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EQL Memorandum No. 3

Analysis of an Evaporative Controls Retrofit Program for the South Coast Air Basin

by Kenneth Heitner
and Randall G. Williams

California Institute of Technology
ENVIRONMENTAL QUALITY LABORATORY

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and

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April, 1973

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Preface

The Environmental Quality Laboratory has disseminated the results of its work in a series of detailed formal reports that are widely circulated. In many cases, however, it is more important that the information be disseminated quickly but to a smaller group. To facilitate the circulation of this second kind of information a different form of report, which we will term an EQL Memorandum, has been established. The recipients for each note will be selected on an ad hoc basis but the notes will be available to anyone on request.

Lester Lees

Lester Lees
Director
Environmental Quality Laboratory

Introduction

The retrofitting of evaporative control systems to pre-1970 model light duty vehicles is one of the few viable options available to speed up the rate of reduction of reactive hydrocarbon emissions over the next few years. (All 1970 and later light duty vehicles were required by California how to be fitted with evaporative control systems.) The purpose of this paper is to give a more detailed analysis of this particular retrofit option.

The pre-1970 vehicle population of the South Coast Air Basin is analyzed back to 1962 to find which makes and models will continue to constitute a major fraction of the vehicle population over the next few years. These are the vehicles that it will be most practical to retrofit, since a retrofit kit can cover a large number of vehicles.

On the basis of this population analysis, we have made a series of case studies, illustrating how the new vehicle control technology can be adopted to the retrofit situation. The cost of the materials and labor are estimated in detail, in order to obtain a realistic idea of typical retrofit costs.

The possibility of a partial retrofit of controls covering either the carburetor or the fuel tank is also discussed.

Finally, the legal status of the retrofit situation is reviewed. The cost of a retrofit program covering 65 percent of the eligible vehicles is estimated at about 200 million dollars for the South Coast Air Basin. This is a 'one time' cost, which could be spread over a 1-2 year retrofit program.

Evaporative Emissions Control and Retrofit Potential

Evaporative emissions account for as much as 20 percent of the total hydrocarbons emitted from an uncontrolled vehicle.* As exhaust and crankcase emissions were controlled, it was realized that evaporative emissions would also have to be eliminated to reach very low overall emissions levels. This task involved controlling both the breathing and running losses from the fuel tank as well as the carburetor. Also, the 'hot soak' loss from the carburetor when the engine is turned off had to be eliminated.

A variety of control systems were devised to cope with this requirement. When the engine is operating, they draw the hydrocarbon vapors from the fuel tank and the various carburetor chambers either directly into the engine intake manifold or indirectly to the manifold via the Positive Crankcase Ventilation (PCV) system. The breathing losses and 'hot soak' losses, which occur when the engine is off, are stored either in the engine crankcase or a special canister of activated charcoal. The storage systems are purged when the engine is next operated, the vapors being drawn into the engine and burned.

All 1970 and later light-duty vehicles (under 6,001 pounds) in

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* Maga, John A., "Motor Vehicle Emissions in Air Pollution and Their Control", Advances in Environmental Science and Technology, Vol. II, Dec., 1971, Wiley - Interscience -

California to have evaporative control systems. Based on the simple birth and death rates commonly used to project vehicle emissions, (Table 1) the vehicle emissions from evaporative losses decrease according to the curve marked present strategy in Figure I. If increasing fractions of the pre-1970 vehicle are retrofitted, the reductions can be accelerated as shown, (the curves are based on a 90 percent effective system).

Because of the very large number of makes and models, it will probably be very difficult to retrofit all of the vehicles. However, significant reductions in evaporative losses can be made because a large fraction of the population is made up of the more popular vehicles.

Analysis of the Vehicle Population

In order to ascertain what fraction of the population would be practical to retrofit, a detailed analysis of the vehicle population by make and model was done. The data base used were breakdowns of the 1971 registration data* for Los Angeles, Orange, and Ventura counties as an approximation of the entire South Coast Air Basin (this was the only data available at the time). See Appendix A.

This data was "smoothed" to construct the birth-death model

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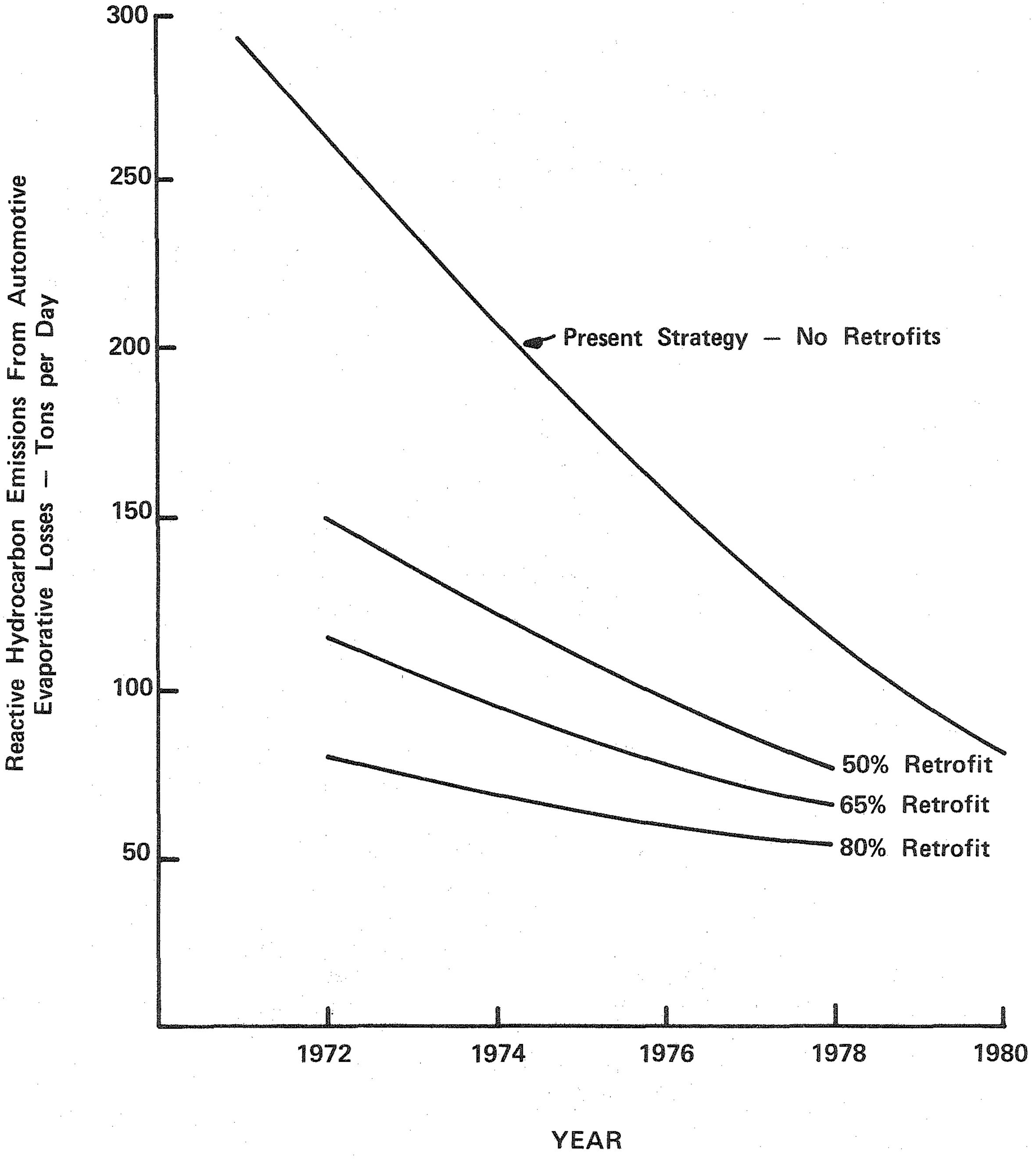
* Supplied by the Reuben H. Donnelley Corporation

TABLE I

BIRTH-DEATH MODEL

Age of Vehicle	Percentage of Population	Cumulative Percentage
1	11.4	11.4
2	11.0	22.4
3	10.6	33.0
4	10.2	43.2
5	9.8	53.0
6	9.3	62.3
7	8.8	71.1
8	7.9	79.0
9	6.7	85.7
10	4.9	90.6
11	3.0	93.6
12	2.3	95.9
13	1.7	97.6
14	1.2	98.8
15 +	1.2	100.0

Figure 1
AUTOMOTIVE EVAPORATIVE EMISSION REDUCTION FOR THE SOUTH COAST AIR BASIN



of the vehicle population (Table I). The total vehicle population was projected to grow at 3.5 percent annually, in accordance with the DMV projections.**

When the projected population growth and the birth-death model is used, the number of vehicles in each make and model can be projected for the years 1973 and 1975. The vehicles are then grouped by the number of vehicles of each type 'surviving' and this data is used to construct Figure II showing the number of makes and models needed to cover different percentages of the eligible vehicle population. Some of the uncertainty in utilizing the available data base is indicated by giving both a 'conservative' and 'optimistic' curve.

It should also be pointed out that this analysis does not include the additional variations because of different engines found in each type, nor variations in their carburetion systems. This omission is somewhat compensated for by the fact that the details of those systems do not radically change every year and essentially the same systems are used in different makes of vehicle from the same manufacturer.

The conclusion one draws from this analysis is that 50% of the population is in large blocks consisting of 5,000 or more vehicles of one type and can be easily retrofitted. With a little more effort and

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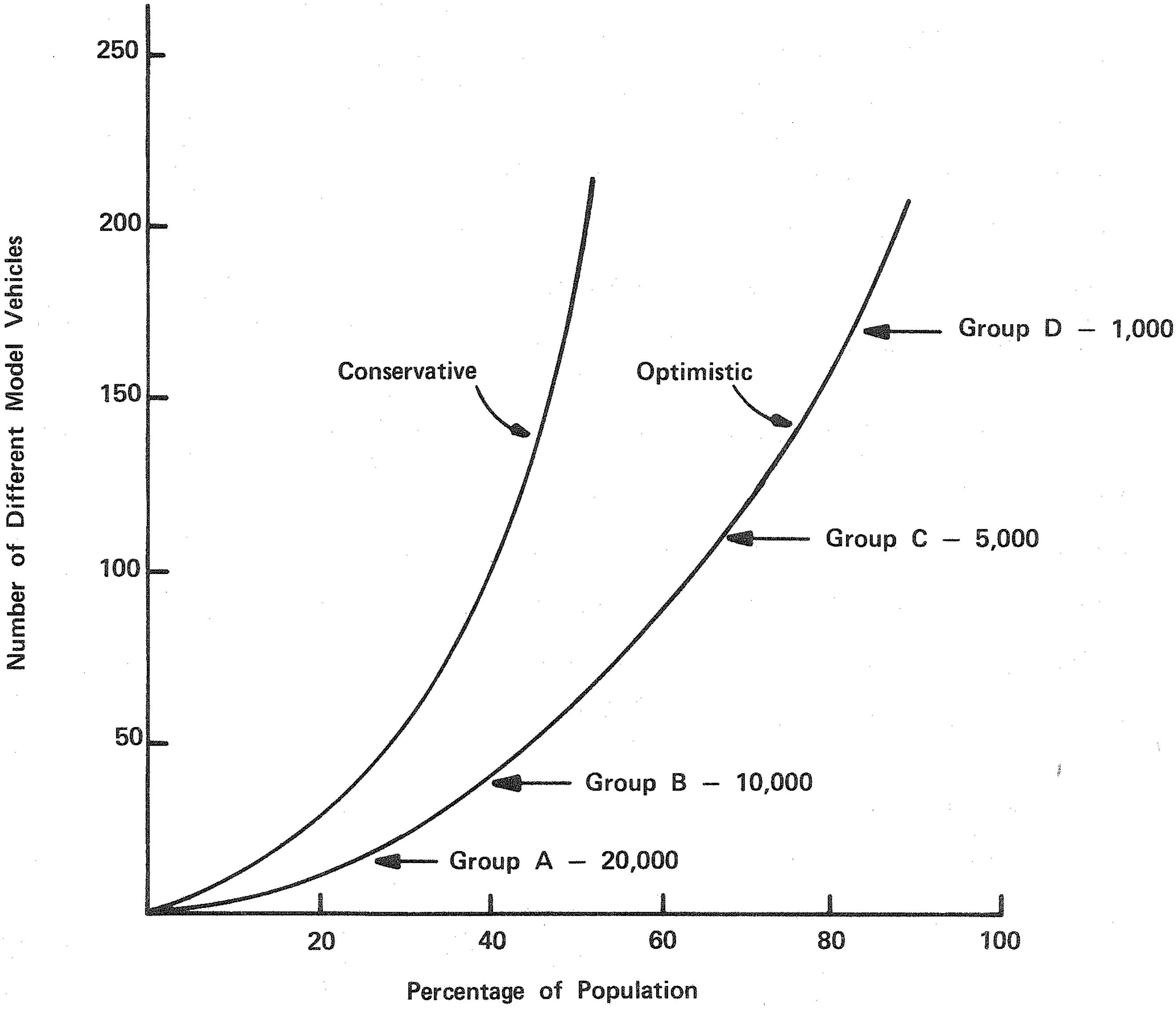
** Projected Motor Vehicle Registration and Drivers Licenses Outstanding 1970-1985, Report No. 31 - March 1970 - DMV - State of Calif.

Figure 2
DISTRIBUTION OF NUMBER OF VEHICLE MODELS IN PRE – 1970 AUTO POPULATION – PROJECTION FOR 1975



(+ See text (page 7) for explanation of group sizes.)

expense, up to 65% of the population (blocks of 1,000 or more vehicles) can be covered. The last portion of the vehicle population is mainly the PC-6 and PC-7 classification as well as station wagons and light trucks for which there is no detailed breakdown. We have assumed this portion of the population would be made up of very small groups of vehicles and would not be practical to retrofit. However, there may well be some large blocks of similar vehicles within this group that can be practically retrofitted. Only a more careful analysis of the data can establish this.

In the interim, we can conclude that a substantial fraction of the vehicle population can be successfully retrofitted, i.e., up to 65 percent. We would encourage that a much more detailed analysis be done as soon as possible.

Case Studies

A series of detailed case studies was made to better understand the retrofit problem. This analysis involved creating a suitable retrofit technique for each sample vehicle, and estimating the time (labor costs) and material (component costs) needed to perform the retrofit. Several types of popular vehicle were selected for the study, as well as some unusual types that might present special problems. The estimates are summarized in Table IV. (The details are in Appendix B)

TABLE IV - SUMMARY OF CASE STUDIES

No.	Vehicle Type	Engine Type	Carburetor	Retrofit Costs (Net Prices) in Dollars				
				Fuel Tank	Replace Carburetor	Replace Total	Rebuild Carburetor	Rebuild Total
1.	1966 Chevrolet	283-V8	Rochester-2B	61	46	107	32	93
2.	1969 Ford	429-V8	Autolite-4B	60	72	132	40	100
3.	1966 Mustang	289-V8	Autolite-2B	60	48	108	32	92
4.	1967 Cadillac	429-V8	Rochester-4B	60	93	153	46	106
5.	1967 Pontiac	400-V8	Rochester-4B	60	85	145	44	104
6.	1968 Plymoth	318-V8	Carter-2B	60	46	106	32	92
7.	1968 Dodge	383-V8	Holley-4B	60	98	158	47	107
8.	1969 Crysler	383-V8	Holley-2B	60	50	110	32	92
9.	1969 Chevy II	230-6cyl.	Rochester-1B	60	34	94	27	87
10.	1966 Falcon	170-6cyl.	Autolite-1B	60	30	90	42	102
11.	1961-1969 Volkswagon	-4cyl.	Solex	75	Not needed	75	Not needed	75

Several conclusions seem to follow from this work. First, the very similar nature of the fuel tank installation in most vehicles gives a constant cost figure for all vehicles, except for the unusual Case 11.

Second, there is a much greater variation in carburetor costs, but this variation correlates roughly with the number of barrels in the carburetor. Rebuilding the carburetor instead of replacing it entirely is very desirable, especially for the more expensive four barrel carburetors.

Partial Retrofit Possibilities

The possiblility of electing to control either the fuel tank or the carburetor losses exists, but at present there is not adequate data to show which controls are more effective. If anything, the limited data indicates the relative emissions from the two sources on the average are equal, though the mix may vary greatly.

From the present data, one can only conclude there does not seem to be any clear desirability for a split retrofit, but the matter should be investigated further to clarify which course of action is most desirable.

Legal Status

The present law already has certain provisions for retrofit of evaporative control devices (See Appendix C for all applicable sections).

The key features are that the device must meet ARB Standards (Health and Safety Code 39175. c) which have been set at 6 grams per test.*
The devices must be good for 50,000 miles (39180. e) and be reasonably practical and not unsafe (39180. d).

However, the ARB may not require installation of any evaporative control until the Legislature grants it authority to do so (39180. 2). The ARB is directed to accredit systems if any manufacturer desires, but then it must report to the Legislature on the costs and performance of the device (39180.1). Only then will the legislature empower the ARB to require evaporative retrofit devices.

Costs of a Retrofit

As seen from Table IV the cost of a retrofit can vary widely depending on the vehicle and its particular engine and carburetor. By estimating the distribution of engine (and carburetor) types in the vehicle population. Appendix D derives an average retrofit cost of $117 including replacement of the carburetor. If the 2-barrel and 4-barrel carburetors are rebuilt, it is estimated the average retrofit would cost only $95. The consequences of this are that a retrofit program covering 65 percent of the applicable vehicles in the South Coast Air Basin is estimated to cost 230 million dollars total for the former case and $185 million dollars for the latter case.

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* California Exhaust and Fuel Evaporative Emission Standards and Test Procedures for Used Motor Vehicles under 6001 pounds Gross Vehicle Weight

The maintenance costs on the system involves replacement of the carbon cannister every 12,000 miles (once a year) at a cost of $1.95. Adding in labor, the replacement cost might be $4.00 total per vehicle per year.

Conclusions

On the basis of these estimated costs, an evaporative emissions retrofit procedure could be established with the following characteristics:

1. A price limit on a retrofit system installed of $125 dollars
2. A maintenance price limit of $5 per 10,000 miles or one year
3. A requirement that an adequate number of devices be provided to cover 65% of the pre-1970 vehicle population of the South Coast Air Basin.

In addition, because of the high cost of the device, at least when compared to other retrofit devices, consideration should be given to a partial subsidy of the device costs from General Funds or from an emissions tax program if one was created. The total cost to the State of such a subsidy would be whatever fraction of the approximately 200 million dollar program cost the State elected to underwrite.

Appendix A

Analysis of the Vehicle Population

The vehicle population of the South Coast Air Basin can be estimated from the county registration data. This analysis only includes automobiles and trucks which are the major contributors to air pollution. (Motorcycles are not included in this analysis.)

The breakdown is as follows:*

County	Autos (1000's)	Trucks (1000's)
Los Angeles	3,748	491
Orange	794	102
Riverside	235	48
San Bernadino	332	69
Santa Barbara	136	23
Ventura	191	33
Total	5,436	766

The truck population is further subdivided by weight into heavy-duty and light-duty vehicles. The latter have the same emissions control requirements as automobiles. Detailed breakdowns by vehicle weight are

* DMV summary sheet for 1971 registration data

given by the DMV.* Analysis of the statewide data indicates 84% of the trucks are light duty vehicles and thus should be grouped with autos in discussing controls. That is, about 98 percent of the vehicle population is light-duty vehicles.

The only more detailed breakdown of the vehicle population is that made available by the analysis of the DMV data tapes by commercial organizations, such as the Ruben H. Donnelley Corp. Their breakdowns cover only automobiles owned by private individuals, not businesses, governments and other organizations. They also do not include other vehicle types.

Approximately half the total vehicle population is covered by this analysis. (See Figure A-1) No breakdowns are available on the other sectors, and so one can only make various assumptions about that segment of the vehicle population in order to better understand the retrofit problem.

Referring to Figure A-1, it seems reasonable that the remaining automobile population of business, government, and organization autos is similar to the individually owned vehicles, if anything, there is probably less variation and more blocks of similar vehicles. On the other hand, the station wagons and light trucks probably add considerably to the number of variations in body types, and hence fuel tank retrofits, though engines and

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* Statistical Record on Motive Power Body Type and Weight Divisions for Automobiles, Motorcycles, Commercial Trucks and Trailers, Jan. 1 to Dec. 31, 1971 - DMV - State of California

therefore carburetors may be very similar to those found on autos.

Because of the uncertainty in extending the analysis Figure II has two curves. The 'conservative' projection is based only on those vehicles definitely covered by the R. H. Donnelley data. The 'optimistic' projection assumes the remaining light duty vehicle population is made up of the same makes and models.

The analysis* of the R.H. Donnelley Data is the basis for Figures A-2 and A-3, summarizing the number of different models needed to cover the automobile population. The data points show the divisions into vehicle types with various minimum populations. These curves are derived from the 1971 registration data by projecting the vehicle population according to the following:

$$\text{(Number of year y cars in 1973)} = \frac{\text{(Fraction of year y cars in 1973)}}{\text{(Fraction of year y cars in 1971)}}$$

$$\times \underbrace{(1.035)^2}_{\text{Annual growth factor}}$$

$$\times \text{(Number of year y cars in 1971)}$$

The calculation assumes that the growth rate is constant, the year to year variations being averaged out. The birth-death model includes the growth rate, so the number of new cars remains virturally constant the first few years, though they are a decreasing percentage of the population.

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* Analysis of the R.H. Donnelley Data - on file at EQL - April 1973

Figure A-1
ANALYSIS OF SOUTH COAST BASIN VEHICLE POPULATION – 1971

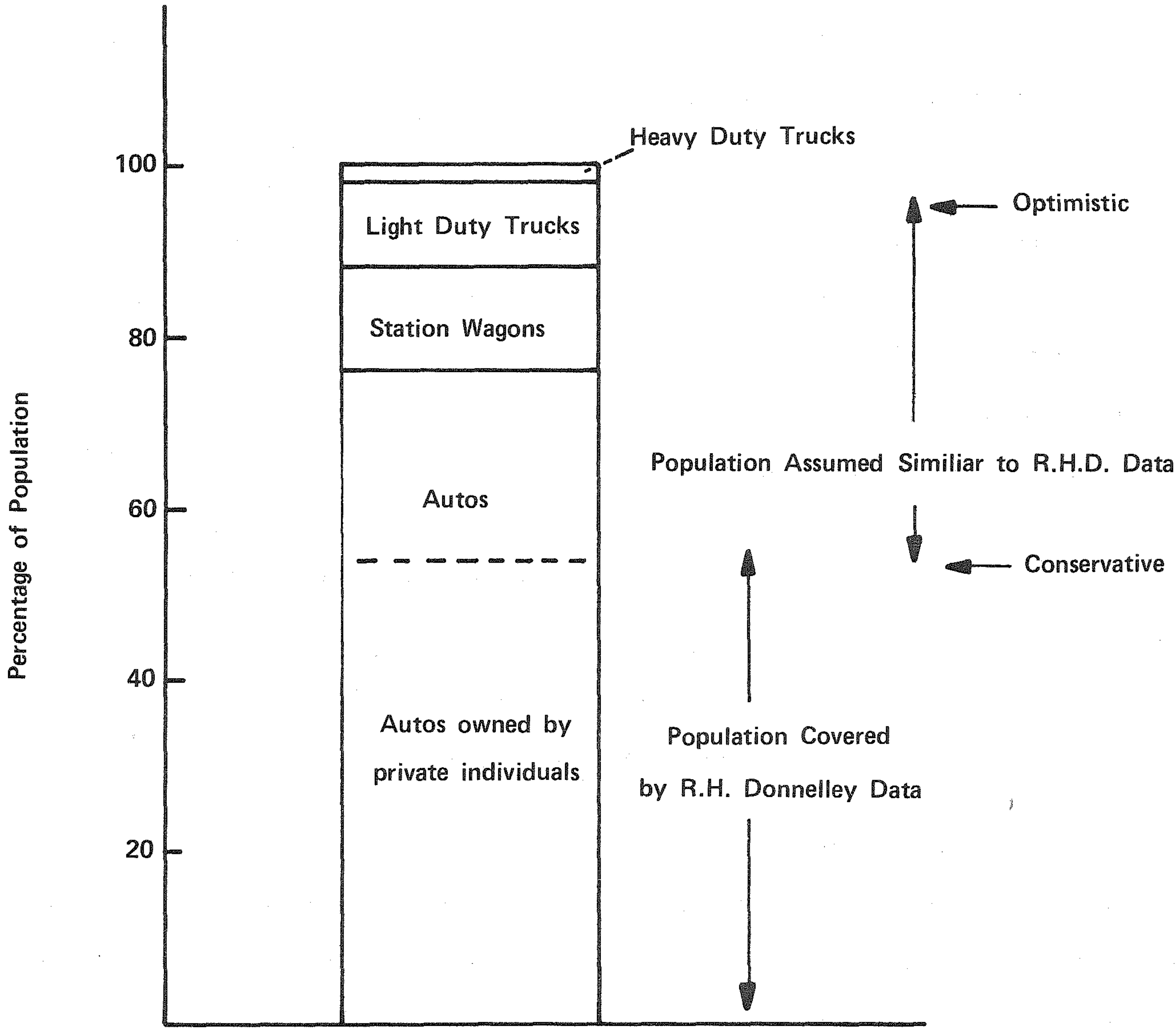


Figure A-2
DISTRIBUTION OF NUMBER OF VEHICLE MODELS IN PRE – 1970 AUTO POPULATION – PROJECTION FOR 1973
(R.H. Donnelley data only)

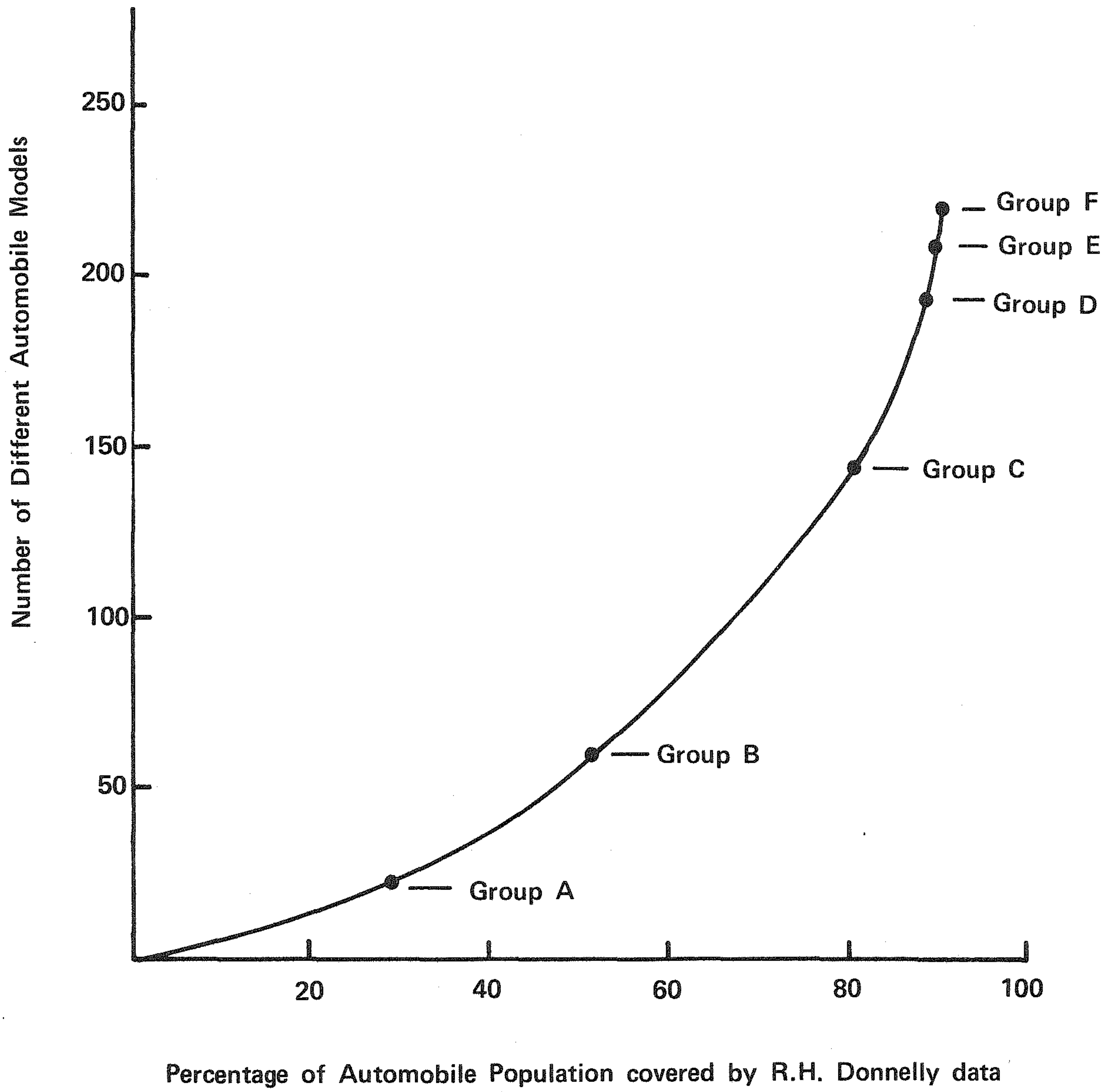
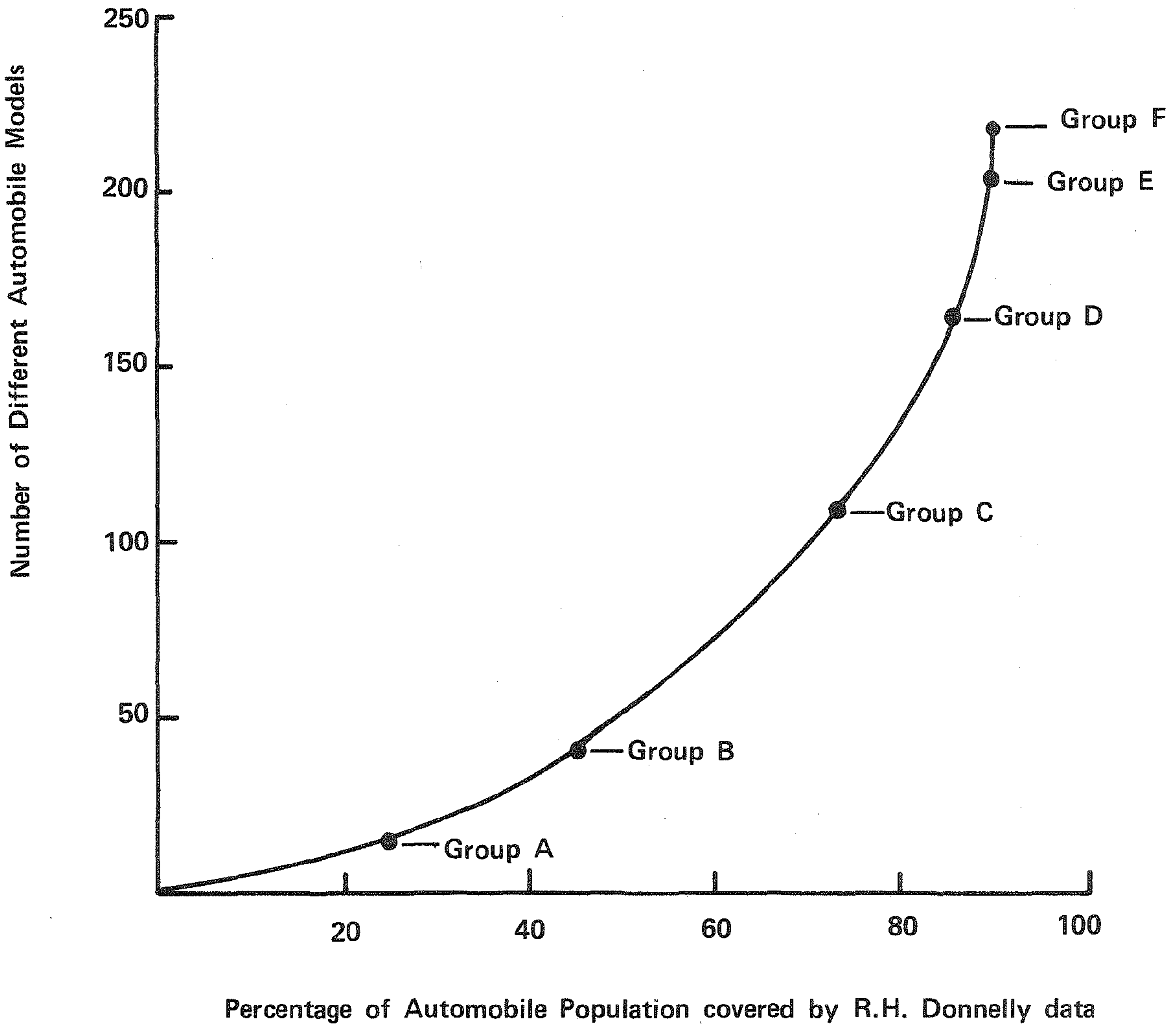


Figure A-3
DISTRIBUTION OF NUMBER OF VEHICLE MODELS IN PRE – 1970 AUTO POPULATION – PROJECTION FOR 1975
(R.H. Donnelley data only)



APPENDIX B

Examples of Case Studies of Retrofits

A total of eleven case studies* were done of popular makes and models of automobiles to examine in detail the possible retrofit techniques and their associated costs. Because of the great similarities in automobile construction, it was felt presenting Case 1 and Case 11 would provide an adequate example of these studies.

General Description of Retrofit Technique

In each of the case studies with the exception of Case Study Number 11, the fuel tank for the automobile in question can be modified to reduce evaporative emissions into the atmosphere using the same general procedure. Consequently, rather than describe the control system for the fuel tank ten different times, it shall be discussed here in detail.

Briefly, the retrofit control system requires the addition of an expansion tank to the fuel tank, a means of directing evaporative emissions into some convenient storage device, and a new gas cap. The expansion tank chosen is manufactured by Volkswagen for its automobiles, but the tank can readily be adapted for use by American

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* Summary of Case Studies of Evaporative Control Retrofits - On file at EQL - April 1973

automobiles. The tank is made of metal, eliptical in cross-section, about 12-15 inches long, and is readily mounted in the trunk of an American automobile. The storage device is a cannister filled with activated carbon, manufactured by Ford. This cannister was chosen because it is the cheapest cannister manufactured by an American firm.

In order to install the evaporative control retrofit system, the expansion tank should be mounted as far forward as possible in the trunk of the automobile being modified. Two holes should then be drilled near the mounted chamber. One of the holes will be used to permit a length of tubing to connect the expansion tank to the fuel tank. The other hole will permit a length of tubing to connect the expansion tank to the carbon cannister. The carbon cannister is to be mounted in the engine compartment of the automobile. Generally, there is room for this cannister near the radiator. Once the expansion tank has been connected to the carbon cannister, a sealing compound is to be placed in the holes in the trunk to ensure that the trunk remains sealed, and the carbon cannister is to be connected to the PCV valve in the engine induction system.

Procedure for Fuel Tank Modification

1. Remove the fuel tank using standard procedures.
   Time: 30 minutes.

2. Flush the tank with solvent and blow it out with compressed air.
   Time: 5 minutes.

3. Steam clean the inside and the outside of the fuel tank.
   Time: 10 minutes.

4. Fill the tank with an inert gas such as nitrogen or carbon dioxide, or fill the tank completely with water.
   Time: 10 minutes.

5. Braze a small nipple into the end of the fuel tank as shown in the accompanying illustration.
   Time: 10 minutes.

6. Seal the vents of the fuel tank.
   Time: 10 minutes.

7. Mount the expansion tank as far forward in the trunk of the automobile as possible.
   Time: 20 minutes.

8. Drill two holes in the floor of the trunk near the expansion tank.
   Time: 5 minutes.

9. Mount the carbon cannister at a convenient location in the engine compartment.
   Time: 10 minutes.

10. Empty the fuel tank. Slosh about 1 quart of gasoline inside, then drain the gasoline and blow the tank dry with compressed air.
    Time: 10 minutes.

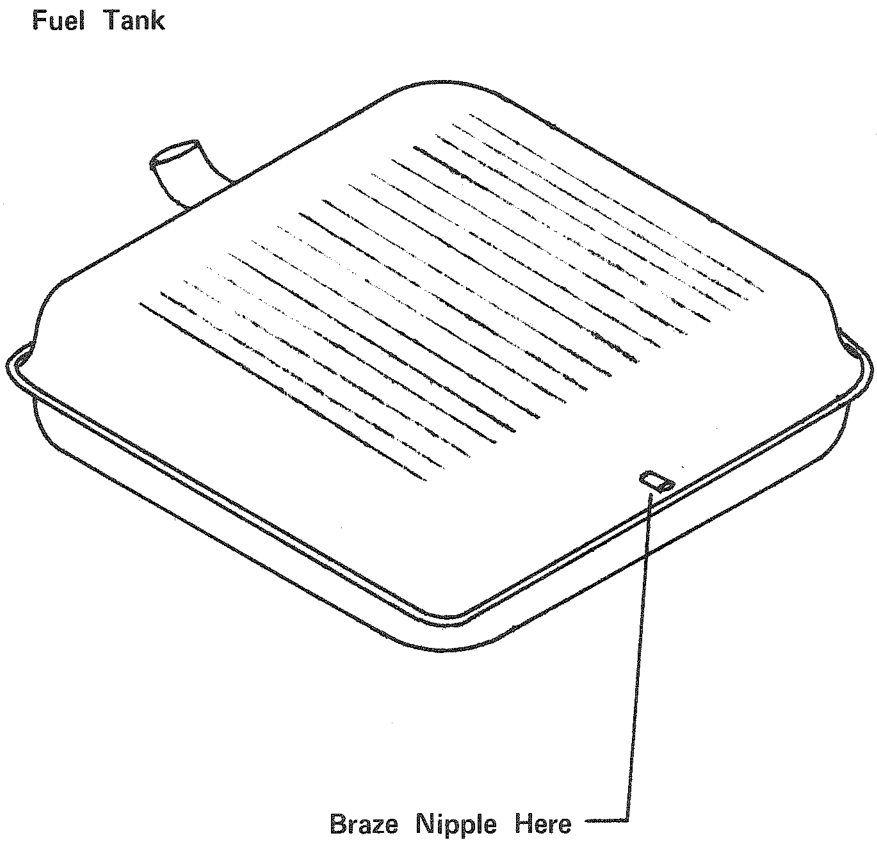
11. Remount the fuel tank using standard procedures.
    Time: 30 minutes.

12. Connect the fuel tank to the expansion tank, the expansion tank to the carbon cannister, and the carbon cannister to the PCV valve; all connections to be made using fuel-proof tubing and hose.
    Time: 30 minutes.

13. Fit the fuel tank with a new vacuum-pressure relief gas cap.

Total estimated time to complete modifications: 180 minutes = 3 hours.

Figure B–1
TYPICAL FUEL TANK MODIFICATION



CASE STUDY NUMBER 1

Make of automobile: Chevrolet

Year of manufacture: 1966

Engine type: V8

Engine size: 283 cu. in.

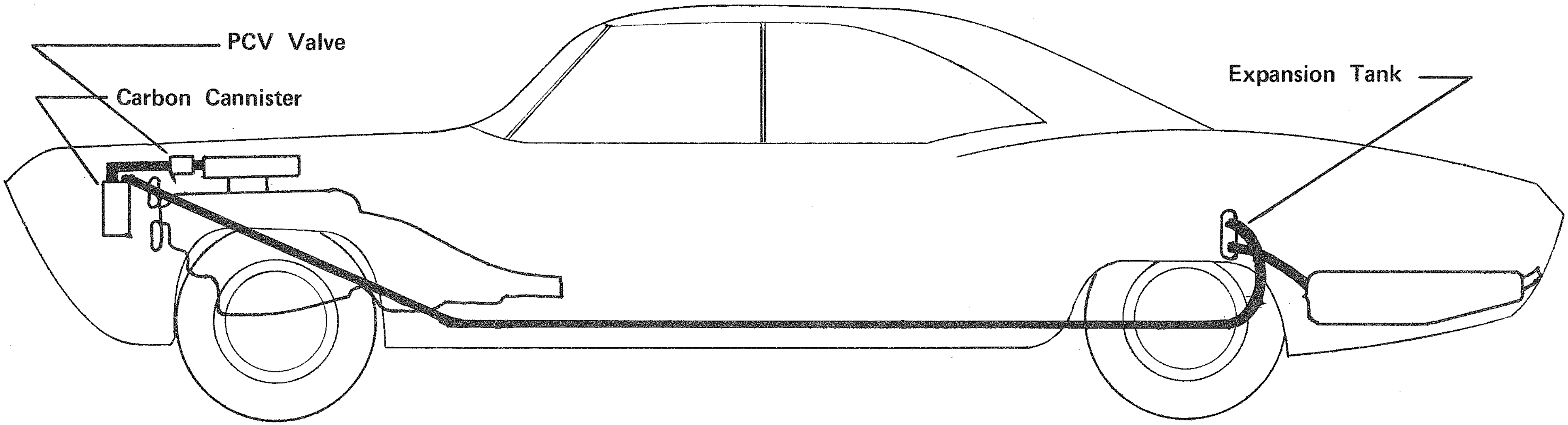
Horsepower rating: 195

Carburetor: 2 barrel Rochester

Carburetor number: 7024112

LOCATION OF EVAPORATIVE CONTROL SYSTEM COMPONENTS

Chevrolet



Carburetor

The Rochester carburetor found on the Chevrolet does not have any provisions for evaporative emissions control. Consequently, it will be necessary to modify or replace the carburetor with a new one. At the present time, the easiest choice is to simply replace the present carburetor with a new one manufactured by Rochester. In the event that the carburetor does not seat properly on the intake manifold, then an adaptor plate must be used. The need for this adaptor plate must be determined by the person or persons installing the evaporative emissions control retrofit system. The estimated cost for retrofitting an evaporative emissions control system using a replacement carburetor is shown in the first cost estimate.

At the present time, the airhorn assembly for the carburetor is a special-order item. In the event that the airhorn assembly could be modified for evaporative emissions control, then a kit consisting of the airhorn assembly and a present carburetor rebuilding kit could be sold as part of the retrofit evaporative emissions control system. The estimated cost for this type of retrofit control system is shown as the second cost estimate.

Maintenance

The only preventative maintenance necessary is to make certain that the tubing and hoses are in good repair and that the connections are tight.

The carbon cartridge in the carbon cannister should be replaced as per the manufacturer's recommendation. This will occur about every 12,000 miles. The cost of a replacement cartridge is about $1.95.

Estimated Costs - Replacing Carburetor

Item	List Price	Net Price
Fuel Tank		
Expansion Tank	$ 9.95	$ 7.95
Carbon Cannister	20.25	15.19
Hardware	3.50	2.80
Tubing and Hose	10.00	7.50
Parts Subtotal	$43.70	$33.44
Labor at $9.00 per hour 3 hours	$27.00	$27.00
Fuel Tank Subtotal	$70.70	$60.44
Carburetor		
New Rochester carburetor Number 7042112	$36.00	$28.90
Adaptor Plate	5.00	4.00
Labor at $9.00 per hour 1.5 hours	13.50	13.50
Carburetor Subtotal	$54.50	$46.40
Estimated Total Cost	$125.20	$106.84

Estimated Costs - Rebuilding Carburetor

Item	List Price	Net Price
Fuel Tank		
Expansion Tank	$ 9.95	$ 7.95
Carbon Cannister	20.25	15.19
Hardware	3.50	2.80
Tubing and Hose	10.00	7.50
Parts Subtotal	$43.70	$33.44
Labor at $9.00 per hour 3 hours	$27.00	$27.00
Fuel Tank Subtotal	$70.70	$60.44
Carburetor		
Carburetor rebuilding kit	$ 6.50	$ 4.88
New Airhorn Assembly	10.80	8.67
Parts Subtotal	$17.30	$13.55
Labor at $9.00 per hour 2 hours	$18.00	$18.00
Carburetor Subtotal	$35.30	$31.55
Estimated Total Cost	$106.00	$91.99

CASE STUDY NUMBER 11

Make of automobile: Volkswagen

Year of manufacture: any year between 1961 and 1969

Engine type: 4 cylinder

Engine size: depends on year of manufacture

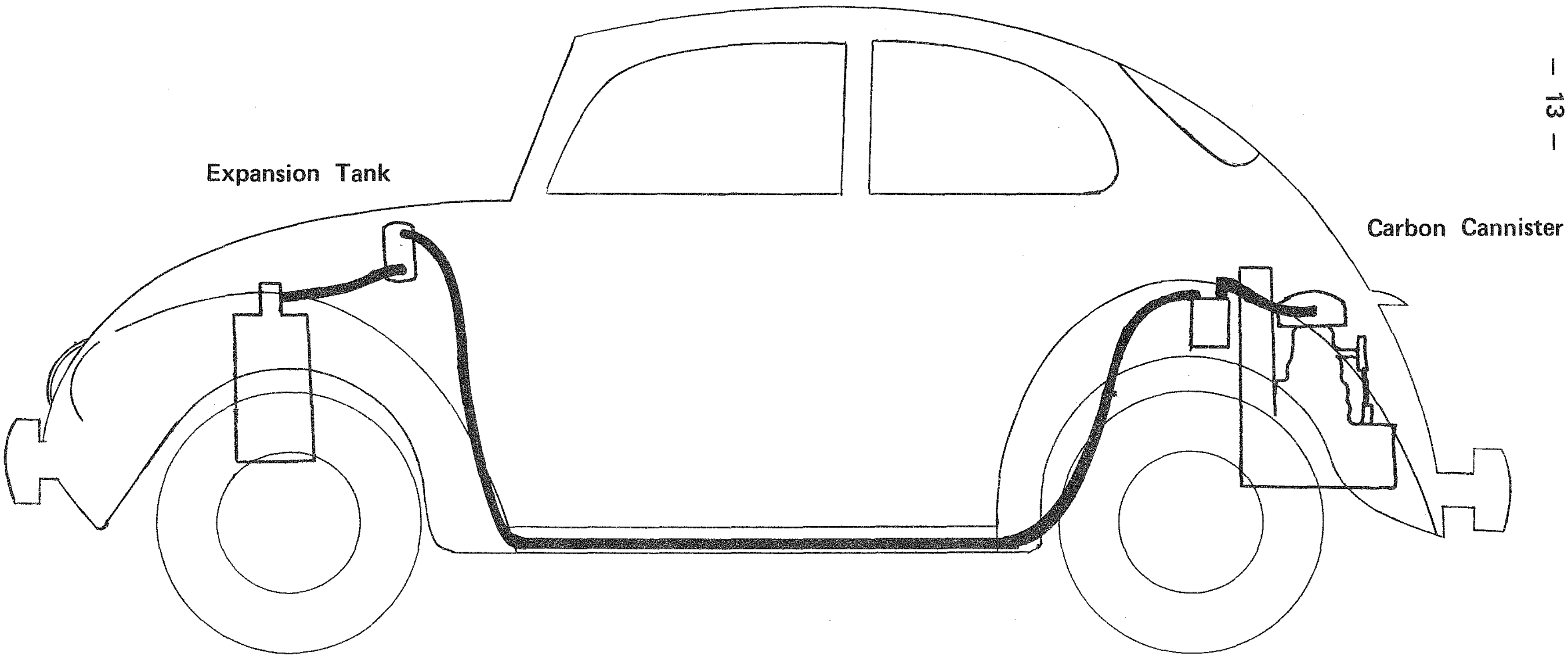
Horsepower rating: depends on year of manufacture

Carburetor: depends on year of manufacture

Carburetor number: depends on year of manufacture

LOCATION OF EVAPORATIVE CONTROL SYSTEM COMPONENTS

Volkswagen



Carburetor

The carburetor used on Volkswagens manufactured between 1961 and 1969 was a Solex downdraft type, the choice being determined by the year of manufacture. None of the models have an external vent located above the carburetor bowl, but rather, they have just a single internal vent. The internal vent for any model is located at the top of the carburetor throat where the air cleaner rests. The air cleaner, an oil bath type, acts as a seal to control evaporative losses from the internal vent.

In summary, the carburetor is already controlled as well as can be expected. No modifications of any kind need be done to the carburetor.

Fuel Tank

The fuel tank for Volkswagens manufactured between 1961 and 1969 should be modified to a design similar to that used on Volkswagens sold in California beginning in 1970. This modification will consist of adding an expansion tank onto the present fuel tank and also adding a cannister of activated carbon, to be placed in the engine compartment.

The modifications can be accomplished in the following manner:

1. Remove the fuel tank from the automobile using standard procedures.
   Time: 30 minutes.

2. Flush the tank with solvent and blow it out with compressed air.
   Time: 10 minutes.

3. Steam clean the inside and the outside of the fuel tank.
   Time: 10 minutes.

4. Fill the tank with an inert gas such as nitrogen or carbon dioxide, or fill the tank completely with water.
   Time: 5 minutes.

5. Braze a small nipple into the side of the filler neck of the fuel tank.
   Time: 10 minutes.

6. Mount the expansion tank in the right side of the front luggage compartment.
   Time: 15 minutes.

7. Remove the fan housing and the air cleaner using standard procedures.
   Time: 50 minutes.

8. Steam clean both the fan housing and the air cleaner.
   Time: 10 minutes.

9. Braze small nipples onto both the lower body of the air cleaner and the fan housing as shown in the accompanying illustration.
   Time: 20 minutes.

10. Mount the cannister of activated carbon under the right rear fender.
    Time: 10 minutes.

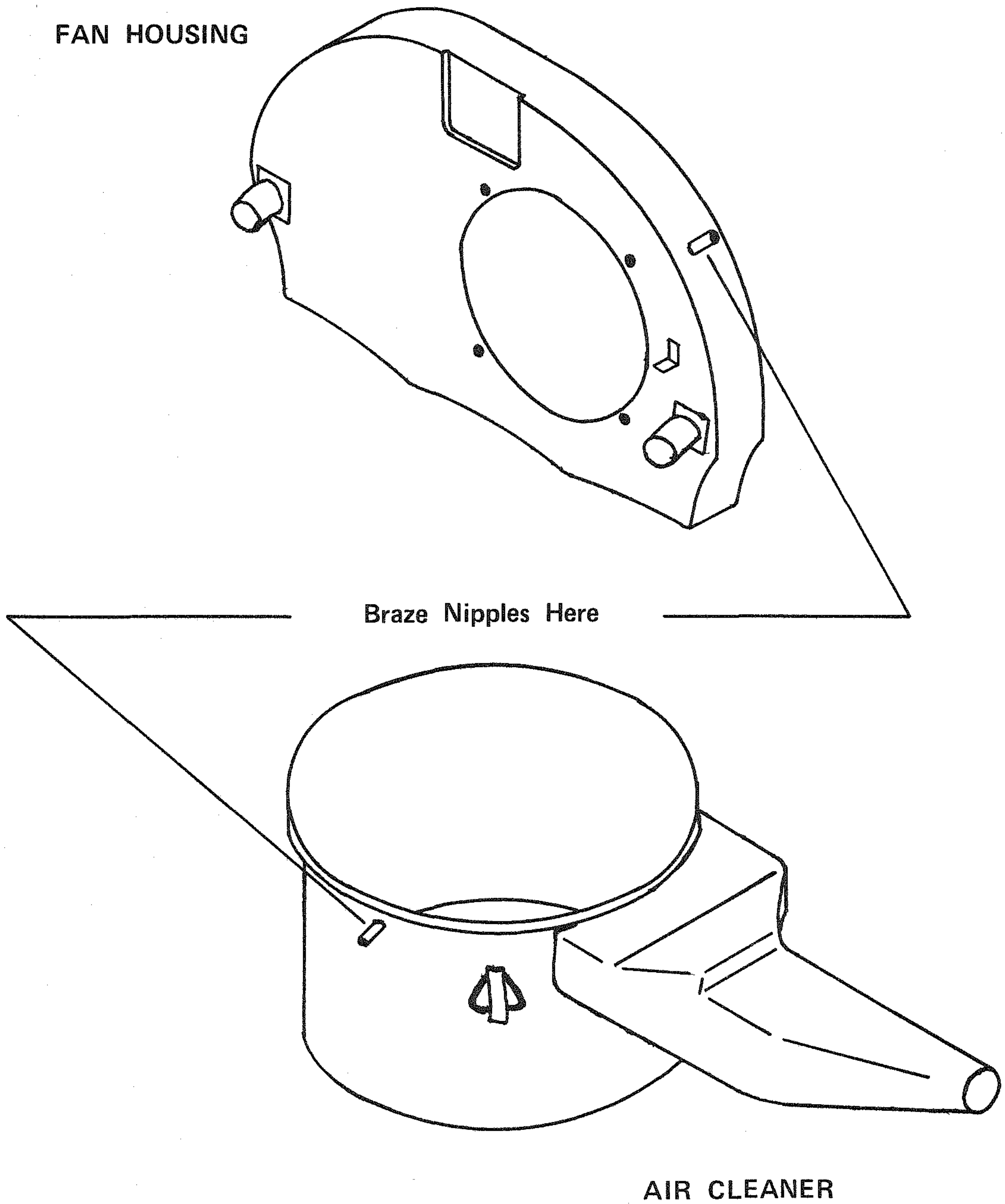
11. Remount the fan housing and the air cleaner using standard procedures.
    Time: 50 minutes.

12. Empty the fuel tank. Slosh about 1 quart of gasoline in the fuel tank, then drain the gasoline and blow the tank dry with compressed air.
    Time: 10 minutes.

13. Remount the fuel tank using standard procedures.
    Time: 30 minutes.

14. Connect the fuel tank to the expansion tank, the expansion tank to the carbon cannister, and the carbon cannister to the lower body of the air cleaner; all connections to be made using fuel-proof tubing.
    Time: 40 minutes.

Estimated time to complete modifications: 300 minutes = 5.0 hours.


FAN HOUSING
Braze Nipples Here
AIR CLEANER

Maintenance

The only preventative maintenance necessary is checking to see that all vent lines are tight and in good condition. The cannister of activated carbon should be replaced as per the manufacturers recommendation.

Estimated Costs

Item	List Price	Net Price
Expansion Tank	$ 9.95	$ 7.95
Carbon Cannister	13.55	10.95
Cover	1.55	1.25
Strap	1.95	1.55
Hose and tubing	10.00	8.00
Parts Subtotal	$37.00	$29.70
Labor at $9.00 per hour 5 hours	$45.00	$45.00
Total Estimated Costs	$82.00	$74.70

APPENDIX C

Legal Status of Retrofits

(Part 1, Division 26, Health & Safety Code)

Article 5. Used Motor Vehicle Device Accreditation

(Article 5 added by Stats. 1968, Ch. 764. See note at beginning of Division 26)

39175. The board shall have the powers and authority necessary to carry out the duties imposed on it by this article including, but not limited to, the following:

(c) To determine and publish by January 1, 1969, tests and procedures for the accreditation of used car exhaust emission control and fuel system evaporative loss control devices.

39177. The board may exempt classifications of motor vehicles for which accredited devices are not available, and motor vehicles whose emissions are found by appropriate tests to meet state standards without additional equipment, and motor-driven cycles, implements of husbandry, and vehicles which qualify for special license plates under Section 5004 of the Vehicle Code.

39180. In establishing tests and procedures the board shall adopt standards including, but not limited to, the following:

(d) Standards for an accredited fuel system evaporative loss control device shall take into consideration the cost of the device and its installation, its durability, the ease and facility of determining whether the device, when installed on a motor vehicle is properly functioning, and any other factors which, in the opinion of the board, render such a device suitable or unsuitable for the control of motor vehicle air pollution or for the health, safety, and welfare of the public.

(e) An accredited fuel system evaporative loss control device shall equal or exceed the performance criteria established by the board for such new device required on new motor vehicles, or in the alternative, must have an expected useful life of at least 50,000 miles of operation.

39180.1. Whenever the board accredits a fuel system evaporative loss control device for which standards have been set by this chapter, it shall submit a report of its finding and its recommendations for installation on used vehicles to the Legislature within 10 days, if it is then in session, or if not in session not later than January 15, of the next general session. Such report shall contain a report on the cost of such device, including the cost of installation and a review of its potential performance, including required maintenance and the cost of parts and labor.

39180.2. No accredited fuel system evaporative loss control device for installation on used motor vehicles, nor any other accredited device not mentioned in Section 39129 shall be required to be installed on any used motor vehicles until approved by statute enacted by the Legislature.

APPENDIX D

Calculation of Evaporative Control Retrofit Costs

To estimate the cost of the total retrofit program, we can use the data from the case studies. The fuel tank retrofit cost is fixed and the carburetor cost depends on the number of barrels and whether the carburetor is replaced or rebuilt. For the VW, only the fuel tank is retrofitted. Using the costs as given below: (costs are in dollars)

	Tank	New Carburetor	Total
VW	75	-	75
1-Barrel	60	32	92
2-Barrel	60	48	108
4-Barrel	60	85	145

	Rebuild Carburetor	Rebuild Total
2-Barrel	32	92
4-Barrel	44	104

we can estimate the cost for the entire retrofit program.

There is no data available on the distribution of carburetor types in the vehicle population. However, we have used the ARB's* estimates

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* ARB Memo - Used Car Device Accreditation Test Fleet - March 30, 1970

of the distributions of engine displacements to estimate the percentage of carburetors each type. The ARB's breakdown is as follows:

Engine Size Cubic Inches	Vehicles (in thousands)	Percentage
under 140	390	8.2
140-200	370	7.8
200-250	850	17.8
250-300	1310	27.6
300-375	680	14.3
over 375	1150	24.2

We have arbitrarily assigned carburetor sizes as follows: The 'under 140' class was assumed to be VW's with just a fuel tank retrofit. The '140-200' class and approximately half the '200-250' class was assumed to have a one-barrel carburetor, typical of 4 cylinder and most 6 cylinder cars. The remaining '200-250' class and all the '250-300' class were assumed to be two barrel carburetors, typical of small V-8 engines. The '300-375' and 'over 375' class vehicles were assumed to have four barrel carburetors typical of large V-8 engines.

Thus the average cost of a retrofit can be calculated.

Class	'VW'	1 Barrel	2 Barrel	4 Barrel
Fraction of Population	8.2	16.6	36.6	38.6
Replace Costs	75	92	108	145
Rebuild Costs	-	-	92	104

Weighted average———Replace———→ ~ $117

Weighted average———Rebuild———→ ~ $95
(2-barrel and 4-barrel only)

The pre-1970 light duty vehicle population in the South Coast Air Basin will decrease over the next few years from 3.6 million in 1973 to 2.5 million in 1975. Assuming the average number of vehicles in this period is 3.0 million and that 65 percent are retrofitted, the total cost is approximately $230 million when the carburetor replacement price is used, $185 million if the rebuild price is used.