State of California
AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons
for Proposed Rulemaking

PUBLIC HEARING TO CONSIDER ADOPTION OF AMENDMENTS TO REGULATIONS REGARDING EVAPORATIVE EMISSION STANDARDS AND TEST PROCEDURES APPLICABLE TO 1995 AND SUBSEQUENT MODEL YEAR PASSENGER CARS, LIGHT-DUTY TRUCKS, MEDIUM-DUTY VEHICLES, AND HEAVY-DUTY VEHICLES

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I. INTRODUCTION

The federal Clean Air Act Amendments of 1990 mandate that every metropolitan area in the country must be in compliance with the National Ambient Air Quality Standards by the year 2010. This includes extreme ozone non-attainment areas such as California's South Coast Air Basin. In addition to the federal requirements, the California Clean Air Act mandates that the Air Resources Board (the "Board" or "ARB") "achieve the maximum degree of emission reduction possible from vehicular and mobile sources in order to accomplish the attainment of the state standards at the earliest practical date."

In order to reach attainment goals mandated by the federal Clean Air Act and the California Clean Air Act, emissions from mobile sources must be reduced. Mobile sources contribute up to 50 percent of the reactive organic gas emissions generated in the state. These mobile source emissions are primarily a result of either uncombusted fuel (exhaust emissions) or fuel evaporation (evaporative emissions).

Significant reductions in exhaust emissions are expected to be achieved via the Low-Emission Vehicles and Clean Fuels Regulations adopted by the Board in 1990. These regulations require that exhaust emissions be significantly reduced through the 2003 model year. Beginning with the 1998 model year, manufacturers will also be required to produce a small percentage of zero-emission vehicles.

Evaporative emissions were addressed by the Board in August 1990 with the adoption of stringent evaporative emissions standards and test procedures (hereinafter "enhanced test procedures"). These procedures were designed to more effectively control evaporative emissions from motor vehicles during summer months when high ambient temperatures exacerbate the potential for high evaporative emissions. Implementation of the enhanced test procedures begins in the 1995 model year, with full compliance required in the 1998 model year.

Subsequent to the Board's adoption of the enhanced test procedures, the United States Environmental Protection Agency (U.S. EPA), on March 24, 1993, published in the Federal Register the final rule for its own enhanced evaporative emissions standards and test procedures (58 F.R. 16002). These procedures were patterned after the ARB enhanced test procedures except for one major difference. The federal procedures contain a "supplemental procedure," which provides additional assurance of adequate evaporative canister purge during short trips. The federal procedures also contain other relatively minor differences which were designed to address various practical and technical concerns related to the test procedures.

The ARB staff believes that the supplemental procedure and many of the other revisions contained in the federal procedures not only resolve practical and technical testing concerns but also allow for a more robust set of regulations by providing added assurance of evaporative emissions control under virtually all real-world conditions. In addition, by harmonizing the ARB enhanced test procedures with the federal test procedures, federal and California vehicles can be certified using common test procedures. Thus, in this rulemaking, the staff proposes the incorporation of the supplemental procedure and various practical and technical revisions to harmonize the federal and the ARB enhanced test procedures.

II. BACKGROUND

A. The Current Enhanced Test Procedures

There are three major types of motor vehicle hydrocarbon (HC) evaporative emissions: hot soak, diurnal, and running loss emissions. Hot soak emissions typically occur as a result of fuel evaporation due to high underhood temperatures after the vehicle's engine is turned off. Diurnal emissions arise from a parked vehicle when the fuel warms up and evaporates due to an increase in ambient temperature. During engine operation, running loss emissions can originate anywhere from which fuel or fuel vapors can escape. A charcoal canister is used to store hot soak and diurnal evaporative emissions until the vehicle's engine is started. If the generated vapors exceed the storage capacity of the canister, "breakthrough" occurs, releasing vapors into the atmosphere. Upon start-up, the vapors are "purged" into the engine's intake system and subsequently burned in the engine. To control running loss emissions, vapors generated in the fuel tank are also "purged" into the engine's intake system. However, running loss emissions can result when the vapor generation in the fuel tank exceeds the purge capacity of the system. In general, evaporative emissions may also occur from permeation of fuel through hoses and fuel tanks (particularly plastic fuel tanks) and from leaks in valves and seals.

The ARB enhanced test procedures target these major types of evaporative emissions. As shown in Figure 1, the test sequence consists of

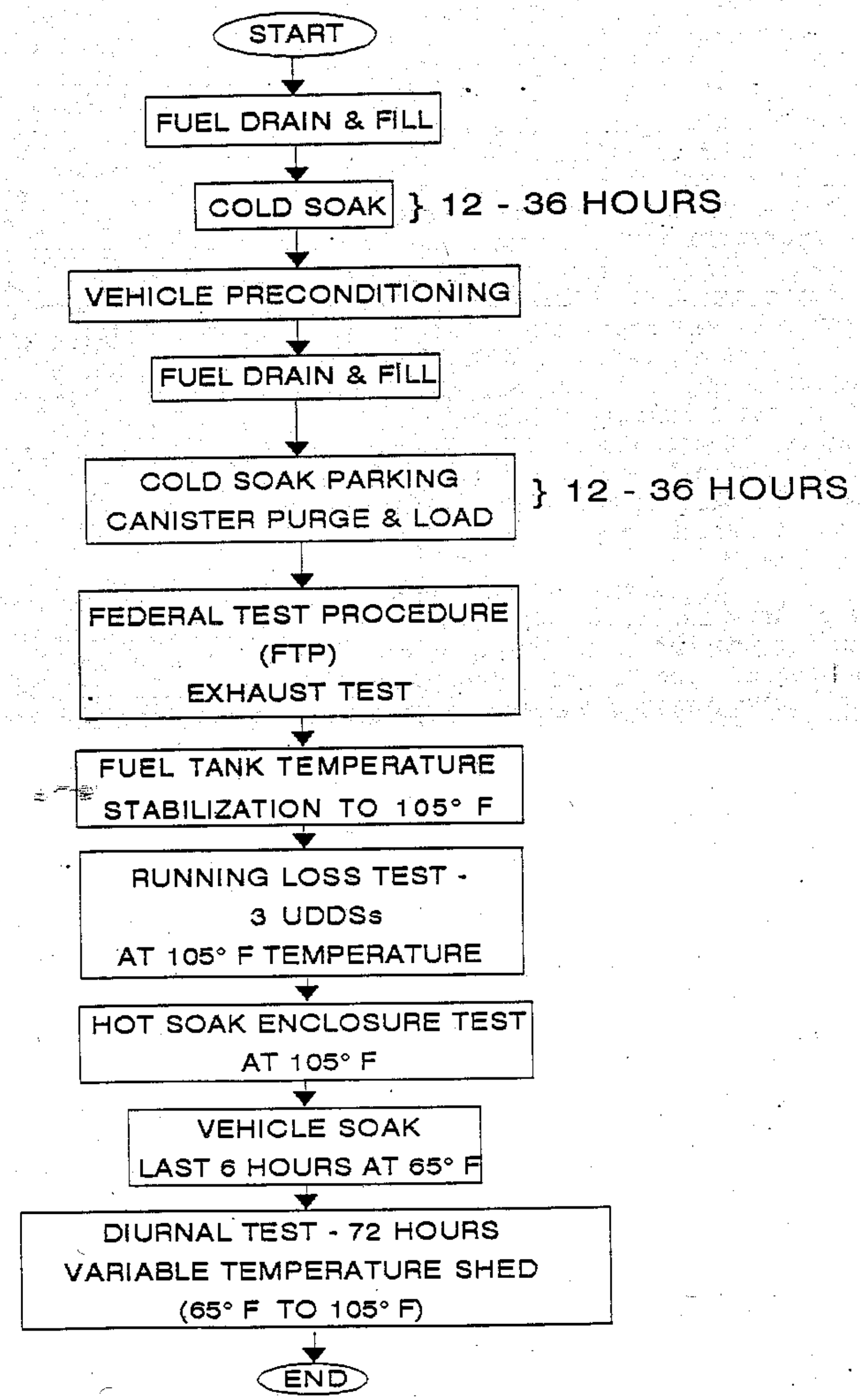

FIGURE 1. 1995 MODEL YEAR TEST PROCEDURES:
THE ENHANCED TEST PROCEDURES

a number of steps. After being properly prepared and preconditioned, a test vehicle undergoes the standard Federal Test Procedure (FTP) exhaust emissions test. The fuel temperature is then stabilized to 105°F in preparation for the running loss test. The running loss test consists of operating the vehicle through three recognized "Urban Dynamometer Driving Schedules" (UDDS) under conditions representative of high ozone-concentration days. The ambient temperature of the enclosure must be maintained at 105°F. The liquid and vapor fuel temperatures of the vehicle must match the liquid and vapor fuel temperature profile generated from an analogous or worst-case vehicle actually driven on-road on a 105°F temperature day. The hot soak test immediately follows the running loss test. Most hot soak emissions occur within the first ten minutes after engine shut-off. Accordingly, the vehicle must be within an enclosure where hot soak emissions can be measured within five minutes after engine shut-off. The sampled hot soak emissions are, therefore, the most realistic measurement of in-use hot soak emissions possible. The diurnal portion of the test simulates the conditions a parked vehicle would experience. The ambient temperature of the test enclosure cycles from 65°F to a maximum of 105°F three times over a three-day period. Thus, an evaporative canister must be designed to store the diurnal emissions generated throughout three hot summertime days.

To determine compliance, the highest emissions of the three twenty-four hour periods during the diurnal test are added to those generated during the hot soak test and are then compared to the 2.0 grams per test standard. The standard for the running loss test is 0.05 grams per mile. The standards are applicable to all passenger cars and light-duty trucks (LDTs), as well as all light medium-duty vehicles (MDVs) and heavy-duty vehicles (HDVs). Implementation of the enhanced test procedures begins in the 1995 model year with 10 percent of sales, and continues with 30 percent and 50 percent requirements in the 1996 and 1997 model years respectively. Full 100 percent compliance is required in the 1998 and subsequent model years.

The enhanced test procedures are not currently applicable to heavier MDVs in the 8,501 - 14,000 lbs. gross vehicle weight rating (GVWR) class. The test procedures for this class of vehicles were not revised at the time the enhanced test procedures were adopted. Therefore, these vehicles are currently only required to meet the Sealed Housing Evaporative Determination (SHED) conducted in accordance with the procedures set forth in Title 40, CFR, sections 86.130-78 through 86.143-90, as they existed on July 1, 1989.

Substantial HC emissions benefits are associated with the enhanced test procedures: 23-25 percent emissions reductions in the year 2000 and as much as 80-83 percent reductions in the year 2010 for passenger cars. Similar percentage reductions would also be expected in evaporative HC emissions from LDTs, light MDVs, and HDVs.

B. The Supplemental Procedure

When the ARB enhanced test procedures were adopted in August 1990, the U.S. EPA was still working on revisions to the federal evaporative emissions standards and test procedures. Section 202(k) of the federal Clean Air Act, as amended in November 1990, mandated that the federal regulations reflect the greatest degree of emission reductions achievable during vehicle operation and over two or more days of nonuse under summertime conditions, giving appropriate consideration to fuel volatility and to cost, energy, and safety factors. Manufacturers recommended at that time that the U.S. EPA adopt the ARB enhanced test procedures. The U.S. EPA staff was resistant to this recommendation because it believed that the ARB procedures could not ensure adequate purge of the canister during short trips. The ARB procedures allow a total of 100 minutes of driving time (31 minutes during the exhaust test and 69 minutes during the running loss test) to purge the loaded canister.[1] The U.S. EPA's concern was that the manufacturers may minimize the amount of purge from the canister during the exhaust test while allowing normal or even abnormally high purge flow during the running loss test, since exhaust emissions are not measured during the running loss test. If manufacturers incorporated this strategy, their vehicles would have a loaded canister that would be inadequately purged in the "real world" during short trips, causing saturation of the canister and breakthrough of vapor.

The ARB did not share the U.S. EPA's concern. The ARB staff contended that deliberately delaying purge or purging intermittently until the running loss test could be viewed as a defeat device (a strategy which circumvents the procedures) and would therefore be prohibited under existing regulations. Despite this position, the ARB staff did recognize that the prohibition of defeat devices may not be easily enforceable. Thus, during the federal rulemaking, the ARB staff acknowledged the possible merit of an additional safeguard, such as the supplemental procedure.

The U.S. EPA supplemental procedure (shown in Figure 2, left side) consists of vehicle preconditioning (which includes canister loading), the FTP exhaust test, a hot soak, and a two-day diurnal test. Assuring adequate canister purge is accomplished by eliminating the additional driving time of the running loss test. Accordingly, the evaporative emission control system must be designed such that it sufficiently purges the loaded canister during the 31 minutes of the exhaust emissions test to accommodate the hot soak and the two-day diurnal emissions.

III. SUMMARY OF RECOMMENDED ACTION

The staff recommends that the Board amend section 1976, Title 13, California Code of Regulations, and the incorporated "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Vehicles." The staff is proposing that the U.S. EPA supplemental procedure

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1. By the end of the running loss test, the canister must be purged because it must be capable of storing additional vapor generated during the hot soak and three-day diurnal test.

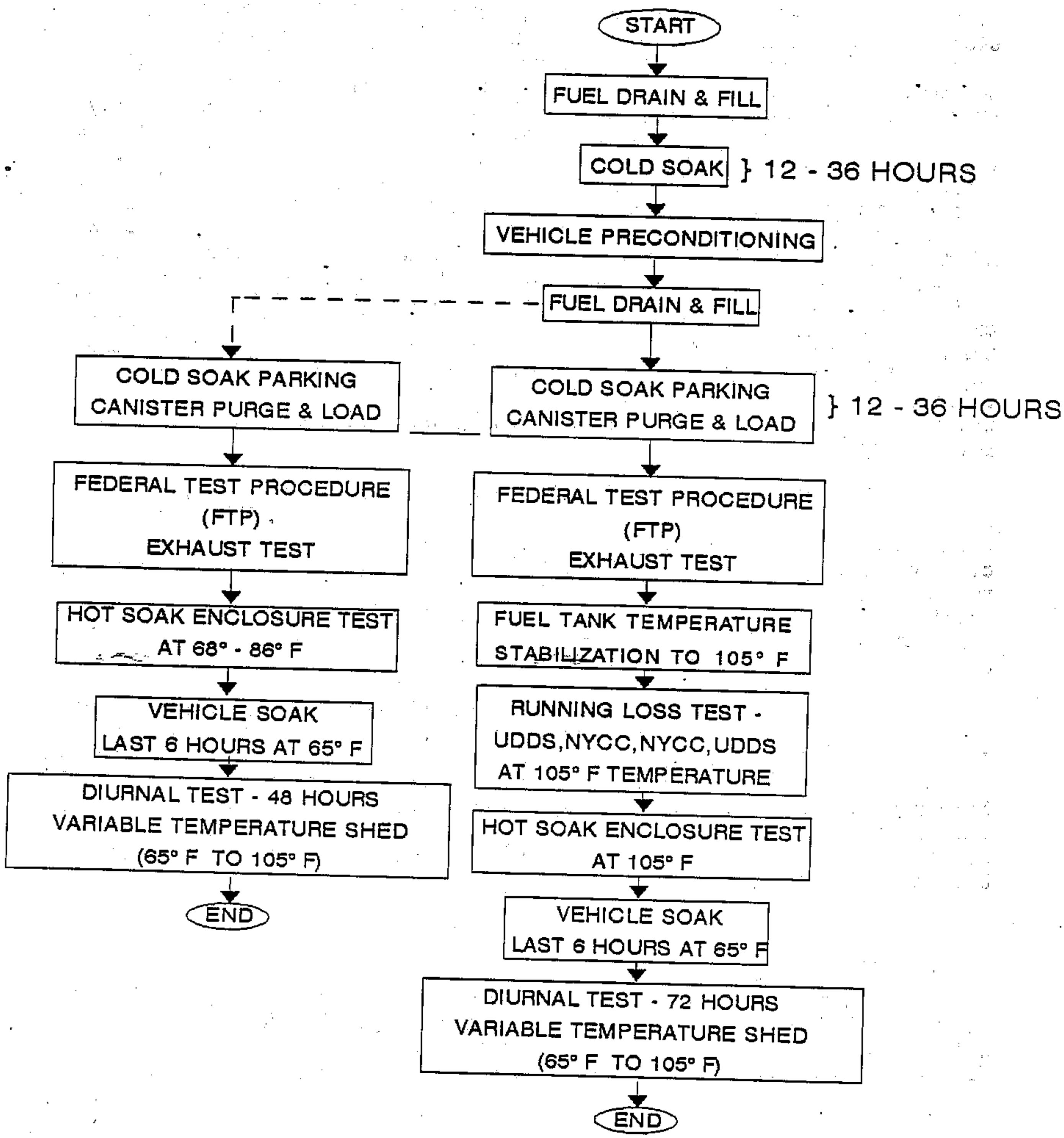

FIGURE 2. 1996 AND SUBSEQUENT MODEL YEAR TEST PROCEDURES: "NEW" ENHANCED TEST PROCEDURES AND SUPPLEMENTAL PROCEDURES

be incorporated into the ARB enhanced test procedures, effective in the 1996 model year. Thus manufacturers would be required to conduct both procedures for 1996 and subsequent model-year certification.

The complete test procedures required for certification are illustrated in Figure 2. The proposed ARB supplemental procedure is identical to the federal supplemental procedure except for the Reid Vapor Pressure (RVP) of the certification test fuel and the diurnal test temperatures. Both the existing ARB enhanced test procedures and the supplemental procedure proposed by the staff allow the use of a test fuel with a RVP of 7.0 psi and require cycling the temperatures from 65°F to 105°F for the diurnal test. The federal requirements specify the use of a test fuel with a RVP of 9.0 psi and diurnal temperatures ranging from 72°F to 96°. The ARB specifications were designed to reflect the commercial Phase 2 reformulated gasoline requirements and ambient conditions in California while the federal specifications are representative on a national level. As an alternative, the proposed ARB regulations allow the use of the federal test procedures with the corresponding federal fuel. Current data indicate that despite this difference in test fuel RVP and testing temperatures, the evaporative emissions generated in the federal testing sequence and the California sequence are roughly equivalent. Therefore, data generated with the lower RVP fuel and the higher ARB test temperatures should be accepted by the U.S. EPA as demonstrating compliance with the federal regulations, eliminating the need for duplicate tests.

The proposed diurnal plus hot soak standards for the supplemental procedure are compared to the corresponding standards for the ARB enhanced test procedures in Table 1. The standards for the supplemental procedure are numerically higher because the sole purpose of the supplemental procedure is to ensure adequate canister purge; it is not intended to increase the stringency of the complete evaporative emission test procedures or result in the need for any new vehicle hardware. The cost associated with this supplemental procedure will therefore be minimal.

Table 1

ARB Evaporative Emissions Standards

Class of Vehicles	3 Day Diurnal + Hot Soak Standard (grams/test)	Proposed Supplemental Standard (grams/test)
Passenger Car	2.0	2.5
Light-Duty Trucks	2.0	2.5
Medium-Duty Vehicles		
(6,000 - 8,500 lbs. GVWR)	2.0	3.0
(8,501 - 14,000 lbs. GVWR)	3.0	3.5
Heavy-Duty Vehicles		
(over 14,000 lbs. GVWR)	2.0	4.5

The staff is also proposing that complete heavy MDVs (8,501 - 14,000 lbs. GVWR) be required to certify according to the enhanced test procedures and the supplemental test, instead of the current SHED procedure. The combined diurnal and hot soak standard proposed for this class is 3.0 grams per test, as shown in Table 1. The staff is also proposing that these vehicles meet a running loss standard of 0.05 grams per mile. The proposed standards are identical to the recently adopted federal standards.

In addition to the incorporation of the supplemental procedure and the revised test procedure for the complete heavy MDV class, the staff proposes various technical modifications to the enhanced test procedures. Most of these modifications will harmonize the ARB enhanced test procedures with the federal evaporative emissions regulations. Modifications are also proposed to the test procedures to clarify some of the requirements. The proposed modifications are described below.

IV. DISCUSSION OF THE PROPOSED MODIFICATIONS

The proposed modifications to the evaporative emissions regulations will be identified and discussed in more detail in this section. Most of these changes parallel requirements in the federal evaporative emissions regulations, as amended March 24, 1993. These modifications would result in nearly identical ARB and U.S. EPA test procedures; manufacturers have expressed a need for consistent test procedures to minimize cost and testing burden. However, a few differences would remain between the two sets of test procedures, and these differences are discussed in Section V, "Remaining Differences with the Federal Regulations."

Most of the proposed modifications would be effective in the 1996 and subsequent model years. However, several of the proposed modifications would take effect beginning in the 1995 model year and are so indicated in the regulatory text.

A. Supplemental Procedure

The staff proposes that manufacturers be required to perform the supplemental procedure as part of the enhanced test procedure for the 1996 and subsequent model years. The supplemental procedure differs from the enhanced test procedures in several ways: one diurnal heat build is eliminated; the canister is loaded to breakthrough rather than to one and a half times breakthrough; the running loss test is not conducted; the hot-soak test is conducted at a moderate temperature; and the hot soak plus diurnal emissions standards are numerically higher.

B. Medium-Duty Vehicle Test Procedures

Currently, the complete heavy MDV class (8,501 - 14,000 lbs. GVWR) is the only vehicle class not required to demonstrate compliance with the enhanced evaporative test procedures. Staff is proposing that beginning in the 1996 model-year, complete heavy MDVs be required to certify according to the enhanced test procedures with diurnal plus hot soak and running loss standards of 3.0 grams per test and 0.05 grams per miles, respectively.

These standards are the same as the U.S. EPA standards for such vehicles. Although the proposed diurnal plus hot soak standard is numerically higher than the current ARB standard (3.0 vs. 2.0 grams per test), the increased stringency associated with the enhanced test procedures will result in an emissions benefit.

Incomplete MDVs, which are certified according to the heavy-duty engine exhaust emission standards and test procedures in Title 13, California Code of Regulations (CCR), section 1956.8, are currently required to demonstrate compliance with the enhanced test procedures through an engineering evaluation. Since the exhaust systems of these vehicles are certified according to the heavy-duty test procedures, their evaporative systems are also more appropriately certified according to the heavy-duty engine protocol, i.e., an engineering evaluation.

C. Carry-over of 1995 Model-Year Certification Data

Manufacturers expressed concern over their ability to carry-over 1995 model-year enhanced certification data in light of the new set of testing requirements proposed for the 1996 and subsequent model years. To alleviate this concern, staff is proposing to allow carry-over of 1995 model-year enhanced certification data as long as the supplemental test certification data is also provided. Applications for carry-over must be accompanied by an engineering analysis demonstrating that the durability and emissions of the vehicle for which certification is being sought will be adequately represented by a certified platform/powertrain/fuel tank combination application. In addition, staff is also proposing to allow the manufacturer to carry-across the enhanced test procedures durability data for the supplemental durability, provided it is demonstrated that the durability data of the enhanced test procedures are at least as stringent as the durability data that would be generated for the supplemental procedure.

D. Technical Revisions and Alignment with the Federal Regulations

Listed below are the remaining proposed amendments to the enhanced test procedures. These proposed modifications are intended to improve the effectiveness, practicality, and clarity of the test procedures.

(1) <u>Test Procedure Effectiveness</u>

- o Revise the running loss driving cycle schedule from three UDDSs, to two UDDSs and two New York City Cycles.
- o Require the pavement surface temperature during the running loss profile generation to be at least 30°F above ambient.
- o Require a temperature tolerance of ± 10°F for the first five minutes of the hot soak test.
- o Require the hot soak test to begin no more than five minutes after the completion of the running loss test and no more than two minutes after engine shutdown.
- o Require the engine intake air to be supplied from outside the enclosure, at a temperature of 105°F ± 5°F during the running loss test (atmospheric sampling method only).

- Establish a minimum overall circulation requirement of 1.0 cfm/ft^3 for the running loss test.
- Establish an air circulation criterion of 0.8 ± 0.2 cfm/ft^3 during both the hot soak and diurnal test.
- Require the use of vehicle options that limit underbody airflow if the production vehicles are so equipped.
- Require six consecutive monthly HC retention checks on the equipment without corrective action before reducing to quarterly checks.
- Require the use of the "highest expected" temperature profile in the running loss test rather than the "representative" temperature profile.

(2) <u>Test Procedure Practicality</u>

- Revise the humidity requirement during canister purge from 75 ± 10 grains of water per pound of dry air to 50 ± 25 grains of water per pound of dry air.
- Allow evaporative emission durability testing schedules to correspond to alternative exhaust emission durability testing schedules. (Currently, additional testing may be required since the testing schedules may not correspond.)
- Allow manufacturers to use alternative evaporative emission durability testing schedules, which is permitted for exhaust emission durability testing.
- Revise the implementation schedule compliance requirement from the number of vehicles to the percentage of vehicles, which is consistent with other ARB phase-in programs.
- Allow manufacturers the option of meeting the phase-in percentage requirement by grouping passenger cars and LDTs separately from MDVs and HDVs or by grouping passenger cars separately from LDTs, MDVs, and HDVs.
- Allow faster rates of canister loading if more than 12 hours at 15 grams/hour is required.
- Extend the stabilization period prior to the running loss test from 1 hour to up to 4 hours.
- Allow the canister to be removed from the vehicle for loading if it is inaccessible.
- Allow three speed variations greater than the tolerance during the running loss profile determination, 15 seconds each.
- Allow either continuous sampling or collection in bags for subsequent measurements for the point source method in the running loss test.
- Allow a soak period of 6-36 hours after the hot soak test and before the start of the diurnal test, with the last six hours at 65°F.
- Increase driving speed tolerance during the running loss temperature profile generation from ± 2 mph to ± 4 mph.
- Allow the driver the option to put the vehicle in neutral (for vehicles equipped with either manual or automatic transmission) during the idle periods in the running loss test.

- Limit the propane injection for calibration and retention checks to 2-6 grams.
- Include a transition procedure for transporting the vehicle from the running loss enclosure to the hot soak enclosure.
- Allow 10 minutes to transport a vehicle from the test area to a soak area if the vehicle is to be soaked at an ambient temperature other than 68°F to 86°F.
- Allow the use of electronic mass flow controllers as an optional technique of canister loading.

(3) <u>Test Procedure Clarity</u>

- Allow manufacturers to submit a test plan for evaporative emission testing of liquefied petroleum gas-fueled vehicles.
- Require collectors in the point source method of the running loss test to be positioned at emissions sources rather than only at the vapor vents of the vehicle's fuel system.
- Define the working capacity of the canister in terms of a two-gram breakthrough.
- Revise the calculations to include fixed-volume enclosures and fuel-flexible vehicles.
- Specify that the hood must be closed as much as possible during the point source method of the running loss test.
- Require a profile to be generated for each fuel tank, if multiple fuel tanks are used.
- Require each canister to be loaded separately, if multiple canisters are used.
- Limit the refueling to a maximum of 1 hour after the preconditioning drive.
- Specify that the test run is terminated if the engine coolant temperature warning light is illuminated.
- Include a fuel tank pressure limit of 10 inches of water during the running loss test if the point source method is used.
- Require fixed-volume enclosures to have a slightly negative pressure of 0 to -2 inches of water.
- Specify the temperature at which the nominal volume of the variable-volume enclosure is determined.
- Specify that the ambient temperature levels encountered by the test vehicle shall be not less than 68°F nor more than 86°F, unless otherwise specified.

E. Implementation of Proposed Modifications in the 1995 Model Year

In order to alleviate potential testing difficulties and inconsistencies, staff is proposing to allow manufacturers the flexibility of applying the 1996 and subsequent model year modifications to 1995 model-year certification testing. Manufacturers would have the option to use portions or the complete set of proposed modifications in the 1995 model year. If a manufacturer elects to use this option, prior Executive Officer approval would be needed based on a showing that the effectiveness of the evaporative control system is not diminished. This provision will minimize any additional testing time or equipment necessary for the implementation of these proposed modifications.

V. REMAINING DIFFERENCES WITH THE FEDERAL REGULATIONS

The proposed regulations differ in a few areas from the evaporative emissions regulations adopted by the U.S. EPA. The following is a list of these differences. The explanation/justification of each difference is also provided.

A. Test Temperatures

The staff is not proposing to amend the ARB's current 105°F testing temperature requirement for the enhanced test procedures. The corresponding federal requirement is 95°F. The 105°F specification is representative of high ambient summer temperatures in California and provides a worst-case condition when the probability of gross evaporative emissions is highest. The federal specification of 95°F is typical of ambient conditions on a national level. Fuel evaporation is highly dependent on temperature and thus the higher ARB testing temperature independent of other factors will result in greater emissions control than the federal test procedures. Maintaining the 105°F specification is also appropriate in light of the option to use lower-RVP Phase 2 certification gasoline as discussed below.

B. Test Fuel RVP

Manufacturers of 1995 and subsequent model-year gasoline-powered motor vehicles and engines (except motorcycles) have the option in California of using emission-test fuels meeting either of two sets of specifications while the federal regulations offer the use of only one of these emission-test fuels for certification testing. The first fuel, referred to as Phase 2 certification gasoline, reflects the specifications for Phase 2 reformulated gasoline that will be commercially available in California starting in the spring of 1996. The other fuel, commonly referred to as Indolene, is identical to the only certification gasoline identified in the federal test procedures. Phase 2 certification gasoline has a RVP within the range of 6.7-7.0 psi. Indolene has a RVP between 8.7 and 9.2 psi. The California test procedures for passenger cars, LDTs, and MDVs provide that when a manufacturer elects to certify using Phase 2 certification gasoline, both exhaust and evaporative emission testing is to be conducted using that fuel.

Manufacturers are generally expected to certify their 1995 and subsequent model-year vehicles and engines using Phase 2 certification gasoline, because it results in reduced mass exhaust emissions compared to Indolene. When Phase 2 certification gasoline is used in the evaporative emission tests, the lower RVP will result in less evaporative emissions in comparison to the federal Indolene fuel. However, the higher ARB testing temperature of 105°F will offset the emissions differences resulting from the lower RVP test fuel. The limited data now available indicate roughly equivalent evaporative emissions will result from using Phase 2 certification gasoline with a 105°F test procedure, compared to the use of federal Indolene and a 95°F test procedure.

Because the use of Phase 2 certification gasoline provides one of the strategies manufacturers will use to meet the ARB's stringent low-emission vehicle standards, and because it best reflects the gasoline that will be used in California, it is important to retain the option of using it in evaporative emission testing. In order for the California evaporative emission standards to remain as protective as the federal standards, the 105°F test temperature is needed to offset the emissions impact of the lower RVP test fuel. We expect that the U.S. EPA will be willing to issue federal certification to vehicles that meet the California evaporative emission standards and test procedures, thus avoiding the need for separate California and federal tests. However, to assure that inconsistencies between the California and federal test procedures do not pose problems for California's waiver of federal preemption, the staff's proposal allows a manufacturer to use the federal evaporative emission test procedures when the manufacturer chooses Indolene as the certification test fuel. This is discussed in more detail in Section VII below.

C. Emission Standards

As shown in Table 2, the ARB's three-day diurnal plus hot soak emission standards for HDVs and some MDVs are more stringent than the federal standards. A more thorough discussion on this issue is provided in Section VI, "Issues of Controversy."

D. Running Loss Temperature Control

In the running loss test, the ARB test procedures require that the manufacturers control the fuel *vapor* temperature for the last 120 seconds of the test within a tolerance of ± 3°F of the running loss profile. (This requirement is in addition to the control of the fuel *liquid* temperature within a tolerance of ± 3°F of the profile during the entire duration of the running loss test.) Controlling the fuel vapor temperature during the last 120 second of the test is critical because it can have a significant impact on vapor generation. While vehicle manufacturers do not dispute this point, they do argue that the fuel vapor temperature is more difficult to control than fuel liquid temperature. The federal specifications tighten the tolerance on the fuel *liquid* temperature from ± 3°F to ± 2°F in the last 120 seconds as a means of increased fuel vapor temperature control. Manufacturers would not need to perform duplicate tests due to this difference between the two procedures since both ARB's *vapor* temperature tolerance and U.S. EPA's slightly less rigorous *liquid* temperature tolerance can be met simultaneously. Further discussion on the issue is also provided in Section VI, "Issues of Controversy."

E. Running Loss Temperature Profile Correction Factor

The ARB allows manufacturers to initiate the running loss test at a lower starting temperature than 105°F if the manufacturer can demonstrate

Table 2
Comparison of the ARB and the Federal Evaporative Emission Standards

Class of Vehicles	3 Day Diurnal + Hot Soak (grams/test)		Supplemental Procedure (grams/test)	
	ARB	Federal	ARB	Federal
Passenger Car	2.0	2.0*	2.5	2.5
Light-Duty Trucks	2.0	2.0*	2.5	2.5
Medium-Duty Vehicles				
(6,001 - 8,500 lbs. GVWR)	2.0	2.0*	3.0	3.0
(8,501 - 14,000 lbs. GVWR)	3.0	3.0	3.5	3.5
Heavy-Duty Vehicles				
(over 14,000 lbs. GVWR)	2.0	4.0	4.5	4.5

* 2.5 grams/test for vehicles with fuel tanks equal to or greater than 30 gallons.

that the fuel temperature would be less than 105°F on a 105°F ambient temperature day. This provision encourages manufacturers to develop mechanisms which would keep the fuel cooler than the ambient temperature during hot summer days. The federal test procedures do not contain such an allowance and thus would not provide any incentive for manufacturers to develop and use such mechanisms. Similarly, the federal temperature correction factor does not address those evaporative control fuel systems which would have an in-use fuel temperature higher than the prescribed running loss test temperature. Such a vehicle could have high evaporative emissions in-use which would not be detected in the running loss test. A more detailed discussion is provided in Section VI, "Issues of Controversy."

F. Cooling Fan Specifications

The ARB fan specifications are different from the federal specifications. Staff believes that the ARB specifications provide a more representative simulation of "wind" conditions and thus will not create any unrealistic cooling of the vehicle. However, the federal specification may be less costly. The federal specifications do allow the use of the ARB's cooling fan specifications. In addition, the ARB regulations allow alternative fan configurations, such as the federal specifications, with Executive Officer approval, if the manufacturer can demonstrate that the equipment will yield test results equivalent to those resulting from the use of the specified fan configuration.

G. Air Circulation Under the Fuel Tank During the Diurnal Test

The U.S. EPA was concerned that during the diurnal test, present air circulation specifications would be inadequate and would develop temperature stratification under the fuel tank. To alleviate this concern, the proposed modification of the air circulation specification increases the airflow from 0.3 to 0.6 cubic feet per minute per cubic feet of the nominal enclosure volume to 0.6 to 1.0 cubic feet per minute per cubic feet of the nominal enclosure volume. This airflow specification is consistent with the enhanced federal test procedures. In addition, to ensure adequate mixing of the heated air, the federal procedures require the use of a 5 miles per hour underbody fan. Manufacturers have informally indicated that this underbody circulation is hard to quantify and maintain since its measurement is highly dependent on the configuration of a vehicle underbody. Therefore, the staff has chosen to propose a more straightforward approach of placing a thermocouple under the fuel tank. The underbody thermocouple must meet an instantaneous tolerance of ±3°F of the nominal enclosure temperature.

H. Pressure Limit During the Running Loss Test

The proposed ARB regulations require the fuel tank pressure during the running loss test to be less than 10 inches of water from 30 seconds after the start of the engine until the end of engine operation. Federal regulations do not provide for a 30-second allowance. The 30-second allowance was proposed to address industry's concern over the fuel tank pressure observed at the beginning of the running loss test. After the exhaust test, a one to four hour soak period is allowed where the fuel may be heated to the initial running loss test temperature of 105°F (95°F for the federal procedure). This manipulation of the fuel tank temperature in combination with a soak at high temperatures may cause the fuel tank vapor pressure to unnaturally increase and exceed the 10 inches of water limit during the initial portion of the running loss test. Since the purpose of the fuel tank pressure requirement is to prevent emission losses during refueling, this 30-second allowance will not affect the stringency of the test.

VI. ISSUES OF CONTROVERSY

Technical mail-outs describing the proposed modifications were sent to interested parties on May 14, 1993, and October 1, 1993. Manufacturers and others were encouraged to submit comments on the proposed modifications. Meetings with interested parties were also arranged if requested. The current proposal includes a number of modifications which reflect written comments received during the technical mail-out comment periods and comments made during individual meetings. However, as summarized below, several significant issues remain in which staff's position differs from the comments received.

A. Evaporative Emissions Standards

In its May 14, 1993, technical mail-out, staff proposed a diurnal plus hot soak standard of 2.0 grams per test for all vehicles, including complete heavy MDVs, for which the enhanced test procedures were also being proposed. Several manufacturers expressed concern over the requirements for testing vehicles in the heavy MDV class according to the enhanced test procedures with the proposed standard. Manufacturers asserted that requiring these vehicles to meet the three-day diurnal plus hot soak standard is technically difficult and is not cost-effective. These manufacturers stated that the ARB standard should coincide with the less stringent federal standard of 3.0 grams per test. In addition to the diurnal emissions that could be associated with the larger fuel tanks in these vehicles, manufacturers believe that a larger number of accompanying fuel lines, hoses, and connectors will result in greater permeation losses, which in turn will increase both diurnal and hot soak emissions. Manufacturers have also similarly asserted that the ARB should relax its existing standards for LDTs and light MDVs with large fuel tanks and HDVs, to be consistent with the federal standards.

Response: Compared to passenger cars and LDTs, the potential for excessive evaporative emissions from heavy MDVs equipped with larger fuel tanks could likely be offset by their relatively greater backpurge effects, better fuel tank cooling, and additional room for larger canisters. Thus, staff does not agree with manufacturers' assertion that meeting a 2.0 grams per test standard would be technically difficult and cost-ineffective. However, staff recognizes that the larger fuel tanks may necessitate greater purge flow. The greater purge flow would likely have a significant impact on whether the vehicle could meet the low-emission vehicle exhaust standards. Therefore, because manufacturers have not had sufficient lead time to design a system that minimizes these interactions, staff is proposing the less stringent federal standard of 3.0 grams per test for complete heavy MDVs. Currently, minimal data are available on the effects of purge interactions for these vehicles. If future data indicate this effect is not excessive, staff intends to propose that the hot soak plus diurnal standard for the complete heavy MDV class be revised to a more stringent 2.0 grams per test standard to be consistent with the standard for the other vehicle classes.

The staff is not proposing changes to the existing ARB emission standards for either LDTs and complete light MDVs with large fuel tanks, incomplete MDVs, or HDVs, all of which have less stringent federal standards. Since the ARB standards were adopted in 1990, manufacturers have had sufficient lead time to minimize possible purge interactions. Also, for HDVs, the effect of purge interactions are much less significant since these vehicles are not currently subject to any low-emission exhaust standards. It should also be noted that manufacturers have not submitted any data or other pertinent information which would indicate a compelling need for a relaxation of these standards.

B. Running Loss Emissions Determination: Enclosure vs Point Source

The enhanced test procedures allow the use of either of two methods of determining running loss emissions: enclosure (which incorporates atmospheric sampling) and point source (which utilizes discrete samplers at suspected sources of emissions). In this respect, the ARB procedures are identical to the U.S. EPA procedures. Manufacturers have expressed concern that the enclosure method of determining running loss emissions is not technically feasible due to safety issues. Manufacturers believe that the current procedures do not comply with Federal regulations promulgated under the Occupational Safety and Health Act and that to resolve these safety concerns would necessitate revisions that would excessively sacrifice precision in the enclosure measurements. Thus, they do not believe that based on current technology, the enclosure method should be used. Nearly all manufacturers are using the point source method for developmental work and for certification testing. Though they acknowledge that the point source method does not collect all the evaporative losses during the running loss test, they believe that this methodology is the only feasible option at this point. Therefore, they request that the ARB use only the point source method for in-use compliance testing.

Response: The enclosure method provides a more complete determination of the running loss emissions that would occur in-use. Vehicle running loss emissions may emanate from fuel vapor vents as well as from hose joints, hoses (permeation), engine gaskets and seals, and other fuel system sources. While the point source method can adequately collect emissions from major sources, many of the smaller emission sources may not be sampled. Collectively, these vehicle "fugitive emissions" could contribute significantly to overall running loss emissions.

The ARB is currently in the process of constructing a running loss enclosure which is projected to be completed by mid-1994. The HC (and alcohol, if applicable) concentration will be consistently monitored during the running loss test to ensure that the enclosure concentration does not increase dramatically or approach the flammability limit. If at any time the HC concentration reaches 15,000 parts per million carbon, the test shall terminate and the entire enclosure purged. This concentration allows for at least a four to one safety factor against the lean flammability limit. The enclosure is equipped with an evacuation system which can purge the entire volume of the enclosure within 15 seconds. In addition, the carbon monoxide concentration is also monitored to ensure that no exhaust gas leaks inside the enclosure.

To alleviate the concern of the safety of personnel inside the enclosure when the test is being conducted, engine controls can be manipulated via robot drivers. Robot drivers are available for both automatic and manual transmission-equipped vehicles. Though robots capable of manipulating manual-transmission configurations are substantially more expensive, a manufacturer would only need a limited number of these robots to perform the necessary tests for their entire product line. The ARB intends to use robot drivers for testing vehicles with an automatic transmission. Due to the wide range of manual-transmission configurations that the ARB will test, it would not be practical for the ARB to utilize robot drivers. In these instances, where vehicles equipped with an manual transmission are to be tested, personnel would be required to manually operate the vehicle during the test cycles.

Inspectors from both the California Occupational Safety and Health Consultation Service and the State Fire Marshal have visited the facilities and have been consulted on the necessary safety precautions. Both parties indicated that the ARB's current safety precautions are adequate. They did not believe the issues raised by the manufacturers presented insurmountable difficulties. In addition, discussions with staff from Automotive Testing Laboratories Inc., which currently has three running loss enclosure facilities, did not indicate any safety problems associated with the enclosure method. One of their facilities in particular has been using the enclosure since 1990.

In conclusion, staff believes that the enclosure method is a technologically feasible and safe approach for determining running loss emissions and that the ARB needs to maintain the flexibility of using either the point source method or the enclosure method.

C. Running Loss Profile Correction Factor

Several manufacturers commented on the running loss profile correction factor. Since the running loss fuel temperature profile may be developed at any ambient temperature greater than 95°F, the profile must be adjusted so that it is representative of a fuel temperature profile on a 105°F ambient temperature day (or at 95°F per the federal requirements).

Some commenters suggest the use of the method specified in the Society of Automotive Engineers (SAE) Paper 930078[2]. This method corrects the profile based on the fuel characteristic of the vehicle. Another commenter indicated that the federal method is more accurate in adjusting the on-road profile and is preferred. The federal correction factor adjusts the fuel temperature profile based on an initial 95°F fuel temperature. Others preferred the original ARB methodology. The ARB correction factor adjusts the fuel temperature profile based on a 105°F ambient temperature.

<u>Response:</u> The SAE method for the profile correction requires that a fuel characteristic curve be developed for each engine family. In order to alleviate this burden, manufacturers proposed to use an average fuel characteristic curve for all engine families. Staff believes that it would not be appropriate to allow an average curve for all engine families since data from manufacturers show that the range of the curve may deviate significantly from the average and would result in an inaccurate correction of the fuel temperature profile.

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2. Tam M. Cam, Kevin Cullen, Steve L. Baldus, and Karl A. Sime, "Running Loss Profiles", SAE Paper 930078.

Manufacturers have not provided any data which could support their preference for either the federal or ARB correction factor. The staff is proposing modifications of the ARB correction factor to clarify its use for adjusting the profile. Compared to the federal correction factor, staff believes that because the ARB correction factor allows adjustments of the fuel temperature profile, it will provide greater evaporative emissions reductions. The federal methodology always adjusts the initial fuel temperature to 95°F regardless of system design. This methodology would not benefit system designs that would maintain relatively cool fuel temperatures nor penalize designs that would actually generate higher fuel temperatures than the ambient temperature. The proposed ARB regulations consider such designs and would provide incentives for manufacturers to develop such mechanisms which, in turn, would have in-use evaporative emissions benefits.

The current regulations allow for other methodologies, such as the SAE method or the U.S. EPA method, for correcting the liquid and vapor fuel temperature profiles with advance approval by the Executive Officer if the manufacturer demonstrates equivalence to data collected at 105°. If manufacturers believe that another method is more appropriate, this provision will allow consideration of the specific alternative correction method.

D. Running Loss Test Fuel Vapor Temperature Control

Manufacturers have expressed concern that the fuel vapor temperature during the running loss test is extremely difficult to control. The ARB regulations specify that fuel vapor temperatures during the last 120 seconds of the running loss test must follow the profile fuel vapor temperature within ± 3°F. The federal specifications, rather than require fuel vapor temperature control, require a tight fuel liquid temperature tolerance of ± 2°F as a means of increased control during the last 120 seconds.

Some manufacturers have also expressed concern that the fuel vapor temperature during the last 120 seconds can directly affect the performance of the evaporative system and thus, following the fuel vapor temperature profile trace is important. They have also indicated that despite the difficulty, it is possible to maintain the fuel vapor temperature within ± 3°F of the fuel vapor temperature profile during the last 120 seconds of the running loss test.

Response: The American Automobile Manufacturers Association (AAMA) supports the ARB's fuel vapor temperature requirement while some individual manufacturers oppose it in favor of the federal approach. The fuel vapor temperature, rather than the fuel liquid temperature, is the more accurate representation of evaporative emissions. The fuel vapor temperatures on-road and during dynamometer operation may differ due to the on-road agitation and vibration of the fuel that is absent from dynamometer driving. The requirement for vapor control during the last 120 seconds of the running loss test is necessary and therefore, the staff is not proposing to revise this requirement.

E. Background Emissions

In the May 14, 1993, mail-out, staff requested manufacturers and interested parties to comment on the allowance of subtracting background emissions from the total measured emissions of the running loss test, hot soak test, and the diurnal test if these background emissions adversely affect test accuracy. In addition, staff requested comments on the types of emissions that would be considered in this subtraction. Manufacturers commented that the ARB should retain this allowance of subtracting background emissions from the results. They believe that non-fuel emissions should be categorized as "background" emissions and should be differentiated from fuel evaporative emissions, especially since their impact on ozone is considerably less.

U.S. EPA staff provided comments stating their concern of allowing such a subtraction from the total measured emissions. Their belief is that any evaporative emissions emitted by the vehicle should be considered as part of the test, whether fuel or non-fuel, and thus, the federal regulations do not allow such an allowance. In addition, U.S. EPA staff indicated that such an allowance may result in waiver concerns over the stringency of the federal and California test procedures.

Response: Staff is not proposing any modifications to the background emissions allowance at this time. The subtraction of background emissions will be allowed if the manufacturer demonstrates that background emissions adversely affect test accuracy. The staff will work closely with the U.S. EPA staff to determine what types of emissions may be defined as background emissions, in order to provide consistency for both federal and California testing measurements and quantification.

F. On-board Vapor Recovery

As a result of a decision on January 22, 1993, by the U.S. Court of Appeals for the District of Columbia Circuit, the U.S. EPA is mandated to promulgate standards for On-board Refueling Vapor Recovery (ORVR) for light-duty vehicles. The ORVR system is designed to control evaporative emissions during refueling. The federal adoption of ORVR regulations may necessitate modification to the federal evaporative emissions regulations since ORVR procedures may not be compatible with present evaporative test procedures. The U.S. EPA staff is presently involved in the rulemaking process for these regulations.

Since 1975, the Air Pollution Control Districts in California, have controlled refueling emissions by requiring Stage 2 vapor recovery systems at service stations. However, due to the U.S. Court of Appeals' mandate, California may be required to consider the use of ORVR systems which will either complement or replace the existing Stage 2 vapor recovery systems. This issue is not part of the proposed rulemaking. It will be more appropriately addressed as part of the rulemaking on refueling tentatively scheduled for consideration in August 1994.

G. Spitback Test

The U.S. EPA has also adopted a spitback test along with the federal evaporative emission regulations. This test ensures that no spitback occurs during refueling of a gasoline- or methanol-fueled vehicle at a rate of up to 10 gallons per minute. The ARB has a comparable spillage test as part of the Specifications for Fill Pipes and Openings of Motor Vehicle Fuel Tanks Regulation. In addition, as part of proposed amendments to the ARB's Stage 2 Vapor Recovery Test Procedure, there is a spillage test that is conducted for certification of service station vapor recovery systems. This test not only takes into account the spillage due to the interaction of the nozzle with the vehicle, but also measures spillage due to consumer habits. Again, it is more appropriate to consider the spitback test requirements in connection with the more closely related refueling regulations scheduled for consideration in August 1994.

VII. WAIVER CONSIDERATIONS

Under section 209 of the federal Clean Air Act (42 U.S.C. §7543), the ARB is required to seek a waiver of federal preemption after it adopts emission standards for new motor vehicles. The waiver request is to be accompanied by the ARB's determination that the California emission standards will be, in the aggregate, at least as protective of the public health and welfare as the applicable federal standards. The U.S. EPA is required to issue the waiver unless the Administrator finds (1) that the ARB's protectiveness determination is arbitrary and capricious, (2) that the state standards and test procedures are not consistent with section 202(a) of the federal Clean Air Act, or (3) that California does not need separate state standards to meet compelling and extraordinary conditions. Congress has made clear that the underlying intent of the waiver provision is to afford California the broadest discretion in selecting the best means to protect the health of its citizens and the public welfare.

Following adoption of the enhanced test procedures, the ARB requested a waiver of preemption covering the California evaporative emission standards as applied under the enhanced test procedures. In connection with the request, the Board determined that the state standards were, in the aggregate, at least as protective of the public health and welfare as the applicable federal standards. This determination was based on a comparison of the amended California evaporative emissions regulations with the then-existing "unenhanced" federal regulations. After U.S. EPA's March 1993 adoption of the enhanced federal test procedures (phased-in starting with the 1996 model year), the ARB Executive Officer asked U.S. EPA to limit the pending waiver request to 1995 model-year motor vehicles. This will allow the evaluation of the waiver request for the 1996 and subsequent model years to be made on the basis of the California evaporative emissions regulations as updated by the present rulemaking.

The staff believes that the Board's protectiveness finding regarding the California enhanced test procedures is still valid, both when the currently existing state and federal evaporative emission standards and enhanced test procedures are compared, and when the complete state motor vehicle exhaust and evaporative emission standards are compared to the corresponding federal standards. However, the Board's adoption of the supplemental procedure will eliminate any concerns that the lack of such a procedure undermines the protectiveness of the California standards. As discussed above, the other aspects of the California evaporative emission standards will be, in the aggregate, at least as protective as the corresponding federal standards. The differences in test fuel RVP and test temperatures roughly offset each other, and the other differences result in the California requirements being on balance at least as stringent as the U.S. EPA's.

The waiver requirement that the California regulations be consistent with section 202(a) of the federal Clean Air Act has two components. First, the state regulations need to be technologically feasible within the available leadtime, giving appropriate consideration to the cost of compliance in the time provided. The Board has already found that the existing enhanced test procedures are technologically feasible. Most of the modifications now being proposed are already required under the federal program and no significant concerns regarding technological feasibility have been raised.

The second part of the "consistency" requirement is that the California and federal test procedures cannot be so different that a vehicle is precluded from being tested under the two sets of procedures at the same time. The U.S. EPA will waive this requirement if it is satisfied that any vehicle meeting the California certification requirements will necessarily meet the federal standards. In that case, the U.S. EPA will accept the California test results for purposes of federal certification and two sets of tests will not be necessary.

The differences in test temperature and test fuel RVP do preclude manufacturers from using one test to directly determine compliance with both the state and federal evaporative emission standards. However, as discussed in Section V.B., the staff expects that successful tests conducted using the lower RVP gasoline allowed by the California regulations with the higher ARB test temperatures would be accepted by U.S. EPA as demonstrating compliance with the federal regulations, eliminating the need for duplicate tests. In case the U.S. EPA chooses not to accept the California test results, the staff proposal provides for an optional means of compliance in which a manufacturer wishing to do so can meet both the state and federal requirements with one test. Under the option, a manufacturer choosing to conduct the exhaust and evaporative emission tests with Indolene would use the federal evaporate emission test procedures rather than the California procedures. This option should provide additional assurance that the U.S. EPA will not find the state test procedures inconsistent with the corresponding federal procedures.

VIII. REGULATORY ALTERNATIVES

One alternative considered by staff was to preserve the status quo by relying on defeat device restrictions to ensure adequate purge during short trips and allowing the differences to remain between the federal and the ARB procedures. However, enforcement of the purge strategies in-use would be both impractical and difficult. With regard to the differences between the federal and the ARB procedures, it is in the best interest of the U.S. EPA, the ARB, and manufacturers to pursue common evaporative emission test procedures. The proposed amendments strive to do just that. Thus, no alternatives considered would be more effective in carrying out the purpose for which this regulatory action is proposed or would be as effective or less burdensome to affected private persons than the proposed action.

IX. AIR QUALITY, ENVIRONMENTAL AND ECONOMIC IMPACTS

A. Air Quality and Environmental Impacts

The proposed amendments to the evaporative emissions test procedures are designed to parallel the federal procedures. Most of the modifications are related to minor technical differences that will not affect the stringency of the test and thus will not result in quantifiable changes in emissions. The addition of the supplemental procedure will provide added assurance that the emission benefits originally projected for the enhanced test procedures will be realized.

Implementation of the enhanced test procedures for the complete heavy MDV class will result in a small emissions benefit of approximately 4 tons HC per day statewide by the year 2010. This estimate is based on the U.S. EPA emissions reduction factors from the baseline emissions as a result of the use of the federal enhanced test procedures. It should be noted that the emissions benefit is calculated from the entire estimated fleet of heavy MDVs, both complete and incomplete vehicles since it is difficult to predict at this time which certification procedure manufacturers will use to certify heavy MDVs: the enhanced test procedures (complete vehicles) or the heavy-duty engine exhaust emission test procedures (incomplete vehicles). At a useful vehicle life of 120,000 miles, a total reduction of 66 pounds of HC per vehicle lifetime would result.

Staff has not identified any significant adverse environmental impacts that would result from the proposed amendments.

B. Cost, Cost-Effectiveness, and Economic Impacts

Staff estimates the manufacturer's cost associated with the implementation of the enhanced test procedures for complete heavy MDVs will be approximately $11 per vehicle: $8.60 in hardware costs, $0.90 in packaging costs, $0.35 in research, development, and testing costs, $0.15 in certification costs, and $0.60 in facilities costs. These figures are based on cost estimates made by the U.S. EPA for the vehicles in this weight and class to implement the federal enhanced test procedures. With an average emissions reduction of 66 pounds of HC per vehicle lifetime and estimated sales of less than 50,000 vehicles per year in California, the cost-effectiveness of the proposed regulations for these vehicles by industry is $0.17 per pound of HC reduced and a total cost to industry of less than

$550,000 per year. This cost-effectiveness compares favorably with the cost-effectiveness of other mobile source control measures recently adopted.

Implementing the supplemental test will not contribute to any significant costs. Since the supplemental test consists of test segments similar to those in the enhanced test procedures (i.e., vehicle preconditioning, the FTP exhaust test, the hot soak test, and the diurnal test), conducting the supplemental procedure will not require any additional equipment or facility modifications. The only contributions to cost by implementing the supplemental procedure will be due to additional testing time necessary to conduct the supplemental test.

Implementing the remaining proposed modifications will not contribute to any substantial design or manufacturing costs, since most of the proposed changes are intended simply to either clarify the existing enhanced test procedures or provide for a common ARB/U.S. EPA test procedure. Since the effective implementation date of the federal enhanced test procedures is in the 1996 model year, any ARB proposed modification designed to align with the federal regulations, which would be required in the 1996 model year, would not incur any additional cost to the manufacturer or the consumer. In addition, many of these proposed modifications are aimed at facilitating manufacturers in conducting the evaporative emission testing and may result in a reduction of overall testing time and savings in costs. Therefore, any increased costs associated with the implementation of these proposed modifications would be minimal.

The adoption of this regulatory action will not have an adverse economic impact on small businesses.

REFERENCES

1. California Air Resources Board. 1990. Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Responses: Public Hearing to Consider the Adoption of Amendments to Regulations Regarding Evaporative Emissions Standards, Test Procedures, and Durability Requirements Applicable to Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles and Heavy-Duty Vehicles. Mobile Source Division. El Monte, California.

2. California Air Resources Board. 1990. Staff Report: Public Hearing to Consider Amendments to Regulations Regarding Evaporative Emissions Standards, Test Procedures, and Durability Requirements Applicable to Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles. Mail-out #90-45. Mobile Source Division. El Monte, California.

3. California Air Resources Board. 1990. Technical Support Document for a Proposal to Amend Regulations Regarding Evaporative Emissions Standards, Test Procedures, and Durability Requirements Applicable to Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles. Mail-out #90-45. Mobile Source Division. El Monte, California.

4. Motor Vehicle Manufacturers Association of the United States, Inc. 1991. MVMA Motor Vehicle Facts & Figures '91. MVMA. Detroit, Michigan. 96 pp.

5. United States Environmental Protection Agency. 1993. Control of Air Pollution From New Motor Vehicles and New Motor Vehicles Engines: Evaporative Emission Regulations for Gasoline- and Methanol-Fueled Light-Duty Vehicles, Light-Duty Trucks and Heavy-Duty Vehicles. Federal Register. Vol. 58, No. 55. Docket A-89-18. Washington, D.C.

6. United States Environmental Protection Agency. 1993. Final Regulatory Impact Analysis and Summary and Analysis of Comments: Control of Vehicular Evaporative Emissions. Docket A-89-18. Washington, D.C.

Appendix A

PROPOSED

Amend Title 13, California Code of Regulations, section 1976, to read as follows:

1976. Standards and Test Procedures for Motor Vehicle Fuel Evaporative Emissions.

(a) Fuel evaporative emissions from 1970 through 1977 model passenger cars and light-duty trucks are set forth in Title 40, Code of Federal Regulations, Part 86, Subparts A and C, as it existed on June 20, 1973. These standards are enforced in California pursuant to section 43008 of the Health and Safety Code.

(b)(1) Evaporative emissions for 1978 and subsequent model gasoline-fueled, 1983 and subsequent model liquefied petroleum gas-fueled, and 1993 and subsequent model alcohol-fueled motor vehicles and hybrid electric vehicles subject to exhaust emission standards under this article, except petroleum-fueled diesel vehicles, hybrid electric vehicles that have sealed fuel systems which can be demonstrated to have no evaporative emissions, and motorcycles, shall not exceed~~:~~ the following standards.

(A) For vehicles identified below, tested in accordance with the test procedure based on the Sealed Housing for Evaporative Determination as set forth in Title 40, Code of Federal Regulations, sections 86.130-78 through 86.143-90 as they existed July 1, 1989, the evaporative emission standards are:

~~Hydrocarbons or OMHCE (1)~~

~~Hot Soak + Diurnal (grams per test) 50K Useful Life (2)~~ ~~Running Loss (grams/mile) Useful life (2)~~

Vehicle Type	*Model Year*	*Hydrocarbons (1) Diurnal + Hot Soak (grams/test) 50K miles*
Passenger cars	1978 and 1979	6.0
Light-duty trucks		6.0
Medium-duty vehicles		6.0
Heavy-duty vehicles		6.0
Passenger cars	1980 - 1994 (2)	2.0
Light-duty trucks		2.0
Medium-duty vehicles		2.0
Heavy-duty vehicles		2.0

(1) Organic Material Hydrocarbon Equivalent, for alcohol-fueled vehicles.

(2) Other than hybrid electric vehicles.

(B) For the vehicles identified below, tested in accordance with the test procedure which includes the running loss test, the hot soak test, and the 72 hour diurnal test, the evaporative emission standards are:

Vehicle Type	Model Year	Hydrocarbons (1) Three-Day Diurnal + Hot Soak (grams/test) Useful Life(2)	Hydrocarbons (1) Running Loss (grams/mile) Useful Life(2)
Passenger cars	1995 and subsequent (3)	2.0	0.05
Light-duty trucks		2.0	0.05
Medium-duty vehicles (6,000-8,500 lbs. GVWR)		2.0	0.05
(8,501-14,000 lbs. GVWR) (4)		3.0	0.05
Heavy-duty vehicles (over 14,000 lbs. GVWR)		2.0	0.05
Hybrid Eelectric Ppassenger Ccars	1993 and subsequent (5)	2.0	0.05
Hybrid Eelectric Llight-Dduty Ttrucks		2.0	0.05
Hybrid Eelectric Mmedium-Dduty Vvehicles		2.0	0.05

(1) ~~Organic Material Hydrocarbon Equivalent,~~ Total hydrocarbon plus the hydrocarbon component of alcohol for alcohol-fueled vehicles.

(2) For purposes of this section, "useful life" shall have the same meaning as provided in section 2112, Title 13, California Code of Regulations. Approval of vehicles which are not exhaust emission tested using a chassis dynamometer pursuant to section 1960.1, Title 13, California Code of Regulations shall be based on an engineering evaluation of the system and data submitted by the applicant. The useful life of incomplete medium-duty vehicles certified to the "California Exhaust Emission Standards and Test Procedures for 1987 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles" shall be defined by the useful life of the medium-duty vehicle engine used in such vehicles.

(3) The running loss and useful life three-day diurnal plus hot soak evaporative emission standards (hereinafter "running loss and useful life standards") shall be phased-in beginning with the 1995 model year. Each manufacturer, except small volume manufacturers, shall certify the specified percent (a) of passenger cars and

(b) of light-duty trucks, medium-duty vehicles and heavy-duty vehicles to the running loss and useful life evaporative emission standards according to the following schedule:

Model Year	*Number Minimum Percentage of Vehicles Certified to Running Loss and Useful Life Standards**
1995	10 percent
1996	30 percent
1997	50 percent

* The number minimum percentage of motor vehicles of each vehicle type required to be certified to the running loss and useful life standards shall be based on determined by applying the specified percentage to the manufacturer's projected California model-year sales (a) of passenger cars and (b) of light-duty trucks, medium-duty vehicles and heavy-duty vehicles. Optionally, the percentage of motor vehicles can also be based on the manufacturer's projected California model-year sales (a) of passenger cars and light-duty trucks and (b) of medium-duty vehicles and heavy-duty vehicles.

Beginning with the 1998 model year, all motor vehicles subject to the running loss and useful life standards, including those produced by small volume manufacturers, shall be certified to the specified standards.

All 1995 through 1997 model year motor vehicles which are not subject to running loss and useful life standards pursuant to the phase-in schedule shall comply with the 50,000-mile standards in effect for 1980 through 1994 model-year vehicles.

(4) For the 1995 model year only, the evaporative emission standards for complete vehicles in this weight range shall be 2.0 grams/test and Ccompliance with the evaporative emission standards for complete vehicles in this weight range shall be based on the Sealed Housing for Evaporative Determination (SHED) conducted in accordance with the procedures set forth in Title 40, Code of Federal Regulations, sections 86.130-78 through 86.143-90 as they existed July 1, 1989.

(5) The running loss and useful life diurnal plus hot soak evaporative emission standards (hereinafter "running loss and useful life standards") for all hybrid electric vehicles shall be effective in the 1993 and subsequent model years.

(C) For vehicles identified below, tested in accordance with the test procedure which includes the hot soak test and the 48 hour diurnal test, the evaporative emission standards are:

Vehicle Type	*Model Year*	*Hydrocarbon (1) Two-Day Diurnal + Hot Soak (grams/test) Useful Life(2)*
Passenger cars	1996 and subsequent (3)	2.5
Light-duty trucks		2.5
Medium-duty vehicles		
(6,000 - 8,500 lbs. GVWR)		2.5
(8,501 - 14,000 lbs. GVWR)		3.5
Heavy-duty vehicles (over 14,000 lbs. GVWR)		4.5
Hybrid electric passenger cars	1996 and subsequent (3)	2.5
Hybrid electric light-duty trucks		2.5
Hybrid electric medium-duty vehicles		2.5

(1) Total hydrocarbon plus the hydrocarbon component of alcohol for alcohol-fueled vehicles.

(2) For purposes of this paragraph, "useful life" shall have the same meaning as provided in section 2112, Title 13, California Code of Regulations. Approval of vehicles which are not exhaust emission tested using a chassis dynamometer pursuant to section 1960.1, Title 13, California Code of Regulations shall be based on an engineering evaluation of the system and data submitted by the applicant. The useful life of incomplete medium-duty vehicles certified to the "California Exhaust Emission Standards and Test Procedures for 1987 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles" shall be defined by the useful life of the medium-duty vehicle engine used in such vehicles.

(3) The two-day diurnal plus hot soak evaporative emission standards (hereinafter "supplemental standards") shall be phased-in beginning with the 1996 model year. Those vehicles certified under the running loss and useful life standards for the 1996 and subsequent model years must also be certified under the supplemental standards.

(2) Evaporative emissions for gasoline-fueled motorcycles subject to exhaust emission standards under this article shall not exceed:

Motorcycle Class	*Model Year*	*Hydrocarbons (grams per test)*
Class I and II (50-279cc)	1983 and 1984	6.0
	1985 and subsequent	2.0
Class III (280cc and larger)	1984 and 1985	6.0
	1986 and subsequent	2.0
Class III (280cc and larger) (Optional Standard for Small-Volume Manufacturers)	1986-1988	6.0

(c) The procedure for determining compliance with the standards in subsection (b) above is set forth in "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles," adopted by the state board on April 16, 1975, as last amended ~~November 29, 1991, effective January 16, 1992.~~ ________________.

(d) Motorcycle engine families certified to 0.2 grams per test or more below the applicable standards shall be exempted from the state board's "Specifications for Fill Pipes and Openings of Motor Vehicle Fuel Tanks" pursuant to section 2290, Title 13, California Code of Regulations.

(e) Small volume motorcycle manufacturers electing to certify 1986, 1987, or 1988 model-year Class III motorcycles in accordance with the optional 6.0 gram per test evaporative emission standard shall submit, with the certification application, a list of the motorcycle models for which it intends to seek California certification and estimate sales data for such models. In addition, each such manufacturer shall, on or before July 1 of each year in which it certifies motorcycles under the optional standard, submit a report describing its efforts and progress toward meeting the more stringent evaporative emission standards. The report shall also contain a description of the manufacturer's current hydrocarbon evaporative emission control development status, along with supporting test data, and shall summarize future planned development work.

(f) For purposes of this section, a small volume manufacturer means a manufacturer which sells less than 5,000 new motorcycles per year in California.

NOTE: Authority cited: Sections 39600, 39601, 39667, 43013, 43018, 43101, 43104, and 43107, Health and Safety Code. Reference: Sections 39003, 39500, 39667, 43000, 43013, 43018, 43100, 43101, 43102, 43104, and 43107, Health and Safety Code.

Appendix B

PROPOSED

State of California
AIR RESOURCES BOARD

CALIFORNIA EVAPORATIVE EMISSION STANDARDS AND TEST PROCEDURES FOR 1978 AND SUBSEQUENT MODEL MOTOR VEHICLES

ADOPTED: April 16, 1975
AMENDED: May 14, 1975
AMENDED: March 31, 1976
AMENDED: October 5, 1976
AMENDED: November 23, 1976
AMENDED: June 8, 1977
AMENDED: December 19, 1977
AMENDED: October 12, 1979
AMENDED: April 23, 1980
AMENDED: June 26, 1980
AMENDED: June 8, 1981
AMENDED: March 9, 1983
AMENDED: October 30, 1985
AMENDED: January 22, 1990
AMENDED: May 15, 1990; effective July 15, 1990
AMENDED: November 20, 1991; effective January 16, 1992
AMENDED: September 22, 1993; effective December 8, 1993
AMENDED: ____________________

Note: The regulatory amendments proposed in this rulemaking are shown in underline to indicate additions and ~~strikeout~~ to indicate deletions from the version of the test procedures adopted on September 22, 1993.

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CALIFORNIA EVAPORATIVE EMISSION STANDARDS AND TEST PROCEDURES
FOR 1978 AND SUBSEQUENT MODEL MOTOR VEHICLES

The provisions of Title 40, Code of Federal Regulations (CFR), Part 86, Subparts A and B, as they pertain to evaporative emission standards and test procedures and as they were amended or adopted as of July 1, 1989, are hereby adopted as the California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles, with the following exceptions and additions:

1. These standards and test procedures are applicable to all new 1978 and subsequent model gasoline-fueled~~, 1983 and subsequent model liquefied petroleum gas (LPG)-fueled,~~ and 1993 and subsequent model alcohol-fueled passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, hybrid electric vehicles, and motorcycles.

   These standards and test procedures are applicable to all new 1983 and subsequent model liquefied petroleum gas (LPG)-fueled passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, hybrid electric vehicles, and motorcycles. In those instances that the testing conditions or parameters are not practical or feasible for such vehicles, the manufacturer shall provide a test plan that provides equal or greater confidence in comparison to these test procedures. The test plan must be approved in advance by the Executive Officer.

   A manufacturer may implement, for 1995 model motor vehicles, test procedure requirements mandated for 1996 and subsequent model motor vehicles upon approval of the Executive Officer. The Executive Officer shall approve such a request if the manufacturer provides a demonstration that the effectiveness of the evaporative control system is not diminished.

   Carry-over of 1995 model year data will be allowed if the Executive Officer determines that the carry-over data will adequately represent the performance of the vehicle to be certified. Applications for carry-over must be accompanied by an engineering analysis demonstrating that the durability and emissions of the vehicle for which certification is being sought will be adequately represented by a certified platform/powertrain/fuel tank combination application.

   These standards and test procedures do not apply to motor vehicles which are exempt from exhaust emission certification or petroleum-fueled diesel vehicles or hybrid electric vehicles that have sealed fuel systems which can be demonstrated to have no evaporative emissions.

   a. The evaporative emission standards for vehicles subject to these procedures, except motorcycles, are as follows:

      i. For vehicles identified below, tested in accordance with the test procedure based on the Sealed Housing for Evaporative Determination (SHED) as set forth in Title 40, Code of Federal Regulations, sections 86.130-78 through 86.143-90 as they existed July 1, 1989, the evaporative emission standards are:

		~~Hydrocarbons or OMHCE (1)~~ ~~Diurnal + Hot Soak (grams per test)~~ 50K miles ~~Useful Life (2)~~	~~Running Loss (grams/mile) Useful life(2)~~
Class of Vehicle	*Model Year*	*Hydrocarbons (1) Diurnal + Hot Soak (grams/test) 50K miles*	
Passenger Cars	1978 and 1979	6.0	
Light-Duty Trucks		6.0	
Medium-Duty Vehicles		6.0	
Heavy-Duty Vehicles		6.0	
Passenger Cars	1980 - 1994 (2)	2.0	
Light-Duty Trucks		2.0	
Medium-Duty Vehicles		2.0	
Heavy-Duty Vehicles		2.0	

(1) The applicable evaporative emission standards for alcohol-fueled vehicles are expressed in terms of Organic Material Hydrocarbon Equivalent.

(2) Other than hybrid electric vehicles.

ii. For the vehicles identified below, tested in accordance with the test procedure which includes the running loss test, the hot soak test, and the three-day diurnal test (hereinafter "three-day diurnal sequence"), the evaporative emission standards are:

		Hydrocarbons (1)	
Class of Vehicle	*Model Year*	*Three-Day Diurnal + Hot Soak (grams/test) Useful Life(2)*	*Running Loss (grams/mile) Useful life(2)*
Passenger Cars	1995 and subsequent (3)	2.0	0.05
Light-Duty Trucks		2.0	0.05
Medium-Duty Vehicles (6,000 - 8,500 lbs. GVWR)		2.0	0.05
(8,501 - 14,000 lbs. GVWR) (4)		3.0	0.05
Heavy-Duty Vehicles (over 14,000 lbs. GVWR)		2.0	0.05
Hybrid Electric Passenger Cars	1993 and subsequent (5)	2.0	0.05
Hybrid Electric Light-Duty Trucks		2.0	0.05
Hybrid Electric Medium-Duty Vehicles		2.0	0.05

(1) The applicable evaporative emission standards for alcohol-fueled vehicles are expressed as organic material hydrocarbon equivalent (OMHCE) in terms of total hydrocarbon plus the hydrocarbon component of alcohol. These evaporative standards are effective in the 1993 model year.

(2) For purposes of this paragraph, "useful life" shall have the same meaning as provided in section 2112, Title 13, California Code of Regulations. Approval of vehicles which are not exhaust emission tested using a chassis dynamometer pursuant to section 1960.1, Title 13, California Code of Regulations shall be based on an engineering evaluation of the system and data submitted by the applicant. The useful life of incomplete medium-duty vehicles certified to the "California Exhaust Emission Standards and Test Procedures for 1987 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles" shall be defined by the useful life of the medium-duty vehicle engine used in such vehicles.

(3) The running loss and useful life three-day diurnal plus hot soak evaporative emission standards (hereinafter "running loss and useful life standards") shall be phased in beginning with the 1995 model year. Each manufacturer, except small volume manufacturers, shall certify the specified percent (a) of passenger cars and (b) of light-duty trucks, medium-duty vehicles and heavy-duty vehicles to the running loss and useful life standards according to the following schedule:

Model Year	Number Minimum Percentage of Vehicles Certified to Running Loss and Useful Life Standards*
1995	10 percent
1996	30 percent
1997	50 percent

* The number minimum percentage of motor vehicles in each vehicle type required to be certified to the running loss and useful life standards shall be based on determined by applying the specified percentage to the manufacturer's projected California model-year sales (a) of passenger cars and (b) of light-duty trucks, medium-duty vehicles and heavy-duty vehicles. Optionally, the percentage of motor vehicles can also be based on the manufacturer's projected California model-year sales (a) of passenger cars and light-duty trucks and (b) of medium-duty vehicles and heavy-duty vehicles.

Beginning with the 1998 model year, all motor vehicles subject to the running loss and useful life standards, including those produced by small volume manufacturers, shall be certified to the specified standards.

All 1995 through 1997 model-year motor vehicles which are not subject to running loss and useful life standards pursuant to the phase-in schedule shall comply with the 50,000-mile standards in effect for 1980 through 1994 model-year vehicles.

(4) For the 1995 model year only, the evaporative emission standards for complete vehicles in this weight range shall be 2.0 grams/test and Ccompliance with the evaporative emission standards for complete vehicles in this weight range shall be based on the Sealed Housing for Evaporative Determination (SHED) conducted in accordance with the procedures set forth in Title 40, Code of Federal Regulations, sections 86.130-78 through 86.143-90 as they existed July 1, 1989.

(5) The running loss and useful life diurnal plus hot soak evaporative emission standards (hereinafter "running loss and useful life standards") for all hybrid electric vehicles shall be effective in the 1993 and subsequent model years.

iii. For vehicles identified below, tested in accordance with the test procedure sequence which includes the hot soak test and the two-day diurnal test (hereinafter "two-day diurnal sequence"), the evaporative emission standards are:

Class of Vehicle	*Model Year*	*Hydrocarbons (1) Two-Day Diurnal + Hot Soak (grams/test) Useful Life(2)*
Passenger Cars	1996 and subsequent (3)	2.5
Light-Duty Trucks		2.5
Medium-Duty Vehicles		
(6,000 - 8,500 lbs. GVWR)		2.5
(8,501 - 14,000 lbs. GVWR)		3.5
Heavy-Duty Vehicles (over 14,000 lbs. GVWR)		4.5
Hybrid Electric Passenger Cars	1996 and subsequent (3)	2.5
Hybrid Electric Light-Duty Trucks		2.5
Hybrid Electric Medium-Duty Vehicles		2.5

(1) The applicable evaporative emission standards for alcohol vehicles are expressed in terms of total hydrocarbon plus the hydrocarbon component of alcohol.

(2) For purposes of this paragraph, "useful life" shall have the same meaning as provided in section 2112, Title 13, California Code of Regulations. Approval of vehicles which are not exhaust emission tested using a chassis dynamometer pursuant to section 1960.1, Title 13, California Code of Regulations shall be based on an engineering evaluation of the system and data submitted by the applicant. The useful life of incomplete medium-duty vehicles certified to the "California Exhaust Emission Standards and Test Procedures for 1987 and Subsequent Model Heavy-Duty Otto-Cycle

Engines and Vehicles" shall be defined by the useful life of the medium-duty vehicle engine used in such vehicles.

(3) The two-day diurnal plus hot soak evaporative emission standards (hereinafter "supplemental standards") shall be phased in beginning with the 1996 model year. Those vehicles certified under the running loss and useful life standards for the 1996 and subsequent model years must also be certified under the supplemental standards.

b. Evaporative emission standards for gasoline-fueled motorcycles are:

Motorcycle Class	*Model Year*	*Hydrocarbons (grams per test)*
Class I and Class II (50-279 cc)	1983 - 1984	6.0
	1985 and subsequent	2.0
Class III (280 cc and greater)	1984 - 1985	6.0
	1986 and subsequent	2.0
Class III (280cc and greater) (Optional Standard for Small-Volume Manufacturers)	1986 - 1988	6.0

2. The definitions in section 1900, Title 13, California Code of Regulations, and in the applicable model-year California exhaust emission standards and test procedures, are hereby incorporated into this test procedure by reference.

3. ~~Approval of medium-duty vehicles shall be based on the same standards and test procedures as light-duty trucks.~~ In selecting medium-duty test vehicles, the Executive Officer shall consider the availability of test data from comparably equipped light-duty vehicles and the size of medium-duty vehicles as it relates to the practicability of evaporative emission testing.

4. For all motor vehicles subject to these test procedures, except ~~complete medium-duty vehicles 8,501 to 14,000 lbs GVWR (see footnote 4 to Table 1.a. above),~~ heavy-duty vehicles over 14,000 lbs GVWR, incomplete medium-duty vehicles (see paragraph 5. below), and motorcycles (see paragraphs 7. and 8. below):

Demonstration of system durability and determination of an evaporative emission (diurnal and hot soak) and running loss emission deterioration factor (DF) for each evaporative emission engine family shall be based on tests of representative vehicles and/or systems. For purposes of evaporative emission durability testing, a representative vehicle is one which, with the possible exception of the engine and drive train, was built at least three months prior to the commencement of evaporative emission testing, or is one which the manufacturer demonstrates has stabilized non-fuel-related evaporative emissions.

a. For 1978 model evaporative emission engine families which require durability testing for exhaust emissions certification, either:

i. Evaporative emission testing shall be conducted on all durability vehicles at the 5,000, 10,000, 20,000, 30,000, 40,000, and 50,000 mile test points. Testing may be performed at more frequent intervals with advance written approval from the Executive Officer. The results of all valid evaporative emission tests within each evaporative emission engine family shall be plotted as a function of mileage, and a least-squares-fit straight line shall be drawn through the data. The evaporative emission DF is defined as the interpolated 50,000 mile value on that line minus the interpolated 4,000 mile value on that line, but in no case shall the factor be less than zero. The interpolated 4,000 and 50,000 mile points on this line must be within the standards of paragraph 1. of these test procedures or the data will not be acceptable for use in the calculation of a DF, unless no applicable data point exceeded the standard.

OR

ii. The manufacturer shall propose in his preliminary application for certification a method for durability testing and for determination of a DF for each evaporative emission engine family. The 4,000 and 50,000 mile test points (or their equivalent) used in determining the DF must be within the standards of paragraph 1. or data will not be acceptable for use in the calculation of a DF. The Executive Officer shall review the method, and shall approve it if it meets the following requirements:

A. The method must cycle and test the complete evaporative emission control system for the equivalent of at least 50,000 miles of typical customer use.

B. The method must reflect the flow of liquid and gaseous fuel through the evaporative emission control system, and the exposure (both peak and cyclical) to heat, vibration, and ozone expected through 50,000 miles of typical customer use.

C. The method must have the specifications for acceptable system performance, including maximum allowable leakage after 50,000 miles of typical customer use.

No evaporative emission control system durability testing shall be required for 1978 model-year vehicles which do not require exhaust emission control system durability testing, unless the Executive Officer determines that durability performance is likely to be significantly inferior to 1977 model-year systems.

b. For 1979 through 1994 evaporative emission engine families and 1995 and subsequent evaporative emission engine families which are not subject to the running loss and useful life standards specified in paragraph 1. of this test procedure, both paragraphs 4.a.i. and 4.a.ii. shall apply to all families selected for exhaust emission durability testing, and paragraph 4.a.ii. shall apply to those evaporative emission engine families which are not subject to testing for exhaust emission durability. The DFs determined under paragraph 4.a.i., if any, shall be averaged with the DFs determined under paragraph 4.a.ii. to determine a single evaporative emission ~~deterioration factor~~ <u>DF</u> for each evaporative emission engine family.

c. Engine families subject to the running loss and useful life standards specified in paragraph 1. of this test procedure shall demonstrate compliance with durability requirements using one of the following:

i. Evaporative emission testing shall be conducted on all durability vehicles at 5,000 and 10,000 miles, and at every 10,000 mile test point interval thereafter to the applicable final test point. Testing may be performed at more frequent intervals with advance written approval from the Executive Officer. Compliance with the running loss and ~~evaporative emission~~ <u>useful life</u> standards shall be demonstrated as follows: The results of all valid evaporative emission and running loss emission tests within each evaporative emission engine family shall be plotted as a function of mileage, and a least-squares-fit straight line shall be drawn through the data. The evaporative emission and running loss emission DFs shall be defined as the interpolated value at the applicable useful life mileage on that line, minus the interpolated 4,000 mile value on that line, but in no case shall the factor be less than zero. The interpolated 4,000 and 100,000 mile points (for passenger cars and light-duty trucks), or 4,000 and 120,000 mile points (for medium-duty vehicles and heavy-duty vehicles) on this line must be within the standards of paragraph 1. or the data will not be acceptable for use in the calculation of a DF, unless no applicable data point exceeded the standard.

OR

ii. At least one evaporative emission test shall be conducted on all passenger car and light-duty truck durability vehicles at 5,000, 40,000, 70,000, and 100,000 mile test points. At least one evaporative emission test shall be conducted on all medium-duty durability vehicles at 5,000, 40,000, 70,000, 90,000, and 120,000 mile test points. With prior written approval from the Executive Officer, manufacturers may terminate evaporative emissions testing at the mileage corresponding to 75 percent of the vehicle's useful life if no significant vehicle maintenance or emissions change are observed. Testing may be performed at more frequent intervals also with advance written approval from the Executive Officer. Evaporative emission testing may be performed at corresponding exhaust emission mileage points subject to section 6.a.4. of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles", as incorporated by reference in §1960.1(k) of Title 13, California Code of Regulations. An alternative durability test schedule based on Appendix III of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" may be used. Compliance with the running loss and ~~evaporative emission~~ useful life standards shall be demonstrated as follows: The results of all valid evaporative emission and running loss emission tests within each evaporative emission engine family shall be plotted as a function of mileage, and a least-squares-fit straight line shall be drawn through the data. The evaporative emission and running loss emission DFs are defined as the interpolated value at the useful life mileage on that line minus the interpolated 4,000 mile value on that line, but in no case shall the factor be less than zero. The interpolated 4,000 and 100,000 mile points (for passenger cars and light-duty trucks) or 4,000 and 120,000 mile points (for medium-duty vehicles) must be within the standards of paragraph 1. or the data will not be acceptable for use in the calculation of a DF, unless no applicable data point exceeded the standard.

OR

iii. The manufacturer shall propose in its preliminary application for certification a method for durability testing and for determination of evaporative emission and running loss emission DFs for each evaporative emission engine family. The 4,000, and 100,000 or 120,000 "useful life" mile test points (or their equivalent) used in determining a DF must be within the standards of paragraph 1. or data will not be acceptable for use in the calculation of a DF. The Executive Officer shall review the method, and shall approve it if it meets the following requirements:

A. The method must cycle and test the complete evaporative emission control system for the equivalent of the applicable vehicle useful life (i.e., 100,000 or 120,000 miles) of typical customer use.

B. The method must reflect the flow of liquid and gaseous fuel through the evaporative emission control system, and the exposure (both peak and cyclical) to heat, vibration, and ozone expected based on typical customer use through the applicable useful life.

C. The method must have the specifications for acceptable system performance, including maximum allowable leakage based on typical customer use through the applicable vehicle useful life.

For 1995 and subsequent model evaporative emission engine families subject to the running loss and useful life ~~evaporative emission~~ standards specified in paragraph 1. of this test procedure, except hybrid electric vehicles, either paragraphs 4.c.i and 4.c.iii., or paragraphs 4.c.ii. and 4.c.iii. shall apply to all families selected for exhaust emission durability testing, and paragraph 4.c.iii. shall apply to those evaporative emission engine families which are not subject to testing for exhaust emission durability. For all 1993 and subsequent model hybrid electric vehicles subject to the running loss and useful life ~~evaporative emission~~ emission standards specified in paragraph 1. of this test procedure, paragraphs 4.c.i. and 4.c.iii. shall apply to all families selected for exhaust emission durability testing, and paragraph 4.c.iii. shall apply to those evaporative emission engine families which are not subject to testing for exhaust emission durability. The DFs determined under paragraph 4.c.i. or 4.c.ii., if any, shall be averaged with the DFs determined under paragraph 4.c.iii. to determine a single evaporative emission ~~deterioration factor~~ DF for each evaporative emission engine family. Evaporative emission DFs shall be generated for the running loss test and for the hot soak and the diurnal test in the three-day diurnal sequence, and for the hot soak and the diurnal test in the two-day diurnal sequence. The manufacturer may carry-across the DF generated in the three-day diurnal sequence to the two-day diurnal sequence if the manufacturer can demonstrate that the DF generated in the three-day diurnal sequence is at least as great as the DF generated in the two-day diurnal sequence.

d. Instrumentation

The instrumentation necessary to perform evaporative emission testing is described in 40 CFR 86.107-90. For 1993 and subsequent model hybrid electric vehicles and 1995 and subsequent model motor vehicles subject to running loss and useful life ~~evaporative emission~~ standards, the following language is applicable in lieu of §86.107-90(a)(1):

i. Diurnal Evaporative Emissions Measurement Enclosure

A. The diurnal evaporative emissions measurement enclosure shall be equipped with an internal blower or blowers coupled with an air temperature management system (typically air to water heat exchangers and associated programmable temperature controls) to provide for air mixing and temperature control. For 1993 through 1995 model hybrid electric vehicles and 1995 model motor vehicles, T the blower(s) shall be sized to provide a nominal total flow rate within a range of 0.3 to 0.6 ft^3/min per ft^3 of the nominal enclosure SHED volume (V_n). For 1996 and subsequent model motor vehicles, the blower(s) shall provide a nominal total flow rate of 0.8 $\pm$ 0.2 ft^3/min per ft^3 of the V_n. The inlets and outlets of the air circulation blower(s) shall be configured to provide a well dispersed air circulation pattern that produces effective internal mixing and avoids significant temperature or hydrocarbon and alcohol stratification. The discharge and intake air diffusers in the enclosure shall be configured and adjusted to eliminate localized high air velocities which could produce non-representative heat transfer rates between the vehicle fuel tank(s) and the air in the enclosure. The enclosure temperature shall be taken with thermocouples located 3 feet above the floor of the approximate mid-length of each side wall of the enclosure and within 3 to 12 inches of each side wall. The temperature conditioning system shall be capable of controlling the internal enclosure air temperature to follow the prescribed temperature versus time cycle as specified in 40 CFR 86.133-90 as modified by paragraph 4.g.x. of these procedures within an instantaneous tolerance of $\pm$ 3.0°F of the nominal temperature versus time profile throughout the test, and an average tolerance of $\pm$ 2.0°F over the duration of the test. The control system shall be tuned to provide a smooth temperature pattern which has a minimum of overshoot, hunting, and instability about the desired long term temperature profile. Another thermocouple shall be placed near the fuel tank to verify adequate air mixing and to ensure that the average tolerance specified for the temperature conditioning system is met.

B. The variable volume SHED enclosure shall be of sufficient size to contain the test vehicle with personnel access space. It shall use materials on its interior surfaces which do not adsorb or desorb hydrocarbons or alcohol (if the enclosure is used for alcohol-fueled vehicles). The enclosure shall be insulated to enable the test temperature profile to be achieved with a heating/cooling system which has maximum surface temperatures in the enclosure no greater than 25.0°F above the maximum diurnal temperature specification, and minimum surface temperatures in the enclosure no less than 25.0°F below the minimum diurnal temperature specification. The enclosure shall be equipped with a pressure transducer with an accuracy and precision of ± 0.1 inches H_2O. The enclosure shall be constructed with a minimum number of seams and joints which provide potential leakage paths. Particular attention shall be given to sealing and gasketing of such seams and joints to prevent leakage.

C. The ~~variable volume~~ SHED enclosure shall be equipped with features which provide for the effective SHED enclosure volume to expand and contract in response to both the temperature changes of the air mass in the SHED enclosure, and any fluctuations in the ambient barometric pressure during the duration of the test. Either a variable volume enclosure or a fixed volume enclosure may be used for diurnal emission testing.

I. The variable volume enclosure shall have the capability of latching or otherwise constraining the enclosed volume to a known, fixed value which shall be termed the nominal SHED enclosure volume (V_n). The nominal SHED enclosure volume shall be determined by measuring all pertinent dimensions of the enclosure in its latched configuration, including internal fixtures, based on a temperature of 84°F, to an accuracy of ± 1/8 inch (0.5 cm) and calculating the net ~~enclosure nominal volume~~ V_n to the nearest 1 ft^3. In addition, the enclosure volume shall be measured based on a temperature of 65°F and 105°F. The latching system shall provide a fixed volume with an accuracy and repeatability of $0.005xV_n$. Two potential means of providing the volume accommodation capabilities are a moveable ceiling which is joined to the enclosure walls with a flexure; or a flexible bag or bags of Tedlar or other suitable materials which are installed in the SHED enclosure and provided with flowpaths which communicate with the ambient air outside the enclosure. By moving air into and out of the bag(s), the contained volume can be adjusted dynamically. The total enclosure volume accommodation shall be sufficient to balance the volume changes produced by the difference between the extreme enclosure temperatures and the ambient laboratory temperature with the addition of a superimposed barometric pressure change of 0.8 in. Hg. A minimum total volume accommodation range of $\pm 0.07xV_n$ shall be used. The action of the enclosure volume accommodation system shall limit the differential between the enclosure internal pressure and the external ambient barometric pressure to a maximum value of ± 2.0 inches H_2O.

II. The fixed volume enclosure shall be constructed with rigid panels that maintain a fixed enclosure volume, which shall be referred to as the nominal enclosure volume (V_n). V_n shall be determined by measuring all pertinent dimensions of the enclosure including internal fixtures to an accuracy of ± 1/8 inch (0.5 cm) and calculating the net V_n to the nearest 1 ft^3. The enclosure shall be equipped with an outlet flow stream that withdraws air at a low, constant rate from the enclosure throughout the test. An inlet flow stream may provide make-up air to balance the outgoing flow with incoming ambient air. Inlet air must be filtered with activated carbon to provide a relatively constant hydrocarbon and alcohol level. Any method of volume accommodation shall maintain the differential between the enclosure internal pressure and the barometric pressure between 0 and -2 inches of water. The equipment shall be capable of measuring the mass of hydrocarbon and alcohol (if the enclosure is used for alcohol-fueled vehicles) in the inlet and outlet flow streams with a resolution of 0.01 gram. A bag sampling system may be used to collect a proportional sample of the air withdrawn from and admitted to the enclosure. Alternatively, the inlet and outlet flow streams may be continuously analyzed using an on-line Flame Ionization Detector (FID) analyzer and integrated with the flow measurements to provide a continuous record of the mass hydrocarbon and alcohol removal.

D. An online computer system or stripchart recorder shall be used to record the following parameters during the diurnal evaporative emissions test sequence:

-~~SHED e~~Enclosure internal air temperature

-Diurnal ambient air temperature specified profile as defined in §86.133-90 as modified in paragraph 4.g.x.

-Vehicle fuel tank liquid temperature

-~~SHED~~ ~~e~~Enclosure internal pressure

-~~SHED~~ ~~e~~Enclosure temperature control system surface temperature(s)

-FID output voltage recording the following parameters for each sample analysis:

-zero gas and span gas adjustments

-zero gas reading

-~~SHED~~ Enclosure sample reading

-zero gas and span gas readings

The data recording system shall have a time resolution of 30 seconds and shall provide a permanent record in either magnetic, electronic or paper media of the above parameters for the duration of the test.

E. Other equipment configurations may be used if approved in advance by the Executive Officer. The Executive Officer shall approve alternative equipment configurations if the manufacturer demonstrates that the equipment will yield test results equivalent to those resulting from use of the specified equipment.

ii. Running Loss Measurement Facility

A. For all types of running loss measurement test facilities, the following shall apply:

I. The measurement of vehicle running loss fuel vapor emissions shall be conducted in a test facility which is maintained at a nominal ambient temperature of 105.0°F. Manufacturers have the option to perform running loss testing in either an enclosure incorporating atmospheric sampling equipment, or in a cell utilizing point source sampling equipment. Confirmatory testing or in-use compliance testing may be conducted by the Executive Officer using either sampling procedure. The test facility shall have space for personnel access to all sides of the vehicle and shall be equipped with the following test equipment:

-A chassis dynamometer which meets the requirements of 40 CFR 86.108-79.

-A fuel tank temperature management system which meets the requirements specified in ii.A.III. of this paragraph.

-A running loss fuel vapor hydrocarbon analyzer which meets the requirements specified in §86.107-90(a)(2)(i) and a running loss fuel vapor alcohol analyzer which meets the requirements specified in §86.107-90(a)(2)(ii).

-A running loss test data recording system which meets the requirements specified in ii.A.IV. of this paragraph.

II. All types of running loss test facilities shall be configured to provide an internal ambient temperature of 105°F ± 5°F maximum and ± 2°F on average throughout the running loss test sequence. This shall be accomplished by any one or combination of the following techniques:

-Using the test facility without artificial cooling and relying on the residual heat in the test vehicle for temperature achievement.

-Adding insulation to the test facility walls.

-Using the test facility artificial cooling system (if so equipped) with the setpoint of the cooling system adjusted to a value not lower than 105.0°F, where the cooling system setpoint refers to the internal test facility air temperature.

-Using a full range test facility temperature management system with heating and cooling capabilities.

III. Cell/enclosure temperature management shall be conducted at the inlet of the vehicle cooling fan. The vehicle cooling fan shall be a road speed modulated fan which is controlled to a discharge velocity which matches the dynamometer roll speed throughout the driving cycle. The fan outlet shall airflow discharge to both the vehicle radiator air inlet(s) and the vehicle underbody.

The fuel tank temperature management system shall be configured and operated to control the fuel tank temperature profile of the test vehicle during the running loss test sequence. The use of a discrete fuel tank temperature management system is not required provided that the existing temperature and airflow conditions in the test facility are sufficient to match the on-road fuel tank liquid (T_{liq}) temperature profile of the test vehicle within a tolerance of $\pm$ 3.0°F throughout the running loss driving cycle, and the fuel tank vapor (T_{vap}) temperature profile of the test vehicle within a tolerance of $\pm$ 3.0°F during the final 120 second idle period of the test. The system shall provide a ducted air flow directed at the vehicle fuel tank which can be adjusted in flow rate and/or temperature of the discharge air to manage the fuel tank temperature. The system shall monitor the vehicle fuel tank temperature sensors located in the tank according to the specifications in paragraph 4.f. (§86.129-80(d)(1)) during the running loss drive cycle. The measured temperature shall be compared to a reference on-road profile for the same platform/ powertrain/fuel tank combination developed according to the procedures in §86.129-80(c). The system shall adjust the discharge flow and/or temperature of the outlet duct to maintain the tank liquid temperature profile within $\pm$ 3.0°F of the reference on-road profile throughout the test. Additionally, the vapor temperature during the final 120 second idle period shall match the reference on-road vapor temperature within $\pm$ 3.0°F. The system shall provide a discharge airflow not to exceed 6000 cfm. <u>For 1996 and subsequent model motor vehicles, blowers or fans shall be used to mix the enclosure contents during evaporative emission testing. The blowers or fans shall have a total capacity of at least 1.0 ft^3/min per ft^3 of the nominal enclosure volume. The inlets and outlets of the air circulation blower(s) shall be configured to provide a well dispersed air circulation pattern that produces effective internal mixing and avoids significant temperature or hydrocarbon and alcohol stratification.</u> The temperature of the air supplied to the outlet duct shall be within a range of 70°F to 160°F for systems which utilize artificial heating and/or cooling of the air supply to the outlet duct. This requirement does not apply to systems which recirculate air from inside the test cell without temperature conditioning the airflow. The control system shall be tuned and operated to provide a smooth and continuous fuel tank temperature profile which is representative of the on-road temperature profile.

IV. An on-line computer system or strip-chart recorder shall be used to record the following parameters during the running loss test sequence:

- -Cell/enclosure ambient temperature
- -Vehicle fuel tank liquid (T_{liq}) and vapor space (T_{vap}) temperatures
- -Vehicle coolant temperature
- -Vehicle fuel tank headspace pressure
- -Reference on-road fuel tank temperature profile developed according to paragraph 4.f. (§86.129-80(d))
- -Dynamometer rear roll speed (if applicable)
- -FID output voltage recording the following parameters for each sample analysis:
    - -zero gas and span gas adjustments
    - -zero gas reading
    - -dilute sample bag reading (if applicable)
    - -dilution air sample bag reading (if applicable)
    - -zero gas and span gas readings
- -methanol sampling equipment data:
    - -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

-the chromatogram of the analyzed sample

B. If an enclosure, or atmospheric sampling, running loss facility is used, the following requirements (in addition to those in subparagraph A. above) shall also be applicable:

I. The enclosure shall be readily sealable and rectangular in shape. When sealed, the enclosure shall be gas tight in accordance with 40 CFR 86.117-90. Interior surfaces shall be impermeable and non-reactive to hydrocarbons and to alcohol (if the enclosure is used for alcohol-fueled vehicles). One surface should be of flexible, impermeable, and non-reactive material to allow for minor volume changes, resulting from temperature changes.

II. In the event an artificial cooling or heating system is used, the surface temperature of the heat exchanging elements shall be ~~within a range of~~ a minimum of 70.0°F ~~to 125.0°F~~.

III. For 1996 and subsequent model motor vehicles, the enclosure shall be equipped to supply air to the vehicle, at a temperature of 105 $\pm$ 5 F, from sources outside of the running loss enclosure directly into the operating engine's air intake system. Supplemental air requirements shall be supplied by drawing air from the engine intake source.

C. If a point source running loss measurement facility (cell) is used, the following requirements (in addition to those in subparagraph A. above) shall also be applicable:

I. The running loss vapor ~~vent~~ collection system shall be configured to collect all running loss emissions from each of the discrete ~~point sources which function~~ as emissions sources, which include vehicle fuel system vapor vents , and transport the collected vapor emissions to a CFV or PDP based dilution and measurement system. The collection system shall consist of a collector at each discrete vehicle ~~vapor vent~~ emissions source, lengths of heated sample line connecting each collector to the inlet of the heated sample pump, and lengths of heated sample line connecting the outlet of the heated sample pump to the inlet of the running loss fuel vapor sampling system. Up to 3 feet of unheated line connecting each of the vapor collectors to the heated sample lines shall be allowed. Each heated sample pump and its associated sample lines shall be maintained at a temperature between 175.0°F and 200.0°F to prevent condensation of fuel vapor in the sample lines. The heated sample pump(s) and its associated flow controls shall be configured and operated to draw a flow of ambient air into each collector at a flow rate of at least 40 standard cubic feet per hour (SCFH). The flow controls on each heated sampling system shall include an indicating flow meter which provides an alarm output to the data recording system if the flow rate drops below 40 SCFH by more than 5 percent. The collector inlet for each discrete ~~vapor vent~~ emissions source shall be placed in proximity to the ~~vent~~ source as necessary to capture any fuel vapor emissions without significantly affecting flow or pressure of the normal action of the ~~vent~~ source. The collector inlets shall be designed to interface with the configuration and orientation of each specific ~~vapor vent~~ source. For vapor vents which terminate in a tube or hose barb, a short length of tubing of an inside diameter larger throughout its length than the inside diameter of the vent outlet, may be used to extend the vent into the mouth of the collector as illustrated in Figure 1. For those vapor vent designs which are not compatible with such collector configurations and other emissions sources, the vehicle manufacturer shall supply a collector which is configured to interface with the vapor vent design or the specific emissions source design, and which terminates in a fitting approved by the Executive Officer. The Executive Officer shall approve the fitting if the manufacturer demonstrates that it is capable of capturing all vapor emitted from the ~~vent~~ source.

II. The running loss fuel vapor sampling system shall be a CFV or PDP based dilution and measurement system which further dilutes the running loss fuel vapors collected by the vapor ~~vent~~ collection system(s) with ambient air, collects continuously proportional samples of the diluted running loss vapors and dilution air in sample bags, and measures the total dilute flow through the sampling system over each test interval. In practice, the system shall be configured and operated in a manner which is directly analogous to an exhaust emissions constant volume sampling system, except that the input flow to the system is the flow from the running loss vapor ~~vent~~ collection system(s) instead of vehicle exhaust flow. The system shall be configured and operated to meet the following requirements:

(1) The running loss fuel vapor sampling system shall be designed to measure the true mass of fuel vapor emissions collected by the running loss vapor ~~vent~~ collection system from the specified ~~fuel vapor vents~~ discrete emissions source. The total volume of the mixture of running loss emissions and dilution air shall be measured, and a continuously ~~proportioned~~ proportionated sample of volume shall be collected for analysis. Mass emissions shall be determined from the sample concentration and total flow over the test period.

(2) The PDP-CVS shall consist of a dilution air filter and mixing assembly, heat exchanger, positive displacement pump, sampling system, and associated valves, pressure and temperature sensors. The PDP-CVS shall conform to the following requirements:

The gas mixture temperature, measured at a point immediately ahead of the positive displacement pump, shall be within $\pm$ 10°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 $\pm$ 10°F during the entire test. The temperature measuring system shall have an accuracy and precision of $\pm$ 2°F.

The pressure gauges shall have an accuracy and precision of ± 1.6 inches of water (± 0.4 kPa).

The flow capacity of the CVS shall not exceed 350 CFM (0.165 m^3/s).

Sample collection bags for dilution air and running loss fuel vapor samples shall be sufficient size so as not to impede sample flow.

(3) The CFV sample system shall consist of a dilution air filter and mixing assembly, a sampling venturi, a critical flow venturi, a sampling system and assorted valves, and pressure and temperature sensors. The CFV sample system shall conform to the following requirements:

-The temperature measuring system shall have an accuracy and precision of ± 2°F and a response time of 0.100 seconds of 62.5 percent of a temperature change (as measured in hot silicone oil).

-The pressure measuring system shall have an accuracy and precision of ± 1.6 inches of water (0.4 kPa).

-The flow capacity of the CVS shall not exceed 350 CFM (0.165 m^3/s).

-Sample collection bags for dilution air and running loss fuel vapor samples shall be of sufficient size so as not to impede sample flow.

III. The on-line computer system or strip-chart recorder specified in ii.A.IV. of this paragraph shall be used to record the following additional parameters during the running loss test sequence, if applicable:

-CFV (if used) inlet temperature and pressure

-PDP (if used) inlet temperature and pressure and differential pressure

-Running loss vapor ~~vent~~ collection system low flow alarm(s)

D. Other equipment configurations may be used if approved in advance by the Executive Officer. The Executive Officer shall approve alternate equipment configurations if the manufacturer demonstrates that the equipment will yield test results equivalent to those resulting from use of the specified equipment.

iii. Hot Soak Evaporative Emissions 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 §86.117-90. Interior surfaces shall be impermeable and non-reactive to hydrocarbon and to alcohol (if the enclosure is used for alcohol-fueled vehicles). One surface shall be of flexible, impermeable and non-reactive material to allow for minor volume changes, resulting from temperature changes. The enclosure shall be configured to provide an internal enclosure ambient temperature of 105°F ± 5°F maximum and ± 2°F on average during the test time interval from 5 minutes after the enclosure is closed and sealed until the end of the one hour hot soak interval. For the first 5 minutes, the ambient temperature shall be maintained at 105°F ± 10°F. For 1996 and subsequent model motor vehicles, the enclosure shall be equipped with an internal air circulation blower(s). The blower(s) shall be sized to provide a nominal total flow rate within a range of $0.8 \pm 0.2\ ft^3/min$ per ft^3 of the nominal enclosure volume. The inlets and outlets of the blower(s) shall be configured to provide a well dispersed air circulation pattern that produces effective internal mixing and avoids significant temperature or hydrocarbon and alcohol stratification. The discharge and intake air diffusers in the enclosure shall be configured and adjusted to eliminate localized high air velocities which could produce non-representative heat transfer rates between the vehicle fuel tank(s) and the air in the enclosure. The enclosure temperature shall be taken with thermocouples located 3 feet above the floor of the approximate mid-length of each side wall of the enclosure and within 3 to 12 inches of each side wall. This shall be accomplished by any one or combination of the following techniques:

-Using the enclosure without artificial cooling and relying on the residual heat in the test vehicle for temperature achievement.

-Adding insulation to the enclosure walls.

-Using the enclosure artificial cooling system (if so equipped) with the setpoint of the cooling system adjusted to a value not lower than 105.0°F, where the cooling system setpoint refers to the internal enclosure air temperature.

-Using a full range enclosure temperature management system with heating and cooling capabilities.

In the event an artificial cooling or heating system is used, the surface temperature of the heat exchanging elements shall be within a range of 70.0°F to 125.0°F.

For 1995 through 1997 vehicles subject to running loss and useful life ~~evaporative emission~~ standards, and 1998 and subsequent motor vehicles, except petroleum-fueled diesel vehicles, electric vehicles, and motorcycles, omit §86.107-90(a)(4).

e. Calibrations

Evaporative-emission enclosure calibrations are specified in 40 CFR 86.117-90. Methanol measurements may be omitted when methanol-fueled vehicles will not be tested in the evaporative enclosure. For all 1993 and subsequent model hybrid electric vehicles and 1995 and subsequent model motor vehicles subject to running loss and useful life ~~evaporative emission~~ standards, section 86.117-90 is amended to include an additional subsection (which shall be cited herein as subsection (e) of §86.117-90), to read:

(e)(1) Diurnal evaporative emission enclosure. The diurnal evaporative emission measurement enclosure calibration consists of the following parts: initial and periodic determination of enclosure background emissions, initial determination of enclosure volume, and periodic hydrocarbon and alcohol retention check and calibration.

(i) The initial and periodic determination of enclosure background emissions shall be conducted according to the procedures specified in §86.117-90(a)(1) through (a)(6). The SHED enclosure shall be maintained at a nominal temperature of 105.0°F throughout the four hour period. Variable volume SHED enclosures may be operated in either the latched volume configuration, or with the variable volume feature active. Fixed volume enclosures shall be operated with inlet and outlet flow streams closed. The allowable enclosure background emissions as calculated according to §86.117-90(a)(7) shall not be greater than 0.05 grams in 4 hours. The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the initial HC concentration reading (C_{HCi}) is taken and the four hour background measurement period begins.

(ii) The initial determination of enclosure internal volume shall be performed according to the procedures specified in ~~§86.117-90(b)(1) through (b)(3)~~ paragraph 4.d.i.C. If the enclosure will be used for hot soak determination, the determination of enclosure internal volume shall also be performed based on 105°F.

(iii) The hydrocarbon and alcohol measurement and retention check shall evaluate the accuracy of enclosure HC and alcohol mass measurements and the ability of the enclosure to retain trapped HC and alcohol. The check shall be conducted over a 24 hour period with all of the normally functioning subsystems of the enclosure active. A known mass of propane shall be injected into the ~~SHED~~ enclosure and an initial ~~SHED~~ enclosure mass measurement shall be made. The enclosure shall be subjected to the temperature cycling specified in paragraph 4.g.x.G. of these procedures (revising §86.133-90(l)) for a 24 hour period. A final ~~SHED~~ enclosure mass measurement shall be made. The following procedure shall be performed prior to the introduction of the enclosure into service~~,~~ and following any modifications or repairs to the enclosure that may impact the integrity of this enclosure~~, and on at least a quarterly basis otherwise:~~; otherwise, the following procedure shall be performed on a monthly basis. (If six consecutive monthly retention checks are successfully completed without corrective action, the following procedure may be determined quarterly thereafter as long as no corrective action is required.):

(A) Zero and span the hydrocarbon analyzer.

(B) Purge the enclosure until a stable enclosure HC level is attained.

(C) Turn on the enclosure air mixing and temperature control system and adjust it for an initial temperature of 105.0°F and a programmed temperature profile covering one diurnal cycle ~~from 65.0°F to 105.0°F~~ over a 24 hour period according to the profile specified in paragraph 4.g.x.G. of these procedures (revising §86.133-90). Close the enclosure door. On variable volume ~~SHED~~ enclosures, latch the enclosure to the ~~nominal volume position~~ enclosure volume measured at 105°F. On fixed volume enclosures, close the outlet and inlet flow streams.

(D) When the enclosure temperature stabilizes at 105.0°F ± 3.0°F seal the enclosure; measure the enclosure background HC concentration (C_{HCe1}), background methanol concentration (C_{CH3OH1}), and the temperature (T_{1}) and pressure (P_{1}) in the enclosure.

(E) Inject into the enclosure a known quantity of propane ~~of~~ between ~~4 to 8~~ 2 to 6 grams and a known quantity of methanol in gaseous form between 2 to 6 grams. The injection method shall use a critical flow orifice to meter the propane at a measured temperature and pressure for a measured time period. Techniques which provide equivalent resolution (± 0.2 percent) of the injected mass are also acceptable. Allow the enclosure internal HC concentration to mix and stabilize for up to 300 seconds. Measure the enclosure HC concentration ~~after mixing~~ (C_{HCe2}), the enclosure methanol concentration (C_{CH3OH2}), and the temperature (T_2) and pressure in the enclosure (P_2). On variable volume SHED enclosures, unlatch the enclosure ~~from the nominal volume configuration to accommodate temperature and barometric pressure changes~~. On fixed volume enclosures, open the outlet and inlet flow streams. Start the temperature cycling function of the enclosure air mixing and temperature control system. These steps shall be completed within 900 seconds of sealing the enclosure.

(F) Calculate the initial recovered HC mass (M_{HCe1}) according to the following formula:

$$M_{HCe1} = (3.05 x V_n x 10^{-4} x [P_{2} * (C_{HCe2} - rC_{CH3OH2})/T_2 - P_1(C_{HCe1} - rC_{CH3OH1}))/T_1])$$

where:

V_n is the enclosure ~~nominal~~ volume at 105°F (ft^3)

P_{n} is the enclosure initial pressure at event n (inches Hg absolute)

C_{HCen} is the enclosure HC concentration at event n (ppm C)

C_{CH3OHn} is the enclosure methanol concentration calculated according to §86.117-90 (d)(2)(iii) at event n (ppm carbon) r is the FID response factor to methanol

T_{in} is the enclosure initial temperature at event n (^{o}R)

If the recovered mass agrees with the injected mass within 2.0 percent, continue the test for the 24 hour temperature cycling period. If the recovered mass differs from the injected mass by greater than 2.0 percent, repeat the enclosure concentration measurement in step (E) and recalculate the initial recovered mass (M_{HCe1}). If the recovered mass based on the latest concentration measurement agrees within 2.0 percent of the injected mass, continue the test for the 24 hour temperature cycling period and substitute this second enclosure concentration measurement for C_{HCe2} in all subsequent calculations. In order to be a valid calibration, the final measurement of C_{HCe2} shall be completed within the 900 second time limit outlined above. If the discrepancy persists, the test shall be terminated and the cause of the difference determined, followed by the correction of the problems(s) and the restart of the test.

(G) At the completion of the 24 hour temperature cycling period measure the final enclosure HC concentration (C_{HCe3}), the final enclosure methanol concentration (C_{CH3OH3}), and the final pressure (P_3) and final temperature (T_3) in the enclosure. Calculate the final recovered HC mass (M_{HCe2}) as follows:

$$M_{HCe2} = [3.05 \times V_n \times 10^{-4} \times (P_{i3} \times (C_{HCe3} - rC_{CH3OH3})/T_3 - P_1(C_{HCe1} - rC_{CH3OH1})/T_{i1}] + M_{HC,out} - M_{HC,in}$$

where:

V_n is the enclosure nominal volume at 105°F (ft^3)

P_{i1} is the enclosure initial pressure (inches Hg absolute)

P_3 is the enclosure final pressure (inches Hg absolute)

C_{HCe3} is the enclosure HC concentration at the end of the 24 hour time temperature cycling period (ppm C)

C_{CH3OH3} is the enclosure methanol concentration at the end of the 24 hour temperature cycling period, calculated according to §86.117-90 (d)(2)(iii) (ppm carbon)

r is the FID response factor to methanol

T_i is the enclosure initial temperature (^oR)

$M_{HC,out}$ is mass of hydrocarbon exiting the enclosure, in the case of fixed volume enclosures (grams)

$M_{HC,in}$ is mass of hydrocarbon entering the enclosure, in the case of fixed volume enclosures (grams)

(H) If the calculated final recovered HC mass for ~~variable volume SHED~~ the enclosures is not within 3 percent of the initial enclosure mass, then action shall be required to correct the error to the acceptable level.

(e)(2) The running loss equipment shall be calibrated as follows:

(i) The chassis dynamometer shall be calibrated according to the requirements of 40 CFR 86.118-78. The calibration shall be conducted at a typical ambient temperature of 75°F ± 5°F.

(ii) The running loss hydrocarbon analyzer shall be calibrated according to the requirements of 40 CFR 86.121-90.

(iii) If a point source facility is used, the running loss fuel vapor sampling system shall be calibrated according to the requirements of 40 CFR 86.119-90, with the additional requirement that the CVS System Verification at 40 CFR 86.119-90(c) be conducted by injecting the known quantity of propane into the inlet of the most frequently used fuel vapor ~~vent~~ collector configured to collect vapors from the ~~vent~~ source of the evaporative emission vapor storage canister. This procedure shall be conducted in the running loss test cell with the collector installed in a vehicle in the normal test configuration, except that the vent hose from the vehicle evaporative emission canister shall be routed to a ventilation outlet to avoid unrepresentative background HC concentration levels. The propane injection shall be conducted by injecting approximately 4 grams of propane into the collector while the vehicle is operated over one Urban Dynamometer Driving Schedule (UDDS) test procedure, as described in 40 CFR 86.115-78 and Appendix I. The propane injection shall be conducted at a typical ambient temperature of 75°F ± 5°F. ~~In this manner, the ability of the running loss vapor collection system to effectively capture and measure a representative quantity of HC vapor under realistic test conditions will be verified.~~

(iv) In the event the running loss test is conducted using the ~~SHED enclosure~~ atmospheric sampling measurement technique, the following procedure shall be used for the enclosure calibration: ~~a propane injection recovery test shall be conducted, with a test vehicle being driven over one UDDS cycle in the enclosure during the propane injection test.~~

(A) The initial and periodic determination of enclosure background emissions shall be conducted according to the procedures specified in §86.117-90(a)(1) through (a)(6). The enclosure shall be maintained at a nominal temperature of 105.0°F throughout the four hour period. The allowable enclosure background emissions as calculated according to §86.117-90 (a)(7) shall not be greater than 0.2 grams in 4 hours. The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the initial HC concentration reading is taken.

(B) The initial determination of enclosure internal volume shall be performed according to the procedures specified in §86.117-90 (b).

(C) The enclosure shall meet the calibration and retention requirements of §86.117-90(c). The propane injection recovery test shall be conducted with a test vehicle being driven over one UDDS cycle in the enclosure during the propane injection test. The vehicle used shall be configured and operated under conditions which ensure that its own running loss contribution is negligible, by using fuel of the lowest available volatility (7.0 psi RVP), maintaining the tank temperature at low levels (<100°F), and routing the canister vent to the outside of the SHED enclosure.

(~~i~~v) Diurnal and hot soak enclosure hydrocarbon analyzer. The hydrocarbon analyzers used for measuring the diurnal and hot soak samples shall be calibrated according to the requirements of §86.121-90.

(vi) Other equipment. Other test equipment including temperature and pressure sensors and the associated amplifiers and recorders, flow measurement devices, and other instruments shall be calibrated and operated according to the manufacturer's specifications and recommendations, and good engineering practice.

f. Road Load Power, Test Weight, Inertia Weight Class, and Running Loss Fuel Tank Temperature Profile Determination

For all 1993 and subsequent model hybrid electric vehicles and 1995 and subsequent model motor vehicles subject to running loss and useful life ~~evaporative emission~~ standards, §86.129-80 is amended to include an additional subsection (which shall be cited herein as subsection (d) of §86.129-80), to read:

(d) Determination of running loss test fuel tank temperature profile

The manufacturer shall establish for each combination of vehicle platform/powertrain/fuel tank submitted for certification a representative profile of fuel tank liquid and vapor temperature versus time to be used as the target temperature profile for the running loss evaporative emissions test drive cycle. <u>If a vehicle has more than one fuel tank, a profile shall be established for each tank. For 1996 and subsequent model motor vehicles, if manufacturers use a vehicle model to develop a profile to represent multiple vehicle models, the vehicle model selected must have the greatest expected fuel liquid temperature and fuel vapor temperature increase during driving of all of the vehicle models it will represent. For 1996 and subsequent model motor vehicles, manufacturers must select test vehicles with any available vehicle options that could increase fuel temperature during driving, such as any feature that limits underbody air flow.</u> The profile shall be established by driving the vehicle on-road over the same driving schedule as is used for the running loss evaporative emissions test according to the following sequence:

(1) The vehicle to be used for the fuel tank temperature profile determination shall be equipped with at least 2 thermocouples installed so as to provide a representative bulk liquid average fuel temperature. The specific placement of the thermocouples shall take into account the tank configuration and orientation and shall be along the major axis of the tank. The thermocouples shall not be placed within internal reservoirs or other locations which are thermally isolated from the bulk volume of the fuel. The thermocouples shall be placed at a vertical depth equivalent to the mid-volume of the liquid fuel at a fill level of 40 percent of nominal tank capacity. A third thermocouple shall be installed in the approximate center of the vapor space of the fuel tank. A pressure transducer with a minimum precision and accuracy of ± 1.0

inches H_2O shall be connected to the vapor space of the fuel tank. A means of conveniently draining the fuel tank shall be provided. The vehicle shall be equipped with a driver's aid which shall be configured to provide the test driver with the desired UDDS vehicle speed versus time trace as defined in Part 86, Appendix I and with the desired NYCC vehicle speed versus time trace as defined in Part 86, Appendix I of the CFR, amended as of March 24, 1993, and the actual vehicle speed. Vehicle coolant temperature shall be monitored to ensure adequate vehicle coolant air to the radiator intake(s). A computer, data logger, or strip chart data recorder shall record the following parameters during the test run:

-Desired speed

-Actual speed

-Average liquid fuel temperature (T_{liq})

-Vapor space temperature (T_{vap})

-Vapor space pressure

The data recording system shall provide a time resolution of 1 second, and an accuracy of ± 1 MPH, ± 2.0°F, and + 1.0 inches H_2O. The temperature and pressure signals may be recorded at intervals of up to 30 seconds.

(2) The temperature profile determination shall be conducted during ambient conditions which include:

-ambient temperature above 95°F and increasing or stable (± 2°F)

-sunny or mostly sunny with a maximum cloud cover of 25 percent

-wind conditions calm to light with maximum sustained wind speed of 15 MPH

-road surface temperature (T_{sur}) at least 20°F above ambient temperature (T_{amb}) for 1993 to 1995 model hybrid vehicles and 1995 model motor vehicles and at least 30°F above T_{amb} for 1996 and subsequent model motor vehicles

The track surface temperature shall be measured with an embedded sensor, a portable temperature probe, or an infrared pyrometer which can provide an accuracy of ± 2.0°F. Temperatures must be measured on a surface representative of the surface where the vehicle is driven. The test shall be conducted on a track or other restricted access facility so that the speed versus time schedule can be maintained without undue safety risks.

Tank pressure shall not exceed 10 inches of water at ~~any time~~ 30 seconds after the start of the engine until the end of engine operation during the temperature profile determination unless a pressurized system is used and the manufacturer demonstrates in a separate test that vapor would not be vented to the atmosphere if the fuel cap was removed at the end of the running loss fuel tank temperature profile determination.

(3) The vehicle fuel tank shall be drained and filled to 40 percent of the nominal tank capacity with fuel meeting the requirements of paragraph 4.i. of these procedures. The vehicle shall be moved to the location where the driving cycle is to be conducted. It may be driven a maximum distance of 5.0 miles, longer distances shall require that the vehicle be transported by other means. The vehicle shall be parked for a minimum of 12 hours in an open area on a surface that is representative of the test road. The orientation of the front of the vehicle during parking (N, SW, etc.) shall be documented. Once the 12 hour minimum parking time has been achieved and the ambient temperature and weather conditions and track surface temperature are within the allowable ranges the vehicle engine shall be started. The vehicle air conditioning system (if so equipped) shall be set to the "NORMAL" air conditioning mode and adjusted to the minimum discharge air temperature and high fan speed. Vehicles equipped with automatic temperature controlled air conditioning systems shall be operated in "AUTOMATIC" temperature and fan modes with the system set at 72°F. The vehicle may be operated at minimum throttle for periods up to 60 seconds prior to beginning the first UDDS cycle in order to move from the parking location onto the road surface. The driver's aid shall be started and the vehicle operated over three sequential UDDS cycles with the transmission operated in the same manner as specified in 40 CF~~G~~R 86.128-79. For 1996 and subsequent model motor vehicles, the vehicles shall be operated over one UDDS cycle, then two NYCCs, and another UDDS cycle instead of over three UDDS cycles. The end of each UDDS cycle and the end of the two NYCCs, if applicable shall be followed by an idle period of 120 seconds during which the engine shall remain on with the

vehicle in the same transmission range and clutch (if so equipped) actuation mode as ~~during the UDDS idle periods.~~ as specified in §86.128-90 except for the following:

Revise section (c) to include: Idle modes may be run with automatic transmission in "Neutral" and shall be placed in "Drive" with the wheels braked at least 5 seconds before the end of the idle mode. Manual transmission may be in "Neutral" with the clutch engaged and shall be placed in gear with the clutch disengaged at least 5 seconds before the end of the idle mode.

The data recording system shall provide a record of the required parameters over the entire sequence from the initiation of the first UDDS cycle to the end of the third 120 second idle period. Following the completion of the test, the data recording system and driver's aid shall be turned off.

(4) In addition to the vehicle data recording, the following parameters shall be documented for the running loss test fuel tank temperature determination:

- -Date and time of vehicle fueling
- -Odometer reading at vehicle fueling
- -Date and time vehicle was parked and parking location and orientation
- -Odometer reading at parking
- -Date and time engine was started
- -Time of initiation of first UDDS cycle
- -Time of completion of third 120 second idle period
- -Ambient temperature and track surface temperature at initiation of first UDDS cycle (T_{amb1} and T_{sur1})
- -Ambient temperature and track surface temperature at completion of third 120 second idle period (T_{amb2} and T_{sur2})

(5) The three UDDS cycle driving traces and the two UDDS and two NYCC driving traces shall be verified to meet the speed tolerance requirements of 40 CFR 86.115-78 (b), amended as follow:

Revise (v) to read: When conducted to meet the requirements of §86.129, up to three additional occurrences of speed variations greater than the tolerance are acceptable, provided they occur for less than 15 seconds on any occasion. All speed variations must be clearly documented as to the time and speed at that point in relation to the driving schedule.

Add (vi) to read: When conducted to meet the requirements of §86.129 and § 86.132, the speed tolerance shall be as specified above, except that the upper and lower limits shall be 4 mph.

The following temperature conditions shall be verified:

$$(T_{amb1}) \geq 95.0^{o}F$$

$$(T_{amb2}) \geq (T_{amb1} - 2.0^{o}F)$$

For 1993 to 1995 model hybrid vehicles and 1995 model motor vehicles:

$$(T_{sur1} - T_{amb1}) \geq 20.0^{o}F$$

$$(T_{sur2} - T_{amb2}) \geq 20.0^{o}F$$

For 1996 and subsequent model motor vehicles:

$$(T_{sur(n)} - T_{amb(n)}) \geq 30.0^{o}F$$

where n is the incremental measurements in time.

Failure to comply with any of these requirements shall result in a void test, and require that the entire test procedure be repeated beginning with the fuel drain specified in (d)(3) of this subparagraph. If all of these requirements are met, the following calculations shall be performed:

T_{corr} = ~~$105.0 - \{(T_{amb1} + T_{amb2})/2\}$~~ $T_{(i)} - T_{o}$

where: $T_{(i)}$ is the liquid fuel temperature during the drive (^{o}F) where i is the incremental measurements in time

T_o is the liquid fuel temperature observed at the start of the specified driving schedule (°F)

The individual tank liquid (T_{liq}) and vapor space (T_{vap}) temperatures recorded during the test run shall be adjusted by arithmetically adding the temperature correction (T_{corr}) adjustment calculated above to each liquid and vapor temperature data point. 105°F. This step may be omitted if the calculated absolute value of T_{corr} is less than 2.0°F. If T_o is higher than the corresponding ambient temperature, the temperature correction shall be determined by the above equation plus the difference in T_o and the corresponding ambient temperature.

(6) Other methodologies for developing corrected liquid and vapor space temperature profiles are acceptable if approved in advance by the Executive Officer. The Executive Officer shall approve an alternate method if the manufacturer demonstrates equivalence to data collected at 105°F.

g. Test Procedure

For all 1993 and subsequent model hybrid electric vehicles and 1995 and subsequent model motor vehicles subject to running loss and useful life evaporative emission standards, the exhaust emission test sequence described in 40 CFR 86.130 through 86.140 shall be performed with the following modifications:

i. General Requirements.

The following language shall be applicable in lieu of §86.130-78:

For 1993 to 1995 model hybrid electric vehicles and 1995 model motor vehicles, T the test sequence shown in Figure 2 (Figure 3 for hybrid electric vehicles) describes the steps encountered as the vehicle undergoes the procedures the three-day diurnal sequence to determine conformity with the standards set forth. For 1996 and subsequent model motor vehicles, the test sequence shown in Figure 4 (Figure 5 for hybrid electric vehicles) describes the steps encountered as the vehicle undergoes the three-day diurnal sequence and the supplemental two-day diurnal sequence to determine conformity with the standards set forth. ~~During the exhaust protion of the test procedure, i.e., from "START" to the completion of the "HOT START EXHAUST TEST," a~~ Ambient temperature levels encountered by the test vehicle throughout the entire duration of this test sequence shall not be less than 68°F nor more than 86°F, unless otherwise specified. The temperatures monitored during testing shall be representative of those experienced by the test vehicle. The test vehicle shall be approximately level during all phases of the test sequence to prevent abnormal fuel distribution. The temperature tolerance of a soak period may be waived for up to 10 minutes to allow purging of the enclosure or transporting the vehicle into the enclosure.

The three-day diurnal test sequence shown in Figure 2 (and Figure 3 for hybrid electric vehicles) is briefly described as follows:

A. The fuel tank shall be drained and filled to the prescribed tank fuel volume, as specified in 40 CFR 86.082-2, in preparation for the vehicle preconditioning.

B. The vehicle preconditioning drive shall be performed in accordance with 40 CFR 86.132-90, except that following the vehicle fueling step at §86.132-90(a)(1) a soak period of 12 to 36 hours shall be provided to allow the vehicle to stabilize to ambient temperature prior to the preconditioning drive. For hybrid electric vehicles only, the manufacturer may elect to perform the All-Electric Range Test pursuant to §9.f. of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" as incorporated by reference in §1960.1(k) of Title 13, ~~CCR~~ California Code of Regulations prior to vehicle preconditioning.

C. Following the vehicle preconditioning drive, the fuel tank shall be drained and then filled to 40 percent capacity.

D. The vehicle shall be allowed to soak for 12 to 36 hours prior to the exhaust emissions test.

E. During the 12 to 36 hour soak specified in subparagraph D. above, the vehicle's canister shall be purged with a volume of air equivalent to 300 canister charcoal bed volumes at a flow rate of 48 SCFH (22.7 slpm). For hybrid electric vehicles, the battery pack shall be discharged to the state of charge that satisfies one of the following two conditions: (1) the state of charge is at the lowest level allowed by the control unit of the auxiliary power unit, or (2) the state of charge is set such that auxiliary power unit operation will be at its maximum power level at the beginning and through the emission test.

F. The canister shall then be loaded ~~to saturation~~ using a butane-nitrogen mixture.

G. Perform exhaust emission tests in accordance with procedures as provided in section 1960.1(k), Title 13, California Code of Regulations, and these procedures.

H. Upon completion of the hot start test, the vehicle shall be parked in a temperature controlled area to stabilize the fuel temperature at 105°F for a maximum of four hours. Artificial cooling or heating of the fuel tank may be induced ~~if a one hour soak is not sufficient~~ to achieve a fuel temperature of 105°F. The initial fuel temperature for the running loss test may be less than 105°F if the manufacturer is able to provide data demonstrating that a lower initial temperature reflects the maximum fuel temperature achieved by a stabilized vehicle during a 105°F day.

I. A running loss test shall be performed after the fuel tank is stabilized at 105°F. The fuel tank temperature shall be controlled using a specified tank temperature profile for that vehicle during the test. The temperature profile shall be achieved either using temperature controllers or by an air management system that would simulate airflow conditions under the vehicle during driving.

J. The hot soak enclosure test shall then be performed at an ~~SHED~~ enclosure ambient temperature of 105°F.

K. Upon completion of the hot soak enclosure test, ~~fuel temperature shall be heated or cooled to a temperature of~~ ~~65°F.~~ the vehicle shall be soaked for no less than 6 hours nor more than 36 hours. For at least the last 6 hours of this period, the vehicle shall be soaked at 65°F.

L. A ~~72-hour~~ three-day diurnal test shall be performed in a variable temperature ~~SHED~~ enclosure.

The supplemental two-day diurnal sequence in Figure 4 (and Figure 5 for hybrid electric vehicles) shall be conducted according to the steps described in (A) through (G), followed by (J) through (L) of this paragraph except that the ambient temperature of the hot soak test is conducted at an ambient temperature between 68°F and 86°F at all times and that the diurnal test will consist of a two-day test.

ii. Vehicle Preparation

Amend 40 CFR 86.131-90 to read:

(a) Prepare the fuel tank(s) for recording the temperature of the prescribed test fuel and fuel vapor according to the requirements of paragraph 4.f. (§86.129-80(d)(1)).

(b) The vehicle shall be equipped with a pressure transducer to monitor the fuel tank headspace pressure during the test. The transducer shall have an accuracy and precision of ± 1.0 inches water.

(c) Provide additional fittings and adapters, as required, to accommodate a fuel drain at the lowest point possible in the fuel tank(s) as installed on the vehicle.

(d) Provide valving or other means to allow purging and loading of the evaporative emission canister(s). Special care shall be taken during this step not to alter normal functions of the fuel vapor system components.

(e) For vehicles to be tested for running loss emissions, prepare the exhaust system by sealing and/or plugging all detectable sources of exhaust gas leaks. The exhaust system shall be tested or inspected to ensure that detectable exhaust hydrocarbons are not emitted into the running loss enclosure during the running loss test.

iii. Vehicle Preconditioning

Amend paragraph 86.132-90 by adding the following subparagraph (a)(2)(i) which reads:

(i) For hybrid electric vehicles, the battery pack shall be discharged to or just below the state-of-charge at which operation of the auxiliary power unit will be initiated by the vehicle's control strategy. One ~~Urban Dynamometer Driving Schedule (~~UDDS~~)~~ shall be used for preconditioning. If the auxiliary power unit is capable of being manually activated (which would cause the vehicle to be classified as a Type C HEV), the auxiliary power unit shall be activated at the beginning and throughout the emission test.

The following language shall be applicable in lieu of §86.132-90(a)(4):

The Executive Officer may also choose to conduct or require the performance of optional or additional preconditioning to ensure that the evaporative emission control system is subjected to conditions typical of normal driving. The optional preconditioning shall consist of no less than 20 and no more than 50 miles of on-road mileage accumulation under typical driving conditions.

The following language shall be applicable in lieu of §86.132-90(b):

A. Within five minutes of completion of preconditioning, the vehicle shall be driven off the dynamometer to a work area.

B. The fuel tank(s) of the prepared vehicle shall be drained and refilled with the applicable test fuel, as specified in paragraph 4.i. of these procedures, to the prescribed tank fuel volume, defined in §86.082-2. The vehicle shall be refueled within 1 hour of completion of the preconditioning drive.

C. Following the fuel drain and fill described in subparagraph B. above, 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 emissions test. During the soak period, the canister shall be connected to a pump or compressor, purged with air, then loaded with butane as described in D. below for the three-day diurnal sequence and in E. below for the supplemental two-day diurnal sequence.

D. For the three-day diurnal sequence, ~~T~~ the evaporative emissions storage canister(s) shall be preloaded with an amount of butane equivalent to 1.5 times the nominal working capacity. For vehicles with multiple canisters, each canister shall be preconditioned separately. The nominal working capacity of a carbon canister shall be ~~determined by each manufacturer for each evaporative emissions engine family~~ established by determining the mass of butane required to load a stabilized canister to a two gram breakthrough. The 2 gram breakthrough is defined as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams. ~~This~~ The determination of nominal capacity shall be based on the average capacity of no less than five canisters which are in a stabilized condition ~~each having been~~. For stabilization, each canister must be cycled no less than 10 times and no more than 100 times ~~according to the~~

~~method specified in paragraph 4.e.iii. of this test procedure, utilizing the fuel used in normal operation.~~ to a two gram breakthrough with a 50/50 mixture by volume of butane and nitrogen, at a rate of 15 ± 2 grams butane per hour. Each canister loading step must be preceded by canister purging with 300 canister bed volume exchanges at 48 CFH. The following procedure shall be used to preload the canister:

I. Prepare the evaporative emission canister(s) for the canister purging and loading operation. The canister shall not be removed from the vehicle, unless access to the canister in its normal location is so restricted that purging and loading can only reasonably be accomplished by removing the canister from the vehicle. Special care shall be taken during this step so that the normal functions of the fuel system components or the normal pressure relationships in the system are not disturbed. The canister purge shall be performed with ambient air of controlled humidity to ~~75~~ 50 ± ~~10~~ 25 grains per pound of dry air. This may be accomplished by purging the canister in a room which is conditioned to this level of absolute humidity. The flow rate of the purge air shall be maintained at a nominal flow rate of 48 SCFH (22.7 slpm), and the duration shall be determined to provide a total purge volume flow through the canister equivalent to 300 canister charcoal bed volume exchanges.

II. The evaporative emission canister(s) shall then be loaded with an amount of commercial grade butane vapors equivalent to 1.5 times the nominal working capacity. Canister loading shall not be less than 1.5 times the nominal canister capacity. The canister shall be loaded with a mixture composed of 50 percent butane and 50 percent nitrogen by volume. ~~The rate of butane loading shall not exceed~~ The butane shall be loaded into the canister at a rate of 15 ± 2 grams of butane per hour ~~into the canister.~~ If the canister loading at this rate takes longer than 12 hours, a manufacturer may determine a new rate, based on completing the canister loading in no less than 12 hours. Either a Critical Flow Orifice (CFO) butane injection device ~~or~~, a gravimetric method, or electronic mass flow controllers shall be used to fulfill the requirements of this step. The time of completion of the canister(s) loading activity shall be recorded. Manufacturers shall disclose to the

Executive Officer their canister loading procedure. The protocol may not allow ~~for the removal of the canister during loading, or~~ for the replacement of components. In addition, ~~manufacturers shall~~ <u>the Executive Officer may require that the manufacturer</u> demonstrate that the procedure does not unduly disturb the components of the evaporative system.

III. Reconnect the evaporative emission canister(s).

<u>E. For the supplemental two-day diurnal sequence, the evaporative emission storage canister(s) shall be preloaded to the point of breakthrough using either I or II below. For vehicles with multiple canisters, each canister shall be preconditioned separately. Breakthrough may be determined by emission measurement in an enclosure or by measuring the weight gain of an auxiliary evaporative canister connected downstream of the vehicle's canister, in which case, the following references to the enclosure can be ignored. The auxiliary canister shall be well purged with dry air prior to loading. Breakthrough is defined as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams.</u>

<u>I. The following procedure provides for loading of the canister to breakthrough with a mixture composed of 50 percent butane and 50 percent nitrogen by volume.</u>

<u>1. Prepare the evaporative emission canister(s) for the canister loading operation. The canister shall not be removed from the vehicle, unless access to the canister in its normal location is so restricted that loading can only reasonably be accomplished by removing the canister from the vehicle. Special care shall be taken during this step to avoid damage to the components and the integrity of the fuel system. The evaporative emission enclosure shall be purged for several minutes. The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the canister loading procedure. If not already on, the evaporative enclosure mixing fan shall be turned on at this time. Place the vehicle in the sealed enclosure and measure emissions with the FID.</u>

<u>2. Load the canister with a mixture composed of 50/50 mixture by volume of butane and nitrogen at a rate of 40 $\pm$ 2 grams butane per hour. As</u>

soon as the canister reaches breakthrough, the vapor source shall be shut off.

3. Reconnect the evaporative emission canister.

II. The following procedure provides for loading the canister with repeated diurnal heat builds to breakthrough.

1. The evaporative emission enclosure shall be purged for several minutes. The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the diurnal heat builds. If not already on, the evaporative enclosure mixing fan shall be turned on at this time. The average temperature of the dispensed fuel shall be 60 $\pm$ 12^{o}F. Within one hour of being refueled, the vehicle shall be placed, with the engine shut off, in the evaporative emission enclosure. The fuel tank temperature sensor shall be connected to the temperature recording system. A heat source, specified in §86.107-90(a)(4), shall be properly positioned with respect to the fuel tank(s) and connected to the temperature controller.

2. The fuel may be artificially heated to the starting diurnal temperature of 65^{o}F. Turn off purge blower (if not already off); close and seal enclosure doors; and initiate measurement of the hydrocarbon level in the enclosure. When the fuel temperature reaches 65^{o}F, start the diurnal heat build. The diurnal heat build should conform to the following function to within $\pm$ 4^{o}F:

$$F = T_o + 0.4t$$

F is the fuel temperature, ^{o}F

T_o is the initial temperature, ^{o}F

t is the time since beginning of test, minutes

3. As soon as breakthrough occurs or when the fuel temperature reaches 105^{o}F, whichever occurs first, the heat source shall be turned off, the enclosure doors shall be unsealed and opened.

If breakthrough has not occurred by the time the fuel temperature reaches 105°F, the heat source shall be removed from the vehicle, the vehicle shall be removed (with the engine still off) from the evaporative emission enclosure and the entire procedure outlined above shall be repeated until breakthrough occurs.

4. After breakthrough occurs, the fuel tank(s) of the prepared vehicle shall be drained and filled with test fuel, as specified in paragraph 4.i. of these procedures, to the "tank fuel volume" defined in §86.082-2. The fuel shall be stabilized to a temperature within $\pm$ 3°F of the lab ambient before beginning the driving cycle for the exhaust emission test.

iv. Dynamometer procedure.

To be conducted according to 40 CFR 86.135-90.

v. Engine starting and restarting.

~~To be conducted according to 40 CFR 86.136-90.~~ Amend 40 CFR 86.136-90 to read as follows:

Revise section (c) to read: If the vehicle does not start after the manufacturer's recommended cranking time (or 10 continuous seconds in the absence of a manufacturer's recommendation), cranking shall cease for the period recommended by the manufacturer (or 10 seconds in the absence of a manufacturer's recommendation). This may be repeated for up to three start attempts. If the vehicle does not start after three attempts, the reason for failure to start shall be determined. The gas flow measuring device on the CVS (usually a revolution counter) or CFV shall be turned off and the sampler selector valves, including the alcohol 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.

vi. Dynamometer test run, gaseous and particulate emissions.

To be conducted according to 40 CFR 86.137-90.

vii. Vehicle Fuel Tank Temperature Stabilization

Immediately after the hot transient exhaust emission test, the vehicle shall be soaked in a temperature controlled area for a maximum of ~~one hour~~ four hours until the fuel temperature is stabilized at 105°F. This is a preparatory step for the running loss test. Cooling or heating of the fuel tank may be induced ~~if the one hour soak is not sufficient~~ to bring the fuel tank to 105 F°. The vehicle fuel temperature stabilization step may be omitted on vehicles whose tank fuel temperature is already at 105°F upon completion of the exhaust emission test.

The initial fuel temperature for the running loss test may be less than 105°F if the manufacturer is able to provide data justifying a lower initial temperature. The fuel temperature shall reflect the maximum fuel temperature achieved by a stabilized vehicle during a 105°F day.

The vehicle air conditioning system (if so equipped) shall be set to the "NORMAL" air conditioning mode and adjusted to the minimum discharge air temperature and high fan speed. Vehicles equipped with automatic temperature controlled air conditioning systems shall be operated in "AUTOMATIC" temperature and fan modes with the system set at 72°F.

viii. Running Loss Test

After the fuel temperature is stabilized at 105°F or at the temperature specified by the manufacturer, the running loss test shall be performed. During the test, the running loss measurement enclosure ~~(§86.107.90(a)(1))~~ shall be maintained at 105°F ± 5°F maximum and within ± 2°F on average throughout the running loss test sequence. If the vehicle has more than one fuel tank, the fuel temperature in each tank shall follow the profile generated in paragraph 4.f. If a warning light or gauge indicates that the vehicle's engine coolant has overheated, the test run may be stopped.

A. If running loss testing is conducted using an enclosure which incorporates atmospheric sampling equipment, the manufacturer shall perform the following steps for each test:

   I. The running loss enclosure shall be purged for several minutes immediately prior to the test. If at any time the concentration of hydrocarbons, of alcohol, or of alcohol and hydrocarbons exceeds

15,000 ppm C, the enclosure should be immediately purged. This concentration provides at least a 4:1 safety factor against the lean flammability limit.

~~I.~~ II. Place the drive wheels of the vehicle on the dynamometer without starting the engine.

~~II.~~ III. Attach the exhaust tube to the vehicle tailpipe(s).

~~III.~~ IV. The test vehicle windows and the luggage compartments shall be closed.

~~IV.~~ V. The fuel tank temperature sensor and the ambient temperature sensor shall be connected to the temperature recording system and, if required, to the air management and temperature controllers. The vehicle cooling fan shall be positioned as described in 40 CFR 86.135-90(b). During the running loss test, the cover of the vehicle engine compartment shall be closed as much as possible, windows shall be closed, and air conditioning system (if so equipped) shall be operated according to the requirements of paragraph 4.f. (§86.129-80 (d)(3)). Vehicle coolant temperature shall be monitored to ensure adequate vehicle coolant air to the radiator intake(s). The temperature recording system and the hydrocarbon and alcohol emission data recording system shall be started.

~~V.~~ VI. Close and seal enclosure doors.

~~VI.~~ VII. Analyze enclosure atmosphere for hydrocarbons and alcohol at the beginning of each ~~P~~phase of the test (i.e., each UDDS and 120 second idle; the two NYCCs and 120 second idle) and record. This is the background hydrocarbon concentration, ~~and is~~ herein denoted as $C_{HCa(n)}$ for each ~~P~~phase of the test and the background methanol concentration, herein denoted as $C_{CH3OHa(n)}$ for each ~~P~~phase of the test. The methanol sampling must start simultaneously with the initiation of the hydrocarbon analysis and continue for 4.0 ± 0.5 minutes. Record the time elapsed during this analysis. If the 4 minute sample period is inadequate to collect a sample of sufficient concentration to allow accurate Gas Chromatography analysis, 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 flow through the impingers should be minimized to prevent any losses.

~~VII.~~ VIII. For 1993 to 1995 model hybrid electric vehicles and 1995 model motor vehicles. ~~T~~ the vehicle shall be driven through three UDDS test procedures. For 1996 and subsequent model motor vehicles, the vehicle shall be driven through one UDDS, then two NYCCs and followed by one UDDS. The UDDS and the NYCC driving traces shall be verified to meet the speed tolerance requirements of §86.115-78 (b). The end of each UDDS cycle and the two NYCCs, if applicable, shall be followed by an idle period of 120 seconds during which the engine shall remain on with the vehicle in the same transmission range and clutch (if so equipped) actuation mode as ~~during the UDDS idle periods~~ specified in §86.128-90, modified by paragraph 4.f.d.3. The fuel tank liquid temperature during the dynamometer drive shall be controlled within ± 3.0°F of the fuel tank temperature profile obtained on the road according to the procedures in paragraph 4.f. (§86.129-80(d)) for the same vehicle platform/ powertrain/fuel tank configuration. The fuel tank vapor temperature during the final 120 second idle period shall agree with the corresponding vapor temperature from the on-road profile within ± 3.0°F. The fuel tank temperatures shall be monitored at a frequency of at least once every 15 seconds.

~~VIII.~~ IX. For engine starting and restarting, the provisions of §86.136-90(a) and (e) shall apply. If the vehicle does not start after the manufacturer's recommended cranking time or 10 continuous seconds in the absence of a manufacturer's recommendation, cranking shall cease for the period recommended by the manufacturer or 10 seconds in the absence of a manufacturer's recommendation. This may be repeated for up to three start attempts. If the vehicle does not start after these three attempts, cranking shall cease and the reason for failure to start shall be determined. If the failure is caused by a vehicle malfunction, corrective action of less than 30 minutes duration may be taken (according to §86.090-25), and the test continued, provided that the ambient conditions to which the vehicle is exposed are maintained at 105°F + 5°F. When the engine starts, the timing sequence of the driving schedule shall begin. If the vehicle cannot be started, the test shall be voided.

X. Tank pressure shall not exceed 10 inches of water at any time 30 seconds after the start of the engine until the end of engine operation during the running loss test unless a pressurized system is used and the manufacturer demonstrates in a separate test that vapor would not be vented to the atmosphere if the fuel cap was removed at the end of the test. No pressure checks of the evaporative system shall be allowed. If the manufacturer suspects faulty or malfunctioning instrumentation, a repair of the test instrumentation may be performed. Under no circumstances will any changes/repairs to the evaporative emissions control system be allowed.

~~IX.~~ XI. The FID hydrocarbon analyzer shall be zeroed and spanned immediately prior to the end of each Pphase of the test.

~~X.~~ XII. Analyze the enclosure atmosphere for hydrocarbons and for alcohol following each Pphase. This is the sample hydrocarbon concentration, ~~and is~~ herein denoted as $C_{HCs(n)}$ for each Pphase of the test and the sample alcohol concentration, herein denoted as $C_{CH3OHs(n)}$ for each phase of the test. The sample hydrocarbon and alcohol concentration for a particular Pphase of the test shall serve as the background concentration for the next Pphase of the test. The running loss test ends with completion of the final 120 second idle and occurs 75 ± 2 minutes (if the three UDDS are conducted) or 72 ± 2 minutes (if the UDDS, two NYCCs, and the UDDS are conducted) after the test begins. The elapsed time of this analysis shall be recorded.

~~XI.~~ XIII. The test vehicle windows and luggage compartment shall be opened. This is a preparatory step for the hot soak evaporative emission test.

~~XII.~~ XIV. The technician may now leave the enclosure through one of the enclosure doors. The enclosure door shall be open no longer than necessary for the technician to leave.

~~XIII.~~ XV. If background emissions adversely affect test accuracy, a manufacturer may submit data to the Executive Officer demonstrating the problem. If, based on the information provided by the manufacturer, the Executive Officer determines that background emissions do adversely affect test accuracy, the manufacturer shall submit for Executive Officer approval some means to compensate for the problem. The Executive Officer shall approve the use of correction factors to minimize the effects of the problem if supported by experimental data submitted by the manufacturer.

B. If running loss testing is conducted using a cell which incorporates point source sampling equipment, the manufacturer shall perform the following steps for each test:

I. The running loss test shall be conducted in a test cell meeting the specifications of §86.107-90 (a)(1) as modified by paragraph 4.d.ii of these procedures. Ambient temperature in the running loss test cell shall be maintained at 105 ± 5°F maximum and within ± 2°F on average throughout the running loss test sequence. The ambient test cell temperature shall be measured in the vicinity of the vehicle cooling fan, and it shall be monitored at a frequency of at least once every 15 seconds. The vehicle running loss collection system and underbody cooling apparatus (if applicable) shall be positioned and connected. The vehicle shall be allowed to re-stabilize until the liquid fuel tank temperature is within ± 3.0°F of the initial liquid fuel temperature calculated according to paragraph 4.f. (§86.129-80(d)(5)) before the running loss test may proceed.

II. The vehicle cooling fan shall be positioned as described in 40 CFR 86.135-90(b). During the running loss test, the cover of the vehicle engine compartment shall be closed as much as possible, windows shall be closed, and air conditioning system (if so equipped) shall be operated according to the requirements of paragraph 4.f. (§86.129-80 (d)(3)). Vehicle coolant temperature shall be monitored to ensure adequate vehicle coolant air to the radiator intake(s).

III. For 1993 to 1995 model hybrid electric vehicles and 1995 model motor vehicles, T the vehicle shall be operated on the dynamometer over three UDDS ~~schedules.~~ For 1996 and subsequent model motor vehicles, the vehicle shall be operated on the dynamometer over one UDDS, two NYCCs, and one UDDS. Each UDDS and NYCC driving trace shall be verified to meet the speed tolerance requirements of §86.115-78 (b) as modified by paragraph 4.f. Idle periods of 120 seconds shall be added to the end of each of the UDDS ~~driving schedules.~~ and to the end of the two NYCCs. ~~For hybrid electric vehicles, if the vehicle is unable to maintain the UDDS trace, the vehicle shall be operated at wide open throttle.~~ The transmission may be operated according to the specifications of §86.128-90 as modified by paragraph 4.f.d.3. Engine starting and restarting shall be conducted according to paragraph 4.g.viii.A.IX.

IV. The fuel tank liquid temperature during the dynamometer drive shall be controlled within ± 3.0°F of the fuel tank liquid temperature profile obtained on the road according to the procedures in paragraph 4.f. (§86.129-80(d)) for the same vehicle platform/powertrain/fuel tank configuration. The fuel tank vapor temperature during the final 120 second idle period shall agree with the corresponding vapor temperature from the on-road profile within ± 3.0°F. The fuel tank temperatures shall be monitored at a frequency of at least once every 15 seconds.

V. Tank pressure shall not exceed 10 inches of water 30 seconds after the start of the engine until the end of engine operation during the running loss test unless a pressurized system is used and the manufacturer demonstrates in a separate test that vapor would not be vented to the atmosphere if the fuel cap was removed at the end of the test. No pressure checks of the evaporative system shall be allowed. If the manufacturer suspects faulty or malfunctioning instrumentation, a repair of the test instrumentation may be performed. Under no circumstances will any changes/repairs to the evaporative emissions control system be allowed.

~~V.~~ VI. After the test vehicle is positioned on the dynamometer, the running loss vapor ~~vent~~ collection system shall be properly positioned at the specified discrete emissions sources, which include ~~fuel~~ vapor vents of the vehicle's fuel system, if not already positioned. The typical vapor vents for current fuel systems are the vents of the evaporative emission canister(s) and the tank pressure relief vent typically integrated into the fuel tank cap as depicted in Figure 1. Other designated places, if any, where fuel vapor can escape, shall also be included.

~~VI.~~ VII. The running loss vapor ~~vent~~ collection system ~~shall~~ may be connected to the PDP-CVS or CFV bag collection system. Otherwise, running loss vapors shall be sampled continuously with analyzers meeting the requirements of §86.107-90(a)(2).

~~VII.~~ VIII. The temperature of the collection system until it enters the main dilution airstream shall be maintained between 175°F to 200°F throughout the test to prevent fuel vapor condensation.

~~VIII.~~ IX. The sample bags shall be analyzed within 20 minutes of their respective sample collection phases, as described in §86.137-90(b)(15).

C. Manufacturers may use an alternative running loss test procedure if it provides an equivalent demonstration of compliance. However, confirmatory testing or in-use compliance testing may be conducted by the Executive Officer using either the running loss measurement enclosure incorporating atmospheric sampling equipment or point source sampling equipment as specified in paragraph 4.d.ii (§86.107-90(a)(1)), and the procedure as outlined in either paragraph 4.g.viii.A. or 4.g.viii.B. of this test procedure.

ix. Hot-soak test.

Amend 40 CFR 86.138-90 as follows:

Revise the first paragraph of this section to read: For the three-day diurnal sequence, ~~T~~ the hot soak evaporative emission test shall be conducted immediately following the running loss test. The hot soak test shall be performed at an ~~average~~ ambient temperature of 105 F° ± 10.0 F° for the first 5 minutes of the test. The remainder of the hot soak test shall be performed at 105°F ± 5.0°F ~~maximum~~ and ± 2.0 F° on average.

A. ~~Omit §86.138-90(a), (e), and (f).~~ Revise section (a) to read: If the hot soak test is conducted in the running loss enclosure, the final hydrocarbon and alcohol concentration for the running loss test, calculated in paragraph 4.g.xi.C.2.II., shall be the initial hydrocarbon concentration (time=0 minutes) C_{HCe1}

and the initial alcohol concentration (time=0 minutes) $C_{CH3OHe1}$ for the hot soak test. If the vehicle must be transported to a different enclosure, sections (b) through (f), as modified below, shall be conducted.

B. Revise section (d) to include: Analyze the enclosure atmosphere for hydrocarbons and alcohol and record. This is the initial (time=0 minutes) hydrocarbon concentration, C_{HCe1} and the initial (time=0 minutes) alcohol concentration, $C_{CH3OHe1}$, required in paragraph 4.g.xi.B.2.i.

C. Revise section (e) to read: If the hot soak test is not conducted in the running loss enclosure, 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.

~~B.~~ D. Revise ~~§86.138-90~~ section (i) to read: If hot soak testing is not conducted in the same enclosure as running loss testing, the hot soak enclosure doors shall be closed and sealed within two minutes of engine shutdown and within five minutes ~~of engine shutdown following~~ after the end of the running loss test. If running loss and hot soak testing is conducted in the same enclosure, the hot soak test shall commence immediately after the completion of the running loss test.

E. Revise section (j) to read: The 60 ± 0.5 minutes hot soak begins when the enclosure door(s) are sealed or when the running loss test ends if the hot soak test is conducted in the running loss enclosure.

~~C.~~ F. Add section (p) to read: If background emissions adversely affect test accuracy, a manufacturer may submit data to the Executive Officer demonstrating the problem. If, based on the information provided by the manufacturer, the Executive Officer determines that background emissions do adversely affect test accuracy, the manufacturer shall submit for Executive Officer approval some means to compensate for the problem. The Executive Officer shall approve the use of correction factors to minimize the effects of the problem if supported by experimental data submitted by the manufacturer.

For the supplemental two-day diurnal test sequence, the hot soak test shall be conducted immediately following the hot start exhaust test. The hot soak test shall be performed at an ambient temperature between 68° to 86°F at all times. The hot soak test shall be conducted according to §86.138-90, revised by (A) through (F) of this paragraph.

x. Diurnal breathing loss test.

A ~~72-hour~~ three-day diurnal test shall be performed in a variable temperature ~~SHED~~ enclosure, described in paragraph 4.d.i. of this test procedure. The test consists of three 24-hour cycles. For purposes of this diurnal breathing loss test, all references to methanol shall be applicable to ~~ethanol~~ alcohol.

Revise 40 CFR 86.133-90 to read as follows:

A. Revise section (a)(1) to read: Upon completion of the hot soak test, the ~~start of the diurnal breathing loss test shall follow within 24 hours.~~ test vehicle shall be soaked for no less than 6 hours nor more than 36 hours. For at least the last 6 hours of this period, the vehicle shall be soaked at 65°F ± 3°F. The diurnal breathing loss test shall consist of three 24-hour test cycles.

B. Omit section (f).

C. ~~Revise section (i) to read: The dirunal breathing loss test shall commence with a fuel temperature of 65°F. The fuel may be artificially cooled or heated to the starting diurnal temperature.~~ Omit section (i).

D. Revise section (j) to read: ~~When the fuel temperature recording system reaches at least 63°F, immediately:~~ Prior to initiating the emission sampling:

E. Revise section (k) to read: ~~When the fuel temperature recording system reaches 65°F ± 2°F, immediately:~~ Emission sampling shall begin within 10 minutes of closing and sealing the doors, as follows:

F. Revise section (k)(3) to read: Start diurnal heat build and record time. This commences the 24 hour ± 2 minute test cycle.

G. Revise section (l) to read: For each 24-hour cycle of the diurnal breathing loss test, the ambient temperature in the SHED enclosure shall be changed in real time as specified in the following table:

Hour	Temperature (^{o}F)	Hour	Temperature (^{o}F)
0	65.0	12	104.2
1	66.6	13	101.1
2	72.6	14	95.3
3	80.3	15	88.8
4	86.1	16	84.4
5	90.6	17	80.8
6	94.6	18	77.8
7	98.1	19	75.3
8	101.2	20	72.0
9	103.4	21	70.0
10	104.9	22	68.2
11	105.0	23	66.5
		24	65.0

H. Omit section (m).

I. Revise section (n) to read: The end of the first 24-hour cycle of the diurnal test occurs 24 hours ± 2 minutes after the heat build begins~~,~~ ~~paragraph (j)(2)~~. Analyze the enclosure atmosphere for hydrocarbons and alcohol and record. This is the final hydrocarbon concentration, C_{HCfe2} , and the final alcohol concentration, $C_{CH3OHe2}$, in paragraph 4.g.xi.C.2.III. which modifies §86.143-90, for this test cycle. The time (or elapsed time) of this analysis shall be recorded. The procedure, commencing with paragraph (k)(1) shall be repeated until three consecutive 24-hour tests are completed. The data from the test cycle yielding the highest diurnal hydrocarbon mass shall be used in evaporative emissions calculations as required by paragraph 4.g.xi.C.2.III. which modifies §86.143-90.

~~I.~~ J. Revise section (q) to read: Upon completion of the final 24-hour test cycle, and after the final ~~ethanol~~ alcohol sample has been collected, ~~the heat source shall be turned off and~~ the enclosure doors shall be unsealed and opened.

K. Omit section (r).

~~J.~~ L. Add section (t) to read: If background emissions adversely affect test accuracy, a manufacturer may submit data to the Executive Officer demonstrating the problem. If, based on the information provided by the manufacturer, the Executive Officer determines that background emissions do adversely affect test accuracy, the manufacturer shall submit for Executive Officer approval some means to compensate for the problem. The Executive Officer shall approve the use of correction factors to minimize the effects of the problem if supported by experimental data submitted by the manufacturer.

~~K.~~ M. Add section (u) to read: For hybrid electric vehicles, ~~T~~the manufacturer shall specify the working capacity of the evaporative emission control canister, and shall specify the number of 24-hour diurnals that can elapse before the auxiliary power unit ~~APU~~ will activate solely for the purposes of purging the canister of hydrocarbon vapor.

~~L.~~ N. Add section (v) to read: In order to determine that the working capacity of the canister is sufficient to store the hydrocarbon vapor generated over the manufacturer specified number of days between auxiliary power unit activation events for the purposes of purging the evaporative canister, the evaporative canister shall be weighed after completion of the ~~72-hour~~ three-day diurnal period. The weight of the vapor contained in the canister shall not exceed the working capacity of the canister multiplied by three days and divided by the manufacturer specified number of days between auxiliary power unit activation events.

~~M.~~ O. Add section (w) to read: The manufacturer shall specify the time interval of auxiliary power unit operation necessary to purge the evaporative emission control canister, and shall submit an engineering analysis to demonstrate that the canister will be purged to within five percent of its working capacity over the time interval.

The two-day diurnal test shall be performed in an enclosure, described in paragraph 4.d.i. of this test procedure. The test consists of two 24-hour cycles. The test procedure shall be conducted according to §86.133-90, revised by (A) through (O) of this paragraph except that only two consecutive 24-hour cycles will be performed. For the purposes of this diurnal breathing loss test, all references to methanol shall be applicable to alcohol.

xi. Calculations; evaporative emissions.

For purposes of this section, all references to methanol shall also be applicable to ~~ethanol~~ alcohol.

Revise 40 CFR 86.143-90 as follows:

A. Revise section (a) to read: The calculation of the net hydrocarbon plus methanol ~~(organic material hydrocarbon equivalent)~~ mass change in the enclosure is used to determine the diurnal, hot soak, and running loss mass emissions. <u>If the emissions also include ethanol and other alcohol components, the manufacturer shall determine an appropriate calculation(s) which reflect characteristics of the alcohol component similar to the equations below, subject to the Executive Officer approval.</u> 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:

B. <u>Revise section (a)(1) to read:</u>

<u>Methanol calculations shall be conducted according to §86.143-96 (b)(1)(i)</u>

<u>C.</u> Revise section (a)(2) to read:

(2) For hydrocarbons:

~~(a)~~ <u>(I)</u> Hot soak HC mass. The hot soak enclosure mass is determined as:

$$M_{HCd\underline{hs}} = [2.95\underline{7} x (V_n - 50) x 10^{-4} x \{P_{\underline{f}} * (C_{HCe2} - \underline{rC_{CH3OHe2})/T_f - P_i}(C_{HCe1} \underline{- rC_{CH3OHe1}})\}/T_i\underline{]}$$

where: M_{HChs} is the hot soak HC mass emissions (grams)

V_n is the enclosure nominal volume <u>if the running loss enclosure is used or the enclosure volume at 105°F if the diurnal enclosure is used.</u> (ft^3)

P_i is the initial barometric pressure (inches Hg)

<u>P_f is the final barometric pressure (inches Hg)</u>

C_{HCe2} is the final enclosure <u>hydrocarbon</u> concentration <u>including FID response to methanol in the sample</u> (ppm C)

C_{HCe1} is the initial enclosure <u>hydrocarbon</u> concentration <u>including FID response to methanol in the sample</u> (ppm C)

$C_{CH3OHe2}$ is the final methanol concentration calculated according to §86.143-90 (a)(2)(iii) (ppm C equivalent)

$C_{CH3OHe1}$ is the initial methanol concentration calculated according to §86.143-90 (a)(2)(iii) (ppm C equivalent)

r is the FID response factor to methanol

T_i is the initial enclosure temperature (°R)

T_f is the final enclosure temperature (°R)

~~(b)~~ (ii) Running loss HC mass. The running loss HC mass per distance traveled is defined as:

$$M_{HCrlt} = (M_{HCrl(1)} + M_{HCrl(2)} + M_{HCrl(3)})/(D_{rl(1)} + D_{rl(2)} + D_{rl(3)})$$

where: M_{HCrlt} is the total running loss HC mass per distance traveled (grams HC per mile)

$M_{HCrl(n)}$ is the running loss HC mass for ~~P~~phase n of the test (grams HC)

$D_{rl(n)}$ is the actual distance traveled over the driving cycle for ~~P~~phase n of the test (miles)

~~and:~~For the point-source method:

Hydrocarbon emissions:

$$M_{HCrl(n)} = (C_{HCs(n)} - C_{HCa(n)}) \times \text{~~17.10~~ } 16.88 \times V_{mix} \times 10^{-6}$$

where: $C_{HCs(n)}$ is the sample bag HC concentration for ~~P~~phase n of the test (ppm C)

$C_{HCa(n)}$ is the background bag concentration for ~~P~~phase n of the test (ppm C)

~~17.10~~ 16.88 is the density of ~~butane divided by 4~~ pure vapor at 68°F (grams/ft³)

V_{mix} is the total dilute CVS volume (std. ft³) and: V_{mix} is calculated per §86.144-90

Methanol emissions:

$$M_{CH3OHrl(n)} = (C_{CH3OHs(n)} - C_{CH3OHa(n)}) \times 37.74 \times V_{mix}$$

where: $C_{CH3OHs(n)}$ is the sample bag methanol concentration for phase n of the test (ppm C equivalent)

$C_{Ch3OHa(n)}$ is the background bag concentration for phase n of the test (ppm C equivalent)

37.74 is the density of pure vapor at 68°F (grams/ft^3)

V_{mix} is the total dilute CVS volume (std. ft^3)

and: V_{mix} is calculated per §86.144-90

For the enclosure method:

$M_{HCrl(n)}$ shall be determined by the same method as the hot soak hydrocarbon mass emissions determination specified in paragraph 4.g.xi.C.2.I.

~~(e)~~ (III) Diurnal mass. The HC mass for each of the three diurnals is defined for an ~~variable volume~~ SHED enclosure as:

$$M_{HCd} = [2.987 \times (V_n - 50) \times 10^{-4} \times \{P_{f} \times (C_{HCe2} - rC_{CH3OHe2})/T_f - P_i(C_{HCe1} - rC_{CH3OHe1})/T_i\}] + M_{HC,out} - M_{HC,in}$$

where: M_{HCd} is the diurnal HC mass emissions (grams)

V_n is the enclosure ~~nominal~~ volume at 65°F (ft^3)

P_i is the initial barometric pressure (inches Hg)

P_f is the final barometric pressure (inches Hg)

C_{HCe2} is the final enclosure hydrocarbon concentration including FID response to methanol in the sample (ppm C)

C_{HCe1} is the initial enclosure hydrocarbon concentration including FID response to methanol in the sample (ppm C)

$C_{CH3OHe2}$ is the final methanol concentration calculated according to §86.143-90 (a)(2)(iii)

$C_{CH3OHe1}$ is the initial methanol concentration calculated according to §86.143-90 (a)(2)(iii)

r is the FID response factor to methanol

T_i is the initial enclosure temperature (^oR)

T_f is the final enclosure temperature (^oR)

$M_{HC,out}$ is the mass of hydrocarbon exiting the enclosure from the beginning of the cycle to the end of the cycle, in the case of fixed volume enclosures, (grams)

$M_{HC,in}$ is the mass of hydrocarbon exiting the enclosure from the beginning of the cycle to the end of the cycle, in the case of fixed volume enclosure, (grams)

~~C.~~ D. Revise section (a)(3) to read:

The total mass emissions shall be adjusted as follows:

(1) $M_{hs} = M_{HChs} + (14.2284/32.042) \times 10^{-6} M_{CH3OH}$

(2) $M_{di} = M_{HCd} + (14.3594/32.042) \times 10^{-6} M_{CH3OH}$

(3) $M_{rl} = M_{HCrlt} + (14.2284/32.042) \times 10^{-6} M_{CH3OH}$

E. Revise section (b) to read: The final evaporative emission test results reported shall be computed by summing the adjusted evaporative emission result determined for the hot soak test (M_{hs}) and the highest 24-hour result determined for the diurnal breathing loss test (M_{di}). The final reported result for the running loss test shall be the adjusted emission result (M_{ri}), expressed on a grams per mile basis. computed by dividing the sum of the three masses by the total miles traveled over the three Phases of the test.

h. For 1983 and subsequent model-year LPG-fueled motor vehicles, the introduction of 40 percent by volume of chilled fuel and the heating of the fuel tank under the diurnal part of the evaporative test procedures shall be eliminated.

i. Evaporative emission test fuel shall be the fuel specified for exhaust emission testing in the applicable exhaust emission test procedures.

The maximum Reid Vapor Pressure of gasoline used for testing and in service accumulation shall be consistent with the fuel specification applicable to vehicles in California.

Fuel additives and ignition improvers intended for use in methanol alcohol test fuels shall be subject to the approval of the Executive Officer. In order for such approval to be granted, a manufacturer must demonstrate that vehicle performance will be adversely affected without the use of the fuel additive.

j. With respect to 1996 and subsequent model vehicles and engines, if a manufacturer uses for evaporative and exhaust emission testing a gasoline test fuel meeting a specification set forth in § 86.113-94, the manufacturer may use the evaporate emission test procedures set forth in §§ 86.107-96 through 86.143-96 in place of the test procedures set forth in this California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles.

5. Approval of heavy-duty vehicles over 14,000 lbs GVWR, excluding medium-duty vehicles from 6,000 to 8,500 lbs GVWR and complete and incomplete medium-duty vehicles 14,000 lbs GVWR or less, shall be based on an engineering evaluation of the system and data submitted by the applicant. Such evaluation may include successful public usage on light-duty or medium-duty vehicles, adequate capacity of storage containers, routing of lines to prevent siphoning, and other emissions-related factors deemed appropriate by the Executive Officer. For LPG systems, this engineering evaluation shall include: emissions from pressure relief valves, carburetion systems and other sources of leakage; emissions due to fuel system wear and aging; and evaporative emission test data from light-duty or medium-duty vehicles with comparable fuel systems.

6. For the 1980 model year, the measured evaporative emissions from all test vehicles, except vehicles tested pursuant to paragraph 4. above and motorcycles, shall be corrected for background emissions by subtracting 1.0 gram per test. This correction for background emissions may be extended to include the 1981 model year, on a case-by-case basis, if the Executive Officer finds that a manufacturer has had insufficient lead-time to comply with the April 23, 1980 amendment to this procedure.

7. For the purposes of these test procedures, the following references in 40 CFR, Part 86, Subpart B, to light-duty vehicle evaporative testing shall also apply to motorcycles: §§86.117-78, 86.117-90, 86.121-82, and 86.121-90. In addition, 40 CFR, Part 86, Subparts E, F, and other cited sections of Subpart B are incorporated into this test procedure by reference.

8. Certification of a motorcycle evaporative emission control system requires that the manufacturer demonstrate the durability of each evaporative emission control system family.

   a. The motorcycle manufacturer can satisfy the vehicle durability testing requirement by performing an evaporative emission test at each scheduled exhaust emission test (§86.427-78) during the motorcycle exhaust emissions certification test (§86.425-78) for each evaporative emission family. The minimum mileage accumulated shall be the total distance (one-half the useful life distance), although the manufacturer may choose to extend the durability test to the useful life distance (§86.436-78). The displacement classes and test distances are shown below:

Displacement Class	Engine Displacement Range (CC)	Total Test Distance (km)	Useful Life Distance (km)
I	50-169	6,000	12,000
II	170-279	9,000	18,000
III	280 and greater	15,000	30,000

      i. All durability vehicles shall be built at least one month before the evaporative emissions test, or the manufacturer must demonstrate that the non-fuel related evaporative emissions have stabilized.

      ii. Testing at more frequent intervals than the scheduled exhaust emissions tests may be performed only when authorized in writing by the Executive Officer.

      iii. The DF ~~(deterioration factor)~~ shall be determined by calculating a least-squares linear regression of the evaporative emissions data with respect to mileage. The DF is defined as the extrapolated (from the regression) value at the useful life distance minus the interpolated value at the total test distance, where these distances are taken from the table in paragraph 8.a.

iv. The extrapolated useful life and total test distance emissions shall be less than the applicable evaporative emission standards of paragraph 1. or the data will not be acceptable for use in the calculation of a DF and demonstration of compliance.

v. Motorcycle manufacturers may use the ARB Component Bench Test Procedures or propose in their application a method for durability bench testing and determination of a DF for each evaporative emission engine family. The Executive Officer shall review the method, and shall approve it if it is similar to the requirements specified in paragraph 4.a.ii. Any reference to 4,000 miles and 50,000 miles in paragraph 4.a.ii. shall mean total test distance and useful life distance, respectively, as defined in paragraph 8.a. for the appropriate engine displacement class.

vi. The DF determined under paragraph 8.a.iii. shall be averaged with the DF determined under paragraph 8.a.v. to determine a single evaporative emission DF for each evaporative emission engine family. For those motorcycles which do not require exhaust emission control system durability testing, the evaporative emission control system DF shall be determined under paragraph 8.a.v. only. Compliance with the standard shall be demonstrated by performing an evaporative emission test on a stabilized motorcycle. The motorcycle shall have accumulated at least the minimum test distance. The extrapolated useful life distance emissions after applying the bench test-derived DF shall be less than the applicable evaporative emission standards of paragraph 1.

vii. (A) Manufacturers of Class III motorcycles may elect to use an assigned evaporative emission control system DF, provided they meet the following requirements:

- Annual California motorcycle sales do not exceed 500 units, and

- The evaporative emission control system has been previously certified to meet the emission standards specified in these procedures, or the manufacturer provides test data from previous certification demonstrating that the system complies with the durability requirements set forth in this paragraph.

(B) Manufacturers of Class III motorcycles using an assigned evaporative emission control system DF pursuant to subparagraph 8.a.vii.A. may submit a written request for a waiver of evaporative emission testing. The waiver shall be granted if the Executive Officer determines that the motorcycles will comply with the evaporative emission standard. The determination shall be based on the performance of the evaporative emission control system on other motorcycles, the capacity of vapor storage containers, the routing of lines to prevent siphoning, and other emission-related factors determined by the Executive Officer to be relevant to evaluation of the waiver request.

(C) Nothing in this paragraph shall be construed as an exemption from the exhaust emission standards and test procedures applicable pursuant to section 1958, Title 13, California Code of Regulations, or paragraph 8.c.ii. of these procedures.

viii. The emission label (§86.413-78) shall identify the evaporative emission family.

ix. Preconditioning shall be performed in accordance with §86.532-78. The provisions of §86.132-78 which prohibit abnormal loading of the evaporative emission control system during fueling and setting the dynamometer horsepower using a test vehicle shall be observed. Additional preconditioning (§86.132-82(a)(3) and §86.132-90(a)(3)) may be allowed by the Executive Officer under unusual circumstances.

b. Instrumentation

The instrumentation necessary to perform the motorcycle evaporative emission test is described in 40 CFR 86.107-78 and 86.107-90, with the following changes:

i. Revise section (a)(4) to read: Tank fuel heating system. The tank fuel heating system shall consist of two separate heat sources with two temperature controllers. A typical heat source is a pair of heating strips. Other sources may be used as required by circumstances and the Executive Officer may allow manufacturers to provide the heating apparatus for compliance testing. The temperature controllers may be manual, such as variable transformers, or they may be automated. Since vapor and fuel temperature are to be controlled independently, an automatic controller is recommended for the fuel. The heating system must not cause hot spots on the tank wetted surface which could cause local overheating of the fuel or vapor. Heating strips for the fuel, if used, should be located as low as practicable on the tank and should cover at least 10 percent of the wetted surface. The centerline of the fuel heating strips, if used, shall be below 30 percent of the fuel depth as measured from the bottom of the fuel tank and approximately parallel to the fuel level in the tank. The centerline of the vapor heating strips, if used, should be located at the approximate height of the center of the vapor volume. The temperature controller must be capable of controlling the fuel and vapor temperatures to the diurnal heating profile within the specified tolerance.

ii. Revise section (a)(5) (Temperature Recording System) to read: In addition to the specifications in this section, the vapor temperature in the fuel tank shall be measured. When the fuel or vapor temperature sensors cannot be located in the fuel tank to measure the temperature of the prescribed test fuel or vapor at the approximate mid-volume, sensors shall be located at the approximate mid-volume of each fuel or vapor containing cavity. The average of the readings from these sensors shall constitute the fuel or vapor temperature. The fuel and vapor temperature sensors shall be located at least one inch away from any heated tank surface. The Executive Officer may approve alternate sensor locations where the specifications above cannot be met or where tank symmetry provides redundant measurements.

iii. Calibration shall be performed in accordance with 40 CFR 86.516-78 or 86.516-90.

c. Test Procedure

i. The motorcycle exhaust emission test sequence is described in 40 CFR 86.530-78 through 86.540-78. The ~~Sealed Housing Evaporative Determination (SHED)~~ test shall be accomplished by performing the diurnal portion of the SHED test (§86.133-78 except subsections a(1), k, and p; §86.133-90 except subsections a(1), l, and s; and neglecting references to windows and luggage compartments in these sections) after preconditioning and soak but prior to the "cold" start test.

The fuel will be cooled to below 30°C after the diurnal test. The "cold" and "hot" start exhaust emission tests shall then be run. The motorcycle will then be returned for the hot soak portion of the SHED test. This general sequence is shown in Figure E78-10, under §86.130-78. The specified time limits shall be followed with the exception of soak times which are specified in §86.532-78 for motorcycles.

Running loss tests, when necessary, will be performed in accordance with §86.134-78, except references to §§86.135-82 through 86.137-82 and §§86.135-90 through 86.137-90 shall mean §§86.535-78 through 86.537-78.

ii. Manufacturers of Class III motorcycles with annual California sales of less than 500 units using an assigned evaporative emission control system DF pursuant to paragraph 8.a.vii.

shall measure and report to the Executive Officer exhaust emissions from the CVS test between the diurnal and the hot soak tests even if the test is being conducted for evaporative emissions only. The exhaust emission levels projected for the motorcycle's useful life utilizing the exhaust emission ~~deterioration factor~~ DF determined during previous federal or California certification testing shall not exceed the standards set forth in section 1958, Title 13, California Code of Regulations.

iii. The fuel and vapor temperatures for the diurnal portion of the evaporative emission test shall conform to the following functions within ± 1.7°C with the tank filled to 50 percent ± 2.5 of its actual capacity, and with the motorcycle resting on its center kickstand (or a similar support) in the vertical position.

$$T_f = (1/3)\ t + 15.5^{\circ}C$$

$$T_v = (1/3)\ t + 21.0^{\circ}C$$

Where: T_f = fuel temperature, °C

T_v = vapor temperature, °C

t = time since the start of the diurnal temperature rise, minutes.

The test duration shall be 60 ± 2 minutes, giving a fuel and vapor temperature rise of 20°C. The final fuel temperature shall be 35.5°C ± .5°C.

An initial vapor temperature up to 5°C above 21°C may be used. For this condition, the vapor shall not be heated at the beginning of the diurnal test. When the fuel temperature has been raised to 5.5°C below the vapor temperature by following the T_f function, the remainder of the vapor heating profile shall be followed.

iv. An alternate temperature rise for the diurnal test may be approved by the Executive Officer. If a manufacturer has information which shows that a particular fuel tank design will change the temperature rise significantly from the function above, the manufacturer may present the information to the Executive Officer for evaluation and consideration.

v. The hot soak evaporative emission test shall be performed immediately following the "hot" start exhaust emission test. This test is described in §§86.138-78 and 86.138-90, except for §§86.138-78(d) and 86.138-90(e) which are revised to require that the motorcycle be pushed with the engine off rather than driven at minimum throttle from the dynamometer to the SHED.

vi. Calculations shall be performed in accordance with §86.143-78 or 86.143-90, except the standard volume for a motorcycle shall be 5 ft^3 instead of 50 ft^3.

d. Motorcycle manufacturers with annual sales of less than 2,000 units for the three displacement classes in California are not required to submit the information specified by these test procedures to the Executive Officer. However, all information required by these test procedures must be retained on file and be made available upon request to the Executive Officer for inspection. These manufacturers shall submit the following information for evaporative emission certification:

i. A brief description of the vehicles to be covered by the Executive Order. (The manufacturer's sales data book or advertising, including specifications, will satisfy this requirement for most manufacturers.)

ii. A statement signed by an authorized representative of the manufacturer stating "The vehicles described herein have been tested in accordance with the provisions of the 'California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles', and on the basis of those tests, are in conformance with the aforementioned standards and test procedures."

9. The evaporative emissions for LPG systems shall be calculated in accordance with §86.143-78 or 86.143-90 except that a H/C ratio of 2.658 shall be used for both the diurnal and hot soak emissions.

Definitions:

Motorcycle Evaporative Emission Family: The group of motorcycle models which meet the criteria of EPA's MSAPC Advisory Circular No. 59, section D.

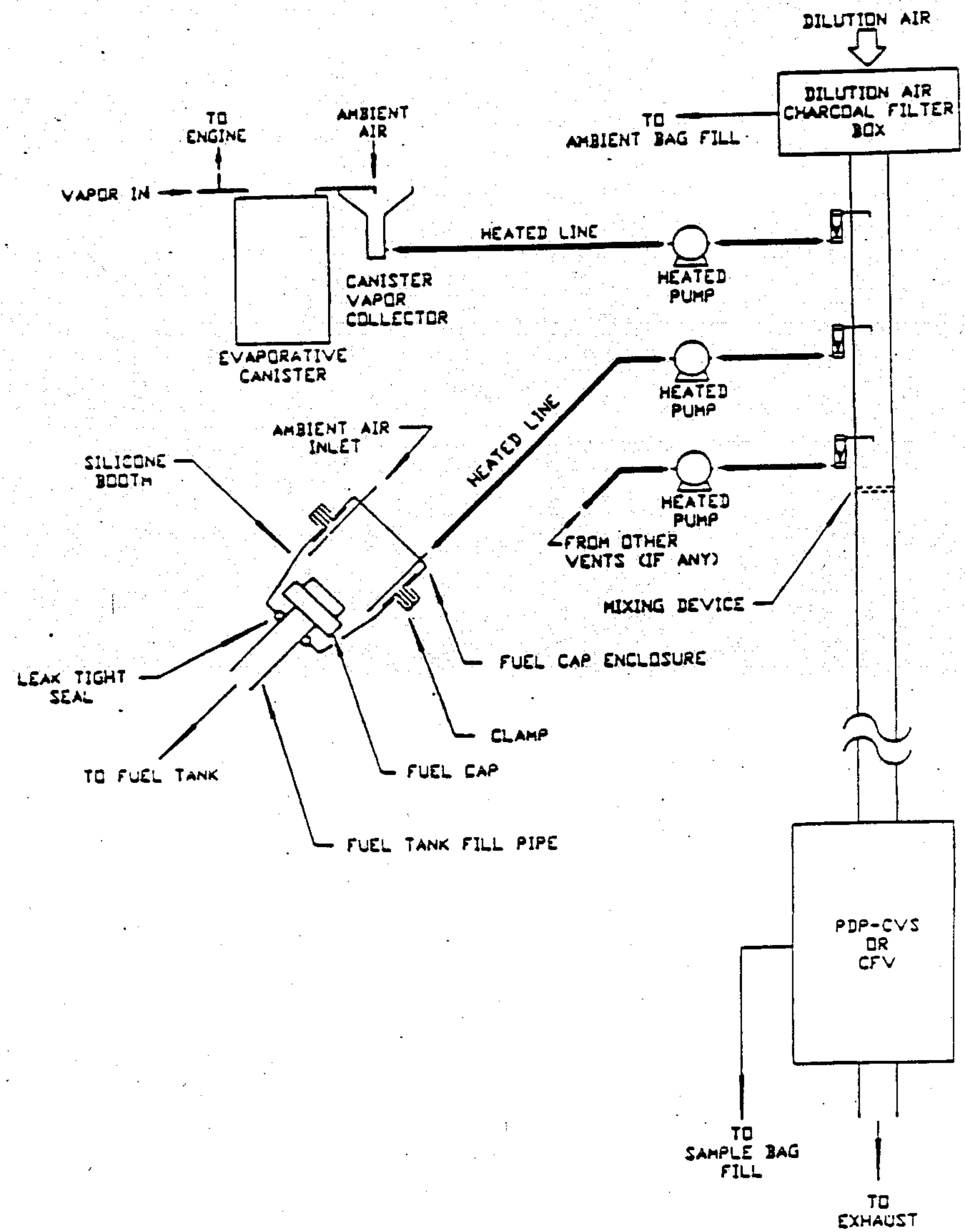

Figure 1. Running Loss Vapor Vent Collection System

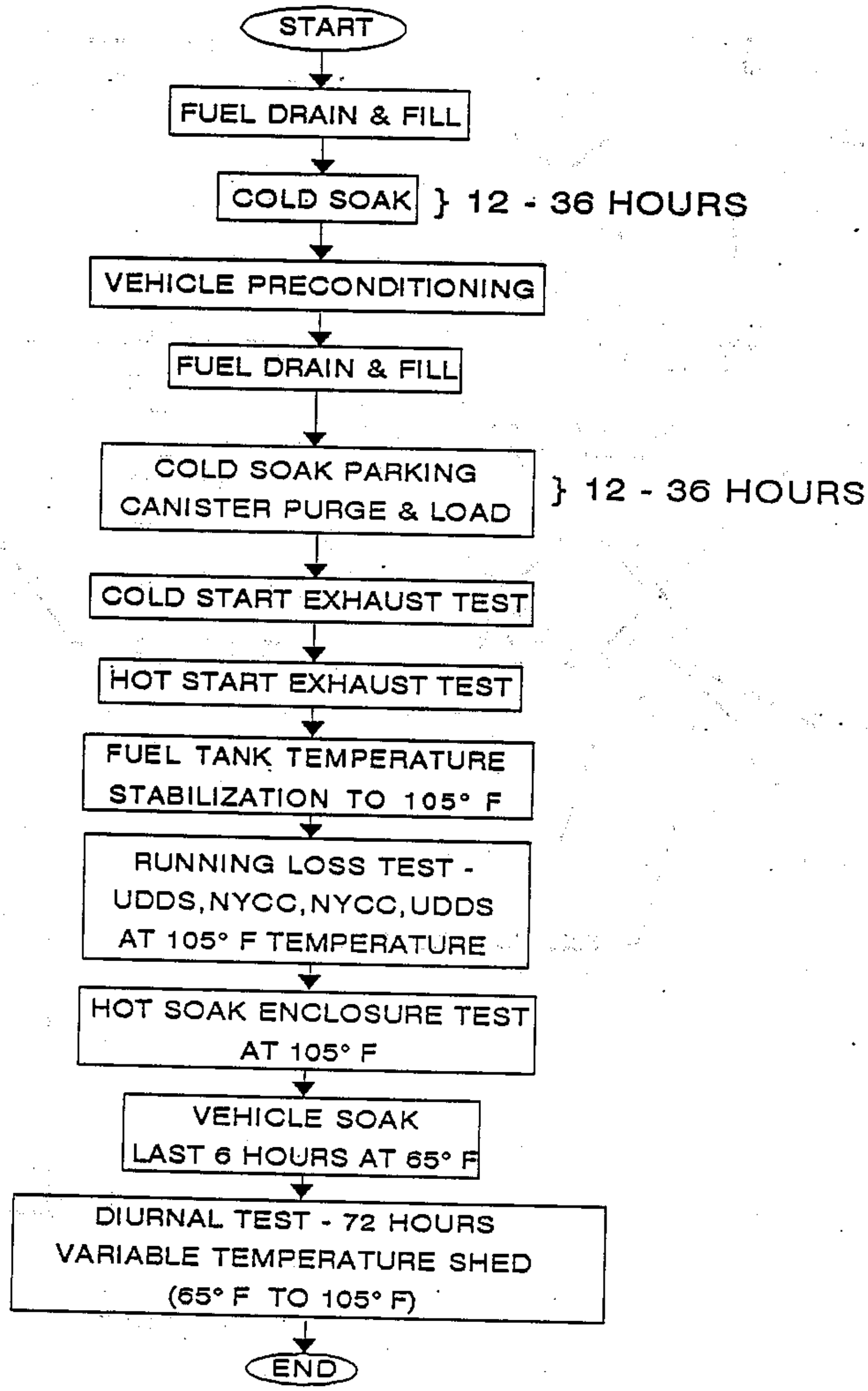

FIGURE 2. TEST PROCEDURE FOR 1995 MODEL MOTOR VEHICLES

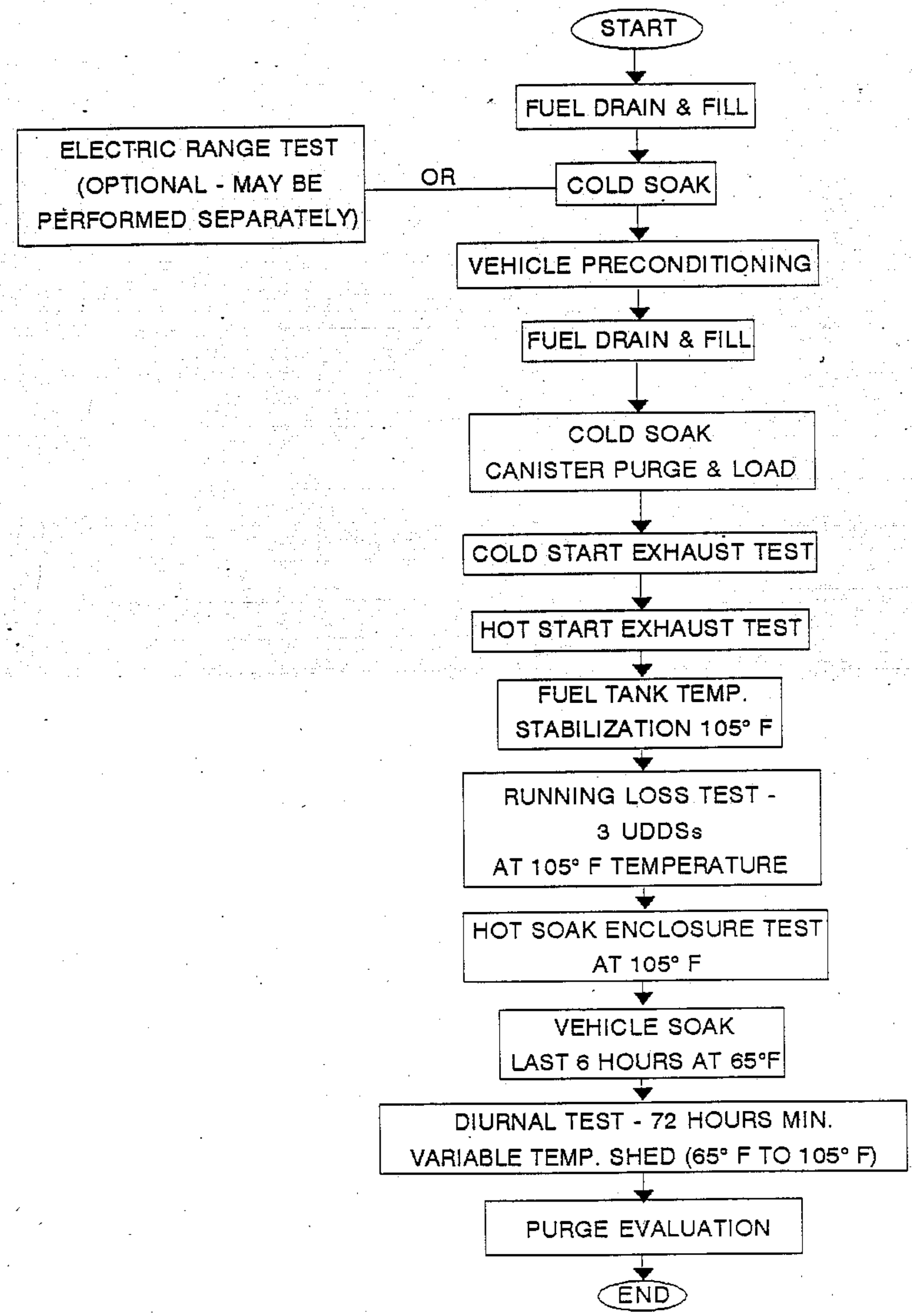

FIGURE 3. TEST PROCEDURES FOR 1993 TO 1995 MODEL HYBRID ELECTRIC VEHICLES

[This is a new figure proposed to be added to the test procedures.]

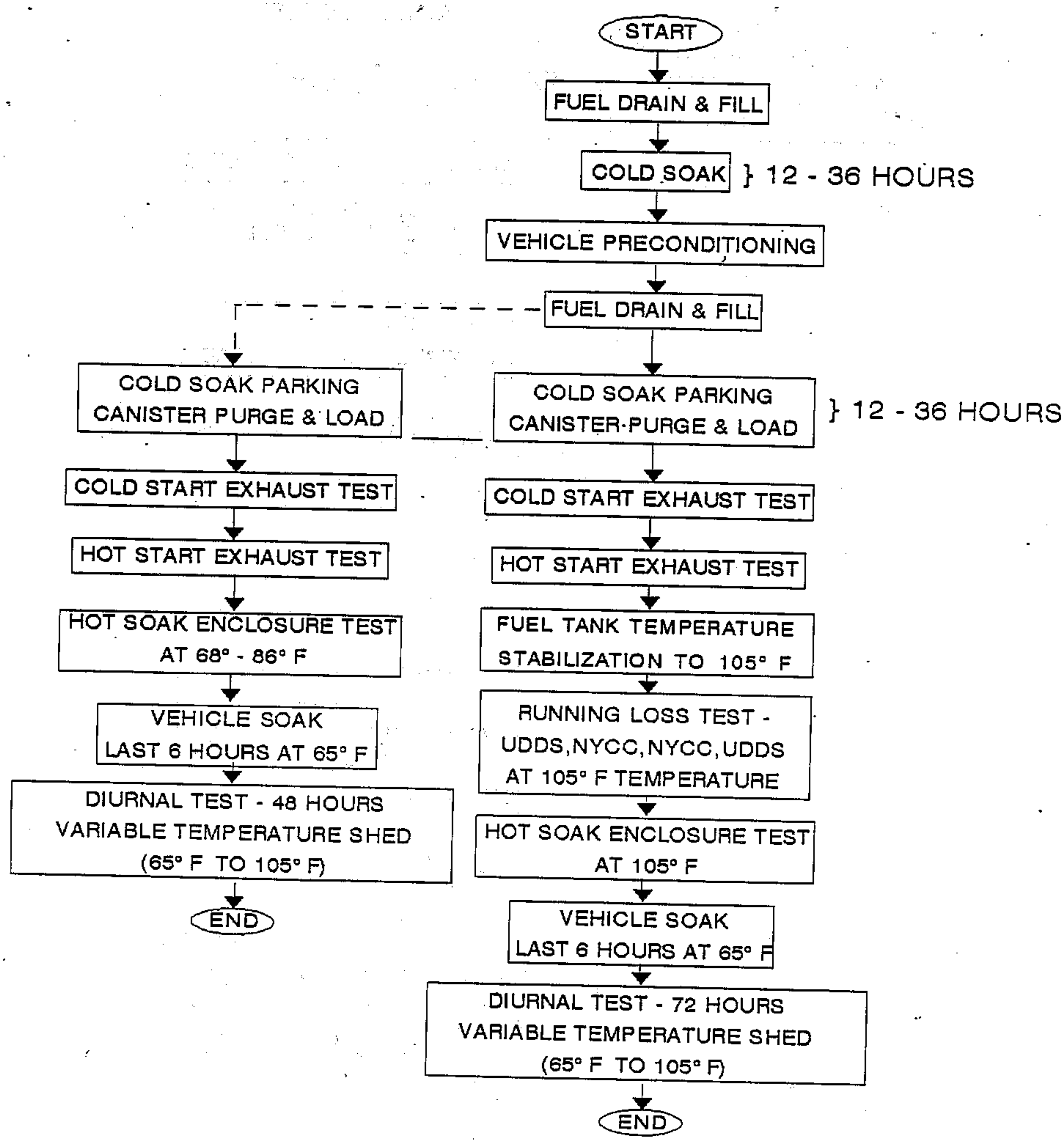

FIGURE 4. TEST PROCEDURES FOR 1996 AND SUBSEQUENT MODEL MOTOR VEHICLES

[This is a new figure proposed to be added to the test procedures.]

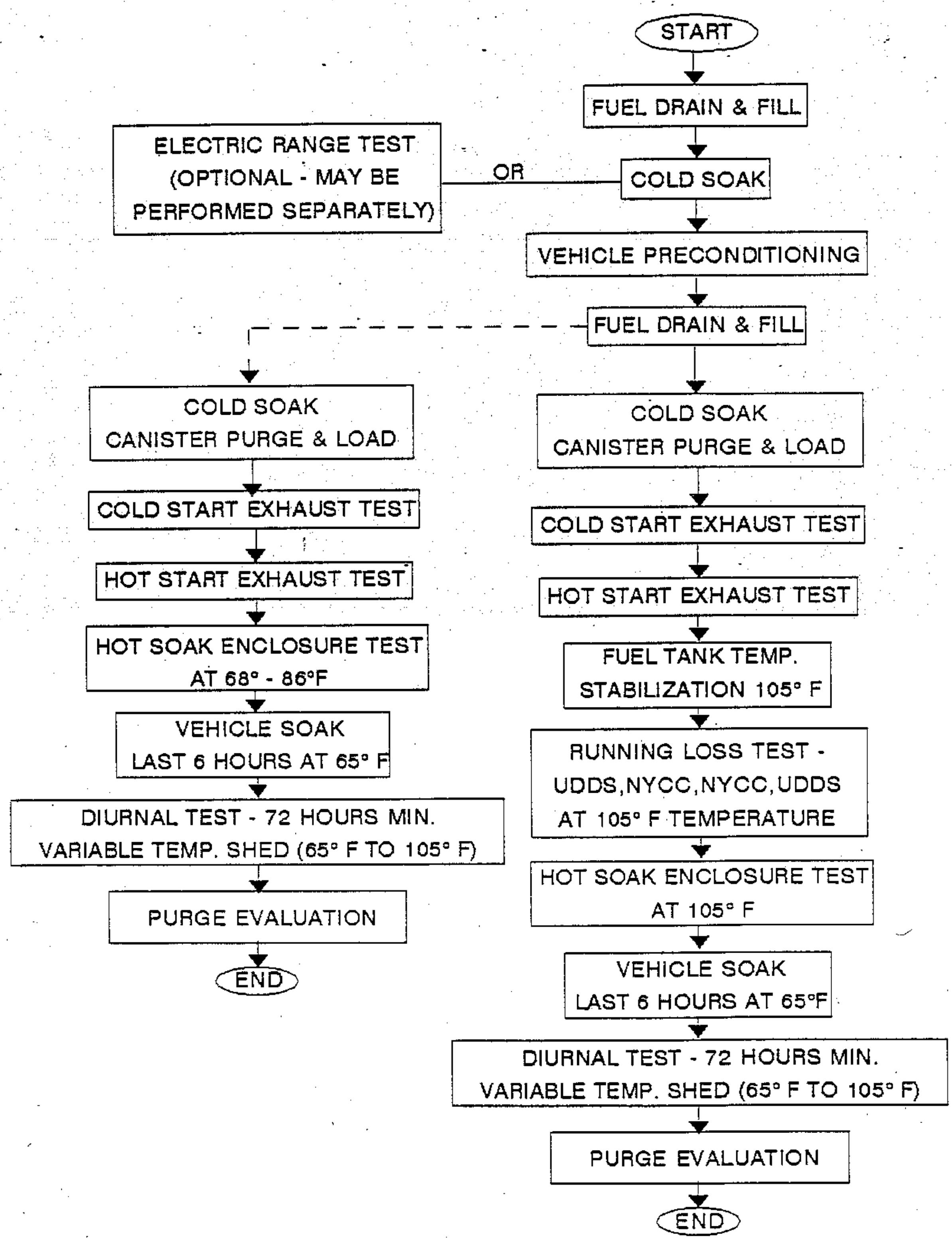

FIGURE 5. TEST PROCEDURES FOR 1996 AND SUBSEQUENT MODEL HYBRID ELECTRIC VEHICLES