UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
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OFFICE OF AIR AND RADIATION / OFFICE OF MOBILE SOURCES

EPA Aftermarket Retrofit Device Evaluation Program

The Environmental Protection Agency (EPA) conducts a program to evaluate the effects of fully developed aftermarket devices on vehicle emissions and fuel economy. Participation in this program by manufacturers of devices is voluntary. EPA evaluations of engines, retrofit devices, emission control devices, and related products are conducted for the purpose of keeping policy makers, technical personnel in government and industry, and the general public, abreast of developments in the field of automotive fuel economy and pollutant emission control. Aftermarket fuel additives are also included in the evaluation program and are hereafter also referred to as devices; oil additives, however, are **not** evaluated in this program. Aftermarket fuel additive manufacturers are required to register their products with the EPA Fuels and Energy Division (202-933-9020). It should be noted that many of the fuel line devices and liquids sold and associated with vapor bleed devices may be considered additives for the purpose of registration.

Because evaluations are intended to increase public knowledge, all data reported as a result of EPA testing become public information. **However, EPA findings do not constitute approval, endorsement or certification of these additives, devices or systems.**

EPA evaluates devices under two authorities: Section 206(a)(2) of the Clean Air Act (42 U.S.C. 1857f-5) and Section 511 of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2011). EPA has established a single evaluation and test program for these two authorizations.

This document contains information to help apply for EPA device evaluation. It outlines the application format, explains EPA test policy, and describes test sequences. Applicable regulations are found in 40 CFR (Code of Federal Regulations) Parts 79, 86, 600 and 610.

EPA works directly with product manufacturers to produce a fair evaluation. (Other parties, such as distributors, retailers and importers of devices, must obtain written authorization from the manufacturer to act as their representative.)

EPA will not conduct an evaluation without a completed application. Applications must contain test data collected by an independent laboratory demonstrating significant emission reduction and / or fuel economy benefits from using the device. The applicant may then proceed with confirmatory testing by EPA at its laboratory. Costs for independent and EPA testing must be paid by applicants.

EPA provides technical assistance in designing the test program to be performed at an independent laboratory. For confirmatory testing performed by EPA at its laboratory, EPA develops the test program in coordination with the applicant, analyzes the test results, and writes an official report summarizing the results in the Federal Register. Reports are available to the general public through the National Technical Information Service (NTIS), the Federal Trade Commission (FTC) and elsewhere. All tested devices are recorded in the "EPA Listing of Fuel Economy Devices" on page 26 of this document.

EPA recommends that device manufacturers consider the following factors before entering the evaluation program:

Test Laboratory Independence - Section 610.11(a)(20) of Federal Regulations states that test laboratories "shall have no financial interests in the outcome of these tests other than a fee charged for each test performed", and that "independence of the testing agent" will be considered in determining the validity of manufacturer furnished test data. Applicants must confirm that the selected laboratory has no vested financial interest in the outcome of the tests prior to the start of testing. (For convenience, a list of laboratories is provided on page 25.)

Minimum Test Requirements - Although some devices may require complex test plans, our minimum test requires two vehicles with replicate test sequences in each configuration for each vehicle. The vehicles should be selected from different manufacturers and should be representative of the largest selling engine/transmission combinations in the United States. Each vehicle will be set to its manufacturer's tune-up specifications for the baseline tests. Baseline emissions and fuel economy should be near the levels at which the vehicles were certified.

Test sequences are conducted in "back-to-back" fashion. Minimum testing requirements are as follows: (a) If device installation does not involve adjustment of vehicle manufacturer specifications (e.g., timing, fuel-air mixture, choke or idle speed, etc.), then conduct duplicate tests with the vehicle in baseline condition, and duplicate tests with the device installed with no vehicle adjustments between tests. (b) If installation of the device also involves adjustments (e.g., timing, fuel-air mixture, choke or idle speed, etc.), then conduct duplicate tests with the vehicle in baseline condition, duplicate tests with the adjustments and the device installed, and then conduct duplicate tests with only these adjustments. If mileage accumulation is necessary to realize the full benefit, or to determine whether the vehicle meets emission standards, the same number of miles that were accumulated before the tests with the device must also be accumulated before baseline tests without the device. In addition, the method of mileage accumulation should be kept constant.

Confirmation tests and/or evaluations performed by EPA will include the complete Federal Test Procedure (FTP). **The FTP is the only valid test used to evaluate devices for emission effects.** As a final requirement, the personnel of the independent laboratory selected for screening tests should perform every element of the applicant's test plan including preparation of the test vehicle, adjustment of parameters, and installation of the device.

Submission of Data - Section 610.16(b)(5) of Federal Regulations requires all test data obtained from the independent laboratories in support of the application be submitted to EPA including any results declared void or invalid by the laboratory. We also ask that, prior to the screening tests, applicants provide EPA with the name of the laboratory, test date schedule, and tests to be conducted. Applicants should allow EPA to contact the laboratory during testing, and allow them to directly answer any EPA questions about the test program.

Test Costs - Independent laboratory cost for the minimum test plan described above is estimated at $6000 per vehicle tested. Additions to the minimum test plan, such as providing test vehicles, mileage accumulation, parameter adjustment, or additional testing, etc. may increase costs. Applicants should contact the laboratories for actual costs.

Test Results - EPA confirmation tests will only be performed with devices demonstrating statistically significant fuel economy or emissions benefits based on the independent laboratory screening test data. EPA has established guidelines which help determine the size of the test fleet and whether test results with subject device should be considered encouraging. These values are chosen to assure that a real difference in emissions or fuel economy exists and do not reflect random variability of results. The table below presents the minimum number of cars needed to test varying degrees of fuel economy improvement assuming a typical amount of variability in fuel economy measurement. For a minimum test plan conducted on a fleet of two cars, the average improvement should be at least 6%. If at least a 6% difference in average fuel economy can be shown, one may usually conclude with a reasonable degree of confidence that a real improvement exists. Analysis by EPA for potential fuel economy effects will be based on actual test results (and test variability), not these guidelines.

Similarly, if one expects a nominal 3% improvement in fuel economy, a fleet of 5 vehicles would be appropriate for testing. Test results displaying a significant increase in emission levels are reason for concern.

Guidelines For Minimum Fuel Economy Improvements Versus Size of Test Fleet

Fleet Size	Average Improvement Required
2	6%
3	5%
4	4%
5	3%
10	2%

A similar table can be developed to evaluate the emissions effect of a device. However, because the variability in vehicle emissions is much greater than for fuel economy, a larger number of vehicles is required. The analysis by EPA for potential emissions effects will be based on test results.

Guidelines For Minimum Emission Improvements (Reduction) Vs. Size of Test Fleet

HC and NOx		CO	
Fleet Size	Average Improvement	Fleet Size	Average Improvement
2	20%	2	20%
2	15%	3	15%
3	10%	7	10%
10	5%	20	5%

Applications will be reviewed for compliance with the format beginning on page 8. Submitted data and information labeled confidential or proprietary must be justified on a case-by-case basis by the applicant. EPA can not treat test results, including those conducted by independent or other laboratories, as confidential since Section 511(c) of the Motor Vehicle Information and Cost Savings Act (MVICSA) requires disclosure of such information. (EPA may not perform an evaluation of a device if it judges it cannot develop a technically sound final report because an applicant declared information was confidential.)

EPA will request further information for incomplete applications. If confirmation tests are required, EPA will advise applicants of costs and provide applicants with the opportunity to review the test plan. Once testing is completed, an evaluation report will be written on the basis of independent test data submitted, EPA test data, and EPA engineering analysis.

EPA intends to process applications promptly and has established a goal of twelve weeks from the acceptance of an application to the announcement of our report. The attainment of this objective requires very precise scheduling, and is dependent on the applicant's prompt response to requests for further information. Failure to respond in a timely manner will delay the process. If the applicant does not complete the independent lab tests and submit data to EPA within a half year after EPA develops the test program, it will be considered a withdrawal from the program. A flow chart outlining the steps in the evaluation process is found on page 6.

In October 1994, EPA issued a final rule setting interim and final standards for detergent use in gasoline. To maintain the integrity of the rule, EPA requires that applicants for aftermarket fuel additive evaluation must provide information demonstrating that the additive has no adverse effect on the deposit control properties of gasoline. EPA will not accept applications for fuel additive evaluation program without this information.

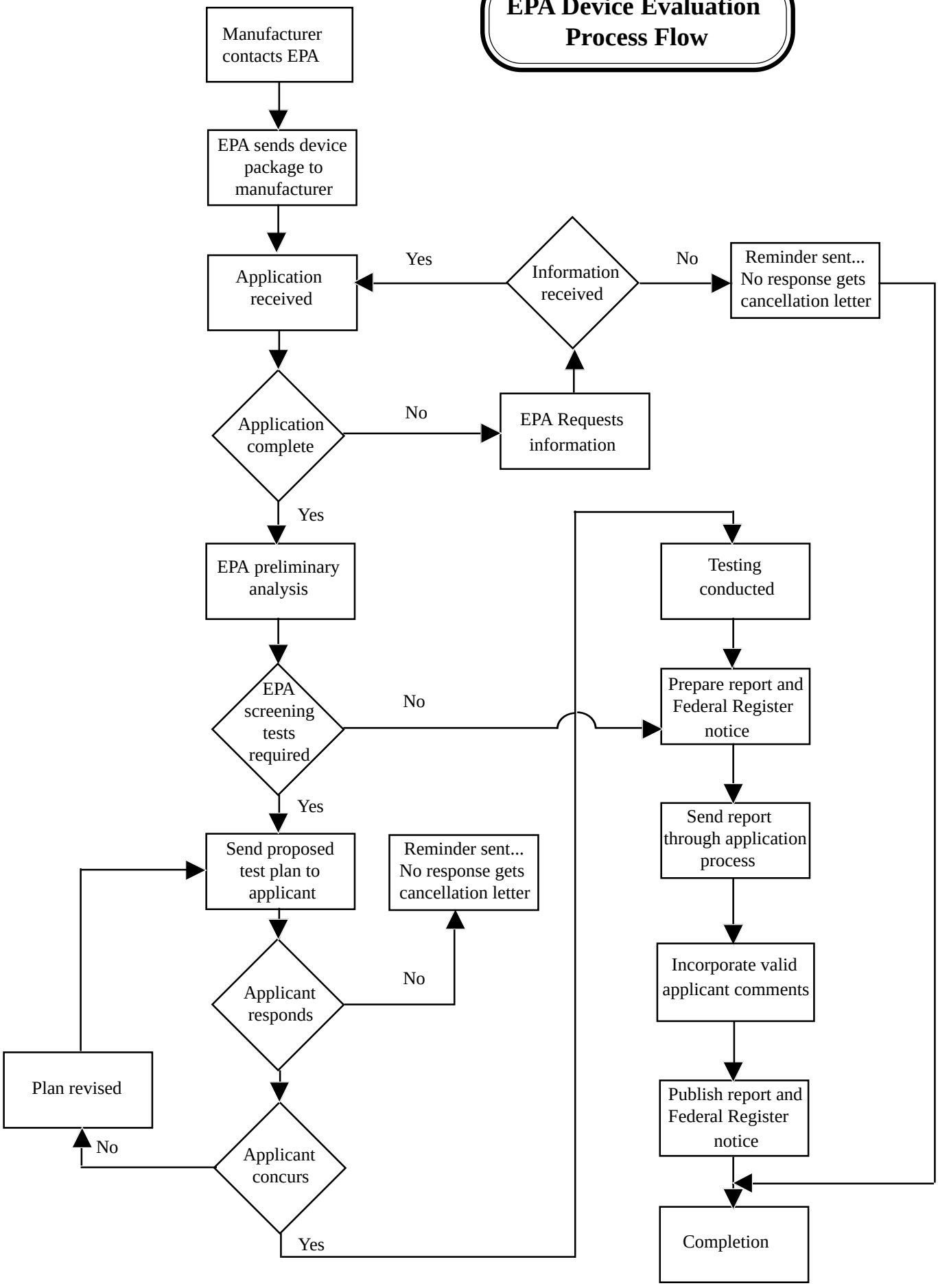
Applicants are cautioned that the installation of an aftermarket retrofit device, or use of a fuel additive, raises the issue of tampering liability and the potential for civil fines of up to $25,000 (see page 23). In the past, one approach for a device or additive manufacturer to address the tampering issue was to demonstrate by durability, aging, and FTP tests that the device did not increase vehicle emissions over its useful life. However, beginning with

1994 models, vehicle manufacturers must provide an onboard emission diagnostic capability for their vehicles. As a consequence, applicants must insure that, besides not adversely affecting vehicle emissions, their device or additive must not render inoperative, degrade, or defeat the operation of vehicle onboard diagnostic systems.

EPA trusts that this information will aid in the preparation of an acceptable application for evaluation of a device. The Device Evaluation Team will be the contact in the application process and any subsequent EPA evaluation. Our address is:

Device Evaluation Program
EPA, National Vehicle and Fuel Emissions Laboratory
2565 Plymouth Road
Ann Arbor, Michigan 48105
Telephone: (313) 668-4333
Internet: banush.russell@epamail.epa.gov

EPA Device Evaluation Process Flow



Supplement

DEVICE EVALUATION APPLICATION FORMAT

Applications for EPA evaluation of retrofit and aftermarket fuel additives devices must use the following format (There is no application form as such):

1. Title:

   Application for Evaluation of (Name of Product) Per Section 511 of the Motor Vehicle Information and Cost Savings Act.

2. Identification Information:

   a. Marketing Identification:

   Trade name, marketing name, trade mark, or other methods which are (or will be) used to identify the product. Include model numbers and/or other designations where appropriate.

   b. Inventor and Patent Protection:

   (1) Name and address of the inventor.
   (2) One complete copy of the patent or patent application.

   c. Applicant:

   (1) Name and address of the individual or corporation applying for this evaluation.
   (2) Principal officers and/or owners of this organization.
   (3) The person(s) who are authorized to represent the organization in communications with the EPA. Include name, address, FAX, and telephone number.

   d. Manufacturer:

   (1) Name and address of the individual or corporation who is (or will be) manufacturing the product.
   (2) Principal officers and/or owners of this organization.

3. Description:

   a. Purpose:

   Purpose and/or objective of the product.

b. Applicability:

(1) Provide a statement indicating which types or groups of vehicles for which the product is, or is not, applicable. The statement should include make, model and year, engine size, ignition type, fuel delivery, and transmission type. If the product is (or will be) marketed in different sizes and/or calibrations, identify which models correspond to which type of vehicle.

(2) Provide a statement describing other conditions for which the product is, or is not, applicable. The statement should address weather conditions, types of driving, topographical differences, etc.

c. Theory of Operation:

Provide a detailed description of the theory and principles of operation for the product in sufficient detail to permit technical personnel at EPA to understand the theory of operation.

d. Construction and Operation:

A detailed description of the product itself, including drawings and/or schematics, should be included.

e. Specific Claims:

Specific claims made in advertising, sales literature, packaging and installation instructions as they relate to improvements in fuel economy, emissions, driveability, etc., should be provided. Test data to support these claims must be included with the application.

f. Cost and Marketing:

Provide suggested retail price and methods used to market the product. This discussion should also identify the stage of the development of the product or state that it is in production or is ready for production.

4. Installation:

a. Equipment:

Provide installation instructions for the product to include those for general and special applications. Indicate tools, equipment and skills required. Advise adjustments required to the vehicle or the product upon installation.

b. Operation:

Furnish a copy of the consumer's operating instructions with details on maintenance procedures, service intervals, and basic diagnostics.

c. Safety:

Provide all available information regarding use of the product which could result in unsafe conditions for the vehicle, its occupants, or persons or property in close proximity. This information should also address situations where the product is not in use or has malfunctioned in some way.

d. Maintenance:

Include maintenance procedures and scheduled maintenance required to ensure the correct operation of the product. List tools, equipment, and skills required to perform maintenance. Also, describe how the use of the product will affect the normal maintenance schedule for the vehicle.

5. Effects on Emissions and Fuel Economy:

a. Regulated Emissions and Fuel Economy:

Furnish all information related to the product and its effects on regulated emissions and fuel economy* obtained through screening tests at an independent laboratory which conforms with applicable regulations for emissions and fuel economy testing. Regulated exhaust emissions include unburned hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate (diesel vehicles only). Unburned hydrocarbons in the form of evaporative emissions are also regulated. This information may be obtained through testing or as a result of an engineering evaluation of the product. It should also address the effects of the product when it is not in use or during typical modes of failure.

b. Unregulated Emissions:

Provide all information related to the effect of the product on types of pollutants other than those regulated by EPA.

6. Testing

The actual test plans required to properly evaluate the worth of a product vary widely although the basic premise of any plan is that it is able to accurately define benefits due solely to the product. In some cases, this requires only duplicate tests on two vehicles with and without the product. For products which require adjustments of engine parameters, such as timing or mixture, a third set of tests with only these adjustments is also required. In any case, an acceptable test plan can be developed in consultation with EPA before or after the remainder of this application is submitted.

*The FTP (40 CFR Part 86) is the primary test for vehicle emissions. The FTP and the Highway Fuel Economy Test (HFET)(40 CFR Part 600) are the only tests recognized by EPA for evaluating fuel economy of light-duty vehicles. Data which have been collected in accordance with other standardized procedures may be used to supplement results from the FTP and HFET and will be considered in EPA's evaluation of the product.

EPA RETROFIT AND EMISSION CONTROL DEVICE EVALUATION TEST POLICY

General

Applicants must provide EPA with all information necessary to describe and explain the functioning of the device or engine. The information must include the theory of operation, drawings and schematic diagrams. In addition, any standard test data performance on the device that demonstrate the emission and fuel economy performance of the system should be provided. The Federal Test Procedure (FTP) (40 CFR Part 86) is the only test which is recognized by EPA for the evaluation of vehicle emissions, and data generated in accordance with the FTP are essential for the evaluation of a device.

A preliminary evaluation of a device will be made by EPA engineering staff on the basis of information supplied in the application. If testing has not been performed when the application is first filed, EPA will determine if testing of the device is needed or warranted. If the conduct of testing would not, in the professional judgment of EPA engineers, support the claims for the device and its cost would represent an unprofitable drain on the applicant's resources, EPA will so advise. However, if the applicant elects, EPA will proceed with the development of a test program, i.e., a program for testing by an independent laboratory. The applicant will select a technically competent independent laboratory to test the device in accordance with the EPA developed test program at the applicant's expense. A list of laboratories is provided on page 25.

If further testing beyond that initially performed by an independent laboratory is needed to make an evaluation, EPA engineering staff will work with applicants to design a test program to be performed by EPA to validate the device's effectiveness.

Size of Sample and Test Program Cost

Sample size is a major determinant of testing cost. It may range from two vehicles to 100 vehicles, depending upon the type and variability of the effects that are being measured, and on the accuracy and applicability of the final conclusions which are necessary. EPA will provide an applicant with a cost estimate for tests to be conducted at its laboratory.

Conclusions drawn from small samples have limited applicability. A complete evaluation of the effectiveness of devices on the many different types of vehicles that are in actual use requires a large sample. The conclusions from small tests may be quantitatively valid only for the specific test cars used. However, it is often possible to extrapolate test results to other vehicle types to suggest that similar results may be expected.

Applicants must pay the costs for the device, vehicle procurement and other costs incurred by the testing laboratory. There is no charge for EPA's preliminary evaluation and subsequent analyses, but the applicant must provide funds to cover the cost of any confirmation testing deemed necessary in the EPA lab. EPA will not conduct confirmation tests without adequate screening test results from an independent laboratory and without submission in advance of funds to cover costs of EPA testing.

Conduct of Tests

Vehicles selected for evaluating a device will be tested in at least two configurations: one with the vehicles adjusted to the original manufacturer's specification, the other with the device installed on the vehicles. If any test vehicle engine parameters (such as ignition timing or idle mixture) are different from manufacturer specification when the device is installed, the vehicle will also need to be tested with the equivalent changes to engine parameters without the device installed. If a prototype engine rather than a device for retrofit to existing engines is tested, the vehicle is adjusted to the design specifications.

Emission tests will be run by a laboratory using the equipment specified in the Federal Register (40 CFR Part 86) for the FTP. As a minimum requirement, a laboratory must have a chassis dynamometer capable of reproducing road load and vehicle inertia weight, a constant volume sampling system and the following types of analyzers for measurement of exhaust emissions:

Hydrocarbon - flame ionization detector
Carbon monoxide and carbon dioxide - nondispersive infrared
Oxides of nitrogen - chemiluminescence

If intrusion into the fuel delivery system is necessary to install a device, the diurnal portion of the FTP will be required.

Evaluations conducted in the EPA test program are for the purpose of demonstrating the effectiveness of developed devices and are not to be construed as development testing. All development work must precede EPA evaluation. The applicant will not be permitted to make adjustments to the test vehicle or to the device except to repair malfunctions. Such repairs will be permitted at the discretion of the EPA test engineer.

EPA engineering staff will prepare a draft report on the evaluation of the device, and it will be available to the applicant for review to ensure accuracy of the information describing the device. The developer should transmit his comments to EPA promptly. Final test reports are distributed upon request to technical personnel in federal and state governments, private industry, universities and are also available to the general public through the National Technical Information Service (NTIS).

Applicants may cite final EPA reports (but not draft reports) to indicate the exhaust emission and fuel economy levels attained with the device, but the developer may not claim that the EPA report constitutes approval. Cases of misrepresentation of EPA evaluation reports will be referred to the Department of Justice or the Federal Trade Commission, as appropriate.

BASIC TEST PLANS AND TESTING SEQUENCE

General

Device and engine evaluation tests conducted by EPA generally include measurement of two, or more, of the following items:

1. gaseous emissions
2. particulate and other emissions
3. fuel economy
4. power / acceleration / driveability

Currently regulated gaseous emissions are unburned hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NOx) and particulate. Other emissions currently unregulated by EPA may be recorded for investigative purposes.

Unburned hydrocarbons and oxides of nitrogen react in the atmosphere to form photochemical smog. Smog, which is highly oxidizing in nature, causes eye and throat irritation, odor, plant damage and decreased visibility. Certain oxides of nitrogen have toxic effects on people.

Carbon monoxide impairs the ability of the blood to carry oxygen. Excessive exposures to carbon monoxide during periods of high concentrations (such as rush-hour traffic), can decrease the supply of oxygen to the brain, resulting in slower reaction time and impaired judgment.

Other emissions include such things as sulfates, aldehydes and smoke from diesel-powered vehicles. These emissions are generally not measured as part of a routine device evaluation. They may be measured if the control system or engine being tested contribute to such emissions.

Exhaust emissions from passenger cars, light trucks, and motorcycles are measured in the FTP where vehicles are driven on a chassis dynamometer to simulate urban driving (see Figure 1). The FTP is the test used for the certification of new cars and an earlier version has been used in the evaluation of prototype engines and emission control systems since 1971.

Fuel economy is measured on a chassis dynamometer reproducing typical urban and highway driving speeds and loads. Urban fuel economy is measured during the FTP, and highway fuel economy is measured over the HFET. The fuel economy of the test vehicle is calculated from the exhaust emission data using the carbon balance method.

Engine power may be measured on a chassis dynamometer. Power is usually not measured unless a device is expected to have a significant effect on engine power output. Engine power may also be measured to substantiate power output claims made for prototype engines.

Acceleration times (0-60, 30-50 mph, etc.) may be measured either on the road or on a chassis dynamometer. Driveability may be evaluated by the test engineer, based on the behavior of the test vehicle during the dynamometer testing or under actual road conditions.

Figure l -- Vehicle Test Arrangement

Driving Schedules

City Driving Cycle - The Urban Dynamometer Driving Schedule, or LA-4, is the result of more than 10 years of effort by various groups to translate the Los Angeles smog-producing driving conditions to dynamometer operations. The LA-4 is derived from data taken from a vehicle driving under actual city traffic conditions, so it is typical of a vehicle operating in an urban environment (see drive cycles on page 16.) It is a nonrepetitive driving cycle covering 7.5 miles in 1372 seconds at an average speed of about 20 mph. During the FTP, the first 505 seconds of the LA-4 are rerun following the hot start of the engine so the distance traveled during a full FTP is 11.1 miles, and the average speed is 21.6 mph. However, the emissions collected during the 11.1 mile trip are mathematically reweighed to represent the results of two 7.5 mile trips made from hot and cold starts with average speeds of about 20 mph. The maximum speed attained during the LA-4 cycle (or FTP) is 56.7 mph.

EPA highway Cycle - Since the LA-4 does not represent the type of driving done in nonurban areas, especially on highways, a driving cycle to assess highway fuel economy was developed by the EPA. The EPA Highway Cycle was constructed from actual speed-versus-time traces generated by an instrumented test car driven over a variety of nonurban roads, and preserves the nonsteady-state characteristics of real-world driving. The average speed of the cycle is 48.2 mph, the maximum speed is 59.0 mph, and the cycle length is 10.2 miles, close to the average nonurban trip length.

Steady-States - Constant speed, road load tests are not routinely conducted on prototype systems. Many vehicle operation surveys conducted by EPA and others have clearly shown that true steady-state operation rarely occurs in customer use. If steady-state data are collected, they must be interpreted cautiously because the vehicle is being exercised in an unrepresentative manner.

Testing Procedures

A chassis dynamometer is employed to reproduce vehicle inertia and road load. Inertia, representing the vehicle weight, is simulated either by flywheel or electric generator, and it is selected in 125-pound increments between 1000 pounds and 4000 pounds, in 250-pound increments between 4000 pounds and 6000 pounds, and in 500-pound increments between 6000 pounds and 8500 pounds. Roadload represents rolling resistance and aerodynamic drag and is simulated either by a water brake or electric generator.

The vehicle's exhaust is collected, diluted and thoroughly mixed with filtered background air, to a known constant volume flow, using a positive displacement pump or a critical flow venturi. This procedure is known as Constant Volume Sampling (CVS). A proportional sample of the diluted exhaust is collected in a sample bag for analysis at the end of the test.

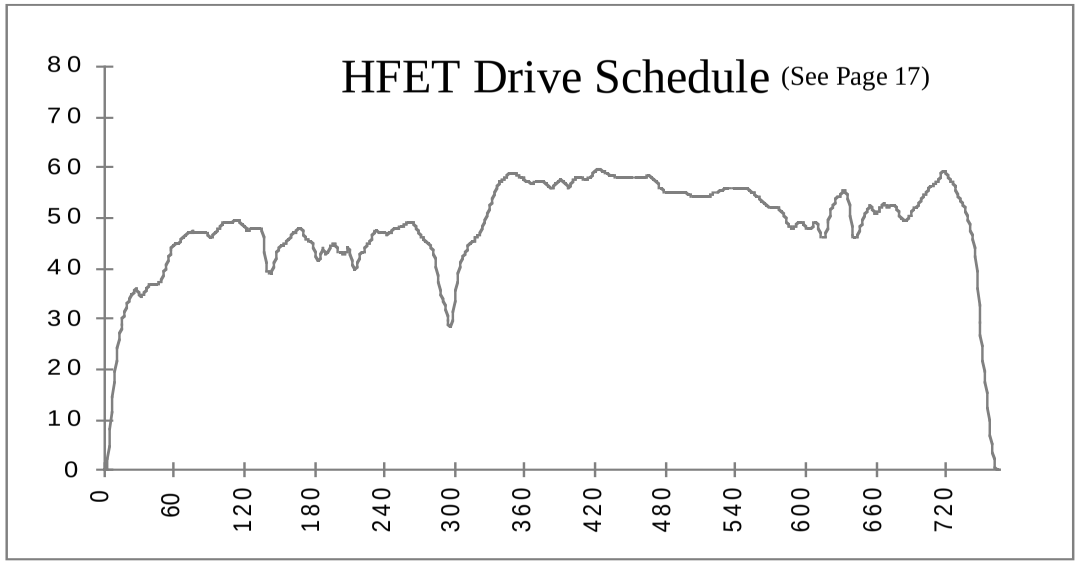
On the day prior to the scheduled FTP, the test vehicle is prepared by driving over the urban driving schedule (LA-4) on a dynamometer. This "prep" drive is performed to insure that all vehicles have been driven in a similar manner on the day preceding the exhaust emission test. After the prep drive, the vehicle must be parked for at least 12 hours in an area where the temperature is maintained between 68 and 86 degrees F. This period is referred to as the "cold" soak.

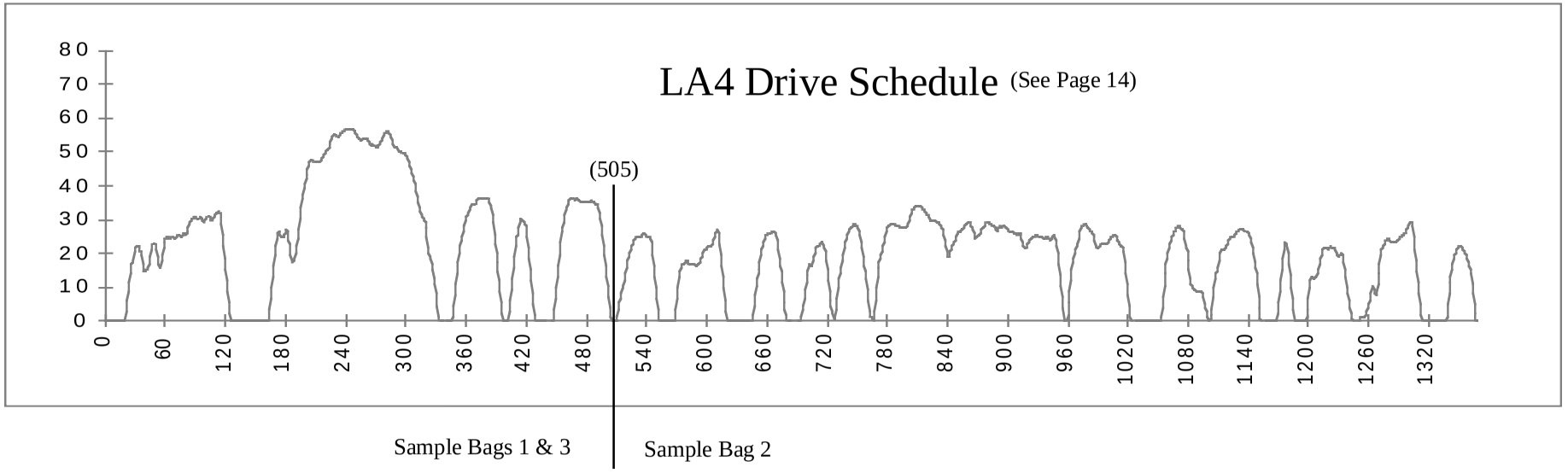
FTP is a cold start test in which the test vehicle is pushed onto the dynamometer without starting the engine. After placement of the vehicle on the dynamometer, the emission collection system is attached to the tailpipe, and a cooling fan is placed in front of the vehicle. The emission test is run with the engine compartment hood open.

The emission sampling system is started immediately prior to starting the engine of the test vehicle so that emissions are collected during engine cranking. After starting the engine, the driver follows the Urban Dynamometer Driving Schedule (UDDS) or LA-4. The driving schedule is displayed to the driver of the test vehicle who matches the vehicle speed to that displayed on the schedule. At the end of the driving cycle, the engine is stopped, the cooling fan and sample collection system are shut off, and the hood is closed. The vehicle remains on the dynamometer and soaks for 10 minutes. This is the "hot" soak preceding the hot start portion of the test. At the end of ten minutes, the vehicle and CVS are again restarted and the vehicle is driven through the first 505 seconds (3.59 miles) of the LA-4 cycle. (EPA drive cycle graphs are found on page 16.)

Exhaust emissions measured during the FTP cover three regimes of engine operation. The exhaust emissions during the first 505 seconds of the test are the "cold transient" emissions. During this period, the vehicle gradually warms up as it is driven over the LA-4 cycle. The

EPA Test Drive Cycles





emissions during this period will show the effects of any fuel enrichment associated with a "cold" start and vehicle warm-up characteristics. When the vehicle enters the remaining 867 seconds of the LA-4 cycle, it is considered to be fully warmed up. The emissions during this portion of the test are the "stabilized" emissions. The final period of the test, following the hot soak, is the "hot transient" section, and shows the effect of the hot start. A sample of the emissions from each of the three portions of the test are collected in separate bags.

After completion of the FTP, the vehicle is tested on the EPA Highway Fuel Economy Test (HFET). The vehicle is fully warmed up and running at the start of the HFET. A warm-up Highway Cycle is run before the actual HFET. This insures that the vehicle drivetrain is at full operating temperature.

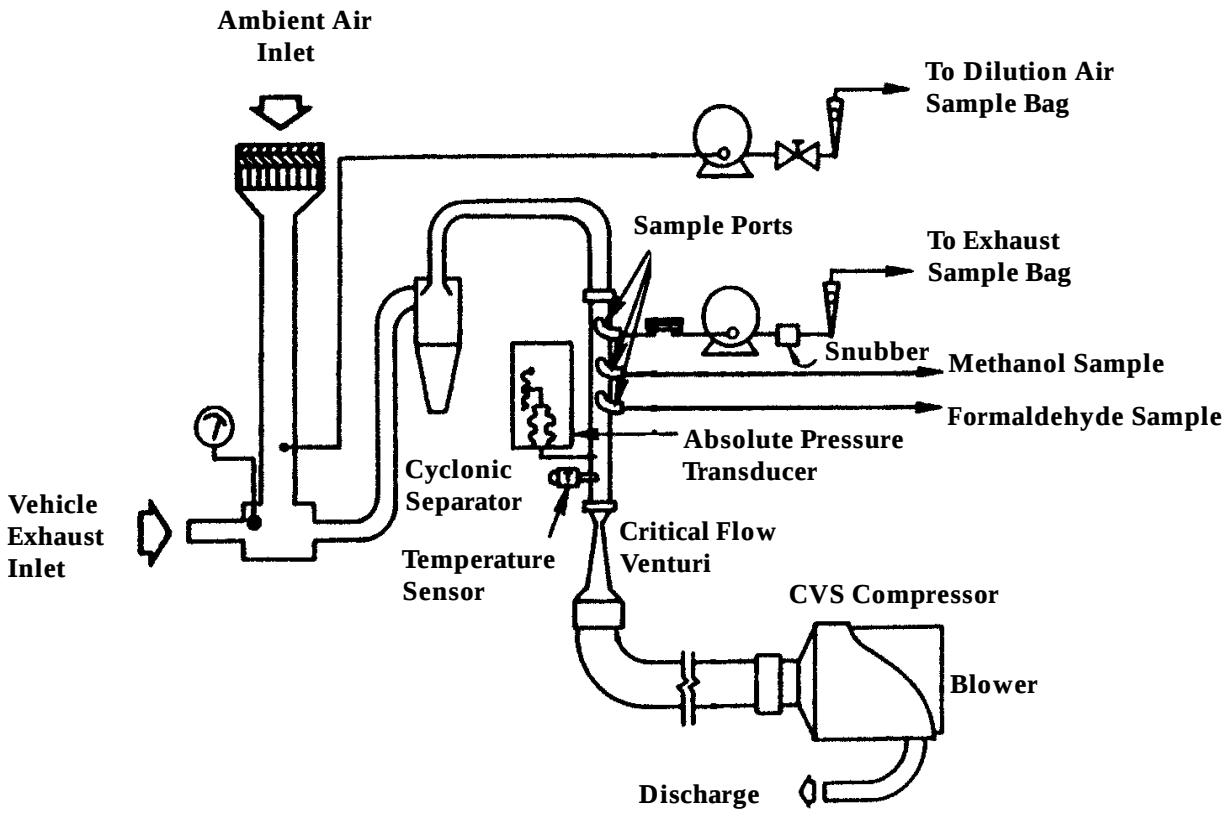
If intrusion into the fuel delivery system is necessary to install the device, the diurnal portion of the FTP may be required. A complete description of this procedure can be found in the Code of Federal Regulations 40 CFR Part 86 and 40 CFR Part 600. Evaluation tests made by EPA usually do not include measurement of evaporative emissions.

Sample Collection and Analysis

Figure 2 on page 18 is a schematic diagram of a typical Constant Volume Sampler (CVS) used to collect exhaust emissions. Vehicle exhaust is transported from the tailpipe to a dilution box where it mixes with filtered background air. After passing through the heat exchanger, a sample of the exhaust mixture is drawn off and collected in a bag constructed of an impermeable, chemically inert substance named Tedlar. A sample of the background air is taken concurrently with the exhaust sample. Most sampling systems presently use a critical flow venturi to control the flow rate of the exhaust mixture.

The driver of the test vehicle operates the CVS using a remote control unit, with which he can start sampling at the beginning of the FTP, switch from the cold transient to the stabilized sample bag at 505 seconds, and stop sampling at the end of the test.

After a sample has been collected, it is taken to an analyzer where the concentrations of HC, CO, CO_2 and NO_x in the sample bag are determined. The analytical system provided for the determination of hydrocarbon concentrations by flame ionization detector (FID) analysis, carbon monoxide and carbon dioxide concentrations by nondispersive infrared (NDIR) analysis and oxides of nitrogen concentrations by chemiluminescence (CL) analysis.



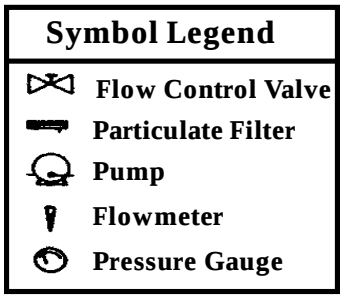


Figure 2 Constant Volume Sample Unit

Calculations

To correct for background levels of HC, CO, $C0_2$, and NO_x in the dilution air, the concentrations in the background bags are subtracted from the concentrations in the sample bags. The resultant values are referred to as corrected concentrations. The mass of each pollutant (HC, CO and NO_x) is calculated from the corrected concentration and the total volume flow during each of the three test phases, and the density of each compound. Once the mass emissions for each test phase are known, the emissions in grams per mile are calculated using the following formula:

$$Y_{wm} = 0.43\ (Y_{ct} + Y_s) / (D_{ct} + D_s) + 0.57\ (Y_{ht} + Y_s) / (D_h + D_s)$$

Where:

Y_{wm} = weighted mass emissions of each pollutant, i.e., HC, CO, or NO_x in grams per vehicle mile.

Y_{ct} = mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_{ht} = mass emission as calculated from the "transient phase of the hot start test, in grams per test phase.

Y_s = mass emission as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

D_{ct} = The measured driving distance from the "transient" phase of the cold start test, in miles.

D_{ht} = The measured distance from the "transient" phase of the hot start test, in miles.

D_s = The measured driving distance from the "stabilized" phase of the cold start test, in miles.

The cold start and hot start portions of the test are weighted 0.43 and 0.57 respectively.

Detailed explanations of the calculations can be found in the Federal Register.

Fuel Economy Calculations

Fuel economy is measured by the carbon balance method. The carbon balance procedure for measuring fuel economy relates the carbon products in the vehicle exhaust to the amount of fuel burned during the test. The major factors in using this technique are:

1. Carbon from HC, CO, and CO_2 is the only significant carbon source considered in the

exhaust (minor amounts from other compounds are insignificant). Other carbon containing compounds, such as oxygenated hydrocarbons (undetected by flame ionization) and carbonaceous particulates, are ignored for gasoline and diesel fuels. The use of alternative fuels (ethanol, methanol, etc.) would dictate the analysis of oxygenated hydrocarbons.

2. All of the carbon that is measured in the exhaust in the form of HC, CO and CO_2 come from the fuel; there are no other sources of carbon.

3. All of the fuel consumed during the test can be accounted for by the carbon in the exhaust. This means that all of the fuel that leaves the tank is assumed to pass through the engine and that no carbon leaks out of the exhaust system before being analyzed or evaporated from the vehicle.

Since the carbon weight fraction of the fuel is known, it is a simple matter to calculate the amount of fuel consumed during the test. Agreement between the carbon balance method and direct fuel consumption measurement is normally within 2 percent.

Test Fuels

EPA tests are generally run on commercial unleaded gasoline or, if warranted, Indolene HO. Indolene HO is an unleaded fuel with a minimum research octane of 96; it is a special fuel having closely controlled production characteristics. The fuel specifications must fall within certain limits set by the EPA. Tight control of fuel quality eliminates fuel as a source of test variability in certification tests. There is no reason to expect that the emission characteristics from a vehicle running on Indolene fuel would be significantly different from the emission characteristics when running on a summer grade of commercial pump gasoline.

Other Emissions

Occasionally, it is necessary to test vehicles for emissions other than those that have already been discussed. Emissions that may be measured include oxygenated compounds and specific reactive and nonreactive hydrocarbons. These tests are usually conducted only on prototype powerplants.

Power, Driveability, Durability

Relative engine power output can be measured on a chassis dynamometer. Power output can be determined for any engine speed including the maximum engine power point.

Driveability is evaluated by the test engineer. Items to be considered include acceleration, cold start performance, tendency to stumble or hesitate, surge, and hot start performance.

Comments about the expected durability of a device or prototype engine will be based on several considerations. Among these are exposure of the control system to severe operating conditions and previously demonstrated durability of similar systems.

Narrative Description - Sequence of Evaluation (See pages 23 & 24 for flow diagram)

Obtain and Prepare Vehicles - At least two vehicles are to be tested. They should represent the models for which the device or additive is to be advertised and sold. Each vehicle must be in proper operating condition and safe to operate on the dynamometer. The vehicles must be adjusted to the manufacturer's specifications before beginning the test sequence. A complete tune-up (including oil and filter change) is recommended before beginning a program which includes mileage accumulation. Vehicle preparation consists of installing the tailpipe adapter(s), inflating tires and removing wheel covers.

Accumulate Mileage - This is a type of preconditioning which may be an important part of the evaluation. It must be conducted in exactly the same manner at each point in the test plan. Mileage may be accumulated on the road or in the laboratory, but it should approximate typical driving.

Test

Install Device - The device or additive is to be installed (or introduced) in accordance with the printed instructions which accompany the product. Parameter adjustments may be made as directed. Applicants may observe the process, but the actual effort is to be either carried out by laboratory personnel or by an independent person under the supervision of laboratory personnel. Any problems with the installation should be noted.

Remove Device - At this point, the device is to be removed, but parameters which were adjusted are not to be changed. The purpose of this portion of the sequence is to address the effect of only parameter adjustments on the levels of emissions and fuel economy.

De-Prep Vehicles - Once the testing is complete and all tests have been validated, the vehicles may be restored to their original condition. Deflate the tires to the appropriate pressure, install the hubcaps and remove the tailpipe adapter.

Assemble Data - Gather all the results and other documents together into one package. Prepare a concise report which summarizes the conduct and results of the project.

Narrative Description - Sequence of Testing

Check Basic Parameters - With the vehicle at normal operating temperature, measure and record values for basic timing, idle rpm, idle HC and idle CO. The emissions measurements should be made in both neutral and drive. The fuel tank should be filled to approximately 40 % capacity.

Perform Cold Start FTP - This step begins with preconditioning on the dynamometer, or on the road, and is followed by a 12 to 36 hour soak before the FTP. Except in special cases where evaporative emission control may be affected, the SHED phase of the test need not be conducted. In any case, however, all portions of the test procedure at each point must be as close to identical as possible. This includes the type of preconditioning and soak time as well as the more obvious parameters such as driver, test cell, dynamometer setting and

starting procedures.

Precondition (HFET or LA-4 "hot start" Cycle) - A single driving cycle is used to precede a Hot Start sequence. The test vehicle is to be at normal operating temperatures before-this cycle. For this type of evaluation, the test vehicle itself may be used to warm up the dynamometer and to set the horsepower.

Perform Hot Start LA-4 - If employed, this test is 1372 seconds long and is to be run into two bags. It is preceded by a 10 minute soak period.

Perform HFET - This is a single cycle. It can be run immediately after the FTP or LA-4. If a soak period is required, up to 20 minutes is allowed. In this case, three minutes at 50 mph must be used for preconditioning.

Calculate Results - Assemble all strip charts, driver's traces, computer outputs and other documentation into a single package. Review the packet to ensure validity of the test. Calculate and record the results in grams per mile and miles per gallon.

Potential Tampering Liability Associated with Fuel Economy Retrofit Devices

The federal tampering prohibition is contained in section 203 (a) (3) of the Clean Air Act (Act), 42 U.S.C. 7522 (a) (3). Section 203 (a) (3) (A) of the Act prohibits any person from removing or rendering inoperative any device or element of design installed on or in any motor vehicle in compliance with regulations under Title II of the Act (i.e., regulations requiring certification that vehicles meet federal emissions standards). The maximum civil penalty for a violation of this section by a manufacturer or dealer is $25,000; for any other person, $2,500.

Section 203(a) (3) (B) of the Act prohibits any person from manufacturing or selling, or offering to sell, or installing, any part or component intended for use with, or as part of, any motor vehicle or motor vehicle engine where a principal effect of the part or component is to bypass, defeat, or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine, and where the person knows or should know that such part or component is being offered for sale or is being installed for such use. The maximum civil penalty for a violation of this section is $2,500.

Installing any device, system or part(s) which affect the fuel delivery rate or the combustion process would be expected to affect elements of design of the emissions control system. Accordingly, any change from the original certified configuration of a vehicle such as adding a system or parts that affect the fuel delivery rate or the combustion process, or the manufacture or sale of nonoriginal equipment aftermarket parts or systems could be considered a violation of section 203 (a) (3) of the Act. However, the Environmental Protection Agency (EPA) has established an enforcement policy, Mobile Source Enforcement Memorandum No. 1A (Memorandum 1A), to provide guidance to the public to reduce the uncertainty regarding potential liability under section 203 (a) (3) of the Act for using or selling aftermarket parts or systems, or making adjustments or alterations to parts or system parameters.

Basically, Memorandum 1A states that EPA will not consider any modification to a certified emissions control configuration to be a violation of the tampering prohibition if there is a reasonable basis for knowing that emissions are not adversely affected. In many cases, durability aging and emissions testing according to the Federal Test Procedure (FTP) would be necessary to make this determination.

There are two different methods for establishing a reasonable basis for knowing that emissions are not adversely affected by the installation of a retrofit device: 1) the installer knows of, or the manufacturer of the device represents in writing, that FTP emission tests have been performed as prescribed in 40 CFR 86 showing that the device does not cause similar vehicles to fail to meet applicable emission standards for their useful life; or 2) a federal, state or local environmental control agency expressly represents that a reasonable basis exists. Such an agency determination is limited to the geographic area over which that agency has jurisdiction. The results of EPA vehicle emission testing which is done under the authority of Section 511 of the Motor Vehicle Information and Cost Savings Act can be applied to similar vehicles throughout the country.

If the results of EPA emission testing of a retrofit device show that any of the regulated emissions increase (even though other regulated emissions may have decreased), EPA will publish a Federal Register Notice (Notice) explaining the legal implications of those findings on persons engaged in the business of servicing, repairing, selling, leasing, or trading motor vehicles, fleet operators, new car dealers and individuals. The Notice will alert the regulated parties that the installation of such a device by them may be deemed to be a violation of section 203 (a) (3) of the Act.

EPA does not have a mandatory, formal program to evaluate and make determinations of compliance of aftermarket parts with Memorandum 1A. Although EPA has informally evaluated compliance information in the past, because of current budget cuts and resource constraints we are not reviewing compliance with Memorandum 1A . While compliance with Memorandum 1A is required, submission of the information to us is not required unless we request the information to verify compliance. We emphasize, however, that our lack of review of the information does not relieve any one from responsibility to comply with Memorandum 1A or liability for violations of section 203 (a) (3) and Memorandum 1A.

The results of an FTP test are valid only for similar vehicles. Therefore, the test fleet should be diverse and large enough to provide an adequate data base from which conclusions can be drawn with reasonable confidence. When appropriate, however, analyses based upon engineering judgment can be used to determine the applicability of FTP test results to other vehicles and the devices' effect on the durability of the emission control systems.

The EPA's National Vehicle and Fuel Emissions Laboratory does not make decisions as to whether the installation of a particular retrofit device constitutes tampering with the emission control system of a vehicle. Questions regarding tampering or requests for copies of Memorandum 1A are handled by:

Steve Albrink 202-233-9033 (Washington, DC)

Test Laboratories

Name of Laboratory	Street	City	St.	ZIP	Telephone
Alternative Fuels Laboratory	6111 HWY 290 East	Austin	TX	78723	(512) 452-1776
Auto. Club of Southern California	2601 S. Figueroa St.	Los Angeles	CA	90007	(213) 741-3378
Auto. Testing & Developm't Servs.	400 S. Etiwanda Ave.	Ontario	CA	91761	(909) 390-1100
Automotive Testing Labs.,Inc.	263 S Mulberry St	Mesa	AZ	85202	(602) 649-7906
Automotive Testing Labs.,Inc.	P.O. Box 289	East Liberty	OH	43319	(513) 666-4351
Autoresearch Laboratories, Inc.	6735 S. Old Harlem Ave	Chicago	IL	60638	(708) 563-0900
California Analytic Instruments Inc.	1238 W. Grove Ave.	Orange	CA	92665	(714) 974-5560
California Environmental Engring.	3231 S. Standard	Santa Anna	CA	92705	(714) 545-9822
Certified Emission Testing Laboratory Inc.	15 Trade Zone Drive	Ronkonkoma	NY	11779	(516) 588-9666
Clean Air Vehicle Tech. Center	26233 Executive Place	Hayward	CA	94545	(510) 785-3100
Colorado School of Mines		Golden	CO	80401	(303) 273-3967
Colorado State University	Dept. of Ind. Sciences	Fort Collins	CO	80523	(303) 491-7240
Compliance and Research Services	2 Garfield St	Linden	NJ	07036	(908) 925-5533
Crane Emissions Laboratory	530 Fentress Blvd.	Daytona Beach	FL	32114	(904) 252-1151
Echlin Automotive Test Center	2155 State St.	Hamden	CT	06517	(203) 777-7444
EG&G Automotive Research, Inc.	5404 Bandera	San Antonio	TX	78238	(210) 523-4603
Environmental R & D Corp.	8557 Atlas Drive	Gaithersburg	MD	20877	(301) 921-0066
Environmental Testing Corp.	1859 Jasper Street	Aurora	CO	80011	(303) 344-5470
General Motors Corporation	GM Proving Grounds, M/C 483-331-000	Milford	MI	48380-3726	(810) 685-5497
GM - LA Vehicle Emission Laboratory	14411 Cabrito Road	Panorama City	CA	91402	(818) 997-5500
Mercedes-Benz Service Corp.	3953 Research Park Dr.	Ann Arbor	MI	48104	(313) 995-3066
Mich. Automotive Research Corp	1254 N. Main	Ann Arbor	MI	48107	(313) 995-2544
Nat. Inst. for Petrol., Energy Res.	220 N. Virginia	Bartlesville	OK	74005	(918) 337-4464
NGV Development Company	2250 Cherry Industrial Cir.	Long Beach	CA	90805	(310) 630-5768
NGV Southeast Tech. Center	616 Highway 138	Riverdale	GA	30274	(770) 907-5213
Northern California Emission Lab	2748 Jefferson St.	Napa	CA	94558	(707) 258-1753
NYC Dept of Envir. Protection	75 Frost Street	Brooklyn	NY	11211	(718) 388-4994
Roush Emissions Laboratory	12257 Market Street	Livonia	MI	48150	(313) 591-4310
Siemens/Bendix Automotive Electronics	2400 Executive Hills Dr.	Auburn Hills	MI	48321	(810) 253-1000
Southwest Research Institute	6220 Culebra Road	San Antonio	TX	78284	(210) 522-2646
Testing Services Inc.	200 W. Fifth St.	Lansdale	PA	19446	(215) 362-1194
Wallace Environmental Testing Lab	2140 Wirtcrest	Houston	TX	77055	(713) 956-7705

Updated 2/1/96

Note: EPA does not endorse, rate, or certify individual vehicle emission laboratories. It is the responsibility of the individual customer to evaluate a laboratory's current test capabilities and quality. Although this list is updated as we receive new information, other laboratories may exist that can perform emissions testing. For further information call the EPA National Vehicle and Fuel Emissions Laboratory at 313-668-4216.

DEVICE AND ADDITIVE TEST LIST

NAME	REPORT	SOURCE	TYPE	SUB TYPE
ACDS Automotive Cylinder Deactivation System (2)	PB 81 228 256	NTIS	Internal Engine Modifier	
ADAKS Vacuum Breaker Air Bleed	PB 220 005	NTIS	Air Bleed Device	
Air-Jet Air Bleed	PB 220 002	NTIS	Air Bleed Device	
Analube Synthetic Lubricant	PB 80 181 985	NTIS	Oil/Additive	
Aquablast Wyman Valve Air Bleed	PB 81 113001	NTIS	Air Bleed Device	
Atomized Vapor Injector	PB 83 214 684	NTIS	Vapor Bleed Device	
Auto-Miser	EPA-AA-TEB-511-80-1	EPA	Air Bleed Device	
Autosaver	PB 81 220 840	NTIS	Ignition Device	
AUTOTHERM (1) (circulates coolant for heater)	PB 85 233 310	NTIS	Driving Habit Modifiers	
Ball-Matic Air Bleed	PB 80 159 429	NTIS	Air Bleed Device	
Basko Enginecoat	PB 82 123 837	NTIS	Mixture Enhancer	Other
Baur Condenser	EPA-AA-TEB-511-81-18	EPA	Ignition Device	
Berg Air Bleed	PB 218 574	NTIS	Air Bleed Device	
BIAP Electronic Ignition Unit	PB 218 647	NTIS	Ignition Device	
BRAKE-EZ	EPA-M-TEB-511-82-10	EPA	Miscellaneous	
Brisko PCV	PB 218 398	NTIS	Air Bleed Device	
Bycosin	EPA-AA-TEB-71-24	EPA	Fuel/Additive	
Cyclone-Z	PB 83 227 587	NTIS	Air Bleed Device	
Dresser Economizer	EPA-AA-TEB-511-82-6	EPA	Internal Engine Modifier	
Dresser Economizer	PB 84 155 936	NTIS	Mixture Enhancer	Other
Dynamix	PB 83 159 384	NTIS	Miscellaneous	
Econo Needle Air Bleed	PB 218 638	NTIS	Air Bleed Device	
Econo-Jet Air Bleed Idle Screws	PB 81 012 931	NTIS	Air Bleed Device	
Econo-Mist Vacuum Vapor Injection System	PB 80 190 952	NTIS	Vapor Bleed Device	
El-5 Fuel Additive	EPA-AA-TEB-76-28	EPA	Fuel/Additive	
Electro-Dyne Superchoke	EPA-AA-TEB-76-11	EPA	Mixture Enhancer	Other
Energy Gas Saver	EPA-AA-TEB-511-82-7	EPA	Mixture Enhancer	Under Carb
Environmental Fuel Saver	EPA-AA-TEB-511-80-3	EPA	Mixture Enhancer	Under Carb
Filtron Urethane Foam Filter	EPA-AA-TEB-74-23	EPA	Mixture Enhancer	Other
Frantz Vapor Injection System	EPA-AA-TEB-72-5	EPA	Vapor Bleed Device	
Fuel Conservation Device	PB 82 124 215	NTIS	Driving Habit Modifiers	
Fuel Economizer	PB 83 181 149	NTIS	Ignition Device	
Fuel Max (2)	PB 82 229 866	NTIS	Air Bleed Device	
Fuel Maximiser	PB 84 129 881	NTIS	Miscellaneous	
Fuelon Power	PB 93 236 693	NTIS	Fuel/Additive	
FuelXpander	PB 80 140 809	NTIS	Fuel Line Device	Heat/Cool
Gas Meiser I	PB 81 219 032	NTIS	Fuel Line Device	Heat/Cool
Gas Saving Device	PB 83 181 123	NTIS	Air Bleed Device	

DEVICE AND ADDITIVE TEST LIST

NAME	REPORT	SOURCE	TYPE	SUB TYPE
Gas Saving/Emission Control Improvement	PB 83 181 123	NTIS	Mixture Enhancer	Under Carb
Gastell	PB 81 215 899	NTIS	Driving Habit Modifiers	
Glynn-50	EPA-AA-TEB-511-81-28	EPA	Mixture Enhancer	Under Carb
Goodman Engine System, Model 1800	EPA-AA-TEB-511-80-4	EPA	Liquid Injection	
Grancor Air Computer	PB 82 215 899	NTIS	Air Bleed Device	
Greer Fuel Preheater	PB 82168 949	NTIS	Fuel Line Device	Heat/Cool
Gyroscopic Wheel Cover	PB 84 143 577	NTIS	Miscellaneous	
Hot Tip	PB 83 181 156	NTIS	Air Bleed Device	
Hydro-Catalyst Pre-Combustion Catalyst System	PB 81 153 827	NTIS	Mixture Enhancer	Under Carb
Hydro-Vac	PB 84 144 088	NTIS	Vapor Bleed Device	
IDALERT (1)	PB 84 1 54 111	NTIS	Driving Habit Modifiers	
Jacona Fuel System	PB 83 159 301	NTIS	Fuel Line Device	Heat/Cool
Johnson Fuel Additive	EPA AA-TEB-74-26	EPA	Fuel/Additive	
Kamei Spoilers(1)	PB 83 211 243	NTIS	Miscellaneous	
Kat's Engine Heater	PB 83 165 548	NTIS	Miscellaneous	
Lamkin Fuel Metering Device	PB 80 177 272	NTIS	Mixture Enhancer	Other
Landrum Mini-Carb	PB 82 142 100	NTIS	Air Bleed Device	
Landrum Retrofit Air Bleed	PB 82 142 100	NTIS	Air Bleed Device	
Lee Exhaust and Fuel Gasification EGR	EPA-M-TEB-74-14	EPA	Miscellaneous	
Magna Flash Ignition Control System	PB 218 570	NTIS	Ignition Device	
Malpassi Filter King (fuel pressure)	PB 83 214 700	NTIS	Fuel Line Device	Other
Mark II Vapor Injection System	EPA-AA-TEB-76-13	EPA	Vapor Bleed Device	
Mesco Moisture Extraction System	PB 84 148 014	NTIS	Miscellaneous	
Mini Turbocharger Air Bleed	EPA-AA-TEB-76-12	EPA	Air Bleed Device	
Moleculetor (metallic)	PB 81 247 942	NTIS	Fuel Line Device	Other
Monocar HC Control Air Bleed	PB 218 685	NTIS	Air Bleed Device	
Morse Constant Speed Accessory Drive (1)	PB 80 159 601	NTIS	Accessory Drive Modifiers	
MSU Cylinder Deactivation (2)	EPA-AA-TEB-75-11	EPA	Internal Engine Modifier	
NRG #1 Fuel Additive	PB 80 226 558	NTIS	Fuel/Additive	
Optimizer	PB 84 154 194	NTIS	Fuel Line Device	Heat/Cool
P.A.S.S. KIT (1)	PB 83 194 381	NTIS	Accessory Drive Modifiers	
P.S.C.U. 01 Device	PB 84 146 166	NTIS	Miscellaneous	
Paser Magnum/Paser 500/Paser 500 HEI	PB 82 183 567	NTIS	Ignition Device	
Pass Master Vehicle Air Conditioner (1)	PB 82 178 534	NTIS	Accessory Drive Modifiers	
Peterman Air Bleed	EPA-AA-TEB-74-16	EPA	Air Bleed Device	
PETRO-MIZER	PB 83 181 115	NTIS	Fuel Line Device	Magnet
PETROMIZER SYSTEM	PB 81 227 043	NTIS	Mixture Enhancer	Under Carb
Platinum Gasaver	PB 92 104 413	NTIS	Vapor Bleed Device	
POLARION X	PB 83 175 752	NTIS	Fuel Line Device	Magnet

DEVICE AND ADDITIVE TEST LIST

NAME	REPORT	SOURCE	TYPE	SUB TYPE
POLARION X (second evaluation)	PB 86 127 107	NTIS	Fuel Line Device	Magnet
Pollution Master Air Bleed	PB 218 438	NTIS	Air Bleed Device	
POWERFUEL	PB 84 148 543	NTIS	Vapor Bleed Device	
QEI 400 Fuel Additive	EPA-M-TEB-76-8	EPA	Fuel/Additive	
Ram-Jet	PB 80 170 657	NTIS	Air Bleed Device	
Rolfite Upgrade Fuel Additive	PB 80 190 960	NTIS	Fuel/Additive	
Russell Fuelmeiser	PB 83 181 131	NTIS	Fuel Line Device	Heat/Cool
Sav-A-Mile	PB 82 197 417	NTIS	Mixture Enhancer	Under Carb
SCATPAC Vacuum Vapor Induction System	PB 81 153 819	NTIS	Vapor Bleed Device	
Smith Power and Deceleration Governor	PB 80 173 867	NTIS	Mixture Enhancer	Other
Special Formula Ignition Advance Springs	EPA-AA-TEB-75-13	EPA	Ignition Device	
Spritzer	EPA-AA-TEB-74-15	EPA	Mixture Enhancer	Under Carb
Sta-Power Fuel Additive	PB 218 567	NTIS	Fuel/Additive	
Stargas Fuel Additive	P8 218 568	NTIS	Fuel/Additive	
Super-Mag Fuel Extender	PB 82 194 937	NTIS	Fuel Line Device	Magnet
SYNeRGy 1	PB 82 122 169	NTIS	Fuel/Additive	
Technoi G Fuel Additive	PB 219 396	NTIS	Fuel/Additive	
Tephguard	no number report	EPA	Oil/Additive	
Treis Emulsifier	PB 82 109 711	NTIS	Miscellaneous	
Turbo Vapor Injection System	EPA-AA-TEB-73-22	EPA	Vapor Bleed Device	
Turbo-Carb	PB 83 159 939	NTIS	Mixture Enhancer	Under Carb
Turbo-Dyne G.R. Valve	PB 285 381	NTIS	Air Bleed Device	
Turbocarb	PB 84 156 462	NTIS	Mixture Enhancer	Under Carb
ULX-15/ULX-15D	PB 81 226680	NTIS	Fuel/Additive	
V-70 Vapor Injector	PB 84 163 062	NTIS	Vapor Bleed Device	
Vareb10 Fuel Additive	EPA-M-TEB-74-30	EPA	Fuel/Additive	
Waag-Injection System (2)	EPA-AA-TEB-511-80-6	EPA	Liquid Injection	
Wickliff Polarizer (fuel line and air intake)	PB 82 117 898	NTIS	Fuel Line Device	Magnet
XRG #1 Fuel Additive	PB 80 180 672	NTIS	Fuel/Additive	

(1) Indicated a statistically significant improvement in fuel economy without an increase in exhaust emissions although cost effectiveness must be determined by the consumer for his particular application.

(2) Indicated a statistically significant improvement in fuel economy but with an increase in exhaust emissions. According to Federal Regulations, installation of this device could be considered tampering.