***Cal*/EPA**

California Environmental Protection Agency

Air Resources Board

HAAGEN-SMIT LABORATORY
P.O. Box 8001
9528 Telstar Avenue
El Monte, CA
91734-8001

Pete Wilson
Governor

James M. Strock
Secretary for Environmental Protection

April 3, 1997 Mail-Out # MSC 97-07

TO: ALL PASSENGER CAR MANUFACTURERS
ALL LIGHT-DUTY TRUCK MANUFACTURERS
ALL MEDIUM-DUTY VEHICLE MANUFACTURERS
OTHER INTERESTED PARTIES

RE: Draft Regulatory Measure to Control Emissions During Non-Federal Test Procedure Driving Conditions From Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles Under 8,500 Pounds Gross Vehicle Weight Rating

The Air Resources Board (ARB) staff, in a cooperative effort with the United States Environmental Protection Agency (U.S. EPA), investigated the representiveness of the motor vehicle certification test procedure as compared to current conditions under which motor vehicles are used. Specifically, the Federal Test Procedure (FTP) was reviewed in the context of its representation of current driving behavior and air-conditioning (A/C) usage, and the associated exhaust emissions. It was found that a significant portion of current driving conditions were not included in the FTP.

This notice provides the background of the ARB regulatory development to control these non-FTP exhaust emissions and the staff's draft regulatory proposal. Due to the coordinated efforts with the U.S. EPA, staff is proposing identical new test procedure elements to the recently adopted federal requirements. While staff proposes the same federal emission standards for the new test procedures applicable to California-certified "Tier 1" vehicles and transitional-low-emission vehicles (TLEV), staff is proposing more stringent emission standards for low-emission vehicles (LEVs), ultra-low-emission vehicles (ULEVs), and super-ultra-low-emission vehicles (SULEVs).

BACKGROUND

To collect data on current driving behavior, driving surveys were conducted in four major metropolitan areas, including the Greater Los Angeles Metropolitan Area, during the Spring and Summer of 1992. The results of this study are published in the “Final Technical Report on Aggressive Driving Behavior for the Revised Federal Test Procedure Notice of Proposed Rulemaking” by U.S. EPA on January 31, 1995. One of the conclusions in the study was that driving representation in the FTP did not include 28 percent of current vehicle miles traveled and 13 percent of the current vehicle driving time. Most of this underrepresented driving occurred during high speed or high load type conditions. Consequently, the U.S. EPA and the ARB formed an Ad Hoc Committee with the members of the American Automobile Manufacturers Association (AAMA), the Association of International Automobile Manufacturers (AIAM), to investigate options for addressing revisions to the FTP.

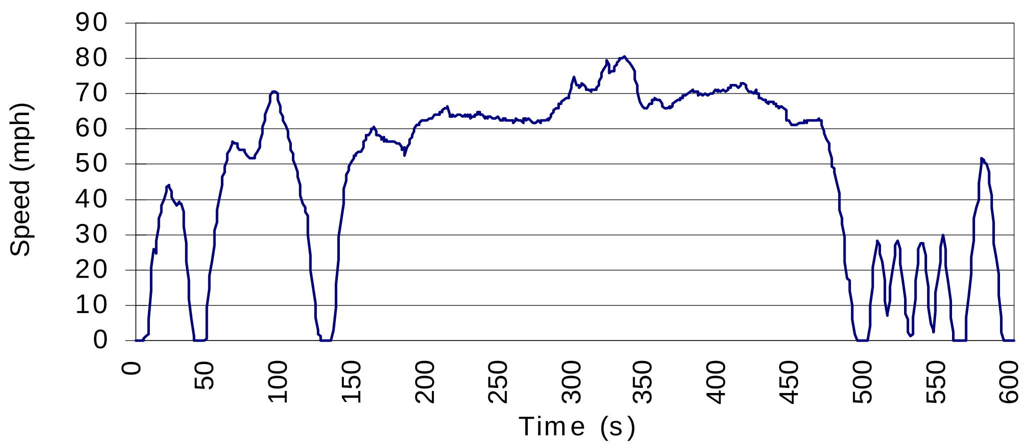
Data were also generated to determine the emission impact of A/C usage through various test programs. Current FTP representation of the A/C usage is simulated by increasing the dynamometer road-load horsepower by 10 percent. The test programs to evaluate the A/C effect are described in the U.S. EPA “Final Technical Report on Air Conditioning for the Federal Test Procedure Revisions Notice of Proposed Rulemaking,” published January 31, 1995. As documented in the report, a U.S. EPA test program compared the FTP emission increase between 1) A/C off with the 10 percent increase in dynamometer load and 2) A/C operating without the 10 percent increase in dynamometer load. The results indicated that the 10 percent increase in dynamometer load underrepresents the actual A/C load on the engine. To determine the emission levels attributable to A/C usage on a hot summer day, a motor vehicle industry test program, using an environmental test cell, showed significant emission increases associated with turning the A/C on. Most significant were the oxides of nitrogen (NOx) emissions, which increased, on average, by 92 percent when the A/C was turned on during the FTP test. The data from the test programs show that A/C emissions are substantial and underpresented by the current FTP.

FEDERAL RULEMAKING

On October 22, 1996, the U.S. EPA promulgated final regulations[1] for the adoption of standards and test procedures to address aggressive driving, rapid speed fluctuations, driving behavior following startup, and air conditioning usage. These new regulations are applicable to federally-certified “Tier 1" passenger cars, light light-duty trucks (0 - 5750 pounds loaded vehicle weight), and heavy light-duty trucks (over 3751 pounds adjusted loaded vehicle weight)[2]. These standards are phased-in beginning in the 2000 model year. The primary element of the federal rulemaking was the adoption of a Supplemental Federal Test Procedure (SFTP), which included an aggressive new driving test and an A/C test. The aggressive driving test is based on a new US06 driving schedule (shown in Figure 1). This high speed and high acceleration test cycle was derived from driving surveys conducted in 1992.

The new federal A/C test will be used to control exhaust emissions associated with real-world vehicle A/C usage. The A/C test is based on a new hot-start driving

Figure 1. US06 Driving Schedule



cycle, the SC03 which is shown in Figure 2. The vehicle would be tested in a full environmental chamber with the A/C on. The full environmental chamber would simulate the ambient conditions the vehicle would experience on a hot summer day.

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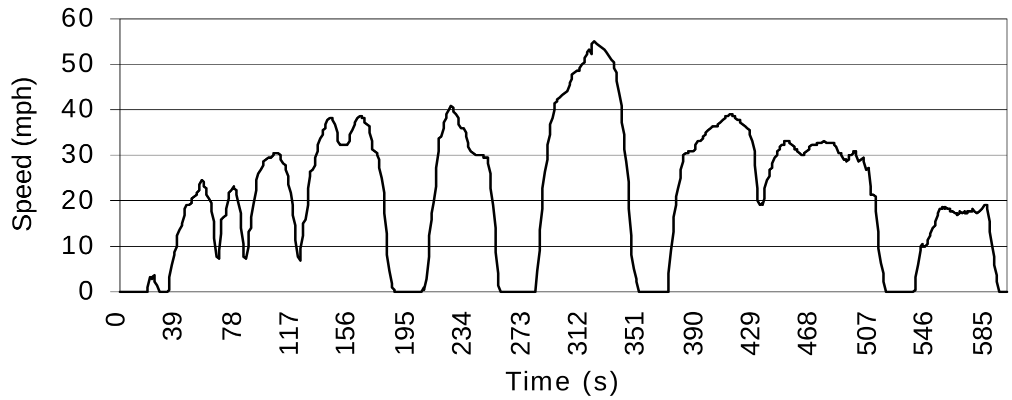
[1] Vol. 61 F.R. 54851 (October 22, 1996).

[2] The federal heavy light-duty truck category is the same as the California medium-duty vehicle category under 8500 pounds gross vehicle weight rating.

Figure 2. SC03 Driving Schedule



Composite non-methane hydrocarbon (NMHC) plus oxides of nitrogen (NOx) emission standards were developed for compliance with the SFTP tests rather than the traditional stand-alone NMHC and NOx standards. The standards adopted for NMHC plus NOx emissions, as well as for CO emissions, were based on useful life.

Also adopted as part of the SFTP regulations are provisions to use a 48-inch single-roll dynamometer with electronic control of power absorption. Dynamometer improvements are needed due to the higher power absorption requirements of the US06 cycle. The large rolls and electronic inertia simulation in these new dynamometers provide a more realistic representation of actual road load forces compared to the current dynamometer systems which use small 8-inch rolls, mechanical inertia simulation, and hydrokinetic power absorption. The federal requirements for the use of the 48-inch single-roll dynamometer are applicable to vehicles subjected to the SFTP requirements. For these vehicles, both FTP and SFTP testing would be conducted with the improved dynamometer system.

TEST PROGRAMS

Several test programs were conducted by the ARB and jointly by AAMA and AIAM, to investigate the SFTP emission levels of current production and future vehicles. The SFTP tests are described in detail under “Description of the Staff Proposal.” The data from the test programs were used to determine a single set of SFTP emission standards for LEVs, ULEVs, and SULEVs. In the ARB test programs, over thirty production vehicles were tested. AAMA and AIAM supported the standard-setting process by providing SFTP data on over twenty LEV-prototypes. These data provided insight into the SFTP emission characteristics of future vehicles.

Since the beginning of these test programs in 1996, ARB staff and motor vehicle industry representatives have met on a regular basis to discuss the test programs and the generated data. During the execution of the ARB test program, manufacturers provided input on test vehicle information, US06 and A/C testing concerns, and other related issues. Analysis of the test data was conducted by all parties, affording numerous discussions of test data interpretation in the context of the ARB SFTP standard-setting.

ARB Test Programs

ARB conducted two test programs using rental vehicles. Although the composite FTP emissions of the majority of the test vehicles are higher than those expected for a typical LEV, the warmed-up FTP emissions (Bags 2 and 3), which are better indicators of whether the vehicle would perform LEV-like on the SFTP conditions, were LEV-like on most of the test vehicles. Based on the warmed-up FTP emissions, 80 percent of the test vehicles in the US06 test program were considered LEV-like while 60 percent of the vehicles were LEV-like in the A/C test program.

To reduce SFTP emissions, an emission control technique known as “rich-bias” calibration was used. “Rich-bias” calibration refers to modifying the engine calibration for specific speed and load points such that the engine is operating with slightly more fuel than is needed for stoichiometric combustion. The “rich-bias” allows for better NOx catalytic conversion efficiency compared to stoichiometric conditions. Various “rich-bias” set points were tested until an optimal set point was found which exhibited the lowest US06 or A/C NMHC plus NOx emissions. During A/C testing on several vehicles, stable NMHC plus NOx emissions were not obtainable using the “rich-bias” calibration due to On-Board Diagnostics II interference. These vehicles were not included in the standard-setting process and will not be discussed in this document.

In 1996, the ARB tested eleven passenger cars, one light-duty truck, and six medium-duty vehicles to determine their low-mileage US06 emission levels. (See Appendix A.) The average uncontrolled and NMHC plus NOx emissions are shown in Table 1. The optimized emission levels using the “rich-bias” calibration are also shown in Table 1. The optimized passenger car NMHC plus NOx emissions averaged 0.095 g/mi compared to the average baseline of 0.255 g/mi, a reduction of 63 percent. Similar trends were observed on the light-duty trucks and the medium-duty vehicles.

From late-1996 to the beginning of 1997, staff quantified the emissions from A/C usage on LEV-like vehicles. A second test program was conducted on eight passenger cars, and eight light-duty trucks and medium-duty vehicles. (See Appendix B.) An A/C simulation was used to mimic vehicle exhaust emissions during A/C usage on a hot summer day. Although this simulation does not consistently correlate well with the full environmental chamber, it is generally believed that simulation averages approximately 80 to 85 percent of the full environmental A/C-on emissions. The light-duty truck and medium-duty vehicle portion of the test program was conducted in an expedited manner; consequently, duplicate tests at the optimal setting were not performed. In addition, optimal emission results of several vehicles were not possible. (See Appendix B, Table 3.) As shown in Table 1, the average baseline passenger car A/C-on NMHC plus NOx emissions on the SC03 cycle were 0.360 g/mi. Using the “rich-bias” strategy, the passenger car NMHC plus NOx emissions averaged 0.131 g/mi, a 64 percent reduction. Modest NMHC plus NOx reductions were observed on the light-duty trucks and medium-duty vehicles.

Manufacturer Test Programs

Manufacturers provided low-mileage SFTP data on LEV-prototype light-duty trucks and medium-duty vehicles. US06 data were generated on five medium-duty vehicles from 3751-5750 pounds test weight and four medium-duty vehicles from 5751-8500 pounds test weight. The A/C test was also conducted on four light-duty truck, three medium-duty vehicles from 3751-5750 pounds test weight and one medium-duty vehicle from 5751-8500 pounds test weight. The NMHC plus NOx emission results are shown in Table 2 below.

In general, the manufacturer LEV-prototypes emitted higher SFTP NMHC plus NOx emission levels than the optimized emissions of the ARB test vehicles. This was due to several reasons. First, different levels of emission optimizations were performed on the

Table 1. ARB Test Programs: Comparison of US06 and A/C Average Baseline and Optimized NMHC plus NOx Emissions (g/mi)

		US06		A/C	
Vehicle Class	Weight (lbs.)	Baseline	Optimized	Baseline	Optimized
PC	All	0.255	0.095	0.360	0.131
LDT	3,751-5,750 LVW[A]	0.418	0.156	0.277	0.166
MDV	3,751-5,750 TW[B]	0.326	0.155	0.091	0.091
MDV	5,751-8,500 TW	0.558	0.267	0.420	0.313

[A] "LVW" is loaded vehicle weight, which is the vehicle's curb weight plus 300 pounds.
[B] "TW" is test weight, which is the average of the vehicle's curb weight and the gross vehicle weight.

Table 2. Manufacturer Test Programs. US06 and A/C NMHC plus NOx Emissions (g/mi)

Vehicle Class	Weight (lbs.)	US06	A/C
LDT	3,751-5,750 LVW[A]	-	0.273
MDV	3,751-5,750 TW[B]	0.382	0.380
MDV	5,751-8,500 TW	0.623	0.301

[A] "LVW" is loaded vehicle weight, which is the vehicle's curb weight plus 300 pounds.
[B] "TW" is test weight, which is the average of the vehicle's curb weight and the gross vehicle weight.

manufacturer vehicles. Some of the test vehicles were not optimized in terms of the SFTP conditions while others had various degrees of emission optimization. Secondly, some of the vehicles in the US06 test program were tested at a higher inertial weights than required for the US06 test, and thus overstated emissions. Finally, two of the test vehicles were tested at significantly higher mileage than the other test vehicles.

DESCRIPTION OF THE STAFF PROPOSAL

Staff proposes the adoption of the new SFTP which consists of an aggressive driving test procedure and the A/C simulation test procedure for California-certified vehicles. See Appendix C to E for the regulatory text of staff's proposal. Staff is proposing identical US06 and A/C test procedure requirements as adopted by the U.S. EPA.

For LEVs, ULEVs, and SULEVs, staff proposes a single set of SFTP NMHC plus NOx emission standards at 4,000 miles. Due to uncertainties associated with SFTP emissions deterioration at high mileage on LEV-like vehicles, staff is not proposing SFTP useful life standards at this time. Although SFTP emissions may be more sensitive to deterioration of emission control components than the FTP emissions, the LEV FTP exhaust deterioration will be a good indicator of SFTP emission deterioration. Since manufacturers are liable for their vehicles to comply with FTP useful life emission standards, staff expects that SFTP emission deterioration will be indirectly controlled. In addition, with On-Board Diagnostics II monitoring of the exhaust components and emissions, a low mileage standard for US06 and A/C emissions will be protective of SFTP emission benefits. Staff recommends revisiting the regulations, if necessary, in the future when in-use vehicles certified to these standards and test procedures are available for testing and evaluation.

US06 Test Procedure

The US06 exhaust test, using the driving schedule shown in Figure 1, is conducted as a *hot-stabilized* test, such that the vehicle is running fully warmed-up with the critical emission control components (e.g., the catalytic converter and the oxygen sensor(s)) at typical operating temperatures. Since the test does not include start-up emissions, the engine is not turned off between the preconditioning drive and the exhaust test. Several vehicle preconditioning options are allowed in order for the vehicle to reach the hot stabilized condition. Immediately following the preconditioning drive, the official US06 exhaust test is conducted.

Adjustments to the US06 test cycle are allowed for those vehicles for which some of the US06 accelerations may be too severe. One such adjustment is for low-powered vehicles. Five windows, varying from 14 to 30 seconds, have been identified where adjustments can be allowed. If the vehicle is at wide-open throttle for at least eight seconds within each window, a dynamic load dynamometer adjustment is applied to decrease its dynamometer load such that the vehicle is operating at less than wide-open throttle. Once the window ends, the dynamic load adjustment can not be applied. A second adjustment is for medium-duty vehicles. From the driving surveys, it was determined that, on average, these vehicles tend to be driven at lower speeds, and less aggressively at higher speeds than passenger cars.[3] Thus, a lower US06 dynamometer inertia test weight than the FTP is allowed; the US06 inertia weight will be based on the curb weight plus 300 pounds. (For FTP testing, the dynamometer inertia weight is determined by the test weight, the average of the curb weight and the gross vehicle weight.) For FTP testing, the use of the test weight to determine the dynamometer inertia weight is unchanged.

Consistent with the federal SFTP requirement, a minimum air-fuel ratio calibration is required to prevent excessive CO emissions during commanded fuel enrichment. This requirement specifies that the air-fuel ratio may not, at any time, be richer than the leanest air-fuel mixture required to obtain maximum engine torque (termed "lean best torque"), with a tolerance of six percent of the lean best torque fuel consumption. If additional enrichment beyond lean best torque is required for engine or emission control hardware protection, the manufacturer may submit a request for ARB approval.

A/C Test Procedure

The A/C exhaust test is conducted as a *hot-start* test using the new SC03 cycle (shown in Figure 2), such that the vehicle is fully warmed up with the critical emission control components (e.g., the catalytic converter and the oxygen sensor(s)) at typical operating temperatures. The test is conducted in a full environmental chamber with the A/C turned on. The full environmental chamber simulates the ambient conditions of a hot summer day. The facility ambient specifications include a high ambient temperature (95°F), solar heat load (850 watts per square meter), humidity (100 grains of water per pound of dry air), and wind effects (proportional-speed cooling fan requirements).

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[3] U.S. EPA. Final Technical Report on Aggressive Driving Behavior for the Revised Federal Test Procedure Notice of Proposed Rulemaking. January 31, 1995.

As an alternative, an A/C simulation in the standard test cell can be used if it is demonstrated to correlate with the full environmental chamber. To account for variability, the minimum criteria are that the vehicle’s A/C-on emissions using the simulation must be at least 85 percent of the NOx emissions and 95 percent of the fuel economy associated with the full environmental chamber. To obtain approval to use an alternative procedure, the manufacturer must submit a description of the simulation; additional required instrumentation, if any; data demonstrating the correlation between the simulation and the full environmental chamber; and any vehicle-specific parameters.

The Executive Officer would have the authority to conduct testing either before or after certification to confirm that the simulation correlates with the full environmental chamber. During testing, if the selected vehicles fail the correlation criteria, the manufacturer can provide additional data to demonstrate that the simulation correlates to the full environmental chamber. If this can not be demonstrated, the manufacturer must submit an engineering evaluation of the cause of the improper simulation and the extent of the vehicles affected. The manufacturer will be given an opportunity to correct the failed simulation. Otherwise, no further A/C testing using the simulation will be accepted. While there is no penalty for failing the correlation demonstration, enforcement testing may be conducted with either the full environmental chamber or the corrected simulation.

In the first three years of the SFTP phase-in (2001 to 2003 MY), manufacturers may use two A/C simulations in a standard test cell without full environmental chamber correlation approval. Although these simulations have been shown to correlate with the full environmental chamber on some vehicles, the simulations have not consistently met the correlation criteria specified above. By allowing the use of these simulations, additional time is provided for manufacturers to develop an adequate simulation which correlates with the full environmental chamber. Beginning in the 2004 MY, only simulations which have been adequately proven to correlate with the full environmental chamber will be allowed.

US06 and A/C Standards

Staff proposes the standards shown in Table 3 applicable to gasoline, diesel, alternative fuel, and hybrid electric passenger cars, light-duty trucks, and medium-duty vehicles under 8,501 pounds gross vehicle weight rating (GVWR), certified to the LEV, ULEV, and

SULEV FTP exhaust emission standards. These proposed SFTP standards are applicable at 4,000 miles. The standards were developed based on the results of the ARB and the motor vehicle industry test programs described above. Staff evaluated the test data in the context of whether the vehicle was LEV-like and made appropriate adjustments to the compliance margin factor. (The compliance margin factor allows for a headroom between the vehicle emission levels and the emission standards to account for various sources of emission variability.)

For Tier 1 vehicles and TLEVs, staff proposes the federal gasoline SFTP emission standards for California-certified gasoline, diesel, and alternative fuel vehicles. The U.S. EPA allows higher SFTP emission standards for diesel passenger cars and light-duty trucks, and exempts the heavier diesel vehicles and alternative fuel vehicles. Given the ARB’s historical fuel-neutral policy, staff proposes applying the same standard to vehicles certified on all fuels. These standards are applicable for the useful life, as defined by U.S. EPA.

Table 3. US06 and A/C 4,000 Mile Standards for LEVs, ULEVs, and SULEVs

Vehicle Type	Weight (lbs.)	US06 (gram/mile)		A/C (gram/mile)	
		NMHC+NOx	CO	NMHC+NOx	CO
PC	All	0.14	8.0	0.20	2.7
LDT	0-3,750 LVW[A]	0.14	8.0	0.20	2.7
	3,751-5,750 LVW[A]	0.25	10.5	0.27	3.5
MDV	3,751-5,750 TW[B]	0.40	10.5	0.31	3.5
	5,751-8,500 TW[C]	0.60	11.8	0.44	4.0

[A] "LVW" is loaded vehicle weight, which is the vehicle's curb weight plus 300 pounds.
[B] "TW" is test weight, which is the average of the vehicle's curb weight and the gross vehicle weight.
[C] Applicable to medium-duty vehicles under 8,500 pounds gross vehicle weight rating

Implementation Schedule

Table 4 is the proposed implementation schedule applicable to gasoline, diesel, alternative fuel, and hybrid electric passenger cars, light-duty trucks, and medium-duty vehicles under 8,501 pounds GVWR, certified to the LEV, ULEV, and SULEV FTP exhaust emission standards. For each manufacturer, compliance with the model-year phase-in percentages is based on the total number of vehicles produced and delivered for sale in California in the specific vehicle category during the specific model year. Small volume manufacturers need not comply with the SFTP requirement until the final year of the phase-in schedule.

For vehicles certified to Tier 1 and TLEV FTP exhaust emission standards, staff proposes the same phase-in schedule as the federal SFTP phase-in schedule. As with the federal program, small volume manufacturers would have to comply with the SFTP requirements in the final year of the phase-in schedule.

Table 4. SFTP Phase-In Schedule for LEVs, ULEVs, and SULEVs

Model Year	PC, LDT (0-3750 lbs. LVW)	LDT (3751-5750 lbs. LVW)	MDV (under 8501 lbs. GVWR)
2001	25	25	-
2002	50	50	-
2003	85	85	25
2004	100	100	50
2005 and subsequent	100	100	100

Single-Roll Dynamometer Requirement

Staff proposes the phase-in of the improved dynamometer requirements according to the California SFTP schedule. (See Table 4.)

In-Use Liability

Staff proposes the new vehicle audit requirements be applied to confirm compliance with the US06 and the A/C emissions beginning in the 2002 MY. Under Section 2101, Title 13, California Code of Regulations, the Executive Officer has the authority to randomly select a reasonable number of vehicles representing any California vehicle engine family to inspect and compliance test. These vehicles are to be made available from the manufacturer and delivered to the ARB's Haagen-Smit Laboratory in El Monte. The vehicle test results will be used to determine compliance with the proposed standards and test procedures.

During the first six months of the first-year implementation of the proposed standards and test procedures, staff proposes to allow manufacturers to submit data generated on new 2001 MY production vehicles certified to the proposed standards and test procedures. These data will be used to determine the accuracy of testing new vehicles at essentially zero mileage to determine compliance with the proposed 4,000 mile standards. The data would be reviewed jointly by manufacturers and ARB staff, and problems associated with the testing identified and resolved.

Staff is not proposing an assembly-line component to the compliance requirements of the proposed regulations. In addition, a useful life requirement is not proposed. However, if indications of significant deterioration of US06 or A/C emissions are found, staff anticipates revisiting the useful life standards and in-use compliance liability.

COMMENTS

Interested parties are encouraged to provide comments on the proposed standards and test procedures. Staff is requesting that written comments be received no later than May 6, 1997. Written comments should be addressed to:

Air Resources Board
Attn: Mr. Michael Carter, Chief
Emission Research and Off-Road Controls Branch
9528 Telstar Avenue
El Monte, CA 91731-2990

Staff anticipates proposing the SFTP rulemaking to the Board at the July 24, 1997 hearing. If you have any questions or comments regarding this item, please contact Ms. Susan Kwan, Air Resources Engineer, Emission Research Section, at (818) 575-6621.

Sincerely,

Robert H. Cross, Chief
Mobile Source Control Division

Appendix A

US06 Test Program

Table 1. Test Vehicle Description

Test Vehicle	**Model Year**	**Engine Displacement (L)**	**Inertia Test Weight (lbs)**	**Mileage (Miles)**
Passenger Cars				
Dodge Intrepid	1996	3.5	3,750	4,500
Honda Accord	1995	2.2	3,250	7,600
Honda Civic (LEV)	1996	1.6	2,750	4,200
Honda Civic (TLEV)	1994	1.5	2,625	3,500
Mazda 626	1995	2.5	3,250	10,600
Mazda 929	1995	3.0	3,750	18,800
Mercury Grand Marquis	1995	4.6	4,000	5,800
Nissan Maxima	1996	3.0	3,500	4,100
Nissan Sentra	1996	1.6	2,750	8,800
Plymouth Neon	1995	2.0	2,750	20,800
Pontiac Grand Am	1995	2.3	3,250	19,400
LDT (3751-5750 pounds loaded vehicle weight)				
Chevrolet Astrovan	1996	4.3	4,750	22,400
MDV (3571-5750 pounds test weight)				
Chevrolet 1500 P/U	1997	5.0	4,750	5,100
Ford F150 P/U	1996	4.9	5,250	15,900
MDV (5751-8500 pounds test weight)				
Chevrolet Suburban	1996	5.7	6,500	23,200
Dodge Ram Van	1996	5.9	6,000	28,000
Ford E-250 Van	1996	5.8	6,500	7,800
Ford E-350 Van	1996	7.5	8,000	16,300

Table 2. Baseline US06 Emissions (g/mi)

Test Vehicle	**NMHC**	**CO**	**NOx**	**NMHC+NOx**
Passenger Cars				
Dodge Intrepid	0.009	0.073	0.092	0.101
Honda Accord	0.009	1.018	0.033	0.042
Honda Civic (LEV)	0.042	14.778	0.022	0.064
Honda Civic (TLEV)*	0.083	1.964	0.065	0.148
Mazda 626	0.022	3.251	0.036	0.058
Mazda 929	0.040	3.120	0.859	0.899
Mercury Grand Marquis*	0.005	0.489	0.113	0.118
Nissan Maxima	0.057	3.744	0.490	0.547
Nissan Sentra	0.029	6.586	0.536	0.565
Plymouth Neon*	0.006	0.392	0.195	0.201
Pontiac Grand Am	0.042	4.650	0.025	0.067
Average	**0.031**	**3.64**	**0.22**	**0.255**
LDT (3751-5750 pounds loaded vehicle weight)				
Chevrolet Astrovan	0.029	1.257	0.389	0.418
MDV (3571-5750 pounds test weight)				
Chevrolet 1500 P/U	0.011	0.177	0.553	0.564
Ford F150 P/U	0.04	12.54	0.048	0.088
Average	**0.026**	**6.359**	**0.301**	**0.326**
MDV (5751-8500 pounds test weight)				
Chevrolet Suburban	0.085	6.65	0.388	0.473
Dodge Ram Van	0.036	4.98	0.604	0.64
Ford E-250 Van	0.027	5.46	0.947	0.974
Ford E-350 Van	0.081	13.63	0.064	0.145
Average	**0.057**	**7.680**	**0.501**	**0.558**

* Tested with stoichiometric calibration

Table 3. Optimized "Rich-Bias" US06 Emissions (g/mi)

Test Vehicle	**NMHC**	**CO**	**NOx**	**NMHC+NOx**
Passenger Cars				
Dodge Intrepid	0.008	0.044	0.050	0.058
Honda Accord	0.009	1.018	0.033	0.042
Honda Civic (LEV)	0.042	14.778	0.022	0.064
Honda Civic (TLEV)*	0.083	1.964	0.065	0.148
Mazda 626	0.022	3.251	0.036	0.058
Mazda 929	0.033	3.126	0.118	0.151
Mercury Grand Marquis*	0.015	1.467	0.039	0.054
Nissan Maxima	0.053	1.995	0.090	0.143
Nissan Sentra	0.024	5.065	0.163	0.187
Plymouth Neon*	0.007	1.167	0.070	0.077
Pontiac Grand Am	0.042	4.650	0.025	0.067
Average	**0.031**	**3.502**	**0.065**	**0.095**
LDT (3751-5750 pounds loaded vehicle weight)				
Chevrolet Astrovan	0.091	3.72	0.065	0.156
MDV (3571-5750 pounds test weight)				
Chevrolet 1500 P/U	0.014	0.387	0.208	0.222
Ford F150 P/U	0.04	12.54	0.048	0.088
Average	**0.027**	**6.464**	**0.128**	**0.155**
MDV (5751-8500 pounds test weight)				
Chevrolet Suburban	0.105	7.23	0.200	0.305
Dodge Ram Van	0.058	7.66	0.349	0.407
Ford E-250 Van	0.009	2.73	0.201	0.21
Ford E-350 Van	0.081	13.63	0.064	0.145
Average	**0.063**	**7.813**	**0.204**	**0.267**

* Tested with stoichiometric calibration

Appendix B

A/C Test Program

Table 1. Test Vehicle Description

Test Vehicle	Model Year	Engine Displacement (L)	Inertial Test Weight (lbs)	Mileage (Miles)
Passenger Cars				
Dodge Intrepid	1996	3.5	3,750	4,900
Ford Taurus FFV	1996	4.0	3,750	6,400
Honda Accord	1996	2.2	3,250	3,300
Honda Civic (LEV)	1996	1.6	2,750	4,300
Mazda (Prototype)*	-	-	-	-
Plymouth Neon	1996	2.0	2,875	7,300
Pontiac Bonneville	1996	3.8	3,750	16,300
Pontiac Grand AM	1996	2.4	3,250	10,200
LDT (3751-5750 pounds loaded vehicle weight)				
Chevrolet Astrovan	1996	4.3	4,750	20,900
Chevrolet Blazer	1997	4.3	4,500	4,500
Ford Aerostar	1997	3.0	4,000	3,800
Ford Explorer	1996	4.0	4,750	10,900
MDV (3571-5750 pounds test weight)				
Ford F-150 P/U	1996	4.9	5,250	17,300
MDV (5751-8500 pounds test weight)				
Chevrolet Suburban	1996	5.7	6,500	23,700
Ford E-250 Van	1996	5.8	6,500	8,200
Ford E-350 Van	1996	7.5	8,000	16,400

* Confidential information

Table 2. Baseline SC03 A/C-On Emissions (g/mi)

Test Vehicle	**NMHC**	**CO**	**NOx**	**NMHC+NOx**
Passenger Cars				
Dodge Intrepid	0.052	1.180	0.222	0.274
Ford Taurus FFV	0.015	1.380	0.066	0.081
Honda Accord	0.008	0.240	0.162	0.170
Honda Civic (LEV)	0.021	1.440	0.082	0.103
Mazda (Prototype)	0.004	0.170	0.533	0.537
Plymouth Neon	0.007	1.980	0.303	0.310
Pontiac Bonneville	0.002	0.230	0.614	0.616
Pontiac Grand AM	0.014	1.350	0.776	0.790
Average	**0.015**	**0.996**	**0.345**	**0.360**
LDT (3751-5750 pounds loaded vehicle weight)				
Chevrolet Astrovan	0.030	0.851	0.270	0.300
Chevrolet Blazer	0.048	0.447	0.129	0.177
Ford Aerostar*	0.006	0.066	0.427	0.433
Ford Explorer	0.009	0.490	0.190	0.199
Average	**0.023**	**0.464**	**0.254**	**0.277**
MDV (3571-5750 pounds test weight)				
Ford F-150 P/U	0.024	0.460	0.067	0.091
MDV (5751-8500 pounds test weight)				
Chevrolet Suburban	0.087	1.500	0.460	0.547
Ford E-250 Van	0.007	0.196	0.660	0.667
Ford E-350 Van	0.039	3.040	0.008	0.047
Average	**0.044**	**1.579**	**0.376**	**0.420**

* The A/C system was somewhat underloaded using the AC2 simulation method, as the “Defrost” setting was necessary to return hot air to the air-conditioning system.

Table 3. Optimized SC03 A/C-On Emissions (g/mi)

Test Vehicle	NMHC	CO	NOx	NMHC+NOx
Passenger Cars				
Dodge Intrepid	0.063	1.600	0.096	0.159
Ford Taurus FFV	0.015	1.380	0.066	0.081
Honda Accord	0.007	0.290	0.117	0.124
Honda Civic (LEV)	0.021	1.440	0.082	0.103
Mazda (Prototype)	0.002	0.095	0.061	0.063
Plymouth Neon	0.010	2.390	0.183	0.193
Pontiac Bonneville	0.032	1.540	0.137	0.169
Pontiac Grand AM	0.040	1.760	0.116	0.156
Average	**0.024**	**1.312**	**0.107**	**0.131**
LDT (3751-5750 pounds loaded vehicle weight)*				
Chevrolet Astrovan	0.170	3.710	0.050	0.220
Chevrolet Blazer	0.045	0.491	0.106	0.151
Ford Aerostar**	0.013	0.271	0.133	0.146
Ford Explorer	0.030	1.510	0.117	0.147
Average	**0.065**	**1.496**	**0.10**	**0.166**
MDV (3571-5750 pounds test weight)*				
Ford F-150 P/U	0.024	0.460	0.067	0.091
MDV (5751-8500 pounds test weight)*				
Chevrolet Suburban	0.087	1.500	0.460	0.547
Ford E-250 Van	0.016	0.650	0.329	0.345
Ford E-350 Van	0.039	3.040	0.008	0.047
Average	**0.047**	**1.730**	**0.27**	**0.313**

* The LDT and MDV portion of the test program was conducted in an expedited manner, and duplicate tests at the optimal setting were not performed.

** The A/C system was somewhat underloaded using the AC2 simulation method, as the “Defrost” setting was necessary to return hot air to the air-conditioning system.