NOTE: THE ELECTRONIC VERSION OF THIS DOCUMENT MAY NOT APPEAR TO BE IDENTICAL TO THE OFFICIAL COPY OF THIS DOCUMENT WHICH IS AVAILABLE IN THE AIR AND RADIATION PUBLIC DOCKET A-92-64, ALTHOUGH THE TEXT IS IDENTICAL. SOME OF THE TABLES HAVE BEEN MODIFIED TO FACILITATE BETTER TRANSLATION TO MULTIPLE COMPUTER PLATFORMS, ALTHOUGH SOME REFORMATTING MAY BE NECESSARY.

January 31, 1995

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Mobile Sources

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 86

[FRL -]

RIN: 2060-AE27

Proposed Regulations for Revisions to the Federal Test Procedure for Emissions from Motor Vehicles

AGENCY: Environmental Protection Agency (EPA)

ACTION: Notice of Proposed Rulemaking (NRPM)

SUMMARY: This notice proposes additions and revisions to the tailpipe emission portions of the Federal Test Procedure (FTP) for light-duty vehicles (LDVs) and light-duty trucks (LDTs). The primary new element of the proposal is a Supplemental Federal Test Procedure (SFTP) designed to address shortcomings with the current FTP in the representation of aggressive (high speed and/or high acceleration) driving behavior, rapid speed fluctuations, driving behavior following startup, air conditioning, and intermediate-duration periods where the engine is turned off. An element of the SFTP that also affects the conventional FTP is a new set of requirements designed to more accurately reflect real road forces on the test dynamometer. The Agency is also proposing new emission standards for the new control areas with a specified phase-in period for these standards. After complete fleet turnovers, the standards proposed today are estimated to reduce emissions from LDVs and LDTs by eight percent for non-methane hydrocarbons (NMHC), 18 percent for carbon monoxide (CO), and 14 percent for oxides of nitrogen (NOx).

DATES: Written comments on this NPRM must be submitted on or before 30 days after public hearing date. The location and date of the public hearing will be published in a future Federal Register notice.

ADDRESSES: Interested parties may submit written comments (in duplicate if possible) to Public Docket No. A-92-64, at: Air Docket Section, U.S. Environmental Protection Agency, 401 M Street SW, Washington, DC 20460. The public hearing will be held at 9:00 A.M. at [insert location].

Materials relevant to this proposed rulemaking have been placed in Docket No. A-92-64. The docket is located at the above address in Room M-1500, Waterside Mall, and may be inspected weekdays between 8:30 a.m. and 5:30 p.m. A reasonable fee may be charged by EPA for copying docket materials.

FOR FURTHER INFORMATION CONTACT: John German, Certification Division, U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory, 2565 Plymouth Road, Ann Arbor, Michigan, 48105. Telephone (313) 668-4214.

SUPPLEMENTARY INFORMATION:

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I. Obtaining Copies of the Regulatory Language

Electronic copies (on 3.5" diskettes) of both the proposed regulatory language and the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis, Regulatory Impact Analysis (RIA), and Technical Reports may be obtained free of charge by visiting, calling, or writing the Environmental Protection Agency, Certification Division, 2565 Plymouth Road, Ann Arbor, MI 48105, (313) 668-4384. Refer to Docket A-92-64. A copy is available for inspection in the docket (See Addresses).

The proposed regulatory language and the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis, RIA, and Technical Reports are also available electronically on the Technology

Transfer Network (TTN). TTN is an electronic bulletin board system (BBS) operated by EPA's Office of Air Quality Planning and Standards. Users are able to access and download TTN files on their first call. The steps required to access information on this rulemaking are listed below. The service is free, except for the cost of the phone call.

TTN BBS: 919-541-5742 (1,200 - 14,400 bps, no parity, eight data bits, one stop bit)
Voice help: 919-541-5384
Internet address: TELNET ttnbbs.rtpnc.epa.gov Off-line: Mondays from 8:00 - 12:00 Noon ET

1. Technology Transfer Network Top Menu: <T> GATEWAY TO TTN TECHNICAL AREAS (Bulletin Boards) (Command: T)
2. TTN TECHNICAL INFORMATION AREAS: <M> OMS - Mobile Sources Information (Command: M)
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At this stage, the system will list all available FTP Review files. To download a file, select a transfer protocol which will match the terminal software on your computer, then set your own software to receive the file using that same protocol.
If unfamiliar with handling compressed (that is, ZIP'd) files, go to the TTN top menu, System Utilities (Command: 1) for information and the necessary program to download in order to unZIP the files of interest after downloading to your computer. After getting the files you want onto your computer, you can quit TTN BBS with the <G>oodbye command.

II. Introduction

Automobiles are among the largest producers of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx), all of which have documented impacts on public health. Hydrocarbons and oxides of nitrogen contribute to the formation of ozone, a powerful oxidant which irritates the respiratory system and reduces lung function. Some studies indicate that ozone may permanently damage lung and other tissues. Elevated levels of CO decrease the ability of blood to transport oxygen throughout the body, which tends to exacerbate cardiovascular stress. High ambient levels of CO can also adversely affect the central

nervous system, and the presence of CO in even moderate levels in the bloodstream may impact the health of fetuses and newborns. [1]After complete turnover of the fleet, the Agency believes that the changes proposed today would result in an eight percent reduction in non-methane hydrocarbons (NMHC), an 18 percent reduction in CO, and a 14 percent reduction in NOx emissions from automobiles during typical summertime ozone exceedance days.

The Agency has established a number of emission standards for motor vehicles and engines, designed to control air pollution by reducing in-use emissions from motor vehicles. Compliance with these standards is typically measured using a test procedure that simulates in-use driving. In 1990, Congress amended the Clean Air Act with passage of the Clean Air Act Amendments (hereafter, CAAA or Amendments) and required that EPA review these test procedures and revise them as appropriate to reflect in-use conditions. The Agency's review focused on the procedures for light-duty motor vehicles, especially the Federal Test Procedure (FTP), the procedure used to measure compliance with motor vehicle tailpipe and evaporative emission standards.

The Agency, in conjunction with automobile manufacturers and California's Air Resources Board (CARB), conducted an extensive review of in-use driving behavior, obtaining a wealth of data on how cars are driven during trips, the length of trips, the length of time between trips, and so on. [2]The Agency then generated representative driving cycles from the data and conducted emission testing to compare emissions over these cycles with emissions over driving cycles used in the FTP. These results confirmed that revisions to the FTP were needed, as significant emissions were seen under conditions not represented by the current FTP.

The Agency sought an approach which would extend the level of control found under current FTP conditions across all in-use driving behavior. Thus, EPA developed various changes to the FTP,

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Regulatory Impact Analysis for FTP Revisions, U.S. EPA, Office of Air and Radiation. Available in the public docket for review.

See the "Federal Test Procedure Review Project: Preliminary Technical Report," EPA 420-R-93-007 and the Technical Reports for this rulemaking, both in the public docket, for descriptions of the surveys and data gathered.

focusing on new driving cycles to add to the current FTP. The Agency also investigated possible control technologies that could be used to control emissions over these new compliance cycles. Today's proposal includes these various changes in the test procedure for tailpipe emissions, as well as the emission standards related to them.

In developing new compliance cycles, EPA did not re-evaluate the stringency of current standards. Rather, EPA sought parity between the types and extent of controls that manufacturers currently employ to comply with existing FTP standards and those they would implement to comply across all driving behavior. Thus, EPA believes that manufacturers for the most part will comply by making simple changes to their existing calibration strategies.

INSERT FIGURE 1 - NOT AVAILABLE IN THIS ELECTRONIC VERSION

The FTP is the core procedure used to measure compliance with emission standards for light-duty vehicles (LDVs) and light-duty trucks (LDTs). The current version of the FTP (40 CFR 86.130-96) consists of a series of preparatory steps to ensure the vehicle has been properly preconditioned on the test fuel, periods when the engine is off between vehicle operation (called "soaks"), and emission tests which measure tailpipe and evaporative emissions. Tailpipe emissions are measured while the vehicle is operated according to a specified driving cycle on a dynamometer. Figure 1 presents the Urban Dynamometer Driving Schedule, commonly referred to as the LA4. With the exception of running losses, which are measured during dynamometer operation, evaporative emissions are measured in a sealed enclosure while the vehicle is turned off. An additional cold temperature CO test procedure measures tailpipe emissions at 20°F following a cold soak. By comparing the emission test results to emission standards applicable to a given vehicle class, combustion cycle, and motor fuel, EPA determines if the vehicle meets applicable certification or in-use requirements.[3]

The current evaporative emission procedure, including refueling, and cold temperature CO test procedures were promulgated following passage of the Amendments. Thus, the test procedures in these rules were recently developed to reflect the actual current driving conditions under which motor vehicles are used (57 FR 31888; 58 FR 16002). The Agency is not proposing to change these test procedures and the remainder of this section and the subsequent proposal focuses on the light-duty tailpipe emission testing procedures of the FTP.

The FTP simulates on-road vehicle operation using a dynamometer in a laboratory test cell held between 68°F and 86°F.

The Agency has historically relied on emission performance standards because they directly limit production of exhaust constituents that affect attainment of the National Ambient Air Quality Standards, while providing maximum flexibility to the vehicle manufacturers in determining cost-effective compliance strategies. Other basic compliance program approaches include system performance standards, which set bounds on measurable performance parameters of the engine or emission control system rather than actual emission levels, and design standards, which prescribe primary design elements of the engine or control system.

The vehicle is driven on the dynamometer over cycles that prescribe the vehicle operator's speed as a function of time. The method for measuring tailpipe emissions of HC, CO, and NOx requires filling a bag with exhaust drawn from the tailpipe and diluted with background air while the vehicle is driven over the appropriate cycle. The bagged sample is analyzed for the concentrations of exhaust constituents, which serve as inputs to subsequent emission compliance calculations. Additional procedures apply to the sampling of particulate matter from diesel-cycle vehicles and organic gases from alternative-fuel vehicles.

III. Proposal Requirements and Alternative Approaches

Today's proposal deals primarily with five areas of driving behavior that have not previously been represented in the test procedure: aggressive driving behavior (such as high acceleration rates and high speeds); rapid speed fluctuations (microtransient driving behavior); start driving behavior; intermediate soak times (engine-off times between 10 minutes and 2 hours prior to vehicle start); and actual air conditioner (A/C) operation. The Agency is proposing new requirements for these areas, separate from the existing FTP requirements. Also included in this proposal are requirements to improve the simulation of actual road load forces[4] across all speed ranges and to revise the criteria for allowable speed variation for a valid test, which would be applicable both to the new provisions proposed in this NPRM and the existing FTP.

As most of this proposal deals with areas that have not previously been regulated, the Agency is considering a broad range of alternative approaches and requests. Comment on the alternative approaches, as well as the central proposal, are requested. Depending on comments and data received and analyses conducted subsequent to today's proposals, EPA may include some of the alternatives, in whole or in part, in the final rule. Interested parties may also submit comments on alternatives not specifically identified or analyzed by EPA for this proposal.

While both the central proposal and the alternatives are EPA's own design, they incorporate some concepts put forth both by the California Air Resources Board (CARB) and the Ad Hoc Panel

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[4] Road load forces refers to the force needed to overcome wind and tire resistance when driving at specific speeds.

on Revisions to the FTP (Ad Hoc Panel), a joint committee of the American Automobile Manufacturers Association (AAMA) and the Association of International Automobile Manufacturers (AIAM).

The proposed additions and revisions to the tailpipe emission portions of the FTP would apply to all LDVs and LDTs, certifying on all current motor fuels. The proposed changes would apply to testing conducted during certification, Selective Enforcement Audits, and in-use enforcement (recall). Adjustments are included to accommodate certain vehicle types, transmission types, and performance categories where the additions are not representative of in-use driving. The Agency solicits comments and data on the appropriate treatment of vehicles for which adjustments are allowed and the methods for making the adjustments.

A. Central proposal

The central proposal relies on a new Supplemental Federal Test Procedure (SFTP) that addresses various conditions under which vehicles are actually driven and used, which are not in the FTP. The SFTP includes three new driving cycles to represent (1) aggressive driving (as characterized by high speeds and/or high accelerations); (2) driving immediately following vehicle startup; and (3) microtransient driving (rapid speed fluctuations), which occur across the majority of the normal ranges of operating speeds and accelerations. The proposed SFTP incorporates conditions that are designed to more accurately reflect actual engine load due to A/C operation under typical ozone exceedance conditions. A new intermediate-duration (10- to 60-minute) soak period is also included.

Two components of today's proposal have wider impacts than just the SFTP. The first is to more accurately simulate real on-road loads at the tire/dynamometer interface, which is an element of the proposal that affects dynamometer operation throughout both the FTP and SFTP. The second would remove language specifying "minimal throttle movement" when conducting emission tests and replace it with "appropriate throttle movement" and require a specification of allowable speed variation, which also impacts both SFTP and FTP testing. The Agency is also requesting comment on whether the increased sophistication of vehicle computers necessitates replacing existing defeat device language with a requirement for proportional emission control under conditions not directly represented by the FTP and the SFTP.

The proposed standards would apply for full useful life under section 202 of the Clean Air Act. The warranty provisions under section 207 of the Clean Air Act also apply to this rulemaking.

Supplementary Federal Test Procedure––The SFTP includes three single-bag emission test cycles: a hot stabilized 866 Cycle[5] run with a new simulation of in-use A/C operation; a new Start Control Cycle (SC01, see figure 2) simulating driving with the new simulation of in-use A/C operation and proceeded by a soak period; and a new Aggressive Driving Cycle (US06, see figure 3) run in the hot stabilized condition. The cycles of the SFTP can be run as a sequence to save on preconditioning and setup

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[5] Refers to Bag 2 of the LA4, preceding the 10-minute hot soak, lasting 866 seconds.

time; however, separate runs of the cycles are permissible with the appropriate soak or preconditioning steps appended.

INSERT FIGURE 2 - NOT AVAILABLE IN THIS ELECTRONIC VERSION

INSERT FIGURE 3 - NOT AVAILABLE IN THIS ELECTRONIC VERSION

Elements of the proposed A/C simulation for certification testing include, a 95°F ± 5°F test cell ambient temperature, A/C set to "maximum A/C" with interior air recirculation, high interior fan setting, coldest setting on the temperature slide, driver's window down, and front-end supplemental fan cooling. Although certification testing would occur at 95°, the compliance requirement would apply at less demanding temperatures as well. Thus, EPA confirmatory testing could take place at any point across the range 68°F to 95°F. The compliance requirement would would The Agency proposes these conditions as a cost-effective surrogate for testing in a fully controlled environmental chamber set to simulate ozone-exceedance conditions of ambient temperature, humidity, solar load, and pavement temperature, although the use of a fully controlled environmental chamber would be permitted.

The required elements for the SC01 include the preconditioning, soak period, and compliance cycle requirements. Prior to the soak period, the vehicle is to be preconditioned to allow engine and catalyst temperatures to stabilize at typical warmed-up operating temperatures. The Agency believes that running the vehicle over EPA's Urban Dynamometer Driving Schedule (LA4) is adequate to achieve engine and catalyst stabilization regardless of the time period for which the vehicle was not operational prior to preconditioning. However, in the event the vehicle was shut off for less than two hours prior to preconditioning, the Agency believes that a 505 cycle is adequate for preconditioning the vehicle, although the 866 or the SC01 is also acceptable.

Immediately following the preconditioning cycle, the vehicle will enter the soak period. Manufacturer testing of engine families required to comply with the intermediate soak requirements for certification or SEA testing must soak the vehicle for at least 60 minutes. EPA will have the option of testing any soak duration between 10 and 60 minutes for certification, SEA, and in-use testing. If the engine family is not required to meet the intermediate soak requirements, a 10-minute soak period is proposed. During this period, cooling fans directed at the vehicle are to be shut off. The vehicle may be removed from the dynamometer, provided the vehicle is not subjected to unrepresentative cooling of the engine or catalyst. Following the soak period, the vehicle will be run over the SC01 cycle using the proposed A/C simulation for proper representation of engine and catalyst warm-up and start driving.

The US06 driving cycle is designed to be run in hot stabilized condition. High-volume exhaust flow for larger-displacement vehicles run on US06 dictates use of a larger-

capacity constant volume sampler (CVS) than is needed for current FTP testing. The proposed A/C simulation is not required for this test cycle.

The Agency proposes that manufacturers determine the appropriate shift points for their manual transmission applications and submit the shift schedules for EPA approval. In general, EPA will allow manufacturers to specify upshift points, but downshifting will not be permitted unless the vehicle is unable to stay within the driving tolerance on the speed trace in the existing gear.

Hot stabilized condition is achieved by including several preconditioning options as part of the formal procedure immediately prior to the US06 Cycle. If the vehicle has undergone a soak of 2 hours or less, the preconditioning may be a 505 Cycle, the 866 Cycle, US06, or the SC01. Following longer soaks, the proposed preconditioning cycle is an LA4. For manufacturers who have concerns about fuel effects on adaptive memory systems, the proposal allows manufacturers, and upon manufacturer request, requires EPA to run the vehicle over the US06 Cycle on the certification test fuel before entering the formal test procedure.

The Agency proposes adjustments to the aggressive driving test cycle for all heavy light-duty trucks (HLDTs)[6], and also, for some low- and high-performance LDVs and LDTs. . The proposal calls for US06 Cycle testing of HLDTs with the truck ballasted to curb weight plus 300 lbs and the dynamometer inertia weight determined from this same basis, while FTP testing remains at Adjusted Loaded Vehicle Weight. The proposed US06 Cycle adjustments based on performance level are summarized in Table 1. For low performance vehicles, the inertia weight is adjusted by multiplying the original inertia weight by the adjustment factor which is equal to the ratio of the applicable performance cutoff and the W/P of the test vehicle. Where an adjustment factor is called for, it is applied dynamically by the dynamometer only during those portions of the US06 Cycle that are the most aggressive. [7]No adjustment factors are proposed for mid-

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Light-duty trucks are divided into two weight categories known as light light-duty trucks (rated up through 6000-pounds Gross Vehicle Weight Rating (GVWR)) and heavy light-duty trucks (rated greater than 6000-pounds GVWR).

Refer to the Final Technical Report on Aggressive Driving

performance ("normal") vehicles. For high performance vehicles, the manufacturer must demonstrate stoichiometric control for wide-open throttle events of two seconds or less in order to ensure that these vehicles have aggressive driving emission control over similar vehicle operation as the rest of the fleet.

Behavior for the Revised Federal Test Procedure Notice of Proposed Rulemaking for a detailed discussion of the points in the cycle where the proposed adjustments would be made.

Table 1: Performance-Based Adjustments

Transmission type:	**Performance (W/P range)**	**Adjustment:**
manual	low W/P>34	dynamic dynamometer inertia weight reduction
	normal 18 W/P 34	none
	high W/P<18	2 second stoich control
automatic	low W/P>31	dynamic dynamometer inertia weight reduction
	normal 18 W/P 31	none
	high (W/P<18)	2 second stoich control

Determining compliance with standards––With the exception of changes prompted by use of new dynamometers and an additional driver speed variation tolerance, no changes are proposed for the driving cycle of the conventional FTP. Similarly, EPA proposes to retain unchanged the method of calculating compliance with the existing FTP. However, an additional "composite" compliance calculation is proposed that brings together elements of the conventional FTP with results from the SFTP. In the composite calculation, emissions from the range of in-use driving are appropriately weighted, summed, and compared to the proposed emission performance standards. For total hydrocarbon (THC), non-methane hydrocarbons (NMHC), organic material hydrocarbon equivalents (OMHCE), organic material non-methane hydrocarbon equivalents (OMNMHCE), and CO, the proposed standards are the same as the standards applicable under the conventional FTP; for NOx, an adjustment factor of 1.15 is applied to that standard to account for the emission response of vehicles to the new A/C test conditions. See the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis for the specific numerical standards. Due to the absence of relevant test data on which to base a decision, no supplemental test procedures or standards are proposed for diesel

particulate.

Included in the composite calculation are a cold start bag (based on Bag 1 of the conventional FTP) and the three bags of the SFTP (called Bag 4, 5, and 6). The weighting factor for each of the four bags is adjusted as appropriate to reflect the proposed level of control for each type of driving in the SFTP. Because the exhaust constituents respond differently to the loads and speeds of the new SFTP cycles, the proposed levels of control and, thus, the weighting factors of the composite calculation differ somewhat for different pollutants. The proposed weighting factors are:

	THC/NMHC	CO & NOx
Bag 1 (cold start from FTP)	21%	15%
Bag 4 (866 cycle from SFTP)	24%	37%
Bag 5 (SC01 from SFTP)	27%	20%
Bag 6 (US06 from SFTP)	28%	28%

The Agency is proposing that changes in the achievable levels of control over the SFTP tests would track changes in the underlying FTP standards and, thus, adoption of the central proposal would have the effect of automatically reducing the composite standards in step with any mandatory future declines in the FTP standards.[8]

Flexibilities are proposed to allow manufacturers to reduce their testing burden, particularly during development testing. (See Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and Technical Reports for discussion.[9])

Emissions Standards and Phase-in--The Agency is proposing to phase in the proposed requirements for aggressive driving and air conditioning control prior to implementing the intermediate soak

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The issue of what standards would apply in the context of a voluntary Federal low emission vehicle program will be determined in a separate rulemaking (60 FR 4712, January 24, 1995).

Both the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and the Technical Reports are in the public docket for review.

requirements. It is proposed that the standards apply to 40 percent of each manufacturer's combined production of LDVs and LDTs for the 1998 model year, 80 percent in 1999, and 100 percent in 2000. Small volume manufacturers would not have to comply until the 2000 model year. All the proposed requirements would apply during this phase-in period, except that Bag 5 could be conducted with a 10-minute soak instead of the proposed 60-minute soak for control of intermediate soak emissions. The 60-minute soak would be required for all vehicles starting with model year 2001, including small volume manufacturers.

The Agency is continuing to analyze the impact of this phase-in schedule, particularly when considered in conjunction with other recently promulgated rules (such as revisions to the evaporative test procedures) as well as potential future programs (such as voluntary Federal low emission vehicle standards). Comments are specifically requested (1) on the impact of this phase-in schedule when considered with other programs and (2) providing suggestions for other schedules which will coordinate programs more effectively. The Agency will review this information in developing the final rule to determine if a more logical coordination schedule is possible while maximizing the cost/benefit effectiveness of this rule.

The proposal recognizes that adoption of emission standards more stringent than current Federal Tier 1 standards will likely result in emission control strategies that reduce catalyst light-off times.[10] This could have a significant impact on the costs and benefits of the intermediate soak requirement. As Tier 1 standards are the current legal requirement and the status of future standard changes is uncertain at this time, this proposal presumes Tier 1 applicability. The Agency invites comments and data addressing the cost/benefit implications of the proposed soak requirement under a Federal Tier 2 (or equivalent) program..

Each of the test cycles is run on a system providing accurate replication of real road load forces at the interface between drive tires and the dynamometer over the full speed range. In addition, the new US06 cycle requires significantly higher power absorption capacity, due to the higher power requirements of this aggressive driving cycle. While EPA intends to use a large-diameter single-roll dynamometer with electronic control of power absorption to meet these requirements for both

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[10] Time required for the catalyst to reach the temperature needed to sustain significant catalytic activity.

the new SFTP and current FTP testing, any system would be allowed that yields equivalent or superior test results.

The improved road load simulation and the new criteria for allowable speed variation for FTP compliance determination are proposed to be implemented in the 1998 model year. Manufacturers could elect to use improved road load simulations prior to 1998, at their option.

The Agency is also proposing a minor procedural change that would remove the current 5500-pound test weight cap, to be implemented in the 1998 model year with the improved road load simulations.

B. Alternative Approaches

As indicated, EPA is considering a number of alternatives to critical elements of the central proposal. The following provides a summary of the most important of these alternatives. A full discussion of all the options and alternatives considered is found in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis.

In determining compliance with the emission standards, EPA is considering two alternatives to the proposed FTP/SFTP composite and the related standards: (1) promulgating three separate sets of standards, one set each for aggressive driving, post-soak startup emissions, and A/C impacts; and (2) promulgating a single set of standards, based on a simple weighted average of separate standards for each control area. Both of these alternatives would use the same cycles and test procedures as the composite approach of the central proposal. However, instead of weighting them with Bag 1 of the FTP and using bag weights to help establish appropriate compliance procedures and standards, the alternative approaches would establish emission standards specifically for each new control area.

The Agency did not select either of these alternatives as the central proposal because of difficulties encountered in determining the appropriate amount of in-use compliance margin to allow when establishing emission standards. Also, the proposed concept of indexing the SFTP standards to any future changes in FTP standards probably would not work with either of the two alternatives. If data are submitted that could help establish appropriate in-use margins, EPA would reevaluate the most appropriate compliance structure and, if appropriate, may select one of the alternatives in the final rule.

The Agency is also considering the alternative of

establishing a single standard for NMHC+NOx, instead of separate standards, and invites comments on the cost and emission impacts of this alternative.

One issue was identified too late for EPA to properly evaluate it. Concern was raised that the proposed level of CO control may significantly interfere with the ability for vehicles to comply with the proposed level of NOx control. Should further data and analyses substantiate that tradeoffs between CO and NOx control would preclude meeting the proposed level of NOx control, EPA would consider reducing the stringency of the CO standards for the new control areas in the final rule.

On October 20, 1994, EPA representatives received a joint vehicle manufacturer proposal from the Ad Hoc Panel that addressed emissions arising from aggressive driving and A/C operation and proposed emission standards for each of these two areas. The Agency has not had sufficient time to fully analyze the concepts offered by the panel or to incorporate the manufacturer proposal as an explicit, complete alternative to the primary Agency proposal presented today. Nevertheless, the manufacturers' specific proposals fall within the scope of the options and alternatives discussed by EPA in today's notice. The Agency has submitted materials supplied by the panel on October 20, 1994, to the rulemaking docket. [11]Analysis of these elements by the Agency, as well as any related material supplied in the future, will also be docketed. In order that the Agency may make the most informed and appropriate judgments in any final rulemaking, EPA encourages interested persons and organizations to evaluate and comment upon these materials.

In the area of A/C emission control, EPA is considering an alternative to the proposed test simulation of A/C operation, as well as the alternative of requiring A/C testing across the cold start (that is, Bag 1 of the FTP). The alternative A/C simulation would leave the A/C off in the test cell, but would increase the dynamometer load curve across the range of vehicle speeds to reflect the additional load imposed by an A/C compressor during ozone exceedance conditions.[12]

Ad Hoc Panel, "Industry Proposal on FTP Revisions," October 20, 1994.

The Ad Hoc Panel has submitted a proposed methodology for such a dynamometer simulation of A/C load, dubbed "Nissan II." Manufacturers are pursuing additional refinements to

In the intermediate soak area, the effect on in-use emissions of the alternatives depends on future changes to the stringency of the FTP standards, the control strategies manufacturers would employ to meet such future standards, and the impacts those strategies might have on post-soak emissions. Because these are not known, alternatives might include exemption from aspects of the soak requirement or total deletion of the soak requirement.

IV. Statutory Authority and Legal Analysis

The promulgation of these regulations is authorized by sections 202, 206, 208, and 301 of the Clean Air Act (CAA or the Act) as amended by the Clean Air Act Amendments of 1990 (42 U.S.C. 7521, 7525, 7542, and 7601). Section 206(h) of the Act requires EPA to "review and revise as necessary…the testing of motor vehicles and motor vehicle engines to insure that vehicles are tested under circumstances which reflect the actual current driving conditions under which motor vehicles are used, including conditions relating to fuel, temperature, acceleration, and altitude." Congress mandated that EPA exercise its authority under section 206(a) of the Act, giving broad authority to determine appropriate test procedures, consistent with the broad direction of section 206(h), to determine appropriate changes to reflect real world conditions.

Although the text of the statute and the legislative history do not provide explicit criteria or intent for this review, EPA believes the primary concern of Congress is having test procedures for LDVs and LDTs reflect in-use conditions in order to obtain better in-use emission control. This flows from the basic purpose of test procedures––to measure compliance with the emission standards––and from standards designed to obtain in-use emission reductions. Therefore, EPA made this the primary concern and objective.

A more detailed analysis of the statute, the scope of EPA's authority, and interpretation of how best to exercise EPA's discretion under section 206(h) are found in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis.

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address potential concerns with the approach, such as the ability to simulate air compressor cycling and A/C loads at idle, which cannot be simulated on a dynamometer.

V. The FTP Review Project and Areas of EPA Concern

In response to the review requirement of the CAAA, EPA initiated the FTP Review Project (the FTP Review) in November 1990. The first action of the project team was to perform an initial review of existing information to identify elements of the current FTP that might be of concern (justifying additional focus) and others that might not justify concern at this time.

Of immediate concern to EPA was representativeness of the driving cycle used in the current FTP, the "LA4" or "Urban Dynamometer Driving Schedule," especially in the area of aggressive driving behavior.[13] It was clear that the LA4 maximum speed of 57 mph excluded a significant fraction of higher-speed, in-use operation.[14] Similarly, EPA suspected that an important fraction of in-use accelerations were more severe than those found in the LA4. A 1990 CARB study found much higher emissions, particularly for CO, during operation at high acceleration rates relative to those seen during FTP-level accelerations.

One possible explanation for these emission increases is that the engines were not calibrated for emission control during the higher engine loads associated with aggressive driving, as these loads are not encountered during current FTP testing. However, insufficient data existed at the time to quantify the in-use frequency of aggressive driving events or the actual emission impacts. There were also concerns, based on engineering judgment, about other aspects of driving behavior that were not represented in the current test procedures for which no data existed. Thus, the Agency concluded that further information was necessary to properly represent actual driving conditions. In collaboration with key stakeholders, EPA began extensive research into driving behavior and conditions and their emission implications.

In this report, "driving behavior" refers to the measurable consequences of the operator's action on the accelerator pedal, including vehicle speed, throttle variation, acceleration, and power.

Details about the development of the LA4 driving cycle can be found in an SAE paper, "Development of the Federal Urban Driving Schedule," Ronald E. Kruse and Thomas A. Huls, EPA, 1973, #730553.

During the course of the research a number of other concerns with the current FTP were identified, including two additional concerns with the LA4 representation of in-use driving behavior. The first concern was start driving behavior; that is, behavior immediately following vehicle startup and initial idle. The LA4 cycle used in the current FTP brings the most aggressive operation close to the beginning of the cycle; driving survey data suggest this is atypical of in-use operation. The second concern was microtransient behavior (rapid speed fluctuations). In-use driving survey data contains more frequent speed fluctuations than the FTP.

The Agency identified concerns about four additional elements of the FTP: the duration of the soaks; the representation of A/C load; representation of additional loads on the engine due to factors such as road grade, extra cargo, or trailer towing; and the adequacy of the dynamometer specification for representation of real road load.

With respect to soaks, EPA sought to determine if significant levels of emissions are missed by the current FTP because only very short- and long-duration soaks are reflected in the current structure. One related hypothesis was that the much faster cooling rate of catalysts compared to engines might lead to excessive emissions during intermediate-duration soaks.

Several aspects of the A/C load simulation were problematic. The current FTP adds load as a percentage of the base road load horsepower curve, which means the FTP A/C load decreases with decreasing speed, while real A/C system loads relative to road load horsepower are highest at low speed. Also, vehicles with different base horsepower curves end up with different FTP A/C load simulations, even if they have identical A/C systems. Additionally, the Agency believes that the current method significantly under-represents the magnitude of in-use A/C loads. As in the case of aggressive driving behavior, incorrect representation of A/C loads during the FTP risks incorrect simulation of the emissions these loads would generate from an engine in-use.

Road grade, vehicle towing, and cargo also represent a load effect on the engine. The 300-pound passenger-plus-cargo allowance on the FTP is clearly unrepresentative for some driving situations, especially for trucks, and the absence of road grade or vehicle towing simulations on the FTP means these actual in-use loads are not a factor determining emission standards or compliance with those standards.

Three aspects of the current FTP dynamometer configuration have the potential to misrepresent the actual road load experienced by vehicles in-use. First, the shape of the

speed/load curve on current certification dynamometers is fixed and cannot be changed; the magnitude of the speed/load curve is adjusted by periodically calibrating the dynamometer at a single speed (currently, 50 mph). As a consequence, loads at speeds other than the calibration point can be misrepresented. Second, current FTP dynamometers cradle the vehicle drive wheels between two small (8.65-inch) rolls. Heating effects and pinching of the tire result in an unrepresentative simulation of road "surface." Third, the dynamometer rolls are currently uncoupled and the front roll (which bears the power absorber) spins somewhat more slowly than the rear (which provides the vehicle speed signal); this tends to bias the system towards underloading the vehicle.

The Agency analyzed three other elements of the FTP and believes revising the current procedures is unnecessary at this time. The first such area was the altitude of testing. Given that EPA has the authority to perform vehicle testing at any altitude, and it currently exercises that authority, the Agency is not proposing to supplement by further regulation the altitude testing flexibility in current law. While it is possible that driving behavior may differ at high altitudes, EPA believes that any emission controls required for aggressive driving will also be effective during high altitude driving.

A second element which EPA did not pursue beyond the initial evaluation was test fuels. In-use fuels have a wide range of properties. This specification for fast fuel allowance for a range of fuels (40 CFR 86.113-94) appear to provide EPA with the flexibility to use a variety of test fuels ranging from an average in-use fuel to some of the less typical in-use fuels with qualities that could effect emissions. Significant differences, with potentially large emissions implications, do appear to exist between average in-use gasoline and the gasoline (indolene) typically purchased by both EPA and industry for certification testing. After evaluating approaches to addressing this situation, EPA concluded that changes to the regulations are not necessarily required, since the current regulations provide the flexibility needed to address those situations where the use of indolene may not be representative. In addition, various programs to address in-use fuel qualities are still under consideration. If a decision is ultimately made to change the certification fuel regulations, it may be best to do so along with changes to the specifications for in-use fuels.

Finally, EPA believes that it is unnecessary to further address the direct impacts of ambient temperature on FTP tailpipe emissions in this proposal. At the time the Amendments were adopted, the FTP evaluated tailpipe emissions performance in the midrange of temperature (68°F to 86°F), but omitted both cold and

hot temperature testing. The emission concern following cold temperature soaks and during cold temperature operation is increased CO emissions. This concern was addressed through EPA's Cold Temperature CO rulemaking (57 FR 31888). The direct emission impact during hot temperature operation is increased fuel evaporation. Ambient temperature should not otherwise affect tailpipe emissions, as the engine and combustion temperature are not affected in any significant way by temperatures hotter than 86°F. This concern was addressed through the Agency's Evaporative Emissions rulemaking (58 FR 16002). Ambient temperature also produces indirect emission effects through increased operation of the vehicle A/C, affecting the load on the engine. This indirect aspect of temperature was addressed in EPA's detailed review of the FTP and is reflected in today's proposal.

The FTP Review project team found that existing information was clearly inadequate for evaluating potential revisions to the test procedures. Consequently, a number of new data gathering and analytical efforts were undertaken in connection with the project. In several of these efforts, EPA resources were supplemented by significant cooperative investments from other sources, including the American Automobile Manufacturers Association (AAMA), the Association of International Automobile Manufacturers (AIAM), and the California Air Resources Board (CARB). These studies provided EPA with unprecedented data on which to base its comparative review with the FTP and to construct the options presented in today's proposal.

VI. In-Use Behavior

The first critical need in reviewing the FTP was a current database on in-use driving and vehicle soak behavior. The Agency collaborated with AAMA, AIAM, and CARB over the spring and summer of 1992 to conduct surveys of in-use driving and soak behavior in four major U.S. cities.

A. In-Use Driving Behavior

Instrumented vehicle surveys and/or chase car studies were conducted in Baltimore, Maryland; Spokane, Washington; Atlanta, Georgia; and Los Angeles, California. In May of 1993, EPA published its initial conclusions regarding aggressive driving behavior in the "Federal Test Procedure Review Project:

Preliminary Technical Report."[15] These conclusions were largely based on the Baltimore instrumented vehicle survey data. Subsequent analysis has found the larger three-city instrumented vehicle results to be consistent with the Baltimore-only results. The three-city analysis showed that nearly 13 percent of vehicle operation, on a time-wrighted basis, occurs at combinations of speed and acceleration that fall outside the matrix of speeds and accelerations found on the LA4 driving cycle. The maximum observed in-use speed was 95.5 mph, compared to the LA4 maximum speed of 56.7 mph, and slightly more than seven percent of in-use vehicle operation time was spent at speeds greater than 60 mph. Average speed from the three-city in-use data was 25.9 mph compared to 19.6 mph over the LA4.

Specific power is also useful when analyzing aggressive driving behavior.[16] Measures of power also indicated that in-use driving behavior was more aggressive than reflected in the LA4. Specific power in the three-city sample ranged up to 723 mph^2/sec and averaged 47.0 mph^2/sec. The LA4 has maximum power of 192 mph^2/sec and an average of 38.6 mph^2/sec.

The Agency analyzed the in-use survey data to determine how the above findings on speeds, accelerations, and power measures were affected by other factors, including vehicle type (car/truck), transmission type, vehicle performance level, time of day, and day of the week. The first three vehicle-related factors are reflected in today's proposal. The discussion of the analysis and findings are in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and the Technical Reports.

The Agency also examined start driving behavior as

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[15] U.S. Environmental Protection Agency, Federal Test Procedure Review Project: Preliminary Technical Report, EPA 420-R-93-007, Office of Air and Radiation, May 1993.

[16] The power needed from an engine to move a vehicle is proportional to both the vehicle speed and the acceleration rate. Neither variable, by itself, is a good measure of the load placed on the engine. The joint distribution of speed and acceleration is probably the best measure, but it must be examined in three dimensions, which is difficult to visualize and comprehend. The concept of specific power provides a two-dimensional measure which is roughly equal to 2*speed*acceleration and has the units of mph^2/sec.

represented by the instrumented vehicle survey data. The Agency determined that the start driving (operation following the initial idle and before coolant temperature exceeded 140°F) in the survey data generally did not exceed 240 seconds. Further analysis showed that the speeds of start driving did not change substantially following soaks of different durations, but they did differ from those found in hot stabilized driving. The results for in-use initial idle time and start driving are different than the representation of these elements in the FTP. The LA4 cycle has atypical high speeds over the first four minutes of a vehicle trip. On the other hand, the LA4 has substantially less aggressive accelerations than the first 80 seconds or so of typical in-use start driving, while it is substantially over-aggressive when compared to the succeeding 160 seconds. For initial idles, the FTP presumes 20-second durations for both cold and hot starts, whereas the in-use averages from EPA's data were 28 seconds for cold starts and only 12 seconds for hot starts.

The previous discussion of in-use speeds and accelerations presents a snapshot of driving behavior. Although the acceleration measure, which looks at the change in speed from one second to the next, partially characterizes the transient nature of driving, other measures expand the time interval to examine the rapid fluctuations in speed, or microtransients. One measure, referred to as jerk, is equal to the change in acceleration. A related measure is the second-to-second change in specific power. Conceptually, this measure captures the change in the power requirement imposed by the driving behavior.

The Agency used the three-parameter instrumented vehicle data from Baltimore, Spokane, and Atlanta,[17] to calculate these microtransient measures for in-use driving behavior and compared the results to the LA4's representation. The measures of jerk and change in power are shown in Table 2.

Table 2: Measures of microtransient driving from instrumented vehicle data/sec

Source	Jerk		Change in Power	
	Mean of the absolute values (mph/sec)	Standard deviation (mph/sec)	Mean of the absolute values (mph^2/sec)	Standard deviation (mph^2/sec)

See the Technical Reports for a full description and analysis of this data.

In-use driving	0.47	0.89	20.48	34.36
LA4	0.36	0.63	14.96	22.96

For both jerk and change in power, the mean of the absolute values were used in order to look at both the positive and negative values (the mean of the signed values of jerk is always equal to zero). The in-use means were higher than those for the LA4, indicating larger in-use changes in acceleration and power, as well as reflecting, in part, the LA4's acceleration rate cutoff of 3.3 mph/sec and the maximum speed of 57 mph. The standard deviations of jerk and change in power are probably a better measure of microtransient behavior. Again, in-use data show larger values for both measures. The greater variation around the mean demonstrated by the in-use data suggests that the LA4 does not adequately represent the microtransient nature of in-use driving behavior.

B. Soak Behavior

The survey data were also analyzed to determine the frequencies at which soaks of different durations occurred in-use. The Agency found that soaks of less than 10 minutes and greater than 8 hours occur with the highest frequencies in use. However, EPA also found that a significant portion of in-use soaks are of intermediate duration. For example, nearly 40 percent of all soaks in the Baltimore survey data were between 10 minutes and 2 hours. Given that the current FTP employs only two soaks (the 10-minute hot soak and the 12- to 36-hour cold soak) to represent the range of soaks in-use, EPA was concerned that the current FTP might not adequately control for emissions following these intermediate-duration soaks.

C. Air Conditioning

A number of variables affect the range of A/C usage, particularly temperature, sun load, and humidity, all of which vary by season, time of day, and geographic location. Given that the overall goal of the Act is to help bring localities and regions into compliance with the National Ambient Air Quality Standards (NAAQS), the Agency chose to focus attention on the contribution of A/C to vehicle emissions during typical high ozone situations. Analyses of ozone exceedances revealed that ozone exceedances typically occur on days with a mean ambient temperature of 95°F, 30-40 percent relative humidity, and limited cloud cover.

In August and September 1994, the Agency conducted an instrumented vehicle study in Phoenix, Arizona. Preliminary

analyses of the survey data indicate that the average A/C usage was 77 percent for days that reached a peak temperature between 90°F and 100°F. The A/C compressor was actually engaged 61 percent of the total time (see Technical Reports and the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis for full analysis). The high use of A/C in ozone exceedance conditions makes the accurate simulation of A/C during the FTP more important.

D. Additional Elements Affecting Engine Load

A comprehensive evaluation of additional elements affecting engine load would require surveys of the frequency of occurrence of the elements in-use, as well as evaluation of interactive effects with driving behavior. For road grade, a 1980 EPA report[18] indicated that positive road grades average 1.66 percent nationally and that roughly six percent of national VMT is spent on grades of four percent or higher. The Agency sought to supplement this information with driving behavior data over road grade, gathered during the chase car portion of the in-use driving surveys. Unfortunately, problems with noise and insufficient resolution on the measure of grade rendered the data inadequate, and no alternative data source was available. In addition, EPA was unable to conduct in-use surveys in the areas of passenger/cargo loading and trailer towing, due to the scope and nature of the necessary survey instrument. As a consequence, EPA has insufficient data for use in evaluating the additional elements affecting engine load that were originally identified as areas of concern.

VII. Representative Driving Cycles

In order to evaluate the emission impacts of in-use driving and soak behavior, EPA designed three driving cycles that were representative of the in-use survey results, using segments of actual in-use driving survey data. Concurrently, EPA determined weighting factors to reflect the fraction of in-use operation represented by each cycle; these factors are used to properly weight the emissions from the cycles when doing an emission assessment.

The Agency developed separate cycles for start driving and aggressive driving. The Agency chose to develop individual cycles

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[18] U.S. Environmental Protection Agency, Passenger Car Fuel Economy: EPA and Road, EPA# 460/3-80-010, September 1980, p. 119.

rather than a single "representative" cycle in order to evaluate EPA's areas of concern independently. This is most critical in the case of aggressive driving where both capturing the diversity of aggressive driving behavior and representing it proportionally in a single cycle covering all in-use operation would lead to a very long cycle.

The Start Cycle (ST01) represents three successive 80-second segments of in-use driving immediately following the initial idle. Testing using ST01 allowed separate determination of start driving emissions; ST01 was also used to quantify the emissions effects of varying soak duration.

The second cycle, characterizing aggressive driving, was the Representative Non-LA4 Cycle (REP05). This cycle targeted speeds and accelerations, as well as microtransient effects, not covered by the current LA4.

To complete the representation of in-use driving behavior for emission assessment purposes, a third cycle, the Remnant Cycle, was developed to characterize in-use driving behavior not represented by either the ST01 or REP05.

The Agency used the same basic cycle development methodology for each of the three representative cycles. A full discussion of the methodology used, the composition of each cycle, and how it compares to the cycle in the FTP is found in the Technical Reports.

It seemed clear from the in-use survey data that rapid speed fluctuations, including ones not well represented on the LA4, could be found in all types of in-use vehicle operation. The Agency's use of actual microtrips as the building blocks for the three representative cycles directly incorporated such microtransient driving behavior into all three cycles.

The Agency has assumed that driving behavior is not affected significantly by A/C operation and that the representative driving cycles developed from the in-use driving survey data are equally applicable to testing with the A/C system on and off. In fact, even though the Atlanta driving survey was the only one of the three surveys conducted during the summer, that city had the most aggressive driving of the three cities. Thus, it does not seem likely that A/C operation could have a significant impact on driving behavior. Nonetheless, the Agency welcomes data and comments on the relationship between A/C operation and driving behavior.

VIII. Emission Inventory Assessments

An assessment of emissions from four areas for potential emission control was conducted using the representative test cycles developed from the survey data. A full description of the test programs and the results can be found in the Technical Reports. The following summarizes the conclusions for each area considered.

A. In-Use Driving Behavior

The FTP Review's emission assessment of in-use driving behavior was based on a vehicle emission test program conducted cooperatively by EPA, CARB, AAMA, and AIAM during 1993 and early 1994 (referred to subsequently as the Non-LA4 Emissions Test Program).[19]

On the basis of the EPA data, the project team concluded that the LA4 under-predicts actual in-use hot stabilized emissions by 0.043 g/mi NMHC, 2.8 g/mi CO, and 0.083 g/mi NOx on current technology, properly operating vehicles. [20]These numbers do not have any direct bearing on the FTP standards; they are simply an estimate of the additional amount such vehicles actually emit in-use, compared to the FTP test results.

Table 3 shows the percentage contribution to the in-use emission increase from the Start (ST01), Remnant, and aggressive (REP05) driving cycles, weighted by their respective proportion of in-use driving. As expected, the aggressive driving of REP05 contributed significantly to the difference. More surprisingly, however, significant contributions to the increase also came from the Start and Remnant Cycles, particularly for NMHC and NOx.

Table 3: Contributions to the in-use g/mi increase by three types of driving

Driving	NMHC	CO	NOx
All (In-Use Increase)	0.043 g/mi	2.784 g/mi	0.083 g/mi
Start	30.2%	17.1%	23.0%
Remnant	33.8%	25.0%	45.6%
Aggressive	36.0%	57.8%	31.4%

The AAMA/AIAM portion of the program was conducted in late

EPA's assessment was limited to EPA's and AAMA/AIAM data. Due to differences in testing hardware, CARB's emission results were not directly comparable.

These estimates are only for the emission under-prediction related to driving behavior. Other factors such as soak are addressed in the sections to follow.

1993 and early 1994. This 26-vehicle, 8-manufacturer program included hot stabilized testing with REP05, the 505, and the 866, but none with the Remnant or Start Cycles; thus, a complete assessment of in-use hot stabilized driving could not be conducted with the manufacturers' data. Nevertheless, comparisons were made between the EPA and manufacturer program results for REP05 as well as the difference between REP05 emissions and hot stabilized LA4 emissions. In looking at the emission difference between REP05 and hot LA4, the LDV and light light-duty truck (LLDT) average for the EPA tested vehicles was 0.04 g/mi while it was 0.06 g/mi for the vehicles tested by the manufacturers. The CO emissions tracked better, with the REP05 and hot LA4 difference of 5.71 g/mi for EPA and 5.32 g/mi for the manufacturer tests. The manufacturer testing showed a much larger NOx differential. The NOx difference between REP05 and hot LA4 was 0.25 g/mi for the manufacturers' testing while only 0.09 g/mi for EPA testing. The NMHC and CO differences are primarily among the LLDTs while the NOx difference was found in LDVs and LLDTs. The Agency did not test any heavy light-duty trucks (HLDTs); however, the manufacturers' results showed these vehicles as having the largest grams per mile increases from hot LA4 to REP05. This comparison suggests that EPA's emission assessment should provide a reasonable, if not conservative, estimate of in-use emissions.

B. Intermediate Soaks

The Agency conducted the assessment of in-use emissions following intermediate soaks using data from EPA's Soak/Start Test Program, conducted in two phases between July 1993 and June 1994. The testing represented the soaks observed in the driving survey data. The primary cycles used to measure post-soak emission levels for the emission assessment were variations of EPA's representative Start Cycle (ST01).

Post-soak emissions in the Soak/Start Test Program, measured over the ST01 cycle, increased steadily and sharply as soak duration was incremented between 10 minutes and 60 minutes. The average ST01 emissions for all vehicles tested for NMHC, CO, and NOx were higher following the 60-minute soak than they were for the 10-minute soak by factors of seven, two, and four, respectively. The increases were significant in absolute terms as well; for example, the average NMHC emissions on three Tier 1 vehicles went from about 0.05 g/mi following the 10-minute soak to over 0.50 g/mi following the 60-minute soak. The rate of increase moderated with soaks longer than 60 minutes, such that emissions of all constituents following a 2-hour soak were within 50 percent of cold soak levels. The subset of Tier 1 vehicles in the EPA program showed similar percentage increases as a function of soak duration relative to the Tier 0 vehicles, although the average emission levels of these vehicles were lower than the

Tier 0 vehicles.

C. In-Use Air Conditioner Operation

The Agency conducted three test programs and participated cooperatively with AIAM and AAMA in an additional test program during late 1993 and early 1994 with the purpose of assessing in-use emissions due to A/C operation. Detailed descriptions of all of these programs and the results are contained in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis.

The first test program compared emissions during the current FTP A/C simulation to emissions obtained with the A/C actually operating and confirmed that the current A/C simulation method significantly under-represents the actual load of the A/C on the engine.[21]

The second test program went beyond the current FTP by testing A/C impacts over the three representative cycles (REP05, ST01, Remnant) as well as over the LA4. As in the first program, results from this testing demonstrated an overall increase in actual emissions with the A/C operating. In particular, the magnitude of the NOx increase in both programs was much larger than expected and caused the Agency to focus further research and analysis on the effects of A/C operation on NOx emissions.

The third test program was very similar to the second but was designed to collect second-by-second emissions and vehicle operating data. Analysis of these data indicated that the significant A/C-related emission impacts were occurring during idles and accelerations; on the LA4, ST01, and Remnant cycles the combination of idles and accelerations accounted for more than 80 percent of the total observed NOx increase. As was the case in the previous program, the overall increases in NOx were heavily weighted towards the moderate and lower speed driving of the ST01, Remnant, and LA4 cycles, although some increases were seen on the REP05 cycle.

A detriment of these test programs is that they did not adequately or fully represent the actual conditions under which A/C systems are likely to be operated. To test vehicles under an accurate simulation of environmental conditions and vehicle speed, an emission testing program (referred to as the AC Rochester [ACR],test program) was conducted by vehicle

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In fact, the Agency believes that the effect on emission values of the additional ten percent dynamometer road load horsepower is negligible and unobservable within the range of current test-to-test variability.

manufacturers in a sophisticated environmental test facility.[22] The Agency and manufacturers cooperatively defined for the testing a set of environmental and meteorological parameters to represent a typical ozone nonattainment day.

Eight vehicles certified to the EPA's Tier 1 emission standards with HFC-134a A/C refrigerant systems were tested in the program. Once again, the effects of A/C operation were most pronounced on the moderate-to-lower speed cycles. On a hot, stabilized LA4, the average increases were 0.011 g/mi for NMHC, 0.3 g/mi for CO, and 0.205 g/mi for NOx. The increases observed on the REP05 cycle were smaller than on the LA4, but still noteworthy due to the performance of several of the vehicles, causing the Agency some concern about the impact of A/C operation during aggressive driving behavior. Fuel economy decreased by about 13 percent on the REP05 with the A/C operating, substantially less than the 20 percent reduction on the LA4, further indicating that the A/C load as a proportion of total load tends to diminish as speeds and accelerations increase.

D. Additional Elements Contributing to Engine Load

As part of the Non-LA4 Emission Test Program, EPA conducted an evaluation of emission impacts from road grade by simulating a two percent grade through increased inertia weight at the dynamometer during testing of three vehicles over the three representative cycles. The road grade effect, weighted by the percentages of the driving types in-use, showed a consistent HC increase of 0.04 g/mile, a highly variable CO increase averaging 3.2 g/mile, and a NOx increase (due largely to one vehicle) of 0.19 g/mi. Due to the absence of comprehensive in-use survey information, EPA did not calculate adjustments to these numbers to reflect in-use frequency of grade or modifications to driving behavior over grades.

This program was developed as a cooperative effort between EPA and manufacturers with funding from manufacturers.

IX. Cause and Control of Emissions

Three candidate areas for emission control are aggressive driving behavior, intermediate soak periods, and A/C operation. Microtransient driving behavior carries over and is addressed withing these candidate areas. The following discusses each of these areas, the causes of emission, and potential strategies for controlling the emission.

A. Aggressive Driving Emissions

Both agencies and the vehicle manufacturers anticipated that a primary cause of higher emissions during aggressive operation would be "commanded enrichment," which is done by programming the vehicle's computer to change the air/fuel ratio to the rich side (more fuel for the same air) of stoichiometric operation, typically in response to high loads on the engine. Aggressive driving, positive road grade, increased vehicle loading, and air conditioning operation all generate increased load on the engine. Further, the effect of these factors are cumulative. Manufacturers currently employ commanded enrichment in essentially all applications when high load at the engine (regardless of the source) is detected, both to provide increased power and to cool the engine or catalyst.

Using data from EPA's Non-LA4 Test Program, supplemented by AAMA/AIAM data,[23] the Agency concluded elevated HC and CO emissions during aggressive driving are due primarily to enrichment, both commanded and transient. High NOx emissions during aggressive driving, EPA believes, are due both to an increase in engine out NOx (from higher temperatures) and to relatively poor catalytic conversion. Poor catalytic conversion is due to lean events resulting from erratic A/F control and to an A/F control strategy which is not biased rich. The Agency also recognizes that catalyst breakthrough is a potential contributor to CO and NOx emissions during aggressive driving.

The Agency considered five strategies that manufacturers might employ for addressing the causes of high emissions from aggressive driving: improved control of the A/F ratio (fuel control) through calibration; improved fuel control by upgrading

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AAMA/AIAM spotlighted commanded enrichment by retesting a portion of the vehicles in their test program in a stoichiometric configuration, as well as in the "production" configuration and provided second-by-second data acquisition capability for emissions and a variety of engine and emission control parameters, allowing fine scrutiny of individual driving events.

fuel injection systems to sequential firing; upgrading to electronic throttle control; improvements to catalyst design; and reapplication or refinement of conventional NOx emission control systems. These strategies are discussed in detail in the Technical Reports.

Of these strategies, the various recalibration options appeared to be the least costly, because each of the remaining strategies involved per-vehicle hardware modifications. In addition, data from the Non-LA4 test program indicated that recalibrations would probably control the vast majority of aggressive driving emissions.

B. Intermediate Soak Periods

The Agency examined the causes of post-soak emissions using data from the EPA Soak/Start Test Program and a preliminary program called the Albany Cooldown Study that gathered real-world engine and catalyst cooldown profiles. The data from these programs indicated that increased emissions following intermediate soaks arise in three ways:

- rapid catalyst cooldown following keyoff,
- slow catalyst thermal recovery following a restart, and
- manufacturer calibration strategies in response to the startup condition.

The Agency data indicate the catalyst cools to below the temperature needed to sustain significant catalytic activity ("light-off" temperature) within 20-30 minutes of vehicle shutoff, while the engine is still near its normal operating temperature. Data also indicated a significant delay in achieving light-off temperature upon restart, apparently due to the cool initial temperature of the engine-out exhaust. Because tailpipe emissions increase dramatically when the catalyst is below light-off temperatures, the relatively long delay in achieving light-off results in disproportionately high emission increases over intermediate soaks.

The current FTP provides no incentive for manufacturers to retard the rapid cooldown of the catalyst during intermediate soaks. In addition, testing found differences in engine-out emissions determined by the manufacturer's calibration strategy upon restart. Following intermediate-duration soaks, one vehicle had a lean calibration strategy which increased NOx emissions. Here again, the test results indicate that significant emissions may be occurring in-use because of a lack of incentive for manufacturers to optimize startup calibrations following intermediate soaks.

In general, strategies for reducing post-intermediate soak emissions are catalyst-based and either focus on the retarding of catalyst cooldown through insulation after the vehicle is shut off or the enhancement of catalyst light-off upon restart.

Of the potential approaches considered for control of

intermediate soaks, EPA is focusing on catalyst insulation as the primary control strategy. Use of insulation results in greater emission reductions over intermediate soaks than strategies which focus on improving catalyst light-off through conventional means and provides more cost-effective emission benefits than advanced cold start approaches. Although intermediate soak emissions will likely be reduced to some extent due to directional improvements in cold start performance, EPA believes that on Tier 1 vehicles intermediate soak emissions will continue to be relatively significant because the primary cause of intermediate soak emissions––rapid cooling of the catalyst––will remain unaddressed. Because insulation directly addresses catalyst cooldown, EPA anticipates that this approach will incur significant emission reductions over intermediate soaks on Tier 1 vehicles, including those which will incidentally reduce intermediate soak emissions through improved cold start performance.

C. Air Conditioner Operation

The Agency focused on the NOx impacts from A/C use because of the large observed increases. The increases in tailpipe NOx with the A/C operating seen in the ACR Test Program could clearly be linked to large increases observed in engine out NOx, which are probably caused primarily by higher combustion temperatures due to the additional load of the A/C system. Tailpipe NOx can be improved by increasing NOx conversion efficiency in the catalyst or decreasing engine out NOx. Control strategies include improving control of the A/F ratio, eliminating the lean-on-cruise calibration strategy, adjusting spark timing, adding or enhancing EGR systems strategic cycling of the A/C compressor, and improving catalysts to enhance NOx conversion efficiency.

The testing at ACR confirmed that HC and CO were also impacted by A/C operation. The Agency believes that these HC and CO increases are related to the increased load on the engine triggering additional periods of commanded enrichment when the A/C is on. The Agency believes that the control strategies for HC and CO discussed in "IX.A. Aggressive Driving Emissions" will eliminate HC and CO emissions increases due to A/C operation as well as during aggressive driving.

X. Options Considered and Information Needed

The following outlines the options which EPA has considered in developing today's proposal and issues on which more information is needed. As has been indicated, EPA and other stakeholders conducted extensive research and examined many options. While today's proposal selects the approach EPA felt would provide the most emission benefits feasible, in developing the final rule EPA will reconsider each of the options in terms

of new research and data submitted. The Agency welcomes comments and additional data on these and any other points. A full discussion of these issues and a detailed analysis of each option is found in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis.

A. Affecting Aggressive Driving Cycle

The Agency evaluated three basic options for establishing standards and vehicle testing aimed at controlling emissions from aggressive driving. Two options were based on emission performance standards with compliance measured using a test cycle, and one option was based on a performance standard using the A/F ratio with a related test procedure.

The Agency was guided by seven criteria in evaluating the options. First, EPA sought an option that would lead to control of emissions over the broad range of aggressive driving behavior found in the in-use driving survey data. Second, due to the non-linear nature of HC and CO emission increase during enrichment, a high priority was to ensure sufficient content from the highest-emission operating modes to prompt manufacturers to employ appropriate control strategies, including curtailing commanded enrichment. Third, the Agency sought consensus with CARB, to avoid duplicate or incompatible test requirements. Fourth, EPA sought to reasonably account for technical concerns raised by vehicle manufacturers, particularly manufacturer comment on the necessity of some commanded enrichment events to avoid elevated catalyst temperature levels from in-use operation leading to catalyst deterioration.[24] Fifth, EPA sought to pursue cost saving elements like reduction in test time where practical. Sixth, the Agency sought practical control of microtransient behavior, a candidate area of control that spans all driving. Finally, EPA favored strategies to control aggressive driving emissions that would also address the potentially significant (but unquantified) emissions from other engine load factors like road grade.

A full analysis of each option, how it was evaluated, how the level of emission control was determined, and the feasibility of the approach is in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and Technical Reports and comment on the analysis is welcome. Comment is specifically solicited on the following items:

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[24] The relationship between curtailing commanded enrichment and catalyst deterioration is addressed in the discussion of feasibility in the Technical Report.

◦ Comment is requested on the need to allow some commanded enrichment events during the USO6 Cycle to avoid elevated catalyst temperature levels from in-use operation leading to catalyst deterioration.

◦ The Agency is proposing that US06 HC and NMHC emissions be controlled to the same gram-per-mile emission levels currently achieved on the second bag of the FTP. US06 CO and NOx emissions are proposed to be controlled to overall FTP emission levels. These proposals are based upon the Agency's analyses of the potential control technology and their related costs and emission reductions, which are described in detail in the Technical Reports. Comments and additional data addressing these proposed levels of control are solicited. Additional information and data are also requested about the potential tradeoffs between NOx and CO control during aggressive driving, and on the impact such tradeoffs could have on the appropriate level of CO control.

◦ Although concern has been expressed that removal of commanded enrichment could impose a 2 percent to 10 percent power penalty, EPA believes power enrichment would not be precluded outright by this proposal, but rather curtailed only within the durations and speed-acceleration combinations found in the US06 cycle. Thus, the Agency has concluded on the basis of available data that compliance with the US06 standard should have a negligible effect on vehicle performance. Additional data on the effect on vehicle performance under this proposal is requested.

• The Agency has proposed adjustments to the US06 for all HLDTs and some LDVs and LDTs. These include a change in determing inertia weight for HLDTs, dynamic load adjustment for low-performance vehicles, and demonstration of stoichiometric control for wide-open throttle events for high-performance vehicles. Comments and data are solicited on the appropriateness of these adjustments and of the weight-to-power cutpoints. Of special concern is the possible unfair advantage the proposed high performance cut-off may provide to vehicles in the 18 - 21 W/P range.

• The Agency has proposed a W/P-based measure for the performance cutoffs after also considering the alternative performance criteria based on a vehicle's acceleration time from zero to 60 mph. The Agency rejected the zero to 60 time approach on the basis of practical problems related to establishing appropriate cutoff points and a standardized procedure for determining zero to 60 times. The Agency solicits comments on the proposed method for making vehicle performance adjustments, as well as input on alternatives, including the one discussed above.

B. Affecting Start Driving Cycle and Intermediate Soak

The compliance program approach evaluated for intermediate soaks and start driving was an emission performance standard applied to the results of testing over an emission control cycle

following a soak period of intermediate duration. As with control program approaches for aggressive driving emissions, EPA believes that an emission performance standard provides the most direct method of controlling the emissions arising during the particular type of vehicle operation. Given the particular causes of high emissions in this case, use of design standards or system performance standards would be particularly complex and restrictive of the manufacturers' options.

The Agency developed a new Start Control Cycle (SC01) to be used for controlling emissions following intermediate soaks. Initial idles and start driving are addressed in SC01 by incorporating the EPA Start Cycle (ST01) in its entirety. The balance of SC01 is composed of two microtrips of moderate driving, selected from the in-use survey database in order to bring the total distance of the new control cycle up to match the 3.6-mile distance of the 505 Cycle; the resulting cycle is 568 seconds long.[25] [26]

A full analysis of the approaches and issues considered, how each was evaluated, how the level of emission control was determined, and the feasibility of the proposed approach is in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and Technical Reports and comment on the analysis is welcome. Comment is specifically solicited on the following items:

◦ The Agency believes that manufacturers should be able to control emissions on the SC01 cycle following a soak of from 10- to 60-minutes to the same gram-per-mile emission levels currently achieved on the third bag of the FTP. Comment on the appropriateness of this level of standard and method for determining compliance is requested.

The severity of one SC01 acceleration was artificially modified to be less severe than in the original microtrip. This preserved the design objectives of matching the 505 trip distance and reflecting moderate, rather than aggressive driving. The representative level of microtransient behavior in the cycle was unaffected by this change.

Analysis of the two microtrips used to complete SC01 shows higher power levels than the comparable portion of the 505. The Agency plans to replace these microtrips with those which match power levels of the 505 more closely. The completed cycle, known as SC02, will replace SC01 and serve the same purpose.

◦ The Agency believes that internal catalyst insulation does not pose a temperature-based feasibility problem for underbody catalysts. [27]However, EPA had insufficient data to reach a firm view on this issue for the small number of Tier 1 vehicles which might need to insulate close-coupled catalysts. Thus, EPA solicits comments or data on the temperature-based feasibility of insulation for close-coupled catalysts.

◦ The Agency believes that application of catalyst insulation as a strategy for control of emissions following intermediate soaks is feasible. Data and comments are solicited on the feasibility of catalyst insulation and its impact on catalyst operation and durability.

◦ Comments are solicited on strategies to mitigate temperature increases in the catalyst brought about by insulation (such as moving the catalyst further downstream and subsequently conserving exhaust heat ahead of the catalyst to not impair cold start performance, or switching to more temperature-resistant noble metals like palladium), as well as spinoff effects of such strategies.

◦ The Agency believes it is necessary to move forward with an intermediate soak standard either if a significant proportion of vehicles are certified to Tier 1 standards for a significant time period following implementation or if it is cost effective and feasible to pursue control over intermediate soaks on vehicles certified to the lower standards. The Agency requests comment on the issues of cost-effectiveness and feasibility of an intermediate soak requirement on vehicles certified to lower emission standards.

◦ Criteria are being considered to permit manufacturers to forego the data submittal requirement for SC01 testing following a 60-minute soak on an engine family basis, allowing manufacturers to reduce the SFTP soak duration to 10 minutes. Under this option, manufacturers would be allowed to submit a technical justification demonstrating that an engine family would clearly pass the intermediate soak requirement. The Agency solicits comment on this option and potential criteria for granting such a waiver.

C. Affecting Air Conditioner Operation

The Agency analyzed several possible approaches to compliance testing designed to control emissions due to A/C operation. These options hinged on determination of two important

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Per vehicles with both under-body and close-coupled catalysts, EPA anticipates that only the underfloor catalyst would need to be insulated.

elements––the choice of a control cycle and the choice of a methodology for simulating A/C operation over that cycle. The Agency pursued a control program for A/C-on emissions that utilized an emission performance standard rather than other control options.

A full analysis of each option considered, how it was evaluated, how the level of emission control was determined, and the feasibility of the approach is in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and Technical Reports and comment on the analysis is welcome. Comment is specifically solicited on the following items:

◦ The control cycle for A/C-related emissions being proposed is the 866 plus SC01. While the Agency believes these are the best cycles for A/C control, comments are solicited on the possibility of substituting the 505 component of the LA4 for SC01. Comments are also solicited on whether full A/C simulation should be added to the US06 cycle.

◦ A cold start test is not included in today's proposal, but the Agency does believe that it may be appropriate to return to this issue with respect to future technologies and future test procedures and emission standards. The Agency specifically solicits comments on this issue.

◦ Independent from determining the appropriate control cycles for testing, the Agency evaluated three principle options for simulating A/C operation on a given test cycle.[28] The Agency requests comment on the potential applicability of each option and the various methods of implementing each option, whether any specific method should be retained as an option in the final rule to allow for its future development and use by petitioning for Agency approval. The "Nissan-II" approach is currently being evaluated by a consortium of auto manufacturers and the Agency expects to review and evaluate the data as soon as it becomes available. The Agency specifically requests comments and data that would allow a better evaluation of this approach and its viability, as well as suggested improvements that would alleviate the Agency's concerns, as detailed in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis.

◦ The Agency has estimated that vehicles can maintain existing NMHC and CO emission levels with the A/C turned on. For

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! discussed in more detail in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis and the Final Technical Report on Air Conditioning for the Federal Test Procedure Revisions Notiace of Proposed Rulemaking U. S. Environmental Protection Agency.

NOx, the Agency believes that 25 percent of the NOx increase with the A/C engaged is likely to be unavoidable without increasing the stringency of the current NOx standard, but is proposing to control the other 75 percent. The Agency requests comments on the feasibility of this proposed level of control and the technology implications of controlling to this level.

D. Affecting Whole Proposal

The Agency evaluated four different options to translate the proposed level of emission control for US06, intermediate soak, and A/C into compliance procedures and appropriate emission standards. The first option would set stand-alone standards for each control area. Compliance procedures and standards would be established individually for aggressive and microtransient driving behavior, A/C, and intermediate soaks. The second option would combine the three non-FTP areas of control into a single standard. The third option would establish a composite standard based on results drawn from both the SFTP and the FTP. While the basic concept is similar to the second option, the approach is specifically structured to directly implement the proposed level of control for each area using bag weights and to preserve the existing FTP compliance margins. The fourth option considered by EPA would replace the current FTP with an entirely new FTP that reflects, as accurately as possible, actual driving behavior.

A full analysis of each option, how it was evaluated, and the feasibility of each approach is in the Support Document to the Proposed Regulations for Revisions to the Federal Test Procedure: Detailed Discussion and Analysis. Comment on the analysis is welcome. Comments are specifically solicited on the following issues which relate to all cycles in the SFTP or changes to the FTP.

◦ Use of a composite non-FTP emission standard was chosen as the central approach chosen instead of using individual stand-alone standards, a single combined stand-alone standard, a replacement FTP, or some other option not considered. Stand-alone standards or a single combined stand-alone standard were not chosen primarily because of the lack of data to determine appropriate compliance margins and the difficulty in determining a single emission level given the disparity in emission levels from vehicle to vehicle. Replacing the current FTP at this time was not chosen primarily because revising the existing FTP would potentially impact the stringency of more stringent emission standards currently being considered for different parts of the country, such as the California LEV and ULEV standards, efforts by the Northeast states to adopt California requirements, and voluntary 49-state emissions standards ("FEDLEV"). Additional information and data are requested on the use of any of these approaches. Comments concerning stand-alone standards, or the simple average of the composite standards, should include

consideration of how to set appropriate standards for both intermediate and full useful life. [29]Durability procedures for new stand-alone standards should also be addressed.

◦ Because replacing the FTP would offer better assurances of in-use emission control and would simplify the test procedure, EPA believes it makes sense in the long term to consolidate all the test requirements into a revised FTP. However, to avoid jeopardizing work on more stringent emission standards and to avoid delaying implementation of today's proposal, EPA believes it is better to incorporate consolidation of the FTP with future consideration of tighter federal standards. Comments are solicited on when consolidation should occur.

◦ Under the non-FTP composite approach, the bag weights for each cycle are selected to mirror the proposed level of control determined using the in-use driving survey data. (A discussion of the proposed levl of control for each pollutant and how it was determined can be found in the Final Technical Report on Aggressive Driving Behavior for the Revised Federal Test Procedure Notice of Proposed Rulemaking). Comments are requested on the method used to select each weighting factor or the weighting given to each bag when determining compliance with the composite non-FTP emission standards.

◦ Emission standards are proposed to be set at current Tier 1 FTP levels, with an adjustment made for NOx, and are tied to future changes in the FTP standards. Comments on tying the non-FTP composite standards to FTP standards, the method used for determining the standards, the Nox adjustment provided, or the need for other adjustments are requested.

◦ The Agency considered separating LDVs and LDTs but determined driving behavior was similar between these classes. Some adjustments are provided in the proposal for specific vehicle types, transmission types, and performance rating. Comments on the method used for determining these adjustments, the need for other adjustments, or other related issues are welcome.

◦ Very little emission data currently exists on emission impacts using fuels other than gasoline during the SFTP. Because of this, EPA considered exempting alternative- and/or diesel-fueled vehicles from the SFTP requirements, but decided such vehicles would be able to comply. Information and data related to applying today's proposal to alternative- and diesel-fueled vehicles are welcome.

◦ The Agency is asking for comments on whether or not it

Tier 1 standards were set for two points in the useful life of a vehicle––50,000 miles (intermediate) and 100,000 miles (full).

would be appropriate to establish a single NMHC+NOx standard for stand-alone A/C or soak/start requirements or for the proposed composite standards. Comments are also solicited on both the potential emission impacts and cost implications of this proposed alternative.

◦ Comments are requested on the benefits and feasibility of the proposed phase-in schedule from MY1998 to 2001. The Agency is particularly interested in data and comments on how potential concerns with higher catalyst temperatures should influence lead time, as well as how these concerns should be balanced with the objective to obtain the emission benefits under this rulemaking as quickly as possible. If it appears that wholesale elimination of commanded enrichment with short lead time could introduce unanticipated problems with catalyst deterioration, EPA may elect to spread the implementation of the requirements over a longer period in the final rule. Another option might be to set an intermediate standard level for the initial phase-in. Comments are solicited on the relative benefits and costs of an intermediate standard compared to a phase-in directly to the final standards.

◦ Today's proposal provides two blanket, automatic substitutions from the SFTP to the FTP to reduce testing costs and time for manufacturers. No substitution of FTP bags into the SFTP calculation is allowed. Flexibility in preconditioning is also provided in the proposal. If stand-alone standards are promulgated, EPA is considering an exemption from the intermediate soak requirements. Comments on any of these aspects or related matters are requested.

◦ Today's proposal will improve the accuracy of the dynamometer simulation of actual on-road operation during vehicle testing. In addition, the change in dynamometers to improve accuracy also allows modifying the equivalent test weight requirements to remove the cap. Comments are solicited on these changes.

◦ Comments are specifically solicited on the need for additional lead time to implement the new road load requirements in terms of the dynamometer changes. If data and additional information submitted supports longer lead times, the Agency may elect to phase in the FTP under the same phase-in schedule used for the new SFTP requirements. Under this alternative, any engine family included in the SFTP phase-in would also use the improved road load simulations for FTP testing. To minimize the laboratory burden of maintaining two different sets of dynamometers, EPA would like to couple any phase-in of the new road load requirements with procedures allowing an electric dynamometer to simulate the existing dynamometer load. Comments addressing new road load lead time should also comment on how such a simulation could be incorporated.

◦ Changes to allow "appropriate" throttle action and new speed tolerance criteria are included in today's proposal. For

each test cycle, a range of acceptable speed variation is created using the DPWRSUM[30] variable. Each driving cycle has a unique value of DPWRSUM, which is compared to the DPWRSUM calculated from the driver's trace (what the vehicle actually drove) to determine a valid test. Comments are solicited on these aspects of today's proposal, specifically on the proper method for setting the lower DPWRSUM threshold for a valid test.

XI. Environmental and Economic Impacts

To estimate the emission reductions associated with the proposal, the expected lifetime emission reductions were determined per vehicle sold after implementation of the proposed regulations. Baseline emissions are taken from the extensive test programs conducted by the Agency and the original equipment manufacturers in support of the FTP Review Project, as discussed earlier. The weighted averages of the emission results of these test vehicles over the various new test procedures constitute the baseline emissions used in this analysis.

A. Emission Reductions

The emission reductions used in this analysis were calculated by subtracting the proposed level of control for each control area from the baseline test vehicle emissions. These test vehicle reductions were then weight averaged to simulate the reductions associated with the actual in-use vehicle fleet mix. It should be noted that the test results were derived for an average vehicle with a 50,000 mile catalyst and do not include any allowance for in-use compliance margins. Thus, the emission benefits calculated here are likely to be understated.

The average emission factor impacts per vehicle associated with the proposed regulations are shown in Table 4. The calculated results for A/C control listed in Table 4 include a factor to account for driving with the A/C "on" versus driving with it "off." A recent survey of actual A/C operation in Phoenix, AZ found that the compressor was engaged about 61 percent of the time during typical ozone exceedance days. Thus, the estimated g/mi reduction from A/C control was multiplied by 0.61 for inclusion in Table 4.

Table 4. -- Average Emission Factor Reduction Per Vehicle

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[30] DPWRSUM is the sum in the change in power, a statistic which is derived from the vehicle speed.

Control Area	NMHC (g/mi)	CO (g/mi)	NOx (g/mi)
High speed/accel:	0.055	2.39	0.062
Soak/Start	0.022	0.02	0.037
Air Conditioning:	0.000	0.00	0.91

These emission reduction numbers constitute the emission reductions associated with the proposed requirements in g/mi. These g/mi values were converted into the estimated lifetime emission reduction per vehicle using assumptions about average annual mileage accumulation rates, a discount rate of seven percent, and estimated survival rates. The results are listed in Table 5; a detailed discussion of the methodology can be found in the Regulatory Impact Analysis.

Table 5.-- Discounted Lifetime Emission Reductions Pounds Per Vehicle

Control Area	NMHC	CO	NOx
US06	10.1	441	11.4
Soak/Start	4.1	4	6.8
Air Conditioning	0.0	0	16.9
Total	14.2	445	35.1

The tons per summer day emission reductions in various years as a result of the proposed test procedure modifications were estimated using vehicle miles traveled (VMT) for different model year vehicles during each year of interest, the emission factor reductions shown in Table 4, and the proposed phase-in schedule. These calculations are show in Appendix B of the Regulatory Impact Analysis (RIA) and are summarized in Table 5. The percent reduction columns in Table 6 compare these estimated tons per summer day (tpsd) emission reductions to the baseline emissions for the light-duty fleet (cars and trucks). Calculations for these percentage reductions are shown in Appendix C of the RIA.

Table 6.--Fleet emission reductions in tons/summer day and percent of light-duty fleet						
	NMHC		CO		NOx	
	tpsd	%	tpsd	%	tpsd	%
2005	404	4	12655	11	1000	9
2010	577	6	18047	15	1427	12
2015	694	7	21717	17	1717	14
2020	765	8	23938	18	1892	14

B. Economic Impact

The proposed additions to emission test procedures will impose several costs on the original equipment manufacturers. These costs include added hardware for improved emission control and associated development and redesign costs, improved engine control calibrations, and increased costs associated with the certification process including durability data vehicle testing and reporting.

The cost estimates correspond to costs incurred by the manufacturer in complying with the proposed requirements. These costs can be divided into fixed and variable costs. Fixed costs are those costs made prior to vehicle production and are relatively independent of production volumes. The fixed costs considered in this analysis are those for engine control recalibration, vehicle redesign, mechanical integrity testing on redesigned engine families, certification durability demonstration, annual certification costs, and test facility upgrades and construction. Variable costs are costs for the necessary emission control hardware and are, by nature, directly dependent on production volume. Table 7 presents a summary of the cost estimates calculated by the Agency. Discussion of the assumptions and data included in these estimates can be found in the RIA.

Table 7.-- Regulatory Cost Estimates		
	Annual Cost ($ million)	Cost/Vehicle ($)
US06	16.8	1.12
Soak/Start	139.4-187.0	9.30-12.47

A/C	18.3	1.22
Totals	174.5-222.1	11.63-14.81

C. Cost-effectiveness

The cost-effectiveness estimate represents the expected cost per ton of pollutant reduced. The costs presented in Table 7 are not necessarily equally spread among the three pollutant emissions (NMHC, CO, and NOx). Since the requirements associated with A/C are targeted for NOx control, all costs associated with A/C have been allocated to NOx. For US06, the costs associated with each area have been allocated equally across each pollutant. As the CO reduction from soak/start is minimal, the costs associated with soak/start have been split equally between NMHC and NOx. Table 8 contains the per vehicle cost allocation to each pollutant within each control area.

Table 8.--Cost Allocation ($/vehicle)

	NMHC	CO	NOx	Total
US06 Costs	0.37	0.37	0.37	1.12
Soak/Start Costs	4.65-6.23	0.00	4.65-6.23	9.30-12.47
A/C Costs	0.00	0.00	1.22	1.22
Total	5.02-6.61	0.37	6.24-7.83	11.63-14.81

Dividing the costs shown in Table 8 by the lifetime emission reductions shown in Table 5, gives the cost-effectiveness estimates shown in Table 9.

Table 9.-- Cost-effectiveness Estimates ($/ton)

Control Area	NMHC	CO	NOx
US06	74	2	65
Soak/Start	2291-3072	NA	1362-1827
A/C	NA	NA	153
Total	707-930	2	355-445

D. Consumer Impacts

Two impacts on value to the consumer not included in the above estimates are potential savings associated with reduced fuel consumption and impact on the horsepower output of some vehicle engines. As previously discussed, EPA expects manufacturers to eliminate or greatly reduce the amount of commanded enrichment currently used in order to meet the NMHC and CO standards for the US06 control cycle. Due to the lower fuel consumption associated with stoichiometric air/fuel control as compared to commanded enrichment, this action will result both in a small improvement in fuel economy and a small loss in horsepower output. The Agency approximated the fuel economy benefit by determining how much extra fuel is used during commanded enrichment operating modes and the in-use incidence of these commanded enrichment operating modes. The result was an estimated 0.51 percent reduction in fuel consumption. Using this fuel consumption reduction and multiplying it by the miles driven in a given year, the appropriate survival rate and a seven percent discount factor, results in an estimated lifetime fuel economy savings of $16.56, based on a gasoline cost of $0.80 per gallon, excluding state and federal taxes.[31] A more detailed discussion of fuel economy cost savings can be found in the RIA for this rule.

Accompanying the lost horsepower output will be the potential for some consumers to consider such affected vehicles as having less value. The Agency does not believe that this lost value will be noticed by most consumers, as the horsepower loss is quite small, but acknowledges its potential effect nonetheless. Due to the difficult nature of trying to quantify a cost associated with reduced power output, or reduced 0 to 60 mph acceleration time, etc., the Agency has not been able to quantify the loss in consumer value. However, the Agency believes that this cost should be roughly negated by the associated savings in fuel expenses. Comments and data are solicited on ways to quantify the consumer value of the power loss.

The Agency does not anticipate that today's proposal will have any impact on Inspection/Maintenance programs.

XII. Public Participation

From Cost Projections, FFA, 1992, updated from DOE/EIA Monthly Energy Review, May 1994, and DOT/FHA. According to FHA, average sales-weighted state taxes for gasoline were 18.54¢ in June 1994. Federal tax is 18.4¢.

A. Comments and the Public Docket

The Agency welcomes comments on all aspects of this proposed rulemaking. All comments, with the exception of proprietary information, should be directed to the EPA Air Docket Section, Docket No. A-92-64 (see "ADDRESSES"). Commenters who wish to submit proprietary information for consideration should clearly separate such information from other comments by:

◦ labeling proprietary information "Confidential Business Information" and

◦ sending proprietary information directly to the contact person listed (see "FOR FURTHER INFORMATION CONTACT") and not to the public docket.

This will help ensure that proprietary information is not inadvertently placed in the docket. If a commenter wants EPA to use a submission labeled as confidential business information as part of the basis for the final rule, then a nonconfidential version of the document, which summarizes the key data or information, should be sent to the docket.

Information covered by a claim of confidentiality will be disclosed by EPA only to the extent allowed and by the procedures set forth in 40 CFR Part 2. If no claim of confidentiality accompanies the submission when it is received by EPA, the submission may be made available to the public without notifying the commenters.

B. Public Hearing

Anyone wishing to present testimony about this proposal at the public hearing (see "DATES") should, if possible, notify the contact person (see "FOR FURTHER INFORMATION CONTACT") at least seven days prior to the day of the hearing. The contact person should be given an estimate of the time required for the presentation of testimony and notification of any need for audio/visual equipment. A sign-up sheet will be available at the registration table the morning of the hearing for scheduling those who have not notified the contact earlier. This testimony will be scheduled on a first-come, first-served basis, and will follow the testimony that is arranged in advance.

The Agency recommends that approximately 50 copies of the statement or material to be presented be brought to the hearing for distribution to the audience. In addition, EPA would find it helpful to receive an advance copy of any statement or material to be presented at the hearing at least one week before the scheduled hearing date. This is to give EPA staff adequate time to review such material before the hearing. Such advance copies should be submitted to the contact person listed.

The official records of the hearing will be kept open for 30 days following the hearing to allow submissions of rebuttal and

supplementary testimony. All such submittals should be directed to the Air Docket, Docket No. A-92-64 (see "ADDRESSES").

The hearing will be conducted informally, and technical rules of evidence will not apply. Written transcripts of the hearing will be made and a copy thereof placed in the docket. Anyone desiring to purchase a copy of the transcript should make individual arrangements with the court reporter recording the proceeding.

XIII. Administrative Designation

Under Executive Order 12866 (58 FR 51735), the Agency must determine whether the regulatory action is "significant" and therefore subject to OMB review and the requirements of the Executive Order. The Order defines a "significant regulatory action" as one that is likely to result in a rule that may:

(1) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, it has been determined that this rule is a "significant regulatory action" because of annual impacts on the economy that are likely to exceed $100 million. As such, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

XIV. Regulatory Flexibility Act

The Regulatory Flexibility Act of 1990 requires federal agencies to identify potentially adverse impacts of federal regulations upon small entities. In instances where significant impacts are possible on a substantial number of these entities, agencies are required to perform a Regulatory Flexibility Analysis (RFA).

The Agency has determined that this action will not have a

significant impact on a substantial number of small entities. This regulation will affect only manufacturers of motor vehicles, a group which does not contain a substantial number of small entities.

Therefore, as required under section 605 of the Regulatory Flexibility Act, 5 U.S.C. 601 et. seq., I certify that this regulation does not have a significant impact on a substantial number of small entities.

XV. Reporting and Recordkeeping Requirement

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

The information collection burden associated with this rule (testing, record keeping and reporting requirements) is estimated to average 566 hours annually for a typical manufacturer. However, the hours spent annually on information collection activities by a given manufacturer depends upon manufacturer-specific variables, such as the number of engine families, production changes, emissions defects, and so forth. The burden estimate includes such things as reviewing instructions, searching existing data sources, setting up and maintaining equipment, performing emission testing, gathering and maintaining data, performing analyses, and reviewing and submitting information.

Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Chief, Information Policy Branch, EPA, 401 M St., SW (Mail Code 2136), Washington, DC 20460 and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503, and marked "Attention: Desk Officer for EPA." The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

List of Subjects in 40 CFR Part 86

Administrative practice and procedure, Air pollution control, Confidential business information, Environmental protection, Gasoline, Imports, Labelling, Motor vehicles, Motor vehicle pollution, Reporting and recordkeeping requirements.