22.225)/[762-(22.225\times48.2/100)]=62$ grains of water per pound of dry air.

(iii) $K_H=1/[1-0.0047(62-75)]=0.9424$.

(iv) $CO_e=[1-(0.01+0.005\times3.14\times1.43)-0.000323(48))]\times306.6=291.9$ ppm.

(v) $CO_d=(1-0.000323(48))\times15.3=15.1$ ppm.

$$\text{(vi) } C_{CH3OHe}=\frac{(3.813\times10^{-3})(71)(567)[(4460)(25.2)+(360)(24.9)]}{(3660)(762)(1.18)}=56.60 \text{ ppm.}$$

$$\text{(vii) } DF=\frac{100(1/[1+(3.14/2)+3.76(1+(3.14/4)-(0.6/2))])}{1.43+10^{-4}[81.6+291.9+(1-0.75)(56.60)]}=8.350$$

$$\text{(viii) } C_{CH3OHd}=\frac{(3.813\times10^{-3})(71)(532)[(110)(25.0)+(10)(25.1)]}{(3660)(762)(1.17)}=1.32 \text{ ppm.}$$

(ix) $CH_3OH_{conc} = 56.60 - 1.32[1 - 1/8.350] = 55.44$ ppm.

(x) $CH_3OH_{mass} = 2595.0 \times 37.71 \times [55.44/1,000,000] = 5.43$ grams per test phase.

(xi) $HC_{conc} = [31.6 - (0.75)(56.60)] - [12.1 - (0.75)(1.32)][1 - 1/8.536] = 29.34$ ppm.

(xii) $HC_{mass} = (2594)(16.33)(29.34/1,000,000) = 1.24$ grams per test phase.

$$\text{(xiii) } C_{HCHOe} = \frac{4.069 \times 10^{-3}(20)(5)(0.1429)(569)}{(0.30)(762)} = 1.4473 \text{ ppm.}$$

$$\text{(xiv) } C_{HCHOe} = \frac{4.069 \times 10^{-3}(1)(5)(0.1429)(532)}{(0.31)(762)} = 0.0655 \text{ ppm}$$

(xv) $HCHO_{conc} = 1.4473 - 0.0655[1 - 1/8.350] = 1.3896$ ppm.

(xvi) $HCHO_{mass} = (2595)(35.36)(1.3896/1,000,000) = 0.1275$ grams per test phase

(xvii) $OMHCE = 1.24 + [(13.8756/32.042)(5.43) + (13.8756/30.0262)(0.1275)] = 3.65$ grams per test phase.

(xviii) $NOx_{conc} = 11.2 - (0.8)[1 - 1/8.350] = 10.50$ ppm

(xix) $NOx_{mass} = (2595)(54.16)(10.50/1,000,000)(0.9424) = 1.390$ grams per test phase.

(xx) $CO_{conc} = 291.9 - 15.1\ [1 - 1/8.350] = 278.61$ ppm.

(xxi) $CO_{mass} = (2595.0)(32.97)(278.69/1,000,000) = 23.84$ grams per test phase.

(xxii) $CO_{2conc} = 1.43 - 0.032\ [1 - 1/8.350] = 1.402$ percent.

(xxiii) $CO_{2mass} = (2595.0)(51.85)(1.402/100) = 1886$ grams per test phase.

(2) For the stabilized portion of the cold start test assume that similar calculations resulted in the following:

(i) $OMHCE = 0.55$ grams per test phase.

(ii) $NOx_{mass} = 1.27$ grams per test phase.

(iii) $CO_{mass} = 5.98$ grams per test phase.

(iv) $CO_{2mass} = 2346$ grams per test phase.

(v) $D_s = 3.902$ miles.

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

(i) $OMHCE = 0.67$ grams as carbon equivalent per test phase.

(ii) $NOx_{mass} = 1.38$ grams per test phase.

(iii) $CO_{mass} = 5.01$ grams per test phase.

(iv) $CO_{2mass} = 1758$ grams per test phase.

(v) $D_{ht} = 3.598$ miles.

(4) Weighted emission results:

(i) $OMHCE_{wm} = 0.43[(3.65 + 0.55)/(3.598 + 3.902)] + 0.57[(0.67 + 0.55)/(3.598 + 3.902)] = 0.334$ grams as carbon equivalent per mile.

(ii) $NOx_{wm} = 0.43[(1.390 + 1.27)/(3.598 + 3.902)] + 0.57[1.38 + 1.27)/(3.598 + 3.902)] = 0.354$ grams per vehicle mile

(iii) $CO_{wm} = 0.43[(23.84 + 5.98)/(3.598 + 3.902)] + 0.57[(5.01 + 5.98)/(3.598 + 3.902)] = 2.54$ grams per vehicle mile.

(iv) $CO_{2wm} = 0.43[(1686 + 2346)/(3.598 + 3.902)] + 0.57[(1758 + 2346)/(3.598 + 3.902)] = 555$ grams per vehicle mile.

58. A new § 86.401–90 is added to Subpart E, to read as follows:

§ 86.401–90 General applicability.

(a) This subpart applies to 1978 and later model year, new, gasoline-fueled motorcycles built after December 31, 1977, and to 1990 and later model year, new, methanol-fueled motorcycles built after December 31, 1989.

(b) Motorcycles with engine displacements less than 50 cc (3.1 cu in) are excluded from the requirements of this subpart.

(c) Motorcycles are excluded from the requirements of this subpart, if with an 80 kg (176 lb) driver, it cannot:

(1) Start from a dead stop using only the engine, or

(2) Exceed a maximum speed of 40 km/h (25 mph) on level paved surfaces.

59. A new § 86.410–90 is added to Subpart E, to read as follows:

§ 86.410–90 Emission standards for 1990 and later model year motorcycles.

(a)(1) Exhaust emissions from 1990 and later model year gasoline-fueled motorcycles shall not exceed:

(i) *Hydrocarbons.* 5.0 grams per vehicle kilometer.

(ii) *Carbon monoxide.* 12 grams per vehicle kilometer.

(2) Exhaust emissions from 1990 and later model year methanol-fueled motorcycles shall not exceed:

(i) *Organic material hydrocarbon equivalent.* 5.0 grams per vehicle kilometer.

(ii) *Carbon monoxide.* 12 grams per vehicle kilometer

(3) The standards set forth in paragraphs (a) (1) and (2) of this section refer to the exhaust emitted over driving schedule as set forth in Subpart F and measured and calculated in accordance with those procedures

(b) No crankcase emissions shall be discharged into the ambient atmosphere from any new motorcycle subject to this subpart.

60. A new § 86.509–90 is added to Subpart F, to read as follows:

§ 86.509–90 Exhaust gas sampling system.

(a)(1) *General.* The exhaust gas sampling system is designed to measure the true mass emissions of vehicle exhaust. In the CVS concept of measuring mass emissions, two conditions must be satisfied: the total volume of the mixture of exhaust and dilution air must be measured and a continuously proportioned volume of sample must be collected for analysis. Mass emissions are determined from the sample concentration and totalized flow over the test period.

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

(i) Using a duct of unrestricted length maintained at 113°±8 °C (235°±15 °F), heating and possibly cooling capabilities are required; or

(ii) Using a short max. length) duct (up to 12 feet long) constructed of smooth wall pipe with a minimum of flexible sections, maintained at 112°±8 °C (235°±15 °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 a smooth wall duct less than five feet long with no required heating; 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 motorcycles only, the sample lines for the methanol and formaldehyde samples are heated to 113±8 °C (235±15 °F) Note: For 1990 through 1994 model year methanol-fueled motorcycles, methanol and formaldehyde sampling may be omitted provided the bag sample is analyzed using a HFID calibrated with methanol.

BILLING CODE 6560-50-M

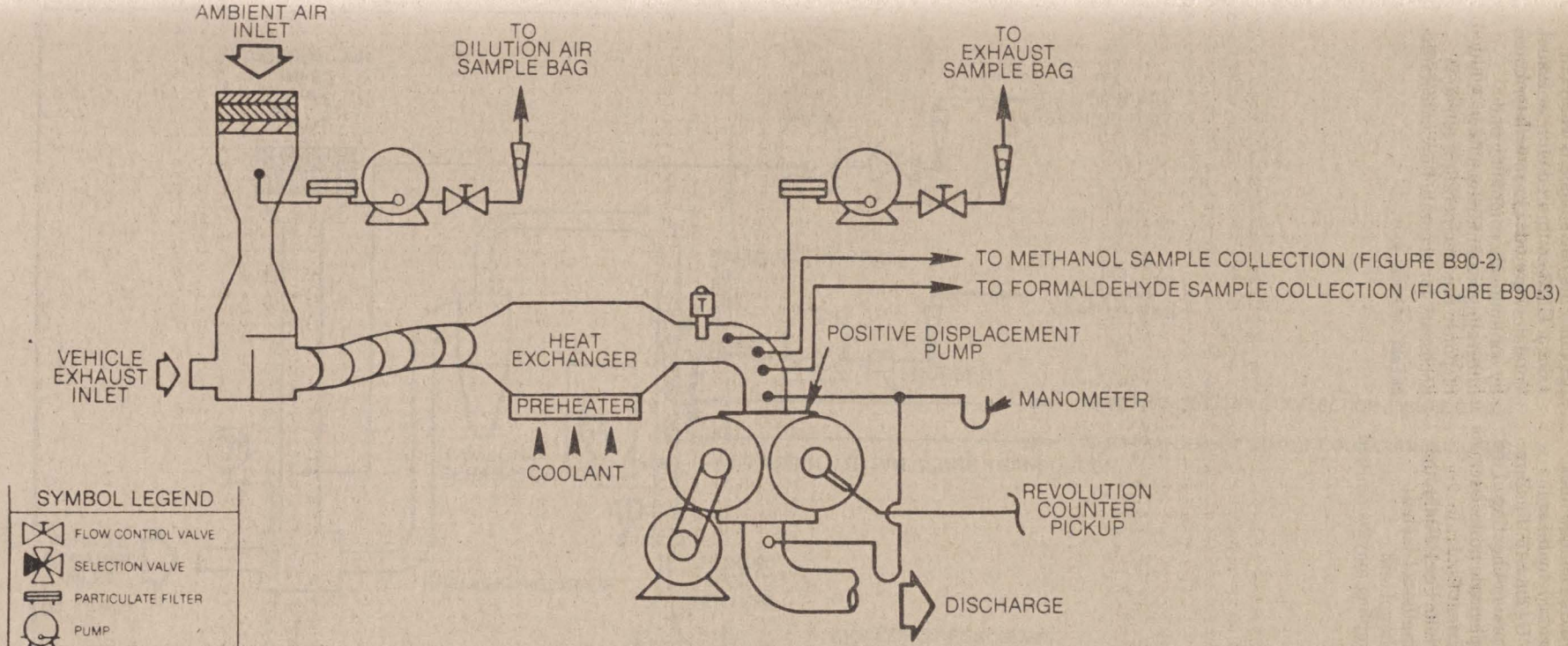


FIGURE F90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)

BILLING CODE 6560-50-C

(4) *Critical Flow Venturi.* The operation of the Critical Flow Venturi-Constant Volume Sampler (CFV–CVS), Figure F90–2, is based upon the principles of fluid dynamics associated with critical flow. Proportional sampling is maintained by use of small CFVs in the sample lines, which responds to the varying temperatures in the same manner as the main CFV. For methanol-fueled motorcycles, the sample lines (methanol and formaldehyde) are heated to 113±8 °C (235±15 °F). Care must be taken to prevent heating of the small CFVs in the sample probe because heating 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 is analyzed using a HFID calibrated with methanol. Total flow per test phase is determined by continuously computing and integrating instantaneous flow. A low response time temperature sensor is necessary for accurate flow calculation.

BILLING CODE 6560–50–M

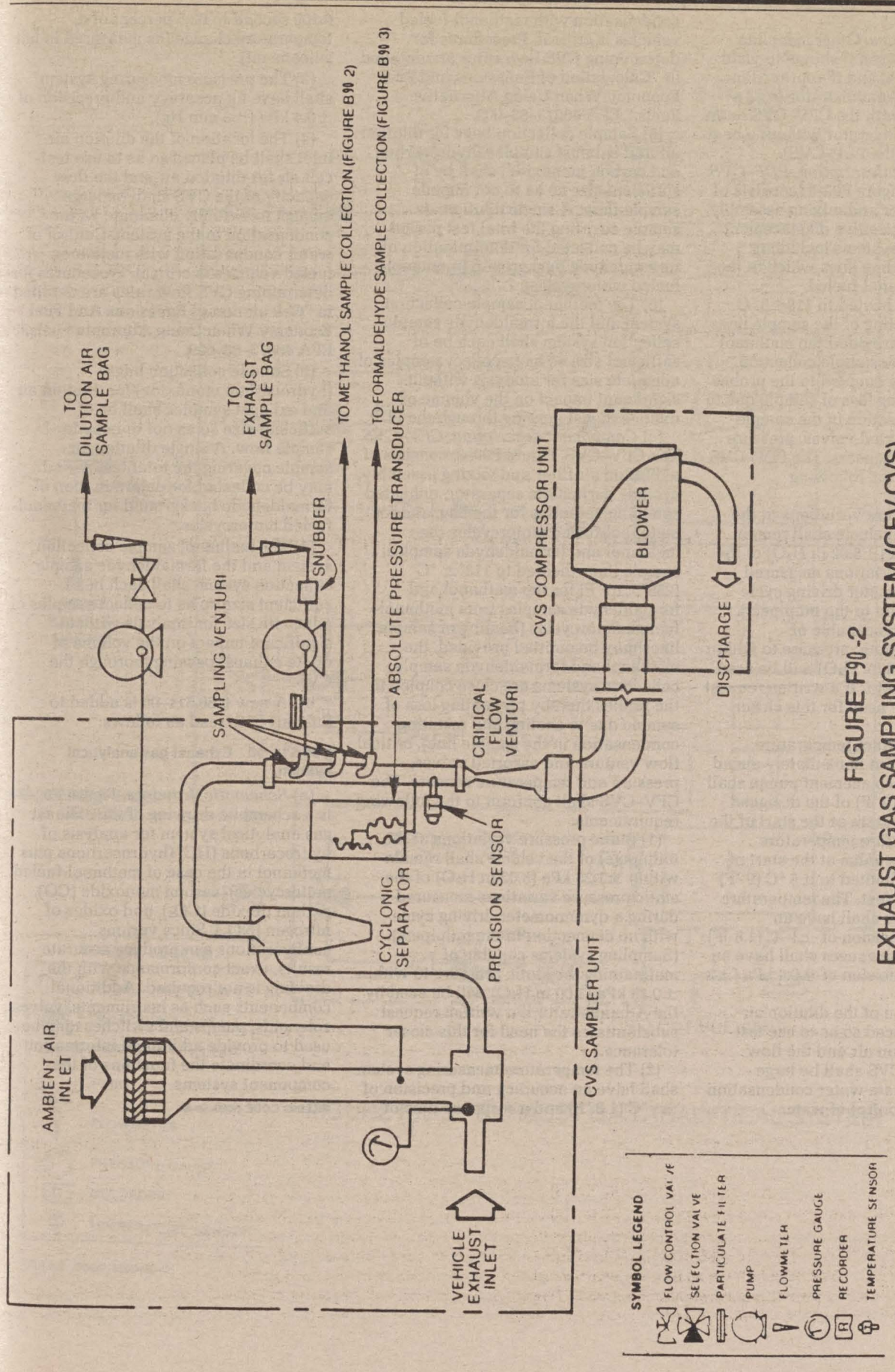


FIGURE F90-2
EXHAUST GAS SAMPLING SYSTEM (CFV-CVS)

BILLING CODE 6560-50-C

(5) [Reserved]

(6) *Other systems.* Other sampling systems may be used if shown to yield equivalent results, and if approved in advance by the Administrator (*e.g.*, a heat exchanger with the CFV–CVS or an electronic flow integrator without a heat exchanger, with the PDP–CVS).

(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 113±8 °C (235±15 °F) (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 resulting condensation in the sample lines) and associated valves, pressure and temperature sensors. The PDP–CVS shall conform to the following requirements:

(1) Static pressure variations at the tailpipe(s) of the vehicle shall remain within ±1.25 kPa (±5.02 in H_2O) of the static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s). (Sampling systems capable of maintaining the static pressure to within ±0.25 kPa (±1.00 in. H_2O) will be used by the Administrator if a written request substantiates the need for this closer tolerance.)

(2) The gas mixture temperature, measured at a point immediately ahead of the positive displacement pump, shall be within ±5°C (9 °F) 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 ±5 °C (9 °F) during the entire test. The temperature measuring system shall have an accuracy and precision of ±1 °C (1.8 °F).

(3) The pressure gauges shall have an accuracy and precision of ±0.4 kPa (±3 mm Hg).

(4) The location of the dilution air inlet shall be placed so as to use test-cell air for dilution air and the flow capacity of the CVS shall be large enough to eliminate water condensation in the system. Control of water condensation with methanol-fueled vehicles is critical. Procedures for determining CVS flow rates are detailed in "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3–83–009.

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

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

(c) *Component description, CFV–CVS.* The CFV–CVS, Figure F90–2, consists of a dilution air filter and mixing assembly, cyclone particulate separator, unheated sampling venturies for the bag, and for methanol-fueled motorcycles the methanol and formaldehyde samples, sample lines (heated to 113°± °C (235°±15 °F) for the methanol and formaldehyde samples from methanol–fueled motorcycles (heating of 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 line), critical flow venturi, and assorted valves, pressure and temperature sensors. The CFV–CVS shall conform to the following requirements:

(1) Static pressure variations at the tailpipe(s) of the vehicle shall remain within ±1.25 kPa (5.02 in H_2O) of the static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s). (Sampling systems capable of maintaining the static pressure to within ±0.25 kPa (1.00 in H_2O) will be used by the Administrator if a written request substantiates the need for this closer tolerance.)

(2) The temperature measuring system shall have an accuracy and precision of ±1 °C (1.8 °F) and a response time of 0.100 second to 62.5 percent of a temperature change (as measured in hot silicone oil).

(3) The pressure measuring system shall have an accuracy and precision of ±0.4 kPa (±3 mm Hg).

(4) The location of the dilution air inlet shall be placed so as to use test-cell air for dilution air and the flow capacity of the CVS shall be large enough to virtually eliminate water condensation in the system. Control of water condensation with methanol fueled vehicles is critical. Procedures for determining CVS flow rates are detailed in "Calculation of Emissions And Fuel Economy When Using Alternate Fuels," EPA 460/3–83–009.

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

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

61. A new § 86.511–90 is added to Subpart F, to read as follows:

§ 86.511–90 Exhaust gas analytical system.

(a) *Schematic drawings.* Figure F90–3 is a schematic drawing of the exhaust gas analytical system for analysis of hydrocarbons (HC) (hydrocarbons plus methanol in the case of methanol-fueled motorcycles), carbon monoxide (CO), carbon dioxide (CO_2), and oxides of nitrogen (NO_x). Since various configurations can produce accurate results, exact conformance with the drawing is not required. Additional components such as instruments, valves, solenoids, pumps and switches may be used to provide additional information and coordinate the functions of the component systems

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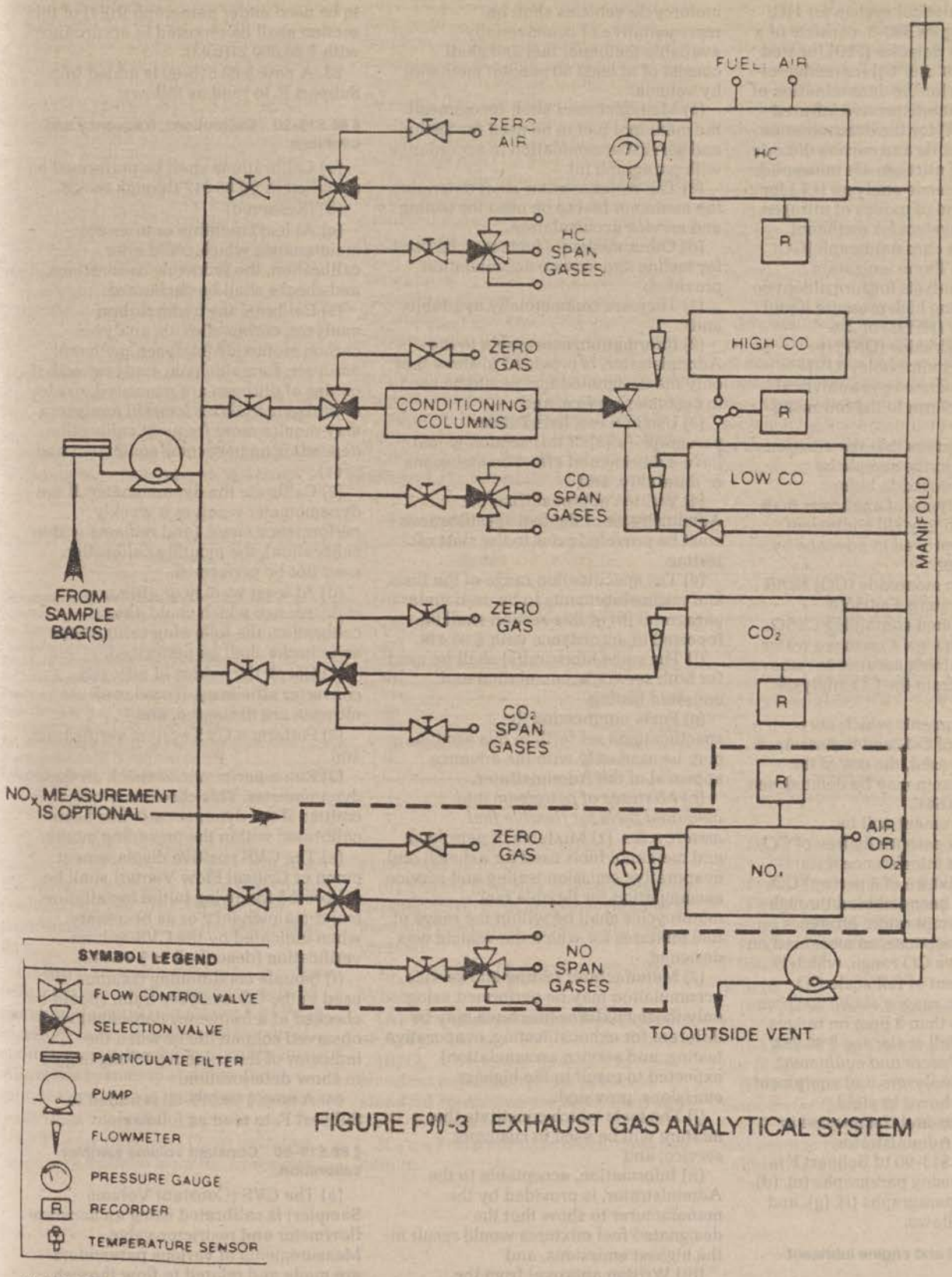


FIGURE F90-3 EXHAUST GAS ANALYTICAL SYSTEM

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(b) *Major component description.* The exhaust gas analytical system for HC, CO and CO_2, Figure F90–3, consists of a flame ionization detector (FID) (heated (235°±15 °C (113°±8 °C)) for methanol-fueled vehicles) for the determination of hydrocarbons, nondispersive infrared analyzers (NDIR) for the determination of carbon monoxide and carbon dioxide and, if oxides of nitrogen are measured, a chemiluminescence analyzer (CL) for the determination of oxides of nitrogen. The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

(1) The CL requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(2) The carbon monoxide (CO) NDIR analyzer may require a sample conditioning column containing $CaSO_4$, or indicating silica gel to remove water vapor and containing ascarite to remove carbon dioxide from the CO analysis stream.

(i) If CO instruments which are essentially free of CO_2 and water vapor interference are used, the use of the conditioning column may be deleted, see §§ 86.522 and 86.544.

(ii) A CO instrument will be considered to be essentially free of CO_2 and water vapor interference if its response to a mixture of 3 percent CO_2 in N_2 which has been bubbled through water at room temperature produces an equivalent CO response, as measured on the most sensitive CO range, which is less than 1 percent of full scale CO concentration on ranges above 300 ppm full scale or less than 3 ppm on ranges below 300 ppm full scale; *see* § 86.522.

(c) *Other analyzers and equipment.* Other types of analyzers and equipment may be used if shown to yield equivalent results and if approved in advance by the Administrator.

62. Section 86.513–90 of Subpart F is amended by revising paragraphs (c), (d), (e), and adding paragraphs (f), (g), and (h) to read as follows:

§ 86.513–90 Fuel and engine lubricant specifications.

* * * * *

(c) Methanol fuel used for exhaust and evaporative emission testing and in service accumulation of methanol-fueled motorcycle vehicles shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol by volume.

(1) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (c).

(2) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(d) Other methanol fuels may be used for testing and service accumulation provided:

(1) They are commercially available, and

(2) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(3) Use of a fuel listed under paragraph (a)(3) of this section would have a detrimental effect on emissions or durability, and

(4) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(e) The specification range of the fuels and engine lubricants to be used under paragraph (b) of this section shall be reported in accordance with § 86.416.

(f) The same lubricant(s) shall be used for both service accumulation and emission testing.

(g) Fuels not meeting the specifications set forth in this section may be used only with the advance approval of the Administrator.

(h) *Mixtures of petroleum and methanol fuels for flexible fuel motorcycles.* (1) Mixtures of petroleum and methanol fuels used for exhaust and evaporative emission testing and service accumulation for flexible fuel motorcycles shall be within the range of fuel mixtures for which the vehicle was designed.

(2) Manufacturer testing and service accumulation may be performed using only those mixtures (mixtures may be different for exhaust testing, evaporative testing, and service accumulation) expected to result in the highest emissions, provided:

(i) The fuels which constitute the mixture will be used in customer service, and

(ii) Information, acceptable to the Administrator, is provided by the manufacturer to show that the designated fuel mixtures would result in the highest emissions, and

(iii) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(3) The specification range of the fuels to be used under paragraph (h)(1) of this section shall be reported in accordance with § 86.090 21(b)(3).

63. A new § 86.516–90 is added to Subpart F, to read as follows:

§ 86.516–90 Calibrations, frequency and overview.

(a) Calibrations shall be performed as specified in §§ 86.517 through 86.526.

(b) [Reserved]

(c) At least monthly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

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

(2) Calibrate the dynamometer. If the dynamometer receives a weekly performance check (and remains within calibration), the monthly calibration need not be performed.

(d) At least weekly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

(1) Check the oxides of nitrogen converter efficiency, if oxides of nitrogen are measured, and

(2) Perform a CVS system verification, and

(3) Run a performance check on the dynamometer. This check may be omitted if the dynamometer has been calibrated within the preceding month.

(e) The CVS positive displacement pump or Critical Flow Venturi shall be calibrated following initial installation, major maintenance or as necessary when indicated by the CVS system verification (described in § 86.519).

(f) Sample conditioning columns, if used in the CO analyzer train, should be checked at a frequency consistent with observed column life or when the indicator of the column packing begins to show deterioration.

64. A new § 86.519–90 is added to Subpart F, to read as follows:

§ 86.519–90 Constant volume sampler calibration.

(a) The CVS (Constant Volume Sampler) is calibrated using an accurate flowmeter and restrictor valve. Measurements of various parameters are made and related to flow through the unit. Procedures used by EPA for both PDP (Positive Displacement Pump) and CFV (Critical Flow Venturi) are

outlined below. Other procedures yielding equivalent results may be used if approved in advance by the Administrator. After the calibration curve has been obtained, verification of the entire system can be performed by injecting a known mass of gas into the system and comparing the mass indicated by the system to the true mass injected. An indicated error does not necessarily mean that the calibration is wrong, since other factors can influence the accuracy of the system, e.g., analyzer calibration. A verification procedure is found in paragraph (d) of this section.

(b) *PDP calibration.* (1) The following calibration procedures outlines the equipment, the test configuration, and the various parameters which must be measured to establish the flow rate of the constant volume sampler pump. All the parameters related to the pump are simultaneously measured with the parameters related to a flowmeter which is connected in series with the pump. The calculated flow rate (at pump inlet absolute pressure and temperature) can then be plotted versus a correlation function which is the value of a specific combination of pump parameters. The linear equation which relates the pump flow and the correlation function is then determined. In the event that a CVS has a multiple speed drive, a calibration for each range must be performed.

(2) This calibration procedure is based on the measurement of the absolute values of the pump and flowmeter parameters that relate the flow rate at each point. Three conditions must be maintained to assure the accuracy and integrity of the calibration curve. First, the pump pressures should be measured at taps on the pump rather than at the external piping on the pump inlet and outlet. Pressure taps that are mounted at the top center and bottom center of the pump drive headplate are exposed to the actual pump cavity pressures, and therefore reflect the absolute pressure differentials. Secondly, temperature stability must be maintained during the calibration. The laminar flowmeter is sensitive to inlet temperature oscillations which cause the data points to be scattered. Gradual changes (±1°C (±1.8°F)) in temperature are acceptable as long as they occur over a period of several minutes. Finally, all connections between the flowmeter and the CVS pump must be absolutely void of any leakage.

(3) During an exhaust emission test the measurement of these same pump parameters enables the user to calculate the flow rate from the calibration equation.

(4) Connect a system as shown in Figure F78–5. Although particular types of equipment are shown, other configurations that yield equivalent results may be used if approved in advance by the Administrator. For the system indicated, the following data with given accuracy are required:

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Tolerances
Barometric pressure corrected	P_B	kPa (in. Hg)	±0.03 kPa (±0.01 in. Hg)
Ambient temperature	T_A	°C (°F)	±0.3°C (±0.54°F)
Air Temperature into LFE	ETI	°C (°F)	±0.15°C (±0.27°F)
Pressure depression upstream of LFE	EPI	kPa (in. H_2O)	±0.01 kPa (±0.05 in. H_2O)
Pressure drop across the LFE matrix	EDP	kPa (in. H_2O)	±0.001 kPa (±0.005 in. H_2O)
Air temperature at CVS pump inlet	PTI	°C (°F)	±0.25°C (±0.45°F)
Pressure depression at CVS pump inlet	PPI	kPa (in. Fluid)	±0.021 kPa (±0.046 in. Fluid)
Specific gravity of manometer fluid (1.75 oil)	Sp Gr		
Pressure head at CVS pump outlet	PPO	kPa (in. Fluid)	±0.21 kPa (±0.046 in. Fluid)
Air temperature at CVS pump outlet (optional)	PTO	°C (°F)	±0.25°C (±0.45°F)
Pump revolutions during test period	N	Revs	± 1 Rev.
Elapsed time for test period	t	sec	±0.05 sec.

(5) After the system has been connected as shown in Figure F78–6, set the variable restrictor in the wide open position and run the CVS pump for twenty minutes. Record the calibration data.

(6) Reset the restrictor valve to a more restricted condition in an increment of pump inlet depression (about 1.0 kPa (4 in. H_2O)) that will yield a minimum of six data points for the total calibration. Allow the system to stabilize for 3 minutes and repeat the data acquisition.

(7) Data analysis:

(i) The air flow rate, Q_s, at each test point is calculated from the flowmeter data using the manufacturers' prescribed method.

(ii) The air flow rate is then converted to pump flow, V_o in m^3 per revolution at absolute pump inlet temperature and pressure.

$$V_o = (Q_s/n) \times (T_p/293) \times (101.3/P_p)$$

Where:

(A) V_o = Pump flow, m^3/rev (ft^3/rev) at T_p, P_p.

(B) Q_s = Meter air flow rate in standard cubic meters per minute; standard conditions are 20°C, 101.3 kPa (68°F, 29.92 in. Hg).

(C) n=Pump speed in revolutions per minute.

(D)(*1*) T_p=Pump inlet temperature, (°K)=PTI+273.

(*2*) *For English units,* T_p=PTI+460.

(E)(*1*) P_p=Absolute pump inlet pressure, kPa (in. Hg)=P_B−PPI.

(*2*) *For English units,* P_p=P_B−PPI(S P.GR./13.57).

Where:

(F) P_B=barometric pressure, kPa (in. Hg.).

(G) PPI=Pump inlet depression, kPa (in. fluid).

(H) SP.GR.=Specific gravity of manometer fluid relative to water.

(iii) The correlation function at each test point is then calculated from the calibration data:

$$X_o = \frac{1}{n}\sqrt{\frac{\Delta P}{\frac{p}{P_e}}}$$

Where:

(A) X_o=correlation function.

(B) ΔP_p=The pressure differential from pump inlet to pump outlet, kPa (in. Hg)=P_e-P_p.

(C)(*1*) P_e=Absolute pump outlet pressure, kPa (in. Hg)=P_B+PPO.

(*2*) *For English units,* $P_e=P_B$+PPO(SP.GR./13.57).

Where:

(D) PPO=Pressure head at pump outlet, kPa (in. fluid).

(iv) A linear least squares fit is performed to generate the calibration equations which have the forms:

$V_o=D_o-M(X_o)$

$n=A-B(\Delta P_p)$

D_o, M, A, and B are the slope-intercept constants, describing the lines.

(8) A CVS system that has multiple speeds shall be calibrated on each speed used. The calibration curves generated for the ranges will be approximately parallel and the intercept values, D_o, will increase as the pump flow range decreases.

(9) If the calibration has been performed carefully, the calculated values from the equation will be within ±0.50 percent of the measured value of V_o. Values of M will vary from one pump to another, but values of D_o for pumps of the same make, model, and range should agree within ±3 percent of each other. Particulate influx from use will cause the pump slip to decrease as reflected by lower values for M. Calibrations should be performed at pump startup and after major maintenance to assure the stability of the pump slip rate. Analysis of mass injection data will also reflect pump slip stability.

(c) *CFV calibration.* (1) Calibration of the Critical Flow Venturi (CFV) is based upon the flow equation for a critical venturi. Gas flow is a function of inlet pressure and temperature:

$$Q_s = \frac{K_v P}{\sqrt{T}}$$

Where:

(i) Q_s=Flow.

(ii) K_v=Calibration coefficient.

(iii) P=Absolute pressure.

(iv) T=Absolute temperature.

The calibration procedure described below establishes the value of the calibration coefficient at the measured values of pressure, temperature and air flow.

(2) The manufacturer's recommended procedure shall be followed for calibrating electronic portions of the CFV.

(3) Measurements necessary for flow calibration are as follows:

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Tolerances
Barometric pressure (corrected)	P_B	kPa (in. Hg)	±0.03 kPa (±0.01 in. Hg)
Air temperature, flowmeter	ETI	°C (°F)	±0.15° C (±0.27° F)
Pressure depression upstream of LFE	EPI	kPa (in. H_2O)	±0.01kPa (±0.05 in. H_2O)
Pressure drop across LFE matrix	EDP	kPa (in. H_2O)	±0.001 kPa (±0.005 in. H_2O)
Air flow	Q_s	m^3/min (ft^3/min)	±0.5%
CFV inlet depression	PPI	kPa (in. fluid)	±0.02 kPa (±0.05 in. fluid)
Temperature at venturi inlet	T_v	°C (°F)	±0.25 °C (±0.45°F)
Specific gravity of manometer fluid (1.75 oil)	Sp Gr		

(4) Set up equipment as shown in Figure F78–6 and check for leaks. Any leaks between the flow measuring device and the critical flow venturi will seriously affect the accuracy of the calibration.

(5) Set the variable flow restrictor to the open position, start the blower and allow the system to stabilize. Record data from all instruments.

(6) Vary the flow restrictor and make at least 8 readings across the critical flow range of the venturi.

(7) *Data analysis.* The data recorded during the calibration are to be used in the following calculations:

(i) The air flow rate, Q_s, at each test point is calculated from the flowmeter data using the manufacturer's prescribed method.

(ii) Calculate values of the calibration coefficient for each test point:

$$K_v = \frac{Q_s\sqrt{T_v}}{P_v}$$

Where:

(A) Q_s=Flow rate in m^3/minute, standard conditions are 20 °C, 101.3 kPa (68 °F, 29.92 in. Hg)

(B) T_v=Temperature at venturi inlet, °K(°R).

(C)(*1*) P_v=Pressure at venturi inlet, kPa (mm Hg)=P_B–PPI.

(*2*) *For English units,* $P_v=P_B-PPI$ (SP.GR./13.57).

Where:

(D) PPI=Venturi inlet pressure depression, kPa (in. fluid).

(E) SP.GR.=Specific gravity of manometer fluid, relative to water.

(iii) Plot K_v as a function of venturi inlet depression. For sonic flow, K_v will have a relatively constant value. As pressure decreases (vacuum increases), the venturi becomes unchoked and K_v decreases (is no longer constant). See Figure F78–7.

(iv) For a minimum of 8 points in the critical region, calculate an average K_v and the standard deviation.

(v) If the standard deviation exceeds 0.3 percent of the average K_v, take corrective action.

(d) *CVS system verification.* The following "gravimetric" technique can be used to verify that the CVS and analytical instruments can accurately measure a mass of gas that has been injected into the system. If the CVS and analytical system will be used only in the testing of gasoline-fueled vehicles, the system verification may be performed using either propane or carbon monoxide. If the CVS and analytical system will be used with

methanol-fueled vehicles as well as gasoline-fueled vehicles, system verification performance check must include a methanol check in addition to either the propane or carbon monoxide check. (Verification can also be accomplished by constant flow metering using critical flow orifice devices.)

(1) Obtain a small cylinder that has been charged with pure propane or carbon monoxide gas (caution—carbon monoxide is poisonous). Obtain another small cylinder which has been charged with pure methanol if the system will be used for methanol-fueled vehicle testing. Since this cylinder will be heated to 150–155 °F, care must be taken to ensure that the liquid volume of methanol placed in the cylinder does not exceed approximately one-half of the total volume of the cylinder.

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

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

(4) Following the completion of paragraph (d)(3) of this section, continue to operate the CVS in the normal manner and release a quantity of pure methanol into the system during the sampling period (approximately 5 minutes).

(5) The calculations of § 86.544 are performed in the normal way except in the case of propane. The density of propane (0.6109 kg/m^3/carbon atom (17.30 g/ft^3/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of carbon monoxide, the density of 1.164 kg/m^3 (32.97 g/ft^3) is used. In the case of methanol, the density of 1.332 kg/m^3 (37.71 g/ft^3) is used.

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

(7) The cause for any discrepancy greater than ±2 percent must be found and corrected.

65. A new § 86.521–90 is added to Subpart F, to read as follows:

§ 86.521–90 Hydrocarbon analyzer calibration.

(a) The FID hydrocarbon analyzer shall receive the following initial and periodic calibration. The HFID used with methanol-fueled vehicles shall be operated at 235°F±15 °F (113°C±8 °C).

(b) *Initial and periodic optimization of detector response.* Prior to its introduction into service and at least annually thereafter, the FID hydrocarbon analyzer shall be adjusted for optimum hydrocarbon response. Alternate methods yielding equivalent results may be used, if approved in advance by the Administrator.

(1) Follow the manufacturer's instructions or good engineering practice for instrument startup and basic operating adjustment using the appropriate FID fuel and zero-grade air.

(2) Optimize on the most common operating range. Introduce into the analyzer a propane in air mixture (methanol in air mixture for methanol-fueled vehicles when optional methanol calibrated FID procedure is used during the 1990 through 1994 model years) with a propane (or methanol) concentration equal to approximately 90 percent of the most common operating range.

(3) Select an operating FID fuel flow rate that will give near maximum response and least variation in response with minor fuel flow variations.

(4) To determine the optimum air flow, use the FID fuel flow setting determined above and vary air flow.

(5) After the optimum flow rates have been determined, record them for future reference.

(c) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter the FID hydrocarbon analyzer shall be calibrated on all normally used instrument ranges, and, if applicable, the methanol response factor shall be determined (paragraph (d) of this section). Use the same flow rate as when analyzing sample.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero grade air.

(3) Calibrate on each normally used operating range with propane in air calibration gases (methanol in air as appropriate) having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. For each range calibrated, if the deviation from a least squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

(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.

(1) The bag sample 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 dry gas meter.

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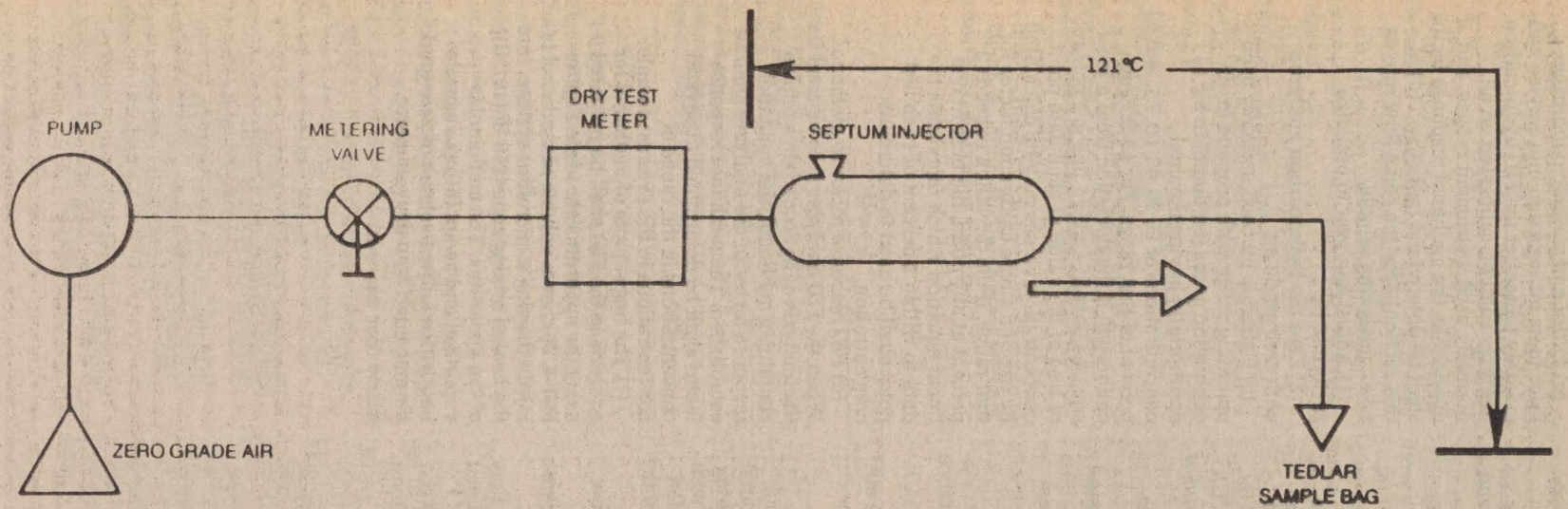


FIGURE F90-4 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

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(2) The bag sample is analyzed using the FID.

(3) The FID response factor, r, is calculated as follows:

$r = FID_{ppm}/SAM_{ppm}$

Where:

(i) r = FID response factor.

(ii) FID_{ppm} = FID reading, ppmC.

(iii) SAM_{ppm} = methanol concentration in the sample bag, ppmC.

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. } CH_3}$$

Where:

(iv) 0.02406 = Volume of one mole at 101.3 kPa (29.92 in. Hg) and 20 °C (68 °F), m^3.

(v) Fuel injected = Volume of methanol injected, ml.

(vi) Fuel Density = Density of methanol, 0.7914 g/ml

(vii) Air volume = Volume of zero grade air, m^3

(viii) Mol. Wt. CH_3OH = 32.04

66. A new § 86.526–90 is added to Subpart F, to read as follows:

§ 86.526–90 Calibration of other equipment.

Other test equipment used for testing shall be calibrated as often as required by the manufacturer or as necessary according to good practice. Specific equipment requiring calibration is the gas chromatograph and flame ionization detector used in measuring methanol and the high pressure liquid chromatograph (HPLC) and ultraviolet detector for measuring formaldehyde.

67. A new § 86.527–90 is added to Subpart F, to read as follows:

§ 86.527–90 Test procedures, overview.

(a) The procedures described in this and subsequent sections are used to determine the conformity of vehicles with the standards set forth in Subpart E.

(b) The overall test consists of prescribed sequences of fueling, parking, and operating conditions.

(c) The exhaust emission test is designed to determine hydrocarbon (gasoline-fueled vehicles), methanol, formaldehyde, and hydrocarbon (methanol-fueled vehicles), carbon monoxide, and oxides of nitrogen mass emissions while simulating an average trip in an urban area. The test consists of engine startups and vehicle operation on a chassis dynamometer, through a specified driving schedule. A proportional part of the diluted exhaust emissions is collected continuously for subsequent analysis, using a constant volume (variable dilution) sampler.

(d) Except in cases of component malfunction or failure, all emission control systems installed on or incorporated in a new motor vehicle shall be functioning during all procedures in this Subpart. Maintenance to correct component malfunction or failure shall be authorized in accordance with Subpart E.

68. A new § 86.535–90 is added to Subpart F, to read as follows:

§ 86.535–90 Dynamometer procedure.

(a) The dynamometer run consists of two tests, a "cold" start test and a "hot" start test following the "cold" start by 10 minutes. Engine startup (with all accessories turned off), operation over the driving schedule, and engine shutdown make a complete cold start test. Engine startup and operation over the first 505 seconds of the driving schedule complete the hot start test. The exhaust emissions are diluted with ambient air and a continuously proportional sample is collected for analysis during each phase. The composite samples collected in bags are analyzed for hydrocarbons, carbon monoxide, carbon dioxide, and, optionally, for oxides of nitrogen. A parallel sample of the dilution air is similarly analyzed for hydrocarbon, carbon monoxide, carbon dioxide, and, optionally, for oxides of nitrogen. Methanol and formaldehyde samples (exhaust and dilution air) are collected and analyzed for methanol-fueled vehicles (a single dilution air formaldehyde sample covering the total time of the test may be collected in place of individual test phases).

(b) [Reserved]

(c) The vehicle speed, as measured from the dynamometer roll, shall be used. A speed *vs.* time recording, as evidence of dynamometer test validity, shall be supplied on request of the Administrator.

(d) Practice runs over the prescribed driving schedule may be performed at test points, provided an emission sample is not taken, for the purpose of finding the minimum throttle action to maintain the proper speed-time relationship, or to permit sampling system adjustments.

(e) The drive wheel tires must be inflated to the manufacturer's recommended pressure, ±15 kPa (±2.2 psi). The drive wheel tire pressure shall be reported with the test results.

(f) If the dynamometer has not been operated during the two-hour period immediately preceding the test, it shall be warmed up for 15 minutes by operating at 50 km/h (31 mph) using a nontest vehicle, or as recommended by the dynamometer manufacturer.

(g) If the dynamometer horsepower must be adjusted manually, it shall be set within one hour prior to the exhaust emissions test phase. The test vehicle shall not be used to make this adjustment. Dynamometers using automatic control of preselectable power settings may be set anytime prior to the beginning of the emissions test.

(h) The driving distance, as measured by counting the number of dynamometer roll revolutions, shall be determined for the transient cold start, stabilized cold start, and transient hot start phases of the test.

69. A new § 86.537–90 is added to Subpart F, to read as follows:

§ 86.537–90 Dynamometer test runs.

(a) The vehicle shall be allowed to stand with the engine turned off (see § 86.532 for required time). The vehicle shall be stored prior to the emission test in such a manner that precipitation (*e.g.*, rain or dew) does not occur on the vehicle. The complete dynamometer test consists of a cold start drive of 12.0 km (7.5 mi), (10.9 km (6.8 mi) for Class I motorcycles) and simulates a hot start drive of 12.0 km (7.5 mi), (10.9 km (6.8 mi) for Class I motorcycles). The vehicle is allowed to stand on the dynamometer during the 10-minute period between the cold and hot start tests. The cold start is divided into two periods. The first period, representing the cold start "transient" phase, terminates at the end of the deceleration which is scheduled to occur at 505 seconds of the driving schedule. The second period, representing the "stabilized" phase, consists of the remainder of the driving schedule including engine shutdown. The hot start test similarly consists of two periods. The period, representing the hot start "transient" phase, terminates at the same point in the driving schedule at the first point of the cold start test. The second period of the hot start test, "stabilized" phase, is assumed to be identical to the second period of the cold start test. Therefore, the hot start test terminates after the first period (505 seconds) is run.

(b) The following steps shall be taken for each test:

(1) Place drive wheel of vehicle on dynamometer without starting engine.

(2) Activate vehicle cooling fan.

(3) For all vehicles, with the sample selector valves in the "standby" position connect evacuated sample collection bags to the dilute exhaust and dilution air sample collection systems.

(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 collection impingers or capsules into the formaldehyde sample collection system, and fresh impingers (or capsules for formaldehyde) into the dilution air sample collection systems for methanol and formaldehyde (may be omitted for 1990 through 1994 model years).

(5) Start the CVS (if not already on), the sample pumps and the temperature recorder. (The heat exchanger of the constant volume sampler, if used, methanol-fueled vehicle hydrocarbon analyzer and sample lines should be preheated to their respective operating temperatures before the test begins.)

(6) Adjust the sample flow rates to the desired flow rate and set the gas flow measuring devices to zero.

(i) For gaseous bag samples (except hydrocarbon samples), the minimum flow rate is 0.17 cfm (0.08 l/s).

(ii) For hydrocarbon samples, the minimum FID (or HFID in the case of methanol-fueled vehicles) flow rate is 0.066 cfm (0.031 l/s).

(iii) For methanol samples, the minimum flow rate is 0.14 cfm (0.067 l/s).

(iv) For formaldehyde samples, the minimum flow rate is 0.036 cfm (0.017 l/s) with capsule collector and 0.014 cfm (0.067 l/s) with impinger.

Note: CFV sample flow rate is fixed by the venturi design.

(7) Attach the flexible exhaust tube to the vehicle tailpipe(s).

(8) Start the gas flow measuring device, position the sample selector valves to direct the sample flow into the "transient" exhaust sample bag, the "transient" methanol exhaust sample, the "transient" formaldehyde exhaust sample, the "transient" dilution air sample bag, the "transient" methanol dilution air sample and the "transient" formaldehyde dilution air sample, turn the key on, and start cranking the engine.

(9) Fifteen seconds after the engine starts, place the transmission in gear.

(10) Twenty seconds after the engine starts, begin the initial vehicle acceleration of the driving schedule.

(11) Operate the vehicle according to the Urban Dynamometer Driving Schedule (§ 86.515).

(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 the "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 "transient" exhaust and dilution air samples to the analytical system and process the samples according to § 86.540 obtaining a stabilized reading of the bag exhaust 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 collection phase of the test (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 (approximately 0 °C) environment until analysis).

(13) Turn the engine off 2 seconds after the end of the last deceleration (at 1,369 seconds).

(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. 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 the § 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 (~ 0 °C) environment until analysis).

(15) Immediately after the end of the sample period, turn off the cooling fan.

(16) Turn off the CVS or disconnect the exhaust tube from the tailpipe(s) of the vehicle.

(17) Repeat the steps in paragraph (b)(2) through (11) of this section for the hot start test, except only two evacuated sample bags, two methanol sample impingers, two formaldehyde sample impingers are required. The step in paragraph (b)(8) of this section shall begin between 9 and 11 minutes after the end of the sample period for the cold start test.

(18) At the end of the deceleration which is scheduled to occur at 505 seconds, simultaneously turn off gas flow measuring device No. 1 and position the sample selector valve to the "standby" position. (Engine shutdown is not part of the hot start test sample period.) Record the measured roll or shaft revolutions.

(19) As soon as possible, transfer the hot start "transient" exhaust and dilution air bag samples to the analytical system and process the samples according to § 86.540 obtaining a stabilized reading of the bag exhaust 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 (~ 0 °C) environment until analysis).

(20) Disconnect the exhaust tube from the vehicle tailpipe(s) and remove the vehicle from dynamometer.

(21) The CVS or CFV may be turned off, if desired.

(22) Continuous monitoring of exhaust emissions will not normally be allowed. Specific written approval must be obtained from the Administrator for continuous monitoring of exhaust emissions.

70. A new § 86.540–90 is added to Subpart F, to read as follows:

§ 86.540–90 Exhaust sample analysis.

The following sequence of operations shall be performed in conjunction with each series of measurements:

(a) For CO, CO_2, gasoline-fueled and methanol-fueled vehicle HC, and, if appropriate, NOx:

(1) Zero the analyzers and obtain a stable zero reading. Recheck after tests.

(2) Introduce span gases and set instrument gains. In order to avoid errors, span and calibrate at the same flow rates used to analyze the test sample. Span gases should have concentrations equal to 75 to 100 percent of full scale. If gain has shifted significantly on the analyzers, check the calibrations. Show actual concentrations on chart.

(3) Check zeros; repeat the procedure in paragraphs (a) (1) and (2) of this section if required.

(4) Check flow rates and pressures.

(5) Measure HC, CO, CO_2, and, if appropriate, NOx, concentrations of samples.

(6) Check zero and span points. If difference is greater than 2 percent of full scale, repeat the procedure in paragraphs (a) (1) through (5) of this section.

(b) For CH_3OH (methanol-fueled vehicles):

(1) Introduce a reference sample of methanol (the concentration of methanol

in deionized water is known, and is C_{MR} in the calculations) into the gas chromatograph and measure the area of the response peak. This reference sample peak area is A_{MR} in the calculations.

(2) Introduce test samples into the gas chromatograph and measure the area of the response peak. This peak area is A_{MS} in the calculations.

(c) For HCHO (methanol-fueled vehicles):

(1) Introduce a reference sample of formaldehyde (the concentration of formaldehyde as a dinitrophenylhydrazine derivative in acetonitrile (C_{FR}) is known) into the high pressure liquid chromatograph and measure the area of the response peak. This reference sample peak area is A_{FR} in the calculations.

(2) Introduce test samples into the high pressure liquid chromatograph and measure the area of the responses peak. This peak area is A_{FS} in the calculations.

71. A new § 86.542–90 is added to Subpart F, to read as follows:

§ 86.542–90 Records required.

The following information shall be recorded with respect to each test:

(a) Test number.

(b) System or device tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument operator.

(e) Driver or operator.

(f) *Vehicle:* Make, Vehicle identification number, Model year, Transmission type, Odometer reading at initiation of preconditioning, Engine displacement, Engine family, Emission control system, Recommended idle RPM, Nominal fuel tank capacity, Inertial loading, Actual curb mass recorded at 0 kilometers, and Drive wheel tire pressure.

(g) *Dynamometer serial number:* As an alternative to recording the dynamometer serial number, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided the test cell records show the pertinent instrument information.

(h) All pertinent instrument information such as tuning-gain-serial number-detector number-range. As an alternative, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided test cell calibration records show the pertinent instrument information.

(i) Recorder Charts: Identify zero, span, exhaust gas, and dilution air sample traces.

(j) Test cell barometric pressure, ambient temperature and humidity.

Note: A central laboratory barometer may be used; *Provided,* that individual test cell barometric pressures are shown to be within ±0.1 percent of the barometric pressure at the central barometer location.

(k) [Reserved]

(l) Pressure of the mixture of exhaust and dilution air entering the CVS metering device, the pressure increase across the device, and the temperature at the inlet. The temperature may be recorded continuously or digitally to determine temperature variations.

(m) The number of revolutions of the positive displacement pump accumulated during each test phase while exhaust samples are being collected. The number of standard cubic meters metered by a critical flow venturi during each test phase would be the equivalent record for a CFV–CVS.

(n) The humidity of the dilution air.

Note: If conditioning columns are not used (see §§ 86.522 and 86.544) this measurement can be deleted. If the conditioning columns are used and the dilution air is taken from the test cell, the ambient humidity can be used for this measurement.

(o) The driving distance for each of the three phases of test, calculated form the measured roll or shaft revolutions.

(p) *Additional required records for methanol-fueled vehicles:* (1) Specification of the methanol fuel 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 concentration in the reference sample and the peak area from the GC analysis of the reference sample.

(4) The peak area of the GC analyses of the test samples (methanol).

(5) Volume of sample passed through the formaldehyde sampling system.

(6) The formaldehyde concentration in the reference sample and the peak area from the HPLC analysis of the reference sample.

(7) The peak area of the HPLC analysis of the test sample (formaldehyde).

72. A new § 86.544–90 is added to Subpart F, to read as follows:

§ 86.544–90 Calculations; exhaust emissions.

The final reported test results, with oxides of nitrogen being optional, shall be computed by use of the following formula: (The results of all emission tests shall be rounded, using the "Rounding-Off Method" specified in ASTM E 29–67, to the number of places to the right of the decimal point indicated by expressing the applicable standard to three significant figures.)

$$(a)\ Y_{wm} = 0.43\left(\frac{Y_{ct}+Y_s}{D_{ct}+D_s}\right) + 0.57\left(\frac{Y_{ht}+Y_s}{D_{ht}+D_s}\right)$$

Where:

(1) Y_{wm} = Weighted mass emissions of CO_2 or of each pollutant (*i.e.,* HC, CO, or NO_x) in grams per vehicle kilometer and if appropriate, the weighted carbon mass equivalent of organic material hydrocarbon equivalent, in grams per vehicle kilometer.

(2) Y_{ct} = Mass emissions as calculated from the "transient" phase of the cold-start test, in grams per test phase.

(3) Y_{ht} = Mass emissions as calculated from the "transient" phase of the hot-start test, in grams per test phase.

(4) Y_s = Mass emissions as calculated from the "stabilized" phase of the cold-start test, in grams per test phase.

(5) D_{ct} = The measured driving distance from the "transient" phase of the cold-start test, in kilometers.

(6) D_{ht} = The measured driving distance from the "transient" phase of the hot-start test, in kilometers.

(7) D_s = The measured driving distance from the "stabilized" phase of the cold-start test, in kilometers.

(b) The mass of each pollutant for each phase of both the cold-start test and the hot-start test is determined from the following:

(1) Hydrocarbon mass:
$HC_{mass} = V_{mix} \times Density_{HC} \times (HC_{conc}/1{,}000{,}000)$

(2) Oxides of nitrogen mass:
$NOx_{mass} = V_{mix} \times Density_{NO2} \times K_H \times (NOx_{conc}/1{,}000{,}000)$

(3) Carbon monoxide mass:
$CO_{mass} = V_{mix} \times Density_{CO} \times (CO_{conc}/1{,}000{,}000)$

(4) Carbon dioxide mass:
$CO_{2mass} = V_{mix} \times Density_{CO2} \times (CO_{2conc}/100)$

(5) Methanol mass:
$CH_3OH_{mass} = V_{mix} \times Density_{CH3OH} \times (CH_3OH_{conc}/1{,}000{,}000)$

(6) Formaldehyde mass:
$HCHO_{mass} = V_{mix} \times Density_{HCHO} \times (HCHO_{conc}/1{,}000{,}000)$

(7) Organic material hydrocarbon equivalent:

(i) OMHCE=

$$HC_{Mass} + \frac{13.8756}{32.042}(CH_3OH)_{Mass} + \frac{13.8756}{30.0262}(HCHO)_{Mass}$$

(c) Meaning of symbols:

(1)(i) HC_{mass}=Hydrocarbon emissions, in grams per test phase.

(ii) $Density_{HC}$=Density of hydrocarbon in the exhaust gas, 576.8 g/m³/carbon atom (16.33 g/ft³/carbon atom), assuming an average carbon to hydrogen ratio of 1:1.85, at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) HC_{conc}=Hydrocarbon concentration of the dilute exhaust sample corrected for background, in ppm carbon equivalent, *i.e.*, equivalent propane x 3.

(B) $HC_{conc}=HC_e-HC_d(1-(1/DF))$

Where:

(iv)(A) HC_e=Hydrocarbon concentrations of the dilute exhaust sample as measured, in ppm carbon equivalent (propane ppm x 3).

(B) $HC_e=FIDHC_e-(r)C_{CH3OHe}$

(v) FID HC_e=Concentration of hydrocarbon plus methanol in dilute exhaust as measured by the FID, ppm carbon equivalent.

(vi) r=FID response to methanol.

(vii) C_{CH3OHe}=Concentration of methanol in dilute exhaust as determined from the dilute exhaust methanol sample, ppm carbon.

(viii)(A) HC_d=Hydrocarbon concentration of the dilution air as measured, ppm carbon equivalent.

(B) $HC_d=FID\ HC_d-(r)C_{CH3OHd}$

(ix) FID HC_d=Concentration of hydrocarbon plus methanol in dilution air as measured by the FID, ppm carbon equivalent.

(x) C_{CH3OHd}=Concentration of methanol in dilution air as determined from dilution air methanol sample, ppm carbon.

(2)(i) NOx_{mass}=Oxides of nitrogen emissions, grams per test phase.

(ii) $Density_{NO2}$=Density of oxides of nitrogen in the exhaust gas, assuming they are in the form of nitrogen dioxide, 1913 g/m³ (54.16 g/ft³), at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) NOx_{conc}=Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, ppm.

(B) $NOx_{conc}=NOx_e-NOx_d(1-(1/DF))$

Where:

(iv) NOx_e=Oxides of nitrogen concentration of the dilute exhaust sample as measured, ppm.

(v) NOx_d=Oxides of nitrogen concentration of the dilution air as measured, ppm.

(3)(i) CO_{mass}=Carbon monoxide emissions, in grams per test phase.

(ii) $Density_{CO}$=Density of carbon monoxide, 1164 g/m³ (32.97 g/ft³), at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) CO_{conc}=Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, ppm.

(B) $CO_{conc}=CO_e-CO_d(1-(1/DF))$

Where:

(iv)(A) CO_e=Carbon monoxide concentration of the dilute exhaust sample volume corrected for water vapor and carbon dioxide extraction, in ppm.

(B) $CO_e=(1-0.01925CO_{2e}-0.000323R)CO_{em}$ for gasoline-fueled vehicles with hydrogen to carbon ratio of 1.85:1

(C) $CO_e=[1-(0.01+0.005HCR)CO_{2e}-0.000323R]CO_{em}$ for methanol-fueled vehicles, where HCR is hydrogen to carbon ratio as measured for the fuel used.

(v) CO_{em}=Carbon monoxide concentration of the dilute exhaust sample as measured, ppm

(vi) CO_{2e}=Carbon dioxide concentration of the dilute exhaust sample, pct.

(vii) R=Relative humidity of the dilution air, pct (*see* § 86.542(n)).

(viii)(A) CO_d=Carbon monoxide concentration of the dilution air corrected for water vapor extraction, ppm.

(B) $CO_d=(1-0.000323R)CO_{dm}$

Where:

(ix) CO_{dm}=Carbon monoxide concentration of the dilution air sample as measured, ppm.

Note: If a CO instrument which meets the criteria specified in § 86.511 is used and the conditioning column has been deleted, CO_{em} can be substituted directly for CO_e and CO_{dm} must be substituted directly for CO_d.

(4)(i) CO_{2mass}=Carbon dioxide emissions, grams per test phase.

(ii) $Density_{CO2}$=Density of carbon dioxide, 1830 g/m³ (51.81 g/ft³), at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) CO_{2conc}=carbon dioxide concentration of the dilute exhaust sample corrected for background, in percent.

(B) $CO_{2conc}=CO_{2e}-CO_{2d}(1-1/DF)$

Where:

(iv) CO_{2d}=Carbon dioxide concentration of the dilution air as measured, in percent.

(5)(i) CH_3OH_{mass}=Methanol emissions corrected for background, grams per test phase.

(ii) $Density_{CH3OH}$=Density of methanol is 1332 g/m³ (37.71 g/ft³), at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) CH_3OH_{conc}=Methanol concentration of the dilute exhaust corrected for background, ppm.

(B) $CH_3OH_{conc}=C_{CH3OHe}-C_{CH3OHd}(1-(1/DF))$

Where:

(iv)(A) C_{CH3OHe}=Methanol concentration in the dilute exhaust, ppm.

(B)

$$C_{CH3OHe}=\frac{3.813\times10^{-2}\times C_{CH3OHR}\times T_{EM}[(A_{S1}\times AV_{S1})+(A_{S2}\times AV_{S2})]}{A_{CH3OHR}\times P_B\times V_{EM}}$$

(v)(A) C_{CH3OHd}=Methanol concentration in the dilution air, ppm.

$$(B)\ C_{CH_3OHd} = \frac{3.813\times10^{-2}\times C_{CH_3OHR}\times T_{DM}[(A_{D1}\times AV_{D1})+(A_{D2}\times AV_{D2})]}{A_{CH_3OHR}\times P_B\times V_{DM}}$$

(vi) C_{CH_3OHR}=Concentration of methanol in standard sample for calibration of GC, μg/ml.

(vii) A_{CH_3OHR}=GC peak area of standard sample.

(viii) T_{EM}=Temperature of methanol sample withdrawn from dilute exhaust, °R.

(ix) T_{DM}=Temperature of methanol sample withdrawn from dilution air, °R.

(x) P_B=Barometric pressure during test, mm Hg.

(xi) V_{EM}=Volume of methanol sample withdrawn from dilute exhaust, ft³.

(xii) V_{DM}=Volume of methanol sample withdrawn from dilution air, ft³.

(xiii) A_s=GC peak area of sample drawn from dilute exhaust.

(xiv) A_D=GC peak area of sample drawn from dilution air.

(xv) AV_s=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml.

(xvi) AV_D=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml.

(xvii) 1=first impinger.

(xviii) 2=second impinger.

(6)(i) $HCHO_{mass}$=Formaldehyde emissions corrected for background, grams per test phase.

(ii) $Density_{HCHO}$=Density of formaldehyde is 1249 g/m³ (35.36 g/ft³), at 20 °C (68 °F) and 101.3 kPa (760 mm Hg) pressure.

(iii)(A) $HCHO_{conc}$=Formaldehyde concentration of the dilute exhaust corrected for background, ppm.

(B) $HCHO_{conc}=C_{HCHOe}-C_{HCHOd}(1-(1/DF))$

Where:

(iv)(A) C_{HCHOe}=Formaldehyde concentration in dilute exhaust, ppm.

$$(B)\ C_{HCHOe} = \frac{4.069\times10^{-2}\times C_{FDE}\times V_{AE}\times Q\times T_{EF}}{V_{SE}\times P_B}$$

(v)(A) C_{HCHOd}=Formaldehyde concentration in dilution air, ppm.

$$(B)\ C_{HCHOd} = \frac{4.069\times10^{-2}\times C_{FDA}\times V_{AA}\times Q\times T_{DF}}{V_{SA}\times P_B}$$

(vi) C_{FDE}=Concentration of DNPH derivative of formaldehyde from dilute exhaust sample in sampling solution, μg/ml.

(vii) V_{AE}=Volume of sampling solution for dilute exhaust formaldehyde sample, ml.

(viii)(A) Q=Ratio of molecular weights of formaldehyde to its DNPH derivative.

(B) Q=0.1429

(ix) T_{EF}=Temperature of formaldehyde sample withdrawn from dilute exhaust, °R.

(x) V_{SE}=Volume of formaldehyde sample withdrawn from dilute exhaust, ft³.

(xi) P_B=Barometric pressure during test, mm Hg.

(xii) C_{FDA}=Concentration of DNPH derivative of formaldehyde from dilution air sample in sampling solution, μg/ml.

(xiii) V_{AA}=Volume of sampling solution for dilution air formaldehyde sample, ml.

(xiv) T_{DF}=Temperature of formaldehyde sample withdrawn from dilution air, °R.

(xv) V_{SA}=Volume of formaldehyde sample withdrawn from dilution air, ft³.

(7)(i) $DF=13.4/[CO_{2e}+(HC_e+CO_e)10^{-4}]$ for gasoline-fueled vehicles.

$$(ii)\quad DF = \frac{100\ x\left(\frac{x}{x + y/2 + 3.76(x + y/4 - z/2)}\right)}{CO_{2e} + (HC_e + CO_e + C_{CH3OHe})\ 10^{-4}}$$

for methanol-fueled vehicles where fuel composition is $C_xH_yO_z$ as measured for the fuel used.

(iii)(A) V_{mix}=Total dilute exhaust volume in cubic meters per test phase corrected to standard conditions (293 °K (528 °R) and 101.3 kPa (760 mm Hg)).

(B)

$$V_{mix} = \frac{V_o\times N\times(P_B-P_i)\times 293}{101.3\times T_p}$$

Where:

(iv) V_o=Volume of gas pumped by the positive displacement pump, in cubic meters per revolution. This volume is dependent on the pressure differential across the positive displacement pump. (See calibration techniques in § 86.519.)

(v) N=Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

(vi) P_B=Barometric pressure, kPa.

(vii) P_i=Pressure depression below atmospheric measured at the inlet to the positive displacement pump, kPa.

(viii) T_p=Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, °K.

(ix)(A) K_h=Humidity correction factor.

(B) $K_h=1/[1-0.0329(H-10.71)]$

Where:

(x)(A) H=Absolute humidity in grams of water per kilogram of dry air.

(B) $H=[(6.211)R_a \times P_d]/[P_B-(P_d \times R_a/100)]$

(xi) R_a=Relative humidity of the ambient air, pct.

(xii) P_d=Saturated vapor pressure, in kPa at the ambient dry bulb temperature.

(xiii) P_B=Barometric pressure, kPa.

(d) Sample calculation of mass emission values for gasoline-fueled vehicles with engine displacements equal to or greater than 170 cc (10.4 cu. in.):

(1) For the "transient" phase of the cold-start test, assume V_o=0.0077934 m^3 per rev; N=12,115; R=20.5 pct; R_a=20.5 pct; P_B=99.05 kPa; P_d=3.382 kPa; P_i=9.851 kPa; T_p=309.8 °K; HC_e=249.75 ppm carbon equivalent; NOx_e=38.30 ppm; CO_{em}=311.23 ppm; CO_{2e}= 0.415 percent; HC_d= 4.90 ppm; NOx_d=0.30 ppm; CO_{dm}=8.13 ppm; CO_{2d}=0.037 pct; D_{ct}=5.650 km.

Then:

(i) $V_{mix}=[(0.0077934)(12,115)(99.05-9.851)(293.15)]/[(101.325)(309.8)]=78.651\ m^3$ per test phase.

(ii) $H=[(6.211)(20.5)(3.382)]/[(99.05)-(3.382)(20.5/100)]$=4.378 grams H_2O per kg dry air.

(iii) $K_h=1/[1-0.0329(4.378-10.71)]$ =0 8276

(iv) $CO_e=[1-0.01925(0.415)-0.000323(20.5)][311.23)]$=306.68 ppm.

(v) $CO_d=[1-0.000323(20.5)](8.13)$ =8.08 ppm.

(vi) $DF=13.4/[0.415+(249.75+306.68)10^{-4}]$=28.472

(vii) $HC_{conc}=249.75-4.90(1-1/28.472)$ =245.02 ppm.

(viii) $HC_{mass}=(78.651)\ (576.8)\ (245.02)\ 10^{-6}$=11.114 grams per test phase.

(ix) $NOx_{conc}=38.30-0.30(1-1/28.472)$ =38.01 ppm.

(x) $NOx_{mass}=(78.651)(1913)(38.01)(0.8276)\times 10^{-6}$=4.733 grams per test phase.

(xi) $CO_{conc}=306.68-8.08\ (1-1/28.472)$ =298.88 ppm.

(xii) $CO_{mass}=(78.651)\ (1164)\ (298.88)\ (10^{-6})$=27.362 grams per test phase.

(xiii) $CO_{2conc}=0.415-0.037\ (1-1/28.472)$=0.3793 percent.

(xiv) $CO_{2mass}=(78.651)(1843)(0.3793)/100$=549.81 grams per test phase.

(2) For the "stabilized" portion of the cold-start test, assume that similar calculations resulted in HC_{mass}=7.184 grams per test phase; NOx_{mass}=2.154 grams per test phase; CO_{mass}=64.541 grams per test phase; and CO_{2mass}=529.52 grams per test phase. D_s=6.070 km.

(3) For the "transient" portion of the hot-start test, assume that similar calculations resulted in HC_{mass}=6.122 grams per test phase; NOx_{mass}=7.056 grams per test phase; CO_{mass}=34.964 grams per test phase; and CO_{2mass}=480.93 grams per test phase. D_{ht}=5.660 km.

(4) For a 1978 motorcycle with an engine displacement equal to or greater than 170 cc (10.4 cu. in):

(i) $HC_{wm}=0.43\ [(11.114+7.184)/(5.650+6.070)]+0.57\ [(6.122+7.184)/(5.660+6.070)]$=1.318 grams per vehicle kilometer.

(ii) $NOx_{wm}=0.43\ [(4.733+2.154)/(5.650+6.070)]+0.57\ [(7.056+2.154)/(5.660+6.070)]$=0.700 gram per vehicle kilometer.

(iii) $CO_{wm}=0.43\ [(27.362+64.541)/(5.650+6.070)]+0.57\ [(34.964+64.541)/(5.660+6.070)]$=8.207 grams per vehicle kilometer.

(iv) $CO_{2wm}=0.43\ [(549.81+529.52)/(5.650+6.070)]+0.57\ [(480.93+529.52)/(5.660+6.070)]$=88.701 grams per vehicle kilometer.

(e) For methanol-fueled vehicle with measured fuel composition of $CH_{3.14}O_{0.6}$ example calculation of exhaust emissions using positive displacement pump:

(1) For the "transient" phase of the cold start test assume the following:

V_o=0.29344 ft^3/rev; N=10,485; R=48.0 pct; R_a=48.2 pct; P_B=762 mm Hg; P_d=22.225 mm Hg; P_i=70 mm Hg; T_p=570°R; FID=HCe=81.6 ppm, carbon equivalent; r=0.75; C_{CH3OHR}=71 ug/ml; T_{EM}=567°R; A_{CH3OHR}=3660; V_{EM}=1.18 ft^3; A_{s1}=4460; AV_{s1}=25.2 ml; A_{s2}=360; AV_{s2}=24.9 ml; T_{DM}=532°R; V_{DM}=1.17 ft^3; A_{D1}=110; AV_{D1}=25.0 ml; A_{D2}=10; AV_{D2}=25.1 ml; C_{FDE}=20 ug/ml; V_{AE}=5.0 ml; Q=0.1429; T_{EF}=569°R; V_{SE}=0.30 ft^3; C_{FDA}=1 ug/ml; V_{AA}=5.0 ml; T_{DF}=532°R; V_{SA}=0.31 ft^3; NOx_e=11.2 ppm; CO_{em}=306.6 ppm; CO_{2e}=1.43 pct; FID HC_d=12.1 ppm; NOx_d=0.8 ppm; CO_{dm}=15.3 ppm; CO_{2d}=0.032 pct; D_{ct}=3.598 mi.

Then:

(i) $V_{mix}=(0.29344)(10,485)(762-70)(528)/(760)(570)$=2595.0 ft^3 per test phase.

(ii) $H=(43.478)(48.2)(22.225)/[762-(22.225x48.2/100)]$=62 grains of water per pound of dry air.

(iii) $K_H=1/[1-0.0047(62-75)]$=0.9424

(iv) $CO_e=[1-(0.01+0.005\times 3.14\times 1.43)-0.000323(48)]$ 306.6=291.9 ppm.

(v) $CO_d=(1-0.000323(48))\ 15.3$=15.1 ppm.

(vi) $$C_{CH3OHe}=\frac{(3.813\times 10^{-2})(71)(567)[(4460)(25.2)+(360)(24.9)]}{(3660)(762)(1.18)}=56.60 \text{ ppm.}$$

$$\text{(vii)}\quad DF = \frac{100 \times \dfrac{1}{1 + (3.14/2) + 3.76(1 + 3.14/4 - 0.6/2)}}{1.43 + [81.6 + 291.9 + (1 - 0.75)(56.60)] \times 10^{-4}}$$

$$= 8.350$$

$$\text{(viii)}\quad C_{CH_3OHd} = \frac{(3.813\times10^{-2})(71)(532)[(110)(25.0)+(10)(25.1)]}{(3660)(762)(1.17)} = 1.32 \text{ ppm.}$$

(ix) $CH_3OH_{conc} = 56.60 - 1.32\,(1 - 1/8.350) = 55.44$ ppm.

(x) $CH_3OH_{mass} = (2595.0)(37.71)(55.44/1{,}000{,}000) = 5.43$ grams per test phase.

(xi) $HC_{conc} = [81.6 - (0.75)(56.60)] - [12.1 - (0.75)(1.32)](1 - 1/8.530) = 29.34$ ppm.

(xii) $HC_{mass} = (2594)(16.33)(29.34/1{,}000{,}000) = 1.24$ grams per test phase.

(xiii) $C_{HCHO_e} = (4.069\times10^{-2})(20)(5)(0.1429)(569)/(0.30)(762) = 1.4473$ ppm.

(xiv) $C_{HCHOd} = (4.069\times10^{-2})(1)(5)(0.1429)(532)/(0.31)(762) = 0.0655$ ppm.

(xv) $HCHO_{conc} = 1.4473 - 0.0655(1 - 1/8.350) = 1.3896$ ppm.

(xvi) $HCHO_{mass} = (2595)(35.36)(1.3896/1{,}000{,}000) = 0.1275$ grams per test phase.

$$\text{(xvii)}\quad OMHCE = 1.24 + \frac{13.8756}{32.042}(5.43) + \frac{13.8756}{30.0262}(0.1275)$$

$= 3.65$ grams per test phase.

(xviii) $NOx_{conc} = 11.2 - (0.8)(1 - 1/8.350) = 10.50$ ppm.

(xix) $NOx_{mass} = (2595)(54.16)(10.50/1{,}000{,}000)(0.9424) = 1.390$ grams per test phase.

(xx) $CO_{conc} = 291.9 - 15.1(1 - 1/8.530) = 278.69$ ppm.

(xxi) $CO_{mass} = (2595.0)(32.97)(278.69/1{,}000{,}000) = 23.84$ grams per test phase.

(xxii) $CO_{2conc} = 1.43 - 0.032\,(1 - 1/8.350) = 1.402$ percent.

(xxiii) $CO_{2mass} = (2595.0)(51.85)(1.402/100) = 1886$ grams per test phase.

(2) For the stabilized portion of the cold start test assume that similar calculations resulted in the following:

(i) OMHCE = 0.55 grams per test phase.

(ii) $NOx_{mass} = 1.27$ grams per test phase.

(iii) $CO_{mass} = 5.98$ grams per test phase.

(iv) $CO_{2mass} = 2346$ grams per test phase.

(v) $D_s = 3.902$ miles.

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

(i) OMHCE = 0.67 grams per test phase.

(ii) $NOx_{mass} = 1.38$ grams per test phase.

(iii) $CO_{mass} = 5.01$ grams per test phase.

(iv) $CO_{2mass} = 1758$ grams per test phase.

(v) $D_{ht} = 3.598$ miles.

(4) Weighted emission results:

(i) $OMHCE_{wm} = 0.43[(3.65 + 0.55)/(3.598 + 3.902)] + 0.57[(0.67 + 0.55)/(3.598 + 3.902)] = 0.334$ grams per vehicle mile.

(ii) $NOx_{wm} = 0.43[(1.390 + 1.27)/(3.598 + 3.902)] + 0.57[(1.38 + 1.27)/(3.598 + 3.902)] = 0.354$ grams per vehicle mile.

(iii) $CO_{wm} = 0.43[(23.84 + 5.98)/(3.598 + 3.902)] + 0.57[(5.01 + 5.98)/(3.598 + 3.902)] = 2.54$ grams per vehicle mile.

(iv) $CO_{2wm} = 0.43[(1886 + 2346)/(3.598 + 3.902)] + 0.57[(1758 + 2346)/(3.598 + 3.902)] = 555$ grams per vehicle mile.

73. A new section 86.608–90 is added to Subpart G, to read as follows:

§ 86.608–90 Test procedures.

(a) The prescribed test procedures are contained in Subpart B of this Part 86. For purposes of Selective Enforcement Audit testing, the manufacturer shall not perform any of the test procedures in Subpart B of this part relating to evaporative emission testing, except as specified in paragraph (a)(2) of this section.

(1) The Administrator may, on the basis of a written application by a manufacturer, prescribe test procedures other than those in Subpart B of this part for any motor vehicle which he determines is not susceptible to satisfactory testing using the procedures in Subpart B of this part.

(2) The following exceptions to the test procedures in Subpart B of this part are applicable to Selective Enforcement Audit testing:

(i) For mileage accumulation, the manufacturer may use test fuel meeting the specifications of mileage and service accumulation fuels of § 86.113. Otherwise, the manufacturer may use fuels other than those specified in this section only with the advance approval of the Administrator.

(ii) The manufacturer may measure the temperature of the test fuel at other than the approximate midvolume of the fuel tank, as specified in paragraph § 86.131–90(a), and may drain the test fuel from other than the lowest point of the tank, as specified in paragraph § 86.131–90(b), provided an equivalent method is used. Equivalency documentation shall be maintained by the manufacturer and shall be made

available to the Administrator upon request.

(iii) The manufacturer may perform additional preconditioning on SEA test vehicles other than the preconditioning specified in § 86.132 only if the additional preconditioning had been performed on certification test vehicles of the same configuration.

(iv) The manufacturer shall perform the heat build procedure 11 to 34 hours following vehicle preconditioning rather than according to the time period specified in paragraph § 86.133–90(a). All references in § 86.133 to an evaporative emission enclosure (SHED) and analyzing for HC during the heat build can be ignored.

(v) The manufacturer may substitute slave tires for the drive wheel tires on the vehicle as specified in paragraph § 86.135–90(e): Provided, that the slave tires are the same size.

(vi) The cold start exhaust emission test described in § 86.137 shall follow the heat build procedure described in § 86.133 by not more than one hour.

(vii) In performing exhaust sample analysis under § 86.140.

(A) When testing diesel vehicles, or methanol-fueled Otto-cycle vehicles, the manufacturer shall allow a minimum of 20 minutes warm-up for the HC analyzer, and for diesel vehicles, a minimum of two hours warm-up for the CO, CO_2, and NOx analyzers. (Power is normally left on infrared and chemiluminescent analyzers. When not in use, the chopper motors of the infrared analyzers are turned off and the phototube high voltage supply to the chemiluminescent analyzers is placed in the standby position.)

(B) The manufacturer shall exercise care to prevent moisture from condensing in the sample collection bags.

(viii) The manufacturer need not comply with § 86.142, since the records required therein are provided under other provisions of Subpart G of this part.

(ix) In addition to the requirements of Subpart B of this part, the manufacturer shall prepare gasoline-fueled and methanol-fueled vehicles as follows prior to exhaust emissions testing:

(A) The manufacturer shall inspect the fuel system to insure the absence of any leaks of liquid or vapor to the atmosphere by applying a pressure of 14.5 ± 0.5 inches of water to the fuel system, allowing the pressure to stabilize, and isolating the fuel system from the pressure source, pressure must not drop more than 2.0 inches of water in 5 minutes. If required, the manufacturer shall perform corrective action in accordance with § 86.608 and report this action in accordance with § 86.609.

(B) When performing this pressure check, the manufacturer shall exercise care to neither purge nor load the evaporative emission control system.

(C) The manufacturer shall not modify the test vehicle's evaporative emission control system by component addition, deletion, or substitution, except to comply with paragraph (a)(2)(ii) of this section if approved in advance by the Administrator.

(b)(1) The manufacturer shall not adjust, repair, prepare, or modify the vehicles selected for testing and shall not perform any emission tests on vehicles selected for testing pursuant to the test order unless this adjustment, repair, preparation, modification, and/or tests are documented in the manufacturer's vehicle assembly and inspection procedures and are actually performed or unless these adjustments and/or tests are required or permitted under this subpart or are approved in advance by the Administrator.

(2) For 1981 and later model years the Administrator may adjust or cause to be adjusted any engine or vehicle parameter which the Administrator has determined to be subject to adjustment for new vehicle compliance testing (e.g., for certification or Selective Enforcement Audit testing) in accordance with § 86.081–22(c)(1), to any setting within the physically adjustable range of that parameter, as determined by the Administrator in accordance with § 86.081–22(e)(3)(ii), prior to the performance of any tests. However, if the idle speed parameter is one which the Administrator has determined to be subject to adjustment, the Administrator shall not adjust it to a setting which causes a lower engine idle speed than will be possible within the physically adjustable range of the idle speed parameter on the vehicle when it has accumulated 4,000 miles, all other parameters being adjusted identically for the purpose of comparison. The Administrator, in making or specifying such adjustments, will consider the effect of the deviation from the manufacturer's recommended setting on emissions performance characteristics as well as the likelihood that similar settings will occur on in-use light-duty vehicles or light-duty trucks. In determining likelihood, the Administrator will consider factors such as, but not limited to, the effect of the adjustment on vehicle performance characteristics and surveillance information from similar in-use vehicles.

(c) Prior to performing exhaust emission testing on an SEA test vehicle, the manufacturer may accumulate on each vehicle a number of miles equal to the greater of 4,000 miles, or the number of miles the manufacturer accumulated during certification on the emission-data vehicle corresponding to the configuration specified in the test order.

(1) Mileage accumulation must be performed in any manner using good engineering judgement to obtain emission results representative of normal production vehicles. This mileage accumulation must be consistent with the new vehicle break-in instructions contained in the applicable vehicle owner's manual, if any.

(2) The manufacturer shall accumulate mileage at a minimum rate of 300 miles per vehicle during each 24 hour period, unless otherwise provided by the Administrator.

(i) The first 24 hour period for mileage accumulation shall begin as soon as authorized vehicle checks, inspections and preparations are completed on each vehicle.

(ii) The minimum mileage accumulation rate does not apply on weekends or holidays.

(iii) If the manufacturer's mileage accumulation target is less than the minimum rate specified (300 miles per day), then the minimum daily accumulation rate shall be equal to the manufacturer's mileage accumulation target.

(3) Mileage accumulation shall be completed on a sufficient number of test vehicles during consecutive 24 hour periods to assure that the number of vehicles tested per day fulfills the requirements of paragraph (g) of this section.

(d) The manufacturer shall not perform any maintenance on test vehicles after selection for testing nor shall the Administrator allow deletion of any test vehicle from the test sequence, unless requested by the manufacturer and approved by the Administrator before any test vehicle maintenance or deletion.

(e) The manufacturer will be allowed 24 hours to ship test vehicles from the assembly plant or storage facility to the test facility if the test facility is not located at the plant or storage facility or in close proximity to the plant or storage facility: Except, That the Administrator may approve more time based upon a request by the manufacturer accompanied by a satisfactory justification.

(f) If a vehicle cannot complete the mileage accumulation or emission tests because of vehicle malfunction, the manufacturer may request the Administrator to authorize the repair of

that vehicle or its deletion from the test sequence.

(g) Whenever the manufacturer conducts testing pursuant to a test order issued under this subpart, the manufacturer shall notify the Administrator within one working day of receipt of the test order, which test facility will be used to comply with the test cells at that facility. If no test cells are available at the desired facility, the manufacturer must provide alternate testing capability satisfactory to the Administrator. The manufacturer shall complete emission testing on a minimum of four vehicles per 24 hour period including voided tests for each available test cell at his testing facility: Except, That the Administrator may approve a longer period based upon a request by the manufacturer accompanied by satisfactory justification.

(h) The manufacturer shall perform test vehicle selection, preparation, mileage accumulation, shipping, and testing in such a manner as to assure that the audit is performed in an expeditious manner.

(i) The manufacturer may retest any test vehicle after a fail decision has been reached in accordance with paragraph (d) of § 86.610 based on the first test on each vehicle; except, that the Administrator may approve retesting at other times during the audit based upon a request by the manufacturer accompanied by a satisfactory justification. The manufacturer may test each vehicle the same number of times. The manufacturer may accumulate additional mileage on test vehicles before conducting retests, subject to the provisions of paragraph (c) of this section.

74. The heading of Subpart I is revised, to read as follows:

Subpart I—Emission Regulations for New Diesel Heavy-Duty Engines; Smoke Exhaust Test Procedure

75. Section 86.884–1 of Subpart I is revised, to read as follows:

§ 86.884–1 General applicability.

The provisions of this subpart are applicable to new petroleum-fueled diesel heavy-duty engines beginning with the 1984 model year and methanol-fueled diesel heavy-duty engines beginning with the 1990 model year.

76. Section 86.884–5 of Subpart I is amended by revising paragraph (b), to read as follows:

§ 86.884–5 Test procedures.

* * * * *

(b) The test is designed to determine the opacity of smoke in exhaust emissions during those engine operating conditions which tend to promote smoke from diesel vehicles.

* * * * *

77. Section 86.884–6 of Subpart I is revised, to read as follows:

§ 86.884–6 Fuel specifications.

The requirements of this section are set forth in § 86.1313.

78. The heading of Subpart K is revised, to read as follows:

Subpart K—Selective Enforcement Auditing and Production Compliance Auditing of New Heavy-Duty Engines and Light-Duty Trucks

79. Section 86.1001–84 of Subpart K is amended, to read as follows:

§ 86.1001–84 Applicability.

The provisions of this subpart are applicable for 1984 and later model year heavy-duty engines and light-duty trucks.

80. A new § 86.1003–90 is added to Subpart K, to read as follows:

§ 86.1003–84 Test orders.

(a) The Administrator shall require any testing under this subpart by means of a test order addressed to the manufacturer.

(b) The test order will be signed by the Assistant Administrator for Air and Radiation or his designee. The test order will be delivered in person by an EPA Enforcement Officer to a company representative or sent by registered mail, return receipt requested, to the manufacturer's representative who signs the Application for Certification submitted by the manufacturer pursuant to the requirements of this applicable section of Subpart A of this part. Upon receipt of a test order, the manufacturer shall comply with all of the provisions of this subpart and instructions in the test order.

(c)(1) The test order will specify the engine or vehicle configuration selected for testing, the manufacturer's vehicle or engine assembly plant or associated storage facility from which the engines or vehicles must be selected, the time and location at which engines or vehicles must be selected, and the procedure by which engines or vehicles of the specified configuration must be selected. The test order may specify the number of vehicles or engines to be selected per day.

(i) If the total production of the specified vehicle configuration is less than the number specified in the test order, the manufacturer will select the actual number of vehicles produced per day.

(ii) Heavy-duty engine manufacturers will be required to select a minimum of four engines per day unless an alternate selection procedure is approved pursuant to § 86.1007–84(a) or unless total production of the specified configuration is less than four engines per day. If total production of the specified configuration is less than four engines per day, the manufacturer will select the actual number of engines produced that day.

(2) The test order may include alternative configurations to be selected for testing in the event that engines or vehicles of the specified configuration are not available for testing because those engines or vehicles are not being manufactured during the specified time, or not being stored at the specified assembly plant or associated storage facilities.

(3) If the specified configuration is not being manufactured at a rate of at least four vehicles per day, in the case of light-duty truck manufacturers, two engines per day, in the case of heavy-duty engine manufacturers specified in paragraph (g)(1) of § 86.1008–84 or one engine per day, in the case of heavy-duty engine manufacturers specified in paragraph (g)(2) of § 86.1008–90, over the expected duration of the audit, the Assistant Administrator or his designated representative may select engines or vehicles of the alternate configuration for testing.

(4) In addition, the test order may include other directions or information essential to the administration of the required testing.

(d) A manufacturer may submit a list of engine families and the corresponding assembly plants or associated storage facilities from which the manufacturer prefers to have engines or vehicles selected for testing or response to a test order. In order that a manufacturer's preferred location be considered for inclusion in a test order for a configuration of a particular engine family, the list must be submitted prior to issuance of the test order. Notwithstanding the fact that a manufacturer has submitted the above list, the Administrator may order selection at other than a preferred location.

(e) Upon receipt of a test order, a manufacturer shall proceed in accordance with the provisions of this subpart.

(f)(1) During a given model year, the Administrator shall not issue to a manufacturer more Selective Enforcement Audit (SEA) test orders than an annual limit determined by the following:

(i) For manufacturers of heavy-duty engines, either petroleum-fueled or methanol-fueled, the number determined by dividing the projected heavy-duty engine sales bound for the United States market for that year, as made by the manufacturer in its Application for Certification, by 30,000 and rounding to the nearest whole number, unless the projected sales are less than 15,000, in which case the number is one;

(ii) For manufacturers of petroleum-fueled or methanol-fueled light-duty trucks, the number determined by dividing the projected light-duty truck sales bound for the United States market for that model year, as made by the manufacturer in its report submitted under paragraph (a)(2) of § 600.207–80 of the Automobile Fuel Economy Regulations, by 300,000 and rounding to the nearest whole number, unless the projected sales are less than 150,000, in which case the number is one.

(iii) If a manufacturer submits to EPA in writing prior to or during the model year a reliable sales projection update, that update will be used for recalculating the manufacturer's annual limit of SEA test orders.

(2) Any SEA test order for which the configuration fails in accordance with § 86.1010 or for which testing is not completed will not be counted against the annual limit.

(3) When the annual limit has been met, the Administrator may issue additional test orders for those configurations for which evidence exists indicating noncompliance. An SEA test order issued on this basis will include a statement as to the reason for its issuance.

81. A new § 86.1005–90 is added to Subpart K, to read as follows:

§ 86.1005–90 Maintenance of records; submittal of information.

(a) The manufacturer of any new petroleum-fueled or methanol-fueled heavy-duty engine or light-duty truck subject to any of the provisions of this subpart shall establish, maintain, and retain the following adequately organized and indexed records:

(1) *General records.* A description of all equipment used to test engines or vehicles in accordance with § 86.1008 pursuant to a test order issued under this subpart, specifically:

(i) If testing heavy-duty gasoline-fueled or methanol-fueled Otto-cycle engines, the equipment requirements specified in §§ 86.1306 and 86.1506 of this part;

(ii) If testing heavy-duty petroleum-fueled or methanol-fueled diesel engines, the equipment requirements specified in §§ 86.1306–84, 86.884–8, and 86.884–9 of this part.

(iii) If testing gasoline-fueled or methanol-fueled Otto-cycle light-duty trucks, the equipment requirements specified in §§ 86.106 (excluding all references to evaporative and particulate emission testing) and 86.1506–84 of this part; and

(iv) If testing petroleum-fueled or methanol-fueled diesel light-duty trucks, the equipment requirements specified in §§ 86.106 (excluding all references to evaporative emission testing) and 86.1506–83 of this part.

(2) *Individual records.* These records pertain to each audit conducted pursuant to this subpart.

(i) The date, time, and location of each test;

(ii) The number of hours of service accumulated on each engine or the number of miles on the vehicle when the test began and ended;

(iii) The names of all supervisory personnel involved in the conduct of the audit;

(iv) A record and description of any repairs performed prior to and/or subsequent to approval by the Administrator, giving the date and time of the repair, the reason for it, the person authorizing it, and the names of all supervisory personnel responsible for the conduct of the repair;

(v) The date when the engine or vehicle was shipped from the assembly plant or associated storage facility and when it was received at the testing facility;

(vi) A complete record of all emission tests performed pursuant to this subpart (except tests performed by EPA directly), including all individual worksheets and/or other documentation relating to each test, or exact copies thereof, specifically

(A) If testing gasoline-fueled or methanol-fueled Otto-cycle heavy-duty engines, the record requirements specified in §§ 86.1342 and 86.1542 of this part;

(B) If testing petroleum-fueled or methanol-fueled diesel heavy-duty engines, the record requirements specified in §§ 86.1342, 86.1542, and 86.884–10;

(C) If testing gasoline-fueled or methanol-fueled Otto-cycle light-duty trucks, the record requirements specified in §§ 86.142 (excluding all references to diesel vehicles) and 86.1542; and

(D) If testing petroleum-fueled or methanol-fueled diesel light-duty trucks, the record requirements specified in § 86.142; and

(vii) A brief description of any significant audit events commencing with the test engine or vehicle selection process, but not described by any subparagraph under paragraph (a)(2) of this section, including such extraordinary events as engine damage during shipment or vehicle accident.

(viii) A paper copy of the driver's trace for each test.

(3) The manufacturer shall record test equipment description, pursuant to paragraph (a)(1) of this section, for each test cell that can be used to perform emission testing under this subpart.

(b) The manufacturer shall retain all records required to be maintained under this subpart for a period of one (1) year after completion of all testing in response to a test order. Records may be retained as hard copy or reduced to microfilm, punch cards, etc., depending upon the manufacturer's record retention procedure: *Provided,* that in every case all information contained in the hard copy is retained.

(c) Pursuant to a request made by the Administrator, the manufacturer shall submit to him the following information with regard to engine or vehicle production:

(1) Number of engines or vehicles, by configuration and assembly plant, scheduled for production for the time period designated in the request.

(2) Number of engines or vehicles, by configuration and assembly plan, produced during the time period designated in the request which are complete form introduction into commerce.

(d) Nothing in this section limits the Administrator's discretion in requiring the manufacturer to retain additional records or submit information not specifically required by this section.

(e) The manufacturer shall address all reports, submissions, notifications, and requests for approvals made under this subpart to: Director, Manufacturers Operations Division, U.S. Environmental Protection Agency, EN–340, 401 M Street, SW., Washington, DC 20460.

82. A new § 86.1008–90 is added to Subpart K, to read as follows:

§ 86.1008–90 Test procedures.

(a)(1) For heavy-duty engines, the prescribed test procedure is the Federal Test Procedure as described in Subparts N, I, and P of this part.

(2) For light-duty trucks, the prescribed test procedure is the Federal Test Procedure as described in Subparts B and P of this part. The manufacturer shall not perform the evaporative emission test procedure contained in Subpart B.

(3) When testing light-duty trucks the following exceptions to the test procedures in Subpart B are applicable:

(i) For mileage accumulation, the manufacturer may use test fuel meeting the specifications of mileage and service accumulation fuels of § 86.113. Otherwise, the manufacturer may use fuels other than those specified in this section only with the advance approval of the Administrator.

(ii) The manufacturer may measure the temperature of the test fuel at other than the approximate midvolume of the fuel tank, as specified in paragraph (a) of § 86.131–90, and may drain the test fuel from other than the lowest point of the fuel tank, as specified in paragraph (b) of § 86.131–90, provided an equivalent method is used. Equivalency documentation shall be maintained by the manufacturer and shall be made available to the Administrator upon request.

(iii) The manufacturer may perform additional preconditioning on SEA test vehicles other than the preconditioning specified in § 86.132 only if the additional preconditioning had been performed on certification test vehicles of the same configuration.

(iv) The manufacturer shall perform the heat build procedure 11 to 34 hours following vehicle preconditioning rather than according to the time period specified in paragraph (a) of § 86.133. All references in § 86.133 to an evaporative emission enclosure (SHED) and analyzing for HC during the heat build can be ignored.

(v) The manufacturer may substitute slave tires for the drive wheel tires on the vehicle as specified in paragraph (e) of § 86.135–90: *Provided*, that the slave tires are the same size.

(vi) The cold start exhaust emission test described in § 86.137 shall follow the heat build procedure described in § 86.133 by not more than one hour.

(vii) In performing exhaust sample analysis under § 86.140.

(A) When testing diesel vehicles or methanol-fueled vehicles, the manufacturer shall allow a minimum of 20 minutes warm-up for the HC analyzer, and a minimum of 2 hours warm-up for the CO, CO_2 and NOx analyzers. (Power is normally left on infrared and chemiluminescent analyzers. When not in use, the chopper motors of the infrared analyzers are turned off and the phototube high voltage supply to the chemiluminescent analyzers is placed in the standby position.)

(B) The manufacturer shall exercise care to prevent moisture from condensing in the sample collection bags.

(viii) The manufacturer need not comply with § 86.142, since the records required therein are provided under other provisions of Subpart K of this part.

(ix) In addition to the requirements of Subpart B of this part, the manufacturer shall prepare gasoline-fueled vehicles and methanol-fueled vehicles as follows prior to exhaust emission testing:

(A) The manufacturer shall inspect the fuel system to insure the absence of any leaks of liquid or vapor to the atmosphere by applying a pressure of 14.5+0.5 inches of water to the fuel system, allowing the pressure to stabilize, and isolating the fuel system from the pressure source. Following isolation of the fuel system, pressure must not drop more than 2.0 inches of water in five minutes. If required, the manufacturer shall perform corrective action in accordance with § 86.1008 and report this action in accordance with § 86.1009.

(B) When performing this pressure check, the manufacturer shall exercise care to neither purge nor load the evaporative emission control system.

(C) The manufacturer shall not modify the test vehicle's evaporative emission control system by component addition, deletion, or substitution, except to comply with paragraph (a)(4)(ii) of this section if approved in advance by the Administrator.

(4) The Administrator, may on the basis of a written application by a manufacturer, prescribe minor test procedure variations from those set forth in paragraphs (a)(1) and (a)(2) of this section for any heavy-duty engine.

(b)(1) The manufacturer shall not adjust, repair, prepare, or modify the engines or vehicles selected for testing and shall not perform any emission tests on engines or vehicles selected for testing and shall not perform any emission tests on engines or vehicles selected for testing pursuant to the test order unless this adjustment, repair, preparation, modification, and/or tests are documented in the manufacturer's engine or vehicle assembly and inspection procedures and are actually performed or unless these adjustments and/or test are required or permitted under this subpart or are approved in advance by the Administrator.

(2) For 1984 and later model years the Administrator may adjust or cause to be adjusted any engine parameter which the Administrator has determined to be subject to adjustment for certification, Selective Enforcement Audit, and Production Compliance Audit testing in accordance with § 86.090–22(e)(1), to any setting within the physically adjustable range of that parameter, as determined by the Administrator in accordance with § 86.090–22(e)(3)(ii), prior to the performance of any tests. However, if the idle speed parameter is one which the Administrator has determined to be subject to adjustment, the Administrator shall not adjust it to any setting which causes a lower engine idle speed than would have been possible within the physically adjustable range of the idle speed parameter if the manufacturer had accumulated 125 hours of service on the engine or 4,000 miles on the vehicle under paragraph (c) of this section, all other parameters being identically adjusted for the purpose of the comparison. The manufacturer may be requested to supply information to establish such an alternative minimum idle speed. The Administrator, in making or specifying these adjustments, may consider the effect of the deviation from the manufacturer's recommended setting on emissions performance characteristics as well as the likelihood that similar settings will occur on in-use heavy-duty engines or light-duty trucks. In determining likelihood, the Administrator may consider factors such as, but not limited to, the effect of the adjustment on engine or vehicle performance characteristics and surveillance information from similar in-use engines or vehicles.

(c) Prior to performing exhaust emission testing on an SEA test engine, the manufacturer may accumulate on each engine a number of hours of service equal to the greater of 125 hours or the number of hours the manufacturer accumulated during certification on the emission-data engine corresponding to the configuration specified in the test order. Prior to performing exhaust emission testing on an SEA test vehicle, the manufacturer may accumulate a number of miles equal to the greater of 4,000 miles or the number of miles the manufacturer accumulated during certification on the emission data vehicle corresponding to the configuration specified in the test order.

(1) Service or mileage accumulation must be performed in a manner using good engineering judgment to obtain emission results representative of normal production vehicles. This service or mileage accumulation must be consistent with the new vehicle break-in instructions contained in the applicable vehicle owner's manual, if any.

(2) The manufacturer shall accumulate service at a minimum rate of 16 hours per engine or mileage at a minimum rate of 300 miles per vehicle during each 24-hour period, unless otherwise provided by the Administrator.

(i) The first 24 hour period for service or mileage accumulation shall begin as soon as authorization checks,

inspections and preparations are completed on each engine or vehicle.

(ii) The minimum service or mileage accumulation rate does not apply on weekends or holidays.

(iii) If the manufacturer's service or mileage accumulation target is less than the minimum rate specified (16 hours or 300 miles per day), then the minimum daily accumulation rate shall be equal to the manufacturer's service or mileage accumulation target.

(3) Service or mileage accumulation shall be completed on a sufficient number of test engines or vehicles during consecutive 24-hour periods to assure that the number of engines or vehicles tested per day fulfills the requirements of paragraph (g) of this section.

(d) The manufacturer shall not perform any maintenance on test vehicles or engines after selection for testing, nor shall the Administrator allow deletion of any test vehicle or engine from the test sequence, unless requested by the manufacturer, and approved by the Administrator before any test vehicle or engine maintenance or deletion.

(e) The manufacturer shall expeditiously ship test engines or vehicles from the point of selection to the test facility. If the test facility is not located at or in close proximity to the point of selection, the manufacturer shall assure that test engines or vehicles arrive at the test facility within 24 hours of selection: *Except,* that the Administrator may approve more time based upon a request by the manufacturer accompanied by a satisfactory justification.

(f) If an engine or vehicle cannot complete the service or mileage accumulation or emission test because of a malfunction, the manufacturer may request that the Administrator authorize the repair of that engine or vehicle or its deletion from the test sequence.

(g) Whenever a manufacturer conducts testing pursuant to a test order issued under this subpart, the manufacturer shall notify the Administrator within one working day of receipt of the test order which test facility will be used to comply with the test order. If no test cells are available at a desired facility, the manufacturer must provide alternate testing capability satisfactory to the Administrator.

(1) Heavy-duty engine manufacturers with projected sales for the United States market for that year of 30,000 or greater shall complete emission testing at their facility on a minimum of two engines per 24-hour period, including each voided test and each diesel engine smoke test.

(2) Heavy-duty engine manufacturers with projected sales for the United States market for that year of less than 30,000 shall complete emission testing at their facility on a minimum of one engine per 24-hour period, including each voided test and each diesel engine smoke test.

(3) Light-duty truck manufacturers shall complete emission testing at their facility on a minimum of four engines per 24-hour period, including each voided test.

(4) The Administrator may approve a lower daily rate of conducting emission tests based upon a request by a satisfactory justification.

(h) The manufacturer shall perform test engine or vehicle selection, shipping, preparation, service or mileage accumulation, and testing in such a manner as to assure that the audit is performed in an expeditious manner.

(i) The manufacturer may retest any engines or vehicles tested during a Selective Enforcement Audit once a fail decision for the audit has been reached in accordance with § 86.1010–84(d) based on the first test on each engine or vehicle: *Except,* that the Administrator may approve retesting at other times based upon a request by the manufacturer accompanied by a satisfactory justification. The manufacturer may test each engine or vehicle a total of three times. The manufacturer shall test each engine or vehicle the same number of times. The manufacturer may accumulate additional service or mileage before conducting a retest, subject to the provisions of paragraph (c) of this section.

83. The heading of Subpart M is revised, to read as follows:

Subpart M—Evaporative Emission Test Procedures for New Gasoline-Fueled and Methanol-Fueled Heavy-Duty Vehicles

84. A new § 86.1201–90 is added to Subpart M, to read as follows:

§ 86.1201–90 Applicability.

(a) The provisions of this subpart are applicable to new gasoline-fueled and methanol-fueled heavy-duty vehicles.

(b) Provisions of this subpart apply to tests performed by both the Administrator and motor vehicle manufacturers.

(c) Test procedures and equipment other than those described in this subpart may be used by the vehicle manufacturer if shown to yield results which correlate with results yielded by those described in this subpart (with the reference driving schedule described in § 86.1215–85(a)) and if approved in advance by the Administrator.

85. A new § 86.1205–90 is added to Subpart M, to read as follows:

§ 86.1205–90 Introduction; structure of subpart.

(a) This subpart describes the equipment required and the procedures to follow in order to determine evaporative emission levels from gasoline-fueled and methanol-fueled heavy-duty vehicles.

(b) Three topics are addressed in this subpart. Sections 86.1206 through 86.1215 set forth specifications and equipment requirements; §§ 86.1216 through 86.1226 discuss calibration methods and frequency; test procedures and data requirements are listed (in approximate order of performance) in §§ 86.1227 through 86.1245.

86. A new § 86.1206–90 is added to Subpart M, to read as follows:

§ 86.1206–90 Equipment required; overview.

This subpart specifies procedures for testing of gasoline-fueled and methanol-fueled heavy-duty vehicles. Equipment required and specifications are as follows:

(a) *Evaporative emissions tests.* § 86.1207 specifies the necessary equipment.

(b) *Fuel, analytical gas, and driving schedule specifications.* Fuel specifications for emission testing and for service accumulation are specified in § 86.1213. Analytical gases are specified in § 86.1214. Both vehicle preconditioning for the diurnal loss test and vehicle operation prior to the hot soak loss test include operation on a chassis dynamometer. The driving cycle (EPA heavy-duty vehicle urban dynamometer driving schedule) is specified in § 86.1215.

87. A new § 86.1207–90 is added to Subpart M, to read as follows:

§ 86.1207–90 Sampling and analytical system; evaporative emissions.

The following is a description of the components which will be used in evaporative emissions sampling systems for testing under this subpart.

(a) *Evaporative emission measurement enclosure.* The enclosure shall be readily sealable, rectangular in shape, with space for personnel access to all sides of the vehicle. When sealed, the enclosure shall be gas tight in accordance with § 86.1217. Interior surfaces must be impermeable and non-reactive to hydrocarbons and to methanol (if used for methanol-fueled vehicles). One surface should be of flexible, impermeable and non-reactive

material to allow for minor volume changes, resulting from temperature changes. Wall design should promote maximum dissipation of heat, and if artificial cooling is used, interior surface temperatures shall not be less than 68 °F (20 °C).

(b) *Evaporative emission hydrocarbon and methanol analyzers.* (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 (235°±15 °F) (113°±8°)) flame ionization detector is required 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:

(i) Stability of the analyzer shall be better than 0.01 Cstd ppm at zero and span over a 15-minute period on all ranges used.

(ii) Repeatability of the analyzer, expressed as one standard deviation, shall be better than 0.005 Cstd ppm on all ranges used.

(2) For methanol-fueled vehicles, a methanol sampling and analyzing system is required in addition to the FID analyzer. The methanol sampling equipment shall consist of impingers for collecting the methanol sample and appropriate equipment for drawing the sample through the impingers. The analytical equipment shall consist of a gas chromatograph equipped with a flame ionization detector. (Note: For 1990 through 1994 model year methanol-fueled vehicles, a HFID, calibrated on methanol may be used in place of the HFID calibrated on propane plus the methanol impingers and associated analytical equipment.)

(c) *Evaporative emission hydrocarbon and methanol data recording system.* (1) The electrical output of the FID used for measuring hydrocarbons (or hydrocarbons plus methanol as appropriate) shall be recorded at least at the initiation and termination of each diurnal or hot soak. The recording may be by means of a strip chart potentiometric recorder, by use of an on-line computer system or other suitable means. In any case, the recording system must have operational characteristics (signal to noise ratio, speed of response, *etc.*) equivalent to or better than those of the signal source being recorded, and must provide a permanent record of results. The record shall show a positive indication of the initiation and completion of each diurnal or hot soak along with the time elapsed between initiation and completion of each soak.

(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, the volumes of each sample introduced into the gas chromatograph, the flow rate of carrier gas through the column, the column temperature, and the chromatogram of the analyzed sample.

(d) *Tank fuel heating system.* The tank fuel heating system shall consist of a heat source and a temperature controller. A typical heat source is a 2,000 W heating pad. Other sources may be used as required by circumstances. The temperature controller may be manual, such as a variable voltage transformer, or may be automated. The heating system must not cause hot spots on the tank wetted surface which could cause local overheating of the fuel. Heat must not be applied to the vapor in the tank above the liquid fuel. The temperature controller must be capable of controlling the fuel tank temperature during the diurnal soak to within ±3 °F (±1.7 °C) of the following equation:

(1) $F = T_o + (0.4)t$

(2) *For SI units,* $C = T_o + (2/9)t$

Where:

F = Temperature in °F.

C = Temperature in °C.

t = Time since start of test in minutes.

T_o = Initial temperature in °F (or in °C for SI units).

(e) *Temperature recording system.* Strip chart recorder(s) or an automatic data processor shall be used to record enclosure ambient and vehicle fuel tank temperature at least once every minute. The temperature recorder or data processor shall have a time accuracy of ±15s, a time precision of ±15s and be capable of resolving temperature to ±0.75 °F (±0.42 °C). The temperature recording system (recorder and sensor) shall have an accuracy of ±3 °F (±1.7 °C). Two ambient temperature sensors, connected to provide one average output, shall be located in the enclosure. These sensors shall be located at the approximate vertical centerline of each side wall extending 4 inches (nominally) into the enclosure at a height of 3±0.5 ft (0.9±0.2 m). The vehicle fuel tank temperature sensor shall be located in the fuel tank so as to measure the temperature of the prescribed test fuel at the approximate mid-volume of the fuel. Manufacturers shall arrange that vehicles furnished for testing at Federal certification facilities be equipped with iron-constantan Type J thermocouples for measurement of fuel tank temperature.

(f) *Purge blower.* One or more portable or fixed blowers shall be used to purge the enclosure. The blowers shall have sufficient flow capacity to reduce the enclosure hydrocarbon and/or methanol concentration from the test level to the ambient level between tests. Actual flow capacity will depend upon the time available between tests.

(g) *Mixing blower.* One or more blowers or fans with a total capacity of 250 to 750 cfm per 1,000 ft³ of enclosure volume shall be used to mix the contents of the enclosure during evaporative emission testing. The mixing blower(s) shall be arranged such that a uniform concentration is maintained. No portion of the air stream shall be directed towards the vehicle.

88. Section 86.1213–90 of Subpart M is amended by revising paragraphs (a), (c), and adding paragraphs (d), (e), and (f) to read as follows:

§ 86.1213–90 Fuel specifications.

(a) Gasoline having the following specifications will be used in emissions testing for gasoline-fueled vehicles.

Item	ASTM	Value
Octane, research, min	D2699	93
Sensitivity, min		7.5
Lead (organic), g/U.S. gal	D3237	0.050[1]
(g/liter)		(0.013)[1]
Distillation range:		
IBP, °F	D86	75–95
(°C)		(23.9–35)
10 pct. point, °F	D86	120–135
(°C)		(48.9–57.2)
50 pct. point, °F	D86	200–230
(°C)		(93.3–110)
90 pct. point, °F	D86	300–325
(°C)		(148.9–162.8)
EP, max. °F	D86	415
(°C)		(212.8)
Sulphur, max. wt. pct	D1266	0.10
Phosphorous, max. g/U.S. gal	D3231	0.005
(g/liter)		(0.0013)
RVP, psi	D323	8.7–9.2
(kPa)		(60.0–63.4)
Hydrocarbon composition:		
Olefins, max. pct	D1319	10
Aromatics, max. pct	D1319	35
Saturates	D1319	[2]

[1] Maximum.
[2] Remainder

* * * * *

(c) Methanol fuel used in evaporative emission testing and in service accumulation of methanol-fueled vehicles shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol (CH_3OH) by volume.

(1) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (c) of this section.

(2) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(d) Other methanol fuels may be used for testing and service accumulation provided:

(1) They are commercially available, and

(2) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(3) Use of a fuel listed under paragraph (c)(2) of this section would have a detrimental effect on emissions or durability, and

(4) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(e) The specification range of the fuels to be used under paragraphs (b), (c), and (d) of this section shall be reported in accordance with § 86.090–21(b)(3).

(f) *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 be within the range of fuel mixtures for which the vehicle was designed.

(2) Manufacturer testing and service accumulation may be performed using only those mixtures (mixtures may be different for exhaust testing, evaporative testing, and service accumulation) expected to result in the highest emissions, provided:

(i) The fuels which constitute the mixture will be used in customer service, and

(ii) Information, acceptable to the Administrator, is provided by the manufacturer to show that the designated fuel mixtures would result in the highest emissions, and

(iii) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(3) The specification range of the fuels to be used under paragraph (f)(2) of this section shall be reported in accordance with § 86.090–21(b)(3).

89. A new § 86.1216–90 is added to Subpart M, to read as follows:

§ 86.1216–90 Calibrations; frequency and overview.

(a) Calibrations shall be performed as specified in § 86.1217 through § 86.1226.

(b) At least yearly or after any maintenance which could alter background emission levels, enclosure background emission measurements shall be performed.

(c) At least monthly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

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

(2) Calibrate the dynamometer. If the dynamometer receives a weekly performance check (and remains within calibration) the monthly calibration need not be performed (see § 86.1218).

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

90. A new § 86.1217–90 is added to Subpart M, to read as follows:

§ 86.1217–90 Evaporative emission enclosure calibrations.

The calibration of the evaporative emission enclosure consists of three parts: Initial and periodic determination of enclosure background emissions (hydrocarbons and methanol); initial determination of enclosure internal volume; and periodic hydrocarbon and methanol retention check and calibration. Methanol measurements may be omitted when methanol-fueled vehicles will not be tested in the evaporative enclosure.

(a) *Initial and periodic determination of enclosure background emissions.* Prior to its introduction into service, annually thereafter, and after any repair which can affect the enclosure background emissions, the enclosure shall be checked to determine that it does not contain materials which will themselves emit hydrocarbons or methanol.[1] Proceed as follows:

(1) Zero and span (calibrate if required) the hydrocarbon analyzer.

(2) Purge the enclosure until a stable background hydrocarbon reading is obtained.

(3) Turn on the mixing blower (if not already on).

(4) Seal enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HCi}, C_{CH_3OHi}, T_i, and P_{Bi}, for the enclosure background determination.

(5) Allow the enclosure to stand undisturbed without sampling for four hours.

(6) Measure the hydrocarbon and methanol concentration on the same FID. These are the final concentrations, C_{HCf} and C_{CH_3OHf}. Also measure final temperature and barometric pressure.

(7) Calculate the mass change of methanol, hydrocarbons, and hydrocarbons plus methanol in the enclosure according to the equations in paragraph (d) of this section. The enclosure background emissions (hydrocarbons plus methanol) shall not be greater than 0.4g for the 4 hours.

(b) *Initial determination of enclosure internal volume.* Prior to its introduction into service the enclosure internal volume shall be determined by the following procedure.

(1) Carefully measure the internal length, width and height of the enclosure, accounting for irregularities (such as braces) and calculate the internal volume.

(2) Perform an enclosure calibration check according to paragraphs (c) (1) through (7) of this section.

(3) If the calculated mass does not agree within ±2 percent of the injected propane mass, then corrective action is required.

(c) *Hydrocarbon and methanol retention check and calibration.* The hydrocarbon and methanol 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 enclosure leak rate shall be determined as follows:

(1) Zero and span (calibrate if required) the hydrocarbon analyzer.

(2) Purge the enclosure until a stable background hydrocarbon reading is obtained.

(3) Turn on the mixing blower (if not already on).

(4) Seal enclosure and measure background hydrocarbon concentration, background methanol, temperature, and barometric pressure. These are the initial readings C_{HCi}, C_{CH_3OHi}, T_i and P_{Bi} for the enclosure calibration.

(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 the methanol if appropriate, shall

[1] **Note:** When methanol as well as hydrocarbons are present in the evaporative enclosure, the HFID hydrocarbon concentration measurement includes the partial response of the HFID to methanol plus the hydrocarbons. Determination of the HFID response to methanol, § 86.1221, prior to its being placed in service is required for the determination of hydrocarbons.

have an accuracy and precision of ±0.5 percent of the measured value.

(6) After a minimum of 5 minutes of mixing, analyze the enclosure atmosphere for hydrocarbon and methanol content, also record temperature and pressure. These measurements are the final readings for the enclosure calibration as well as the initial readings for the retention check.

(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.

(8) Allow the enclosure to remain sealed for a minimum of 4 hours, analyze the enclosure atmosphere for hydrocarbon and methanol content; record temperature and barometric pressure. These are the final readings for the hydrocarbon and methanol retention check.

(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).

(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:

$$M_{CH3OH} = \left(\frac{V \times C_{MR}}{A_{MR}}\right) \times \left[\left(\frac{T_{Ef}}{V_{Ef} \times T_{SHEDf}}\right)[(A_{MS1f} \times AV_{1f}) + (A_{MS2f} \times AV_{2f})] - \left(\frac{T_{Ei}}{V_{Ei} \times T_{SHEDi}}\right)[(A_{MS1i} \times AV_{1i}) + (A_{MS2i} \times AV_{2i})]\right]$$

Where:

(i) M_{CH3OH} = Methanol mass change, μg.

(ii) V = Enclosure volume, ft³, as measured in paragraph (b)(1) of this section.

(iii) C_{MR} = Concentration of methanol in standard sample for calibration of GC, μg/ml.

(iv) A_{MR} = GC peak area of standard sample.

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

(vi) V_E = Volume of sample withdrawn, ft³.

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

(viii) A_{MS} = GC peak area of test sample.

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

(x) i = Initial sample.

(xi) f = Final sample.

(xii) 1 = First impinger.

(xiii) 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:

$$M_{HC} = kV \times 10^{-4}\left[\frac{(C_{HCf} - rC_{CH3OHf}) \times P_{Bf}}{T_f} - \frac{(C_{HCi} - rC_{CH3OHi}) \times P_{Bi}}{T_i}\right]$$

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_{CH3OH} = Methanol concentration as ppm carbon

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

(iv) V = Enclosure volume, ft³ (m³), as measured in paragraph (b)(1) of this section.

(v) r = FID response factor to methanol.

(vi) P_B = Barometric pressure, in. Hg (kPa).

(vii) T = Enclosure ambient temperature, °R(°K).

(viii) i = Indicates initial reading.

(ix) f = Indicates final reading.

(x) (A) k=3.05
(B) *For SI units,* k=17.60

Note: Hydrocarbon concentration is stated in ppm carbon, that is, ppm propane × 3. Expressions in parentheses are for SI units.

91. A new § 86.1221–90 is added to Subpart M, to read as follows:

§ 86.1221–90 Hydrocarbon analyzer calibration.

The FID hydrocarbon analyzer shall receive the following initial and periodic calibrations.

(a) *Initial and periodic optimization of detector response.* Prior to its introduction into service and at least annually thereafter, the FID hydrocarbon analyzer shall be adjusted for optimum hydrocarbon response. (The HFID used with methanol-fueled vehicle shall be operated at 235°±15 °F (113°±8 °C).) Alternate methods yielding equivalent results may be used, if approved in advance by the Administrator.

(1) Follow the manufacturer's instructions or good engineering practice for instrument startup and basic operating adjustment using the appropriate FID fuel and zero-grade air.

(2) Optimize on the most common operating range. Introduce into the analyzer a propane in air mixture with a propane concentration equal to approximately 90 percent of the most common operating range.

(3) Select an operating FID fuel flow rate that will give near maximum response and least variation in response with minor fuel flow variations.

(4) To determine the optimum air flow, use the FID fuel flow setting determined above and vary air flow.

(5) After the optimum flow rates have been determined, record them for future reference.

(b) *Initial and periodic calibration.* Prior to its introduction into service and monthly thereafter the FID hydrocarbon analyzer shall be calibrated on all normally used instrument ranges, and, if applicable, the methanol response factor shall be determined (paragraph (c) of this section). Use the same flow rate as when analyzing sample.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero-grade air.

(3) Calibrate on each normally used operating range with propane in air calibration gases having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of that range. For each range calibrated, if the deviation from a least squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

(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.

(1) The bag sample of methanol for analysis in the FID 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 dry gas meter.

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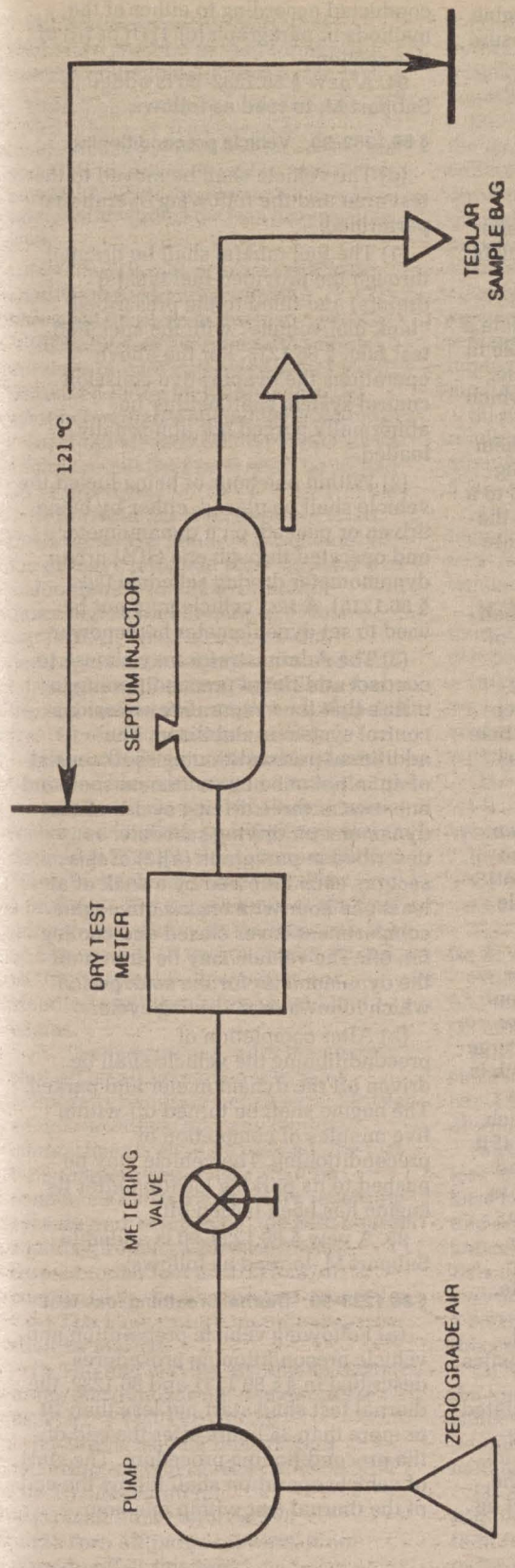


FIGURE M90-1 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

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(2) The bag sample is analyzed using the FID.

(3) The FID response factor, r, is calculated as follows:

$$r = FID_{ppm}/SAM_{ppm}$$

Where:

(i) r = FID response factor.

(ii) FID_{ppm} = FID reading in ppmC.

(iii) SAM_{ppm} = methanol concentration in the sample bag in ppmC.

$$= \frac{0.02406 \times \text{Fuel injected} \times \text{Fuel density}}{\text{Air volume} \times \text{Mol. Wt. } CH_3OH}$$

Where:

(iv) 0.02406 = Volume of one mole at 29.92 in Hg and 68°F, m^3.

(v) Fuel injected = Volume of methanol injected, ml.

(vi) Fuel density = Density of methanol, 0.7914 g/ml.

(vii) Air volume = Volume of zero grade air, m^3.

(viii) Mol. Wt. CH_3OH = 32.04.

(d) The gas chromatograph used in the analysis of methanol samples shall be calibrated at least monthly following manufacturers' recommended procedures (certain equipment may require more frequent calibration based on use and good engineering judgment).

92. A new § 86.1227–90 is added to Subpart M, to read as follows:

§ 86.1227–90 Test procedures; overview.

(a) The overall test consists of prescribed sequences of fueling, parking, and operating conditions. Vehicles are tested only for evaporative emissions.

(b) The evaporative emission test (gasoline-fueled and methanol-fueled vehicles) is designed to determine hydrocarbon and/or methanol evaporative emissions as a consequence of diurnal temperature fluctuation, urban driving and hot soaks during engine-off periods. It is associated with a series of events representative of heavy-duty vehicle operation, which result in hydrocarbon and/or methanol vapor losses. The test procedure is designed to measure:

(1) Diurnal breathing losses resulting from daily temperature changes, measured by the enclosure technique;

(2) Running losses from suspected sources (if indicated by engineering analysis or vehicle inspection) resulting from a simulated trip on a chassis dynamometer, measured by carbon traps; and

(3) Hot soak losses which result when the vehicle is parked and the hot engine is turned off, measured by the enclosure technique.

93. A new § 86.1231–90 is added to Subpart M, to read as follows:

§ 86.1231–90 Vehicle preparation.

(a) Prepare the fuel tank(s) for recording the temperature of the prescribed test fuel at the approximate mid-volume of the fuel when the tank is 40 percent full.

(b) Provide additional fittings and adapters, as required, to accommodate a fuel drain at the lowest point possible in the tank(s) as installed on the vehicle.

(c)(1) Any vapor storage device which absorbs HC vapors and/or CH_3OH vapors and subsequently releases them to the engine induction system during vehicle operation shall be subjected to a minimum of 30 load-purge cycles or the equivalent thereof (4,000 miles or more of actual in-use vehicle service accumulation shall be considered equivalent). One load-purge cycle shall be accomplished by conducting one of the following procedures:

(i) *Vehicle Procedure.* Park a fully-warm vehicle (a vehicle that has been driven for at least 15 minutes) for a time period of at least 3 hours. Fill the fuel tank(s) to the prescribed "tank fuel volume" with specified test fuel (§ 86.1213) at room temperature. Then drive the vehicle through at least one cycle of the HDV reference (transient) urban dynamometer driving schedule.

(ii) *Laboratory Procedure.* Flow vapors (gasoline or methanol, as appropriate) into a pre-purged vapor storage device until at least 10 percent of the input HC or CH_3OH mass flow rate is passing through the device. Purge the device with a volume of air which is at least as great as, and which has a temperature no higher than that which would be drawn through the device if it were installed on the test vehicle and the vehicle was operated according to the HDV reference (transient) urban dynamometer driving schedule. The vapor flow rate, the method used to generate the vapors, the air flow rate, and the air temperature shall be recorded. If pre-blended gas is used, then the composition and characteristics of the gas shall be recorded.

(2) Ten load-purge cycles accumulated immediately prior to testing shall be conducted according to the method in paragraph (c)(1)(i) of this section. The preceding 20 cycles (minimum) shall be conducted according to either of the methods in paragraph (c)(1) (i) or (ii) of this section.

94. A new § 86.1232–90 is added to Subpart M, to read as follows:

§ 86.1232–90 Vehicle preconditioning.

(a) The vehicle shall be moved to the test area and the following operations performed:

(1) The fuel tank(s) shall be drained through the provided fuel tank(s) drain(s) and filled to the prescribed "tank fuel volume" with the specified test fuel, § 86.1213. For the above operations the evaporative emission control system shall neither be abnormally purged nor abnormally loaded.

(2) Within one hour of being fueled the vehicle shall be placed, either by being driven or pushed, on a dynamometer and operated through one HDV urban dynamometer driving schedule (*see* § 86.1215). A test vehicle may not be used to set dynamometer horsepower.

(3) The Administrator may choose to conduct additional preconditioning to insure that the evaporative emissions control system is stabilized. The additional preconditioning shall consist of an initial one hour minimum soak and one, two or three driving cycles of the dynamometer driving schedule, as described in paragraph (a)(2) of this section, each followed by a soak of at least one hour with engine off, engine compartment cover closed and cooling fan off. The vehicle may be driven off the dynamometer for the soak period which follows each driving cycle.

(b) After completion of preconditioning the vehicle shall be driven off the dynamometer and parked. The engine shall be turned off within five minutes of completion of preconditioning. The vehicle may be pushed to its parking location after its engine has been turned off.

95. A new § 86.1233–90 is added to Subpart M, to read as follows:

§ 86.1233–90 Diurnal breathing loss test.

(a) Following vehicle preparation and vehicle preconditioning procedures described in §§ 86.1231 and 86.1232, the diurnal test shall start not less than 10 or more than 35 hours after the end of the preconditioning procedure. The start of vehicle operation shall follow the end of the diurnal test within one hour.

(b) The evaporative emissions enclosure shall be purged for several minutes immediately prior to the test.

Note: If at any time the concentration of hydrocarbons, or of methanol, or of hydrocarbons and methanol exceeds 15,000 ppm C the enclosure should be immediately purged. This concentration provides a 4:1 safety factor against the lean flammability limit.

(c) The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the test.

(d) Impingers charged with known volumes of pure deionized water shall be placed in the methanol sampling system (methanol-fueled vehicles only).

(e) If not already on, the evaporative enclosure mixing fan(s) shall be turned on at this time.

(f) For vehicles with multiple tanks, the largest tank shall be designated as the primary tank and shall be heated in accordance with the procedures described in paragraph (m) of this section. All other tanks shall be designated as auxiliary tanks and shall undergo a similar heat build such that the fuel temperature shall be within 3 °F (1.6 °C) of the primary tank.

(g) Immediately prior to the diurnal breathing loss test, the fuel tank(s) of the prepared vehicle shall be drained and recharged with the specified test fuel as defined in § 86.1213 to the prescribed "tank fuel volume", as defined in § 86.078–2. The temperature of the fuel prior to its delivery to the fuel tank shall be between 45 °F and 60 °F (7.2 °C and 16 °C). The fuel tank cap(s) is not installed until the diurnal heat build begins.

(h) The test vehicle, with the engine shut off, shall be moved into the evaporative emission enclosure, the test vehicle windows and any storage compartments shall be opened, the fuel tank temperature sensor shall be connected to the temperature recording system, and, if required, the heat source shall be properly positioned with respect to the fuel tank(s) and/or connected to the temperature controller.

(i) The temperature recording system shall be started.

(j) The fuel may be artificially heated to the starting diurnal temperature, 60 °F±2 °F (16 °C±1.1 °C).

(k) When the fuel temperature recording system reaches at least 58 °F (14 °C), immediately:

(1) Install fuel tank cap(s).

(2) Turn off purge blowers, if not already off at this time.

(3) Close and seal enclosure doors.

(l) When the fuel temperature recording system reaches 60 °F±2 °F (16 °C±1.1 °C) immediately:

(1) Analyze enclosure atmosphere for hydrocarbons and record. This is the initial (time=0 minutes) hydrocarbon concentration, C_{HCi} (*see* § 86.1243).

(2) Simultaneously with initiation of the hydrocarbon analysis, initiate collection of the methanol sample by drawing a sample from the enclosure through the sampling system for four minutes. This is the initial methanol measurement from which methanol concentration C_{CH_3OHi} and mass are calculated. Remove impingers and replace with freshly charged clean impingers which will be used to collect the final methanol sample.

(3) Record barometric pressure reading. This is the initial (time=0 minutes) barometric pressure, P_{bi} (*see* § 86.1243).

(4) Record enclosure ambient temperature. This is the initial (time=0 minutes) enclosure ambient temperature, T_i (*see* § 86.1243).

(5) Start diurnal heat build and record time. This commences the 60±2 minute test period.

(m) The fuel shall be heated in such a way that its temperature change conforms to the following function to within ±3 °F (±1.6 °C):

(1) $F=T_o+0.4t$

(2) *For SI units,* $C=T_o+(2/9)t$

Where:

F=fuel temperature, °F.

C=fuel temperature, °C.

t=heating time, minutes.

T_o=initial temperature in °F (or in °C for SI units).

After 60±2 minutes of heating, the fuel temperature rise shall be 240±1 °F (13.30±0.5 °C).

(n) The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the end of the diurnal test.

(o)(1) The end of the diurnal breathing loss test occurs 60±2 minutes after the heat build begins (paragraph (k)(4) of this section). Analyze the enclosure atmosphere for hydrocarbon and record. This is the final (time=60 minutes) hydrocarbon concentration, C_{HCf} (*see* § 86.1234). The time (or elapsed time) of this analysis shall be recorded.

(2) Simultaneously with the start of the hydrocarbon analysis, initiate collection of the methanol sample. Sample for four minutes. This is the final methanol sample.

(3) *Alternate method for methanol sampling.* Since sample times of longer than four minutes may be necessary in order to collect an adequate and representative sample of methanol at the end of a test (when SHED concentrations are usually increasing rapidly), it may be necessary to rapidly collect the methanol sample in a bag and then bubble the bag sample through the impingers at the specified flow rate. The time elapsed between collection of the bag sample and flowing through the impingers should be minimized in order to prevent any losses. This alternative must be adopted if the four minute sample period is inadequate to collect a sample of sufficient concentration to allow accurate GC analysis.

(4) Record barometric pressure reading. This is the final (time=60 minutes) barometric pressure, P_{bf} (*see* § 86.1243).

(5) Record enclosure ambient temperature. This is the final (time=60 minutes) enclosure ambient temperature, T_f (*see* § 86.1243).

(p) The heat source shall be turned off and the enclosure doors unsealed.

(q) The heat source shall be moved away from the vehicle, if required, and/or disconnected from the temperature controller, the fuel tank temperature sensor shall be disconnected from the temperature recording system, and the test vehicle windows and any storage compartments may be closed. The vehicle shall be either driven or pushed out of the evaporative emission enclosure.

96. A new § 86.1238–90 is added to Subpart M, to read as follows:

§ 86.1238–90 Hot soak test.

The one-hour hot-soak evaporative emission test shall be conducted immediately following one cycle of the dynamometer driving schedule.

(a) Prior to the completion of the dynamometer cycle, the evaporative emission enclosure shall be purged for several minutes.

(b) The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the test.

(c) Fresh impingers shall be installed in the methanol sample collection system immediately prior to the start of the test, if applicable.

(d) If not already on, the evaporative enclosure mixing fan(s) shall be turned on at this time.

(e) Upon completion of the dynamometer run the exhaust tube shall be disconnected from the vehicle tailpipe(s), the cooling fan(s) shall be moved, and the vehicle shall be disconnected from the dynamometer and driven at minimum throttle to the vehicle entrance of the enclosure.

(f) The vehicle's engine must be stopped before any part of the vehicle enters the enclosure. The vehicle may be pushed or coasted into the enclosure.

(g) The test vehicle windows and any storage compartments shall be opened, if not already open.

(h) The temperature recording system shall be started and the time of engine shut off shall be noted on the evaporative emissions hydrocarbon data recording system.

(i) The enclosure doors shall be closed and sealed within four minutes of engine shutdown and within ten minutes after the end of the dynamometer run.

(j) The 60±0.5 minute hot soak begins when the enclosure doors are sealed. The enclosure atmosphere shall be analyzed and recorded. This is the initial (time=0 minutes) hydrocarbon concentration, C_{HCi}, for use in calculating evaporative losses (*see* § 86.1243). The "zero" time methanol sample shall be collected starting at the same time as the hydrocarbon analysis is started. Sampling shall continue for four minutes.

(k) The test vehicle shall be permitted to soak for a period of one hour in the enclosure.

(l) The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the end of the test.

(m) Fresh impingers shall be installed in the methanol collection system immediately prior to the end of the test, if applicable.

(n) At the end of the 60±0.5 minute test period, the enclosure atmosphere shall again be analyzed (as described in § 86.1238–90(j) and the time recorded. This is the final (time=60 minutes) hydrocarbon concentration, C_{HCf} and the final methanol level for use in calculating evaporative losses (*see* § 86.1243). This operation completes the evaporative emission measurement procedure.

(o) *Alternate method for methanol sampling.* Since sample times of longer than four minutes may be necessary in order to collect an adequate and representative sample of methanol at the end of a test (when SHED concentrations are usually increasing rapidly), it may be necessary to rapidly collect the methanol sample in a bag and then bubble the bag sample through the impingers at the specified flow rate. The time elapsed between collection of the bag sample and flowing through the impingers should be minimized in order to prevent any losses. This alternative must be adopted if the four minute sample period is inadequate to collect a sample of sufficient concentration to allow accurate GC analysis.

97. A new § 86.1242–90 is added to Subpart M, to read as follows:

§ 86.1242–90 Records required.

The following information shall be recorded with respect to each test:

(a) Test number.

(b) System or device tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument operator.

(e) Driver or operator.

(f) Vehicle: ID number; Manufacturer; Model Year; Engine family; Evaporative emissions family; Basic engine description (including displacement, number of cylinders, and catalyst usage); Engine maximum power rating and rated speed; Fuel system (including number of carburetors, number of carburetor barrels, fuel injection type, fuel tank(s) capacity and location, and number and size (volume and working capacity)) of evaporative control canisters, Engine code; Gross vehicle weight rating; Actual curb weight at zero miles; Actual road load at 50 mph; Transmission configuration; Axle ratio; Vehicle line; Odometer reading; Idle rpm; and Drive wheel tire pressure, as applicable.

(g) Indicated road load power absorption at 50 mph (80 km/hr) and dynamometer serial number. As an alternative to recording the dynamometer serial number, a reference to a vehicle test cell number may be used, provided the test cell records show the pertinent information.

(h) All pertinent instrument information such as tuning, gain, serial number, detector number and range. As an alternative, a reference to a vehicle test cell number may be used, with the advance approval of the Administrator, provided test cell calibration records show the pertinent instrument information.

(i) Recorder charts: Identify zero, span and enclosure gas sample traces.

(j) Test cell barometric pressure and ambient temperature.

Note: A central laboratory barometer may be used: *Provided,* That individual test cell barometric pressures are shown to be within ±0.1 percent of the barometric pressure at the central barometer location.

(k) Fuel temperatures as prescribed.

(l) *For methanol-fueled vehicles:* (1) Volume of sample passed through the methanol sampling system and the volume of deionized water in each impinger.

(2) The methanol concentration in the reference sample and the peak area from the GC analysis of the reference sample.

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

98. A new § 86.1243–90 is added to Subpart M, 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:

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

Where:

(i) M_{CH_3OH} = Methanol mass change, μg.

(ii) V_n = Net enclosure volume, ft³, as determined by subtracting 50 ft³ (1.42 m³) (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 ft³) with advance approval by the Administrator: *Provided,* the measured volume is determined and used for all vehicles tested by that manufacturer.

(iii) C_{MR} = Concentration of methanol in standard sample for calibration of GC, μg/ml.

(iv) A_{MR} = GC peak area of standard sample.

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

(vi) V_E = Volume of sample withdrawn, ft³.

(vii) T_{SHED} = Temperature of SHED, °R.

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

(ix) A_{MS} = GC peak area of sample.

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

(xi) i = Initial sample.

(xii) f = Final sample.

(xiii) 1 = First impinger.

(xiv) 2 = Second impinger.

(2) For hydrocarbons:

$$M_{HC} = (kV_n \times 10^{-4}) \left[\frac{(C_{HCf} - rC_{CH_3OH})P_{Bf}}{T_f} - \frac{(C_{HCi} - rC_{CH_3OH})P_{Bi}}{T_i} \right]$$

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.

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

(iv) V_n = Net enclosure volume ft³ (m³), as determined by subtracting 50 ft³ (1.42 m³) (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 ft³) with advance approval by the Administrator: *Provided,* the measured volume is determined and used for all vehicles tested by that manufacturer.

(v) r = FID response factor to methanol.

(vi) P_B = Barometric pressure, in Hg (kPa).

(vii) T = Enclosure temperature, °R(°K).

(viii) i = initial reading.

(ix) f = final reading.

(x) 1 = First impinger.

(xi) 2 = Second impinger.

(xii)(A) k = 0.208 (12 + H/C).

(B) *For SI units,* k = 1.2 (12 + H/C).

Where:

(xiii) H/C = hydrogen carbon ratio.

(A) H/C = 2.33 for diurnal emissions.

(B) H/C = 2.2 for hot soak emissions.

(3) For total evaporative emissions:

Total Evaporative Emissions =

$$(M_{HC} + \frac{14.3594 \times 10^6}{32.042} M_{CH_3OH}) + (M_{HC} + \frac{14.2284}{32.042} \times 10^6 M_{CH_3OH}) \text{g.}$$

(b) The final reported results shall be computed by summing the individual evaporative emission results determined for the diurnal breathing-loss test, running-loss test and the hot-soak test.

99. The heading of Subpart N is revised, to read as follows:

Subpart N—Emission Regulations for New Otto-Cycle and Diesel Heavy-Duty Engines; Gaseous and Particulate Exhaust Test Procedures

100. A new § 86.1301–90 is added to Subpart N to read as follows:

§ 86.1301–90 Scope; applicability.

This subpart contains gaseous emission test procedures for Otto-cycle and diesel heavy-duty engines, and particulate emission test procedures for diesel heavy-duty engines. It applies to 1990 and later model years.

101. A new § 86.1304–90 is added to Subpart N, to read as follows:

§ 86.1304–90 Section numbering; construction.

(a) The model year of initial applicability is indicated by the section number. The two digits following the hyphen designate the first model year for which a section is effective. A section remains effective until superseded.

Example: Section § 86.1311–84 applies to the 1984 and subsequent model years until superceded. If a section § 86.1311–88 is promulgated it would take effect beginning with the 1988 model year; § 86.1311–84 would apply to model years 1984 through 1987.

(b) A section reference without a model year suffix refers to the section applicable for the appropriate model year.

(c) Unless indicated, all provisions in this subpart apply to both Otto-cycle and diesel heavy-duty engines.

102. A new § 86.1305–90 is added to Subpart N, to read as follows:

§ 86.1305–90 Introduction; structure of subpart.

(a) This subpart describes the equipment required and the procedures to follow in order to perform exhaust emission tests on Otto-cycle and diesel heavy-duty engines. Subpart A sets forth

the testing requirements and test intervals necessary to comply with EPA certification procedures.

(b) Four topics are addressed in this subpart. Sections 86.1306 through 86.1315 set forth specifications and equipment requirements; §§ 86.1316 through 86.1326 discuss calibration methods and frequency; test procedures are listed in §§ 86.1327 through 86.1341; calculation formula are found in § 86.1342; and data requirements are found in § 86.1344.

103. A new § 86.1306–90 is added to Subpart N, to read as follows:

§ 86.1306–90 Equipment required and specifications; overview.

(a) *Exhaust emission tests.* All engines subject to this subpart are tested for exhaust emissions. Petroleum-fueled and methanol-fueled, Otto-cycle and diesel engines are tested identically with the exception of the systems used to measure hydrocarbon, nitrogen oxide, methanol, formaldehyde, and particulate; petroleum-fueled diesel engines require a heated, continuous hydrocarbon detector and a continuous nitrogen oxide detector (§ 86.1310); methanol-fueled engines require a heated hydrocarbon detector, a methanol detector and a formaldehyde detector; gasoline-fueled and methanol-fueled Otto-cycle engines are not tested for particulate emissions (§ 86.1309). Necessary equipment and specifications appear in §§ 86.1308, 86.1309, 86.1310 and 86.1311.

(b) *Fuel, analytical gas, and engine cycle specifications.* Fuel specifications for exhaust emission testing are specified in § 86.1313. Analytical gases are specified in § 86.1314. The EPA heavy-duty transient engines cycles for use in exhaust testing are described in § 86.1333 and specified in Appendix I to this part.

104. A new § 86.1309–90 is added to Subpart N, to read as follows:

§ 86.1309–90 Exhaust gas sampling system; gasoline-fueled and methanol-fueled Otto-cycle engines.

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

(2) *Engine exhaust to CVS duct.* For methanol-fueled engines, cooling of the exhaust gases in the duct connecting the engine exhaust to the dilution tunnel shall be minimized. This may be accomplished by:

(i) Using a duct of unrestricted length maintained at 235°±15 °F (113°±8 °C). (Heating and possibly cooling capabilities as required,) or

(ii) Using a short up to 12 feet long, duct constructed of smooth wall pipe with a minimum of flexible sections, maintained at 235°±15 °F (113°±8 °C) prior to the test and during periods when the engine is not in operation (insulation may remain in place and/or heating may occur during testing provided maximum temperature is not exceeded), or

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

(iv) Omitting the duct and performing the exhaust gas dilution function at the engine exhaust manifold or immediately after exhaust aftertreatment systems.

(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 and for methanol fueled vehicles, the methanol sample (Figure N90–2) and the formaldehyde sample (Figure N90–3), 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 235°±15 °F (113°±8 °C). 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.

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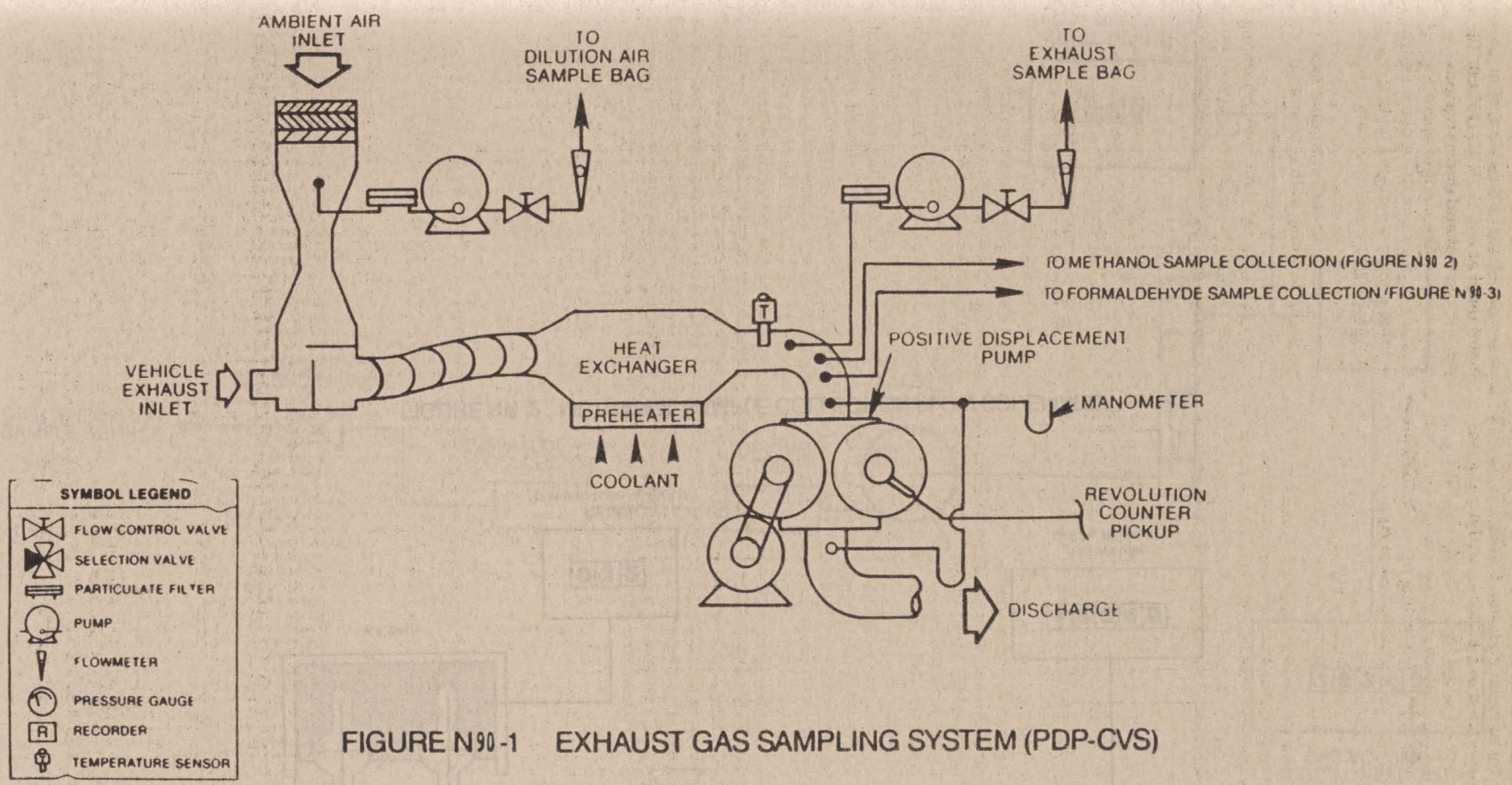


FIGURE N90-1 EXHAUST GAS SAMPLING SYSTEM (PDP-CVS)

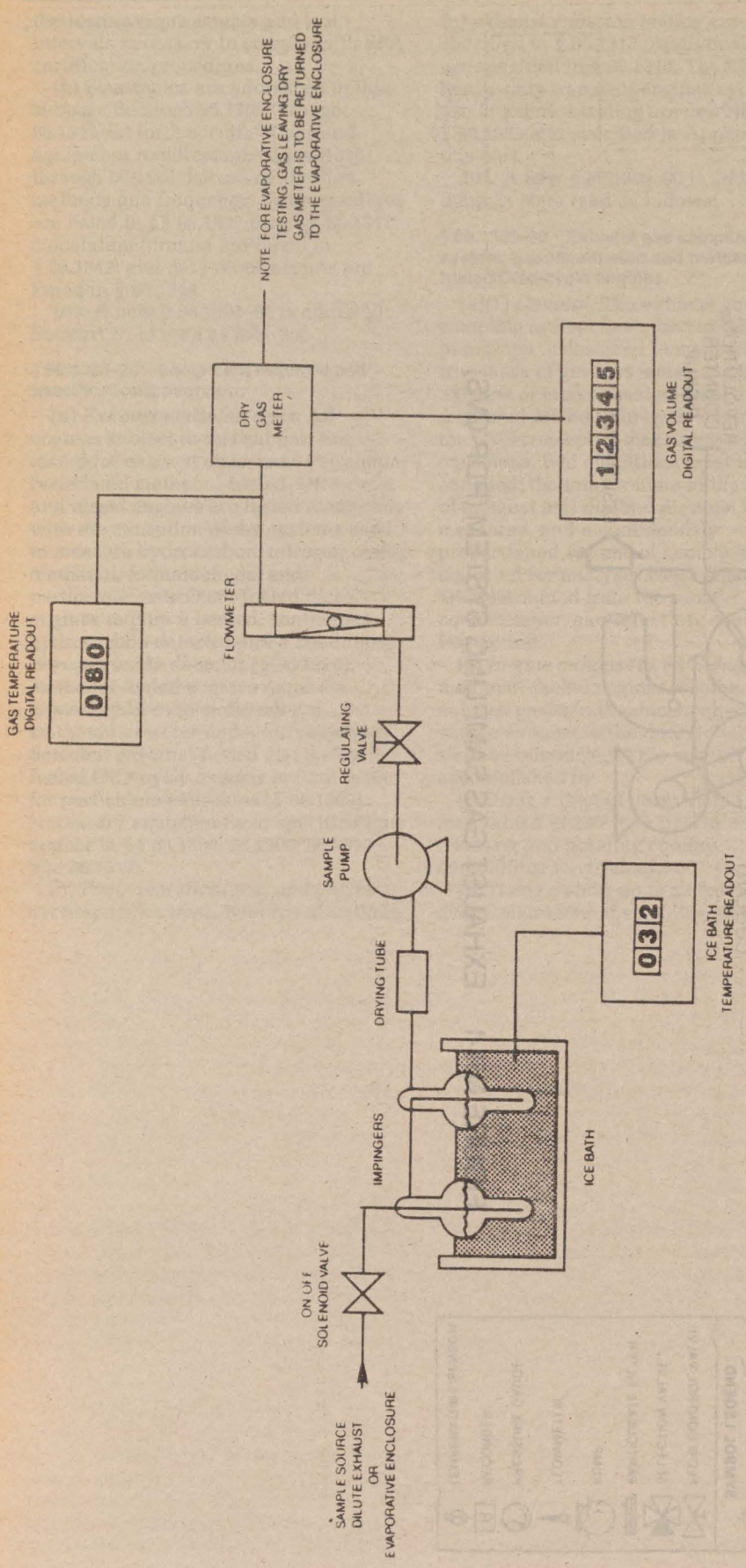


FIGURE No. 2 METHANOL SAMPLE COLLECTION FLOW SCHEMATIC

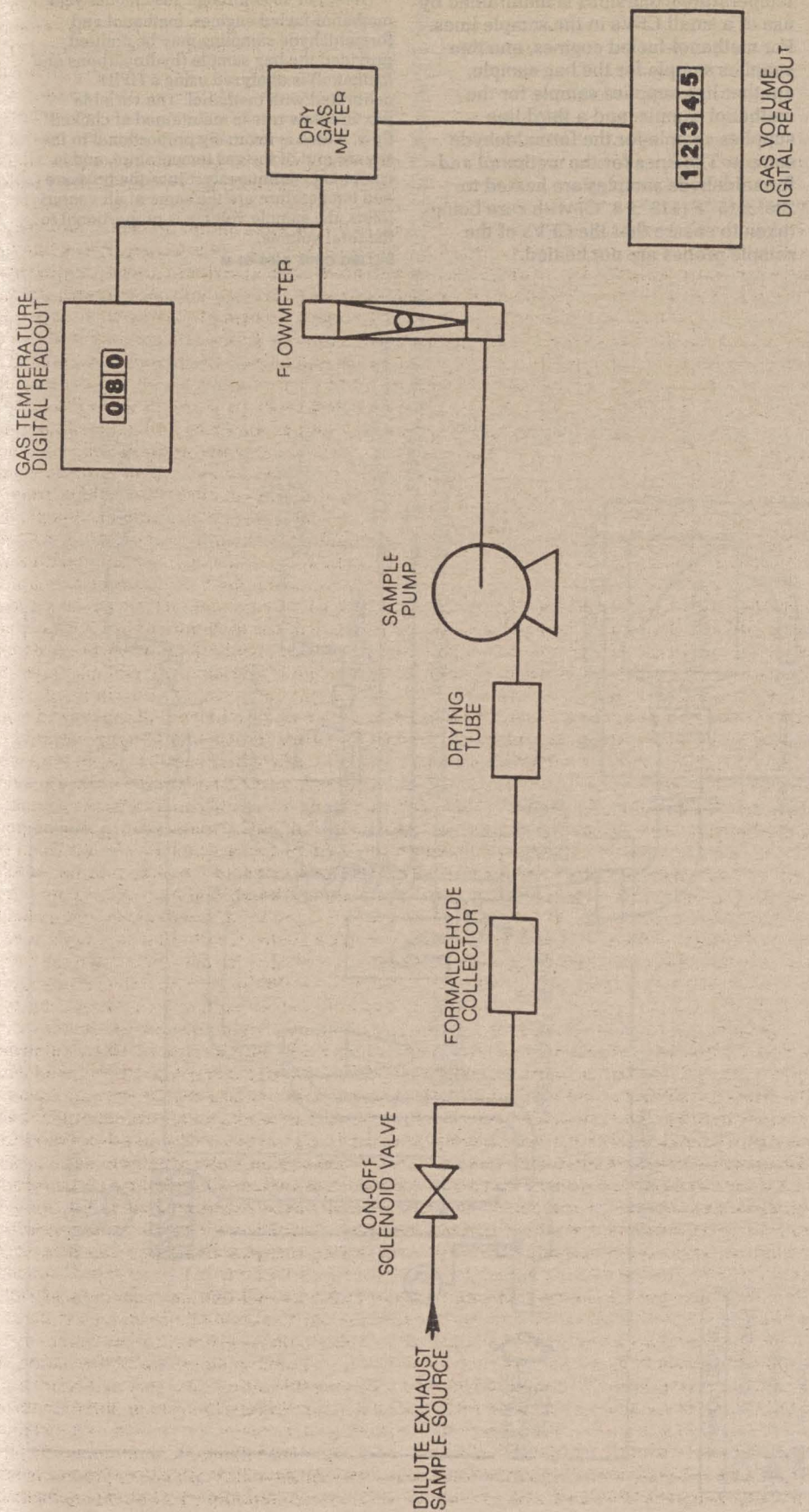


FIGURE N90-3 FORMALDEHYDE SAMPLE COLLECTION FLOW SCHEMATIC

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(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 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 lines for the methanol and formaldehyde samples are heated to 235°±15 °F (113°±8 °C) 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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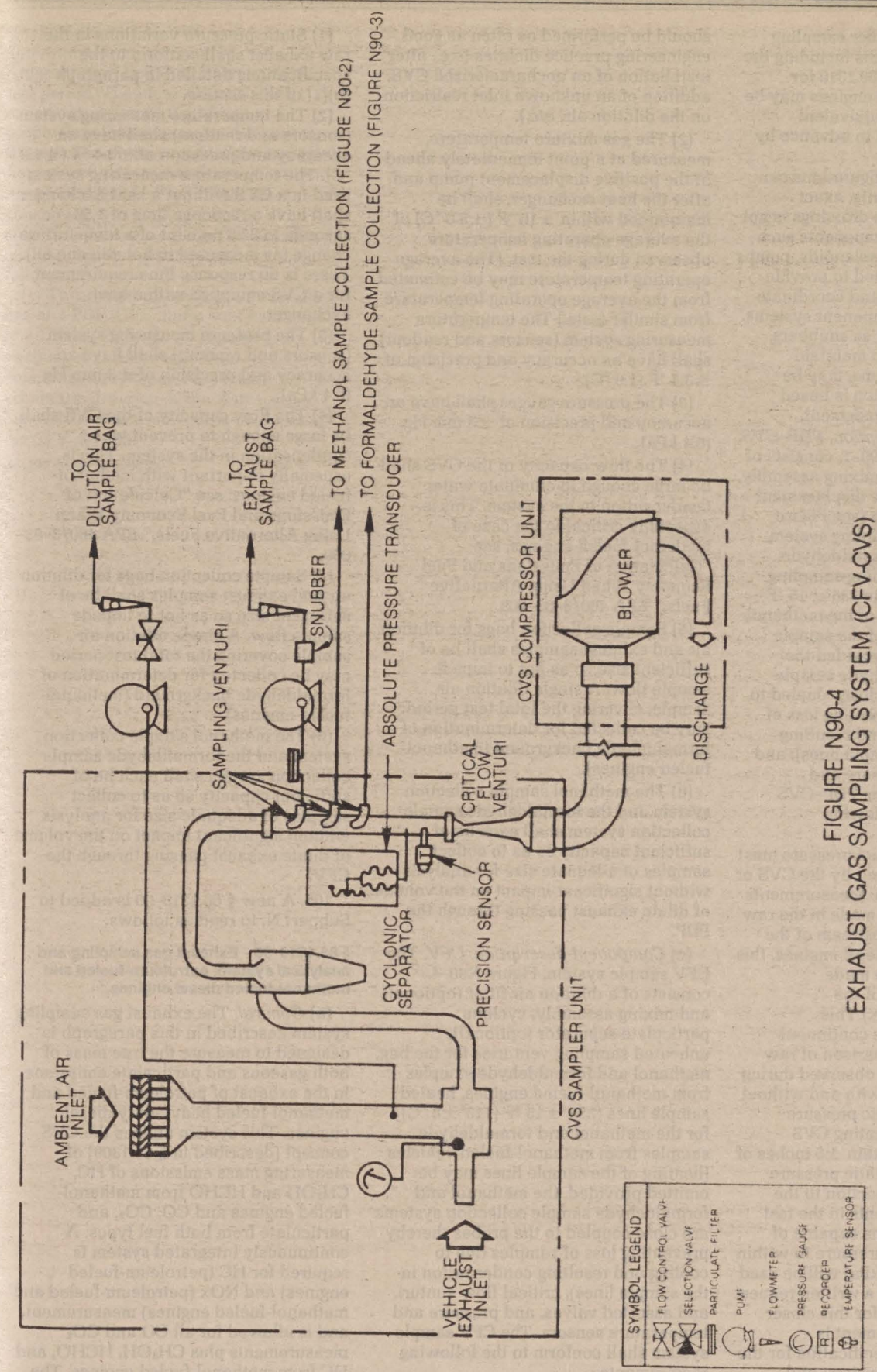


FIGURE N90-4
EXHAUST GAS SAMPLING SYSTEM (CFV-CVS)

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(5) *Other systems.* Other sampling and/or analytical systems including the systems described in § 86.1310 for petroleum-fueled diesel engines may be used if shown to yield equivalent results, and if approved in advance by the Administrator.

(6) Since various configurations can produce equivalent results, exact conformance with these drawings is not required. Additional components such as instruments, valves, solenoids, pumps and switches may be used to provide additional information and coordinate the functions of the component systems. Other components such as snubbers, which are not needed to maintain accuracy on some systems, may be excluded if their exclusion is based upon good engineering judgment.

(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 235°±15 °F (113°±8 °C) in the case of the methanol-fueled engine (heating of the sample lines may be omitted, provided the methanol and formaldehyde sample collection systems are close coupled to the probes thereby preventing loss of sample due to cooling and resulting condensation in the sample lines), and associated valves, pressure and temperature sensors. The PDP–CVS shall conform to the following requirements:

(1) Exhaust system backpressure must not be artificially lowered by the CVS or dilution air inlet system. Measurements to verify this should be made in the raw exhaust immediately upstream of the inlet to the CVS. (For diesel engines, this measurement should be made immediately upstream of the backpressure set device.) This verification requires the continuous measurement and comparison of raw exhaust static pressure observed during a transient cycle, both with and without the operating CVS. Static pressure measured with the operating CVS system shall remain within ±5 inches of water (1.2 kPa) of the static pressure measured without connection to the CVS, at identical moments in the test cycle. (Sampling systems capable of maintaining the static pressure to within ±1 inch of water (0.25 kPa) will be used by the Administrator if a written request substantiates the need for this closer tolerance.) This requirement is essentially a design specification for the CVS/dilution air inlet system, and should be performed as often as good engineering practice dictates (*e.g.*, after installation of an uncharacterized CVS, addition of an unknown inlet restriction on the dilution air, *etc.*).

(2) The gas mixture temperature, measured at a point immediately ahead of the positive displacement pump and after the heat exchanger, shall be maintained within ±10 °F (±5.6 °C) of the average operating temperature observed during the test. (The average operating temperature may be estimated from the average operating temperature from similar tests.) The temperature measuring system (sensors and readout) shall have an accuracy and precision of ±3.4 °F (1.9 °C).

(3) The pressure gauges shall have an accuracy and precision of ±3 mm Hg (0.4 kPa).

(4) The flow capacity of the CVS shall be large enough to eliminate water condensation in the system. This is especially critical in the case of methanol-fueled engines; see "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3–83–009.

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

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

(c) *Component description, CFV.* 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 from methanol-fueled engines, heated sample lines (235°±15 °F (113°±8 °C)) for the methanol and formaldehyde samples from methanol-fueled vehicles (heating of the sample lines may be omitted provided, the methanol and formaldehyde sample collection systems are close coupled to the probes thereby preventing loss of samples due to cooling and resulting condensation in the sample lines), critical flow venturi, and assorted valves, and pressure and temperature sensors. The CFV sample system shall conform to the following requirements:

(1) Static pressure variations in the raw exhaust shall conform to the specifications detailed in paragraph (b)(1) of this section.

(2) The temperature measuring system (sensors and readout) shall have an accuracy and precision of ±3.4 °F (±1.9 °C). The temperature measuring system used in a CVS without a heat exchanger shall have a response time of 1.50 seconds to 62.5 percent of a temperature change (as measured in hot silicone oil). There is no response time requirement for a CVS equipped with a heat exchanger.

(3) The pressure measuring system (sensors and readout) shall have an accuracy and precision of ±3 mm Hg (0.4 kPa).

(4) The flow capacity of the CVS shall be large enough to prevent water condensation in the system. This is especially important with methanol-fueled engines: see "Calculation of Emissions and Fuel Economy When Using Alternative Fuels," EPA 460/3–83–009.

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

(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.

105. A new § 86.1310–90 is added to Subpart N, to read as follows:

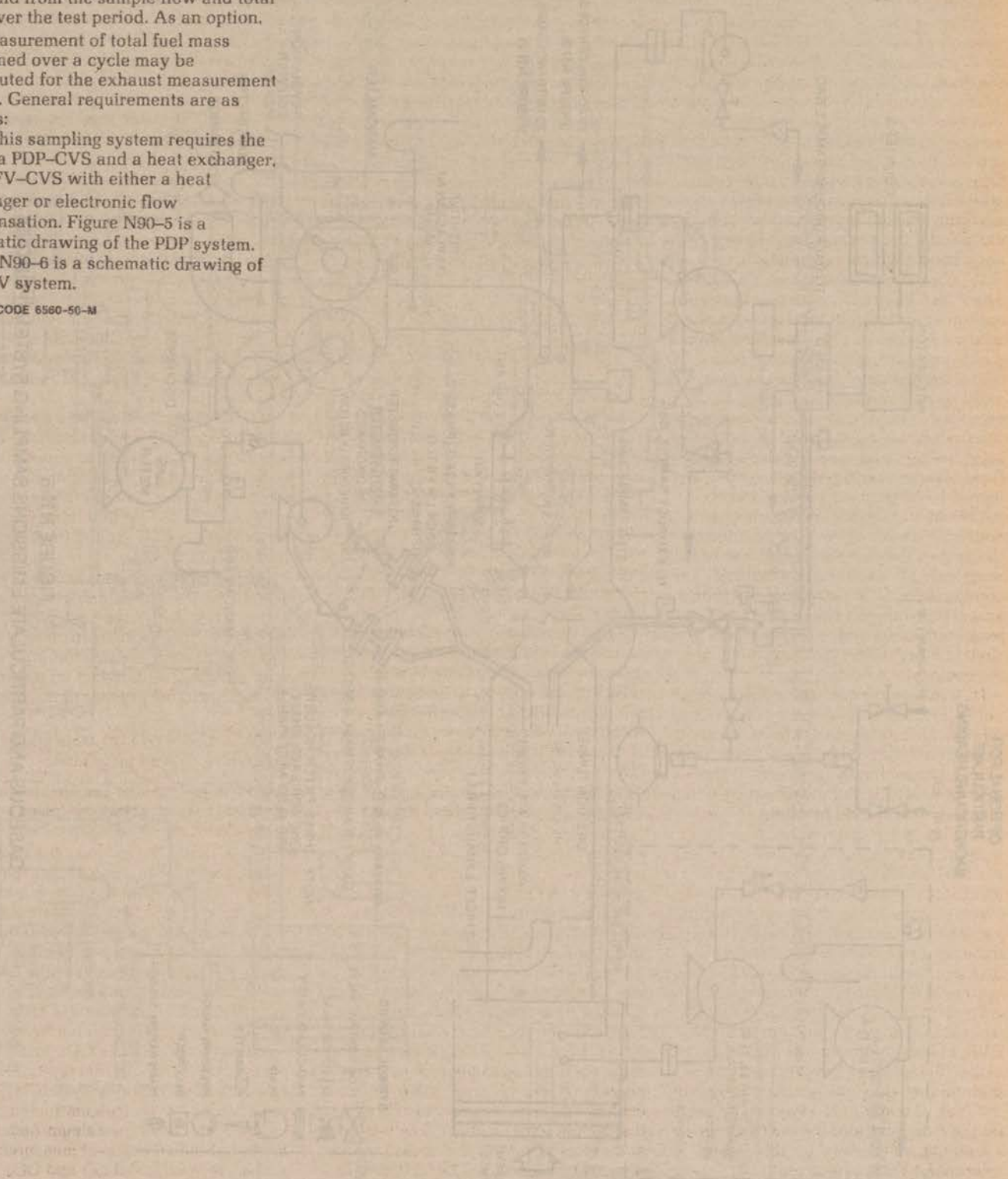
§ 86.1310–90 Exhaust gas sampling and analytical system; petroleum-fueled and methanol-fueled diesel engines.

(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 and methanol-fueled heavy-duty diesel engines. This system utilizes the CVS concept (described in § 86.1309) of measuring mass emissions of HC, CH_3OH and HCHO from methanol-fueled engines and CO, CO_2, and particulate from both fuel types. A continuously integrated system is required for HC (petroleum-fueled engines) and NOx (petroleum-fueled and methanol-fueled engines) measurement, and is allowed for all CO and CO_2 measurements plus CH_3OH, HCHO, and HC from methanol-fueled engines. 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_2. General requirements are as follows:

(1) This sampling system requires the use of a PDP–CVS and a heat exchanger, or a 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 system.

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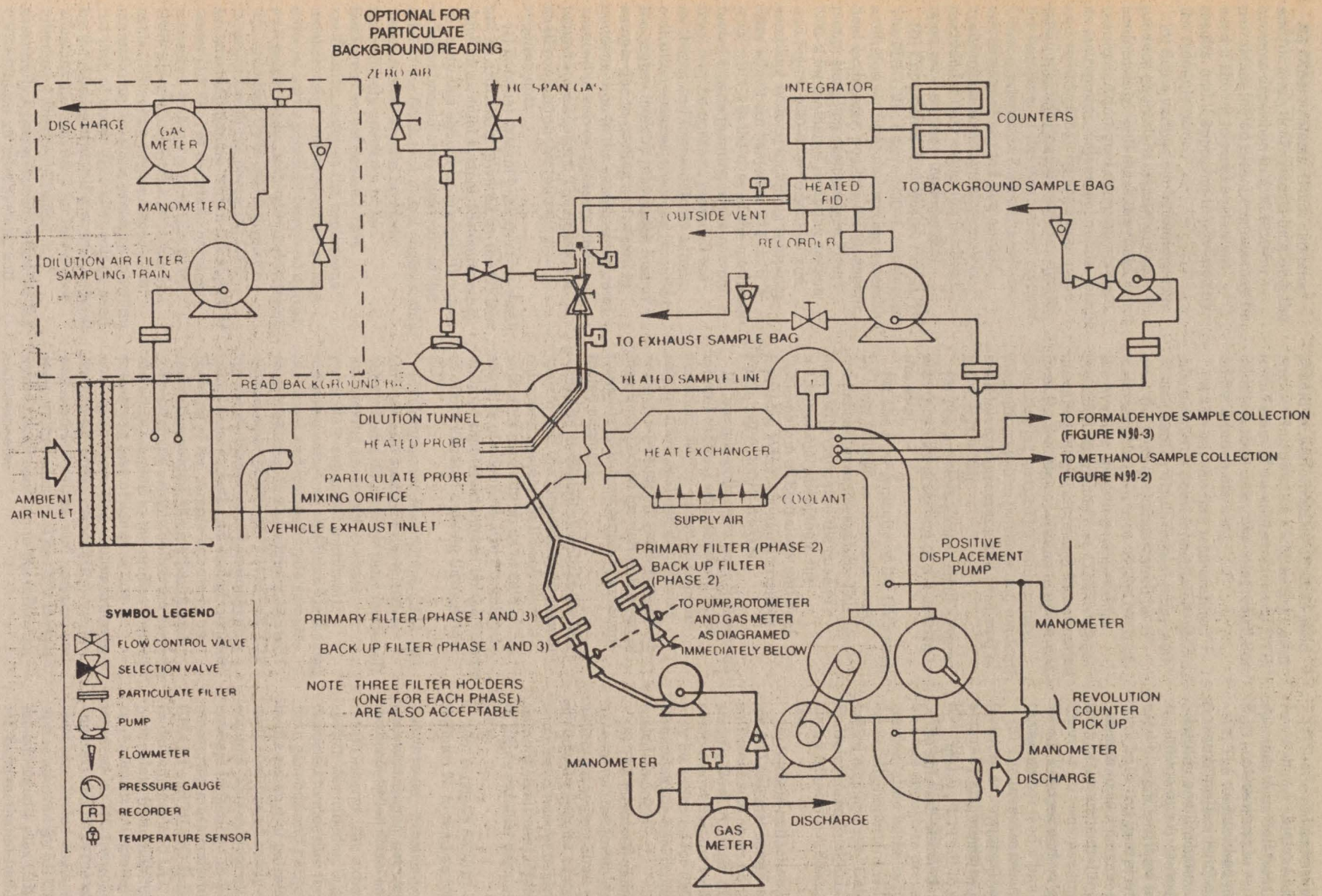


FIGURE N90-5
GASEOUS AND PARTICULATE EMISSIONS SAMPLING SYSTEM (PDP-CVS)

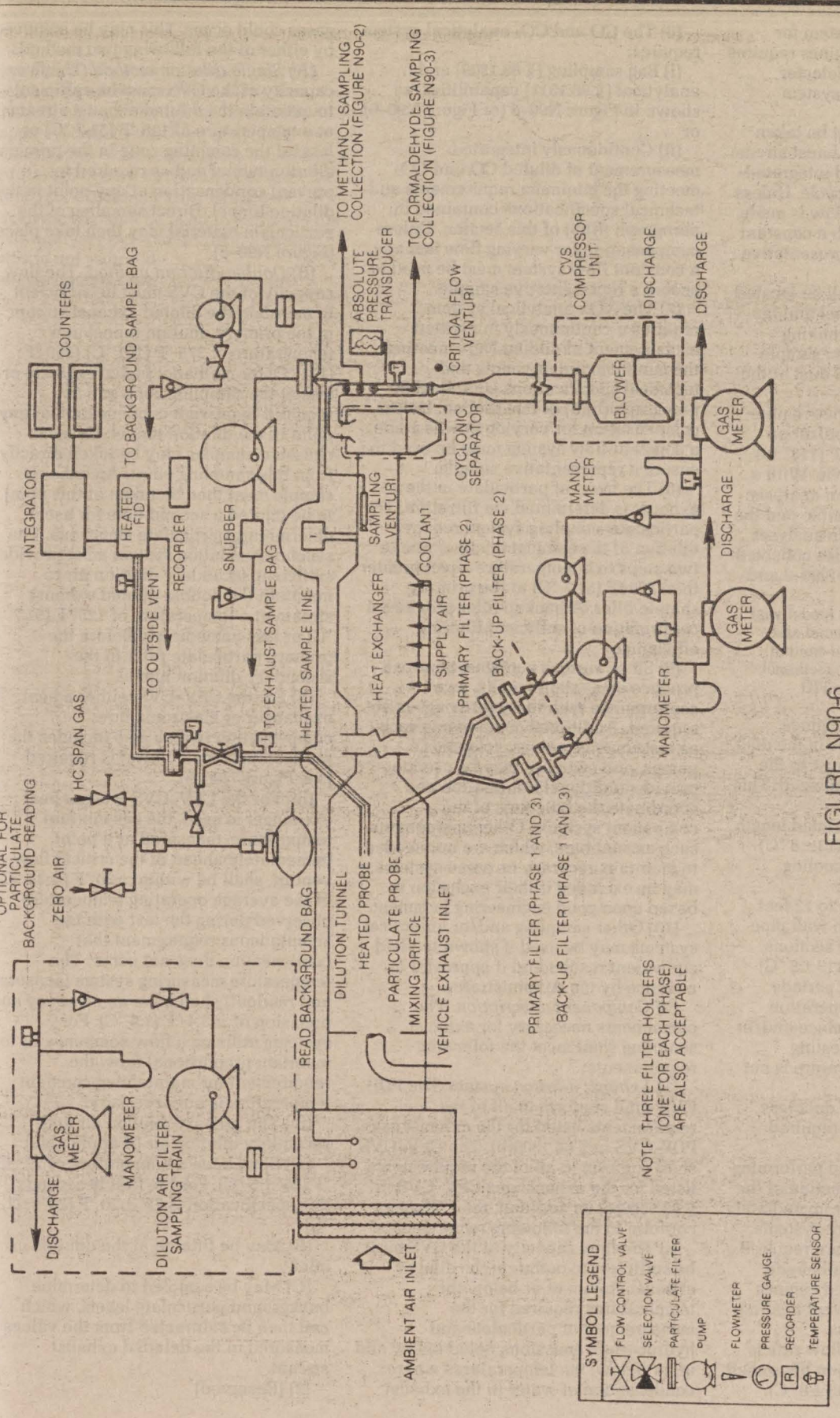


FIGURE N90-6
GASEOUS AND PARTICULATE EMISSIONS SAMPLING SYSTEM (CFV-CVS)

BILLING CODE 6560-50-C

(2) The HC analytical system for petroleum-fueled diesel engines requires a heated flame ionization detector (HFID) and heated sample system (375±20 °F (191±11 °C)).

(i) The HFID sample must be taken directly from the diluted exhaust stream through a heated probe and integrated continuously over the test cycle. Unless compensation for varying flow is made, the HFID must be used with a constant flow system to ensure a representative sample.

(ii) The heated probe shall be located in the primary dilution tunnel and far enough downstream of the mixing chamber to ensure a uniform sample distribution across the CVS duct at the point of sampling.

(3) Methanol-fueled engines require the use of a heated flame ionization detector (HFID) (235°±15 °F (113°±8 °C)) for hydrocarbon analysis. With a heated FID, the hydrocarbon analysis can be made on the bag sample and the methanol and formaldehyde analyses are performed on the samples collected for these purposes (Figures N90–2 and N90–3).

Note: For 1990 through 1994 model year methanol-fueled engines, methanol and formaldehyde sampling may be omitted provided the hydrocarbon plus methanol analyses are performed using a FID calibrated on methanol.

(4) For methanol-fueled engines, cooling of the exhaust gases in the duct connecting the engine exhaust to the dilution tunnel shall be minimized. This may be accomplished by:

(i) Using a duct of unrestricted length maintained at 235±15 °F (113±8 °C) with heating and possibly cooling capabilities 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 235±15 °F (113±8 °C) prior to the test and during periods when the engine is not in operation (insulation may remain in place and/or heating may occur during testing provided maximum temperature is not exceeded), or;

(iii) Using a smooth wall duct less than five feet long with no required heating, or;

(iv) Omitting the duct and performing the exhaust gas dilution function at the engine exhaust manifold or immediately after exhaust aftertreatment systems.

(5) Heated sample lines are required for the methanol and formaldehyde samples for methanol-fueled engines (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 235±15 °F (113±8 °C).

(6) The CO and CO_2 analytical system requires:

(i) Bag sampling (§ 86.1309) and analytical (§ 86.1311) capabilities, as shown in Figure N90–5 (or Figure N90–6), or

(ii) Continuously integrated measurement of diluted CO and CO_2 meeting the minimum requirements and technical specifications contained in paragraph (b)(5) of this section. Unless compensation for varying flow is made, a constant flow system must be used to ensure a representative sample.

(7) The NOx analytical system requires a continuously integrated measurement of diluted NOx meeting the minimum requirements and technical specifications contained in paragraph (b)(5) of this section. Unless compensation for varying flow is made, a constant flow system must be used to ensure a representative sample.

(8) The mass of particulate in the exhaust is determined via filtration. The particulate sampling system requires dilution of the exhaust in either one or two steps to a temperature never greater than 125 °F (51.7 °C) at the primary sample filter. A backup filter provides a confirmation of sufficient filtering efficiency.

(9) Since various configurations can produce equivalent results, exact conformance with these drawings is not required. Additional components such as instruments, valves, solenoids, pumps, and switches may be used to provide additional information and coordinate the functions of the component systems. Other components, such as snubbers, which are not needed to maintain accuracy on some systems, may be excluded if their exclusion is based upon good engineering judgment.

(10) Other sampling and/or analytical systems may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(b) *Component description.* The components necessary for exhaust sampling shall meet the following requirements:

(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). In addition, the 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 emissions noted below and at, or below, the temperatures where condensation of water in the exhaust gases could occur. This may be achieved by either of the following two methods:

(A) *Single-dilution method.* The flow capacity of the CVS must be sufficient to maintain the diluted exhaust stream at a temperature of 125 °F (51.7 °C) or less, at the sampling zone in the primary dilution tunnel and as required to prevent condensation at any point in the dilution tunnel. Direct sampling of the particulate material may then take place (Figure N90–5).

(B) *Double-dilution method.* The flow capacity of the CVS must be sufficient to maintain the diluted exhaust stream in the primary dilution tunnel at a temperature of 375 °F (191 °C) (250 °F (121 °C) for methanol fueled engines) or less at the sampling zone and as required to prevent condensation at any point in the dilution tunnel. Gaseous emission samples may be taken directly from this sampling point. An exhaust sample must then be taken at this point to be diluted a second time for use in determining particulate emissions. The secondary dilution system must provide sufficient secondary dilution air to maintain the double-diluted exhaust stream at a temperature of 125 °F (51.7 °C) or less immediately before the primary particulate filter in the secondary dilution tunnel.

(ii) For the 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 when a heat exchanger is used, the gas mixture temperature, measured at a point immediately ahead of the critical flow venturi, shall be within ±20 °F (±11 °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 ±3.4 °F (1.9 °C). For systems utilizing a flow compensator to maintain proportional flow, the requirement for maintaining constant temperature is not necessary.

(iv) The primary dilution air and secondary dilution air (if applicable):

(A) Shall have a temperature of 77°±9 °F (25°±5 °C). For the first 10 seconds this specification is 77°±20 °F (25°±11 °C).

(B) May be filtered at the dilution air inlet.

(C) May be sampled to determine background particulate levels, which can then be subtracted from the values measured in the detailed exhaust stream.

(2) [Reserved]

(3) *Continuous HC measurement system.* (i) The continuous HC sample system (as shown in Figure N90–7 or N90–8) uses an "overflow" zero and span system. In this type of system, excess zero or span gas spills out of the probe when zero and span checks of the analyzer are made. The "overflow" system may also be used to calibrate the HC analyzer per § 86.1321(b), although this is not required.

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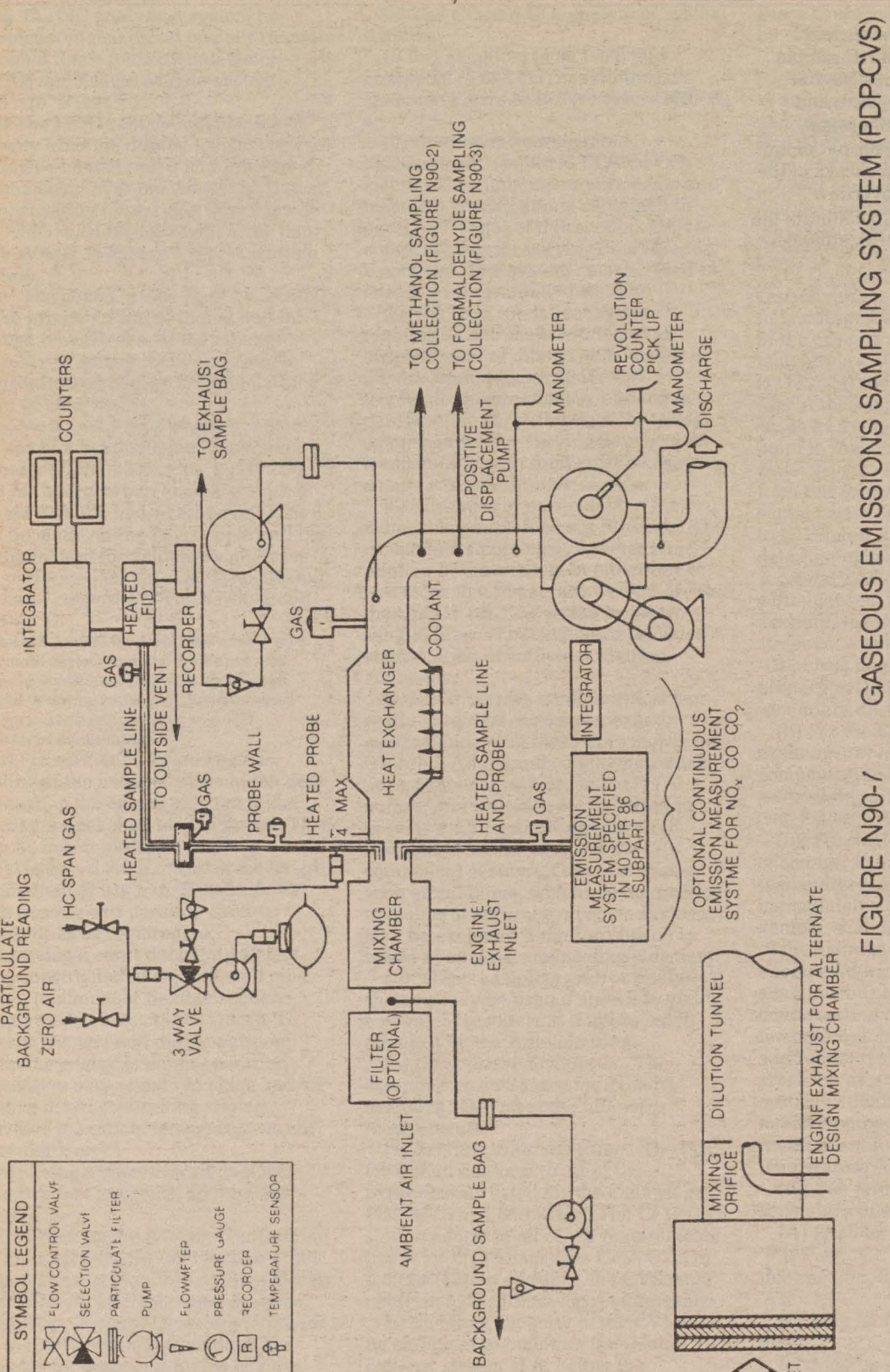


FIGURE N90-/ GASEOUS EMISSIONS SAMPLING SYSTEM (PDP-CVS)

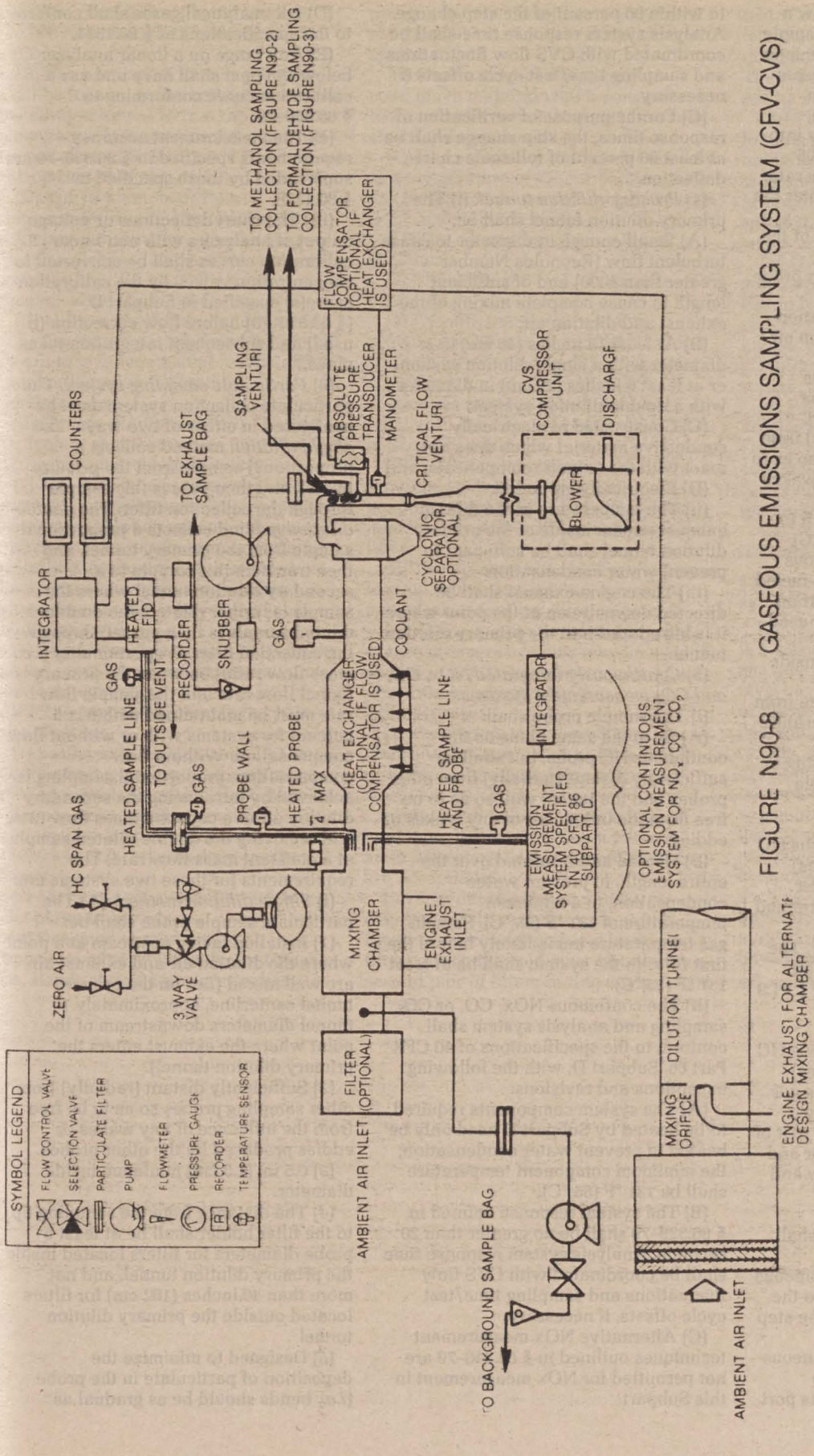


FIGURE N90-8 GASEOUS EMISSIONS SAMPLING SYSTEM (CFV-CVS)

BILLING CODE 6560-50-C

(ii) No other analyzers may draw a sample from the continuous HC sample probe, line or system, unless a common sample pump is used for all analyzers and the sample line system design reflects good engineering practice.

(iii) The overflow gas flow rates into the sample line shall be at least 105 percent of the sample system flow rate.

(iv) The overflow gases shall enter the heated sample line as close as practicable to the outside surface of the CVS duct or dilution tunnel.

(v) The continuous hydrocarbon probe shall be:

(A) Installed in the primary dilution tunnel at a point where the dilution air and exhaust are well mixed (*i.e.*, approximately 10 tunnel diameters downstream of the point where the exhaust enters the dilution tunnel).

(B) Sufficiently distant (radially) from other probes and the tunnel wall so as to be free from the influence of any wakes or eddies.

(C) Heated over the entire length to maintain a 375°±20 °F (191°±11 °C) (235±15 °F) (113±8 °C) if continuous HC sampling is used on methanol-fueled engines) *wall* temperature. (Insulation and other techniques may also be used to maintain the temperature.)

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

(E) Free from cold spots (*i.e.*, free from spots where the probe *wall* temperature is less than 355 °F (180 °C)).

(vi) The dilute exhaust *gas* flowing in the continuous hydrocarbon sample system shall be:

(A) At 375°±10 °F (191°±6 °C) (235±15 °F (113±8 °C) if continuous HC is used for methanol-fueled engines) immediately before the heated filter. This *gas* temperature will be determined by a temperature sensor located immediately upstream of the filter. The sensor and its readout shall have an accuracy and precision of ±3.4 °F (±1.9 °C).

(B) At 375°±10 °F (191°±6 °C) (235±15 °F (113±8 °C) if continuous HC is used for methanol-fueled engines) immediately before the HFID. This *gas* temperature will be determined by a temperature sensor located at the exit of the heated sample line. The sensor and its readout shall have an accuracy and precision of ±3.4 °F (1.9 °C).

(vii) The response time of the continuous measurement system shall be no greater than:

(A) 1.5 seconds from an instantaneous step change at the port entrance to the analyzer to within 90 percent of the step change.

(B) 20 seconds from an instantaneous step change at the entrance to the sample probe or overflow span gas port to within 90 percent of the step change. Analysis system response time shall be coordinated with CVS flow fluctuations and sampling time/test cycle offsets if necessary.

(C) For the purpose of verification of response times, the step change shall be at least 60 percent of full-scale chart deflection.

(4) *Primary-dilution tunnel.* (i) The primary dilution tunnel shall be:

(A) Small enough in diameter to cause turbulent flow (Reynolds Number greater than 4000) and of sufficient length to cause complete mixing of the exhaust and dilution air;

(B) At least 18 inches (46 cm) in diameter with a single-dilution system or at least 8 inches (20 cm) in diameter with a double-dilution system;

(C) Constructed of electrically conductive material which does not react with the exhaust components; and

(D) Electrically grounded.

(ii) The temperature of the diluted exhaust stream inside of the primary dilution tunnel shall be sufficient to prevent water condensation.

(iii) The engine exhaust shall be directed downstream at the point where it is introduced into the primary dilution tunnel.

(5) *Continuously integrated NOx, CO, and CO_2 measurement systems.*

(i) The sample probe shall:

(A) Be in the same plane as the continuous HC probe, but shall be sufficiently distant (radially) from other probes and the tunnel wall so as to be free from the influences of any wakes or eddies.

(B) Heated and insulated over the entire length, to prevent water condensation, to a minimum temperature of 131 °F (55 °C). Sample gas temperature immediately before the first filter in the system shall be at least 131 °F (55 °C).

(ii) The continuous NOx, CO, or CO_2 sampling and analysis system shall conform to the specifications of 40 CFR Part 86, Subpart D, with the following exceptions and revisions:

(A) The system components required to be heated by Subpart D need only be heated to prevent water condensation, the minimum component temperature shall be 131 °F (55 °C).

(B) The system response defined in § 86.329–79 shall be no greater than 20 seconds. Analysis system response time shall be coordinated with CVS flow fluctuations and sampling time/test cycle offsets, if necessary.

(C) Alternative NOx measurement techniques outlined in § 86.346–79 are not permitted for NOx measurement in this Subpart.

(D) All analytical gases shall conform to the specifications of § 86.1314.

(E) Any range on a linear analyzer below 155 ppm shall have and use a calibration curve conforming to § 86.330–79.

(F) The measurement accuracy requirements specified in § 86.338–79 are superseded by those specified in § 86.1338.

(iii) The chart deflections or voltage output of analyzers with non-linear calibration curves shall be converted to concentration values by the calibration curve(s) specified in Subpart D (§ 86.330–79) before flow correction (if used) and subsequent integration takes place.

(6) *Particulate sampling system.* The particulate collection system must be configured in either of two ways. The *single-dilution* method collects a proportional sample from the primary tunnel, and then passes this sample through the collection filter. The *double-dilution* method collects a proportional sample from the primary tunnel, and then transfers this sample to a secondary dilution tunnel where the sample is further diluted; the double-diluted sample is then passed through the collection filter. Proportionality (*i.e.*, mass flow ratio) between the primary tunnel flow rate and the sample flow rate must be maintained within ±5 percent for systems with or without flow compensation. Without flow compensation, proportional sampling is achieved by introducing the secondary dilution air at a constant mass flow rate, and removing the double-diluted sample at a constant mass flow rate. The requirements for these two systems are:

(i) *Single dilution method.* (A) The particulate sample probe shall be:

(*1*) Installed facing upstream at a point where the dilution air and exhaust air are well mixed (*i.e.*, on the primary tunnel centerline, approximately 10 tunnel diameters downstream of the point where the exhaust enters the primary dilution tunnel).

(*2*) Sufficiently distant (radially) from other sampling probes so as to be free from the influence of any wakes or eddies produced by the other probes.

(*3*) 0.5 in. (1.3 cm) minimum inside diameter.

(*4*) The distance from the sampling tip to the filter holder shall be at least 5 probe diameters for filters located inside the primary dilution tunnel, and not more than 40 inches (102 cm) for filters located outside the primary dilution tunnel.

(*5*) Designed to minimize the deposition of particulate in the probe (*i.e.*, bends should be as gradual as

possible, protrusions (due to sensors, *etc.*) should be smooth and not sudden, *etc.*).

(B) The particulate sample pump(s) shall be located sufficiently distant from the dilution tunnel so that the inlet gas temperature is maintained at a constant temperature (±5 °F (±2.8 °C)) if flow compensation is not used.

(C) The gas meters or flow instrumentation shall be located sufficiently distant from the tunnel so that the inlet gas temperature remains constant (±5 °F (±2.8 °C)) if flow compensation is not used.

(D) Other sample flow handling and/or measurement systems may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(ii) *Double-dilution method.* (A) The particulate sample transfer tube shall be configured and installed so that:

(*1*) The inlet faces upstream in the primary dilution tunnel at a point where the primary dilution air and exhaust are well mixed (*i.e.*, on the primary tunnel centerline, approximately 10 tunnel diameters downstream of the point where the exhaust enters the primary dilution tunnel).

(*2*) The particulate sample exits on the centerline of the secondary tunnel and points downstream.

(B) The particulate sample transfer tube shall be:

(*1*) Sufficiently distant (radially) from other sampling probes (in the primary dilution tunnel) so as to be free from the influence of any wakes or eddies produced by the other probes.

(*2*) 0.5 in (1.3 cm) minimum inside diameter.

(*3*) No longer than 36 in (91 cm) from inlet plane to exit plane.

(*4*) Designed to minimize the deposition of particulate during transfer (*i.e.*, bends should be as gradual as possible, protrusions (due to sensors, *etc.*) should be smooth and not sudden, *etc.*).

(*5*) Constructed of electrically conductive material which does not react with the exhaust components, and electrically grounded.

(C) The secondary dilution air shall be at a temperature of 77°±9 °F (25°±5 °C). For the first 10 seconds this specification is 77°±20 °F (25°±11 °C).

(D) The secondary-dilution tunnel shall be:

(*1*) 3.0 inches (7.6 cm) minimum inside diameter.

(*2*) Of sufficient length so as to provide a residence time of at least 0.25 seconds for the double-diluted sample.

(*3*) Constructed of electrically conductive material which does not react with the exhaust components, and electrically grounded.

(E) Additional dilution air must be provided so as to maintain a sample temperature of 125 °F (51.7 °C) or less immediately before the primary sample filter.

(F) The primary filter holder shall be located within 12.0 in (30.5 cm) of the exit of the secondary dilution tunnel.

(G) Other sample flow handling and/or measurement systems may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(*7*) *Particulate sampling filters.* (i) Fluorocarbon-coated glass fiber filters or fluorocarbon-based (membrane) filters are required.

(ii) Particulate filters must have a minimum diameter of 70 mm (60 mm stain diameter). Larger diameter filters are acceptable.

(iii) The dilute exhaust will be simultaneously sampled by a pair of filters (one primary and one back-up filter) during the cold-start test and by a second pair of filters during the hot-start test. The back-up filter holder shall be located no more than 4 inches (10 cm) downstream of the primary filter holder. The primary and back-up filters shall not be in contact with each other.

(iv) The recommended minimum loading on a primary 70 mm filter is 5.3 milligrams. Equivalent loadings (*i.e.*, mass/stain area) are recommended for larger filters. For equivalency calculations assume the 70 mm filter has a 60 mm stain diameter.

(*8*) *Methanol sampling system.* The methanol sampling system, shown in Figure N90–2, consists of impingers (or sample collection capsules) containing known volumes of deionized water and sampling pump to draw the proportional sample through the impingers.

(*9*) *Formaldehyde sampling system.* The formaldehyde sampling system, Figure N90–3, consists of sample collection impingers and sampling pump to draw the proportional sample through the impingers.

106. A new § 86.1311–90 is added to Subpart N, to read as follows:

§ 86.1311–90 Exhaust gas analytical system; CVS bag sample.

(a) *Schematic drawings.* Figure N90–9 is a schematic drawing of the exhaust gas analytical system used for analyzing CVS bag samples from either Otto-cycle or diesel engines. Since various configurations can produce accurate results, exact conformance with the drawing is not required. Additional components such as instruments, valves, solenoids, pumps and switches may be used to provide additional information and coordinate the functions of the component systems. Other components such as snubbers, which are not needed to maintain accuracy in some systems, may be excluded if their exclusion is based upon good engineering judgment.

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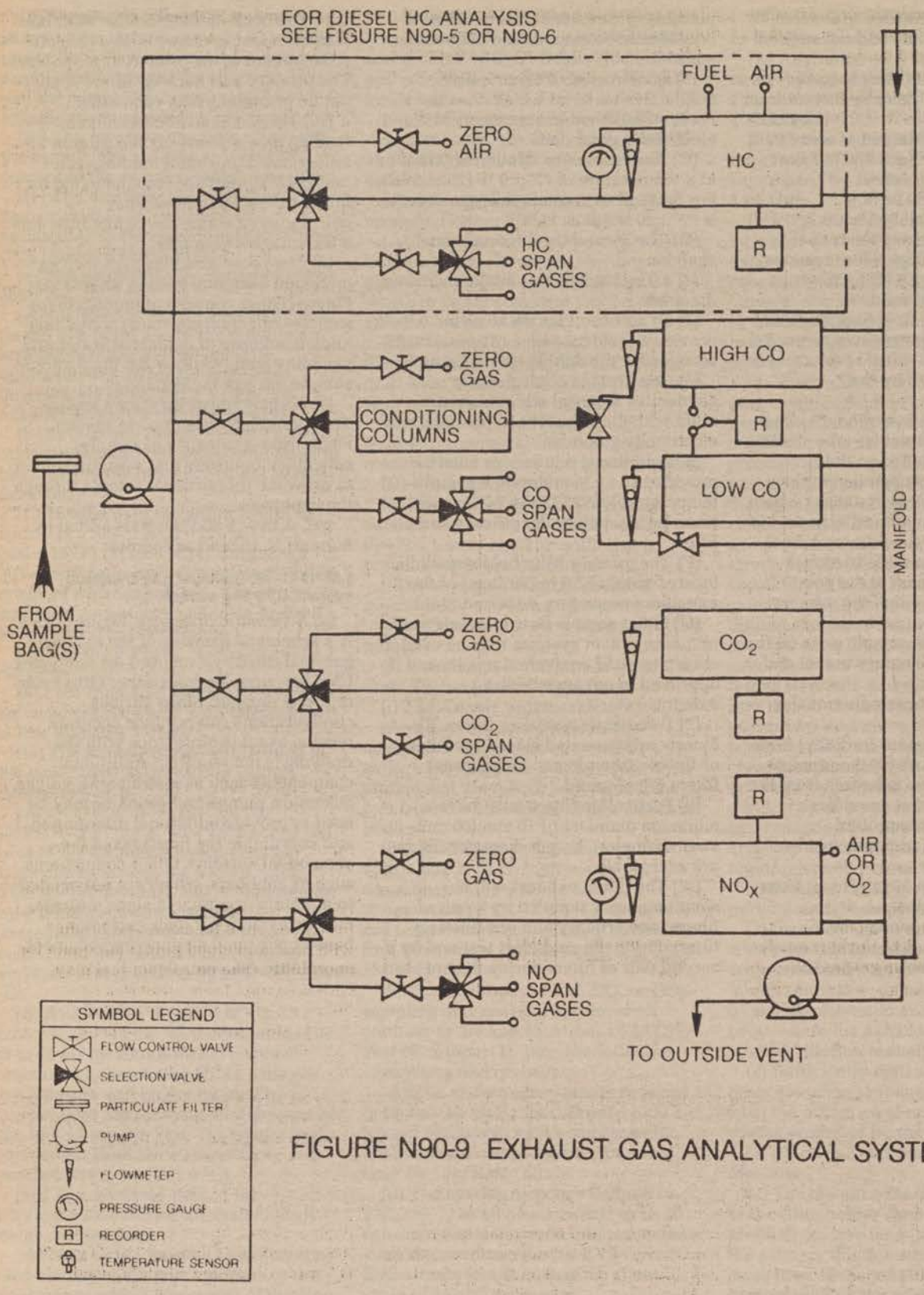


FIGURE N90-9 EXHAUST GAS ANALYTICAL SYSTEM

BILLING CODE 6560-50-C

(b) *Major component description.* The analytical system, Figure N90–9, consists of a flame ionization detector (FID) (heated for methanol-fueled (235±15 °F (113±8 °C)) and for petroleum-fueled diesel (375 °±10 °F (191 °±6 °C) engines) for the measurement of hydrocarbons, nondispersive infrared analyzers (NDIR) for the measurement of carbon monoxide and carbon dioxide, and a chemiluminescence analyzer (CL) for the measurement of oxides of nitrogen. The analytical system for methanol consists of a gas chromatograph (GC), equipped with a flame ionization detector. The analysis for formaldehyde is performed using high pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

(1) The CL requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(2) The carbon monoxide (NDIR) analyzer may require a sample conditioning column containing $CaSO_4$, or dessicating silica gel to remove water vapor, and containing ascarite to remove carbon dioxide from the CO analysis stream.

(i) If CO instruments are used which are essentially free of CO_2 and water vapor interference, the use of the conditioning column may be deleted. (*See* §§ 86.1322 and 86.1342.)

(ii) A CO instrument will be considered to be essentially free of CO_2 and water vapor interference if its response to a mixture of 3 percent CO_2 in N_2, which has been bubbled through water at room temperature, produces an equivalent CO response, as measured on the most sensitive CO range, which is less than 1 percent of full scale CO concentration on ranges above 300 ppm full scale or less than 3 ppm on ranges below 300 ppm full scale. (*See* § 86.1322.)

(c) *Alternate analytical systems.* Analysis systems meeting the specifications of 40 CFR Part 86 Subpart D may be used for testing required under this subpart, with the exception of §§ 86.346 and 86.347 provided that the Subpart D systems meet the specifications of this subpart. Heated analyzers may be used in their heated configuration.

(d) *Other analyzers and equipment.* Other types of analyzers and equipment may be used if shown to yield equivalent results and if approved in advance by the Administrator.

107. Section 86.1313–90 of Subpart N, is revised to read as follows:

§ 86.1313–90 Fuel specifications.

(a) *Otto-cycle test fuel.* (1) Gasoline having the specifications listed in Table N90–1 will be used by the Administrator in exhaust emission testing petroleum-fueled Otto-cycle engines. Gasoline having these specifications or substantially equivalent specifications approved by the Administrator, shall be used by the manufacturer in exhaust emission testing, except that the octane specification does not apply.

TABLE N90–1

Item	ASTM	Value
Octane, research, min	D2699	93
Sensitivity, min		7.5
Lead (organic), g/U.S. gal.	D3237	[1] (0.050)
(g/liter)		[1] (0.013)
Distillation range:		
IBP, °F	D86	75–95
(°C)		(23.9–35)
10 pct. point, °F	D86	120–135
(°C)		(48.9–57.2)
50 pct. point, °F	D86	200–230
(°C)		(93.3–110)
90 pct. point, °F	D86	300–325
(°C)		(148.9–162.8)
EP, max. °F	D86	415
(°C)		(212.8)
Sulphur, max. wt. pct	D1266	0.10
Phosphorus, max., g/U.S. gal.		0.005
(g/liter)	D3231	(0.0013)
RVP, psi	D323	8.0–9.2
(kPa)		(60.0–63.4)
Hydrocarbon composition:		
Olefins, max. pct	D1319	10
Aeromatics, max. pct.	D1319	35
Saturates	D1319	[2]

[1] Maximum.
[2] Remainder.

(2) Unleaded gasoline representative of commercial gasoline which will be generally available through retail outlets shall be used in service accumulation.

(i) The octane rating of the gasoline used shall be not higher than one Research octane number above the minimum recommended by the manufacturer and have a minimum sensitivity of 7.5 octane numbers, where sensitivity is defined as the Research octane number minus the Motor octane number.

(ii) The Reid Vapor Pressure of the gasoline used shall be characteristic of the motor fuel used during the season in which the service accumulation takes place.

(3) Methanol fuel used for exhaust and evaporative emission testing and in service accumulation of methanol-fueled Otto-cycle engines shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol by volume.

(i) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (a)(3) of this section.

(ii) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(4) Other methanol fuels may be used for testing and service accumulation provided:

(i) They are commercially available, and

(ii) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(iii) Use of a fuel listed under paragraph (a)(3) of this section would have a detrimental effect on emissions or durability, and

(iv) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(5) The specification range of the fuels to be used under paragraphs (a)(2), (a)(3), and (a)(4) of this section shall be reported in accordance with § 86.090–21(b)(3).

(b) *Diesel test fuel.* (1) The petroleum fuels for testing diesel engines employed for testing shall be clean and bright, with pour and cloud points adequate for operability. The petroleum fuel may contain nonmetallic additives as follows: Cetane improver, metal deactivator, antioxidant, dehazer, antirust, pour depressant, dye, dispersant, and biocide.

(2) Petroleum fuel for diesel engines meeting the specifications in Table N90–2, or substantially equivalent specifications approved by the Administrator, shall be used in exhaust emissions testing. The grade of petroleum fuel recommended by the engine manufacturer commercially designated as "Type 1–D" or "Type 2–D" grade diesel fuel shall be used.

TABLE N90-2

Item	ASTM	Type 1-D	Type 2-D
Cetane	D613	48-54	42-50
Distillation range:			
IBP, °F	D86	330-390	340-400
(°C)		(165.6-198.9)	(171.1-204.4)
10 pct. point, °F	D86	370-430	400-460
(°C)		(187.8-221.1)	(204.4-237.8)
50 pct. point, °F	D86	410-480	470-540
(°C)		(210-248.9)	(243.3-282.2)
90 pct. point, °F	D86	460-520	550-610
(°C)		(237.8-271.1)	(287.8-321.1)
EP, °F	D86	500-560	580-660
(°C)		(260.0-293.3)	(304.4-348.9)
Gravity, °API	D287	40-44	33-37
Total sulfur, pct	D129 or D2622	0.05-0.20	0.20-0.50
Hydrocarbon composition:			
Aromatics, pct.	D1319	[1] 8	[1] 27
Parafins, Naphthenes, Olefins	D1319	[2]	[2]
Flashpoint, min., °F,	D93	120	130
(°C)		(48.9)	(54.4)
Viscosity, centistokes	D445	1.6-2.0	2.0-3.2

[1] Minimum.
[2] Remainder.

(3) Petroleum fuel for diesel engines meeting the specifications in Table N90-3, or substantially equivalent specifications approved by the Administrator, shall be used in service accumulation. The grade of petroleum diesel fuel recommended by the engine manufacturer, commercially designated as "Type 1-D" or "Type 2-D" grade diesel fuel shall be used:

TABLE N90-3

Item	ASTM	Type 1-D	Type 2-D
Cetane	D613	42-56	30-58
Distillation range:			
90 pct. point, °F	D86	440-530	540-630
(°C)		(226.7-276.7)	(282.2-332.2)
Gravity, °API	287	39-45	30-42
Total sulfur, min., pct	D129 orD2622	0.05	0.20
Flashpoint, min., °F,	D93	120	130
(°C)		(48.9)	(54.4)
Viscosity, centistokes	D455	1.2-2.2	1.5-4.5

(4) Methanol fuel used for exhaust and evaporative emission testing and in service accumulation of methanol-fueled diesel engines shall be representative of commercially available methanol fuel and shall consist of at least 50 percent methanol by volume.

(i) Manufacturers shall recommend the methanol fuel to be used for testing and service accumulation in accordance with paragraph (b)(4) of this section.

(ii) The Administrator shall determine the methanol fuel to be used for testing and service accumulation.

(5) Other fuels may be used for testing and service accumulation provided:

(i) They are commercially available, and

(ii) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service, and

(iii) Use of a fuel listed under paragraphs (b)(2) and (b)(3) or (b)(4) of this section would have a detrimental effect on emissions or durability, and

(iv) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(6) The specification range of the fuels to be used under paragraphs (b)(2), (b)(3), (b)(4), and (b)(5) of this section shall be reported in accordance with § 86.090-21(b)(3).

(c) Fuels not meeting the specifications set forth in this section may be used only with the advance approval of the Administrator.

(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 be within the range of fuel mixtures for which the vehicle was designed.

(2) Manufacturer testing and service accumulation may be performed using only those mixtures (mixtures may be different for exhaust testing, evaporative testing, and service accumulation) expected to result in the highest emissions, provided:

(i) The fuels which constitute the mixture will be used in customer service, and

(ii) Information, acceptable to the Administrator, is provided by the manufacturer to show that the designated fuel mixtures would result in the highest emissions, and

(iii) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(3) The specification range of the fuels to be used under paragraph (d)(2) of this section shall be reported in accordance with § 86.090-21(b)(3).

108. A new § 86.1316-90 is added to Subpart N, to read as follows:

§ 86.1316–90 Calibrations; frequency and overview.

(a) Calibrations shall be performed as specified in §§ 86.1318 through 86.1326.

(b) At least monthly or after any maintenance which could alter calibration, the following calibrations and checks shall be performed:

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

(2) Calibrate the engine dynamometer flywheel torque and speed measurement transducers, and calculate the feedback signals to the cycle verification equipment.

(c) At least weekly or after any maintenance which could alter calibration, the following checks shall be performed:

(1) Check the oxides of nitrogen converter efficiency, and;

(2) Perform a CVS system verification.

(3) Check the shaft torque feedback signal at steady-state conditions by comparing:

(i) Shaft torque feedback to dynamometer beam load, or

(ii) By comparing in-line torque to armature current, or

(iii) By checking the in-line torque meter with a dead weight per § 86.1308(e).

(d) The CVS positive displacement pump or critical flow venturi shall be calibrated following initial installation, major maintenance or as necessary when indicated by the CVS system verification (described in § 86.1319).

(e) Sample conditioning columns, if used in the CO analyzer train, should be checked at a frequency consistent with observed column life or when the indicator of the column packing begins to show deterioration.

109. A new § 86.1319–90 is added to Subpart N, to read as follows:

§ 86.1319–90 CVS calibration.

(a) The CVS is calibrated using an accurate flowmeter and restrictor valve. The flowmeter calibration shall be traceable to the NBS, and will serve as the reference value (NBS "true" value) for the CVS calibration. (*Note:* In no case should an upstream screen or other restriction which can affect the flow be used ahead of the flowmeter unless calibrated throughout the flow range with such a device.) The CVS calibration procedures are designed for use of a "metering venturi" type flowmeter. Large radius or ASME flow nozzles are considered equivalent if traceable to NBS measurements. Other measurement systems may be used if shown to be equivalent under the test conditions in this section and traceable to NBS measurements. Measurements of the various flowmeter parameters are recorded and related to flow through the CVS. Procedures used by EPA for both PDP–CVS and CFV–CVS are outlined below. Other procedures yielding equivalent results may be used if approved in advance by the Administrator.

(b) After the calibration curve has been obtained, verification of the entire system may be performed by injecting a known mass of gas into the system and comparing the mass indicated by the system to the true mass injected. An indicated error does not necessarily mean that the calibration is wrong, since other factors can influence the accuracy of the system (*e.g.*, analyzer calibration, leaks, or HC hangup). A verification procedure is found in paragraph (e) of this section.

(c) *PDP calibration.* (1) The following calibration procedure outlines the equipment, the test configuration, and the various parameters which must be measured to establish the flow rate of the CVS pump.

(i) All the parameters related to the pump are simultaneously measured with the parameters related to a flowmeter which is connected in series with the pump.

(ii) The calculated flow rate, ft^3/min, (at pump inlet absolute pressure and temperature) can then be plotted versus a correlation function which is the value of a specific combination of pump parameters.

(iii) The linear equation which relates the pump flow and the correlation function is then determined.

(iv) In the event that a CVS has a multiple speed drive, a calibration for each range used must be performed.

(2) This calibration procedure is based on the measurement of the absolute values of the pump and flowmeter parameters that relate the flow rate at each point. Two conditions must be maintained to assure the accuracy and integrity of the calibration curve:

(i) The temperature stability must be maintained during calibration. (Flowmeters are sensitive to inlet temperature oscillations; this can cause the data points to be scattered. Gradual changes in temperature are acceptable as long as they occur over a period of several minutes.)

(ii) All connections and ducting between the flowmeter and the CVS pump must be absolutely void of leakage.

(3) During an exhaust emission test the measurement of these same pump parameters enables the user to calculate the flow rate from the calibration equation.

(4) Connect a system as shown in Figure N84–6. Although particular types of equipment are shown, other configurations that yield equivalent results may be used if approved in advance by the Administrator. For the system indicated, the following measurements and accuracies are required:

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Sensor-readout tolerances
Barometric pressure (corrected)	P_B	in. Hg (kPa)	±0.10 in. Hg (±0.340 kPa).
Ambient temperature	T_A	°F (°C)	±0.5 °F (±0.28 °C).
Air temperature into metering venturi	ETI	°F (°C)	±2.0 °F (±1.1 °C).
Pressure drop between the inlet and throat of metering venturi	EDP	in. H_2O (kPa)	±0.05 in H_2O (±0.012 kPa).
Air flow	Q_s	ft^3/min (m^3/min).	±0.5% of NBS "true" value.
Air temperature at CVS pump inlet	PTI	°F (°C)	±2.0 °F (±1.1 °C).
Pressure depression at CVS pump inlet	PPI	in. Fluid (kPa)	±0.13 in. Fluid (±0.055 kPa).
Specific gravity of manometer fluid (1.75 oil)	Sp.Gr.		
Pressure head at CVS pump outlet	PPO	in. Fluid (kPa)	±0.13 in. Fluid (±0.055 kPa).
Air temperature at CVS pump outlet (optional)	PTO	°F (°C)	±2.0 °F (±1.1 °C).

CALIBRATION DATA MEASUREMENTS—Continued

Parameter	Symbol	Units	Sensor-readout tolerances
Pump revolutions during test period	N	Revs	± 1 Rev.
Elapsed time for test period	t	sec.	±0.5 sec.

(5) After the system has been connected as shown in Figure N84–6, set the variable restrictor in the wide open position and run the CVS pump for 20 minutes. Record the calibration data.

(6) Reset the restrictor valve to a more restricted condition in an increment of pump inlet depression that will yield a minimum of six data points for the total calibration. Allow the system to stabilize for 3 minutes and repeat the data acquisition.

(7) *Data analysis:*

(i) The air flow rate, Q_s, at each test point is calculated in standard cubic feet per minute (68°, 29.92 in. Hg.) from the flowmeter data using the manufacturer's prescribed method.

(ii) The air flow rate is then converted to pump flow, V_o, in cubic feet per revolution at absolute pump inlet temperature and pressure:

$V_o = (Q_s/n) \times \{T_p/528\} \times (29.92/P_p)$

Where:

(A) V_o = Pump flow, ft^3/rev (m^3/rev) at T_p, P_p.

(B) Q_s = Meter air flow rate in standard cubic feet per minute, standard conditions are 68 °F, 29.92 in. Hg (20 °C, 101.3 kPa).

(C) n = Pump speed in revolutions per minute.

(D) T_p = Pump inlet temperature °R(°K) = PTI + 460 (°R), or = PTI + 273 (°K).

(E) P_p = Absolute pump inlet pressure, in. Hg. (kPa)

= P_B − PPI(Sp.Gr./13.5955) and

= PB − PPI for SI units.

Where:

(F) P_B = barometric pressure, in. Hg. (kPa).

(G) PPI = Pump inlet depression, in. fluid (kPa).

(H) Sp.Gr. = Specific gravity of manometer fluid.

(iii) The correlation function at each test point is then calculated from the calibration data:

$$X_o = \frac{1}{n}\sqrt{\frac{\Delta P}{P_e}}$$

Where:

(A) X_o = correlation function.

(B) D_p = The pressure differential from pump inlet to pump outlet, in. Hg. (kPa).

= P_{e-Pp}.

(C) P_e = Absolute pump outlet pressure, in. Hg. (kPa)

= P_B + PPO (Sp.Gr./13.5955) and

= P_B + PPO *for SI units.*

Where:

(D) PPO = Pressure head at pump outlet, in. fluid (kPa).

(iv) A linear least squares fit is performed to generate the calibration equation which has the form:

$V_o = D_o - M(X_o)$

D_o and M are the intercept and slope constants, respectively, describing the regression line.

(8) A CVS system that has multiple speeds should be calibrated on each speed used. The calibration curves generated for the ranges will be approximately parallel and the intercept values, D_o, will increase as the pump flow range decreases.

(9) If the calibration has been performed carefully, the calculated values from the equation will be within ±0.50 percent of the measured value of V_o. Values of M will vary from one pump to another, but values of D_o for pumps of the same make, model and range should agree within ±3 percent of each other. Particulate influx over time will cause the pump slip to decrease, as reflected by lower values for M. Calibrations should be performed at pump start-up and after major maintenance to assure the stability of the pump slip rate. Analysis of mass injection data will also reflect pump slip stability.

(d) *CFV calibration.* (1) Calibration of the CFV is based upon the flow equation for a critical venturi. Gas flow is a function of inlet pressure and temperature:

$$Q_s = \frac{K_v P}{\sqrt{T}}$$

Where:

(i) Q_s = flow.

(ii) K_v = calibration coefficient

(iii) P = absolute pressure.

(iv) T = absolute temperature.

The calibration procedure described in paragraph (d)(3) of this section establishes the value of the calibration coefficient at measured values of pressure, temperature and air flow.

(2) The manufacturer's recommended procedure shall be followed for calibrating electronic portions of the CFV.

(3) Measurements necessary for flow calibration are as follows:

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Tolerances
Barometric pressure (corrected)	P_B	in. Hg (kPa).	±0.10 in. Hg. (±0.340 kPa).
Air temperature, into flowmeter	ETI	°F (°C)	±0.5°F (±0.28 °C).

CALIBRATION DATA MEASUREMENTS—Continued

Parameter	Symbol	Units	Tolerances
Pressure drop between the inlet and throat of metering venturi	EDP	in. H_2O (kPa).	±0.05 in. H_2O (±0.012 kPa).
Air flow	Q_s	ft^3/min (m^3/min).	±0.5% of NBS "true" value.
CFV inlet depression	PPI	in. fluid (kPa).	±0.13 in. fluid (±0.055 kPa).
Temperature at venturi inlet	T_v	°F (°C)	±4.0°F (±2.22 °C).
Specific gravity of manometer fluid (1.75 oil)	Sp. Gr		

(4) Set up equipment as shown in Figure N84–7 and eliminate leaks. (Leaks between the flow measuring devices and the critical flow venturi will seriously affect the accuracy of the calibration.)

(5) Set the variable flow restrictor to the open position, start the blower, and allow the system to stabilize. Record data from all instruments.

(6) Vary the flow restrictor and make at least eight readings across the critical flow range of the venturi.

(7) *Data analysis.* The data recorded during the calibration are to be used in the following calculations:

(i) The air flow rate, Q_s, at each test point is calculated in standard cubic feet per minute from the flow meter data using the manufacturer's prescribed method.

(ii) Calculate values of the calibration coefficient for each test point:

$$K_v = \frac{Q_s\sqrt{T_v}}{P_v}$$

Where:

(A) Q_s = Flow rate in standard cubic feet per minute, at the standard conditions of 68 °F, 29.92 in Hg (20 °C, 101.3 kPa).

(B) T_v = Temperature at venturi inlet, °R(°K).

(C) P_v = Pressure at venturi inlet, in. Hg. (kPA)

$= P_B - PPI$ (Sp.GR./13.5955), and

$= P_B - PPI$ *for SI units.*

Where:

(D) PPI = Venturi inlet pressure depression, in. fluid (kPa).

(E) Sp.Gr. = Specific gravity of manometer fluid.

(iii) Plot K_v as a function of venturi inlet pressure. For choked flow, K_v will have a relatively constant value. As pressure decreases (vacuum increases), the venturi becomes unchoked and K_v decreases. (See Figure N84–8.)

(iv) For a minimum of 8 points in the critical region calculate an average K_v and the standard deviation.

(v) If the standard deviation exceeds 0.3 percent of the average K_v, take corrective action.

(e) *CVS system verification.* The following "gravimetric" technique can be used to verify that the CVS and analytical instruments can accurately measure a mass of gas that has been injected into the system. (Verification can also be accomplished by constant flow metering using critical flow orifice devices.)

(1) Obtain a small cylinder that has been charged with pure propane or carbon monoxide gas (CAUTION—carbon monoxide is poisonous). Obtain another small cylinder which has been charged with pure methanol if the system will be used for methanol-fueled vehicle testing. Since this cylinder will be heated to 150–155 °F, care must be taken to ensure that the liquid volume of methanol placed in the cylinder does not exceed approximately one-half of the total volume of the cylinder.

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

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

(4) Following the completion of step (3) above, continue to operate the CVS in the normal manner and release a quantity of pure methanol into the system during the sampling period (approximately 5 minutes).

(5) The calculations of § 86.1342 are performed in the normal way except in the case of propane. The density of propane (17.30 g/ft^3/carbon atom (0.6109 kg/m^3/carbon atom)) is used in place of the density of exhaust hydrocarbons. In the case of methanol, the density of 37.71 g/ft^3 (1.332 kg/m^3) is used.

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

(7) Good engineering practice requires that the cause for any discrepancy greater than ±2 percent must be found and corrected.

110. A new § 86.1320–90 is added to Subpart N, to read as follows:

§ 86.1320–90 Gas meter or flow instrumentation calibration; particulate, methanol, and formaldehyde measurement.

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

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

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

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

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

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

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

(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 ±1.0 percent of the maximum operating range of ±2.0 percent of the point (whichever is smaller).

(7) For double dilution systems, the accuracy of the secondary dilution flow measurement device should be within ±1.0 percent of the total flow through the filter.

(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.

111. A new § 86.1321–90 is added to Subpart N, to read as follows:

§ 86.1321–90 Hydrocarbon analyzer calibration.

The FID hydrocarbon analyzer shall receive the following initial and periodic calibration. The HFID used with petroleum-fueled diesel engines shall be operated to a set point ±10 °F (±5.5 °C) between 365 and 385 °F (185 and 197 °C). The HFID used with methanol-fueled engines shall be operated at 235±15 °F (113±8 °C).

(a) *Initial and periodic optimization of detector response.* Prior to introduction into service and at least annually thereafter, the FID hydrocarbon analyzer shall be adjusted for optimum hydrocarbon response. Alternate methods yielding equivalent results may be used, if approved in advance by the Administrator.

(1) Follow good engineering practices for initial instrument start-up and basic operating adjustment using the appropriate fuel (see § 86.1314) and zero-grade air.

(2) Optimize on the most common operating range. Introduce into the analyzer a propane-in-air mixture with a propane concentration equal to approximately 90 percent of the most common operating range.

(3) One of the following procedures is required for FID or HFID optimization:

(i) The procedures outlined in Society of Automotive Engineers (SAE) paper No. 770141, "Optimization of Flame Ionization Detector for Determination of Hydrocarbons in Diluted Automobile Exhaust"; author, Glenn D. Reschke.

(ii) The HFID optimization procedures outlined in 40 CFR Part 86, Subpart D.

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

(4) After the optimum flow rates have been determined, they are recorded for future reference.

(b) *Initial and periodic calibration.* Prior to introduction into service and monthly thereafter, the FID or HFID hydrocarbon analyzer shall be calibrated on all normally used instrument ranges. Use the same flow rate and pressures as when analyzing samples. Calibration gases shall be introduced directly at the analyzer, unless the "overflow" calibration option of § 86.1310(b)(3)(i) for the HFID is taken.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero-grade air.

(3) Calibrate on each used operating range with propane-in-air calibration gases having nominal concentrations of 15, 30, 45, 60, 75 and 90 percent of that range. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at any point, the best-fit non-linear equation which represents the data to within 2 percent of each test point shall be used to determine concentration.

(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.

(1) The bag sample of methanol for analysis in the FID shall be prepared using the apparatus shown in Figure N90–10. 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 dry gas meter

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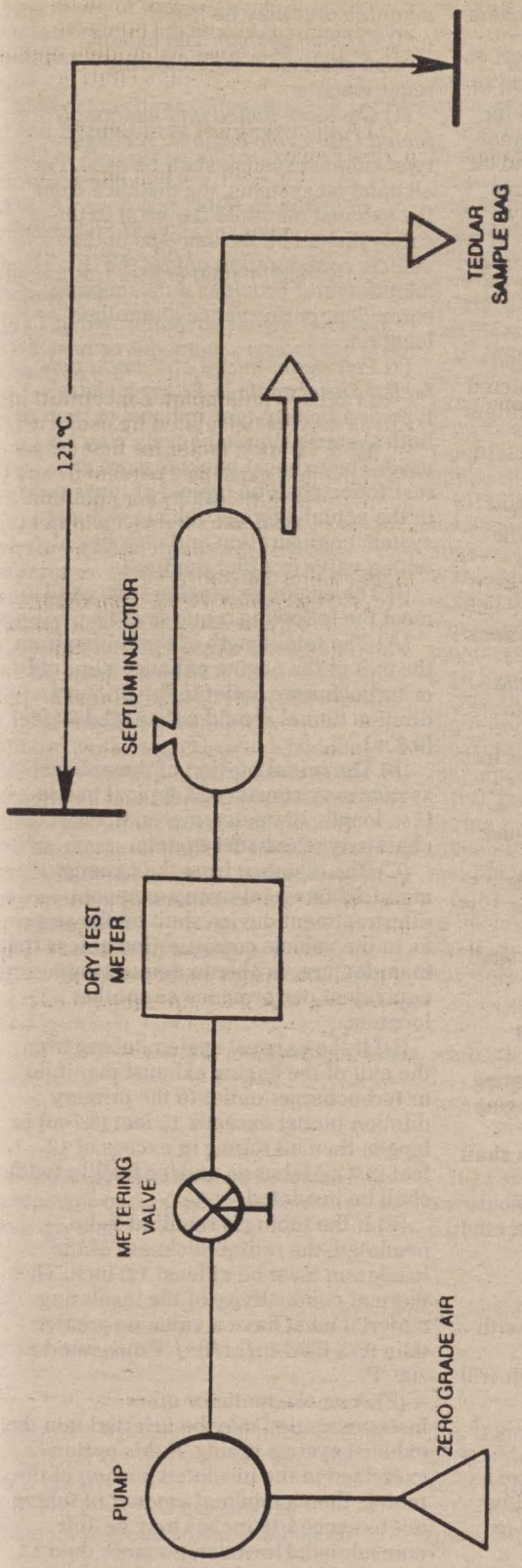


FIGURE N90-10 APPARATUS FOR PREPARATION OF FID METHANOL RESPONSE CALIBRATION MIX

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(2) The bag sample is analyzed using the FID.

(3) The FID response factor, r, is calculated as follows:

r=FIDppm/SAMppm

Where:

(i) r=FID response factor.
(ii) FIDppm=FID reading in ppmC.
(iii) SAMppm=methanol concentration in the sample bag in ppmC

$$=\frac{0.02406\times\text{fuel injected}\times\text{fuel density}}{\text{Air volume}\times\text{mol. wt. }CH_3OH}$$

Where:

(iv) 0.02406=volume of one mole at 29.92 in Hg and 68 °F, m^3.
(v) Fuel injected=volume of methanol injected, ml.
(vi) Fuel density=density of methanol, 0.7914 g/ml.
(vii) Air volume=volume of zero-grade air, m^3.
(viii) Mol. Wt. CH_3OH=32.04.

112. A new § 86.1326–90 is added to Subpart N, to read as follows:

§ 86.1326–90 Calibration of other equipment.

Other test equipment used for testing shall be calibrated as often as required by the manufacturer or as necessary according to good practice. Specific equipment requiring calibration is the gas chromatograph and flame ionization detector used in measuring methanol and the high pressure liquid chromatograph (HPLC) and ultraviolet detector for measuring formaldehyde.

113. A new § 86.1327–90 is added to Subpart N, 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, carbon monoxide, oxides of nitrogen, particulate (petroleum-fueled and methanol-fueled diesel engines), and methanol and formaldehyde (for methanol-fueled diesel engines). 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 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), carbon monoxide (CO), carbon dioxide (CO_2), and oxides of nitrogen (NOx), or in sample collection impingers for methanol (CH_3OH) and sample collection impingers (or capsules) for formaldehyde (HCHO). Measurement of CH_3OH 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, methanol and formaldehyde. In addition, for petroleum-fueled and methanol-fueled diesel engines, particulates are collected on fluorocarbon-coated glass fiber filters or fluorocarbon-based (membrane) filters, and the dilution air may be prefiltered.

(b) Engine torque and rpm shall be recorded continuously during both the cold and hot start tests. Data points shall be recorded at least once every second.

(c) Using the torque and rpm feedback signals the brake horsepower is integrated with respect to time for the cold and hot cycles. This produces a brake horsepower-hour value that enables the brake-specific emissions to be determined (*see* § 86.1342, Calculations; gaseous exhaust emissions., and § 86.1343, Calculations; particulate exhaust emissions.).

(d)(1) When an engine is tested for exhaust emissions or is operated for service accumulation on an engine dynamometer, the complete engine shall be tested, with all emission control devices installed and functioning.

(2) Evaporative emission controls need not be connected if data are provided to show that normal operating conditions are maintained in the engine induction system.

(3) On air-cooled engines, the fan shall be installed.

(4) Additional accessories (*e.g.*, oil cooler, alternators, air compressors, etc.) may be installed or their loading simulated if typical of the in-use application.

(5) The engine may be equipped with a production type starter.

(e) Means of engine cooling which will maintain the engine operating temperatures (*e.g.*, temperatures of intake air, oil, water, etc.) at approximately the same temperature as specified by the manufacturer shall be used. Auxiliary fan(s) may be used to maintain engine cooling during operation on the dynamometer. Rust inhibitors and lubrication additives may be used, up to the levels recommended by the additive manufacturer. Antifreeze mixtures and other coolants typical of those approved for use by the manufacturer may be used.

(f) *Exhaust system.* The exhaust system shall meet the following requirements:

(1) *Gasoline-fueled and methanol-fueled Otto-cycle engines.* A chassis-type exhaust system shall be used. For all catalyst systems, the distance from the exhaust manifold flange(s) to the catalyst shall be the same as in the vehicle configuration unless the manufacturer provides data showing equivalent performance at another location.

(2) *Petroleum-fueled and methanol-fueled diesel engines.* Either a chassis-type or a facility-type exhaust system or both systems simultaneously may be used. The exhaust backpressure or restriction shall be typical of those seen in the actual average vehicle exhaust system configuration and may be set with a valve (muffler omitted).

(i) The engine exhaust system shall meet the following requirements:

(A) The total length of the tubing from the exit of the engine exhaust manifold or turbocharger outlet to the primary dilution tunnel should not exceed 32 feet (9.8 m).

(B) The initial portion of the exhaust system may consist of a typical in-use (*i.e.*, length, diameter, material, *etc.*) chassis-type exhaust system.

(C) The distance from the exhaust manifold flange(s) to any exhaust aftertreatment device shall be the same as in the vehicle configuration unless the manufacturer is able to demonstrate equivalent performance at another location.

(D) If the exhaust system tubing from the exit of the engine exhaust manifold or turbocharger outlet to the primary dilution tunnel exceeds 12 feet (3.7 m) in length, then all tubing in excess of 12 feet (3.7 m) (chassis and/or facility type) shall be insulated.

(E) If the tubing is required to be insulated, the radial thickness of the insulation must be at least 1.0 inch. The thermal conductivity of the insulating material must have a value no greater than 0.75 BTU-in/hr/ft^2/°F measured at 700 °F.

(F) A smoke meter or other instrumentation may be inserted into the exhaust system tubing. If this option is exercised in the insulated portion of the tubing, then a minimal amount of tubing not to exceed 18 inches may be left uninsulated. However, no more than 12 feet of tubing can be left uninsulated in total, including the length at the smoke meter.

(ii) The facility-type exhaust system shall meet the following requirements:

(A) It must be composed of smooth tubing made of typical in-use steel or stainless steel. This tubing shall have a maximum inside diameter of 6.0 in (15 cm).

(B) Short sections (altogether not to exceed 20 percent of the entire tube length) of flexible tubing at connection points are allowed.

114. A new § 86.1330–90 is added to Subpart N, to read as follows:

§ 86.1330–90 Test sequence; general requirements.

(a) The test sequence shown in Figure N84–10 shows the major steps of the test procedure.

(b) *Control of air temperature.* (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.

(2) For engines with auxiliary emission control devices which are temperature dependent (*e.g.*, chokes, air cleaner hot air doors) the test cell ambient air temperature and the temperature of the engine intake air shall be maintained at 77 °±9 °F (25 °C±5 °C) throughout the test sequence.

(3) For engines which are not equipped with temperature dependent auxiliary emission control devices, the test cell ambient air temperature and the temperature of the engine intake air shall be greater than 68 °F (20 °C). No corrections will be made in test results or measured engine power if 86 °F (30 °C) is exceeded.

(4) The only exceptions to these temperatures are as noted in § 86.1335.

(c) No control of ambient air, engine intake air or CVS dilution air humidity is required.

(d) The idle test of Subpart P may be run after completion of the hot start exhaust emission test, if applicable.

(e) The barometric pressure observed during the generation of the maximum torque curve shall not deviate more than 1 in. Hg. from the value measured at the beginning of the map. The average barometric pressure observed during the exhaust emission test must be within 1 in. Hg. of the average observed during the maximum torque curve generation.

(f) *Petroleum-fueled and methanol-fueled diesel engines.* (1)(i) Air inlet and exhaust restrictions shall be set to represent the average restrictions which would be seen in use in a representative application.

(ii) Inlet depression and exhaust backpressure shall be set with the engine operating at rated speed and wide open throttle, except for the case of inlet depression for naturally aspirated engines, which shall be set at maximum engine speed and nominal zero load (high idle).

(iii) The location at which the inlet depression and exhaust backpressure is measured shall be specified by the manufacturer.

(iv) The settings shall take place during the final mode of the preconditioning prior to determining the maximum torque curve.

(2)(i) The temperature of the inlet fuel to the engine shall not exceed 110 °F (or 130 °F during the first 10 seconds of the hot start test).

(ii) The pressure of the inlet fuel and the point at which it is measured shall be specified by the manufacturer.

(g) Pre-test engine measurements (*e.g.*, governed petroleum-fueled or methanol-fueled diesel engine high idle speed, petroleum-fueled or methanol-fueled diesel engine fuel flows, *etc.*), pre-test engine performance checks (*e.g.*, verification of actual rated rpm, *etc.*) and pre-test system calibrations (*e.g.*, inlet and exhaust restrictions, *etc.*) shall be made prior to generation of the maximum torque curve. This can be done during engine preconditioning, or at the manufacturer s convenience subject to the requirements of good engineering practice.

115. A new § 86.1332–90 is added to Subpart N, to read as follows:

§ 86.1332–90 Engine mapping procedures.

(a) Mount test engine on the engine dynamometer.

(b) Determine minimum mapping speed. The minimum speed is defined as the warm engine curb idle rpm.

(c) Determine maximum mapping speed per the following methodologies. (Note paragraph (d)(1) below.)

(1) *Gasoline-fueled and methanol-fueled Otto-cycle engines.* (i) For ungoverned engines using the transient operating cycle set forth in paragraph (f)(1) of Appendix I to this part, the maximum mapping speed shall be no less than that calculated from the following equation:

$$\text{Maximum speed} = \text{curb idle rpm} + \frac{105\ (\text{measured rated rpm} - \text{curb idle rpm})}{100}$$

or when a 3.0 percent drop in maximum horsepower occurs, whichever of the two is greater

(ii) For ungoverned engines using the transient operating cycle set forth in paragraph (f)(3) of Appendix I to this part, the maximum mapping shall be no less than that calculated from the following equation:

$$\text{Maximum speed} = \text{curb idle rpm} + \frac{115\ (\text{measured rated rpm} - \text{curb idle rpm})}{100}$$

or when a 3.0 percent drop in maximum horsepower occurs, whichever of the two is greater

(iii) For governed engines the maximum mapped speed shall be no less than either that speed at which the wide-open throttle torque drops off to zero, or the maximum speed as calculated for ungoverned engines (paragraph (c)(1)(i) of this section)

(2) *Petroleum-fueled and methanol-fueled diesel engines.* (i) For ungoverned engines, the maximum mapping speed shall be no less than that calculated from the following equation:

$$\text{Maximum speed} = \text{curb idle rpm} + \frac{113\ (\text{measured rated rpm} - \text{curb idle rpm})}{100}$$

or when a 3.0 drop in horsepower occurs, whichever of the two is greater

(ii) For governed engines, the maximum mapping speed shall be no less than either that speed at which wide-open throttle torque drops off to zero, or the maximum speed as calculated for ungoverned engines (paragraph (c)(2)(i) of this section).

(d) Perform an engine power map.

(1) During engine preparation or warm-up, the engine may be operated such that a preliminary estimate of measured rated rpm can be made.

(2) *Gasoline-fueled and methanol-fueled Otto-cycle engines.* (i) For a cold engine, start the engine and operate at zero load in accordance with the manufacturer's start-up and warm-up procedures for 1 minute ±30 seconds.

(ii) Operate the engine at a torque equivalent to 10±3 percent of the most recent determination of maximum torque for 4 minutes ±30 seconds at 2000 rpm.

(iii) Operate the engine at a torque equivalent to 55±5 percent of the most recent determination of maximum torque for 35 minutes ±1 minute at 2000 rpm.

(iv) Operate the engine at idle (minimum speed).

(v) Open the throttle fully.

(vi) While maintaining wide-open throttle and full-load, maintain minimum engine speed for at least 15 seconds. Record the average torque during the last 5 seconds.

(vii) In no greater than 100±20 rpm increments, determine the maximum torque curve from minimum speed to maximum speed. Hold each test point for 15 seconds, and record the average torque over the last 5 seconds.

(viii) *Alternate mapping technique.* In place of paragraphs (d)(2) (vi) and (vii) of this section, a continual sweep of rpm is allowed. While operating at wide-open throttle, the engine speed is increased at an average rate of 8 rpm/sec (±1 rpm/sec) from minimum speed to maximum speed. Speed and torque points shall be recorded at a sample rate of at least one point per second.

(ix) Recalculate the maximum speed per paragraph (c)(1) (i) or (ii) of this section using the measured rated speed derived from the new maximum torque curve. If the new maximum speed lies outside the range of speeds encompassed by the actual map, then the map shall be considered void, and another map will need to be run using the newly derived measured rated speed in all calculations.

(x) For warm engines, the entire warm-up procedure specified in paragraphs (d)(2) (i) through (iii) of this section need not be repeated. It is sufficient for an engine already at normal operating temperatures to be operated at the conditions specified in paragraph (d)(2)(iii) of this section until oil and water temperatures are stabilized, after which the procedures of paragraph (d)(2) (iv) through (vii) of this section may be performed. The oil and water temperatures are defined as stabilized if they are maintained within 2 percent of point for 2 minutes.

(3) *Petroleum-fueled and methanol-fueled diesel engines.* (i) If the engine is cold, start and operate at free idle for 2 to 3 minutes.

(ii) Operate the engine at approximately 50 percent power at the peak torque speed for 5 to 7 minutes.

(iii) Operate the engine at rated speed and wide-open throttle for 25 to 30 minutes.

(iv) *Option.* The engine may be pre-conditioned by operating at rated speed and maximum horsepower until the oil and water temperatures are stabilized. The temperatures are defined as stabilized if they are maintained within 2 percent of point for 2 minutes. This optional procedure may be substituted for paragraph (d)(3)(iii) of this section.

(v) Unload the engine and operate at the curb idle speed.

(vi) Operate the engine at wide open throttle and minimum engine speed Increase the engine speed at an average rate of 8 rpm/sec (±1 rpm/sec) from minimum to maximum speed. Engine speed and torque points shall be recorded at a sample rate of at least one point per second.

(vii) Recalculate the maximum speed per paragraph (c)(2) (i) or (ii) of this section using the measured rated speed derived from the new maximum torque curve. If the new maximum speed lies outside the range of speeds encompassed by the actual map, then the map shall be considered void. The entire mapping procedure shall be repeated, using the newly derived measured rated speed in all calculations.

(viii) For warm engines, the entire warm-up procedure specified in paragraphs (d)(3) (i) through (iv) of this section need not be repeated. It is sufficient for an engine already at normal operating temperatures to be operated per the requirements of paragraph (d)(3)(iv) of this section, after which the procedures of paragraph (d)(3) (v) through (vi) of this section may be performed.

(e) Mapping curve generation.

(1) *Gasoline-fueled and methanol-fueled Otto-cycle engines.* (i) Fit all data points recorded under paragraphs (d)(2) (vi) and (vii) of this section (100 rpm increments) with a cubic spline, Akima, or other technique approved in advance by the Administrator. The resultant curve shall be accurate to within ±1.0 ft-lbs of all recorded engine torques.

(ii) All points generated under the continuous rpm sweep by paragraphs (d)(2) (vi) and (viii) of this section shall be connected by linear interpolation between points.

(iii) For governed engines, all points above the maximum speed (see paragraph (c)(1)(ii) of this section) shall be assigned maximum torque values of zero for purposes of cycle generation.

(iv) For all engines, all speed points below the minimum speed shall be assigned a maximum torque value equal to that observed at minimum speed for purposes of cycle generation.

(v) The torque curve resulting from paragraphs (e)(1) (i) through (iv) of this section is the mapping curve and will be used to convert the normalized torque values in the engine cycle (*see* paragraph (f)(1) of Appendix I to this part) to actual torque values for the test cycle

(2) *Petroleum-fueled and methanol-fueled diesel engines.* (i) Connect all data points recorded under paragraph (d)(3)(vi) of this section using linear interpolation between points.

(ii) For governed engines, all points above the maximum speed (*see* paragraph (c)(2)(ii) of this section) shall be assigned maximum torque values of zero for purposes of cycle generation.

(iii) For all engines, all speed points below the minimum speed shall be assigned a maximum torque value equal to that observed at the minimum speed for purposes of cycle generation.

(iv) The torque curve resulting from paragraphs (e)(2) (i) through (iii) of this section is the mapping curve and will be used to convert the normalized torque values in the engine cycle (*see* paragraph (f)(2) of Appendix I to this part) into actual torque values for the test cycle.

(f) *Alternate mapping.* If a manufacturer believes that the above mapping techniques are unsafe or unrepresentative for any given engine or engine family, alternate mapping techniques may be used. These alternate techniques must satisfy the intent of the specified mapping procedures to determine the maximum available torque at all engine speeds achieved during the test cycles. Deviations from the mapping techniques specified in this section for reasons of safety or representativeness shall be reported per § 86.1344(e)(6), along with the justification for their use. In no case, however, shall descending continual sweeps of rpm be used for governed or turbocharged engines.

(g) *Replicate Tests.* An engine need not be mapped before each and every cold cycle test. An engine shall be remapped prior to a cold cycle test if:

(1) An unreasonable amount of time has transpired since the last map, as determined by engineering judgment, or

(2) The barometric pressure prior to the start of the cold cycle test has changed more than 1 in hg. from the average barometric pressure observed durinq the map, or

(3) Physical changes or recalibrations have been made to the engine which may potentially affect engine performance.

116. A new § 86.1333–90 is added to Subpart N, to read as follows:

§ 86.1333–90 Transient test cycle generation.

(a) The heavy-duty transient engine cycles for Otto-cycle and diesel engines are listed in Appendix I ((f) (1), (2) and (3)) to this part. These second-by-second listings represent torque and rpm maneuvers characteristic of heavy-duty engines. Both rpm and torque are normalized (expressed as a percentage of maximum) in these listings.

(1) To unnormalize rpm, use the following equation:

$$\text{Actual rpm} = \frac{\%\ \text{rpm}\ (\text{Measured rated rpm} - \text{Curb idle rpm})}{100} + \text{Curb idle rpm}$$

The method of calculating measured rated rpm is detailed in paragraph (g) of this section.

(2) Torque is normalized to the maximum torque at the rpm listed with it. Therefore, to unnormalize the torque values in the cycle, the maximum torque curve for the engine in question must be used. The generation of the maximum torque curve is described in § 86.1332.

(3) The EPA Engine Dynamometer Schedule for Heavy Duty Diesel Engines listed in Appendix I (f)(2) contains torque points referred to as "closed rack motoring." For reference cycle calculation torque points shall take on unnormalized values determined in either of the following three ways:

(i) Negative 40 percent of the positive torque available at the associated speed point. The generation of this positive maximum torque curve is described in § 86.1332.

(ii) Map the amount of negative torque required to motor the engine between idle and maximum mapping speed and use this map to determine the amount of negative torque required at the associated speed point.

(iii) Determine the amount of negative torque required to motor the engine at idle and rated speeds and linearly interpolate using these two points.

(b) *Example of the unnormalization procedure.* The following test point shall be unnormalized:

Percent RPM	Percent Torque
43	82

Given the following values:

Measured Rated rpm = 3800.

Curb Idle rpm = 600.

(1) *Calculate actual rpm:*

$$\text{Actual rpm} = \frac{\%\ \text{rpm}\ (\text{measured rated rpm} - \text{curb idle rpm})}{100} + \text{curb idle rpm}$$

$$= \frac{43\ (3800 - 600)}{100} + 600$$

$$= \frac{43\ (3800 - 600)}{1976} + 600$$

(2) *Determine actual torque:* Determine the maximum observed torque at 1976 rpm from the maximum torque curve. Then multiply this value (*e.g.*, 358 ft-lbs) by 0.82. This results in an actual torque of 294 ft-lbs.

(c) Engine speed and torque shall be recorded at least once every second during the cold start test and hot start test. The torque and rpm feedback signals may be electronically filtered.

(d) *Cold start enhancement devices.* The zero percent speed specified in the engine dynamometer schedules (Appendix I, (f)(1), (f)(2) or (f)(3) to this part) shall be superseded by proper operation of the engine's automatic cold start enhancement device.

(1) During automatic cold start enhancement device operation a manual transmission engine shall be allowed to idle at whatever speed is reguired to produce a feedback torque of 0 ft-lbs ± 10 ft-lbs (using, for example, clutch disengagement, speed to torque control switching, software overrides, *etc.*) at those points in Appendix I, (f)(1), (f)(2) or (f)(3) to this part where both reference speed and reference torque are zero percent values.

(2) During automatic cold start enhancement device operation an automatic transmission engine shall be allowed to idle at whatever speed is required to produce a feedback torque of CITT ft-lbs ± 10 ft-lbs (see (e)(2) of this section for definition of CITT) at those points in Appendix I (f)(1), (f)(2) or (f)(3) to this part where both reference speed and reference torque are zero percent values.

(3) For Otto-cycle engines tested without an operating clutch, modification to the cycle validation criteria for this automatic cold start enhancement device high idle allowance

is permitted only for the first 150 seconds of the cold cycle and the first 30 seconds of the hot cycle. After this, the cycles shall be run as specified in Appendix I (f)(1) or (f)(3) to this part. (*See* § 86.1341–90 for allowances in the cycle validation criteria.)

(4) For diesel engines tested without an operating clutch, modification to the cycle validation criteria for this automatic cold start enhancement device high idle allowance is permitted only for up to the first 180 seconds of the cold cycle or up to the first 30 seconds of the hot cycle. However, the sum of the seconds deleted from the cold cycle plus the sum of the seconds deleted from the hot cycle may not exceed 180 seconds. After this, the cycles shall be run as specified in Appendix I (f)(2) to this part. (See 86.1341 for allowances in the cycle validation criteria.)

(e) *Automatic transmissions.* The reference cycles in paragraphs (f) (1) and (2) of Appendix I to this part shall be altered for test engines intended primarily for use with automatic transmissions.

(1) Zero percent speed for automatic transmission engines is defined as curb idle rpm (*i.e.*, in-vehicle, coupled with automatic transmission in gear).

(2) All zero-percent speed, zero-percent torque points (idle points) shall be modified to zero percent speed, *x* percent torque, except as permitted in § 86.1337(a)(8). Using the manufacturers' specified curb idle transmission torque (CITT), the maximum torque available at the curb idle (*i.e.*, with transmission) rpm as determined from the maximum torque curve generated in § 86.1332, *x* percent torque is defined per the following equation:

$$x\% = \frac{\text{CITT} \times 100}{\text{Maximum torque at curb idle rpm}}$$

The manufacturer's specified CITT shall be based upon those observed in typical applications.

(f) *Clutch operation.* Manual transmission engines may be tested with a clutch. If used, the clutch shall be disengaged at all zero percent speeds, zero percent torque points, but may be engaged up to two points preceeding a non-zero point, and may be engaged for time segments with zero percent speed and torque points of durations less than four seconds. (*See* § 86.1341 for allowances in the cycle validation criteria.)

(g) *Measured rated rpm.* The measured rated rpm corresponds to the 100 percent rpm values specified in the reference cycles (paragraphs (f) (1) and (2) of Appendix I to this part). It is generally intended to represent the rpm at which maximum brake horsepower occurs. For the purposes of this test sequence, it shall either be defined as the manufacturer's specified rated speed, or calculated in the following way, whichever yields the higher speed:

(1) From the maximum torque curve generated per § 86.1332, find the maximum observed brake horsepower of the engine.

(2) Calculate 98 percent of the observed maximum brake horsepower, and determine from the maximum torque curve the highest and lowest engine rpms at which this brake horsepower is observed.

(3) The highest and lowest of the 98 percent power rpms represent the endpoints of an rpm range. The midpoint of this range shall be considered the measured rated rpm for cycle generation purposes.

117. A new § 86.1335–90 is added to Subpart N, to read as follows:

§ 86.1335–90 Optional forced cool-down procedure.

(a) This forced cool-down procedure applies to Otto-cycle and diesel engines.

(b) No substances or fluids may be applied to the engine's internal or external surfaces except for water and air as prescribed in paragraphs (c) and (d) of this section.

(c) For water-cooled engines two types of cooling are permitted:

(1) Water may be circulated through the engine's water coolant system.

(i) The cooling water may be flowed in either direction and at any desired flow rate. The thermostat may be removed or blocked open during the cool-down but must be restored before the exhaust emissions test begins.

(ii) The temperature of the circulated or injected water shall be at least 10 °C (50 °F). In addition, the temperature of the cooling water shall not exceed 30 °C (86 °F) during the last 30 minutes of the forced cool-down.

(iii) Only water, including the use of a building's standard water supply, or the coolant that is already in the engine (per § 86.1327(e)) is permitted for forced cool-down purposes.

(2) Flows of air may be directed at the exterior of the engine.

(i) The air shall be directed essentially uniformly over the exterior surface of the engine at any desired flow rate.

(ii) The temperature of the cooling air shall not exceed 86 °F (30 °C) during the last 30 minutes of the cool-down, but may be less than 68 °F (20 °C) at any time.

(d) For air-cooled engines, only cooling as prescribed in paragraph (c)(2) of this section is permitted.

(e)(1) The cold cycle exhaust emission test may begin after a forced cool-down only when the engine oil temperature is stabilized between 68 °F and 75 °F (20 °C and 24 °C) for a minimum of ten minutes.

(i) This temperature measurement is to be made by a temperature measurement device immersed in the sump oil, the sensor part of which is not in contact with any engine surface.

(ii) The forced cool-down apparatus shall be shut off during this measurement. No engine oil change is permitted during the test sequence.

(2) Direct forced cooling of engine oil through the use of oil coolers or heat exchangers is permitted, but the cold cycle emission test may begin only when the circulating water temperature has stabilized to within 5 °F (2.8 °C) of the stabilized oil temperature.

(3) Any other means for the direct forced cooling of the engine oil must be approved in advance by the Administrator.

(f)(1) The cold cycle exhaust emission test for engines equipped with catalytic converters may begin after a forced cool-down only when the catalyst bed temperature at the catalyst outlet is 77 °F±9 °F (25 °C±5 °C), in addition to the temperature restrictions in paragraph (e) of this section.

(2) Catalyst cool-down may be accomplished in whatever manner and using whatever coolant deemed appropriate by proper engineering judgment. The catalyst, engine, and exhaust piping configurations shall not be separated, altered, or moved in any way during the cool-down.

(g) At the completion of the forced cool-down all of the general requirements specified in § 86.1330, the oil temperature specification set forth in paragraph (e) of this section, and the catalyst temperature specifications in paragraph (f) of this section must be met before the cold cycle exhaust emission test may begin.

118. A new § 86.1337–90 is added to Subpart N, to read as follows:

§ 86.1337–90 Engine dynamometer test run.

(a) The following steps shall be taken for each test:

(1) Prepare the engine, dynamometer, and sampling system for the cold-start test. Change filters, etc., and leak check as necessary.

Note: For a single dilution particulate system, a propane check will not reveal a pressure side leak (that portion of the system downstream of the pump) since the volume

concentration in ppm will not change if a portion of the sample is lost. A separate leak check is needed.

A leak check of a filter assembly that has only one seal ring in contact with the filter media will not detect a leak when tested under vacuum. A pressure leak test should be performed.

(2) Connect evacuated sample collection bags to the dilute exhaust and dilution air sample collection systems.

(3) For methanol-fueled vehicles, install fresh methanol and formaldehyde impingers (or capsules) 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 formaldehyde background.

(4) Attach the CVS to the engine exhaust system any time prior to starting the CVS.

(5) Start the CVS (if not already on), the sample pumps (except for the particulate sample pump(s), if applicable), the engine cooling fan(s), and the data collection system. The heat exchanger of the constant volume sampler (if used), and the heated components of any continuous sampling system(s) (if applicable) shall be preheated to their designated operating temperatures before the test begins. (*See* § 86.1340(e) for continuous sampling procedures.)

(6) Adjust the sample flow rates to the desired flow rates and set the CVS gas flow measuring devices to zero.

Note: CFV–CVS sample flow rate is fixed by the venturi design.

(7) For petroleum-fueled and methanol-fueled diesel engines, carefully install a clean particulate sample filter into each of the filter holders and install the assembled filter holders in the sample flow line. (Filter holders may be preassembled.)

(8) Follow the manufacturer's choke and throttle instructions for cold starting. Simultaneously start the engine and begin exhaust and dilution air sampling. For petroleum-fueled diesel engines (and methanol-fueled diesels, if used) turn on the hydrocarbon and NO_x (and CO and CO_2, if continuous) analyzer system integrators (if used), and turn on the particulate sample pumps and indicate the start of the test on the data collection medium.

(9) As soon as it is determined that the engine is started, start a "free idle" timer.

(10) Begin the transient engine cycles such that the first non-idle record of the cycle occurs at 25±1 seconds. The free idle time is included in the 25±1 seconds.

(i) During diesel particulate testing without the use of flow compensation, adjust the sample pump(s) so that the flow rate through the particulate sample probe or transfer tube is maintained at a value within ±5 percent of the set flow rate.

(ii) During diesel particulate sampling with the use of flow compensation (*i.e.*, proportional control of sample flow), it must be demonstrated that the ratio of main tunnel flow to particulate sample flow does not change by more than ±5.0 percent of its set point value (except for the first 10 seconds of sampling).

Note: for double dilution operation, sample flow is the net difference between the flow rate through the sample filters and the secondary dilution air flow rate.

(iii) Record the average temperature and pressure at the gas meter(s) or flow instrumentation inlet. If the set flow rate cannot be maintained because of high particulate loading on the filter, the test shall be terminated. The test shall be rerun using a lower flow rate and/or a larger diameter filter.

(11) Begin the transient engine cycles such that the first non-idle record of the cycle occurs at 25±1 seconds. The free idle time is included in the 25±1 seconds. During particulate testing without the use of flow compensation, adjust the sample pump(s) so that the flow rate through the particulate sample probe or transfer tube is maintained at a constant value within ±5 percent of the set flow rate. Record the average temperature and pressure at the gas meter(s) or flow instrumentation inlet. If the set flow rate cannot be maintained because of high particulate loading on the filter, the test shall be terminated. The test shall be rerun using a lower flow rate and/or a larger diameter filter.

(12) On the last record of the cycle, cease sampling. Immediately turn the engine off, and start a hot-soak timer. Also turn off the particulate sample pumps, the gas flow measuring device(s) and any continuous analyzer system integrators and indicate the end of the test on the data collection medium. Sampling systems should continue to sample after the end of the test cycle until system response times have elapsed.

(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. For petroleum-fueled and methanol-fueled diesel engines, 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.

(14) Allow the engine to soak for 20±1 minutes.

(15) Prepare the engine and dynamometer for the hot start test.

(16) Connect evacuated sample collection bags to the dilute exhaust and dilution air sample collection systems.

(17) Install fresh methanol and formaldehyde impingers (or capsules) in the exhaust and dilution air sample systems for methanol and formaldehyde.

(18) Start the CVS (if not already on) or connect the exhaust system to the CVS (if disconnected). Start the sample pumps (except the particulate sample pump(s), if applicable), the engine cooling fan(s) and the data collection system. The heat exchanger of the constant volume sampler (if used) and the heated components of any continuous sampling system(s) (if applicable) shall be preheated to their designated operating temperatures before the test begins. See § 86.1340(e) for continuous sampling procedures.

(19) Adjust the sample flow rates to the desired flow rate and set the CVS gas flow measuring devices to zero.

(20) For petroleum-fueled and methanol-fueled diesel engines, carefully install a clean particulate filter in each of the filter holders and install assembled filter holders in the sample flow line. (Filter holders may be preassembled.)

(21) Follow the manufacturer's choke and throttle instruction for hot starting. Simultaneously start the engine and begin exhaust and dilution air sampling. For diesel engines, turn on the hydrocarbon and NO_x (and CO and CO_2, if continuous) analyzer system integrators (if used), indicate the start of the test on the data collection medium, and turn on the particulate sample pump(s).

(22) As soon as it is determined that the engine is started, start a "free idle" timer.

(23) Allow the engine to idle freely with no-load for 24±1 seconds. The provisions and interpretations of paragraph (a)(10) of this section apply.

(24) Begin the transient-engine cycle such that the first non-idle record of the cycle occurs at 25±1 seconds. The free idle is included in the 25±1 seconds.

(25) On the last record of the cycle, allow sampling system response times to elapse and cease sampling. Turn off

the particulate sample pump(s) (if appropriate), the gas flow measuring device(s) and any continuous analyzer system integrators and indicate the end of the test on the data collection medium.

(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. Analyze the methanol and formaldehyde samples within 24 hours. (If it is not possible to perform analysis within 24 hours, the samples should be stored in a cold (approximately 0°C) dark environment until analysis can be performed). For petroleum fueled and methanol-fueled diesel engines, carefully remove the assembled filter holder from the sample flow lines and remove each particulate sample filter from its holder and place in a clean 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.

(27) The CVS and the engine may be turned off, if desired.

(b) The procedure in paragraph (a) of this section is designed for one sample bag for the cold start portion and one for the hot start portion. It is also permissible to use more than one sample bag per test portion.

(c) If a dynamometer test run is determined to be void, corrective action may be taken. The engine may then be allowed to cool (naturally or forced) and the dynamometer test rerun per paragraph (a) or (b) of this section.

119. A new § 86.1339–90 is added to Subpart N, to read as follows:

§ 86.1339–90 Particulate filter handling and weighing.

(a) At least 1 hour, but not more than 80 hours, before the test, place each filter in a closed (to eliminate dust contamination) but unsealed (to permit humidity exchange) petri dish and place in a weighing chamber meeting the specifications of § 86.1312 for stabilization.

(b) At the end of the stabilization period, weigh each filter on a balance having a precision of 20 micrograms and a readability of 10 micrograms. This reading is the tare weight and must be recorded (see § 86.1344(e)(18)).

(c) The filter shall then be stored in a covered petri dish or a sealed filter holder, either of which shall remain in the weighing chamber until needed for testing.

(d) If the filter is not used within 1 hour of its removal from the weighing chamber, it must be re-weighed before use. This limit of 1 hour may be replaced by an 8-hour limit if either of the following three conditions are met:

(1) A stabilized filter is placed and kept in a sealed filter holder assembly with the ends plugged, or

(2) A stabilized filter is placed in a sealed filter holder assembly, which is then immediately placed in a sample line through which there is no flow, or

(3) A combination of the conditions specified in paragraphs (d) (1) and (2).

(e) After the emissions test, and after the sample and back-up filters have been returned to the weighing room after being used, they must be conditioned for at least 1 hour but not more than 80 hours and then weighed. This reading is the gross weight of the filter and must be recorded (see § 86.1344(e)(18)).

(f) The net weight of each filter is its gross weight minus its tare weight. Should the sample on the filter contact the petri dish or any other surface, the test is void and must be rerun.

(g) The particulate filter weight (P_f) is the sum of the net weight of the primary filter plus the net weight of the backup filter.

(h) The following optional weighting procedure is permitted:

(1) At the end of the stabilization period, weigh both the primary and back-up filters as a pair on a balance having a precision of 20 micrograms and a readability of 10 micrograms. This reading is the tare weight and must be recorded (see § 86.1344(e)(18)).

(2) After the emissions test, in removing the filters from the filter holder, the back-up filter is inverted on top of the primary filter. They must then be conditioned in the weighing chamber for at least one hour but not more than 80 hours. The filters are then weighed as a pair. This reading is the gross weight of the filters (P_f) and must be recorded (see § 86.1344–90(e)(18)).

(3) Paragraphs (a), (c), (d), and (f) of this section apply to this option, except that the word "filter" is replaced by "filters."

120. A new § 86.1340–90 is added to Subpart N, to read as follows:

§ 86.1340–90 Exhaust sample analysis.

(a) The analyzer response may be read by automatic data collection (ADC) equipment such as computers, data loggers, etc. If ADC equipment is used the following is required:

(1) For bag analysis, the analyzer response must be stable at greater than 99 percent of the final reading for the dilute exhaust sample bag. A single value representing the average chart deflection over a 10-second stabilized period shall be stored. For the background bag, all readings taken during the 10-second interval must be stable at the final value to within ±1 percent of full scale.

(2) For continuous analysis systems, the ADC system must read at least two analyzer readings per second. A single value representing the average integrated concentration over a cycle shall be stored.

(3) The chart deflections or average integrated concentrations required in paragraphs (a) (1) and (2) of this section may be stored on long-term computer storage devices such as computer tapes, storage discs, punch cards, or they may be printed in a listing for storage. In either case a chart recorder is not required and records from a chart recorder, if they exist, need not be stored.

(4) If the data from ADC equipment is used as permanent records, the ADC equipment and the analyzer values as interpreted by the ADC equipment are subject to the calibration specifications in §§ 86.1316 through 86.1326, as if the ADC equipment were part of the analyzer.

(b) Data records from any one or a combination of analyzers may be stored as chart recorder records.

(c) *Software zero and span.* (1) The use of "software" zero and span is permitted. The process of software zero and span refers to the technique of initially adjusting the analyzer zero and span responses to the calibration curve values, but for subsequent zero and span checks the analyzer response is simply recorded without adjusting the analyzer gain. The observed analyzer response recorded from the subsequent check is mathematically corrected back to the calibration curve values for zero and span. The same mathematical correction is then applied to the analyzer's response to a sample of exhaust gas in order to compute the true sample concentration.

(2) The maximum amount of software zero and span mathematical correction is ±10 percent of full scale chart deflection.

(3) Software zero and span may be used to switch between ranges without adjusting the gain of the analyzer.

(4) The software zero and span technique may not be used to mask analyzer drift. The observed chart deflection before and after a given time period or event shall be used for computing the drift. Software zero and span may be used after the drift has been computed to mathematically adjust

any span drift so that the "after" span check may be transformed into the "before" span check for the next segment.

(d) For bag sample analysis perform the following sequence:

(1) Warm-up and stabilize the analyzers; clean and/or replace filter elements, conditioning columns (if used), etc., as necessary.

(2) Obtain a stable zero reading.

(3) Zero and span the analyzers with zero and span gases. The span gases shall have concentrations between 75 and 100 percent of full-scale chart deflection. The flow rates and system pressures during spanning shall be approximately the same as those encountered during sampling. A sample bag may be used to identify the required analyzer range.

(4) Re-check zero response. If this zero response differs from the zero response recorded in paragraph (d)(3) of this section by more than 1 percent of full scale, then paragraphs (d) (2), (3), and (4) of this section should be repeated.

(5) If a chart recorder is used, identify and record the most recent zero and span response as the pre-analysis values.

(6) If ADC equipment is used, electronically record the most recent zero and span response as the pre-analysis values.

(7) Measure HC (except diesels), CO, CO_2, and NOx sample and background concentrations in the sample bag(s) with approximately the same flow rates and pressures used in paragraph (d)(3) of this section. (Constituents measured continuously do not require bag analysis.)

(8) A post-analysis zero and span check of each range must be performed and the values recorded. The number of events that may occur between the pre and post checks is not specified. However, the difference between pre-analysis zero and span values (recorded in paragraph (d) (5) or (6) of this section) versus those recorded for the post-analysis check may not exceed the zero drift limit or the span drift limit of 2 percent of full scale chart deflection for any range used. Otherwise the test is void.

(e) For continuous sample analysis perform the following sequence:

(1) Warm-up and stabilize the analyzers; clean and/or replace filter elements, conditioning columns (if used), etc., as necessary.

(2) Leak check portions of the sampling system that operate at negative gauge pressures when sampling, and allow heated sample lines, filters, pumps, etc., to stabilize at operating temperature.

(3) *Optional:* Perform a hang-up check for the HFID sampling system:

(i) Zero the analyzer using zero air introduced at the analyzer port.

(ii) Flow zero air through the overflow sampling system. Check the analyzer response.

(iii) If the overflow zero response exceeds the analyzer zero response by 2 percent or more of the HFID full-scale deflection, hang-up is indicated and corrective action must be taken.

(iv) The complete system hang-up check specified in paragraph (f) of this section is recommended as a periodic check.

(4) Obtain a stable zero reading.

(5) Zero and span each range to be used on each analyzer used prior to the beginning of the cold cycle. The span gases shall have a concentration between 75 and 100 percent of full scale chart deflection. The flow rates and system pressures shall be approximately the same as those encountered during sampling. The HFID analyzer shall be zeroed and spanned through the overflow sampling system.

(6) Re-check zero response. If this zero response differs from the zero response recorded in paragraph (e)(5) of this section by more than 1 percent of full scale, then paragraphs (e) (4), (5), and (6) of this section should be repeated.

(7) If a chart recorder is used, identify and record the most recent zero and span response as the pre-analysis values.

(8) If ADC equipment is used, electronically record the most recent zero and span response as the pre-analysis values.

(9) Measure the emissions (HC required for diesels; NOx, CO, CO_2 optional) continuously during the cold start cycle. Indicate the start of the test, the range(s) used, and the end of the test on the recording medium (chart paper or ADC equipment). Maintain approximately the same flow rates and system pressures used in paragraph (e)(5) of this section.

(10) Collect background HC, CO, CO_2, and NOx in a sample bag.

(11) Perform a post-analysis zero and span check for each range used at the conditions specified in paragraph (e)(5) of this section. Record these responses as the post-analysis values.

(12) Neither the zero drift nor the span drift between the pre-analysis and post-analysis checks on any range used may exceed 3 percent for HC, or 2 percent for NOx, CO, and CO_2, of full scale chart deflection, or the test is void. (If the HC drift is greater than 3 percent of full-scale chart deflection, hydrocarbon hang-up is likely.)

(13) Determine HC background levels for the cold start cycle by introducing the background sample into the overflow sample system.

(14) Determine background levels of NOx, CO, or CO_2 (if necessary) by the bag technique outlined in paragraph (d) of this section.

(15) Repeat paragraphs (e) (4) through (14) of this section for the hot cycle. The post-analysis zero and span check for the cold start (or previous hot start) cycle may be used for the pre-analysis zero and span for the following hot start cycle.

(f) *HC hang-up.* If HC hang-up is indicated, the following sequence may be performed:

(1) Fill a clean sample bag with background air.

(2) Zero and span the HFID at the analyzer ports.

(3) Analyze the background air sample bag through the analyzer ports.

(4) Analyze the background air through the entire sample probe system.

(5) If the difference between the readings obtained is 2 percent or more of the HFID full scale deflection, clean the sample probe and the sample line.

(6) Reassemble the sample system, heat to specified temperature, and repeat the procedure in paragraphs (f) (1) through (6) of this section.

(g) *For CH_3OH* (methanol-fueled vehicles):

(1) Introduce a reference sample of methanol (the concentration of methanol in deionized water is known, and is C_{MR} in the calculations) into the gas chromatograph and measure the area of the response peak. This reference sample peak area is A_{MR} in the calculations.

(2) Introduce test samples into the gas chromatograph and measure the area of the response peak. This peak area is A_{MS} in the calculations.

(h) *For HCHO* (methanol-fueled vehicles):

(1) Introduce a reference sample of formaldehyde (the concentration of formaldehyde as a dinitrophenylhydrazine derivative in acetonitrile (C_{FR}) is known) into the high pressure liquid chromatograph and measure the area of the response peak. This reference sample peak area is A_{FR} in the calculations.

(2) Introduce test samples into the high pressure liquid chromatograph and measure the area of the response peak. This peak area is A_{FS} in the calculations.

121. A new § 86.1341–90 is added to Subpart N, to read as follows:

§ 86.1341-90 Test cycle validation criteria.

(a) To minimize the biasing effect of the time lag between the feedback and reference cycle values, the entire engine speed and torque feedback signal sequence may be advanced or delayed in time with respect to the reference speed and torque sequence. If the feedback signals are shifted, both speed and torque must be shifted the same amount in the same direction.

(b) Calculate the brake horsepower for each pair of engine feedback speed and torque values recorded. Also calculate the reference brake horsepower for each pair of engine speed and torque reference values. Calculations shall be to five significant digits.

(c) Linear regressions of feedback value on reference value shall be performed for speed, torque and brake horsepower. The method of least-squares shall be used, with the best fit equation having the form:

$y=mx+b$

Where:

(1) y=The feedback (actual) value of speed (rpm), torque (ft-lbs), or brake horsepower.

(2) m=Slope of the regression line.

(3) x=The reference value (speed, torque, or brake horsepower).

(4) b=The y-intercept of the regression line.

(d) The standard error of estimate (SE) of y on x and the coefficient of determination (r^2) shall be calculated for each regression line.

(e) For a test to be considered valid, the criteria in Figure N90–11 must be met for both cold and hot cycles individually. Point deletions from the regression analyses are permitted where noted in Figure N90–11.

FIGURE N90–11

	Speed	Torque	BHP
Regression Line Tolerances			
Petroleum-fueled and methanol-fueled diesel engines			
Standard error of estimate (SE) of Y on X	100 rpm	13 pct of power map maximum engine torque.	8 pct of power map maximum BHP.
Slope of the regression line, m	0.970 to 1.030	0.83–1.03 (hot), 0.77–1.03 (cold).	0.89–1.03 (hot), 0.87–1.03 (cold).
Coefficient of determination, r^2	[1] 0.9700	[1] 0.8800 (hot), [1] 0.8500 (cold)	[1] 0.9100.
Y intercept of the regression line, b	±50 rpm	±15 ft-lb +	±5.0 BHP.
Gasoline-fueled and methanol-fueled Otto-cycle engines			
Standard error of estimate (SE) of Y on X	100 rpm	10% (hot), 11% (cold) of power map max. engine torque.	5% (hot), 6% (cold) of power map max. BHP.
Slope of the regression line, m	0.980 to 1.020	0.92–1.03 (hot), 0.88–1.03 (cold).	0.93–1.03 (hot), 0.89–1.03 (cold)
Coefficient of determination, r^2	[1] 0.9700	[1] 0.9300 (hot), [1] 0.9000 (cold)	[1] 0.9400 (hot), [1] 0.9300 (cold)
Y intercept of the regression line, b	±25 (hot), ±40 (cold).	±4% (hot), ±5% (cold) of power map max. engine torque.	±2.0% (hot), ±2.5% (cold) of power map BHP.

[1] Minimum.

Permitted Point Deletions From Regression Analysis

Condition	Points to be deleted
First 24 (±1) seconds of free idle of hot and cold cycles	Speed, Torque, BHP.
Wide-open throttle, and speed control, and torque feedback, torque reference	Torque, BHP.
Wide open throttle, and torque control, and speed feedback, speed reference	Speed, BHP.
Speed control, and gasoline-fueled or methanol-fueled Otto-cycle engine, and closed throttle, and torque reference, torque feedback, and:	
A. Manual transmission, and reference torque not equal to zero, or	Torque, BHP.
B. Automatic transmission, and reference torque not equal to curb idle transmission torque	Do.
Speed control, and petroleum-fueled or methanol-fueled diesel engine, and reference torque equals "closed rack"	Do.
Gasoline-fueled or methanol-fueled Otto cycle engine, and equipped with automatic choke, and first 150 s. of cold cycle or first 30 s. of hot cycle, and closed throttle, and no clutch (or with clutch engaged during idle periods), and:	
A. Manual transmission, and torque feedback is equal to zero (±10 ft-lbs), or	Speed, BHP.
B. Automatic transmission, and torque feedback is equal to curb idle transmission torque (±10 ft-lbs)	Do.
Petroleum-fueled or methanol fueled diesel engines equipped with cold engine idle speed enrichment up to the first 180 s. of cold cycle or up to the first 30 s. of hot cycle, the sum of the seconds deleted of cold cycle plus the sum of the seconds deleted from the hot cycle may not exceed 180 s. and closed throttle and no clutch (or with clutch engaged during idle periods), and:	
A. Manual transmission, and torque feedback is equal to zero (±10ft-lbs)	Do.
B. Automatic transmission, and torque feedback is equal to curb idle transmission torque (±10 ft-lbs)	Do.
Engine equipped with an operating clutch, and clutch disengaged	Do.

(f)(1) The integrated brake horsepower-hour for each cycle (cold and hot start) shall be between −15 percent and +5 percent of the integrated brake horsepower-hour for the reference cycle, or the test is void.

(2) For gasoline-fueled and methanol-fueled Otto-cycle engines, the integrated brake horsepower-hour of the feedback cycle shall be within 5 percent of the integrated brake horsepower-hour of the reference cycle for the cold cycle, or the test is void. The tolerance for the hot cycle shall be 4 percent.

(g) If a dynamometer test run is determined to be statistically or experimentally void, corrective action shall be taken. The engine shall then be allowed to cool (naturally or forced) and the dynamometer test rerun per § 86.1337.

(h) For petroleum-fueled and methanol-fueled diesel engines, all reference torque values specified (in

paragraph (f)(2) of Appendix I to this part) as "closed rack" shall be deleted from the calculation of cycle torque and power validation statistics. Associated reference and feedback brake horsepower points shall be set equal to zero for purposes of calculating integrated power-hour for petroleum-fueled and methanol-fueled diesel engines, and also for gasoline-fueled and methanol-fueled Otto-cycle engines whenever the reference torque is less than zero percent. (Note the regression deletions are specified in Figure N90–11.)

122. A new § 86.1342–90 is added to Subpart N, to read as follows:

§ 86.1342–90 Calculations; exhaust emissions.

(a) The final reported transient emission test results should be computed by using the following formula:

$$A_{WM}=\frac{(1/7)(g_C)+(6/7)(g_H)}{(1/7)(BHP-hr_C)+(6/7)(BHP-hr_H)}$$

Where:

(1) A_{WM} = Weighted mass emission level (HC, CO, CO_2, or NO_x) in grams per brake horsepower-hour and, if appropriate, the weighted mass organic material hydrocarbon equivalent, in grams per brake horsepower-hour.

(2) g_C = Mass emission level in grams or grams carbon mass equivalent, measured during the cold start test.

(3) g_H = Mass emission level in grams or grams carbon mass equivalent, measured during the hot start test.

(4) $BHP-hr_C$ = Total brake horsepower-hour (brake horsepower integrated over time) for the cold start test.

(5) $BHP-hr_H$ = Total brake horsepower-hour (brake horsepower integrated over time) for the hot start test.

(b) The mass of each pollutant for the cold start test and the hot start test for bag measurements and diesel continuously heated sampling system measurements is determined from the following equations:

(1) Hydrocarbon mass:

$HC_{mass}=V_{mix}\times Density_{HC}\times(HC_{conc}/10^6)$

(2) Oxides of nitrogen mass:

$NOx_{mass}=V_{mix}\times Density_{NO2}\times K_H\times(NOx_{conc}/10^6)$

(3) Carbon monoxide mass:

$CO_{mass}=V_{mix}\times Density_{CO}\times(CO_{conc}/10^6)$

(4) Carbon dioxide mass:

$CO_{2mass}=V_{mix}\times Density\ CO_2\times(CO_{2conc}/10^2)$

(5) Methanol mass:

$CH3OH_{mass}=V_{mix}\times Density_{CH3OH}\times(CH3OH_{conc}/10^6)$

(6) Formaldehyde mass:

$HCHO_{mass}=V_{mix}\times Density_{HCHO}\times(HCHO_{conc}/10^6)$

(7) Organic material hydrocarbon equivalent mass:

(i)

$$OMHCE=HC_{mass}+\frac{13.8756}{32.042}(CH_3OH_{mass})+\frac{13.8756}{30.0262}(HCHO_{mass})$$

(c) The mass of each pollutant for the cold start test and the hot start test for flow compensated sample systems is determined from the following equations:

$$(1)\ HC_{mass} = \sum_{i=1}^{n} \left[\frac{(HC_e)_i}{10^6} \times (V_{mix})_i \times (Density_{HC}) \times \Delta T\right] - \frac{HC_d}{10^6}\left(1 - \frac{1}{DF}\right) \times V_{mix} \times Density_{HC}$$

$$(2)\ NOx_{mass} = K_H \times \sum_{i=1}^{n} \left[\frac{(NOx_e)_i}{10^6} \times (V_{mix})_i \times Density_{NO_2} \times \Delta T\right] - K_H \times \frac{NOx_d}{10^6}\left(1 - \frac{1}{DF}\right) \times V_{mix} \times Density_{NO_2}$$

$$(3)\ CO_{mass} = \sum_{i=1}^{n} \left[\frac{(CO_e)_i}{10^6} \times (V_{mix})_i \times Density_{CO} \times \Delta T\right] - \frac{CO_d}{10^6}\left(1 - \frac{1}{DF}\right) \times V_{mix} \times Density_{CO}$$

$$(4)\ CO2_{mass} = \sum_{i=1}^{n} \left[\frac{(CO_{2e})_i}{10^6} \times (V_{mix})_i \times Density_{CO_2} \times \Delta T\right] - \frac{CO_{2d}}{10^6}\left(1 - \frac{1}{DF}\right) \times V_{mix} \times Density_{CO_2}$$

(d) Meaning of symbols:

(1)(i) HC_{mass}=Hydrocarbon emissions, in grams per test phase.

(ii) $Density_{HC}$=Density of hydrocarbons=16.33 g/ft³ (0.5768 kg/m³) for gasoline and the gasoline fraction of methanol-fuel, and may be used for petroleum and the petroleum fraction of methanol diesel fuel if desired, 16.42 g/ft³ (0.5800 kg/m³) for #1 petroleum diesel fuel and 16.27 g/ft³ (0.5746 kg/m³) for #2 diesel, assuming an average carbon to hydrogen ratio of 1:1.85 for gasoline, 1:1.93 for #1 petroleum diesel fuel and 1:1.80 for #2 petroleum diesel fuel at 68 °F (20 °C) and 760 mm Hg (101.3 kPa) pressure.

(iii)(A) HC_{conc}=Hydrocarbon concentration of the dilute exhaust sample corrected for background, in ppm carbon equivalent (i.e., equivalent propane × 3).

(B) $HC_{conc}=HC_e-HC_d(1-(1/DF))$

Where:

(iv)(A) HC_e=Hydrocarbon concentration of the dilute exhaust bag sample or, for diesel continuous heated sampling systems, average hydrocarbon concentration of the dilute exhaust sample as determined from the integrated HC traces, in ppm carbon equivalent. For flow compensated systems $(HC_e)_i$ is the instantaneous concentration.

(B) For petroleum-fueled engines, HC_e is the FID measurement.

(C) For methanol-fueled engines:

HC_e=FID $HC_e-(r)C_{CH_3OHe}$

(v) FID HC_e=Concentration of hydrocarbon plus methanol in dilute exhaust as measured by the FID, ppm carbon equivalent.

(vi) r=FID response to methanol.

(vii) C_{CH_3OHe}=Concentration of methanol in dilute exhaust as determined from the dilute exhaust methanol sample, ppm carbon.

(viii)(A) HC_d=Hydrocarbon concentration of the dilution air as measured, in ppm carbon equivalent.

(B) HC_d=FID $HC_d-(r)C_{CH_3OHd}$

(ix) FID HC_d=Concentration of hydrocarbon plus methanol in dilution air as measured by the FID, ppm carbon equivalent.

(x) C_{CH_3OHd}=Concentration of methanol in dilution air as determined from dilution air methanol sample in ppm carbon.

(2)(i) NOx_{mass}=Oxides of nitrogen emissions, in grams per test phase.

(ii) $Density_{NO2}$=Density of oxides of nitrogen is 54.16 g/ft³ (1.913 kg/m³), assuming they are in the form of nitrogen dioxide, at 68 °F (20 °C) and 760 mm Hg (101.3 kPa) pressure.

(iii)(A) NOx_{conc}=Oxides of nitrogen concentration of the dilute exhaust

sample corrected for background, in ppm.

(B) $NOx_{conc}=NOx_e-NOx_d\ [1-(1/DF)]$

Where:

(iv) NOx_e=Oxides of nitrogen concentration of the dilute exhaust bag sample as measured, in ppm. For flow compensated sample systems $(NOx_e)_i$ is the instantaneous concentration.

(v) NOx_d=Oxides of nitrogen concentration of the dilution air as measured, in ppm.

(3)(i) CO_{mass}=Carbon monoxide emissions, grams per test phase.

(ii) $Density_{CO}$=Density of carbon monoxide is 32.97 g/ft³ (1.164 kg/m³), at 68 °F (20 °C) and 760 mm Hg (101.3 kPa) pressure.

(iii)(A) CO_{conc}=Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, ppm.

(B) $CO_{conc}=CO_e-CO_d[1-(1/DF)]$

Where:

(iv) CO_e=Carbon monoxide concentration of the dilute exhaust bag sample volume corrected for water vapor and carbon dioxide extraction, in ppm. For flow compensated sample systems $(CO_e)_i$ is the instantaneous concentration.

(v)(A) $CO_e=(1-0.01925CO_{2_e}-0.000323R)CO_{em}$ for gasoline and petroleum diesel fuel, with hydrogen to carbon ratio of 1.85:1.

(B) $CO_e=[1-(0.01+0.005HCR)CO_{2_e}-0.000323R]\ CO_{em}$ for methanol fuel, where HCR is hydrogen to carbon ratio as measured for the fuel used.

Where:

(vi) CO_{em}=Carbon monoxide concentration of the dilute exhaust sample as measured, in ppm.

(vii)(A) CO_{2_e}=Carbon dioxide concentration of the dilute exhaust bag sample, in percent, if measured. For flow compensated sample systems, $(CO_{2_e})_i$ is the instantaneous concentration. For cases where exhaust sampling of CO_2 is not performed, the following approximation is permitted:

(B)

$$CO_{2_e}=\frac{44.010}{12.011+(1.008^{\alpha})}\times\frac{M'(453.6)}{\text{Density } CO_2}\times\frac{100}{V_{mix}}$$

Where:

(C) α=Average carbon to hydrogen ratio, as specified by the Administrator.

(D) M'=Fuel mass consumed during the test cycle.

(E) R=Relative humidity of the dilution air, percent.

(viii)(A) CO_d=Carbon monoxide concentration of the dilution air corrected for water vapor extraction, in ppm.

(B) $CO_d=(1-0.000323R)CO_{dm}$.

Where:

(ix) CO_{dm}=Carbon monoxide concentration of the dilution air sample as measured, in ppm.

Note: If a CO instrument which meets the criteria specified in § 86.1311 is used and the conditioning column has been deleted, CO_{em} must be substituted directly for CO_e, and CO_{dm} must be substituted directly for CO_d.

(4)(i) $CO_{2_{mass}}$=Carbon dioxide emissions, in grams per test phase.

(ii) Density CO_2=Density of carbon dioxide is 51.81 g/ft³ (1.830 kg/m³), at 68 °F (20 °C) and 760 mm Hg (101.3 kPa) pressure.

(iii) $CO_{2_{conc}}$=Carbon dioxide concentration of the dilute exhaust sample corrected for background, in percent.

(iv) $CO_{2_{mass}}=CO_{2_e}-CO_{2_d}[1-(1/DF)]$.

Where:

(v) CO_{2_d}=Carbon dioxide concentration of the dilution air as measured, in percent.

(5)(i) CH_3OH_{mass}=Methanol emissions corrected for background, in grams per test phase.

(ii) Density $_{CH_3OH}$=Density of methanol is 37.71 g/ft³ (1.332 kg/m³), at 68 °F (20 °C) and 760 mm Hg (101.3kPa) pressure.

(iii)(A) CH_3OH_{conc}=Methanol concentration of the dilute exhaust corrected for background, in ppm.

(B) $CH_3OH_{conc}=C_{CH_3OHe}-C_{CH_3OHd}\ [1-(1/DF)]$.

Where:

(iv)(A) C_{CH_3OHe}=Methanol concentration in the dilute exhaust, in ppm.

(B)

$$C_{CH_3OHe}=\frac{3.813\times10^{-2}\times C_{CH_3OHR}\times T_{EM}\ [(A_{S1}\times AV_{S1})+(A_{S2}\times AV_{S2})]}{A_{CH_3OHR}\times P_B\times V_{EM}}$$

(v)(A) C_{CH_3OHd}=Methanol concentration in the dilution air, in ppm.

(B)

$$C_{CH_3OHd}=\frac{3.813\times10^{-2}\times C_{CH_3OHR}\times T_{DM}\ [(A_{D1}\times AV_{D1})+(A_{D2}\times AV_{D2})]}{A_{CH_3OHR}\times P_B\times V_{DM}}$$

(vi) C_{CH_3OHR}=Concentration of methanol in standard sample for calibration of GC, μg/ml.

(vii) A_{CH_3OHR}=GC peak area of standard sample.

(viii) T_{EM}=Temperature of methanol sample withdrawn from dilute exhaust, °R.

(ix) T_{DM}=Temperature of methanol sample withdrawn from dilution air, °R.

(x) P_B=Barometric pressure during test, mm Hg.

(xi) V_{EM}=Volume of methanol sample withdrawn from dilute exhaust, ft³.

(xii) V_{DM}=Volume of methanol sample withdrawn from dilution air, ft³.

(xiii) A_S=GC peak area of sample drawn from dilute exhaust.

(xiv) A_D=GC peak area of sample drawn from dilution air.

(xv) AV_S=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilute exhaust is drawn, ml.

(xvi) AV_D=Volume of absorbing reagent (deionized water) in impinger through which methanol sample from dilution air is drawn, ml.

(xvii) 1=first impinger.

(xviii) 2=second impinger.

(6)(i) $HCHO_{mass}$=Formaldehyde emissions corrected for background, grams per test phase.

(ii) $Density_{HCHO}$=Density of formaldehyde is 35.36 g/ft³ (1.249 kg/m³), at 68 °F (20 °C) and 760 mmHg (101.3 kPa) pressure.

(iii)(A) $HCHO_{conc}$=Formaldehyde concentration of the dilute exhaust corrected for background, ppm.

(B) $HCHO_{conc}=C_{HCHOe}-C_{HCHOd}[1-(1/DF)]$.

Where:

(iv)(A) C_{HCHOe}=Formaldehyde concentration in dilute exhaust, ppm.

(B)

$$C_{HCHOe}=\frac{4.069\times10^{-2}\times C_{FDE}\times V_{AE}\times Q\times T_{EF}}{V_{SE}\times P_B}$$

(v)(A) C_{HCHOd}=Formaldehyde concentration in dilution air, ppm.

(B) $$C_{HCHOd}=\frac{4.069\times10^{-2}\times C_{FDA}\times V_{AA}\times Q\times T_{DF}}{V_{SA}\times P_B}$$

(vi) C_{FDE}=Concentration of DNPH derivative of formaldehyde from dilute exhaust sample in sampling solution, μg/ml.

(vii) V_{AE}=Volume of sampling solution for dilute exhaust formaldehyde sample, ml.

(viii)(A) Q=Ratio of molecular weights of formaldehyde to its DNPH derivative.

(B) Q=0.1429.

(ix) T_{EF}=Temperature of formaldehyde sample withdrawn from dilute exhaust, °R.

(x) V_{SE}=Volume of formaldehyde sample withdrawn from dilute exhaust, ft³.

(xi) P_B=Barometric pressure during test, mm Hg.

(xii) C_{FDA}=Concentration of DNPH derivative of formaldehyde from dilution air sample in sampling solution, μg/ml.

(xiii) V_{AA}=Volume of sampling solution for dilution air formaldehyde sample, ml.

(xiv) T_{DF}=Temperature of formaldehyde sample withdrawn from dilution air, °R.

(xv) V_{SA}=Volume of formaldehyde sample withdrawn from dilution air, ft³.

(7)(i) $DF=13.4/[CO_{2e}+\{HC_e+CO_e\}10^{-4}]$ for petroleum-fueled vehicles, or $DF=13.4/CO_{2e}$

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

for methanol-fueled vehicles, where fuel composition is $C_xH_yO_z$ as measured for the fuel used.

(8)(i) K_H=Humidity correction factor.

(ii) For gasoline-fueled and methanol-fueled diesel engines: $K_H=1/[1-0.0047(H-75)]$ (or for SI units, $K_H=1/[1-0.0329(H-10.71)]$).

(iii) For petroleum-fueled and methanol-fueled diesel engines: $K_H=1/[1-0.0026(H-75)]$ (or for SI units= $1/[1-0.0182(H-10.71)]$).

Where:

(iv)(A) H=Absolute humidity of the engine intake air in grains (grams) of water per pound (kilogram) of dry air.

(B)(*1*) $H=[(43.478)R_i\times P_d]/[P_B-(P_d\times R_i/100)]$

(*2*) *For SI units,*

$H=[(6.211)R_i\times P_d]/[P_B-(P_d\times R_i/100)]$

(C) R_i=Relative humidity of the engine intake air, percent.

(D) P_d= Saturated vapor pressure, in mm Hg (kPa) at the engine intake air dry bulb temperature.

(E) P_B=Barometric pressure, in mm Hg (kPa).

(9)(i) V_{mix}=Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions (528 °R) (293 °K) and 760 mm Hg (101.3 kPa).

(ii) $(V_{mix})_i$=Instantaneous dilute exhaust volumetric flow rate (for compensated flow systems), ft³/sec.

(iii) T=Time interval (seconds) between samples in flow compensated systems.

(iv) T=Total sampling time (seconds).

(v) *For PDP-CVS:*

(A)

$$V_{mix}=V_o\times\left(\frac{N(P_B-P_1)(528)}{(760)(T_p)}\right)$$

(B) *For SI units.*

$$V_{mix} = V_o \times \left(\frac{N(P_B - P_A)(293)}{(101.3)(T_p)} \right)$$

Where:

(vi) V_o = Volume of gas pumped by the positive displacement pump, in cubic feet (cubic meters) per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

(vii) N = Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

(viii) P_B = Barometric pressure, mm Hg (kPa).

(ix) P_A = Pressure depression below atmospheric measured at the inlet to the positive displacement pump, in mm Hg (kPa) (during an idle mode).

(x) T_p = Average temperature of dilute exhaust entering positive displacement pump during test, °R (°K).

(e) Sample calculation of mass values of exhaust emissions:

(1) Assume the following test results for a gasoline engine:

	Cold start cycle test results	Hot start cycle test results
V_{mix}	6924 ft³	6873 ft³.
R	30.2 percent	30.2 percent.
R_1	30.2 percent	30.2 percent.
P_B	735 mm Hg	735 mm Hg.
P_d	22.676 mm Hg	22.676 mm Hg.
HC_e	132.07 ppm C equiv.	86.13 ppm C equiv.
NO_{xe}	7.86 ppm	10.98 ppm.
CO_{em}	171.22 ppm	114.28 ppm.
CO_{2e}	0.178 percent	0.381 percent.
HC_d	3.60 ppm C equiv.	8.70 ppm C equiv.
NO_d	0.0 ppm	0.10 ppm.
CO_{dm}	0.89 ppm	0.89 ppm.
CO_{2d}	0.0 percent	0.038 percent.
BHP-hr	0.259	0.347

Then:

(2) *Cold Start Test:*

(i) H
= [(43.478)(30.2)(22.676)]/[735 − (22.676)(30.2)/100]
= 41 grains of water per pound of dry air.

(ii) $K_H = 1/[1 - 0.0047(41-75)] = 0.862$

(iii) CO_e
= [1 − 0.01925(.178) − 0 .000323(30.2)]171.22
= 169.0 ppm

(iv) $CO_d = [1 - 0.000323(30.2)]0.89 = 0.881$ ppm

(v) DF
= 13.4/[.178 + (132.07 + 169.0)(10⁻⁴)]
= 64.390

(vi) HC_{conc}
= 132.07 − 3.6[1 − (1/64.390)]
= 128.5 ppm

(vii) HC_{mass}
= 6924(16.33)(128.5/10⁶)
= 14.53 grams

(viii) NOx_{conc}
= 7.86 − 0.0[1 − (1/64.390)]
= 7.86 ppm

(ix) NOx_{mass}
= 6924(54.16)(.862)(7.86/10⁶)
= 2.54 grams

(x) CO_{conc}
= 169.0 − .881[1 − (1/64.390)]
= 168.0 ppm

(xi) CO_{mass}
= 6924(32.97)(168.0/10⁶)
= 38.35 grams

(xii) CO_{2conc} = .178 − 0[1 − 1/64.390)] = 0.178%

(xiii) CO_{2mass} = 6924(51.81)(.178/100) = 639 grams

(3) *Hot start test:* Similar calculations result in the following:

(i) HC_{mass} = 8.72 grams

(ii) NOx_{mass} = 3.49 grams

(iii) CO_{mass} = 25.70 grams

(iv) CO_{2mass} = 1226 grams

(4) Weighted mass emission results:

(i) HC_{wm}

$$= \frac{1/7(14.53) + 6/7(8.72)}{1/7(0.259) + 6/7(0.347)}$$

= 28.6 grams/BHP-hr

(ii) NOx_{wm}

$$= \frac{1/7(2.54) + 6/7(3.49)}{1/7(0.259) + 6/7(0.347)}$$

= 10.0 grams/BHP-hr

(iii) CO_{wm}

$$= \frac{1/7(38.35) + 6/7(25.70)}{1/7(0.259) + 6/7(0.347)}$$

= 82.2 grams/BHP-hr

(iv) CO_{2wm}

$$= \frac{1/7(639) + 6/7(1226)}{1/7(0.259) + 6/7(0.347)}$$

= 3415 grams/BHP-hr

(f) The final reported brake-specific fuel consumption (BSFC) shall be computed by use of the following formula:

$$BSFC = \frac{1/7(M_C) + 6/7(M_H)}{1/7(BHP-hr_C) + 6/7(BHP-hr_H)}$$

Where:

(1) BSFC = brake-specific fuel consumption in pounds of fuel per brake horsepower-hour (lbs/BHP-hr).

(2) M_C = mass of fuel, in lbs, used by the engine during the cold start test.

(3) M_H = mass of fuel, in lbs, used by the engine during the hot start test.

(4) $BHP-hr_C$ = total brake horsepower-hours (brake horsepower integrated with respect to time) for the cold start test.

(5) $BHP-hr_H$ = total brake horsepower-hours (brake horsepower integrated with respect to time) for the hot start test.

(g)(1) The mass of fuel for the cold start and hot start test is determined from mass fuel flow measurements made during the tests, or from the following equation:

$M = (G_s/R_o)(1/453.6)$

(2) Meaning of symbols:

(i) M = Mass of fuel, in lbs, used by the engine during the cold or hot start test.

(ii) G_s = Grams of carbon measured during the cold or hot start test:

$$G_s = \left[\frac{12.011}{12.011 + a(1.008)} \right] HC_{mass} + 0.429CO_{mass} + 0.273CO_{2\ mass}$$

Where:

(iii) HC_{mass} = Hydrocarbon emissions, in grams, for cold or hot start test.

(iv) CO_{mass} = Carbon monoxide emissions, in grams, for cold or hot start test.

(v) CO_{2mass} = Carbon dioxide emissions, in grams, for cold or hot start test.

(vi) α = The atomic hydrogen to carbon ratio of the fuel.

(vii)(A) R_2 = The grams of carbon in the fuel per gram of fuel.

(B) $R_2 = 12.011/[12.011 + \alpha(1.008)]$

(h) Sample calculation of brake-specific fuel consumption:

(1) Assume the following test results:

	Cold start cycle test results	Hot start cycle test results
BHP-hr	6.945	7.078
α	1.85	1.85

	Cold start cycle test results	Hot start cycle test results
HC_{mass} (grams)	37.08	28.82
CO_{mass} (grams)	357.69	350.33
CO_{2mass} (grams)	5,419.62	5,361.32

Then:

(i) G_g for cold start test = [12.011/(12.011 + (1.008)(1.85))](37.08) + 0.429(357.69) + 0.273(5419.62) = 1665.10 grams

(ii) G_g for hot start test = [12.011/(12.011 + (1.008)(1.85))](28.82) + 0.429(350.33) + 0.273(5361.32) = 1638.88 grams

(iii) $R_2 = 12.011/[12.011 + (1.008)1.85] = 0.866$

(iv)(A) $M_c = (1665.10/.866)(1/453.6) = 4.24$ lbs (calculated), or

(B) = 4.24 lbs (directly measured).

(v)(A) $M_H = (1638.88/.866)(1/453.6) = 4.17$ lbs (calculated), or

(B) = 4.17 lbs (directly measured).

(2) Brake-specific fuel consumption results:

$$BSFC = \frac{(1/7)(4.24) + (6/7)(4.17)}{(1/7)(6.945) + (6/7)(7.078)} = 0.592 \text{ lbs of fuel/BHP-hr}$$

(i) For dilute sampling systems which require conversion of as-measured dry concentrations to wet concentrations, the following equation shall be used for any combination of bagged, continuous, or fuel mass-approximated sample measurements (except for CO measurements made through conditioning columns, as explained in paragraph (d)(3) of this section):

Wet concentration = $K_w \times$ dry concentration.

Where:

(ii)(A)

$$K_w = 1 - .00925CO_{2e}(') - \frac{1.608 \times H'}{7000 + H'}$$

(B) *For SI units,*

$$K_w = 1 - .00925CO_{2e}(') - \frac{1.608 \times H'}{1000 + H'}$$

(iii) $CO_{2e}(')$ = either CO_{2e} or CO_{2e}' as applicable.

(iv)(A) H' = Absolute humidity of the CVS dilution air, in grains (grams) of water per lb (kg) of dry air.

(B) $H' = [(43.478)R_i' \times P_d']/[P_B - (P_d' \times R_i'/100)]$

(C) *For SI units,*

$H' = [(6.211)R_i' \times P_d']/[P_B - (P_d' \times R_i'/100)]$

(v) R_i' = Relative humidity of the CVS dilution air, in percent.

(vi) P_d = Saturated vapor pressure, in mm Hg (kPa) at the ambient dry bulb temperature of the CVS dilution air.

(vii) P_B = Barometric pressure, mm Hg (kPa).

123. Section 86.1343–88 of Subpart N is amended by revising the heading of the section, to read as follows:

§ 86.1343–88 Calculations; particulate exhaust emissions.

* * * * *

124. A new § 86.1344–90 is added to Subpart N, to read as follows:

§ 86.1344–90 Required information.

(a) The required test data shall be grouped into the following three general categories:

(1) *Engine set up and descriptive data.* These data must be provided to the EPA supervisor of engine testing for each engine sent to the Administrator for confirmatory testing prior to the initiation of engine set-up. These data are necessary to ensure that EPA test personnel have the correct data in order to set up and test the engine in a timely and proper manner. These data are not required for tests performed by the manufacturers.

(2) *Pre-test data.* These data are general test data that must be recorded for each test. The data are of a more descriptive nature such as identification of the test engine, test site number, etc. As such, these data can be recorded at any time within 24 hours of the test.

(3) *Test data.* These data are physical test data that must be recorded at the time of testing.

(b) When requested, data shall be supplied in the format specified by the Administrator.

(c) *Engine set-up data.* Because specific test facilities may change with time, the specific data parameters and number of items may vary. The Application Format for Certification for the applicable model year will specify the exact requirements. In general, the following types of data will be required:

(1) Engine manufacturer.

(2) Engine system combination.

(3) Engine code and CID.

(4) Engine identification number.

(5) Applicable engine model year.

(6) Engine fuel type.

(7) Recommended oil type.

(8) Exhaust pipe configuration, pipe sizes, etc.

(9) Curb or low idle speed.

(10) Dynamometer idle speed. (Automatic transmission engines only.)

(11) Engine parameter specifications such as spark timing, operating temperature, advance curves, etc.

(12) Engine performance data, such as maximum BHP, previously measured rated rpm, fuel consumption, governed speed, etc.

(13) Recommended start-up procedure.

(14) Maximum safe engine operating speed.

(15) Number of hours of operation accumulated on engine.

(16) Manufacturer's recommended inlet depression limit and typical in-use inlet depression level.

(17) Exhaust system:

(i) *Petroleum-fueled and methanol-fueled diesel engines:*

(A) Header pipe inside diameter.

(B) Tailpipe inside diameter.

(C) Minimum distance in-use between the exhaust manifold flange and the exit of the chassis exhaust system.

(D) Manufacturer s recommended maximum exhaust backpressure limit for the engine.

(E) Typical backpressure, as determined by typical application of the engine.

(F) Minimum backpressure required to meet applicable noise regulations.

(ii) *Gasoline-fueled and methanol-fueled Otto-cycle engines:* Typical in-

use backpressure in vehicle exhaust system.

(d) *Pre-test data.* The following data shall be recorded, and reported to the Administrator for each test conducted for compliance with the provisions of CFR Part 86, Subpart A:

(1) Engine-system combination.

(2) Engine identification.

(3) Instrument operator(s).

(4) Engine operator(s).

(5) Number of hours of operation accumulated on the engine prior to beginning the test sequence (Figure N84–10).

(6) Identification and specifications of test fuel used.

(7) Date of most recent analytical assembly calibration.

(8) All pertinent instrument information such as tuning, gain, serial numbers, detector number, calibration curve number, etc. As long as this information is traceable, it may be summarized by system or analyzer identification numbers.

(e) *Test data.* The physical parameters necessary to compute the test results and ensure accuracy of the results shall be recorded for each test conducted for compliance with the provisions of 40 CFR Part 86, Subpart A. Additional test data may be recorded at the discretion of the manufacturer. Extreme details of the test measurements such as analyzer chart deflections will generally not be required on a routine basis to be reported to the Administrator for each test, unless a dispute about the accuracy of the data arises. The following types of data shall be required to be reported to the Administrator. The Application Format for Certification for the applicable model year will specify the exact requirements which may change slightly from year to year with the addition or deletion of certain items.

(1) Date and time of day.

(2) Test number.

(3) Engine intake air or test cell temperature.

(4) Barometric pressure. (A central laboratory barometer may be used: *Provided,* that individual test cell barometric pressures are shown to be within ±0.1 percent of the barometric pressure at the central barometer location.)

(5) Engine intake or test cell and CVS dilution air humidity.

(6) Maximum torque versus speed curve as determined in § 86.1332, with minimum and maximum engine speeds, and a description of the mapping technique used.

(7) Measured maximum horsepower and maximum torque speeds.

(8) Measured maximum horsepower and torque.

(9) Measured high idle engine speed (governed petroleum-fueled and methanol-fueled diesel engines only).

(10) Measured fuel consumption at maximum power and torque (petroleum-fueled and methanol-fueled diesel engines only).

(11) Cold-soak time interval and cool down procedures.

(12) Temperature set point of the heated continuous analysis system components (if applicable).

(13) Test cycle validation statistics as specified in § 86.1341 for each test phase (cold and hot).

(14) Total CVS flow rate with dilution factor for each test phase (cold and hot).

(15) Temperature of the dilute exhaust mixture and secondary dilution air (in the case of a double dilution system) at the inlet to the respective gas meter(s) or flow instrumentation used for particulate sampling.

(16) The maximum temperature of the dilute exhaust mixture immediately ahead of the particulate filter.

(17) Sample concentrations (background corrected) for HC, CO, CO_2, and NO_x for each test phase (cold and hot).

(18) *For methanol-fueled vehicles:*

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

(ii) The methanol concentration in the reference sample and the peak area from the GC analysis of the reference sample.

(iii) The peak area of the GC analyses of the test samples (methanol).

(iv) Volume of sample passed through the formaldehyde sampling system.

(v) The formaldehyde concentration in the reference sample and the peak area from the LC analysis of the reference sample.

(vi) The peak area of the LC analysis of the test sample (formaldehyde).

(vii) Specification of the methanol-fuel used during testing.

(19) The stabilized pre-test weight and post-test weight of each particulate sample and back-up filter or pair of filters.

(20) Brake specific emissions (g/BHP-hr) for HC, CO, NO_x and, if applicable, OMHCE, CH_3OH and HCHO for methanol-fueled vehicles for each test phase (cold and hot).

(21) The weighted (cold and hot) brake specific emissions (g/BHP-hr) for the total test.

(22) Tne weighted (cold and hot) carbon balance or mass-measured brake specific fuel consumption for the total test.

(23) The number of hours of operation accumulated on the engine after completing the test sequences described in Figure N84–10.

125. The heading of Subpart P is revised, to read as follows:

Subpart P—Emission Regulations for New Gasoline-Fueled and Methanol-Fueled Otto-Cycle Heavy-Duty Engines and New Gasoline-Fueled and Methanol-Fueled Otto-Cycle Light-Duty Trucks; Idle Test Procedures

126. A new § 86.1501–90 is added to Subpart P, to read as follows:

§ 86.1501–90 Scope; applicability.

This subpart contains gaseous emission idle test procedures for gasoline-fueled and methanol-fueled Otto-cycle heavy-duty engines, and for gasoline-fueled and methanol-fueled Otto-cycle light-duty trucks. It applies to 1990 and later model years.

127. A new § 86.1504–90 is added to Subpart P, to read as follows:

§ 86.1504–90 Section numbering; construction.

(a) The model year of initial applicability is indicated by the section number. The two digits following the hyphen designate the first model year for which a section is effective. A section remains effective until superseded.

Example: Section 86.1511–84 applies to the 1984 and subsequent model years until superseded. If § 86.1511–85 is promulgated, it would take effect beginning with the 1985 model year. Section 86.1511–83 would apply to model years 1983 and 1984.

(b) A section reference without a model year suffix refers to the section applicable for the appropriate model year.

(c) All provisions in this subpart apply to gasoline-fueled and methanol-fueled Otto-cycle heavy-duty engines, and to gasoline-fueled and methanol-fueled Otto-cycle light-duty trucks.

128. A new § 86.1505–90 is added to Subpart P, to read as follows:

§ 86.1505–90 Introduction; structure of subpart.

(a) This subpart describes the equipment and the procedures required to perform idle exhaust emission tests on gasoline-fueled and methanol-fueled Otto-cycle heavy-duty engines, and gasoline-fueled and methanol-fueled Otto-cycle light-duty trucks. Subpart A sets forth the testing requirements, reporting requirements and test intervals necessary to comply with EPA certification procedures.

(b) Four topics are addressed in this subpart. Sections 86.1505 through 86.1515 set forth specifications and

equipment requirement; §§ 86.1516 through 86.1526 discuss calibration methods and frequency; test procedures and data requirements are listed in §§ 86.1527 through 86.1542 and calculation formula are found in § 86.1544.

129. A new § 86.1506–90 is added to Subpart P, to read as follows:

§ 86.1506–90 Equipment required and specifications; overview.

(a) This subpart contains procedures for performing idle exhaust emission tests on gasoline-fueled and methanol-fueled Otto-cycle heavy-duty engines, and gasoline-fueled and methanol-fueled Otto-cycle light-duty trucks. Equipment required and specifications are as follows:

(1) *Exhaust emission tests.* All engines and vehicles subject to this subpart are tested for exhaust emissions. Necessary equipment and specifications appear in §§ 86.1509 through 86.1511.

(2) *Fuel and analytical tests.* Fuel requirements for idle exhaust emission testing are specified in § 86.1513. Analytical gases are specified in § 86.1514.

130. Appendix I of Part 86 is amended by revising paragraphs (f)(1) heading and (f)(3) heading to read as follows:

Appendix I—Urban Dynamometer Schedules

* * * * *

(f)(1) EPA Engine Dynamometer Schedules for Heavy-duty Otto-cycle engines.

* * * * *

(3) Optional EPA Engine Dynamometer Schedule for Heavy-duty Otto-cycle engines.

* * * * *

131. Section 86.091–2 of Subpart A is amended by revising the introductory text to read as follows:

§ 86.091–2 Definitions.

The definitions of § 86.090–2 remain effective. The definitions listed in this section apply beginning with the 1991 model year.

* * * * *

132. Section 86.091–9 of Subpart A is amended by revising paragraphs (a)(1), (b), (d), (e), and (g)(2), to read as follows:

§ 86.091–9 Emission standards for 1991 and later model year light-duty trucks.

(a)(1) The standards set forth in paragraphs (a) through (c) of this section shall apply to light-duty trucks sold for principal use at other than a designated high-altitude location. Exhaust emissions from 1991 and later model year light-duty trucks shall not exceed:

(i)(A) *Hydrocarbons (for petroleum-fueled Otto-cycle and diesel light-duty trucks).* 0.80 gram per vehicle mile (0.50 gram per vehicle kilometer).

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled Otto-cycle and diesel light-duty trucks).* 0.80 gram per vehicle mile (0.50 gram per vehicle kilometer).

(ii) *Carbon monoxide.*

(A) 10 grams per vehicle mile (6.2 grams per vehicle kilometer).

(B) 0.50 percent of exhaust gas flow at curb idle (for Otto-cycle and methanol-fueled diesel light-duty trucks only).

(iii) *Oxides of nitrogen.*

(A) For light-duty trucks up to and including 3,750 lbs loaded vehicle weight, 1.2 grams per vehicle mile (0.75 gram per vehicle kilometer).

(B) For light-duty trucks greater loaded vehicle weight, 1.7 grams per vehicle mile (1.1 grams per vehicle kilometer).

(C) A manufacturer may elect to include all or some of its light-duty truck engine families in the NO_x averaging program, provided that trucks produced for sale in California or in designated high-altitude areas may be averaged only within each of those areas. Petroleum-fueled and methanol-fueled engine families may not be averaged together. Otto-cycle and diesel engines families also may not be averaged together. If the manufacturer elects to participate in the NO_x averaging program, individual familyNO_x emission limits may not exceed 2.3 grams per mile. If the manufacturer elects to average together NO_x emissions of light-duty trucks subject to the standards of paragraphs (a)(1)(iii)(A) and (a)(1)(iii)(B) of this section, its composite NO_x standard applies to the combined fleets of light-duty trucks up to and including, and over, 3,750 lbs loaded vehicle weight included in the average and is calculated as defined in § 86.088–2.

(iv) *Particulate (for diesel light-duty trucks only).*

(A) For light-duty trucks up to and including 3,750 lbs loaded vehicle weight, 0.26 gram per vehicle mile (0.16 gram per vehicle kilometer).

(B) For light-duty trucks 3,751 lbs and greater loaded vehicle weight, 0.13 gram per vehicle mile (0.08 gram per vehicle kilometer).

(C) A manufacturer may elect to include all or some of its diesel light-duty truck engine families in the appropriate particulate averaging program (petroleum or methanol), provided that trucks produced for sale in California or in designated high-altitude areas may be averaged only within each of those areas, and that light-duty trucks subject to the standard of paragraph (a)(1)(iv)(B) of this section may be averaged only with other light-duty trucks subject to the standard of paragraph (a)(1)(iv)(B) of this section. Averaging is not permitted between fuel types. If the manufacturer elects to average both light-duty trucks subject to the standard of paragraph (a)(1)(iv)(A) of this section and light-duty vehicles together in the appropriate particulate averaging program, its composite particulate standard applies to the combined set of light-duty vehicles and light-duty trucks included in the average and is calculated as defined in § 86.088–2.

* * * * *

(b) Fuel evaporative emissions from 1991 and later model year light-duty trucks shall not exceed (compliance with these standards is optional for 1991 model year methanol-fueled vehicles):

(1) *Hydrocarbons (for gasoline-fueled light-duty trucks).* 2.0 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for methanol-fueled light-duty trucks).* 2.0 grams per test.

(3) The standards set forth in paragraphs (b) (1) and (2) of this section refer to a composite sample of the fuel evaporative emissions collected under the conditions set forth in Subpart B of this part and measured in accordance with those procedures.

* * * * *

(d)(1) Model year 1991 and later light-duty trucks sold for principal use at a designated high-altitude location shall be capable of meeting the following exhaust emission standards when tested under high-altitude conditions:

(i)(A) *Hydrocarbons (for petroleum-fueled Otto-cycle and diesel light-duty trucks).* 1.0 grams per vehicle mile (0.62 grams per vehicle kilometer).

(B) *Organic Material Hydrocarbon Equivalent (for methanol-fueled Otto-cycle and diesel light-duty trucks).* 1.0 gram per vehicle mile (0.62 gram per vehicle kilometer).

(ii) *Carbon Monoxide.*

(A) 14 grams per vehicle mile (8.7 grams per vehicle kilometer).

(B) 0.50 percent of exhaust gas flow at curb idle (for Otto-cycle and methanol-fueled diesel light duty trucks only).

(iii) *Oxides of Nitrogen.*

(A) For light-duty trucks up to and including 3,750 lbs loaded vehicle weight, 1.2 grams per vehicle mile (0.75 grams per vehicle kilometer).

(B) For light-duty trucks 3,751 lbs and greater loaded vehicle weight, 1.7 grams per vehicle mile (1.1 grams per vehicle kilometer).

(iv) *Particulate (for diesel light-duty trucks only).*

(A) For light-duty trucks up to and including 3,750 lbs loaded vehicle

weight, 0.26 gram per vehicle mile (0.16 gram per vehicle kilometer).

(B) For light-duty trucks 3,751 lbs and greater loaded vehicle weight, 0.13 gram per vehicle mile (0.08 gram per vehicle kilometer).

(2) The standards set forth in paragraphs (d)(1)(i), (d)(1)(ii)(A), (d)(1)(iii), and (d)(1)(iv) of this section refer to the exhaust emitted over a driving schedule as set forth in Subpart B of this part and measured and calculated in accordance with those procedures. The standard set forth in paragraph (d)(1)(ii)(B) of this section refers to the exhaust emitted at curb idle and measured and calculated in accordance with the procedures set forth in Subpart P of this part.

(e) Fuel evaporative emissions from 1991 and later model year light-duty trucks sold for principal use at a designated high-altitude location, when tested under high-altitude conditions, shall not exceed:

(1) *Hydrocarbons (for gasoline-fueled light-duty trucks).* 2.6 grams per test.

(2) *Organic Material Hydrocarbon Equivalent (for methanol-fueled light-duty trucks).* 2.6 grams per test.

(3) The standards set forth in paragraphs (e) (1) and (2) of this section refer to a composite sample of the fuel evaporative emissions collected under the conditions set forth in Subpart B of this part and measured in accordance with those procedures.

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(g) * * *

(2) The manufacturer may exempt 1991 and later model year vehicles from compliance with the high-altitude emission standards set forth in paragraphs (d) and (e) of this section if the vehicles are not intended for sale at high altitude and if the following requirements are met. A vehicle configuration shall only be considered eligible for exemption if the requirements of either paragraph (g)(2)(i), (ii), (iii), or (iv) of this section are met.

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