Environmental and Economic Impact
Statement

Revised Evaporative Emission
Regulations for 1981
and Later Model Year Gasoline-
Fueled Light-Duty Vehicles and Trucks

Environmental Protection Agency
Office of Air and Waste Management
Mobile Source Air Pollution Control

Approved By

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Date: 7 AUG 1978

SUMMARY SHEETS

FOR

FINAL ENVIRONMENTAL IMPACT STATEMENT

PREPARED BY

OFFICE OF MOBILE SOURCE AIR POLLUTION CONTROL

ENVIRONMENTAL PROTECTION AGENCY

1. Title of Action: Revised Evaporative Emission Regulations for 1981 and Later Model Year Light-Duty Vehicles and Light-Duty Trucks.

2. Description of Action: EPA is establishing a more stringent fuel evaporative emission regulation for light-duty vehicles (LDV) and light-duty trucks (LDT). The standard established for 1978 and later model year LDVs and LDTs is 6.0 grams of hydrocarbon (HC) per test when measured by the SHED (Sealed Housing for Evaporative Determination) test procedure. The revised standard for 1981 and later model year LDVs and LDTs will be 2.0 grams per test (using the SHED test).

3. Environmental Impact: This action will reduce the total tons of hydrocarbons emitted into the air nationwide by up to 900,000 tons in the year 1990. This represents a 25 percent reduction in hydrocarbon emissions from mobile sources in that year. In those urban areas expected

to have difficulty achieving oxidant air quality standards, establishing 2.0 grams per test as the allowable level of fuel evaporative emissions for 1981 and later model year LDVs and LDTs should result in a 2 percent improvement in oxidant air quality by the 1990.

This regulation will have no effect on exhaust hydrocarbon, carbon monoxide, or oxides of nitrogen emissions. Nor will water pollution or noise pollution be adversely impacted. There is some potential that a fuel savings will be realized, but the overall effect on the nation's consumption of fuel is expected to be negligible.

4. Economic Impact: EPA estimates that the incremental cost to comply with this regulation will be between $1 and $5.50 per vehicle (1977 dollars). Based on these costs and the expected sales of light-duty vehicles and trucks for the period 1981-1985, the expected aggregate cost of compliance would be between 79 and 400 million dollars for the first five years of implementation. Actual costs may be lower as manufacturers will optimize control system technology and because many vehicles already comply with with 2.0 gram per test standard and will not have to be modified further in order to comply with the new standard.

The per vehicle cost increase is expected to have an insignificant adverse effect on sales, less than a 0.12 percent decrease in unit sales. No adverse effects on employment, competition or productivity are expected.

5. Alternatives Considered:

A. Take no action (i.e., retain present 6.0 g/test standard).

B. Further control of HC emissions from stationary sources.

C. Further control of exhaust HC emissions from mobile sources.

D. Alternative schedules for implementing a 2g/test evaporative HC emission standard.

1. Impose the standard beginning with the 1980 model year.

2. Impose the standard beginning with the 1981 model year.

6. Availability: The Office of Mobile Source Air Pollution Control officially filed copies of the Final EIS with the Director, Office of Federal Activities, U.S. Environmental Protection Agency, on AUG 8 1978. Single copies of the Final EIS are available to the public upon request from the Office of Mobile Source Air Pollution Control (AW-455) U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460. A copy is on file at the U.S. EPA Public Information Reference Unit (EPA Library), Room 2922, 401 M Street, S.W., Washington, D.C. and is available for inspection and copying during normal business hours.

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Chapter I

Summary

A. Background and Description of this Action

This regulation establishes a 2.0 gram per test (g/test) fuel evaporative emission level for 1981 and subsequent model year gasoline-fueled light-duty vehicles and trucks (0-8500 lbs Gross Vehicle Weight Rating) when measured by the Federal Evaporative Emission Test Procedure implemented for 1978 model year evaporative hydrocarbon (HC) emission testing.

On January 13, 1976 a Notice of Proposed Rule Making (NPRM) was published in the Federal Register (41 FR 2022), to revise the evaporative emission test procedures and establish standards of 6.0 g/test for 1978 and 2.0 g/test for 1979 and subsequent model year light-duty vehicles and light-duty trucks.

The 1978 6.0 g/test standard represented a large (about 70%) reduction from 1972-1977 light-duty vehicle and truck evaporative emission levels. A 2.0 g/test standard would add to this significant improvement in emissions, but there were complex issues surrounding this standard that needed to be resolved before it could be promulgated. The risk of not being able to implement the 6.0 g/test standard due to the additional time necessary to thoroughly study and evaluate the

technical feasibility, cost and lead time associated with the 2 gram level, and the relationship between a 2.0 g/test standard and background emission levels, was not justified. Therefore, in order to allow timely implementation of the revised test procedure and the 6.0 g/test standard for 1978, the originally proposed regulatory action was divided into two separate final rulemaking activities. The revised test procedure and a 6.0 g/test standard were promulgated on August 23, 1976 (41 FR 35626). Promulgation of the final rulemaking for a 2g/test standard was delayed pending further study of the above-noted issues.

The implementation of a 2.0 g/test standard is needed since it is projected that many Air Quality Control Regions (AQCR's) will still exceed the ambient air quality standards for oxidants as late as 1990, even with the implementation of all presently known control strategies for reducing HC emissions from mobile and stationary sources.

B. Environmental Impact

This rulemaking will result in reduction of nationwide hydrocarbon emissions from all mobile sources by as much as 10% in 1985 and 25% in the year 1990. In those Air Quality Control Regions that are expected

to have the most difficulty meeting ambient air quality standards for oxidants in 1990, a 2.0 g/test standard will result in reduction of hydrocarbon emissions from all sources (mobile plus stationary) by an average of about 5% in that year. This will result in a 2% improvement in oxidant (hydrocarbon) levels in these areas.

The implementation of the 2g/test standard is not expected to have any effect on water or solid waste pollution. With proper utilization of existing control technology there should be no increase in exhaust HC emissions as a result of promulgating this more stringent evaporative hydrocarbon emission standard. Exhaust HC emissions are, in any case, subject to separate standards.

C. Economic Impact

1. Character of the Industry

Only manufacturers of gasoline fueled light-duty vehicles and trucks will be affected by this rulemaking. The primary manufacturers of these vehicles are the General Motors Corporation, Ford Motor Company, Chrysler Corporation, American Motors Corporation, International Harvester, Toyota, Nissan (Datsun), Volkswagen and Honda.

U.S. sales of light-duty vehicles and light-duty trucks in 1976 were 12.3 million vehicles sold at a total wholesale value of aprroximately $40 billion. The industry employs 3.7 million employees in manufacturing, wholesaling, and retailing of motor vehicles.

2. Impact on Consumers

Based on EPA and contractor studies, it is estimated that the retail "sticker" price will increase an average of $1 - $5 per vehicle (1976 dollars) for control system components required to meet a 2.0 g/test standard. This is equivalent to about $1.10 - $5.55 in 1978 dollars. No additional costs over the life of the vehicle due to increased fuel consumption or maintenance are expected; and therefore the additional emissions control will cost the consumer $1 - $5.50 over the lifetime of the vehicle. The aggregate five year costs of this regulation are expected to be $79-400 million (undiscounted) assuming no carry over of certification test data is used. However, since over 30 percent of light-duty vehicles already meet a 2g/test standard, these costs estimates may be as much as 30 percent high.

3. Impact on Industry

The major impact on the industry will be due to any decrease in sales resulting from the expected $1 - $5.50 increase in the price of vehicles. The projected sales decrease is 0.02 - 0.12%, assuming a price elasticity 0.88[1/]. Little increase in the cost of certifying vehicles is expected. It is expected that only those vehicles which have not achieved during previous model year's certification a 2.0 g/test level would have to be recertified.

1/ "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p. 4.

4. Government Costs

The cost to the government for the motor vehicle certification program is not expected to change, as the test procedure is essentially unchanged.

5. Cost Effectiveness

The cost effectiveness of this rulemaking is estimated to be $20 - $100 per ton of hydrocarbon removed. This action is more cost effective than HC reductions that will be obtained via other promulgated mobile source regulations, such as the statutory light-duty vehicle standard ($500-$1,400 per ton), light-duty truck standards for 1979 and later model years ($200 per ton) and heavy-duty engine HC standards for 1979 and later model years ($154 per ton).

D. Alternative Actions

The principal alternative actions considered were: (I) Take no action (retain the 6.0 g/test standard); (II) Set a 2.0 g/test standard for 1980 and subsequent model year vehicles; and, (III) Set a 2.0 g/test standard for 1981 and subsequent model year vehicles. Alternative action I (no action) was rejected because further reductions in hydrocarbon emissions are needed in order for a number of Air Quality Control Regions to meet Ambient Air Quality Standards for oxidants. Alternative II was rejected due to insufficient lead time now available to meet the 2.0 g/test level by 1980. The 2.0 g/test level for 1981 (Alternative III) has been shown to

be technically feasible and cost effective. The technical feasibility of a standard more stringent than 2.0 g/test has not yet been demonstrated. Adequate lead time for development of control systems and certification exists for implementation in the 1981 model year.

Other alternatives generally considered were the control of stationary sources of hydrocarbon emissions and the further control of exhaust hydrocarbons from mobile sources. Due to the nature of stationary source HC pollution and the current infeasibility of further exhaust hydrocarbon control from mobile sources over what is currently planned, combined with the fact that even if all known HC control techniques were effected, many ambient air quality control regions would still fail to comply with oxidant standrds, these alternatives were rejected and are not treated in any detail in this report. (See Section B Chapter II)

Chapter II

Introduction

A. Need for Control, Background and Description of This Action

In many geographic regions a large portion of hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides (NOx) present in the air are attributable to motor vehicle emissions. The Congress, in recognition of the air pollution problem, passed the Clean Air Act which provides for a national air pollution program to monitor and control emissions from new motor vehicles and engines.

Section 202(a) of the Clean Air Act (42 U.S.C. 7521) provides that the Administrator shall prescribe standards for motor vehicle emissions if such emissions may reasonably be anticipated to endanger public health or welfare. Under Section 206, the Administrator must test or require testing of new motor vehicles to determine compliance with applicable standards under Section 206 and the general power to promulgate regulations is granted in Section 301.

The need for further control of evaporative hydrocarbon emissions is based on the determination that the present and planned regulations for control of mobile and stationary source hydrocarbon emissions are insufficient to bring many Air Quality Control Regions (AQCR's) into

compliance with the ambient air quality standards for oxidants. This determination was based upon an analysis which used the best available inputs of vehicle mix, growth rates, emission factors and current ambient air quality data. In particular, Los Angeles, Sacramento, San Diego, San Francisco, San Joquin Valley, Corpus Christi, Houston, Phoenix-Tucson, Denver, and the New Jersey portions of the New York AQCR will still exceed oxidant standards in 1990.

The health effects of photochemical oxidants have been considered and described in previous publications.1/ Photochemical oxidants are created during photochemical reactions involving hydrocarbons and are thus controlled indirectly by controlling hydrocarbons. Ambient air quality standards have been set, based on those considerations, at levels which assure adequate public protection from the regulated pollutants. The air quality standard for oxidants is .08 parts per million per cubic meter (maximum 1 hour concentration not to be exceeded more than once per year). Since ambient air quality standards will be exceeded in many air quality control regions as discussed earlier, further reduction of HC emissions is necessary.

Fuel evaporative hydrocarbon emissions have been studied and measured since 1958. Federal control of evaporative emissions was first proposed in the Federal Register on February 4, 1967 (32 FR, pp. 2448-50) to become effective for the 1969 model year. At that time a then novel and relatively untried measurement procedure was

1/ Air Quality Criteria Documents, Nos. AP-62, AP-63, AP-64, and AP-84

proposed in which the evaporative emissions would be collected in a large sealed enclosure containing the test vehicle. However, when final rulemaking was published in the Federal Register on June 4, 1968 (33 FR, pp. 8304-24), the vehicle enclosure measurement procedure was abandoned in favor of a better known procedure, called the carbon trap method, which utilizes the absorption of hydrocarbon on activated carbon to measure emissions. The activated carbon, encased in a metal canister, is weighed before and after the test to determine the mass of hydrocarbon absorbed.

The evaporative emission test measures the evaporative hydrocarbons emitted by the vehicle during simulated daily temperature changes, vehicle operation, and periods of hot engine soaking. This is accomplished during a three part test. The first part consists of artificially heating the fuel tank during a one hour period to simulate the normal rise in tank temperature resulting from normal daily ambient temperature increases (diurnal losses). The second part of the test measures the losses during vehicle operation over a 7.5 mile trip (running losses). The third portion of the test consists of measuring the evaporative losses during the first hour after vehicle operation, when the engine is still hot (hot soak losses).

Using this test sequence, an emission standard was set at 6.0 g/test for the 1971 model year as measured by the carbon trap method. The evaporative emission standard was then reduced to 2.0 g/test for 1972 and subsequent model years.

Over the intervening years since 1967 the vehicle enclosure method has been evaluated by several organizations. Ultimately it was decided that is was "a superior technique, a versatile tool" (SAE paper 680125) compared to the carbon trap method, and was developed into a Society of Automotive Engines recommended practice (J171a).2/ This procedure was further modified to produce the Federal enclosure test method (Sealed Housing for Evaporative Determination, or "SHED" procedure)

On January 13, 1976 a notice of proposed rulemaking (NPRM) was published in the Federal Register (41 FR 2022), proposing the adoption of the SHED evaporative emission test procedure and standards of 6.0 g/test for 1978 and 2.0 g/test for 1979 and subsequent model years.

In the final rulemaking EPA decided at first to promulgate only the new test procedure and the 6.0 gram/test standard. Based on comments received to the NPRM it appeared evident that the issue of a 2.0 g/test gram per test standard was much more complex than issues concerned with the revised test procedures and the 1978 standard. However, the 6.0 gram standard represented so large (about 70%) of a reduction from the existing light-duty vehicle and truck evaporative emission levels, that any delay in promulgating this standard due to performing analysis of issues related to the 2.0 g standard was not justified. Additional time was necessary to thoroughly study and evaluate (1) the technical feasibility, cost and lead time associated with the 2.0 gram level and (2) the relationship between a 2.0 g/test standard and background emission levels. The revised test procedure

2/ "Measurement of Fuel Evaporative Emissions from Gasoline Powered Passenger Cars and Light Trucks Using the Enclosure Technique - SAE J171a," published in the SAE Handbook, 1973.

and 1978 standard were promulgated separately from the final rulemaking for a 2.0 gram/test evaporative emission standard, which is considered in this impact statement. A separate impact statement was prepared for the 6.0 g/test standard and revised test procedure (Environmental and Economic Impact Statement: Revised Evaporative Emission Regulations for the 1978 Model Year).

The regulations now being promulgated will require more stringent control of evaporative emissions from light-duty vehicles and light-duty trucks by reducing the evaporative emission standard from a 6.0 g/test to a 2.0 g/test. When originally proposed, the 2.0 g/test standard was to apply to 1979 and later model year vehicles. However, implementation of the more stringent 2.0 g/test standard will now be delayed until 1981 due to insufficient lead-time for implementation in either 1979 or 1980.

It should be noted that light-duty trucks (0-8500 pounds gross vehicle weight rating) will be controlled to the same 2g/test level as light-duty vehicles, beginning with the 1981 model year. Already developed evaporative emission control technologies can be applied effectively to light-duty trucks to achieve these levels.

B. Alternative Actions Considered

The following alternative actions for further evaporative emissions control will be considered in this report:

Alternative Action I - No action, i.e., retain the present 6.0 g/test standard.

Alternative Action II - Set a 2.0 g/test standard for 1980 and subsequent model years.

Alternative Action III - Set a 2.0 g/test standard for 1981 and subsequent model years.

EPA's procedures for the voluntary preparation of Environmental Impact Statements state that EPA will "...[d]escribe and objectively weigh reasonable alternatives to the proposed action, to the extent such alternatives are permitted by law."[3/] In determining which alternatives are reasonable, EPA has traditionally examined such factors as magnitude of emission reductions, economic considerations, expected adverse impacts and irreversible commitment of resources. Only when all these factors have been balanced can an effective, non-disruptive strategy for the control of emissions be selected.

3/ 39 FR 37419, October 21, 1974, section 3(c)(2).

In the broadest sense the options open to EPA as alternative actions to promulgating a more stringent federal evaporative hydrocarbon standard include: more stringent control of other hydrocarbon emissions from passenger cars, motorcycles, light-duty trucks, heavy-duty vehicles or some as yet uncontrolled mobile source; and control of stationary sources of HC emissions. Each of these strategies has its advantages and disadvantages, and on balance, EPA concludes that promulgating a 2g/test evaporative HC emission standard for light-duty vehicles and trucks represents a reasonable, cost effective emission control strategy.

Control of Stationary Sources

The two categories of man-made sources of HC pollution are stationary sources and mobile sources. In 1972, the stationary source contribution to nationwide emissions of HC was roughly equal to the mobile source contribution. Thus it could be concluded that HC emission control strategies should be apportioned equally among stationary and mobile sources. In practice however, and due to the statutory framework of the Clean Air Act, reductions in HC emissions for significant mobile sources have been accomplished much more quickly than those for stationary sources.

In comparing any mobile or stationary source emission control strategy as a reasonable alternative to this regulation, consideration must be given to the purpose of the control of emissions from both mobile and stationary sources. The Clean Air Act as amended August 1977 requires that the National Ambient Air Quality Standard (NAAAQS) for oxidants be

met in all regions of the nation by 1982. This goal may not be achieved by a number of urban areas of the country so the Act permits States, if a showing can be made that the standard can not be achieved by 1982, to include in their implementation plans provisions which will provide for attainment of the NAAQS as expeditiously as practicable, but not later than 1987. [4/] Obviously, large reduction in HC emissions will be necessary to meet this goal in many regions. To be able to consider one control strategy as an alternative to another implies that the goal of achieving the NAAQS can be achieved by the majority of the nation by implementing a few of the available strategies. Such may not be the case in some air quality control regions given existing air quality levels. Thus some apparent alternative actions are not really alternatives at all.

Analyses performed for a long-range Federal Government planning effort[5/] indicate the need for substantial emissions reductions in large areas of the nation. The following chart, based on measured air quality data for 1971 through 1973, represents the emission reductions needed to meet the HC NAAQS from sources which existed during the 1971-1973 time period. When growth is considered, the needed degree of control is increased (i.e., more control than is indicated by the chart is needed today simply due to the growth in the number of both mobile and stationary sources).

4/ Clean Air Act, Section 172.

5/ Panel Report on Air Quality, Noise and Health, "Interagency Task Force on Mobile Vehicle Goals Beyond 1980, March 1976.

TABLE II-1

COST EFFECTIVENESS STRATEGIES FOR CONTROL OF HC EMISSIONS IN 2000

Control Strategy (with % Control)	HC Removed (10^6 Tons)	% of Baseline Emissions Removed*	Cum % of Baseline Removed	Cost Effectiveness ($/Ton)	Annual Cost (10^6 Dollars)	Cum Annual Cost (10^6 Dollars)	Cum HC Removed (10^6 Tons)
Degreasing 0–40**	0.30	1.1	1.1	–210	–61	–61	0.30
Gravure 0–98**	0.22	0.8	1.9	–50	–11	–72	0.52
Gas Terminal 0–67	0.91	3.4	5.2	0	0	–72	1.43
Acrylonitrile 0–35	0.10	0.5	5.5	0	0	–72	1.53
Polyethylene 0–95	0.19	0.7	6.2	0	0	–72	1.72
Charcoal 0–99	0.34	1.2	7.4	0	0	–72	2.06
Miscellaneous Chemicals 0–35	0.60	2.2	9.6	0	0	–72	2.66
Dry Cleaning 0–80	0.48	1.7	11.3	10	5	–67	3.14
Industrial Finishing 0–75	1.82	6.8	17.8	10	18	–49	4.96
Carbon Black 0–95	0.14	0.5	18.3	10	1	–48	5.10
Formaldehyde 0–95	0.06	0.2	18.5	10	1	–47	5.16
Refining 0–67	1.53	5.7	24.0	13	20	–27	6.69
Arch Coatings 0–100	1.00	3.7	27.6	15	15	–12	7.69
GHDV Evap 5.8 – 0.5 gm/mi	0.58	2.1	29.7	18	10	–2	8.27
Open Burning 0–25	0.30	1.1	30.8	20	6	4	8.57
Ethylene Oxide 0–95	0.44	1.6	32.4	20	9	13	9.01
Acrylonitrile 36–99	0.17	0.6	33.0	37	6	19	9.18
Ethylene Dichloride 0–95	0.16	0.6	33.6	40	6	25	9.34
Paint & Varnish 0–70	0.09	0.3	33.9	50	5	30	9.43
Degreasing 41–90	0.36	1.3	35.2	85	31	61	9.79
Industrial Finishing 76–97	0.55	2.0	37.2	100	55	116	10.34
Gasoline Handling 16–50	0.57	2.0	39.2	100	57	173	10.91
Cyclohexanone 0–95	0.19	0.7	39.9	120	23	196	11.10
Metal Decorating 0–90	0.14	0.5	40.4	150	20	216	11.24
Miscellaneous Chemicals 35–53	0.30	1.1	41.5	200	60	276	11.54
Gasoline Distribution 67–99	0.43	1.5	43.0	270	115	391	11.97
Coke Ovens 0–80	0.24	0.9	43.9	435	105	496	12.21
LDV Exhaust 0.9 – 0.41 gm/mi	0.93	3.5	47.2	470	440	936	13.14
LDT & GHDV Exhaust 2.9 – 0.8 gm/mi	0.84	3.1	50.2	470	395	1330	13.98
Foundries 0–60	0.15	0.5	50.7	500	75	1410	14.13
Letterpress & Lithography 0–90	0.27	1.0	51.7	700	190	1600	14.40
Gas Handling 51–91	0.68	2.5	54.1	700	475	2080	15.08

Baseline Emissions = 26.9 x 10^6 tons in 2000 and is based upon LDV exhaust emissions of 0.9 gm/mi and LDV evaporative loss of 0.4 gm/mi. LDT and GHDV weighted average exhaust emissions of 2.9 gm/mi, LDT evaporative loss of 0.1 gm/mi and GHDV evaporative loss 5.6 gm/mi

* First two strategies listed result in cost savings due to recovered solvents more than offsetting the cost of the control strategies

Thus the Agency finds no reason to further examine alternative mobile or stationary source emission control strategies in its examination of reasonable alternatives to this regulation. For HC emission control strategies, there do not appear to be an adequate number of individual alternative control strategies sufficient to achieve the NAAQS for oxidants in substantial portions of the country. For this reason all reasonable HC emission control strategies are planned to be implemented.

C. Structure of Report

This report is an analysis of the environmental and economic impact of setting an evaporative emission standard of 2.0 g/test for 1981 and subsequent model years, and considers similar impacts for alternative strategies for control of evaporative HC emissions.

Chapter III of this report will set the ground work for these analyses by describing the light-duty vehicle (LDV) and light-duty truck (LDT) industries with respect to production and employment, etc. In addition, current and projected vehicle populations and a description of vehicle usage will be presented.

Chapter IV will discuss the primary and secondary impacts of the alternative actions on environmental quality.

In Chapter V, the analysis of the costs to the consumer, industry and government will be discussed. The predicted costs reflect an average cost to all consumers and industry, and therefore ignore the variability in cost to individual consumers resulting from manufacturer use of a variety of emission control systems to meet the standard, and the costs of the equipment in that system. The actual costs to consumers may also vary depending on a manufacturer's perception of its market position and the discretionary power he has in setting prices of vehicles.

The cost effectiveness of the 2.0g/test standard will be discussed in Chapter VI. The cost effectiveness of this action and the cost effectiveness of alternative actions for the control of hydrocarbon emissions will be compared. Cost effectiveness will be expressed in terms of dollars required to control a ton of hydrocarbons.

Chapter VII will discuss the impact of the alternative actions on the irreversible or irretrievable commitment of our natural resources. Along with this discussion, will be a discussion of the trade-offs between short-term gains and long-term losses, or vice versa, and a rationale for the timing of this action.

Comments on the draft impact statement will be summarized and discussed in Chapter VIII. Comments related to the 2.0 gram/test standard in general are summarized and discussed in detail in a

separate document entitled, "Summary and Analysis of Comments to the NPRM - 2 gram/test standard for Evaporative Hydrocarbon Emissions from Light-Duty Vehicles and Trucks."

Chapter II

Description of Product and the Industry

A. Definition of Product

A light-duty vehicle (LDV) is defined as a passenger car or passenger car derivative capable of seating 12 passengers or less. Prior to 1978, light-duty vehicles (and light-duty trucks) were required to meet a 2.0 g/test evaporative emission standard as measured by the carbon trap method. Beginning with the 1978 model year, light-duty vehicles (and light-duty trucks) are required to meet a 6.0 g/test evaporative emission standard as measured by the enclosure test method.

The definition of light-duty trucks (LDT) for the 1979 and later model years is any motor vehicle rated at 8,500 pounds Gross Vehicle Weight Rating (GVWR) which has a vehicle curb weight of 6,000 pounds or less and which has a basic vehicle frontal area of 46 square feet, or less, which is : 1) Designed primarily for purposes of transportation of property or is a derivative of such a vehicle, or 2) Designed primarily for purposes of transportation of persons and has a capacity of more than 12 persons, or 3) Available with special features enabling off-street or off-highway operation and use. Prior to the 1979 model year, trucks between 6,000 and 8,500 pounds GVW were classified as

heavy-duty vehicles and as such they were not required to comply with evaporative emission regulations.

The manufacturers of LDVs and LDTs produce a wide variety of vehicles consisting of many significant variations in vehicle design and size and many engine configurations, engine sizes, fuel tank sizes, etc. However, variations in product configuration should pose no unsolvable problems for the industry in complying with further evaporative regulations. EPA surveillance data on controlled 1972 and 1973 light-duty vehicles did not show any statistically significant correlation between fuel tank or engine size and evaporative hydrocarbon emissions.

B. Structure of the Industry (Production and Marketing)

Domestic manufacture of light-duty vehicles in the U.S. is almost entirely done by four motor vehicle manufacturers: General Motors Corporation, Ford Motor Company, Chrysler Corp., and American Motors Corp. However, a sizeable percentage of new LDV sales is comprised of imported vehicles. U.S. domestic producers imported over 750,000 cars from plants they operate in Canada. The major foreign importers are Toyota, Nissan (Datsun), Volkswagen and Honda. Imports accounted for roughly 18% of new car sales in the U.S. in 1976.

The manufacture of light-duty trucks sold in the U.S. is primarily accomplished by the major domestic passenger car producers. General Motors (Chevrolet and GMC divisions) Ford Motor, and Chrysler (Dodge) all have separate truck divisions which light-duty trucks. American Motors operates the Jeep division which manufactures light-duty trucks.

The other major domestic manufacturer of LDTs is the International Harvester Corporation (IHC). International does not produce light-duty passenger vehicles but does produce various models of light and heavy-duty trucks.

Some LDTs sold in the U.S. are imported. The majority of U.S. imports of trucks come from the Canadian plants operated by U.S. domestic producers. Others, however come from Japanese producers and consist primarily of light pick up trucks under 4000 pounds GVW. The major importers are Nissan (Datsun), Toyota, Isuzu and Toyo Kogyo (Mazda). Both Toyota and and the British Leyland Company import utility vehicles under 6,000 lbs GVW. Imports account for about 5% of all 1975 factory sales of trucks with a GVW less than 10,000 pounds.

Table III-1 shows unit factory sales for light-duty vehicles and light-duty trucks from U.S. plants. Most data available on light-duty trucks are presented in two categories, based on GVW. There is a 0-6,000 pound and a 6,001-10,000 pound category. Since the definition

Table III-1

Light-Duty Vehicle and Light-Duty Truck

Factory Sales from U.S. Plants[1]

Type of Vehicle	1976[2]	1975[2]	1974[3]	1973	1972	1971
Light-Duty Vehicle	8,497,603	6,712,852	7,331,946	9,657,647	8,823,938	8,584,592
Light-Duty Truck redefined class (0-8,500 lb. GVW)	2,505,448	1,848,223	2,154,892	2,372,269	1,899,204	1,598,785
LDV plus redefined LDT classes	11,003,051	8,561,075	9,486,838	12,029,916	10,723,142	10,183,377

Source: Motor Vehicle Manufacturers Association of the United States, Inc.

1) Includes those vehicle produce in U.S. that are exported

2) Data from Automotive News, 1977 Market Data Book

3) Data from Automotive News Almanac, 1975

of light-duty trucks includes only trucks up to 8,500 pounds GVW, some adjustment to the 6,001-10,000 category was necessary. Industry production data available to EPA indicate that only five percent of all trucks with GVWs less than 10,000 pounds have GVWs of more than 8,500 pounds. This five percent figure is used in Table III-I and throughout this analysis analysis to adjust production data to fit the proposed LDT definition.

Table III-2 shows new car and truck registrations for 1973 through 1976. These figures represent the numbers of both domestic and imported vehicles bought by U.S. consumers in those years.

Table III-3 is a breakdown of market sales by manufacturer for 1976 light-duty vehicles. Also included is the percent of the passenger car market for each manufacturer. Table III-4 gives similar information for the light-duty truck industry. It should be noted that Table III-4 gives market shares for 0-10,000 pounds. GVW truck sales. Data indicating the portion of sales for 0-8,500 pounds. GVW trucks for each manufacturer were not available and the assumption that 5% of sales would be over 8500 pounds. GVW is not valid for every manufacturer.

U.S. light-duty vehicle and light-duty truck manufacturers operate with a fair degree of vertical integration. As is typical of many capital intensive industries, the manufacturer seeks to assure himself of some control over the quality and availability of the final product.

Thus, the major manufacturing companies have acquired subsidiaries or started divisions to produce many of the parts used in the manufacture of their cars and trucks. None, however, build their vehicles without buying some equipment from independent vendors.

The vertical integration typical of passenger car and truck manufacturers extends beyond the production of the vehicle into its sale. The manufacturers establish franchised dealerships to handle retail trade and servicing of their products. Most also produce and sell the parts and accessories required to service their vehicles. Many of the truck dealerships are coupled with the passenger car dealerships. As of January 1, 1977, there was a total of 24,268 passenger car dealerships and 23,021 truck dealerships. The total truck dealerships include dealerships for heavy-duty as well as light-duty trucks, and accounts for those dealerships operating jointly with passenger car sales offices. Table III-5 provides a breakdown of all light-duty vehicle dealerships by manufacturer and Table III-6 provides this information for light-duty truck dealerships.

C. Sales and Revenues

Passenger car sales from domestic manufacturers for 1976 were 8.50 million vehicles at a total wholesale value of about $30 billion. For 1975, 6.71 million vehicles were sold at a wholesale value of $23.4 billion. The light-duty truck industry (0-8,500 lbs. GVW) had 2.51 million sales at a value of about $10 billion in 1976 and 1.85 million sales at a

Table III-2

New Vehicle Registrations[1]

Source	New Car Registrations			
	1976[3]	1975[3]	1974[4]	1973[4]
LDV	9,751,465	8,261,840	8,701,094	11,350,995
LDT[2]	2,588,213	1,995,016	2,143,198	2,431,454
Total	12,339,698	10,256,856	10,844,292	13,782,449

1) Includes imports

2) Redefined Light-Duty Truck Class (0-8,500 lb. GVW)

3) Source. Automotive News, 1977 Market Data Book

4) Source: Automotive News Almanac, 1975

Table III-3

Market Sales of Light-Duty Vehicles
by Manufacturer for 1976

Manufacturer	No. of Units Produced	% of Passenger Car Market
Chevrolet	2,035,858	20.88
Pontiac	706,460	7.24
Oldsmobile	867,485	8.90
Buick	700,778	7.19
Cadillac	293,716	3.01
GM Total	4,604,297	47.22
Ford	1,665,619	17.08
Lincoln	115,801	1.19
Mercury	408,121	4.18
Ford Total	2,189,541	22.45
Plymouth	526,957	5.40
Dodge	460,647	4.72
Chrysler	271,061	2.78
Chrysler Total	1,259,076	12.90
American Motors Corp.	247,032	2.53
Miscellaneous	1,451,539	14.89
Total	9,751,485	100%

Source: Automotive News, 1977 Market Data Book

Table III-4

Market Sales of Light-Duty Trucks[1]
by Manufacturer for 1976

Manufacturer	No. of U.S. Truck Sales	% of Light Truck Market
Chevrolet	1,011,377	37.12
GMC	223,805	8.21
Ford	870,231	31.94
Chrysler	338,078	12.41
AMC/Jeep	107,487	3.95
IHC	34,100	1.25
Other Manufacturers[2]	139,350	5.12
Total	2,724,435	100%

Source: Automotive news, 1977 Market Data Book

[1] Light Truck defined as 0-10,000 lb GVW

[2] Includes imports

Table III-5

Passenger Car Dealerships by Manufacturer

Manufacturer	Total Franchises as of Jan. 1, 1977	Dealers as of Jan. 1, 1977	Unit Sales Per Outlet 1976	Unit Sales Per Outlet 1975
American Motors	1,690	1,690	140	177
Chrysler Corp.	9,235	4,811		
Chrysler	3,272		86	70
Dodge	2,850		166	117
Plymouth	3,113		174	127
Ford Motor Co.	10,125	6,637		
Ford	5,567		308	276
Lincoln	1,618		76	62
Mercury	2,940		143	119
General Motors Corp.	17,205	11,670		
Buick	3,045		244	171
Cadillac	1,610		190	166
Chevrolet	5,990		350	302
Oldsmobile	3,315		272	192
Pontiac	3,245		233	155
Totals	38,255	24,808		
Minus Intercorporate Deals		540		
Net Dealers		24,268		

Source: Automotive News, 1977 Market Data Book

Table II-6

Truck Retail Outlets by Manufacturer

Manufacturer	Outlets as of January 1, 1977	Unit Sales Per Outlet 1976	1975
Ford	5,626	169	132
Chevrolet	5,590	188	136
GMC	2,750	93	62
Dodge	3,170	126	90
IHC	1,948	52	52
AMC/Jeep	1,628	67	54
Others	3,534	-	-
Total	24,246		
Adjustments for Multiple Franchises	1,225		
Total	23,021		

Source: Automotive News, 1977 Market Data Book

value of about $7 billion in 1975.

D. Employment

It is estimated that 3,661,549 workers are employed in manufacturing, wholesaling and retailing of motor vehicles (passenger cars, trucks, and buses) with a total $25.5 billion dollars in annual wages paid to those employees. Accurate employment figures for the separate manufacturing, wholesaling and retailing of light-duty trucks or light-duty vehicles are difficult to find. Most employment data are aggregated for all producers of all classes of cars and trucks since some production facilities manufacture both light and heavy trucks. Statistics show that approximately 31,400 workers were employed in 1972 by U.S. manufacturers of trucks. The annual payroll of these workers totalled $250.25 million dollars. Much of this employment is centered in California, Michigan, Ohio, New York, Indiana, Illinois and Missouri.

Chapter IV

Environmental Impact

A. Primary Impact

This section will describe the expected environmental impact of the establishment of a more stringent evaporative emission standard when measured by the Federal enclosure test method adopted for 1978. The alternative actions considered in this Chapter, Chapter V and Chapter VI, are as follows:

Alternative Action I: No action (retain the 6.0 g/test standard).

Alternative Action II: A 2.0 g/test standard for 1980 and subsequent model years.

Alternative Action III: A 2.0 g/test standard for 1981 and subsequent model years.

The primary impacts of other control strategies will be presented here as a reference to show the relative effectiveness of the final rulemaking in the reduction of hydrocarbon emissions. These strategies include establishment of the 6.0 g/test evaporative emission standard as measured by the enclosure test method, reduction of light-duty vehicle exhaust hydrocarbon standards to the statutory level (0.41 g/mile) and an inspection maintenance program.

1. Current and Projected Emission Factors

In order to evaluate the effect of the alternative actions on ambient air quality, the rates for exhaust and evaporative hydrocarbons must be determined as a function of vehicle age.

Tables IV-1 and IV-2 give the evaporative hydrocarbon emission rates for light-duty vehicles and light-duty trucks, respectively. Past emission rates for light-duty vehicles were obtained from surveillance testing of 1957 through 1972 model year vehicles. 1971 through 1977 vehicles are controlled for evaporative emissions under the "carbon trap" certification test method. 1978 and subsequent model year vehicles will be controlled for evaporative emissions under the Federal enclosure testing method. The 6.0 and 2.0 g/test standards for 1978 and 1981 respectively, assume that the emissions would be comprised of 1.0 g/test from the diurnal portion of the evaporative emission test, with the rest being contributed during the hot soak portion of the test.

Table IV-1

Evaporative HC Emission Factors
for Light Duty Vehicles by Model Year

Model Year(s)	Evaporative HC Emission Factors By Source: Diurnal (g/day)	Hot Soak (g/trip)	Composite Emissions[a]: g/day	g/mi
pre 1970	26.0	14.7	74.5	2.53
1970 (Calif.)	16.3	10.9	52.3	1.78
1970 (non-Calif.)	26.0	14.7	74.5	2.53
1971	16.3	10.9	52.3	1.78
1972-77	12.1	12.0	51.7	1.76
6 g/test std.	1.0	5.0	17.5	0.60
2 g/test std.	1.0	1.0	4.3	0.15

Source: Supplement No. 5 for Compilation of Air Pollutant Emission Factors, AP-42.

a) Gram per day values are hot soak emissions times the average number of trips per day plus diurnal emissions. Nationwide data from the Department of Transportation and Automobile Manufacturers Association indicate that the average vehicle is used 3.3 trips per day. Gram/mile values were determine by dividing average g/day by the average nationwide travel per vehicle of 29.4 mi/day.

Table IV-2

Evaporative HC Emission Factors
for Light Duty Trucks by Model Year

Model Year(s)	HC Emission Factor[1] (g/mi)
pre 1970	3.6
1970-1977	3.1
6 g/test Standard	.60
2 g/test Standard	.15

Source. Supplement No. 5 for Compilation of Air Pollutant Emission Factors, AP-42.

1) Gram per mile values are based on 3.3 hot soaks per day and 29.4 miles travelled per day.

In order to estimate the environmental impact of a 2.0 g/test standard for the 1981 model year, hydrocarbon emission factors must be coupled with vehicle miles travelled data during a year's time in order to estimate the tons of hydrocarbons emitted per year. For the computation of hydrocarbon emissions from various mobile sources, the following assumptions were made:

a. Light-duty vehicles - The standard of 1.5 g/mi for exhaust hydrocarbons is in effect until 1979. In 1980 light-duty vehicles will meet the statutory exhaust hydrocarbon emission standard of 0.41 g/mi. Evaporative emission rates will be those shown in Table IV-1.

b. Light-duty trucks - In the analysis, light-duty trucks are defined as all trucks with gross vehicle weight below 8500 lbs. Prior to 1979, trucks below 6000 lbs. are regulated at a level of 2.0 g/mi of exhaust hydrocarbons, and trucks between 6000 and 8500 lbs. are regulated as heavy-duty vehicles with an estimated exhaust HC level of 5.6 g/mile. In 1979 and subsequent years, all light-duty trucks are assumed to be regulated to an exhaust HC standard of 1.7 g/mi. Evaporative HC emissions from LDT's are as shown in Table IV-2.

c. Heavy-duty vehicles – In this analysis, heavy-duty vehicles are defined as all trucks with a gross vehicle weight above 8500 lbs. It is assumed that exhaust HC emissions from heavy-duty gasoline vehicles are regulated at a level of 19.7 g/mi between 1970 and 1973, 12.4 g/mi between 1974 and 1978, and 3.2 g/mi in 1979 and subsequent years. It is assumed that heavy-duty diesel trucks are regulated at a level of 4.5 g/mi starting in 1974. Evaporative emissions from heavy-duty vehicles are not currrently being regulated.

d. Motorcycles – For this analysis motorcycles are not considered, since data on which population and emission factors for in-use vehicles are not available on a nationwide basis. Motorcycle exhaust carbons, however, are being controlled beginning with the 1978 model year and by 1980 must be less than 5.0 g/kilometer. There is no evaporative emission standard for motorcycles.

2. Vehicle Population and Vehicle Usage

In order to estimate the amount of a pollutant released to the atmosphere, it is necessary to know how many vehicles are in use and what proportion of different age vehicles are in that population. It is also necessary to know how much mileage is accumulated by the different segments of the vehicle population.

Table IV-3

Passenger Car and Truck Registration
For the Last 10 Years*

Year	Passenger Cars	Trucks[1]
1974	105,290,000	25,030,000
1973	101,762,477	23,232,872
1972	96,980,314	21,238,922
1971	92,754,061	19,837,063
1970	89,230,567	18,767,294
1969	86,852,275	17,882,129
1968	83,591,694	16,941,293
1967	80,414,180	16,178,849
1966	78,122,965	15,516,895
1965	75,251,386	14,795,051

*Includes privately and publicly owned vehicles.

Source: Automotive Facts and Figures, MVMA, 1975

1) All classes of trucks included

Table IV-4

Nationwide
Fraction of Annual Travel by Model Year
for Light Duty Vehicles

Age (years)	Fraction of Total Vehicles in use Nationwide (a)	Average Annual miles driven (b)	a x b	Fraction of Annual Miles Traveled
1	0.083	15,900	1,320	0.116
2	0.103	15,000	1,545	0.135
3	0.102	14,000	1,428	0.125
4	0.106	13,100	1,389	0.122
5	0.099	12,200	1,208	0.106
6	0.087	11,300	983	0.086
7	0.092	10,300	948	0.083
8	0.086	9,400	827	0.072
9	0.068	8,500	578	0.051
10	0.055	7,600	418	0.037
11	0.039	6,700	261	0.023
12	0.021	6,700	141	0.012
≥13	0.057	6,700	382	0.033

Source: Supplement No. 5 for compilation of Air Pollutant Emission Factors, AP42.

Table IV-5

Nationwide
Fraction of Light-Duty Truck Annual Travel
by Model Year

Age, Years	Fraction of Total vehicles in use Nationwide (a)	Average Annual Miles Driven (b)	a x b	Fraction of Annual Travel
1	0.061	15,900	970	0.094
2	0.095	15,000	1,425	0.138
3	0.094	14,000	1,316	0.127
4	0.103	13,100	1,349	0.131
5	0.083	12,200	1,013	0.098
6	0.076	11,300	859	0.083
7	0.076	10,300	783	0.076
8	0.063	9,400	592	0.057
9	0.054	8,500	459	0.044
10	0.043	7,600	327	0.032
11	0.036	6,700	241	0.023
12	0.024	6,700	161	0.016
≥13	0.185	4,500	832	0.081

Source: Supplement No. 5 for Compilation of Air Pollutant Emission Factors, AP42.

Table IV-6

Total Vehicle Miles Travelled
by Light-Duty Vehicles

Year	Nationwide[a] (billions of miles)	Los Angeles AQCR[b] (billions of miles)	New Jersey part of New York AQCR[c] (billions of miles)	Houston-Galveston AQCR[d] (billions of miles)	Phoenix-Tuscon AQCR[e] (billions of miles)	Denver AQCR[f] (billions of miles)
71		44.6	27.0	11.3	8.22	5.60
72	986	45.9	27.6	11.9	8.63	6.09
73	1016	47.2	28.1	12.5	9.06	6.62
74	1046	48.6	28.7	13.2	9.51	6.82
75	1077	50.0	29.3	13.8	9.98	7.01
76	1100	51.5	29.9	14.5	10.5	7.23
77	1144	52.9	30.5	15.2	11.0	7.44
78	1177	54.4	31.1	16.0	11.6	7.67
79	1213	56.0	31.7	16.8	12.1	7.90
80	1249	57.6	32.3	17.6	12.7	[illegible]
85	1449	65.1	35.7	19.5	14.8	8.99
90	1679	73.8	39.4	21.5	17.1	9.91

a. Based on FHWA Highway Statistics and an assumption of a 3% growth rate after 1974.

b. Based on data from "Transportation Control Strategy Development for the Metropolitan L.A. Region", APTD-1372, Dec. 1972.

c. Based on vehicle registration data from New Jersey, census data relating the fraction of the population in AQCR, and on nationwide vehicle miles travelled average from AP42 Compilation of Air Pollution Emission Factors. Assumed 2% per year growth rate.

d. Based on Texas Highway Department Data. Growth rate assumed to be 5% until 1980 and 2% thereafter.

e. Based on Arizona Highway Department Data and growth rates of 5% until 1980 and 3% thereafter.

f. Based on Colorado Div. of Highways Data and assumed growth rates of 3% until 1980, 2% thereafter.

Table IV-7

Total Vehicle Miles Travelled
by Light-Duty Trucks

Year	Nationwide[a] (billions of miles)	Los Angeles AQCR[b] (billions of miles)	New Jersey part of New York AQCR[c] (billions of miles)	Houston-Galveston AQCR[d] (billions of miles)	Phoenix-Tuscon AQCR[d] (billions of miles)	Denver AQCR[f] (billions of miles)
71		4.39	3.22	1.35	1.19	.667
72	156	4.51	3.28	1.42	1.25	.725
73	160	4.64	3.35	1.49	1.31	.788
74	165	4.78	3.42	1.57	1.38	.812
75	170	4.91	3.49	1.64	1,45	.835
76	175	5.06	3.56	1.73	1.52	.861
77	180	5.20	3.63	1.81	1.60	.886
78	186	5.35	3.70	1.90	1.68	.913
79	192	5.50	3.77	2.00	1.76	.941
80	197	5.66	3.85	2.10	1.85	.969
85	229	6.40	4.25	2.32	2.14	1.07
90	266	7.25	4.69	2.56	2.49	1.18

a. Based on FHWA Highway Statistics and an assumption of a 3% growth rate after 1974.

b. Based on data from "Transportation Control Strategy Development for the Metropolitan L.A. Region", APTD-1372, Dec. 1972.

c. Based on vehicle registration data from New Jersey, census data relating the fraction of the population in the AQCR, and on nationwide vehicle miles travelled average from AP42 Compilation of Air Pollution Emission Factors. Assumed 2% per year growth rate.

d. Based on Texas Highway Department Data. Growth rate assumed to be 5% until 1980 and 2% thereafter.

e. Based on Arizona Highway Department Data and growth rates of 5% until 1980, 3% thereafter.

f. Based on Colorado Div. of Highways data and assumed growth rates of 3% until 1980, 2% thereafter.

Table IV-3 gives vehicle registrations for 1965 through 1974. Table IV-4 and IV-5 give the fraction of annual travel by model year for light-duty vehicles and light-duty trucks, respectively. By coupling these fractions with the overall annual mileage (urban plus rural) and the emission rates from different age vehicles, one can predict the total amount of hydrocarbons emitted by these vehicles to the atmosphere in a given year. Similar data can used to determine the contribution of other mobile sources.

Mileage accumulation rates nationwide and for the five Air Quality Control Regions to be evaluated in this section are given in Tables IV-6 and IV-7 for light-duty vehicles and light-duty trucks, respectively.

3. Nationwide Emissions

Table IV-8 and Figure IV-1 show the results of an analysis such as is described in the preceding section. Figure IV-1 shows that exhaust hydrocarbons will be reduced by 1990, but will have leveled off. If a further reduction in the evaporative emission standard (to 2.0 g/test) is not made, evaporative emissions will contribute roughly the same amount of HC emissions as exhaust emissions from light-duty vehicles and trucks. Figure IV-2 shows that evaporative hydrocarbons will contribute roughly 36% of all hydrocarbons in 1990 from mobile sources if no further action is taken. Figure IV-2 also shows that a 2.0 g/test standard will significantly lower the percent contribution of evaporative emissions to total mobile source hydrocarbon emissions.

Table IV-8

Hydrocarbon Emissions from Mobile Sources (10^6 ton/year)

	Exhaust Emissions[1]		Crankcase Emissions[1]		Exhaust & Crankcase and EVAP Emissions[2]		EVAP Emissions (No Action)[3]		EVAP Emissions (Alt. Action II)[3]		EVAP Emissions (Alt. Action III)[3]	
Year	LDV	LDT	LDV	LDT	HDG	HDD	LDV	LDT	LDV	LDT	LDV	LDT
1972	5.3	1.25	.59	.22	1.64	.15	2.54	.59	2.54	.59	2.54	.59
1977	4.7	1.0[illegible]	.15	.08	1.53	.16	2.45	.61	2.45	.61	2.45	.61
1975	3.7	.80	.05	.05	1.31	.17	2.27	.60	2.27	.60	2.27	.60
1980	3.0	.69	0	0	1.19	.18	1.89	.49	1.82	.48	1.89	.49
1985	1.6	.42	0	0	.92	.20	1.24	.27	.74	.20	.80	.22
1990	.78	.4[illegible]	0	0	.83	.23	1.10	.17	.31	.06	.33	.06

1) Based on Emission Factors found in "Supplement No. 5 for Compilation of Air Pollutant Emission Factors," [illegible]-42.

2) Based on Emission Factors found in "Second Addendum to Memorandum Entitled 'Revised Estimates of Total Hydrocarbon Emissions and Various Regulatory Alternatives'" Memo from S. Guy Forbes, EPA, to Ernest S. [illegible], EPA, March 26, 1976, (Available in EPA public docket).

3) Based on Emission Factors found in Tables IV-1 and IV-2.

Figure IV-1

Projected Nationwide Vehicle HC Emissions

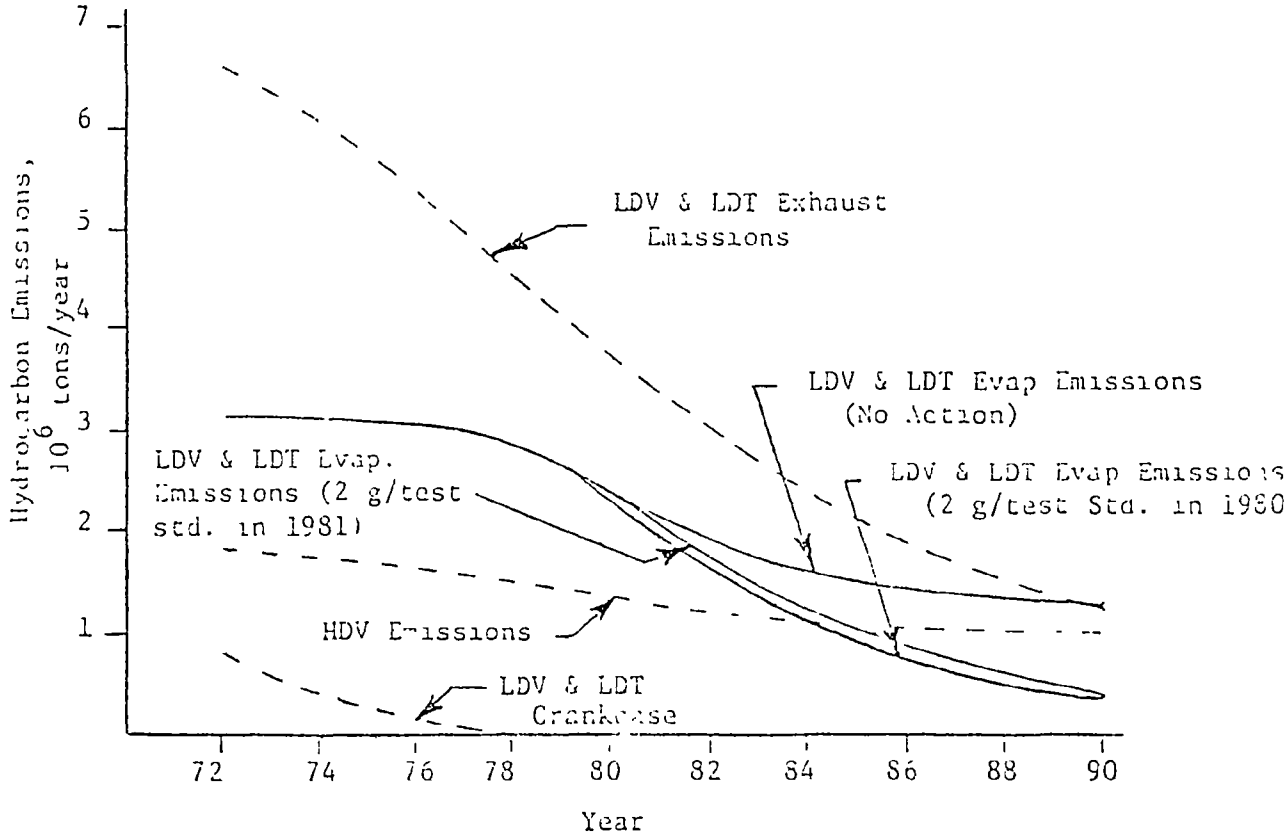

Figure IV-2

Projected Percentage of Mobile Source HC Emissions Attributable to Evaporative Emissions From Light Duty Vehicles and Light Duty Trucks

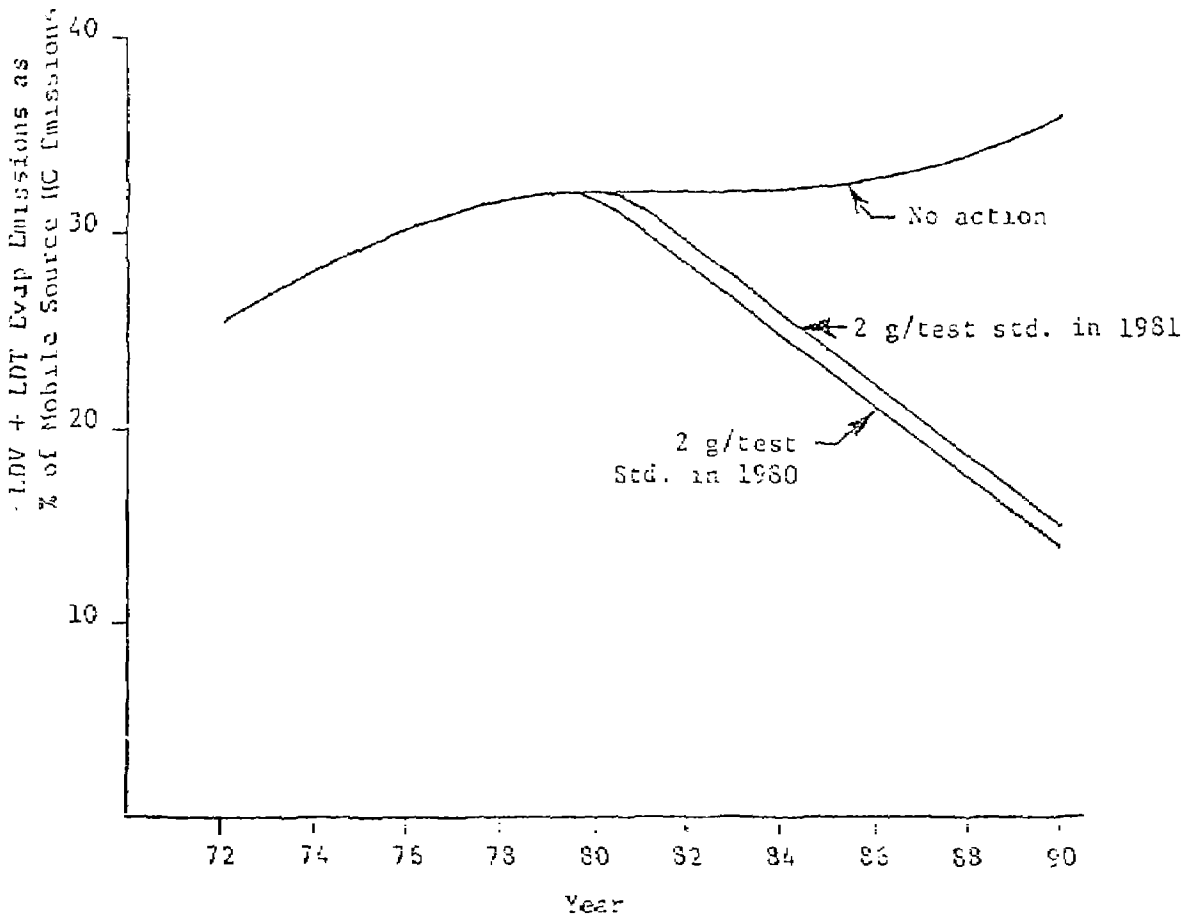

Figure IV-3

Projected Nationwide Hydrocarbon Emissions from Mobile Sources

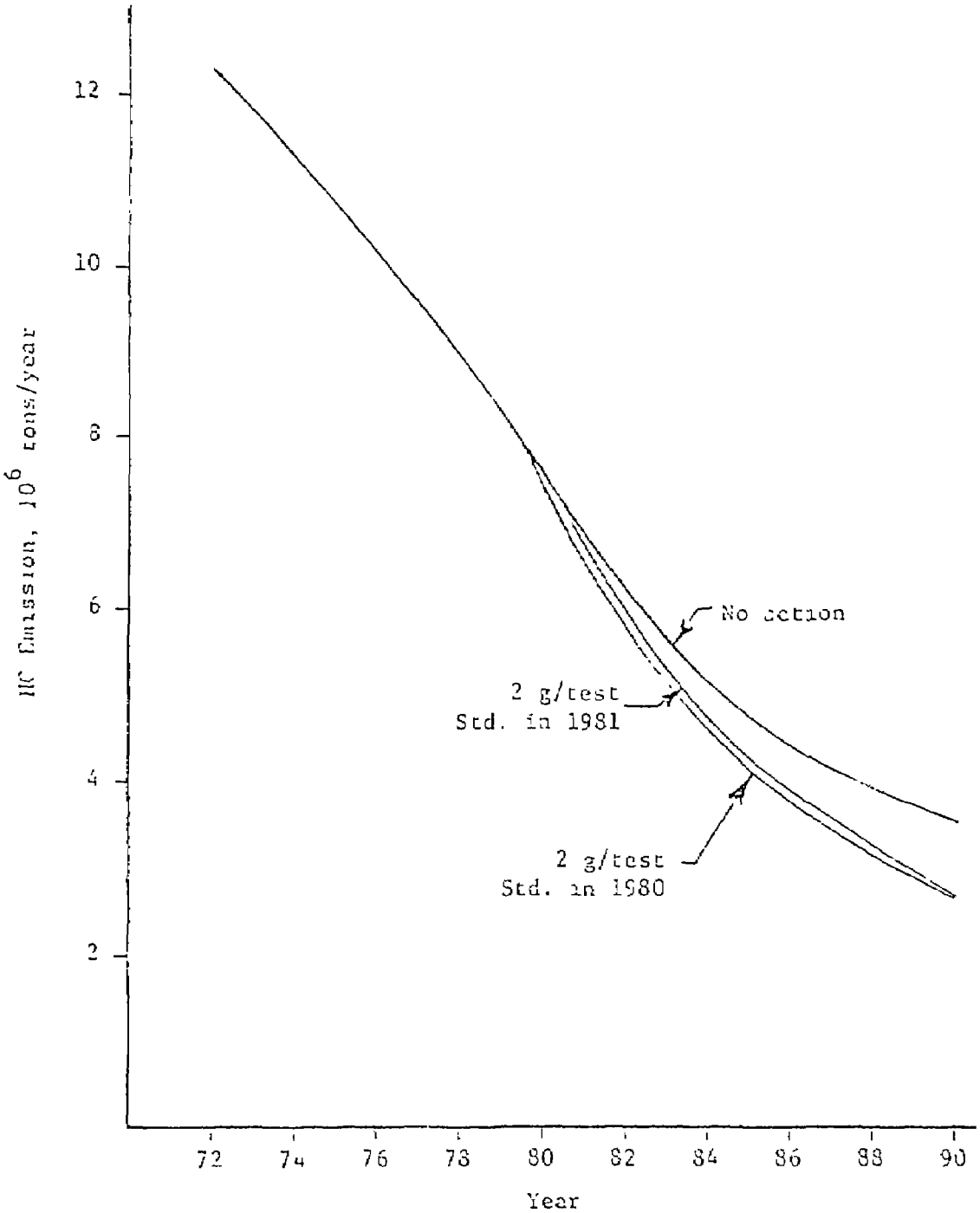

Figure IV-3 contrasts the effect of the alternative actions on nationwide hydrocarbon emissions from mobile sources from 1972 to 1990. It shows that, while emissions are expected to decrease significantly, larger reductions will be realized if evaporative emissions are further controlled by implementation of a 2.0 g/test standard. Using the data in Table IV-8 it is estimated that this regulations would decrease mobile source HC emissions by approximately 25% from levels that would occur if the 6.0 g/test standard were maintained.

Table IV-9 shows what reductions in hydrocarbons are expected by the year 1990. A 2.0 g/test standard implemented for 1981 and subsequent model years would lead to the reduction shown by the year 1990. The table also shows the reductions that will be realized by retaining through 1990 the 1978 6.0 g/test evaporative emission regulations, implementation of the exhaust hydrocarbon emission standard of 0.41 g/mile, and the implementation of an inspection maintenance program.

4. Impact on Selected Air Quality Control Regions

Analyses have been performed which indicate that many Air Quality Control Regions (AQCRs) will still be unable to meet established National Ambient Air Quality Standards for oxidants in 1985 and 1990. Some current non attainment areas are listed in Table IV-10. Four of these regions have been analyzed to show what the effects would be on the tons of HC emitted in

Table IV-9

Projected Nationwide HC Reduction in 1990

Action	Nationwide HC reduction in 1990 in 106 ton/year
Alternative Action I	-
Alternative Action II	0.9
Alternative Action III	0.88
1978 Evaporative Regulations 1/	2.9
Reduce LDV Exhaust Standard from 1.5 to 0.41 g/mile	1.9
Inspection Maintenance 2/	.88-3.1

1/ 2.0 g/test via carbon canister test procedure to 6.0 g/test via SHED test procedure.

2/ Source: Internal EPA memo from M. Williams to J. Lane, Aug. 18, 1975, assuming a 20% failure rate.

Table IV-10
Non-attainment Regions
with Population Greater Than 200,000

New York, New York -
Northeastern New Jersey
Los Angeles Long Beach, California
Chicago, Illinois - Northwestern
Indiana
Philadelphia, Pennsylvania
Detroit, Michigan
Cleveland, Ohio
Houston, Texas
Seattle - Everett, Washington
Miami, Florida
Kansas City, Missouri
Denver, Colorado
Phoenix, Arizona
Louisville, Kentucky
Norfolk - Portsmouth, Virginia
Oklahoma City, Oklahoma
Omaha, Nebraska
Salt Lake City, Utah
Tucson, Arizona
Mobile, Alabama
Little Rock, Arkansas

Source: List Complied by Control Programs Operations Branch,
Office of Air Quality Planning and Standards, EPA, February 1978.

Table IV-11

Hydrocarbon Emission Reductions in 1985

HC Emissions in 10^3 tons/year

	Mobile HC Sources			Total HC Sources			Levels Needed to Meet Ambient Air Quality Standa
	No Action	2g standard in 1980	Reduction	No Action	2g standard in 1980	Reduction	
Phoenix-Tuscon	52.3	46.3	5.0	175.1	169.1	5.0	87.3
Los Angeles	175.1	150 7	24.4	619.1	594.7	24.4	55 3
Denver	34.7	31.3	3.4	57.7	54.3	3.4	25.8
Houston Galveston	61 0	53.5	7.5	369.2	361.7	7.5	61.5

Table IV-12

Hydrocarbon Emission Reductions in 1990

HC Emissions in 10^3 ton/year

	Mobile HC Sources			Total HC Sources			Levels Needed to Meet Ambient Air Quality Stand
	No Action	2g standard in 1980	Reduction	No Action	2g standard in 1980	Reduction	
Phoenix-Tuscon	37.4	28.5	8.9	191.8	182.9	8.9	87.3
Los Angeles	141.8	103.8	38.0	694.2	656.2	38.0	
Denver	23.5	18.3	5.2	50.8	45.6	5.2	25.8
Houston-Galveston	45.6	34.2	11.4	421.8	410.4	11.4	61.5

1985 and in 1990 for the two extreme alternative actions considered; i.e., no control beyond 6.0 g/test (alternative I), and a 2.0 g/test standard beginning with 1980 model year (alternative II). As previously shown in the environmental impact analysis on a nationwide basis, there would not be a large difference in total HC atmospheric loading in 1990 between the 1980 implementation date the 1981 implementation date (alternative III).

The four AQCRs analyzed are Phoenix-Tucson, Los Angeles, Denver, and Houston-Galveston. Trends similar to the ones shown in Figures IV-1, IV-2 and IV-3 for national emissions exist for these AQCRS. More importantly, however, is what percent reductions in overall hydrocarbons will be achieved in these various regions due to implementation of a 2.0 g/test standard, and whether or not this will allow these regions to meet the oxidant ambient air quality standard.

Tables IV-11 and IV-12 show what the mobile and total hydrocarbon levels will be in 1985 and 1990, respectively, for the two alternative actions analyzed. Also, the hydrocarbon levels required to meet the oxidant ambient Air Quality Standard of .08 ppm/m^3 (one hour maximum) are given for each of the four AQCR's. These tables indicate that while a sizeable reduction in hydrocarbon emissions would be achieved, these regions will still be unable to meet the Ambient Air Quality Standards. (Note: This analysis assumes that that the LDV exhaust HC standard of 0.41 g was implemented with the 1978 model year rather than 1980, so the predicted levels of HC emissions in Tables IV-11 through IV-14 are somewhat lower than currently expected.)

Table IV-13 and IV-14 show the expected reduction in hydrocarbon emissions as a percent of mobile HC emissions, total HC emissions, and as a percentage of the emission levels needed to meet the Ambient Air Quality Standards by 1985 and 1990 respectively. Table IV-14 shows that implementing a 2.0 g/test standard will result in a 2.7 to 10.2 percent reduction in total hydrocarbon emissions in these air quality control regions.

Another way to examine the impacts of alternative emission control strategies on air quality control regions is to use a computer modeling approach. Using the modified rollback model[1/] it is possible to estimate the effect that a given emission control strategy will have on ambient oxidant concentrations in selected air quality control regions, as well as the number of regions that will exceed standards and the number of times the standards are exceeded. To conduct this analysis the emission factors for mobile sources given in the January 1978 revision to Supplement 5, AP-42, Compilation of Air Pollutant Emission Factors were used. (Summaries are given in Appendix A.) The revised Supplement 5 data represent the latest assessments of the expected emission performance of in-use vehicles. Since the updated emission factors differ from those used formerly, the results of the rollback model analysis and that of the four-region study just described may also differ significantly.

1/ N. de Nevers and R. Morris, "Rollback Modeling - Basic and Modified," presented at the annual meeting of the Air Pollution Control Association, June 24-28, 1973 Chicago, Illinois, Paper No. 73-139.

Table IV-13

HC Emission Reductions as %
of Mobile Sources, Total Sources and
Ambient Air Quality Standard in 1985

	HC Reductions Due to 2 g/test std. in 1980 (10^3 tons/yr)	HC Reductions as % of Mobile HC Sources	HC Reductions as % of Total HC Sources	HC Reductions as % of Ambient Air Quality Std.
Phoenix-Tuscon	5.0	9.6	2.9	5.7
Los Angeles	24.4	13.9	3.9	43.7
Denver	3.4	9.8	5.9	13.3
Houston Galveston	7.5	12.3	2.0	12.2
	Average	11.4	3.7	18.7

Table IV-14

HC Emission Reductions as %
of Mobile Sources, Total Sources and
Ambient Air Quality Standard in 1990

	HC Reductions Due to 2 g/test std. in 1980 (10^3 tons/yr)	HC Reductions as % of Mobile Sources	HC Reductions as % of Total HC Sources	HC Reductions as % of Ambient Air Quality Std.
Phoenix-Tuscon	8.9	23.8	4.6	10.2
Los Angeles	38.0	26.8	5.5	68.2
Denver	5.2	22.1	10.2	20.1
Houston-Galveston	11.4	24.9	2.7	18.4
	Average	24.4	5.8	29.2

Forty eight AQCRs were studied in this analysis. The results of the analysis on a regional basis are shown in Table IV-15. The total HC emissions in 1990 with and without implementation of the 2.0 g/test evaporative emission standard in 1981 are given. The total reductions of HC emissions in 1990 for these regions is 311.7 thousand tons if a 2.0 g/test evaporative standard is promulgated. This represents a 15.7% reduction in mobile source emissions and a 3% reduction in total HC emissions for these 48 regions. For individual regions, the reduction in total HC emissions ranged from 0.8 to 5.9%.

The reduction in hydrocarbons for the regions studied will result in an additional 2 percent reduction in oxidant air quality concentrations from levels that would occur without the more stringent evaporative standard. Table IV-16 shows that if the 6.0 g/test standard were retained through 1990, the oxidant concentration in that year would be reduced 35 percent from the levels measured in the base year (1975). However, if a 2g/test standard is promulgated, oxidant concentrations would be reduced by 37 percent. It should be noted that this 37 percent reduction is obtained whether the 2.0 g/test standard is promulgated in 1980 or 1981.

Table IV-17 shows that with the more stringent evaporative HC standard, 3 additional air quality control regions would meet ambient standards for oxidants in 1990. Further, there would be 403 fewer violations of the oxidant standard, a reduction of 10.3%.

Table IV-15

1990 Hydrocarbon Emissions (tons x 10^3)
48 Air Quality Control Regions [a]

Regions	Emissions from Mobile Sources (with a 2g std in 1981)	Emissions from All Sources (with a 2g std in 1981)	Emissions from All Sources (without 2g)	Reduction (tons)	Reduction (As % of total Emissions)
1. Birmingham	24.0	324.0	327.4	3.4	1.0
2. Pensacola	35.0	185.0	190.9	5.9	3.1
3. Clark-Mohave	6.2	20.7	22.0	1.3	5.9
4. Phoenix-Tucson	28.8	103.3	108.9	5.6	5.1
5. Los Angeles	64.0	857.5	887.9	30.3	3.4
6. Sacramento Valley	9.2	73.0	77.3	4.3	5.6
7. San Diego	26.2	63.0	67.4	4.4	6.5
8. San Francisco	83.4	241.3	255.4	14.1	5.5
9. San Joaquin	33.7	118.8	124.6	5.8	4.7
10. Se Deserto	2.6	8.1	8.5	0.4	4.7
11. Denver	29.7	83.5	88.0	4.5	5.1
12. Ny-NJ-Conn	188.0	986.8	1021.0	34.2	3.3
13. Philadelphia	79.5	442.8	456.0	13.2	2.9
14. Nat. Capital	48.1	158.0	166.6	8.6	5.2
15. Chicago	77.2	584.1	598.2	14.1	2.4
16. St. Louis	43.1	205.1	212.0	6.9	3.3
17. Cincinnati	25.4	172.9	177.3	4.4	2.5
18. S. Lou/S.E. Tex	46.2	726.3	734.3	8.0	1.1
19. Baltimore	31.4	216.6	222.2	5.6	2.5
20. Boston	42.5	182.9	190.4	7.5	3.9
21. Minn - St. Paul	31.8	195.5	200.7	5.2	2.6
22. El Paso	7.0	28.7	30.0	1.3	4.3
23. Consse-Fngr Lakes	15.2	75.3	78.1	2.8	3.2
24. Dayton	18.1	85.5	88.7	3.2	3.6

Table IV-15 Continued

25. Portland	36.4	147.8	153.6	5.8	3.8
26. S.W. Penn	40.5	152.9	159.7	6.8	4.3
27. Corpus-Christi	7.6	167.2	168.6	1.4	0.8
28. Dallas-Ft. Worth	37.6	237.2	243.1	5.9	2.4
29. Houston Galston	30.4	540.5	545.8	5.3	1.0
30. Puget Sound	27.0	104.7	109.4	4.7	4.3
31. Hartford	45.6	148.9	157.4	8.5	5.4
32. W. Cent. Fla	34.0	99.0	104.6	5.6	5.4
33. Atlanta	25.1	107.6	112.2	4.6	4.1
34. Louisville	10.8	96.6	98.4	1.8	1.8
35. Indianapolis	20.8	80.9	84.2	3.3	3.9
36. Metro Omaha	11.3	101.9	103.4	1.5	1.5
37. Providence	32.0	131.5	137.0	5.5	4.0
38. Merrimack Val	20.7	98.5	102.2	3.7	3.6
39. Detroit	76.6	403.9	416.9	13.0	3.1
40. Rochester	21.7	73.8	77.4	3.6	4.7
41. Del Valley	28.7	130.5	135.3	4.8	3.5
42. Central N.Y.	16.0	69.0	71.9	2.9	4.0
43. Hudson Valley	24.2	78.7	83.1	4.4	5.2
44. Niagara	16.5	76.7	79.7	3.2	4.0
45. Charlotte	18.1	78.9	81.7	2.8	3.4
46. Cleveland	52.8	326.3	335.8	9.5	2.8
47. Columbus	18.7	75.6	79.0	3.4	4.3
48. S.E. Wisconsin	29.4	274.0	278.7	4.7	1.7
Total	1,678.8	9,941.4	10,252.9	311.7	–

a/ Emission inventories taken from "Evaluating the Air Quality Impacts of Alternative Evaporative Emissions Control Strategies," Office of Air Quality Planning and Standards, EPA, March 1978.

Table IV-16

Average Percentage Reduction in Oxidant Air Quality Concentrations From Base Year L975 [a]

	1981	1985	1990
6.0g 1978-1990	14	27	35
6.0g 1978-1979, 2g 1980+	14	28	37
6.0g 1978-1980, 2g 1981+	14	28	37

a/ Source: "Evaluating The Air Quality Impacts of Alternative Evaporative Emissions Control Strategies," Office of Air Quality Planning and Standards, EPA, March 1978.

Table IV-17

	Number of Cities Above Standard	Total Number of Violations
6.0g 1978-1990	38	3909
6.0g 1978-1989; 2.0g 1980+	35	3506
6.0g 1978-1980; 2.0g 1981+	35	3506

a/ Source: "Evaluating The Air Quality Impacts of Alternative Evaporative Emission Control Strategies," Office of Air Quality Planning and Standards, EPA, March 1978.

B. Secondary Environmental Impacts

This section deals with the secondary environmental impacts of the alternative actions. The secondary impacts that are discussed are 1) the effect on energy consumption, 2) the possible interactive effect of evaporative emissions and exhaust emissions, and 3) the potential impact on water and solid waste pollution.

1. Energy Consumption

No change in energy consumption is anticipated through the promulgation of these regulations. Specifically, no increase in fuel consumption is expected as this should be relatively independent of the manufacturer's choice of evaporative control technology. Considering the fuel which is now lost to the atmosphere by evaporation, but which could be burned in the engine with evaporative control, it is possible that evaporative emission control could conserve fuel.

Most evaporative control systems expected to be used to meet either a 6.0 or 2.0 g/test standard use a canister containing activated carbon. Fuel vapors from the fuel tank and the carburetor fuel bowl are vented to this canister during periods when the engine is not running. These fuel vapors are purged out of the canister during vehicle operation. Reducing the standard to 2.0 g/test will decrease the amount of vapors lost to the atmosphere by .45 g/mi on the average. If a vehicle lifetime is assumed to be 100,000 miles, then this reduction would, over

the lifetime of the vehicle, amount to approximately 15 gallons of fuel not lost to the atmosphere. Actual savings may be less than that. (See discussion in Chapter V, Section A-2).

2. Exhaust Hydrocarbon Emission Interaction

Depending on the design of the evaporative control system used to meet a 2.0 g/test standard, an interaction can occur due to the purging of additional evaporative emissions into the engine which will cause additional exhaust hydrocarbons and carbon monoxide to be generated from the combustion process. Whether or not this occurs is dependent on the rate and the total amount of hydrocarbons purged into the engine and the operating condition of the vehicle when purging takes place. These interactions need not occur with proper utilization of existing control technology. Therefore, this rulemaking is not expected to have any measurable effect upon exhaust emissions.

3. Water Pollution and Solid Wastes

The problem of evaporative emissions is one which affects the air quality, and it is not one which should have any significant effect on water quality. Similarly, no effect on the quantity or quality of solid wastes is expected. This is equally true of the control of hydrocarbon emissions by the implementation of the alternatives discussed dealing with controlling exhaust hydrocarbons.

Chapter

Costs of Control and Its Impact on Consumers, Industry, and Government

A. Impact on Consumers

From the consumer's perspective the cost of controlling emissions consists of two elements. First, there is a charge levied on the consumer by the vehicle manufacturer to cover the costs of the emission control system. This is annually done by increasing the "sticker" price of the vehicle. Secondly, the consumer must pay for any additional cost to operate and/or maintain the vehicle due to any change made to the vehicle, in order to reduce emissions.

1. Initial Costs

The initial cost to the consumer which is reflected in a higher sticker price, is due to the costs of research and development, production, design, raw materials, manufacturing and markup (profit) of any required component change or addition to the vehicle. The actual cost, of course, will vary from vehicle to vehicle depending upon the technologies used to meet a 2.0 g/test standard in 1981.

A study of the cost of achieving a 2.0 g/test emission level has been conducted by Exxon Research and Engineering Company under EPA contract (No. 68-03-2172)[1/]. In this study, six 1973-75 production vehicles which represented the four major U.S. light-duty vehicle manufacturers and two foreign manufacturers, were modified in order to reduce evaporative emissions. Costs for the required modifications were then estimated. The resulting sales weighted retail price increase to reduce evaporative emissions from a 6.0 g/test level to a 2.0 g/test level on each vehicle was estimated to be $1 per vehicle. (1976 dollars)

A further study done by EPA [2/] evaluated the cost of manufacturer developed control systems which have given test results of less than 2.0 g/test. The component costs used were the same as those used in the Exxon study. This evaluation concluded that the sales weighted retail price increase would be $5 per vehicle to go from a 6.0 g/test level to a 2.0 g/test level. (1976 dollars)

Therefore, it has been concluded that the incremental retail price increase will be between $1 and $5 per vehicle. This is in agreement with EPA's original estimate of $3.70 contained in the NPRM.

1/ Clarke, P.J., "Investigation and Assessment of Light-Duty Vehicle Evaporative Emission Sources and Control", Exxon Research and Engineering, EPA Contract #68-03-2172, June 1976.

2/ "Cost Effectiveness of a 2.0 g/test SHED Evaporative Standard for Light-Duty Vehicles and Trucks," Issue Paper by Michael W. Leiferman, U.S. EPA, Ann Arbor, Michigan, June 1976.

To estimate a wholesale price increase (to be used in calculating the drop in vehicle sales), the estimated retail price increase ($1 - $5 per vehicle) should be reduced by 22%. This value is based on the historical dealer discount structure for General Motors. 3/ The wholesale price increase would therefore be $0.80 - $3.90 per vehicle. (1976 dollars)

To inflate the $1-5 dollar per vehicle cost of compliance obtained in the Exxon Research and EPA studies to be representative of 1978 prices, the Transportation Price Index (from the Survey of Current Business) was used. The resultant cost range is $1.10 to $5.55. Because it is impractical to anticipate what these costs will be in 1981 through 1985, the 1978 costs were used to calculate the aggregate five year costs of compliance for this regulation.

Table V-1 shows the total cost of U.S. consumers between 1981 and 1985 based on a retail price increase of $1.10-$5.55 per vehicle. This cost was multiplied by the projected sales figures for light-duty vehicles and light-duty trucks during those years. The projected sales of light-duty vehicles were generated by the econometrics model used by Data Resources, Inc. Since similar econometrics modeling of light-duty vehicle trucks has not been accomplished at this time, it was

3/ Discount data presented in Automotive News, August 10, 1975.

Table V-1

Projected Sales and Incremental
Cost of Control for a 2.0 g/test Standard

Year	U.S. Sales (millions) LDV[1/]	LDT[2/]	LDV & LDT	Incremental Cost to the consumer ($ million)[3]
1981	12.0	3.0	15.0	16.5 - 83.3
1982	11.6	2.9	14.5	16.0 - 80.5
1983	11.4	2.8	14.2	15.6 - 78.8
1984[4]	11.4	2.8	14.2	15.6 - 78.8
1985[4]	11.4	2.8	14.2	15.6 - 78.8
			72.1	79.3 -400.2

1 "Data Resources Inc. - U.S. Long Term Bulletin - Winter 1976" p. 20.

2 Predicted values are based on the assumption that LDT market will be 25% of the size of the LDV market as it as in 1974 as reported in "Automotive News Almanac",1975.

3 Based on a retail cost increase of $1.10-$5.55 per vehicle for a 2.0 g/test standard in 1981.

4 Sales projections for 1984 and 1985 were not available. It was assumed, therefore, that sales would be the same as in 1983.

assumed that the light-duty truck market would be 25% of the size of the light-duty vehicle market during that period, as it was in 1974. The trend in sales in the last few years shows an increasing percentage of light-duty trucks being purchased, so the sales estimate may be conservative.

One limitation of the analysis shown in Table V-1 is of course the assumption that the costs of the pollution control system will remain constant over time. Tending to reduce consumer costs are the cost saving engineering developments which are likely to occur as manufacturers gain more experience in using the system. Tending to increase costs to the consumer are the persistent increases in material costs that are likely to occur in the future. Accurate predictions of how these factors will affect the cost estimates made in this chapter are virtually impossible to make and thus the constant dollar assumption is used.

Another factor which should be considered in estimating aggregate costs of pollution control is the assumption that essentially all light-duty trucks and passenger cars will use gasoline engines. Currently such an assumption is valid as practically all light-duty vehicles and light-duty trucks do use gasoline engines. However, some manufacturers are introducing Diesel engines in light-duty vehicles and light-duty trucks. The extent to which Diesel engines are used in the future could tend to reduce EPA estimates of the aggregate costs of controls, as Diesel fuels have a very low volatility, resulting in very low evaporative emissions. It should be noted at this point that this regulatory action does not include Diesel powered light-duty trucks and light-duty vehicles for

this reason.

The data in Table V-1 also assume that all cars will have to be equipped with additional control components not used in prior model years. However, certification data for the 1978 model year indicate that many vehicles already have achieved control of evaporative emissions to the 2.0g level. These cars will not have to be equipped with any new equipment in 1981 to meet the 2.0g standard, and so for these vehicles there is no cost associated with the implementation of this standard. Therefore total costs in actuality may be considerably lower than the 79-400 million dollars estimated.

2. Fuel Consumption

The fuel control devices used for the containment of evaporative hydrocarbon emissions present no degrading effect on fuel economy and depending on the control strategy used, a cost savings due to fuel saved could occur. As was discussed in Chapter IV, a potential savings of 15 gallons of fuel over the vehicle lifetime could occur due to the trapping of fuel vapors and their subsequent burning in the engine. At current gas prices of around $.60 per gallon this represents a potential lifetime savings of $9. However, this estimate assumes that all of the fuel trapped would be used efficiently. The actual use of this trapped fuel would probably be somewhat less due to inefficiencies of the evaporative emission control system used. Since it is unkown how much could actually be saved, it will be assumed that no savings will be realized.

3. Maintenance Costs

Current systems are designed to last the lifetime of the vehicle without replacement or major maintenance of system components. Thus, for systems expected to be used to meet a 2.0 g/test standard, no maintenance cost should be encountered. Therefore, the initial cost to the consumer is the only cost he should have to bear as a result of this rulemaking.

B. Impact on Industry

Manufacturers are faced with two tasks as a result of this rulemaking. First, they must adapt existing or develop new control systems to accomodate their various models of light-duty vehicles and light-duty trucks. Secondly, they must minimize the cost of additional control devices and/or modifications to existing devices in order to minimize its potential adverse impact on sales if passed in the form of higher vehicle prices or lower profits if the costs are absorbed.

1. Sales

The first task is the most critical. Evaluations have been made which show that for the industry as a whole technology is available or can be developed by 1981 which can achieve 2.0 g/test levels for

both light-duty vehicles and trucks.[4/] Further sufficient lead lead time exists for manufacturers to meet a 2.0 g/test standard for essentially all 1981 model year vehicles.[5/]

It is expected that increased production costs to the manufacturer will be passed on to the consumer as stated earlier. Thus, the cost to the motor vehicle industry will not directly be due to the cost of control, but rather due to any decrease in sales resulting from adverse consumer reaction to increased sticker prices. Generally, it can be stated that sales are inversely proportional to price changes. The degree of sensitivity to price changes is indicated by the price elasticity index. A price elasticity, for example, of .3 would indicate that a 1% increase in price would result in a 0.3% decrease in sales. For the purposes of this study the price elasticity for motor vehicles is assumed to be .88.[6/]

The average wholesale price of a 1978 model year light-duty vehicle or light-duty truck was approximately $4,000. Based on this unit price, the price increase due to evaporative controls, and assuming a price

4/ "Technical Feasibility of a 2.0 g/test SHED Evaporative Emission Standard for Light-Duty Vehicles and Trucks", Issue Paper by Michael W. Leiferman, U.S. EPA, Ann Arbor, Michigan, June 1976 (Revision November 1977).

5/ "Lead Time Requirments for an Evaporative Emission Standard for 2.0 g/test for Light-Duty Vehicles and Trucks", Issue Paper by Michael W. Leiferman, U.S. EPA, Ann Arbor, Michigan, June 1976 (Revision November 1977).

6/ "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption, "Prepared for CEQ by Chase Econometric Associates, May 1974, p.4.

elasticity index of 0.88, the sales drop in sales can be predicted. Table V-2 summarizes such an evaluation. Table V-3 shows the drop in actual sales for 1981 through 1985 for an assumed price elasticity of 0.88. As can be seen from Tables V-2 and V-3 the expected drop in sales due to the implementation of a 2.0 g/test standard in 1981 is very small compared to overall sales.

One manufacturer, GM, has indicated that it will have to expand its production capacity in order to comply with the 1981 2.0g/test standard. This extra plant capacity is for production of evaporative emission control equipment in sufficient numbers to equip all GM model trucks and passenger cars. No estimate of the capital costs GM will incur to expand its capacity was provided by that firm.

This manufacturer has also claimed that it may encounter some difficulty designing its vehicles to achieve a 2.0 g/test evaporative emission standard. This is especially true for the larger light-duty trucks (6,000-8,500 pounds GVWR) in their product line which customers may wish to purchase with optional larger fuel tanks (about 25% of sales according to GM). Representatives of GM at several meetings with EPA personnel (See Appendix B for summaries of these meetings) have indicated a belief that a 2.0 g level may not be achieved for trucks with gas tank capacities of about 40 gallons due to inadequate canister systems. The EPA technical staff, however, has concluded that these problems are not insurmountable. Other manufacturers, noteably the Ford Motor Company, have told EPA that they intend to develop technologies sufficient to achieve a 2.0 g/test level

Table V-2

% Drop in Sales Due to Evaporative Controls

Action Taken	Retail Price Increase ($)1	% Increase in Retail Price	% Drop in Sales[2]
Alternative Action I (No Action)	-0-	-0-	-0-
Alternative Action III (2.0 g/test Std. in 1981)	$1.10-$5.55	.02-.14	.02-.12

1) 1978 dollars

2) Based on price elasticity of 0.88 from "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p.4.

Table V 3

Drop in Actual Sales of Light-Duty Vehicles and Trucks
Due to Evaporative Controls from 1981 to 1985

Action Taken	1981	1982	1983	1984	1985
Alternative Action I (No Action)	-0-	-0-	-0-	-0-	-0-
Alternative Action III (2.0 g/test Std. in '81)	3,200-16,000	3,400-16,000	3,200-16,000	3,200-16,000	3,200-16,000

1) Based on sales projections presented in Table V-1 and a price elasticity of 0.88 from "The Effect of Tax and Regulatory Alternatives on Car Sales and Gasoline Consumption," Prepared for CEQ by Chase Econometric Associates, May 1974, p. 4.

by 1981, even for trucks with larger than normal fuel tank capacities (See Appendix B). Further, GM has told EPA that it has tested 2 vehicles with 40 gallon tanks that achieved control levels of 2.35 and 2.85 grams per test (using 2,500 cc canisters and an air filter with activated charcoal). Therefore, EPA concludes that control systems should be available by 1981 which will permit GM to meet the 2.0g/test standard for most, if not all, of their model line options including the heavier light-duty trucks. It may be, however, that GM may not be able to optimize their evaporative emission control system by that time so that they can continue to offer to buyers of new light-duty trucks optional larger fuel tank capacities. With time such optimization should be possible and GM would again be able to continue to offer auxiliary tanks for sale on its vehicles. But for some period GM may suffer lost sales and revenues (if consumers buy trucks from other manufacturers who have been successful in certifying trucks equipped with larger tanks) or lost revenue (if consumers elect to buy the GM truck anyway, but forego the purchase of the optional fuel tank from GM). The extent to which this will effect the revenue and profitability of GM are impossible to predict with any accuracy, but are likely to be inconsequential.

2. Competitive Structure

The effects of these regulations on the competitive structure of the light-duty vehicle or light-duty truck industries are expected to be minimal. Historically, the market shares shown in Tables III-2 and III-3 in Chapter III have been quite stable and a minor price increase of up to .12% would not be expected to have any effect.

3. Development and Certification Costs

The manufacturer's cost of developing and implementing specific control systems can not be separately determined. However, the development cost per vehicle vehicle should be very small compared to the $1 - $5 estimated vehicle retail price increase. Some development costs will have been incurred as part of manufacturers' efforts to meet the California 2.0 g/test standard in 1980.

The cost of certifying vehicles at 2.0 g/test rather than a 6.0 g/test emission level should also be minimal. Many vehicles are already performing at less than a 2.0 g/test level. These vehicles should not have to be recertified. Still others may have achieved the 2.0 g/test level of control by 1981.

4. Potential Impact on Employment

No production plant closures by any manufacturer of light-duty vehicles or light-duty trucks are anticipated due to the implementation of these regulations. The decrease in sales due to increased vehicle prices discussed earlier is expected to be very small and therefore its impact on employment at worst is expected to also be very small.

It is likely that increased engineering and manufacturing effort will be required to provide the new control systems. As noted earlier, GM has said that it will expand plant capacity to produce the required control systems thereby creating new jobs. However, little effect on the size of the overall work force is expected to occur. Generally the control devices required will be modifications or redesigns of existing devices and, thus, the major work effort will be in the engineering and skilled trades labor force.

C. Government Costs

This rulemaking will not significantly affect the Government's cost of vehicle certification, since the test methodology is unchanged, and the number of tests are essentially independent of the level of control.

D. National Annualized Cost and Capital Investment over 5 Years

The national annualized cost of attaining a 2.0 g/test standard for 1981 and subsequent model year vehicles is estimated to be between $12

million* and $62 million* by the fifth year of implementation, 1985. Since there is no change in operating or maintenance cost associated with this action, the annualized cost is based entirely upon the annualized cost of five model years of control systems for cars and light-duty trucks assuming a 10 year useful life (i.e., the value of the vehicle at the end of 10 years is zero) and a 10% annual interest rate.

The national gross capital investment over the first five years is estimated to total between $79 million* and $400 million*. This compares to a projected $280 billion* in retail sales of new cars and light-duty trucks during the same time period, i.e., 1981-1985.

* 1978 dollars

Chapter V'

Cost Effectiveness

One of the goals of the Mobile Source Air Pollution Control activity is to obtain clean air at minimum cost to society. For effectiveness in implementing this goal, a mechanism is needed by which the relative cost and effectiveness of the various mobile source emission control strategies can be assessed. Cost effectiveness (CE) is such a mechanism by which to assess the cost per unit of desired result. In this case, cost effectiveness is expressed in terms of dollars spent to prevent one ton of pollutant from entering the atmosphere. Once cost effectiveness is calculated for a series of control strategies, the strategies can be compared. The most efficient strategy is the one with the lowest cost necessary to control a ton of pollutant. In addition to the cost effectiveness of given strategies, the amount of control available by the strategies and the amount of control required to meet the air quality goal must also be known. A given strategy may be very cost effective but not provide much pollution control. Alternately, a strategy might provide a large amount of pollution control but not be cost effective. Ideally, those strategies which are both cost effective and which control large amounts of pollutants should be implemented first. Other strategies would be implemented as needed to meet air quality goals.

The most appropriate measure of the societal cost of control is the cost that the consumer must bear. This cost consists of an

initial cost caused by an increase in the manufacturer's suggested retail price and a continuing cost which consists of the support or maintenance cost per unit of operation (e.g., per mile) for the life of the vehicle. For this rulemaking, the incremental operating costs are expected to be zero. The initial cost will consist of the cost to the manufacturer to attain the required control plus a mark-up (profit) which is at the discretion of the manufacturer.

The measure of effectiveness of control can most appropriately be determined by comparing the emission per unit of operation (per mile) from vehicles representing the appropriate level of control. The difference between the two represents the amount of control (i.e., the mass per unit of operation (g/mile)) which is gained by the control strategy. The cost effectiveness (CE), then, is the ratio of the total vehicle cost to the total pollution controlled:

$$CE(\$/ton) = \frac{\text{Initial Cost} + [(\text{Operating Cost, } \$/\text{mile}) \times (\text{Total lifetime distance, mi})]}{(\text{Reduction in emissions, tons/mile}) \times (\text{Total lifetime distance, mi})}$$

For this cost effectiveness analysis, the assumption was made that an average vehicle or truck will last 10 years and travel 100,000 miles during that time. The assumption used for other mobile source control strategies, that the deterioration factor will remain constant over the 100,000 mile life of the vehicle, will be used here. This means that, when the vehicle meets the certification requirements at 50,000 miles, the average emission rate for the entire 100,000 mile period will be at or below the standards.

The equivalent g/mi reductions in emissions for light-duty vehicles and light-duty trucks are shown in Table VI-1. For the cost effectiveness analysis it will be assumed that by 1990 all vehicles will be emitting at an evaporative level of 2.0 g/test (equivalent to .15g/mile), and at statutory exhaust hydrocarbon emission level (0.41 g/mile). This assumption is based on the fact that almost all vehicles on the road in 1990 will have been certified at those levels and that the proportion of vehicles old enough to have been certified at higher levels (1979 and earlier model year vehicles) will be relatively small.

Table VI-2 gives the cost and cost effectiveness for controlling a light-duty vehicle or truck to the various levels discussed. Also included are the cost effectiveness figures for the 6.0 g/test standard assuming a SHED test measurement technique, the cost effectiveness of going to the statutory exhaust HC level for light-duty vehicles from a 1.5 g/mi standard, and the cost effectiveness of an Inspection-Maintenance program. These other control strategies are included for additional comparison with the alternative evaporative control actions to show their relative cost effectiveness. The cost effectiveness of alternative action III and achieving statutory exhaust HC levels is in each case based on the composite LDV, LDT reductions from Table VI-1 and the costs shown. Comparison can also be made with various strategies for control of HC emissions from stationary sources by referring back to Table II-1 in Chapter II.

Table VI-1

Reductions in HC Emissions from Light-Duty Vehicles and Light-Duty Trucks

	Light-Duty Vehicles		Light-Duty Trucks		Composite LDV + LDT[1]	
	g/mi	g/mi reduction	g/mi	g/mi reduction	g/mi	g/mi reduction
Current Evaporative Emission levels (6 g/test Evap. Standard)	0.60	----	0.60	----	0.60	----
2 g/test Evap. Standard	0.15	0.45	0.15	0.45	0.15	0.45
Current LDV Exhaust Emission Standards	1.50	----				
Statutory LDV Exhaust Emission Level	0.41	1.09				

[1] Based on vehicle miles travelled by light-duty vehicles being 87.2% of total vehicle miles travelled by light-duty vehicles and light-duty trucks

Table VI-2

Per Vehicle Cost and Cost Effectiveness
of Alternative Actions

	Per Vehicle Cost of Control	Cost Effectiveness $/ton HC
Alternative Action I (No Action)	--	--
Alternative Action III (2.0 g/test Std. in 1981)	$1 - $5	20-100
1978 Evap. Regulations[1]	$7.30	50
LDV Exhaust HC Emissions to Statutory Level[2]	$62 - $164	500-1400
LDT Exhaust HC Emissions[3] (2.0 to 1.7 g/mile & expand class to 8,500 lbs. GVWR)	$220[3]	$200
HDV Exhaust HC Emissions	$120	$154
Inspection Maintenance	--	$58-408

[1] "Environmental and Inflationary Impact Statement - Revised Evaporative Emission Regulations for the 1978 Model Year", Aug. 1976.

[2] Source: "Analysis of Some Effects of Several Specified Alternative Automotive Emission Control Schedules", prepared jointly by EPA, DOT and FEA, April 8, 1976, p. 15. Assumes cost to achieve statutory levels for CO and HC are equally split, (i.e., 50% for CO, 50% for HC). Large range is due to the large range of expected lifetime costs (which includes initial costs, fuel costs, and maintenance costs).

[3] Source: "Environmental Impact Statement - Emission Standards for New Light-Duty Trucks", November 29, 1976. Cost of $220 is to bring 6,000 to 8,500 lb. trucks into compliance. $8 for all others.

[4] Source: "Environmental Impact Statement and Economic Impact Analysis - Revised Heavy-Duty Engine Regulations for 1979 and Later Model Years", August 4, 1977.

[5] Source: Internal EPA memo from M. Williams to J. Lane, Aug. 18, 1975, assuming a failure rate of 20%.

Other General Considerations

A. Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitment of resources is caused by this rulemaking. This rulemaking action will not cause any fuel consumption penalty, and commitment of resources such as steel, aluminum, and carbon for the evaporative emission control systems is so small as to be completely over-shadowed by normal market fluctuations.

B. Relationships of Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

This rulemaking will result in immediate reduction of hydrocarbon emissions from new light duty vehicles and light duty trucks and, as older vehicles are replaced with newer vehicles meeting the revised evaporative emission standards, will result in significant reductions in levels of oxidants in the ambient air. This reduction will also be beneficial and aid in the long term maintenance of ambient air quality levels.

No short term or long term losses to the environment are associated with this rulemaking. The timing and stringency of the standards are aimed entirely at the maximum reduction in evaporative hydrocarbon emis-

sions in the shortest time period tha will not result in undue economic dislocation to the light duty vehicle and light duty truck industry.

Chapter VIII

Problems and Objections Raised by Federal, State, and Local Agencies, and Other Persons

Comments were received on the Draft Environmental Impact Statement for the Revised Evaporative Emission Regulations for 1978 and Subsequent Model Years from private industry, the Council on Wage and Price Stability, and the Department of Commerce. The comments regarding a 2.0 g/test standard focused on the issues of Feasibility, Lead Time, Cost, and Cost Effectiveness of a 2.0 g/test standard. The comments on the issues of Feasibility, Lead Time, and Cost were analyzed in detail in the Summary and Analysis of Comments paper supporting this rulemaking and in three issue papers on those subjects.[1,2,3]

The following is a summary of those discussions:

1. Test results on production and modified vehicles show that an evaporative emission standard of 2.0 g/test (including stabilized background) is technically feasible;

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[1] "Technical Feasibility of a 2.0 g/test SHED Evaporative Emission Standard for Light-Duty Vehicles and Trucks," Issue Paper by Michael W. Leiferman, U.S. EPA, Ann Arbor, Michigan, June 1976.

[2] "Lead Time Requirement for an Evaporative Emission Standard of 2.0 g/test for Light-Duty Vehicles and Trucks", Issue Paper by Michael W. Leiferman, U.S. EPA, Ann Arbor, Michigan, June 1976 (Revision November 1977).

[3] "Cost Effectiveness of a 2.0 g/test SHED Evaporative Standard for Light-Duty Vehicles and Trucks", Issue Paper by Michael W. Leiferman, U.S. EPA, Ann Arbor, Michigan, June 1976.

2. Due to the time requirement for equipment definition, design, development and production, the proposed 1979 implementation date is impossible and implementation for the 1980 model year appears impractical. It is recommended that the 2.0 g/test standard be promulgated for the 1981 model year;

3. The incremental sales weighted increase in the retail vehicle price is expected to be between $1 and $5 per vehicle.

Comments received on the issue of cost effectiveness from the Council on Wage and Price Stability have not been analyzed in the above mentioned documents, and will, therefore, be dealt with in detail here. The following is a summary of the comments from the Council on Wage and Price Stability:

> "The Council has reviewed the EPA's economic analysis and has concluded that it indicates that these regulations are, for the most part, cost effective. There are, however, several points that the Council would like to see addressed by the EPA before these standards are promulgated."

There is some disagreement regarding the increased price that will result from the 2.0 g/test standard. EPA estimates the cost at $11, but one manufacturer (Chrysler) gave the Council an estimate of $50 (costs to go from current levels to 2.0 g/test level). If the cost of a 2.0 g/test system is $50, the incremental cost in

going from 6.0 g to a 2.0 g standard would be $854/ton as opposed to the $74/ton incremental cost estimate of EPA. The Council urges that EPA resolve this cost effectiveness issue before a decision is rendered on the 2.0 g/test standard.

Cost data provided by the EPA for the incremental cost per ton of hydrocarbon pollutants removed includes $29/ton for HDV interim exhaust emission standards, $226/ton for LDT interim exhaust emission standards, $303 for LDV federal interim exhaust emission standards, and $515/ton for the 1978 federal statutory levels for LDV's and LDT's. In view of these estimates, it would seem more cost effective to impose the stricter HDV exhaust emissions standards before imposing a 2 g/test evaporative emission standard on LDVs and LDTs.

"The Council would also urge EPA to consider the economic feasibility of a 2 g/test standard using a SHED procedure that includes background emissions. ...In other words, it is the Council's position that this technical element of the proposed standards be evaluated in a cost effective manner and that the benefits be weighed against the costs before a definitive decision on including background emissions in a 2 gram/test standard using SHED is made."

"Another issue that the Council urges EPA to consider more explicitly in its deliberations on the 2 g/test standard is whether or not the incremental benefits justify the incremental costs...The council would ask whether or not these types of benefits (i.e., million tons per year of reduced hydrocarbon emissions) could be converted

into terms that would be more meaningful to the general public. ...The Council would suggest, if feasible, that the benefits be translated into such terms as a reduction in certain types of illness or at least in terms of the reduced risk of contracting certain types of illnesses."

Discussion

The first concern raised was that the cost estimate of $50 ($44 incremental) from Chrysler was much higher than EPA's original cost estimate of $11 ($3.70 incremental). This issue was dealt with in detail in the Analysis of Comments and in the issue paper on the cost of a 2.0 g/test standard. It was shown in those papers that the cost estimate from Chrysler was much higher than what will be necessary to control evaporative emissions to a 2.0 g/test level. The predicted average incremental retail cost increase was $1 to $5 which is in agreement with EPA's original estimate of an incremental retail cost increase of $3.70 (from $7.30 to $11).

The calculated cost effectiveness of reducing the evaporative emission standard from 6.0 g/test to 2.0 g/test is $20 to $100 per ton of hydrocarbon removed (based on a $1 to $5 retail price increase). Therefore, reducing the evaporative emission standard to 2.0 g/test is expected to be more cost effective than any other control strategy currently being considered except for the HDV interim exhaust emission

standards which has a cost effectiveness of $29 per ton of HC removed. If the ultimate cost effectiveness of a 2.0 g/test standard is actually $20 per ton of HC removed, the 2.0 g/test standard would be the most cost effective action of any currently considered strategy for controlling mobile source HC emissions. It should be further pointed out that the HDV interim exhaust emission standards are being implemented in 1979. Therefore, they are as the Council suggests, being imposed before imposing a 2.0 g/test evaporative emission standard on LDV's and LDT's in 1981.

EPA's analysis of the cost of a 2.0 g/test standard included measurement of stabilized background emissions. Manufacturers can either use old vehicle bodies or artifically aged new vehicles by exposing them to elevated temperatures, removing vinyl and plastic components, etc. Manufacturers will be able to obtain vehicles with low stabilized background levels by such means whether or not an allowance for backgrodund levels is made. It is EPA's position that the manufacturer can and will obtain low background test vehicles.

The Council on Wage and Price Stability has also requested that a cost benefit analysis be performed which would convert the tons/year reduction into terms more meaningful to the public. EPA would very much like to be able to translate incremental emission reductions into incremental health effects such as reduced illnesses, etc. However, the relationship between emission reductions and ambient air quality and effects upon human health are not sufficiently well known to provide

reliable quantification of the expected health benefits. Complicating this further is the different mixtures and levels of pollutants in cities across the Nation.

The National Ambient Air Quality Standards were established in order to quantify the level of pollutants in the ambient air above which there were observed adverse health and welfare effects. It is to the goal of bringing the quality of the air in U.S. cities to such acceptable levels that the evaporative emission standards are addressed. That a large number of Air Quality Control Regions are expected to exceed the standards in 1985 and later and that the proposed 2.0 gram/test standard provides a significant reduction in emissions at a cost-effectiveness level that is very favorable compared to other ongoing strategies is considered sufficient justification for the action.

APPENDICES TO

FINAL

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

Appendix A contains material related to the air quality impact analysis that was completed to determine the effect this regulation would have on oxidant formation by the year 1990. Because of its length, a complete copy of the report "Evaluating the Air Quality Impacts of Alternative Evaporative Emissions Control Strategies," prepared by the Office of Air Quality Planning and Standards, U.S. EPA, has not been included in this appendix. Only a summary of the report is presented. A copy of the complete report is available for public inspection and copying during normal business hours at the Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, S.W., Washington, D.C., 20460. As provided for in 40 CFR Part 2, a reasonable fee may be charged for copying services.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND WASTE MANAGEMENT

MAR 02 1978

SUBJECT: Air Quality Projections for Alternative LDV/LDT Evaporative Emission Control Strategies

FROM: Eric O. Stork, Deputy Assistant Administrator for Mobile Source Air Pollution Control (AW-455)

MEMO TO: Jim Wilson
Control Simulation Section (MD-14)

THRU: Robert Neligan
Monitoring and Data Analysis Division, OAQPS

This office is in the process of completing the Environmental Impact Statement to accompany a final rulemaking for control of fuel evaporative emissions from light-duty vehicles and trucks. This regulation will reduce the maximum allowable levels of evaporative hydrocarbon (HC) from 6.0 grams per test (g/test) to 2.0 g/test beginning with the 1981 model year. To complete the EIS we must ask you to provide us with air quality projections based on anticipated emissions from these vehicles when the 2.0 g/test standard is in effect, as well as for two alternative strategies we considered. Note that only hydrocarbons are at issue in this rulemaking, so the only air quality analysis that will need to be conducted is for oxidants.

Attached are tables which contain the emission factors for mobile sources which you will need to do your analysis. These were calculated using the data contained in the January 1978 final draft of Supplement 8 to AP-42. Hydrocarbon emission factors for light-duty vehicles (LDVs) and light-duty trucks (LDTs) have been separated into an exhaust and an evaporative HC emission component. These are presented in Tables Ia and b and Tables IIa and b. Three alternative evaporative emission standards were considered. They are: Maintain the current 6.0 g/test standard through 1990; implement a 2.0 g/test standard in 1980; and, implement a 2.0 g/test standard in 1981. Thus for model years 1980, 1981, 1985, and 1990 you will find three evaporative emission factors for LDVs and LDTs based on the assumptions underlying each alternative. Heavy-duty vehicles and motorcycles are not impacted by this rulemaking, and so only a total hydrocarbon emission factor is given. (See Tables III and IV)

All emission factors for non-highway vehicles and stationary sources, growth rates, retirement rates, VMT splits, etc., should be selected to be consistent with the most recent medium range (1990) projections which have been circulated outside the agency. We would like to receive a list of the various factors used in making the projections for use in documenting the EIS for this regulation.

From your analysis we would like to know what effect each of the alternatives has on oxidant air quality in 1985 and 1990. We would also like to receive emission inventory data for 1980, 1981, 1985, and 1990 as well as for the base year (1975). Our current schedule for completing work on the Environmental Impact Statement is March 21, so we would like to receive the results of your analysis on or about March 13. Based on your past rapid turn around on our past requests for support and because only an analysis for only one air quality problem is required we trust that this is sufficient time. I would again like to express our appreciation of the fine support you have provided this office during our past rulemakings.

Attachments

Table Ia

HC Emission Factors - Light Duty Vehicles

Calendar ~~Model~~ Year	Exhaust HC (g/mi)	Evaporative HC (g/mi)
1975	5.83	2.26
1976	5.43	2.12
1977	5.02	2.02
1978	4.62	1.82
1979	4.23	1.60
1980	3.77	See Table Ib
1981	3.31	
1985	2.06	
1990	1.59	

Table Ib

Evaporative HC Emission Factors

	Emission Assumption		
calendar ~~Model~~ Year	6.0g 1978-1990	6.0g 1978-1979 2.0g 1980-1990	6.0 1978-1980 2.0g 1981-1990
1980	1.41	1.36	1.41
1981	1.23	1.12	1.19
1985	.79	.48	.52
1990	.63	.20	.21

Table IIa

HC Emission Factors - Light Duty Trucks (0-8,500 lb)

Calendar ~~Model~~ Year	Exhaust HC (g/mi)	Evaporative HC (g/mi)
1975	6.74	2.72
1976	6.36	2.54
1977	6.09	2.40
1978	5.94	2.22
1979	5.70	2.01
1980	5.52	See Table IIb
1981	5.21	
1985	4.09	
1990	2.84	

Table IIb

Evaporative HC Emission Factors

	Emission Assumption		
Calendar ~~Model~~ Year	6.0g (1978-1990)	6.0g 1978-1979 2.0g 1980-1990	6.0g 1978-1980 2.0g 1981-1990
1980	1.78	1.74	1.78
1981	1.56	1.46	1.52
1985	.99	.71	.75
1990	.73	.34	.35

Table III

HC Emission Factors - Heavy - Duty Vehicles

Calendar ~~Model~~ Year	Gasoline Total HC (g/mi)	Diesel Total HC (g/mi)
1975	38.51	5.08
1976	37.82	5.09
1977	37.40	5.10
1978	37.09	5.11
1979	35.62	5.16
1980	33.08	5.23
1981	30.51	5.29
1985	20.96	4.54
1990	17.03	3.69

Table IV

HC Emission Factors - Motorcycles

Calendar ~~Model~~ Year	Total HC (g/mi)
1975	11.43
1976	11.43
1977	11.20
1978	10.12
1979	8.43
1980	7.11
1981	6.07
1985	2.30
1990	0.63

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

DATE 28 MAR 1978

SUBJECT Air Quality Projections for Alternative Evaporative Emissions Control Strategies

FROM James H. Wilson, Source Analysis Section
Air Management Technology Branch, MDAD (MD-14)

and

Warren P. Freas, Technology Development Section
Air Management Technology Branch, MDAD (MD-14)

THRU: Robert E. Neligan, Director
Monitoring and Data Analysis Division (MD-14)

TO: Eric O. Stork, Deputy Assistant Administrator for
Mobile Source Air Pollution Control (AW-455)

Enclosed are the results of the air quality projections for the Environmental Impact Statement to accompany the final rulemaking for control of fuel evaporative emissions from light-duty vehicles and trucks. Table 1 summarizes the estimated air quality impact of three alternative evaporative emissions control strategies. Tables 2 through 10 present the results on an AQCR-by-AQCR basis for each strategy. Table 11 presents the input data used in the projection models. Hydrocarbon emission inventories for the three strategies and four projection years (1980, 1981, 1985 and 1990) are presented as Table 12. Finally, ratios of projected hydrocarbon emissions to base year emissions for each strategy and projection year are presented as Tables 13 through 15.

In addition, a copy of your March 2, 1978, memorandum requesting this analysis has been enclosed as an Appendix. The change from model year to calendar year was discussed with Robert Smith of your staff.

Enclosure

cc: Edward J. Lillis
Bruce Jordan

EPA Form 1320-6 (Rev. 3-76)

EVALUATING THE AIR QUALITY IMPACTS OF ALTERNATIVE EVAPORATIVE EMISSIONS CONTROL STRATEGIES

Air Management Technology Branch
Monitoring and Data Analysis Division
Office of Air Quality Planning and Standards

March 1978

EVALUATING THE AIR QUALITY IMPACTS OF ALTERNATIVE EVAPORATIVE EMISSIONS CONTROL STRATEGIES

This report presents the air quality impacts of three alternative strategies for the control of evaporative emissions of hydrocarbons. These air quality projections were made using the Modified Rollback Model. The oxidant analysis also includes projections made using the Ozone Isopleth Technique. The isopleth analysis included in this report assumes that the NMHC/NO_x ratio is 10:1 in all AQCR's, and the effects of natural background and downwind transport effectively cancel each other to produce a negligible oxidant background. Table 1 summarizes the projection results. The table shows the average percentage change in air quality concentration from the 1975 base year for the years 1980, 1981, 1985 and 1990.

The three cases analyzed are as follows:

Case	Evaporative Emission Assumption (LDV's and LDT's)
I	6.0 g 1978-1990
II	6.0 g 1978-1979; 2.0 g 1980-1990
III	6.0 g 1978-1980, 2.0 g 1981-1990

Tables 2 through 10 present the results of the air quality projections on an AQCR-by-AQCR basis. Most of the AQCR's analyzed include large metropolitan areas with violations of the NAAQS. The base-year concentrations for oxidants are the maximum 1-hour concentrations during the second-worst day in any year from 1971 through 1976.

The annual growth in vehicle miles traveled for mobile sources is

assumed to be 2 percent. The stationary source growth rate is assumed to be 3.2 percent. These assumptions are equivalent to those used in the recent analyses of alternative automotive emission standards prepared for the U.S. Congress. The frequency of occurrence of standards violations was estimated for oxidants for each area under analysis. The frequency of violation calculations for this pollutant are based on national average frequencies of occurrence derived from air quality data in the 1973 "Trends" Report. The oxidant data from the 1973 "Trends" Report were used to relate the second highest hourly oxidant concentration to the percentage of hours in the year when the oxidant standard is violated. A curve was fitted to these data points so that when the oxidant concentration for an area is projected to a future year, this same curve can be used to estimate the number of 1-hour periods in excess of the .08 ppm standard. Because all oxidant frequency of violation calculations are based on national average frequencies of occurrence, these values may not apply to specific locations.

Table 11 shows the composite emission factor ratios for mobile and stationary sources considered in evaluating the three alternative standards. These composite emission factors were provided in the March 2, 1978, memorandum from the Office of Mobile Source Air Pollution Control.

All emission factors for stationary sources are equivalent to those used for air quality projections in the Air Quality, Noise and Health Report of the Interagency Task Force on Motor Vehicle Goals Beyond 1980.

Table 12 shows the base year emission inventory for hydrocarbons from NEDS and the hydrocarbon emission inventories projected to 1990. Tables 13 through 15 provide ratios of projected hydrocarbon emissions to 1975 base year emissions.

The Appendix includes a copy of the March 2, 1978, memorandum from the Office of Mobile Source Air Pollution Control. Corrections to some column headings have been noted in Tables 1 through 3 of that memorandum.

TABLE 1

Average Percentage Reduction in Oxidant Air Quality Concentrations

From Base Year 1975

Linear Rollback With Zero Background

	1980	1981	1985	1990
Case I	10	14	27	35
Case II	10	14	28	37
Case III	10	14	28	37

Linear Rollback With .04 ppm Background

	1980	1981	1985	1990
Case I	8	10	20	27
Case II	8	11	22	29
Case III	8	10	21	29

Ozone Isopleths With 10:1 NMHC/NO_x Ratio With No Background

	1980	1981	1985	1990
Case I	2	3	8	13
Case II	2	3	9	15
Case III	2	3	9	15

Percent reductions reflect the impact of the DOT Report emission control assumptions plus the impact of evaporative emission controls.

APPENDIX B

Appendix B contains memoranda which summarize meetings or discussions between EPA and manufacturer representatives after the public comment period had closed to consider the technological feasibility of meeting a 2g/test evaporative emission standard. Copies of these and other documents on the subject of cost, lead-time, and technological feasibility of the 2g/test standard, which were submitted to or prepared by the Agency both during and after the official comment period, are maintained in the Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, S.W., Washington, D.C., 20460. These records are available for public inspection during normal business hours. As provided for in 40 CFR Part 2, a reasonable fee may be charged for copying services.

DATE November 29, 1977

SUBJECT Meeting with General Motors Concerning Lead Time Necessary for Implementation of a 2.0 g/test Evaporative Emission Standards for Light Duty Vehicles and Light Duty Trucks.

FROM Michael W. Leiferman, SDSB

TO THE FILE

THRU: Charles L. Gray, Chief, SDSB

On November 4, 1977 a meeting between GM and EPA representatives in regard to the lead time necessary for a 2.0 g/test evaporative emission standard was held at the EPA Ann Arbor laboratory. GM representatives present were Gerald Barnes (EAS), Stu Martens (EAS), Al Taylor (EAS), Duane Tangue (Buick), Louis Faix (Chevrolet), T. H. Reaman (Rochester) and Roger Lundquist (Oldsmobile). EPA members present were Charles Gray, Ronald Kruse, Clifford Tyree, Martin Reineman and Mick Leiferman.

GM representatives presented evaporative emission data on vehicles which had received various modification to their induction systems. Most of these modifications were done in an attempt to prevent hydrocarbon leaks from various parts of the carburetor. Among the modifications tested were sealing the interface between the carburetor air horn and the main body of the carburetor, sealing of the accelerator pump shaft and idle mixture screw, sealing the air cleaner housing snorkel during engine-off, sealing of the throttle and choke shafts, installation of activated carbon in the air cleaner housing, and venting of the bottom of the charcoal canister to the air cleaner. Although the data showed that by using some combination of these measures evaporative emissions could be reduced to below 2.0 g/test, GM stated that the production designs for most of these changes had not been finalized.

The modification which appears to require the longest tooling lead time is the addition of activated carbon to the air cleaner. This approach appears more desirable than sealing the snorkel because sealing of the air cleaner results in the vapors being expelled from other locations. GM stated that the tooling time required for putting activated carbon in air cleaners was 93 weeks, and this lead time estimate applies to either the carbon air filter element or carbon in the air cleaner housing. GM is currently working on a design to contain the activated carbon in the air cleaner housing so that carbon covered air filter elements will not be required.

Another modification which may require as much lead time as the activated carbon air cleaner is an improved seal between the carburetor air horn and the main body of the carburetor. GM stated that reducing this source of leakage to an acceptable level would require either an improved gasket or a machining operation to the mating surfaces. If an improved gasket was found acceptable, the lead time required to obtain this item would be 20 weeks. If a satisfactory gasket could not be developed, the lead time for tools to perform the machining operations would be two years. Rochester Products has five carburetor production lines. In anticipation of a California evaporative emission standard of 2.0 g/test in 1980, they are equipping one of these five lines with the tools to perform this machining operation. To make this change for the 1980 model year, the tooling must be installed by March 1, 1979. The tool making lead time for one line is one year, so the blueprints must be released by March 1, 1978. GM stated that the same change for all five production lines requires a tooling time of two years. This is mainly because of the limited availability of tool makers.

GM indicated that implementing the other modifications which were incorporated in the experimental carburetors would not be as major a problem as the two modification discussed above. HC leaks around the idle mixture screws could be eliminated by applying a sealant to the steel plug which will be used to make these screws tamper resistant. And Mr. Redman stated that the acceleration pump shaft leakage problem could be overcome by the 1980 model year. In view of this, it also seems reasonable that an acceptable throttle shaft seal could be developed in the same time frame. Since it appears that choke shafts would be more sensitive to movement interference than acceleration shafts and throttle shafts, it might be expected that seals for this application would need to be more sophisticated than for the other applications.

There was some discussion at the meeting as to whether GM had been making a reasonable effort to develop systems capable of complying with a 2.0 g/test evaporative emission standard. When asked the current level of manhour effort at Rochester Products, the response was that they did not have sufficient knowledge to answer the question. The Rochester Products representative did state, however, that they did not begin working on the carburetor sealing problem until the first of this year (1977). Roger Lundquist, GM representative from Oldsmobile, said that the reason for Rochester's late start was that prior to that time the GM car divisions believed they would be able to meet a 2.0 g/test requirement without carburetor sealing improvements. He stated that one test program which had lead them to this conclusion was with 1974 model year vehicles. Al Taylor also emphasized that the reason Rochester Products had not been working on the carburetor sealing problem prior to 1977 was that until that time the car divisions believed they could handle the evaporative problem. Interesting, in the past, GM had never stated to the EPA that they believed they would be able to meet a 2.0

g/test standard. In fact, in their comments to the evaporative NPRM published in January, 1976, GM stated that the technological feasibility of a 2.0 g/test standard had not been demonstrated and that they did not know of any hardware which could be used to meet such a standard. Considering Mr. Lundquist's and Mr. Taylor's statements at the meeting it appears that GM comments to the NPRM may have been something less than the whole truth. On the other hand, if between tests such as Mr. Lundquist had described and the submittal of comments to the NPRM (in March, 1976) GM had obtained information showing that controlling evaporative emissions was going to be a more difficult task than previously expected, it appears that some foot dragging occurred before Rochester Products started working on the problem.

When asked if they could meet a 2.0 g/test standard in 1980, the GM representatives agreed that they could not. Al Taylor expressed the strong opinion that although GM could not comply with a 2.0 g standard in 1980, they had been making a good faith effort in developing systems to meet such a level. Charles Gray expressed disagreement with Mr. Taylor's view.

In summary, GM stated that they could not comply with a 2.0 g/test standard in 1980; however, they were quite confident in being able to do so for the 1981 model year. The 1980 model year was not possible because of the tooling lead time associated with one, or possibly two, items. The first being an activated carbon containing air cleaner, and the second being an improved seal between carburetor air horn and main body. The long tooling time would be eliminated for the second item if an adequate gasket can be developed. The time which is now needed for GM to comply with a 2.0 g/test requirement appears to be a result of two factors -- up until 2 or 3 years ago GM underestimated the effort that would be required to comply with the standard, and GM's carburetor division was not involved in the effort until some time after the magnitude of the problem was realized.

Attached are two handouts which were distributed by the GM representatives.

cc: Charles Gray
Ron Kruse
Cliff Tyree

ATTACHMENTS (2)

STATUS OF "2 GRAM" EVAPORATIVE EMISSION
DEVELOPMENT PROTOTYPE VEHICLES

AUGUST 1, 1977

All tests were conducted at the Chevrolet Engineering Center Laboratory. Tests were conducted with new equilibrated and purged canisters and new, adsorption type air cleaner elements. Vehicles are conditioned for minimum background emissions but are low mileage. These data should be considered with the qualification that the carburetors (and air cleaners) of the test cars received special treatment to minimize vapor leakage beyond a level likely to be achievable with production cars. Special treatment included:

- Hand selected low leak carburetors.
- Installation of experimental accelerator pump boots (impractical except for lab. work).
- Machined mating surfaces (e.g., air horn).
- Silicone seal over air horn/air cleaner joint.

Model	Number Vehicle	Engine	Evap. System	Grams	No. Tests
Impala	7B485	LG-4 V-8/4 Bbl.	2200cc to Charcoal Air Cleaner	.04+.69=.73	1
Monza	7H682	LG-3 V-8/2 Bbl.	2500cc to Charcoal Air Cleaner (Outside engine compartment)	.25+.79=1.04	1
Chevette	7T099	LY-5 L-4/1 Bbl.	1500cc Canister	.57+.66=1.23	2
			1500cc and Charcoal Air Cleaner	.45+.50=.95	1
			1500cc to Charcoal Air Cleaner	.23+.48=.71	3
Corvette	7Y065	L-48 V-8/4 Bbl.	2500cc to Charcoal Air Cleaner	.20+1.17=1.37	1
Pickup	7C302 (2x20 gal)	LS-9 V-8/4 Bbl. 350 CID	2500cc to Charcoal Air Cleaner	.82+1.53=2.35	2
Suburban	7C515 (40 gal)	LF-8 V-8/4 Bbl. 454 CID	2500cc to Charcoal Air Cleaner	.60+2.25=2.85	3

Oldsmobile Development Test Data

The attached tables illustrate recent efforts of Oldsmobile Engineering to achieve minimum levels of evap. emissions as measured by the SHED technique (1978 Federal test). Target emission levels for such development work are 1.0 to 1.2 g for a system which might qualify for a 2 g certification standard.

All listed data include non-fuel background HC emissions; background levels were not measured separately except for the 260 "B" car which showed less than 1/2 g background. Test car age and mileage in all cases were adequate to assure a level of background emissions typical of certification cars, i.e., less than 1/2 g/test. This is confirmed by the similarity of the "base car" data with similar 1978 certification cars. It should be noted, however, that the latter four cars of the following comparison had carburetors selected for flatness of air horn-to-bowl casting joint surfaces and sealed accelerator pump shafts.

	SHED Evap., g/Test	
Car	Attached Data	4000 Mi. Cert. Data
260/2 B	3.67	1.86-5.79
350/4 C	3.14	2.23-5.93
403/4 C (Calif.)	3.50	3.26-4.60
403/4 E	4.99	---
403/4 E (Calif.)	3.14	2.13-2.16

Vehicle modifications tested (detailed below) are experimental simulations of possible production changes. They have not been evaluated for durability, safety or other possible side effects. Improvements shown may or may not be achievable with production hardware.

Sealed Air Horn (403/4 E car)	- Air Horn epoxied to Bowl Casting
Sealed Accelerator Pump and Idle Needles	- Pump Shaft and Idle Needles sealed with epoxy (pump inoperative)
Semi-Sealed Throttle Shafts	- Clearance filled with silicone lubricant
Sol Op Door A.C. and Trapdoor A.C.	- Solenoid operated cover door for air cleaner snorkel
Charcoal Air Cleaner (403/4 E Car)	- Annulus between air filter element and air cleaner housing filled with charcoal granules

Full Height AC Element	- Bo led charcoal ring inside filter paper and integral with filter element
Half Height AC Element	- Same except charcoal ring "covered" only lower half of filter paper
Canister Vented to Air Cleaner	- Bottom of charcoal canister (filtered vent) closed and bottom of canister (charcoal charge) vented to clean side of engine air cleaner, either lid or base of housing
1500 cc Can.	- 1978 Production Charcoal Canister
2200 cc Can.	- Experimental Canister Containing 2200 cc of charcoal
2500 cc Can.	- Experimental Canister Containing 2500 cc of charcoal

##########

MINIMUM EVAP. EMISSION DEVELOPMENT TESTS

OLDS 403/4 E

78 CARB	SEALED AIR HORN	SEALED ACC. PUMP & IDLE NEEDLES	SEMI SEALED THROTTLE SHAFTS	SOL OP DOOR A.C.	CHARCOAL A.C.	CANISTER VENTED TO AIR CLEANER	GRAMS FOR TOTAL TEST
X							4.99
X	X						3.27
X	X	X		X			1.84
X	X	X			X	X	1.44
X	X	X	X		X	X	1.26

SWH/rmn/w/503
11/2/77

MINIMUM EVAP. EMISSION DEVELOPMENT TESTS

OLDS. B WITH 260/2 FED

TEST COMPONENTS							RESULTS
1500 cc CAN	2500 cc CAN	FULL HEIGHT AC ELEMENT	HALF HEIGHT AC ELEMENT	TRAPDOOR AC	CANISTER VENTED TO AIR CLEANER		GRAMS FOR TOTAL TESTS
					Lid	Base	
X							3.666
X		X					1.371
X			X				1.450
X				X			1.976
X		X			X		1.237
X			X		X		1.258
X		X				X	1.335
X			X			X	1.420
	X		X		X		1.576

SWM/rmn/w/657
1/2/77

MINIMUM EVAP. EMISSION DEVELOPMENT TESTS

OLDS. C WITH 350/4 FED

TEST COMPONENTS							RESULTS
2200 cc CAN	2500 cc CAN	FULL HEIGHT AC ELEMENT	HALF HEIGHT AC ELEMENT	TRAPDOOR AC	CANISTER VENTED TO AIR CLEANER		GRAMS FOR TOTAL TESTS
					Lid	Base	
							3.138
			X				2.214
				X			2.163
		X			X		1.298
			X		X		2.059
				X	X		3.062
		X				X	1.364
			X			X	2.077
X			X				3.273
	X		X				1.890
	X		X		X		1.489

MINIMUM EVAP. EMISSION DEVELOPMENT TESTS

OLDS. C WITH 403/4 CAL

TEST COMPONENTS						RESULTS
500 cc CAR	FULL HEIGHT AC ELEMENT	HALF HEIGHT AC ELEMENT	TRAPDOOR AC	CANISTER VENTED TO AIR CLEANER		GRAMS FOR TOTAL TEST
				Lid	Base	
X						3.496
X		X				2.140
			X			2.065
X		X		X		2.161
X			X	X		3.506

MM/rmn/w/780
1/2/77

MINIMUM EVAP. EMISSION DEVELOPMENT TESTS

OLDS. E WITH 403/4 CAL

TEST COMPONENTS								RESULTS
1500 cc CAN	2200 cc CAN	2500 cc CAN	FULL HEIGHT AC ELEMENT	HALF HEIGHT AC ELEMENT	TRAPDOOR AC	CANISTER VENTED TO AIR CLEANER		GRAMS FOR TOTAL TEST
						Lid	Base	
X								3.136
X			X					2.289
X				X				2.583
X					X			2.634
X			X			X		1.676
X				X		X		1.910
X				X			X	2.056
	X			X				2.569
	X			X		X		2.907
		X		X				2.497
		X		X		X		2.159
		X			X			3.398

SWM/mm/W/452
11/2/77

DATE: February 6, 1978

SUBJECT: Meeting with General Motors (GM) Concerning GM's Progress in Developing Light-Duty Truck Evaporative Control Systems for the Proposed 2.0 g/test Standard

FROM: Michael W. Leiferman, SDSB

TO: MEMORANDUM TO THE FILE

THRU: Charles L. Gray, Chief, SDSB

General Motors (GM) representatives requested a meeting with ECTD to inform EPA of GM's current status in developing light-duty truck evaporative control systems aimed at a 2.0 g/test standard. The meeting was held at the EPA Ann Arbor facility on January 19, 1978 and GM representatives attending were Louis Faix (Chevrolet), Gerald Barns (EAS), Stu Martens (EAS) and Roger Lundquist (Oldsmobile). EPA personnel present were John DeKany, Charles Gray, Ronald Kruse and Mick Leiferman.

Louis Faix presented evaporative emission test data on some passenger cars, two pickup trucks, a van and a suburban, all of which were equipped with essentially the same experimental evaporative control system. This system was effective in controlling evaporative emissions to below 2.0 g/test from the passenger cars, but emission levels from the pickup trucks, van and suburban ranged from 2.24 to 2.50 g/test. The fuel tank capacities of the pickups, van and suburban ranged from 33 to 40 gallons and GM indicated that they believed these large fuel tanks were the cause of the high emissions.

GM emphasized the fact that many aftermarket equipment manufacturers currently install auxiliary fuel tanks, and that if light trucks were not marketed with large fuel capacity options the number of aftermarket installations would increase.

GM presented data which indicated that regardless of the amount of activated carbon in a canister some hydrocarbons will pass through this material while it is being loaded. However, this amount is quite small as long as "breakthrough" does not occur. One test showed that a well purged canister allowed 0.23 g of HC to be emitted during a diurnal test. This amount of HC leakage is not sufficient to explain the relatively high emission levels obtained from the four large fuel capacity vehicles mentioned above. In fact, for those four vehicles the hot soak emissions were much larger than the diurnal emissions, by a ratio of about 3:1. Since the diurnal test is preceeded by a hot soak (which follows preconditioning) the low diurnal emission levels indicate that

the amount of activated carbon was sufficient to adequately adsorb the vapors discharged to the canister(s) from one hot soak and one diurnal. Consequently, it appears that one of two mechanisms (or a combination of the two) accounted for the high measured hot soak emissions. One is that the activated charcoal did not purge sufficiently on the FTP to make it capable of adequately absorbing the vapors discharged to it during the following hot soak. The other possible reason is that during the hot soak a substantial amount of the vapors which were generated escaped from the fuel system (e.g., carburetor fittings) without being transported to the charcoal beds.

Since truck-like vehicles do more work on the FTP than typical passenger cars, it is expected that these vehicles also have greater canister purging than passenger cars. Consequently, it seems unlikely that inadequate canister purging was the cause of the relatively high hot soak losses on the pickup trucks, van and suburban Induction system leakage appears to be the more probable mechanism. The likelihood that induction system leakage really is the source of the hot soak emissions is also consistent with the fact that gasoline float-bowl temperatures are higher for these vehicles than for typical passenger cars, and, therefore, more carburetor vapors are generated.

cc: J DeKany
C. Gray
R. Kruse

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE March 22, 1978

SUBJECT Discussions with Ford Motor Company and Chrysler Corporation Concerning the Feasibility of Controlling Evaporative Emissions from Light-Duty Trucks (0-8500 lbs GVWR) to a 2.0 g/test Standard for the 1981 Model Year

FROM Michael W. Leiferman

TO Memorandum to the File

THRU: Charles L. Gray, Chief, SDSB

In the past two months, I have twice contacted Ford Motor Company representative Don Buist (Executive Engineer for Certification) regarding Ford's efforts and concerns relative to 1981 model year implementation of the proposed 2.0 g/test evaporative emission standard, specifically for light-duty trucks (LDT).

In a phone conversation with Mr. Buist on February 6, 1978, he stated that control of evaporative emissions from LDT was not greatly different than controlling evaporative emission from LDV. Mr. Buist said that controlling emissions from LDT equipped with optional high capacity fuel tanks was somewhat more difficult than passenger car control, and because of this they plan to use two charcoal canisters on LDTs equipped with these larger fuel tanks. He stated that tests show that diurnal emissions can typically be controlled to less than 0.5 g/test, even for large fuel capacity systems; and the greatest source of HC loss, as with passenger cars, is carburetor leakage during the hot-soak tests. Mr. Buist stated that if the proposed 2.0 g/test standard is promulgated for the 1981 model year, Ford intends to certify their LDTs, both standard capacity and optional high capacity fuel systems, to that requirement.

On March 14, 1978 I again called Mr. Buist and asked him if, since I had last discussed LDT evaporative control with him, Ford had obtained any new test data or if he had any new views on the subject. He stated that they had not conducted any new tests, and his position regarding LDT evaporative emission control had not changed.

In summary, if promulgated for the 1981 model year, Ford intends to comply with the proposed 2.0 g/test evaporative emission standard for LDV and LDT (standard and the optional high capacity fuel systems).

On March 14, 1978, I talked to Chrysler Corporation representative Gordon Allardyce (Emissions Planning Specialist) concerning LDT evaporative control. I asked him for any development data or information they had regarding control of LDT evaporative emissions to below 6 g/test, especially large fuel capacity systems. He stated that they have not done a large amount of such testing aimed at the 2.0 g/test level of control, but he would assemble what information they did have and send it to us.

cc: R. Kruse

EPA FORM 1320-6 (REV. 3-76)

May 13, 1978

Meeting with General Motors in Regard to Evaporative Emission Standards for Trucks

Michael W. Leiferman, SDSB

Memorandum to the File

THRU: R. Maxwell, Acting Chief, SDSB

In response to another General Motors (GM) request to discuss evaporative emission regulations for trucks, a meeting between several GM and EPA representatives was held at the EPA Motor Vehicle Emissions Laboratory on May 12, 1978. High level representatives from the two organizations were T. M. Fisher (Director of Automobile Emission Control, GM) and M. P. Walsh (Acting Deputy Assistant Administrator, Office of Mobile Source Air Pollution Control, EPA).

GM began the meeting by distributing copies of a letter dated May 12, 1978 from T. M. Fisher to Charles Gray. The letter expressed GM's concerns relative to evaporative emission control for trucks greater than 6000 lbs. GVW and contained data from truck evaporative emission testing. The letter is attached to this memo.

Distribution of the letter was followed by discussion of the test results which it contained. EPA expressed interest in knowing the source of the measured emission levels and the quantity of emissions from the individual sources. GM stated that their tests show fuel hoses emit emissions at a rate of 0.03 g/hr per foot of hose. Also one of the vehicles tested had a non-fuel (background) emission level of 0.75g. Although GM stated that they had probed with a hydrocarbon analyzer to determine other sources of emissions, they apparently have not made a rigorous attempt to quantify the losses from these sources. Mr. Fisher pointed out that prior to final publication of a regulation, not as much effort is directed to the proposed regulation as could be done. He stated that only after promulgation is a top level of effort concentrated on complying with a regulation.

In previous meetings, GM had stated they would probably not be able to certify (to a 2.0g/test standard) light-duty trucks (0-8500 lbs. GVW) with optional fuel tank capacity because of the effect these options have on evaporative emission levels. However, the attached test data on two Suburbans (one with a 25 gallon tank and the other with 40 gallons capacity) does not show an effect of fuel tank capacity on evaporative emissions. Since the two vehicles also had different engines (400 CID vs. 454 CID), this data also does not show an effect of engine size on emission level. (Perhaps the 0.75g background for the 400 CID, 25

FE-1359

Environmental Activities Staff
General Motors Corporation
General Motors Technical Center
Warren, Michigan 48090

May 12, 1978

Mr. Charles Gray
Acting Director
Emission Control Technology Division
U.S. Environmental Protection Agency
2565 Plymouth Road
Ann Arbor, MI 48105

Dear Mr. Gray:

On April 10, 1978 we submitted to Mr. Stork a "Petition" for consideration of a set of graduated evaporative emission standards for trucks. We explained in that submission our concern for the inequity of imposing a passenger car evaporative emission standard on trucks over 6000# GVW--as currently proposed by EPA. We also provided detailed technical support for our contention that control of truck evaporative emissions to very low levels is fundamentally more difficult than passenger cars.

As indicated in our April 10 submission, we are developing truck evaporative emission control hardware targeted at meeting the 1980 California requirement for 2 g/test. We believe the latest results of this effort will be helpful to EPA as it considers the final decision on a truck evaporative emission standard. We have therefore summarized recent test data from that program in the attachment.

We have previously stated our judgment that a design target of 1.0 to 1.2 g/test is necessary for a 2 g/test standard. It will be seen in the attached data that this performance level is only being approached by the smaller trucks. (It is well to point out in this regard that these data were acquired in General Motors test facilities whereas a recent comparison showed EPA certification laboratory measurements averaged 0.47 g/test higher than General Motors measurements on the same five (2 to 2.5 g/test) 1979 data cars. This suggests that the attached data are excessively optimistic as an assessment of ability to meet a particular standard.)

The attached data support the appropriateness of graduated truck standards beginning at the passenger car level in the case of light trucks increasing by 1 g/test for medium trucks (6,000 to 8,500# GVW) and by 2 g/test for heavy trucks (above 8,500# GVW). However, these data also strongly suggest that such a schedule of truck standards based on a passenger car level of 2 g/test may well exceed our present capability--particularly for the heavy trucks.

It will be seen in the attached data and associated notes that passenger car experience is being applied to trucks in our attempts to achieve minimum evaporative emission levels, e.g., larger carbon canister, "sealed" carburetors, and carbon air cleaners. An additional approach in the truck work has been the substitution of steel tubing for a substantial amount of rubber fuel hose (our April 10 submission mentioned the recently discovered problem of hose permeation). It should be noted however, that some of the rubber hose replacement accomplished for these laboratory tests probably represent greater hose elimination than could be accomplished in a production design.

The notes associated with several test vehicles indicate that two "full high" carbon air cleaner elements were used. In these cases, two carbon containing air cleaner elements were stacked vertically requiring increased air cleaner height. This expedient attempt to improve the performance of the air cleaner through the incorporation of additional carbon is shown to be disappointing.

The data shown for the two heavy duty "Cab Chassis" support the position of our April 10 submission that an equitable standard for such vehicles would be substantially higher than for a passenger car or for a light truck because of the substantially higher uncontrolled emissions from heavy trucks. Again we emphasize, as in the April 10 submission, the cited uncontrolled data do not include running losses and therefore understate the actual uncontrolled emission levels on these vehicles.

Limitation of the available test facilities also acts to understate the evaporative emissions from these vehicles--both controlled and uncontrolled. Inertia weight and 50 mph Road Load Power settings were limited to 8700 lbs. and 40 hp--substantially below those of the "Recommended Practice." The higher dynamometer loadings which would be required by the EPA procedure would increase engine load and therefore very likely increase hot soak emissions.

It is well also to inject a note of caution regarding the [illegible] emission measurements for the second Cab Chassis vehicle ([illegible]). The hot soak emissions measured for the uncontrolled condition of this vehicle appear unrealistically low at 5.4 g. This is a significantly lower level than one would expect for the carburetor emissions [illegible] and represents a single test value. Confirmatory and probably [illegible] testing would be required before that value could be accepted as truly representative.

Again we submit these data for the edification of EPA in its current deliberations. We believe they illustrate quite dramatically the reason for our concern with the proposed extension of a 2 g/test--or even a moderately higher--passenger car standard to all trucks.

Sincerely,

T. M. Fisher, Director
Automotive Emission Control

4SWM/0504/1

cc: M. P. Walsh
R. E. Kruse

GENERAL MOTORS

TRUCK EVAPORATIVE EMISSION DEVELOPMENT SUMMARY

MAY 1, 1978

Vehicle: 46C078 - Pickup, Class: Light Duty
Engine: 350V8-4bbl (Quadrajet), Fuel tank: 20 gal (base)
Control System. 2500cc Canister, vented to partial high carbon air cleaner, carburetor seals and bowl vent to canister; 40" less rubber fuel hose
Evap Emissions: 3 Test average
.31 diurnal + 1.24 hot soak = 1.55 grams

Vehicle: 47C302-Pickup, Class: Light Duty
Engine: 350V8-4bbl (Quadrajet), Fuel tank. 20 gal.
Control System. 2500cc Canister vented to partial high carbon air cleaner, sealed carburetor and bowl vent to canister
Evap Emissions: 3 test average
.40 diurnal + .96 hot soak = 1.36 grams

Vehicle: #7C241 - Pickup, Class: Light Duty
Engine. 250L6-2bbl (Varajet), Fuel Tank 20 gal.
Control System: 2500cc canister, carburetor seals and bowl vent to canister
Evap Emissions: 2 test average
.92 + .90 = 1.82 grams (unsaturated)

Vehicle: #8C228-Pickup, Class: Light Duty
Engine: 250L6-2bbl (Varajet), Fuel Tank: 20 gal.
Control system: Canister as noted, carburetor seals and bowl vent to canister

2500cc Canister	1.00 + 1.44 = 2.44	presaturated
	.65 + 1.50 = 2.15	
	.43 + 1.40 = 1.80	unsaturated
1500cc Canister (similar to 79 production)	.60 + 1.05 = 1.65	presaturated
	.70 + 1.10 = 1.80	

Note Light Duty means trucks under 6000# GVW.

Vehicle: #8G262 Utility Van, Class: Light Duty
Engine 400V8-4bbl (Quadrajet), Fuel Tank. 33 gal.
Control System: 2500cc canister vented to full high carbon air cleaner, carburetor seals and bowl vent to canister modified fuel hoses.

1979 Production Plumbing	.48 + 1.90 = 2.38 .90 + 2.30 = 3.20	2.79 Average
72" less fuel hose	.47 + 1.60 = 2.07	

Vehicle: #7C515 - Suburban, Class: Medium Duty
Engine: 400V8-4bbl (Quadrajet), Fuel Tank: 25 gal.
Control System: 2500cc canister vented to partial high carbon air cleaner, sealed carburetor and bowl vent to canister
Evap Emissions: 2 Test average
.76 + 1.77 = 2.53 grams
Vehicle has 75 gram/test background

Vehicle: #8C103-Suburban, Class: Medium Duty
Engine. 454V8-4bbl (Quadrajet), Fuel Tank 40 gal.
Control System: 2500cc canister vented to air cleaner with two full high carbon elements, carburetor seals and bowl vent to canister, 32" less rubber fuel hose

Evap Emissions.	.55 + 1.75 = 2.30 .80 + 2.10 = 2.90	2.60 Gram Average

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Vehicle: #7C548-Pickup, Class: Medium Duty
Engine. 454V8-4bbl (Quadrajet) Fuel Tank: Dual 20 gal = 40 gal.
Control System: 2500cc canister vented to air cleaner with two full high carbon elements, carburetor seals and bowl vent to canister

Evap Emissions:	.53 + 1.95 = 2.53 .55 + 2.37 = 2.92 .65 + 2.72 = 3.37 .73 + 2.20 = 2.93	2.94 Average (Unsaturated)

Note. Light Duty means trucks under 6000# GVW. Medium Duty means trucks between 6000# and 8500# GVW.

Vehicle: #8C532 Pickup, Class: Medium Duty
Engine. 350V8-4bbl (Quadrajet), Fuel Tank: Dual 20 gal = 40 gal
Control System: 2500cc Canister vented to air cleaner with two full high carbon elements, sealed carburetor with bowl vent to canister

Evap Emissions:

presaturated	.95 + 1.98 = 2.93	
	1.20 + 1.83 = 3.03	2.77 average
	.79 + 1.58 = 2.37	
not saturated	.42 + 1.75 = 2.17	2.24 average
	.71 + 1.59 = 2.30	

Vehicle: #7C508 Pickup, Class: Medium Duty
Engine. 454V8-4bbl (Quadrajet) Fuel Tank Dual 20 gal = 40 gal
Control System: Canisters - see below, carburetor seals and bowl vent to canister, two full high carbon elements in air cleaner

Evap Emissions:

2500cc Canister.	.52 + 1.87 = 2.39	2.67 -	unsaturated
	.60 + 2.35 = 2.95		
	1.20 + 2.14 = 3.34		presaturated
Triple Canisters:	.47 + 2.09 = 2.56	2.44	unsaturated
1500cc ea tank	.44 + 2.30 = 2.74		
850cc to carb	.58 + 1.45 = 2.03		
	1.30 + 1.82 = 3.12		presaturated
Fuel hoses shortened 69"			
2500cc Canister	.64 + 1.57 = 2.21		unsaturated
triple Canister	.79 + 1.70 = 2.49		unsaturated

Vehicle. #T0338 - Cab Chassis, Class: Heavy Duty
Engine. 427V8-4bbl (Holley), Fuel Tanks: Dual 50 = 100 gals
Control System: Dual 1500cc canisters, dual bowl vents to second canister

Evap Emissions.

Uncontrolled	52.33 + 39.14 = 91.49	grams
Controlled	1.69 + 1.16 = 5.85	unsaturated
	3.31 + 2.94 = 6.25	

Vehicle. #T3309-Cab Chassis, Class: Heavy Duty
Engine. 350V8 - 2bbl, Fuel Tanks: Dual 50 = 100 gals
Control System: Dual 1500cc canister, bowl vent to second canister

Evap Emissions

Uncontrolled	49.50 + 5.40 = 54.90	grams
Controlled	3.10 + 1.38 = 4.48	unsaturated

Note *Medium Duty means trucks between 6000# and 8500# GVW. Heavy Duty means trucks over 8500# GVW*