MOTOR VEHICLE EMISSION

INSPECTION AND MAINTENANCE PROGRAM

IMPLEMENTION IN THE

GREATER VANCOUVER REGIONAL DISTRICT

AND THE LOWER MAINLAND

Greater Vancouver Regional District

B. C. Ministry of Environment

Environment Canada

I/M IMPLEMENTATION TASK FORCE REPORT
OCTOBER 1989

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PREFACE

Eleven years of monitoring with continuous analysers at locations throughout the Lower Mainland has shown that the region experiences periods when ambient air quality does not meet the National Ambient Air Quality Objectives.

In May of 1988, the Greater Vancouver Regional District completed a detailed inventory of all sources of air pollution in the Lower Mainland which indicated that motor vehicles are responsible for 80 percent of the five primary air pollutants (CO, NOx, VOC, SOx, and particulate matter) emitted in the area. This information supports earlier estimates by Environment Canada.

Studies carried out by the three levels of government with responsibility for various aspects of air pollution control in the Lower Mainland have consistently supported a motor vehicle emission inspection and maintenance (I/M) program as a key component of an air quality management strategy to deal with the region's air quality problem.

In April of 1989 the GVRD Board of Directors instructed its staff to prepare a draft proposal by the end of 1989 for a Regional District program to control emissions from motor vehicles. This initiative coincided with ongoing work by the British Columbia Ministry of Environment and Environment Canada, and resulted in the formation of an I/M Implementation Task Force to coordinate resources of the three agencies to evaluate the various alternatives for a motor vehicle emission and maintenance program, and to recommend the most effective option for implementation. This report presents the findings of the Task Force.

The I/M Implementation Task Force consisted of the following members:

Greater Vancouver Regional District	-	Barrie Mills
	-	Morris Mennell
B.C. Ministry of Environment	-	Dick Marshall
	-	Kamal Bhattacharyya
B.C. Motor Vehicle Branch	-	Clare Eraut
Environment Canada	-	Ed Wituschek
	-	David Poon
	-	Doug Cope

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EXECUTIVE SUMMARY

In the spring of 1989, the B.C. Minister of Environment and the Board of Directors of the Greater Vancouver Regional District announced the intention to control excess emissions from in-use cars and light duty trucks in the Greater Vancouver Regional District and the Lower Mainland to the east of the GVRD by establishing a motor vehicle emission inspection and maintenance (I/M) program.

Staff of the Greater Vancouver Regional District, the B.C. Ministry of Environment, and the B.C. Motor Vehicle Branch were joined by Environment Canada personnel from Vancouver and Ottawa to form an I/M Implementation Task Force which reviewed existing I/M programs in the United States, selected a preferred type of program for the Greater Vancouver area, and made recommendations on detailed design criteria and the implementation process for the proposed I/M program.

Federal government emission standards for motor vehicles manufactured in Canada or imported into this country have recently been made more stringent. Effective from the 1988 model year, the Canadian new car standards are similar to the standards set by the U.S. federal government. At the October, 1989 meeting of the Canadian Council of Ministers of the Environment it was announced that the federal ministers of Environment and Transport intend to strengthen Canadian standards to the equivalent of the proposed 1994 California motor vehicle emission standards. In addition, the provincial Ministers undertook to implement, by 1992, motor vehicle inspection and maintenance programs in provinces where ozone problems occur.

Studies of in-use motor vehicles have shown that actual emissions from many light duty vehicles on the road do not meet the original manu-

facturer's specifications. This problem is generally due to poor maintenance, to misfueling a vehicle requiring non-leaded fuel with leaded gasoline, or to deliberate tampering with pollution control equipment. Motor vehicle I/M programs are designed to prevent these problems by requiring regular inspections of the vehicle's pollution control equipment and testing of tailpipe emissions.

The GVRD Air Management Plan Stage 1 Report released in October of 1989 shows that motor vehicle sources are responsible for 90 percent of the carbon monoxide, 64 percent of the nitrogen oxides, and 53 percent of the hydrocarbons released into the air in the Greater Vancouver urban area. A motor vehicle I/M program in the GVRD could achieve annual motor vehicle emission reductions of as much as 94,100 tonnes of carbon monoxide (30 percent of total vehicle emissions), 6,400 tonnes of hydrocarbons (15 percent of total vehicle emissions), and 800 tonnes of nitrogen oxides (5 percent of total vehicle emissions). These emission reductions would result in improvements in air quality and would help to prevent problems associated with carbon monoxide levels in downtown Vancouver in the winter, and ozone levels in the eastern areas of the GVRD and in the Lower Mainland to the east of the GVRD in the summer.

A detailed assessment of existing motor vehicle inspection and maintenance programs in Seattle, Portland and the State of California resulted in the Task Force recommending a program for the GVRD and the Lower Mainland modelled after the Seattle system. The selected system includes an administrative and quality assurance function carried out by a lead government agency, centralized inspection stations located at approximately six strategic sites and operated by a contractor with specialized expertise in vehicle testing, and vehicle repairs carried out by the existing automotive repair industry.

It is proposed that each vehicle will be required to have an emission test once per year. A sample of the tailpipe emissions from the vehicle will be analysed by automatic instruments, and the pollution levels will be compared to in-use standards for the specific model year, model type and engine classification of the vehicle being tested. Vehicles which do not pass the emission test will be required to have repairs of the emission control system carried out. The motor vehicle owner must satisfy the

requirements of the I/M program before he or she will be allowed to renew the motor vehicle license.

Test fees will be set to cover all operating costs of the I/M program. While detailed costs have not yet been established, experience from other I/M programs suggest that the test fee will be in the order of $15, and that the average cost of emission-related repairs to failed vehicles will be approximately $50. Much of this cost could be offset by reduced fuel consumption resulting from improvements to the vehicle's operating efficiency.

The Task Force recommends that the various government agencies with an interest in the proposed motor vehicle I/M program establish an agreement on their respective roles and responsibilities, and that tender documents for the contract operation of the inspection stations be prepared as soon as possible. The Task Force estimates that a call for proposals could be issued in June of 1990, and that contracts for an initial five year term could be in place by the end of 1990. A public information program with some voluntary vehicle testing could be initiated in early 1991, with the rest of the test stations being placed into service later that year.

1 INTRODUCTION

Concern about air quality in the Lower Mainland of British Columbia has led to a number of recent technical studies aimed at a better understanding of the air pollution problem and identification of effective emission control strategies. Motor vehicles have been shown to be the major source of air pollution in this area, and therefore control of emissions from this source is a necessary component of any air management strategy.

A motor vehicle emission inspection and maintenance (I/M) program is a system for the reduction of air pollution through mandatory testing of emissions and / or inspection of pollution control equipment to ensure that vehicles are properly maintained and have not been tampered with or misfuelled. The federal government has imposed stringent emission standards for both light and heavy duty motor vehicles at the point of manufacture in Canada or importation into Canada. A program for the testing and regulation of emissions from in-use motor vehicles is required to ensure full benefit from the public investment in emission control equipment on new vehicles.

This report documents the findings of an I/M Implementation Task Force set up in May of 1989 to complete the preliminary design of a motor vehicle emission inspection and maintenance program for the Greater Vancouver Regional District (GVRD) and the areas in the Lower Mainland to the east of the GVRD. All of the government agencies which could have a major role in the implementation and operation of an I/M program were represented on this Task Force, including the Greater Vancouver Regional District, the B.C. Ministry of Environment, the B.C. Motor Vehicle Branch, and Environment Canada.

1.1 Past Motor Vehicle I/M Program Assessment Activities

In August 1984 the Lower Mainland Oxidant Steering Committee, a joint committee of the Greater Vancouver Regional District, the British Columbia Ministry of Environment, and Environment Canada, issued a report[1] which recommended that the feasibility of a motor vehicle emission inspection and maintenance program be examined for the Lower

Mainland. Subsequently, a report[2] issued by the Transport Systems Division of Environment Canada concluded that motor vehicle I/M programs should be considered for certain urban areas as a method of reducing excess light duty vehicle emissions.

Acting on these recommendations, an Oxidant Steering Committee Task Force of federal, provincial and GVRD staff carried out a detailed evaluation of motor vehicle I/M program options for the Lower Mainland area. The report of this Task Force[3], published in March of 1989, proposed that an I/M program for the area be implemented, and recommended that, on approval, the detailed design of such a program be initiated by a multi-agency government committee.

Two motor vehicle I/M field test projects have been carried out in the GVRD during the past decade. In June of 1981 the provincial Ministry of Environment conducted a test program[4] in the City of Vancouver in cooperation with the B.C. Ministry of Transportation and Highways and Environment Canada. Tests of 400 vehicles indicated that only 46 percent were performing satisfactorily on the basis of emissions of hydrocarbons and carbon monoxide, and that proper tuning could reduce fleet emissions of carbon monoxide by 40 percent, hydrocarbons by 15 percent, and nitrogen oxides by 15 percent. The report summarizing the results of the June 1981 test program also pointed out that an I/M program covering one-half of the vehicle population in British Columbia could result in fuel savings conservatively estimated at two percent, representing a potential saving in fuel costs of approximately $16.8 million.

A second field test project was sponsored by Environment Canada during Environment Week in June of 1986. A voluntary emission test program, operated under contract by Vancouver Community College at a shopping mall in Richmond received a good response from the public over the four days that it was held. Results of the June 1986 test program are summarized in Appendix C of this report.

1.2 The Air Quality Problem

Ambient air quality in the Lower Mainland has been monitored intensively since 1978, when a network of sulphur dioxide, carbon monoxide, nitrogen oxides, and ozone continuous analysers was installed to augment an

existing particulate monitoring program. Since 1986, air quality measurements have been publicly reported as an Air Quality Index. The Air Quality Index information for five locations in the Greater Vancouver Regional District is summarized in Table 1-1.

Data from the air quality monitoring network has been reviewed in a number of technical reports published in the past decade, the most recent being the September 1989 report "GVRD Air Management Plan - Stage 1: Assessment of Current and Future Air Quality".[5] Three of the air contaminants studied in this report are closely related to pollution from motor vehicles. Carbon monoxide and nitrogen oxides are emitted directly by cars, trucks and busses. Motor vehicles are also one of the sources of hydrocarbons, a pollutant which reacts with nitrogen oxides in the presence of sunlight to form ozone.

In comparing GVRD ambient air quality to Canadian National Ambient Air Quality Objectives (NAAQO), the Stage 1 GVRD Air Management Plan Report found that the Maximum Acceptable level (Air Quality Index of 50) for ozone has been exceeded every year during the past decade, and that the Maximum Tolerable level (Air Quality Index of 100) for ozone has been exceeded during six of the past eleven years. Episodes of high ozone levels occur during hot days in the late spring and summer seasons, with the concentrations generally increasing toward the eastern areas of the Lower Mainland. Figure 1-1 shows the record of ozone exceedances in the GVRD and in the Lower Mainland areas to the east of the GVRD since 1978.

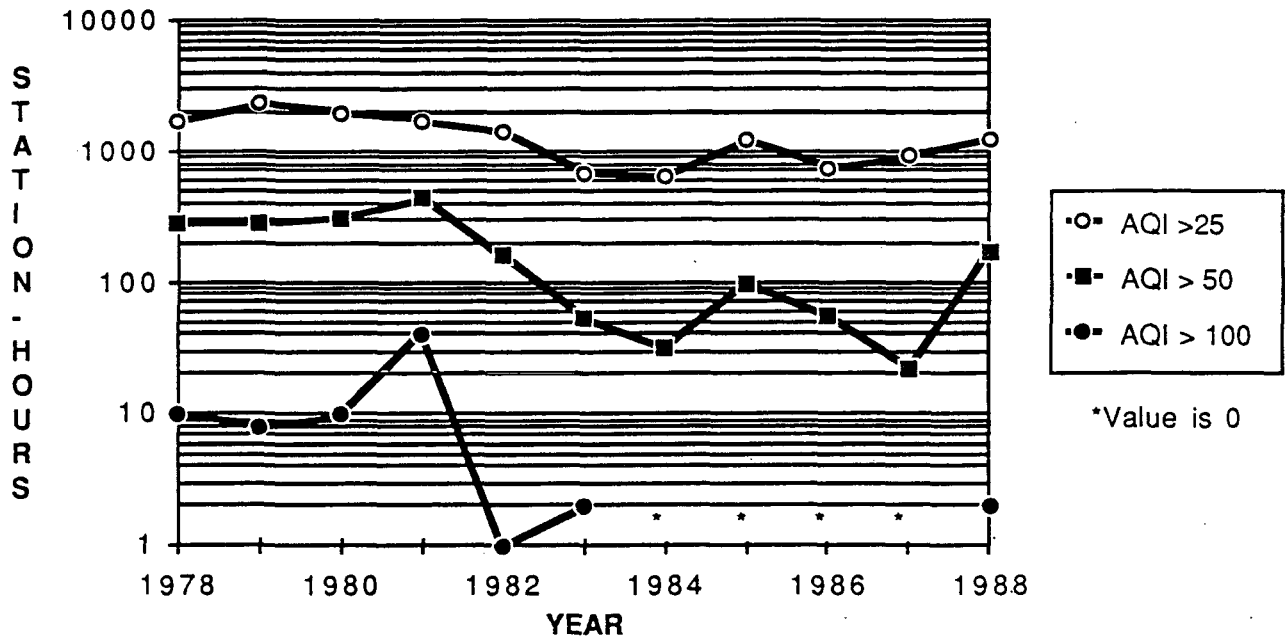
The Stage 1 GVRD Air Management Plan Report concludes that maximum ozone concentrations will persist near historic levels over the next twenty years unless additional controls are implemented for emissions of ozone precursors (hydrocarbons and nitrogen oxides).

The NAAQO Maximum Acceptable level for carbon monoxide has been exceeded very infrequently in the past decade, however the Maximum Desirable level (Air Quality Index of 25) is exceeded in some western areas of the GVRD with high volumes of motor vehicle traffic, particularly in downtown Vancouver. Elevated levels of carbon monoxide generally occur during periods of poor atmospheric dispersion in the winter. Carbon monoxide monitoring data in Figure 1-2 shows lower levels in 1986 through 1988, however the long-term projections indicate continuing NAAQO Maximum Desirable exceedances.

TABLE 1-1 1986-1988 Air Quality Index Summary[5]

Station Location		Year	# Hours AQI in Range				# Hours Pollutant Responsible for AQI>25						
			GOOD 0-25	FAIR 26-50	POOR 51-100	V.POOR >100	SO2 1 hr	SO2 24 hr	CO 1 hr	CO 8 hr	NO2 1 hr	O3 1 hr	COH* 1 hr
T1	Downtown Vancouver	1986	8373	386	0	0	0	0	1	385	0	0	-
		1987	8375	384	0	0	0	0	1	381	2	0	-
		1988	8541	152	0	0	0	0	0	150	2	0	-
T4	North Burnaby	1986	8720	38	0	0	1	0	0	0	19	18	-
		1987	8723	37	0	0	2	0	0	0	12	23	-
		1988	8709	65	10	0	0	0	0	4	3	68	-
T9	Port Moody	1986	8530	0	0	0	0	0	0	0	0	0	-
		1987	8634	122	2	0	0	0	0	0	4	117	-
		1988	8549	190	39	0	0	0	0	16	3	210	-
T15	Central Surrey	1986	8658	57	0	0	0	0	0	0	0	57	-
		1987	8642	108	1	0	0	0	0	0	0	108	-
		1988	8541	183	25	1	0	0	0	0	0	209	-
T17	Richmond	1986	4337	78	0	0	0	0	5	73	0	0	-
		1987	8652	197	1	0	0	0	8	140	0	50	-
		1988	8637	124	0	0	0	0	3	72	0	49	-

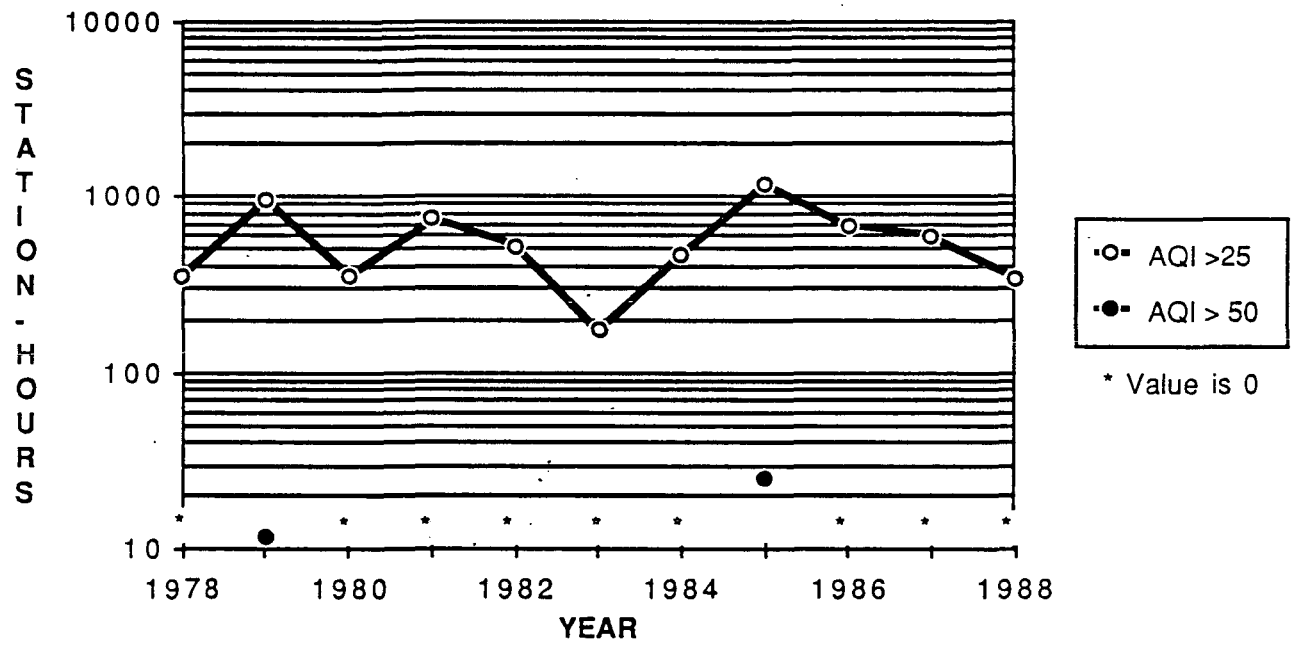
* COH instruments not operated in this period.



Note: 1. Total station-hours of ozone air quality objective exceedances at GVRD monitoring stations T1 through T10 and Ministry of Environment monitoring stations T11 and T12.
2. Station-hours of exceedances is the sum, over a selected group of monitoring stations, of the number of hours during the year that objective exceedances occurred at each station.
3. AQI = 25 is the federal Maximum Desireable Objective (Level A)
AQI = 50 is the federal Maximum Acceptable Objective (Level B)
AQI = 100 is the federal Maximum Tolerable Objective (Level C)

FIGURE 1-1

Exceedances of Air Quality Objectives for Ozone



Note: 1. Total station-hours of carbon monoxide air quality objective exceedances at GVRD monitoring stations T1 through T9.
2. Station-hours of exceedances is the sum, over a selected group of monitoring stations, of the number of hours during the year that objective exceedances occurred at each station.
3. AQI = 25 is the federal Maximum Desireable Objective (Level A)
AQI = 50 is the federal Maximum Acceptable Objective (Level B)
AQI = 100 is the federal Maximum Tolerable Objective (Level C)

FIGURE 1-2

Exceedances of Air Quality Objectives for Carbon Monoxide

The assessment of nitrogen dioxide levels in the Stage 1 GVRD Air Management Plan Report indicates that this air contaminant is of less concern with respect to the National Ambient Air Quality Objectives than is ozone and carbon monoxide. However, nitrogen oxides play a role in the atmospheric photochemical reactions which produce ozone, and therefore must be addressed in any ozone control initiative.

1.3 Sources of Air Pollution

The Greater Vancouver Regional District completed a detailed inventory of emissions of air contaminants in the Lower Mainland in May of 1988. This emission inventory[6] is based on 1985 data and contains information on emissions of five contaminants. All sources of air pollution are covered in the inventory, including Mobile (cars, trucks, trains, ships and airplanes), Point (industrial operations), Area (building heating, fires, natural emissions), and Gasoline Marketing (vehicle fuel transport and filling operations).

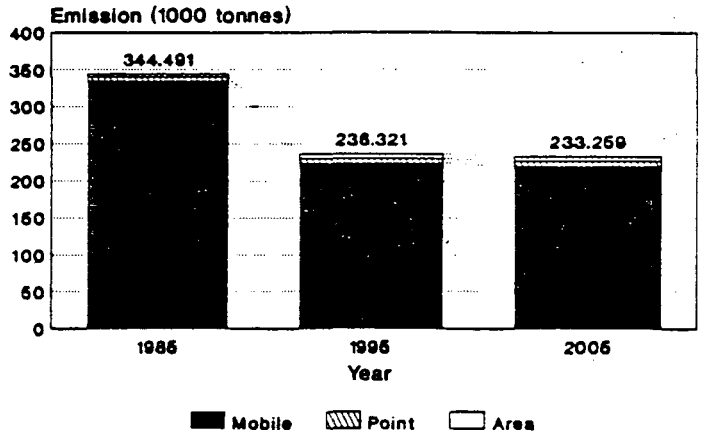
1985 emission inventory data presented in Table 1-2 shows that light duty and heavy duty motor vehicles are responsible for 90 percent of the carbon monoxide, 64 percent of the nitrogen oxides, and 53 percent of the hydrocarbons (VOC) emitted into the air in the GVRD. Projections shown in Figure 1-3 indicate that, even though the number of motor vehicles and the vehicle-kilometers travelled is expected to continue to increase, total emissions of these three pollutants from motor vehicles will decline over the period to 1995 as a result of improved emission control equipment on new vehicles. However, beyond 1995 the forecast growth in vehicle use will offset the per vehicle emission reductions, and total emissions from motor vehicle sources will again trend upward.

1.4 The Role of Motor Vehicle I/M

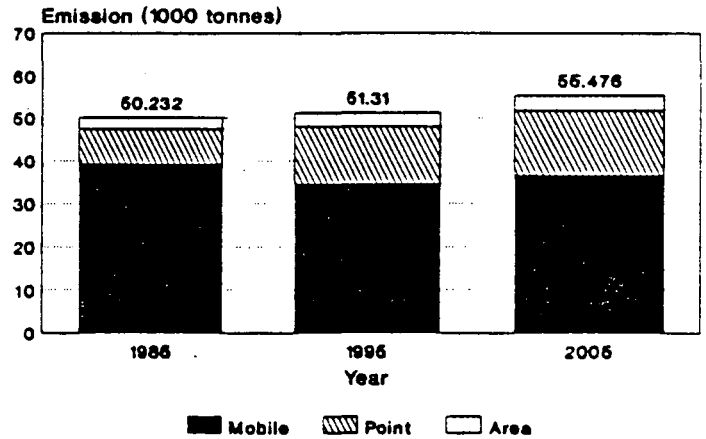
Studies in the United States indicate that I/M programs have the potential to reduce in-use emissions of carbon monoxide and hydrocarbons by in excess of 25 percent[8]. In the 1970's, the U.S. Environmental Protection Agency (EPA) decided that ambient air quality could be improved by reducing or eliminating excess motor vehicle emissions, and that the

TABLE 1-2 GVRD Emissions by Source Sector for 1985[6]

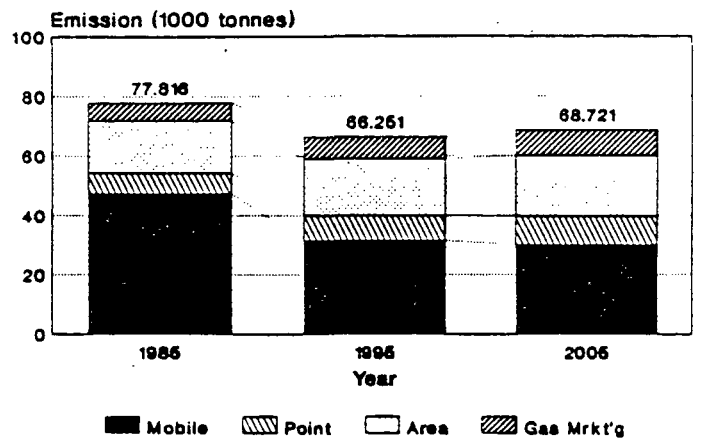
	EMISSIONS (tonnes)					
	SO_x	NO_x	PARTICULATE MATTER	CO	VOC	COMBINED
Mobile Sources						
Aircraft	46	428	30	6,144	1,051	7,699
Heavy Duty Vehicles	1,214	10,717	9,409	45,736	5,268	72,344
Light Duty Vehicles	863	21,510	89,376	262,635	36,246	410,630
Railways	147	950	361	447	226	2,131
Vessels	158	2,137	142	7,867	1,312	11,616
Off-Road	229	3,521	269	12,806	3,295	20,120
Total	2,657	39,263	99,587	335,635	47,398	524,540
Point Sources						
Wood Industry	23	486	9,465	900	255	11,129
Paper & Allied Products	80	605	2,883	276	222	4,066
Non-Metallic Mineral Industry	3,700	4,094	1,177	2,088	34	11,093
Refined Petroleum Industry	4,741	2,042	962	841	5,426	14,012
Chemical Industry	50	268	49	26	212	605
Other Point Sources	109	787	4,329	228	848	6,301
Total	8,703	8,282	18,865	4,359	6,997	47,206
Area Sources						
Commercial Space Heating	318	500	35	114	91	1,058
Industrial Space Heating	77	150	8	33	20	288
Institutional Space Heating	67	151	8	32	19	277
Residential Space Heating	425	1,814	285	1,643	186	4,353
Solid Waste Incineration	5	72	947	2,616	877	4,517
Natural Emissions					8,091	8,091
Other Area Emissions			1,398	58	7,961	9,417
Total	892	2,687	2,681	4,497	17,245	28,502
Gasoline Marketing						
Tanks					606	606
Auto Service Stations					2,837	2,837
Marine & Aircraft Stations					10	10
Loading Operations					1,842	1,842
Bulk Users					881	881
Total					6,176	6,176
GVRD Grand Total	12,252	50,232	121,133	344,491	77,816	605,922



CO



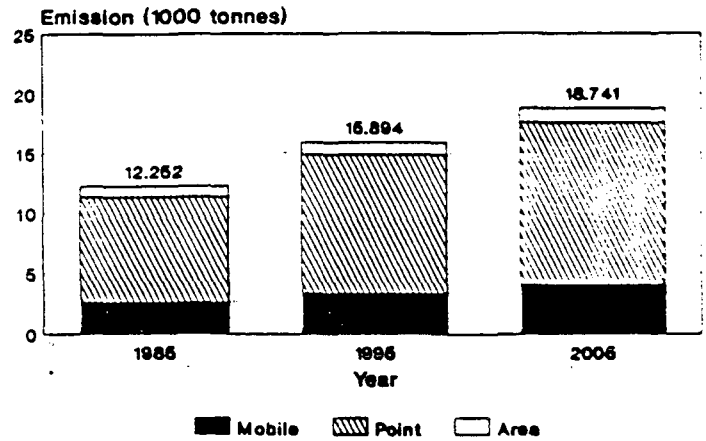
NOx



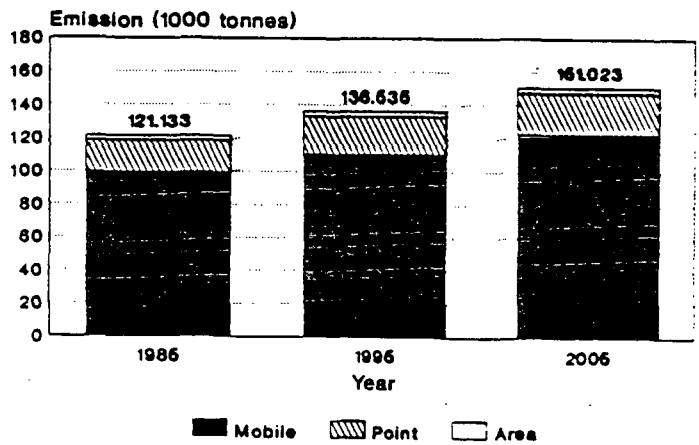
VOC

FIGURE 1-3

Projections of GVRD Emissions to 1995 and 2005[6]



SOx



PARTICULATE MATTER

FIGURE 1-3 (Continued)

Projections of GVRD Emissions to 1995 and 2005[6]

inspection and repair of in-use vehicles was a cost-effective method of decreasing those excess emissions. In the urban areas where pollution levels exceed the air quality standards for ozone or carbon monoxide, the EPA has ordered state governments to implement motor vehicle I/M programs. I/M programs are now operating in almost every major urban area in the United States, including, in the Pacific Northwest, Seattle and Spokane in Washington and Anchorage and Fairbanks in Alaska.

The potential air quality benefits of implementing a motor vehicle I/M program in the Lower Mainland of British Columbia have been emphasized in each of the studies carried out on this subject over the past decade. Table 1-3 shows emission reductions for various I/M scenarios estimated in the March 1989 report to the Lower Mainland Oxidants Steering Committee. Even in 1998, when most older automobiles will be replaced by vehicles equipped with good emission control systems, a fully-implemented I/M program could achieve motor vehicle emission reductions of as much as 30 percent for carbon monoxide, 15 percent for hydrocarbons, and 5 percent for nitrogen oxides. This amounts to an annual pollution reduction resulting from an I/M program of 800 tonnes of nitrogen oxides, 6,400 tonnes of hydrocarbons, and 94,100 tonnes of carbon monoxide. Reductions in years prior to 1998 would be of the same order of magnitude because, although there will be fewer vehicles in use, the percentage of older, higher-polluting vehicles will be greater.

The significant air quality benefits of testing and regulation of in-use motor vehicle emissions have resulted in its inclusion as a one of the key air management strategies identified in the GVRD Air Management Plan Stage 1 Report. It is also a component of the current initiative of Transport Canada and Environment Canada to identify and assess emission reduction opportunities from transportation, industrial engines and motor fuels.[9]

TABLE 1-3 Estimated Reductions in Emissions Under Different I/M Scenarios in the Lower Mainland[3]

(Reductions are relative to 1988 emissions)

Period	Scenario	Light Duty Gasoline Vehicles Emissions						Reduction in Total Emissions from All Sources		
		Emission Reduction								
		$x10^3$ tonnes			%			%		
		THC	CO	NOx	THC	CO	NOx	THC	CO	NOx
1988 - 1993	No I/M Program (New Emission Standard)	12.3	78.2	4.2	30.5	25.3	21.8	12.5	12.6	4.7
	I/M Program	16.7	167.3	-	41.5	54.1	-	17.0	27.0	-
	ATP Program	15.0	-	4.4	37.1	-	23.1	15.3	-	4.9
	I/M + ATP Program	18.5	183.4	*	46.0	59.4	*	18.9	29.6	*
1988 - 1998	No I/M Program (New Emission Standard)	18.2	109.4	5.1	45.1	35.4	26.5	18.5	17.6	5.7
	I/M Program	22.6	188.5	-	56.2	61.0	-	23.0	30.4	-
	ATP Program	21.1	-	5.9	52.5	-	31.1	21.6	-	6.6
	I/M + ATP Program	24.6	203.5	*	61.0	65.9	*	25.0	32.8	*

* Similar reduction as with ATP Program is expected.

2 MOTOR VEHICLE EMISSION CONTROL

2.1 Motor Vehicle Emissions

Almost all motor vehicles currently use petroleum-based fuels; either gasoline, diesel, or an alternate fuel such as propane, natural gas, or methanol. Perfect combustion of hydrocarbons will produce carbon dioxide and water vapour, however complete combustion of hydrocarbon fuels in the internal combustion engine is not possible. As a result, some unburned hydrocarbons pass through the engine and are discharged in the vehicle's exhaust system.

Running losses are evaporative hydrocarbon emissions from an operating motor vehicle other than those from the tail pipe. These running emissions occur mainly on warm summer days when evaporative emissions from the fuel tank and the carburetor can exceed the capacity of evaporative emission control systems. Other sources of hydrocarbon emissions include carburetor evaporative losses that occur primarily within the first hour after the engine is shut off (hot soak losses), and evaporative hydrocarbon losses from the fuel tank as it is heated and cooled by daily changes in the outside air temperature. Evaporative losses are strongly affected by fuel volatility.

Two other pollutants which originate in the combustion process are carbon monoxide and nitrogen oxides. Carbon monoxide is an unstable compound which is formed when there is not enough oxygen present to burn all of the carbon present in the fuel to carbon dioxide. Nitrogen oxides are formed by reaction of the nitrogen and oxygen in the air at the very high temperatures present in the combustion chamber.

A small amount of particulate is emitted in the exhaust of motor vehicles. One component of this particulate is lead, which originates from the tetra ethyl lead in leaded fuel. Other particulate pollution related to motor vehicle operation is associated with tire and brake wear, and road dust which is entrained in the ambient air when the vehicle drives by.

Sulphur oxides emissions occur from the small amount of sulphur which is present in motor vehicle fuel, and which is oxidized in the combustion process.

2.2 Canadian New Vehicle Emission Standards

The responsibility for setting and enforcing emission standards for motor vehicles manufactured in Canada or imported into this country rests with the federal government under the Motor Vehicle Safety Act. Standards introduced in 1971 for light-duty vehicles became effective for the 1975 model year. More stringent requirements were implemented on September 1, 1987 for the 1988 model year. The federal new vehicle emission standards are summarized in Table 2-1. The vehicle must be capable of meeting these standards for the useful life of the vehicle, which, by definition, is five years or 50,000 miles.

The revisions introduced for the 1988 model year bring Canadian standards to a level equivalent to the U.S. standards which have been in effect since 1981. These U.S. standards are referred to as the "49-state standards" because California has adopted separate standards for new vehicles in that state.

2.3 British Columbia In-use Vehicle Requirements

Control of in-use motor vehicle emissions is primarily a provincial responsibility. The Greater Vancouver Regional District could also regulate in-use vehicle emissions, either through the existing air pollution control powers granted to the GVRD under the provincial Waste Management Act or through additional Letters Patent specific to motor vehicle testing.

The B.C. Motor Vehicle Act prohibits tampering with vehicle emission control equipment and sets standards for evaporative emissions of hydrocarbons and tail pipe emissions of hydrocarbons and carbon monoxide.

TABLE 2-1 Canadian Emission Standards for New Light Duty Vehicles[2]

Emission Standards	Canada 1975 to 1987 Model Years				Canada for 1988 Model Year and on***				
	CO	HC	NO_x	Part.	CO	HC	NO_x		Part.
AUTOMOBILES									
g/km	15.54	1.24	1.93	NS	2.11	0.25	0.62		0.12
g/mi	25.0	2.0	3.1	NS	3.4	0.41	1.0		0.20
Evap.-g/test		2.0(C)				2.0(S)			
TRUCKS									
0 - 6000 lbs. GVWR					0 to 8500 lbs (3855.6 kg) GVWR				
g/km	15.54	1.24	1.93	NS	6.21	0.50	0.75*	1.06**	0.16
g/mi	25.0	2.0	3.1	NS	10.0	0.8	1.2*	1.7**	0.26
Evap.-g/test		2.0(C)				2.0(S)			
6000 - 8500 lbs. GVWR		(HC + NO_x)							
g/km	-	-	-	-					
g/mi	-	-	-	-					
g/bhp-hr	40.0	16.0		NS					
Evap.-g/test		NS							

Part.: diesel particulates
Evap.: evaporative HC emissions
GVWR: gross vehicle weight rating
NS: no standard in effect
(C): cannister test
(S): SHED test

Note: Until the 1988 model year, in Canada, vehicles with a GVWR of greater than 6000 lbs were considered Heavy Duty Vehicles. In the revised standards, which came into effect for the 1988 model year, all vehicles of 3855.6 kg (8500 lbs) or less are classed as Light Duty Vehicles. However, for NOx emissions there are now 2 categories based on loaded vehicle weight:

* 0 - 1701.0 kg loaded vehicle weight.
** over 1701.0 kg loaded vehicle weight.

*** Since 1981, the U.S.A. (49 state) standards for automobiles have been virtually the same as the Canada 1988 standards.

2.4 Emission Control Technology

Prior to the mid-1960s, emissions of air contaminants from motor vehicles was very high. Increasingly stringent new vehicle emission standards have resulted in the development of automobles and light duty trucks which are capable of emitting less than 10 percent of the hydrocarbons and carbon monoxide, and about 25 percent of the nitrogen oxides levels emitted by the uncontrolled vehicles of the mid-1960's.[3] These emission improvements have been attained through fuel modifications, optimization of engine design, treatment systems for exhaust emissions, and fuel evaporative control. The various components of a typical emission control system on a late-model car are illustrated in Figure 2-1.

Improvements in fuels have been realized with the reduction in the allowable lead content of gasoline. Lead emissions from motor vehicles will be completely eliminated on December 1, 1990 when the ban on the sale of leaded gasoline in Canada takes effect. The federal government is currently assessing other options for improvements in fuel composition and properties, such as lower gasoline volatility, reduction in the allowable levels of benzene, toluene, xylene and octane enhancing additives in gasoline, and tightening the restrictions on sulphur content in diesel fuels.

A wide range of engine modifications have been implemented by motor vehicle manufacturers in the past 30 years to reduce emissions. One of the first was the introduction in California in 1963 of the positive crankcase ventilation (PCV valve) to recycle crankcase gases to the engine for combustion. Engine modifications which have been incorporated into most modern vehicles include:

- improved control of fuel and air mixing and charging,
- better fuel ignition and burning,
- exhaust gas recirculation (EGR valve) to reduce formation of nitrogen oxides by diluting the air/fuel mixture with regulated amounts of exhaust gases, and
- injection of air (some designs employ an air injection pump) into the exhaust manifold to reduce emissions of carbon monoxide and hydrocarbons.

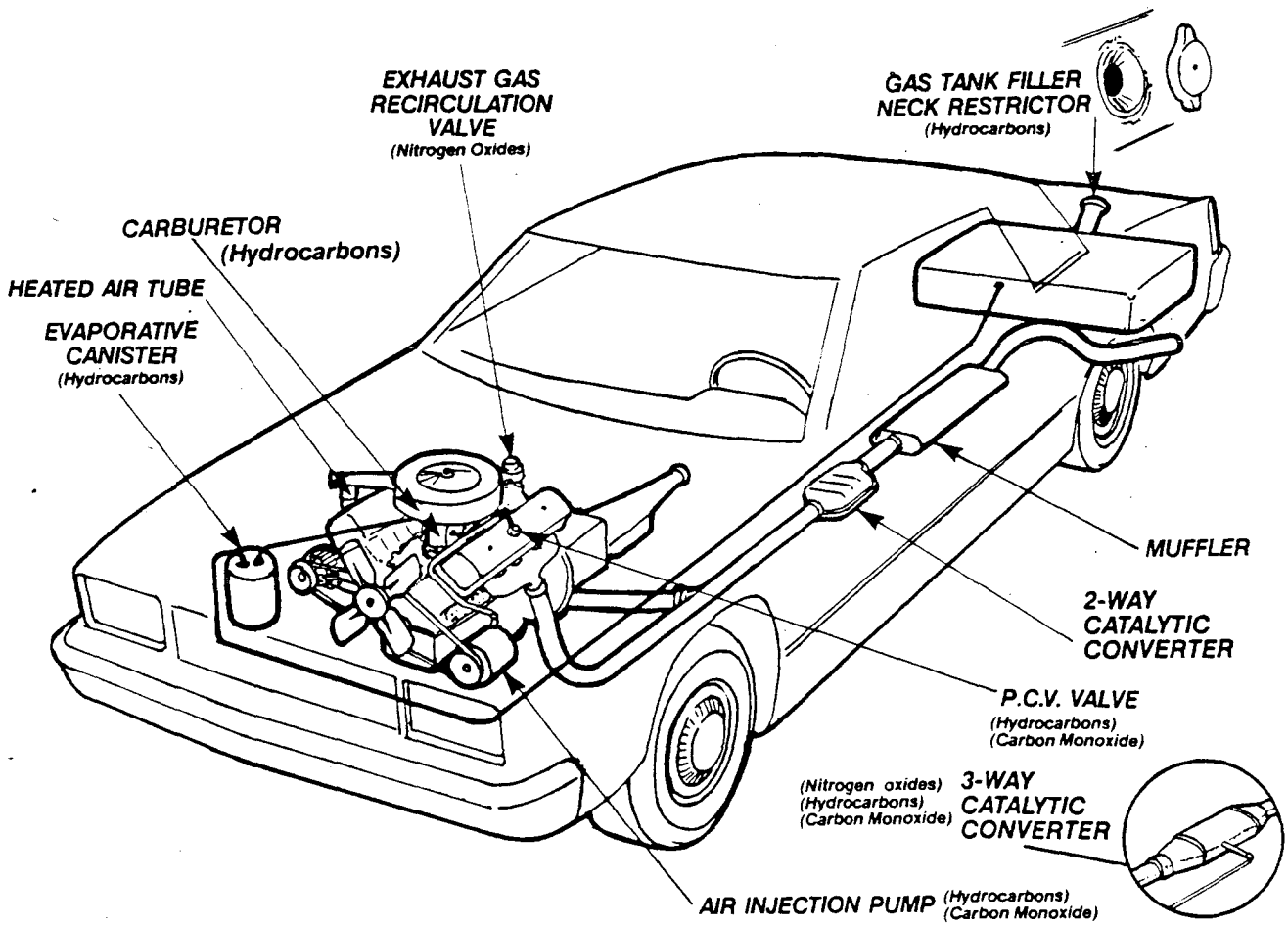


FIGURE 2-1

A Typical Automobile Emission Control System[19]

Treatment of exhaust gases to reduce air contaminants is carried out in a catalytic converter located between the engine and the muffler. Many motor vehicles in Canada were equipped with an oxidation or "two-way" converter in 1975 to meet new Canadian emission standards for new vehicles which were implemented in that year. The oxidation converter uses a platinum or palladium catalyst to promote reactions which reduce carbon monoxide and hydrocarbons. The more stringent Canadian emission standards implemented in the 1988 model year (and the standards in force in the U.S.A. since 1981) resulted in many vehicles being equipped with a dual-bed or "three-way" catalytic converter which reduce concentrations of nitrogen oxides as well.

Converter catalysts are destroyed by lead, therefore any motor vehicles equipped a converter must use lead-free fuel. A gas tank filler neck restrictor prevents misfuelling with the larger diameter leaded fuel nozzle.

About 20 percent of all emissions from pre-1960s automobiles consisted of gasoline hydrocarbon vapours that evaporated from the carburetor and fuel tank. In the early 1970s, automobile manufacturers began equipping vehicles with vapour recovery systems consisting of an evaporative canister filled with charcoal to store the vapours, and to recycle them to the engine for burning when the vehicle is operating.

3 EMISSION PERFORMANCE OF IN-USE VEHICLES

Studies of actual emissions from in-use motor vehicles have shown that many operating vehicles are not maintaining the emission levels that the new vehicle was designed to meet.[10, 11] The average deterioration of emission control performance in the vehicle fleet is proportional to the number of years that the vehicle has been in operation, and generally results from poor maintenance, tampering, or misfuelling with leaded gasoline. These problems can result in emissions of up to 6.5 times the new vehicle emission standard.[10]

3.1 Emission System Maintenance

The most basic of requirements to prevent excessive motor vehicle emissions is proper maintenance and repair of the emission control system to ensure that all equipment is functioning according to the manufacturer's specifications. A well-tuned engine is essential for both fuel economy and pollution reduction.

Tests conducted by Environment Canada in 1977 and 1979 involving automobiles less than one year old indicated that approximately 70 percent had maladjusted carburetors, and that emissions of carbon monoxide were reduced by 35 - 55 percent, and hydrocarbons by 10 - 30 percent, when the proper adjustment was made.[12] Carburetor seals and the increased use of fuel injection systems have helped to address the maladjusted carburetor problem on newer vehicles.

The March 1989 Task Force Report[3] documents reduction of excessive emissions ranging from 10 to 84 percent resulting from repair of other vehicle emission control system components.

3.2 Tampering

Tampering is the deliberate maladjustment, modification, disablement, or removal of any component of the emission control system supplied by the new vehicle manufacturer. A recent Environment Canada report on tampering[10] revealed that the service industry is responsible for much of the physical alterations to vehicles, although the tampering may be performed at the request of a vehicle owner. The frequency of tampering by back-yard mechanics is probably highest for older technology vehicles.

Common types of tampering include removal of the leaded fuel inlet restrictor, plugging the vacuum hose on the EGR valve, disabling of the air injection pump, and replacement of the catalytic converter with a piece of exhaust pipe. Data from random vehicle surveys in the United States and from voluntary inspection clinics in Canada show that tampering can be found on 20 to 50 percent of the vehicles operating on the roads and highways, with the higher rates most commonly found in older vehicles.

Tampering usually occurs because of the idea that emission control systems reduce driveability or fuel economy. Environment Canada advises that, while this may have been true for some pre-1975 model vehicles, modern vehicles are designed for optimum performance with all emission control systems in place and adjusted to manufacturer's specifications.

3.3 Misfuelling

The use of leaded fuel in converter-equipped vehicles requiring unleaded fuel results in the deactivation of the catalyst. As few as ten tankfulls of leaded fuel can cause permanent increases in emissions of up to 5 times for nitrogen oxides, 3.5 times for carbon monoxide, and 2 times for hydrocarbons. A 1985 survey of ten urban areas in Canada showed misfuelling rates varying from 8 to 35 percent, with an average of 12 percent.

In British Columbia, the price of leaded and unleaded gasoline was recently equalized to eliminate the cost incentive for misfueling. The federal government ban on leaded gasoline, which comes into effect on December 1, 1990, will resolve this problem across the country.

3.4 The Need for Inspection and Maintenance

All of the studies on motor vehicle emission control reviewed by the Task Force recommend the implementation of an effective motor vehicle emission inspection and maintenance program in urban areas experiencing air quality problems associated with motor vehicle pollutants. The reduction of excess light duty vehicle emissions is particularly important in cities experiencing rapid growth, as the benefits of per vehicle emission control mandated by new vehicle standards may ultimately be overwhelmed by an increasing number of vehicles in operation.

While the need for an I/M program can be justified solely on the benefits of emission reductions and improved air quality, there is also a potential fuel economy benefit. Recent investigations by the U.S Environmental Protection Agency have shown that improvements in fuel combustion efficiency and reduction of hydrocarbon evaporative losses on vehicles which undergo proper repair after failing an I/M test can be as high as 7 percent.[3]

4 I/M PROGRAM DESIGN

4.1 Inspection Program Options

The inspection component of I/M programs can be described in terms of general options for the delivery of the program and the operation of the test facilities, and detailed design factors which specify the type, frequency, and applicability of tests and how the program is enforced.

Existing I/M programs in the United States fall into one of three delivery / operation options, as follows:

Decentralized I/M Program The decentralized program option involves the testing of vehicles at automobile dealerships or at commercial repair shops that hold a licence from the I/M program government administrative agency. Vehicles which fail an inspection test at a private garage may have repairs performed and be reinspected at the same facility.

Centralized Government-Operated I/M Program In this option, vehicles are tested at strategically-located test facilities designed with special-purpose, high-volume test lanes which carry out the single function of performing the I/M test. The test facility is operated either directly by government, or through a government agency or Crown Corporation. Vehicles which fail a test at a centralized facility may be repaired at an automobile dealership or repair shop of the owner's choice, and then must return to the centralized test station for reinspection.

Centralized Contractor-Operated I/M Program This option is similar to the government-operated centralized option, except that the facilities are supplied and operated by a private company under contract to government to provide the I/M test service. No repairs are offered by the I/M contractor. Failed vehicles must be taken to an automobile dealership or repair shop to have repair work carried out.

A common feature in the three I/M program delivery / operation options is that each must include a government administrative function to manage the program, carry out quality assurance activities, provide referee services to resolve disputes, and ensure that the program is adequately enforced.

4.2 I/M Program Design Factors

Once the basic delivery / operation is selected, there is a wide range of detailed design factors to be specified to ensure that the I/M program will meet the needs for reduction of vehicle emissions, cost effectiveness, and public convenience and acceptability. An I/M program designed and enforced for maximum effectiveness would include the following design factors:[8]

1. Stringent emission standards.
2. Assurance that emissions are properly measured.
3. Visual and/or functional inspections of the emission control system.
4. Sufficient repair requirements and repair cost ceilings to ensure that most failed vehicles are completely repaired.
5. Strict controls on repair waivers (the maximum cost that the vehicle owner is obligated to spend on emission-related repairs).
6. Effective compliance mechanism.
7. Adequate inspection fees to cover the cost of doing the inspection properly.
8. A data collection mechanism to ensure that inspections and repairs are properly performed.

The 1986/1987 U.S. Environmental Protection Agency audit of motor vehicle I/M programs in 33 states showed that many programs are failing to attain effective emission reductions because of program design deficiencies.[13] Some of the more important problems identified by the Environmental Protection Agency were associated with lenient emission standards, high waiver rates, lack of quality control, and ineffective program management.

5 MOTOR VEHICLE I/M ACTIVITIES ELSEWHERE

5.1 United States I/M Programs

U.S. federal government-mandated air pollution control strategies to reduce air pollution in those areas not in compliance with U.S. National Ambient Air Quality Standards has resulted in the implementation of motor vehicle I/M programs in 57 urban areas in 31 states as of September 1986. The first U.S. inspection and maintenance program began operation in California in 1964, with I/M programs in some other states starting in the mid-1970s. The majority of the U.S. programs commenced in 1983 or later.

On the U.S. west coast, I/M programs are operating in Anchorage and Fairbanks, Alaska, in Seattle and Spokane, Washington, in Portland and Medford, Oregon, and in 21 counties in California.

The I/M Implementation Task Force decided to visit three of the U.S. west coast I/M programs, with the selection of site visits to enable an assessment of each of the three I/M program delivery / operation options. Accordingly, the Task Force visited and met with program administrators and operators of the following facilities:

- May 18, 1989
  Portland, Oregon
  Centralized government-operated I/M program
- May 19, 1989
  Seattle, Washington
  Centralized contractor-operated I/M program
- August 29,1989
  Sacramento, California
  Decentralized I/M program

Notes of the I/M Implementation Task Force findings on these visits are detailed in Appendix A, and some of the program design factors are summarized in Table 5-1.

TABLE 5-1

Portland, Seattle, and California I/M Program Design Factor Summary[14]

Program Design Factor	Portland	Seattle	California
Program delivery/ operation option	Centralized Goverment-operated	Centralized Contractor-operated	Decentralized
Test frequency & No. vehicles covered	Biennial 800,000	Annual 700,000	Biennial 12,000,000
Vehicles included	Last 20 years, all vehicles	Last 13 years, all vehicles	Last 20 years, all vehicles
Vehicles exempted	>8,500 lbs., motorcycles, diesels	motorcycles, diesels, alternate fuels	>8,500 lbs motorcycles, diesels, alternate fuels
Emission test mode	Two-speed	Idle	Two-speed
Tampering inspection	Some, 1975+	None	Yes, 1975+
Repair cost waiver	None	$50	Ranges from $50 for '66-'71 to $300 for '90
Enforcement	Registration	Registration	Registration
Provision of repair services	Private auto service industry	Private auto service industry	Private auto service industry
Mechanic Training/ certification	Voluntary	Voluntary	Mandatory
Regulation of repair services	Not part of program	Little gov'mt involvement	Repair shop licencing & audit
Referee services	Not routine	State staff	Separate contractor
Test fee	$7.00	$9.00	Market ($22avg.+$6)
Failure rate & average repair cost	33% approx. $54 ('86)	(info. not available) approx. $48 ('82)	33% approx. $23 ('88)
Staff: -government -contractor	54 FTE None	approx. 18 FTE (info. not available)	approx. 700 FTE (info. not available)

5.1.1 Portland, Oregon

Vehicle I/M is one of several control strategies employed to deal with motor vehicle pollution in Portland. Other approaches include the U.S. federal new car emission standards, City of Portland restrictions on the number of downtown parking spaces, improved traffic flow, and measures to increase use of mass transit. There are six central testing stations with a total of 20 test lanes in the metropolitan Portland area. The inspection takes about five minutes to carry out. Vehicles are also checked for excessive noise levels. Studies indicate that about 88 percent of the vehicles driven on a regular basis in the metropolitan area are registered within the I/M boundary area.[15]

The Portland I/M program is operated by the Oregon State Department of Environmental Quality. It was started in 1975 with state seed money of $1.5 million. The program has repaid this start-up cost, and is now totally funded through the test fee of $7.00. Test fees will have to be increased in the near future to enable the replacement of emission analyzers and the addition of computer data handling facilities.

5.1.2 Seattle, Washington

The Seattle motor vehicle I/M program is administered by the Washington State Department of Ecology, and operated under contract by a private company. There are six central test stations with a total of 17 test lanes. 700,000 vehicles are tested annually, which covers about 85 percent of the light duty vehicles driven in the urban area.

The Seattle I/M program was initiated in January 1982 for an initial five year period. It has since been extended to the end of 1989, and the state government is currently evaluating contractor tenders for an additional five year extension. The program will be modified from an annual to a biennial test requirement.

The Seattle I/M program was initiated with $1.7 million state seed money to cover a two year voluntary program in 1980/1981. The present $9.00 test fee covers all costs of operation and administration of the program, with approximately $6.00 going to the contractor. The fee is expected to increase for the next five year term of the program.

5.1.3 State of California

The State of California began a decentralized motor vehicle I/M program in 1964, with tests carried out at licensed private garages. Concern about the effectiveness of this first generation program led to the implementation of a centralized contractor-operated I/M program in the metropolitan Los Angeles area from 1979 to 1984.

An extensive assessment of these two programs by the California Air Resources Board showed that the centralized Los Angeles program was far more effective in reducing vehicle emissions.[8] The centralized program was able to detect and correct vehicle emission problems in 90 percent of cases associated with excess hydrocarbon and carbon monoxide emissions, and 25 percent of cases associated with excess nitrogen oxides emissions. In contrast, the first generation decentralized program success rate was 6 percent for hydrocarbons and carbon monoxide, and 7 percent for nitrogen oxides. Comparison of emission reductions for the centralized program versus the decentralized program showed the centralized program was performing better in all categories: 32% versus 2% for hydrocarbons; 25% versus 2% for carbon monoxide: and 4% versus 1% for nitrogen oxides.

The California Air Resources Board concluded that a substantial increase in enforcement activity and mechanic training would be required to upgrade the performance of the decentralized program to an acceptable level, and therefore recommended that the centralized program be adopted state-wide. The state legislature accepted the Air Resources Board analysis of the problems, however it responded to concerns of the automotive service industry to maximize private sector business opportunities and terminated the Los Angeles centralized program, initiating a new state-wide decentralized program with substantial improvements to the government authority and resources for management and enforcement.

The second generation program, called "Smog Check", began in March 1984. It is administered by the Bureau of Automotive Repair, which has approximately 700 employees assigned to motor vehicle I/M activities. In addition, the state Air Resources Board has staff dedicated to the planning and program review function. The California government budget for

administering the Smog Check program is approximately $40 million per year, with costs being covered by revenue from a $6.00 per test Smog Certificate fee and fines assessed to out-of-compliance private garage inspection and repair facilities. The inspection fee, which is in addition to the $6.00 Smog Certificate fee, is set by private garages with rates established by competitive market pricing. In January 1988 the test fee averaged $21.45.

The implementing legislation for the Smog Check program established the California I/M Review Committee, composed of representatives of the California Air Resources Board and the various local Air Quality Management Districts, with a mandate to report to the legislature every two years on the success of the program in reducing vehicle emissions and improving air quality. The May 1989 report of the California I/M Review Committee[16] calculates the I/M program cost effectiveness for control of hydrocarbons and nitrogen oxides as $1.35 per pound compared to other control measures being pursued by local air quality management districts in California costing $5.00 to $10.00 per pound. For carbon monoxide, the I/M Review Committee report shows a vehicle emissions reduction of 18.0 percent and an ambient air quality improvement of 13.4 percent.

Improvements recommended in the May 1989 I/M Review Committee report and in an earlier U.S. Environmental Protection Agency audit of the Smog Check program[17] will be implemented in 1990. These modifications include replacement of the BAR84 emission test equipment with new BAR90 analyzers, and an increase in the repair cost ceiling from the current $50 to a sliding scale ranging from $50 for pre-1972 model year vehicles to $300 for 1990 and later model year vehicles.

5.2 I/M Activities in other Canadian Provinces

The current status of legislation and enforcement programs related to motor vehicle emissions in the other nine Canadian provinces and two territories is detailed in Appendix B. While most have anti-tampering legislation in place, none have an effective anti-tampering enforcement program. The in-use motor vehicle anti-tampering enforcement programs in Ontario and Quebec have been curtailed recently due to budget restrictions. Ontario is planning for a motor vehicle I/M program, and investigations are underway in Alberta and New Brunswick.

6 RECOMMENDED I/M PROGRAM

6.1 Implementation Process and Schedule

The I/M Implementation Task Force adopted a four phase approach to the design and implementation of a motor vehicle I/M program for the GVRD and the Lower Mainland which would meet the dual criteria of effectively reducing excess motor vehicle emissions, and be publically and politically acceptable:

Phase 1 - Conceptual Design (May - November, 1989)
In Phase 1, which was completed with the distribution of this report, the Task Force provides recommendations on the preferred I/M program inspection option. Selection and approval of the centralized or decentralized facility, government or contractor operation option is required before the detailed design work can start. Also, the Task Force outlines in this report, for purposes of general information and discussion, some of the considerations which must be dealt with in the detailed design of the I/M program.

Phase 2 - Detailed Design (January - May, 1990)
Phase 2 will involve the completion of the detailed design and costing of the I/M program. It is recommended that a consultant with specific expertise in I/M program design and operation be retained to carry out the technical components of this work. During the period that the Phase 2 detailed design work is being carried out, there will have to be discussions among the several agencies of the regional and provincial governments with interest and legislative mandate for control of in-use motor vehicle emissions to determine the appropriate role of each in the implementation, management, and operation of the I/M program. It is anticipated that the Phase 2 work will require about five months to complete. Approval of the detailed program design and agreement on the program management and operation responsibilities will be required prior to commencing Phase 3 of the implementation program.

Phase 3 - Proposal Calls and Contract Tendering (July - December, 1990)
Following the approval of the detailed program design by the agency or agencies that have accepted the responsibility to implement and operate the I/M program, the lead agency will issue request for proposals and contract documents for the project. Submissions will then be evaluated, and all necessary contracts issued for the construction and operation of facilities. The development of a plan for the training and certification of mechanics who will carry out vehicle emission control repairs in private garages should also be addressed in Phase 3. It is anticipated that Phase 3 would take about six months, and could be completed by the end of 1990 if all the necessary government agency agreements and approvals are expedited.

Phase 4 - Implementation (January - December, 1991)
In Phase 4, the inspection stations would be set up and equipped, and the program staff would be hired and trained. Training programs for repair mechanics would be started to ensure that the automobile repair industry can deal with the problem of correcting emission-related motor vehicle problems. A public information program which could include a voluntary vehicle emission inspection component will also be a priority activity in Phase 4. The timing for this Phase will depend to a large extent on the I/M program inspection option which is adopted. It is anticipated that a centralized I/M program will involve a period of at least 12 months to realize initial operations at some test facilities, and probably 18 months before the program is fully implemented. A decentralized program could take much longer to fully implement due to the larger number of inspection stations involved, the additional quality assurance requirements, and the need for licencing of inspection facilities and staff.

6.2 Preferred Inspection Program Option

The three basic options for the type of I/M inspection stations and private or public sector operation described in Section 4 of this report are decentralized with inspections carried out in private garages, government operated centralized, and contractor-operated centralized. The advantages and disadvantages of these three options have been widely reviewed in the literature[2,8,13,18] and have been further assessed by the

I/M Implementation Task Force in site visits to operating programs in the United States. The key characteristics pertaining to the selection of a preferred I/M program option are highlighted below.

Decentralized I/M Program

Advantages:
- Uses existing private garages, therefore no new test station sites or buildings would be required.
- Convenient to the public, minimizing travel time to a neighbourhood inspection facility.

Disadvantages:
- Private garage operators may not have the funds to purchase expensive emission analysers.
- A large number of emission inspection stations and inspectors would necessitate an extensive government training, certication, quality assurance and audit program.
- Since the same mechanic can inspect the vehicle, specify repair requirements, and carry out the repairs, the system would be prone to abuse.
- Inefficiencies inherent in a system with a large number of small operators would result in a higher inspection cost to the motor vehicle owner.

Centralized Government-Operated I/M Program

Advantages:
- More efficient control over the inspection quality, staff training, equipment auditing, and data processing.
- Higher degree of public confidence in tests directly supervised by a government agency.
- There is no conflict of interest with respect to repairs.
- The inspection service would be under the direct control of the government administrative agency, therefore changes would be easier to implement.

Disadvantages:
- Substantial government resources would be required to finance the capital investment for program facilities.

- It may be difficult for government to justify and quickly implement a new government service requiring substantial new facilities and staff.

Centralized Contractor-Operated I/M Program

Advantages:
- A contractor specializing in the motor vehicle I/M business can bring substantial expertise to the program from operations elsewhere.
- Private companies have the capability to deliver a routine service more efficiently than a government agency.
- The government administrative agencies responsibility would be reduced to contract management, quality control, auditing and data analysis.
- The quality of inspections, testing and training can be specified in the contract.

Disadvantages:
- Competitive tendering of a second term contract may be difficult because the company that completes the first term contract will have detailed knowledge of the program and will have control of existing test facilities.

In reviewing the merits of the centralized versus decentralized type of I/M, the Task Force found that each type of program could achieve effective reductions of excess motor vehicle emissions, however the centralized program could do so at a much reduced cost. This is illustrated by the inspection fee costs of $7.00 in Portland and $9.00 in Seattle for centralized I/M programs as compared with an average of $28.00 in the California decentralized program.

Many decentralized I/M programs in the United States have lower inspection fees than in the California situation, however there are indications that these lower cost decentralized programs are not functioning well. The U.S. Environmental Protection Agency, in its 1986-1987 National Air Audit Report[13], states "The audits also provided convincing evidence that the most effective I/M program design is the centralized design, while the weakest program is the decentralized program with manual analyzers. In fact, audits showed that programs operating with a decentralized design and manual analyzers were so

significantly inferior in identifying failing vehicles and in achieving the minimum emission reductions required by EPA, that the Agency requested corrective action from the Governors of seven States with this type of program."

The I/M Implementation Task Force recommends that the centralized option be adopted for the I/M program proposed for the GVRD and the Lower Mainland.

In assessing the merits of inspection services operated by a contractor versus a government agency, the Task Force was aware of current government preference for contract services where this can be provided in a cost effective manner. The Task Force met with two firms which specialize in contract I/M program operations in the United States, and both indicated an interest in providing a contract service in the GVRD and the Lower Mainland. The contracts are typically of five years duration, which is a sufficient period of time for the contractor to recover the capital costs incurred in setting up the program. One concern identified by the Task Force was the potential difficulty of a fair and competitve bidding process on second and future contract periods, given that the firm just completing a contract would have considerable advantage in terms of program knowledge and existing facilities. This concern could be addressed by specifying a buy-out option for test station facility ownership or leases should the contracted firm not be successful in the subsequent contract tender process.

Therefore, the I/M program inspection option preferred by the I/M Implementation Task Force is the centralized contractor-operated option. This option relies on several groups doing what they are most effective at: government will administer the program, be responsible for quality assurance activities, and oversee a repair mechanic's training/certification program; a contractor with specialized I/M program operating experience will set up and operate the centralized inspection stations; and private garages will carry out the repairs to vehicles which fail the test.

6.3 Preliminary Design Criteria

The Task Force reviewed all of the major program design factors and established the preliminary design criteria for a GVRD / Lower Mainland

I/M program which are outlined in Table 6-1. The approach used in assessing each of the 21 design factors shown in the Table was one of establishing an effective I/M program which will achieve significant emission reductions in the first five year period of operation, and which will have some options to increase both the coverage and the stringency of the program in subsequent periods.

The following discussion relates to the program design factor headings in Table 6-1:

1. TERRITORIAL COVERAGE - The I/M program should cover all of the Lower Mainland up to and including Chilliwack. However, the Task Force considered that the program territorial coverage could be phased, with initial implementation covering vehicles registered at addresses in the Greater Vancouver Regional District.

2. TEST FREQUENCY - Most existing I/M programs are based an an annual inspection requirement. The Task Force considers this to be the most appropriate test frequency for a program in the GVRD and the Lower Mainland. This recommendation is based on considerations of program cost, public acceptance, and information on the length of time that emission related repairs are expected to last before deterioration could lead to a return to unacceptably high emission levels. The Task Force also recommends further review of the option of a mandatory emission and tampering inspection at change of ownership or on transfer of motor vehicle licence.

3. MODEL YEAR - The logical breakpoint for the age of vehicles to be included in the program is the 1975 model year when federal new vehicle emission standards were applied. Older vehicles are relatively few in number and are associated with low annual vehicle miles travelled. The Task Force suggests that the first five year program target light duty vehicles (both cars and trucks less than 8,500 pounds = 3,856 kilograms GVW - Gross Vehicle Weight) from the 1975 model year and later. Expansion of the model year coverage to all registered in-use light duty vehicles should be considered in subsequent I/M program periods.

TABLE 6-1 Motor Vehicle I/M Program Preliminary Design Criteria

	PROGRAM DESIGN FACTOR	I / M PROGRAM DESIGN OPTIONS RELATING TO STRINGENCY AND EFFECTIVENESS			NOTES
		MINIMUM STRINGENCY	MODERATE (typical of many U.S. pgms.)	VERY STRINGENT	
		*** OPTION HIGHLIGHTED IS THE TASK FORCE RECOMMENDATION FOR THE INITIAL PROGRAM ***			
1	TERRITORIAL COVERAGE	**Vehicles registered with GVRD address**	Vehicles registered with GVRD address plus commercial & commuting vehicles entering the GVRD frequently	All vehicles in the Lower Mainland	Long-term goal to cover all of Lower Mainland
2	TEST FREQUENCY	Biennial	**Annual**	Annual, and at new, renewal, or transfer of licence	
3	MODEL YEAR - light-duty (< 8500 lbs = 3856 kg) vehicles covered by program	From 1988 model year	**From 1975 model year**	All registered vehicles (excluding antiques?)	
4	LIGHT-DUTY VEHICLE EXEMPTIONS	Electric, motorcycles, diesels, *alternate fuels*	**Electric, motorcycles**	Only vehicles with non-hydrocarbon *power sources (e.g. electric)*	
5	HEAVY-DUTY GASOLINE VEHICLES	Excluded	**Included**	Included	
6	HEAVY-DUTY DIESEL VEHICLES	Excluded	Excluded	**Included (as a component of existing M.V. Branch safety test?)**	
7	TEST MODE	Idle	Idle - (two speed?) Dynamometer at referee station	Loaded (all test lanes equipped with dynamometers)	To assess as an option in the RFP

TABLE 6-1 (Continued) Motor Vehicle I/M Program Preliminary Design Criteria

	PROGRAM DESIGN FACTOR	I / M PROGRAM DESIGN OPTIONS RELATING TO STRINGENCY AND EFFECTIVENESS			NOTES
		MINIMUM STRINGENCY	MODERATE (typical of many U.S. pgms.)	VERY STRINGENT	
		*** OPTION HIGHLIGHTED IS THE TASK FORCE RECOMMENDATION FOR THE INITIAL PROGRAM ***			
8	EMISSION ANALYSIS	CO, HC	O2, CO2, CO, HC, Visual Opacity	O2, CO2, CO, HC, Visual Opacity, NOx	Defer to program design phase
9	EMISSION STANDARDS	CO, HC cutpoints set for 10% failure rate	CO, HC cutpoints set for 20% failure rate	CO, HC cutpoints set for 30% failure rate	Defer to program design phase
10	TAMPERING INSPECTION	None	* Partial - service provided at * at referee station & recommended at change of ownership	Full, including under hood	Further review indicated
11	MISFUELING CHECK	None - not necessary when leaded gas phased out on December 1,1990	None - not necessary when leaded gas phased out on December 1, 1990	None - not necessary when leaded gas phased out on December 1, 1990	
12	REPAIR COST WAIVER	$100	$100 - $300 with no limit for tampering repairs (Waiver scaled to increase with model year?)	No upper limit	Defer to program design phase
13	ENFORCEMENT	Sticker, with police enforcement	I/M certificate required for annual motor vehicle licensing	* I/M certificate required for * annual motor vehicle licensing * with on-line computer check	
14	REPAIR MECHANIC TRAINING AND CERTIFICATION	None	* Voluntary, with test station * referral to mechanics with * certified qualifications	Mandatory certification for businesses doing repairs related to an I/M test failure	

TABLE 6-1 (Continued) Motor Vehicle I/M Program Preliminary Design Criteria

	PROGRAM DESIGN FACTOR	I / M PROGRAM DESIGN OPTIONS RELATING TO STRINGENCY AND EFFECTIVENESS			NOTES
		MINIMUM STRINGENCY	MODERATE (typical of many U.S. pgms.)	VERY STRINGENT	
		*** OPTION HIGHLIGHTED IS THE TASK FORCE RECOMMENDATION FOR THE INITIAL PROGRAM ***			
15	REFEREE SERVICES	None	**Managed by government staff or agent at one central I/M test station**	Provided by government at separate test facility	
16	TEST PROCEDURE AND ANALYSER QUALITY ASSURANCE	Responsibility of I/M station operator	Regularly scheduled audits by independent contractor	**Frequent audits by government agency**	
17	I/M TEST STATION INSPECTION	None	**Frequent station site visits by government agency**	Intensive station inspections and covert operations by government agency	
18	GOVERNMENT ADMINISTRATIVE AND CONTRACT MANAGEMENT ROLE	Little or no ongoing involvement once program fully implemented	Routine inspection and auditing only	**Full responsibility for inspection, auditing, referee service, public information**	
19	CONTRACTOR DATA REPORTS	None	**Quarterly (with more frequent reporting initially)**	Monthly	
20	MOTOR VEHICLE SAFETY INSPECTION	Not included	One lane at I/M station for voluntary inspections, with provision for addition of mandatory safety test later	Fully integrated I/M and safety inspection program	Under consideration by M.V.Branch
21	CONTRACTOR-OPERATED CENTRAL TEST STATION OWNERSHIP	Contractor developes and owns/leases test station sites and buildings	Contract includes option for government buyout of test station sites and buildings on termination of contract	Government developes and owns test station sites and buildings, and leases them to contractor	Defer to program design phase

4. LIGHT DUTY VEHICLE EXEMPTIONS - Since electric-powered vehicles do not produce air emissions, they should obviously be exempt from the I/M program. It is proposed to exempt motorcycles also, because new vehicle emission standards have yet to be set for this class of vehicle, and because motorcycles are a very minor contributor to airshed emissions. Light duty diesel vehicles should be included, although the pass/fail criteria may have to be based on a test for visible emissions.

5. HEAVY DUTY GASOLINE VEHICLES - The program should include this class of vehicle. They are relatively few in number, and inspection and emission test procedures are similar to light duty trucks.

6. HEAVY DUTY DIESEL VEHICLES - Excess emissions from large diesel trucks and busses are significant both in their impact on air quality and in the amount of public concern that they cause due to their visible nature. Specialized facilities, test equipment and trained personnel are required to deal with inspection of heavy duty diesel vehicles. The Task Force recommends that emission inspection and maintenance be incorporated into the existing provincial Motor Vehicle Branch safety inspection program for heavy duty commercial vehicles.

7. TEST MODE - An in-use vehicle test must meet the dual objectives of being of short duration and able to identify vehicles with excess emissions. Two testing procedures have been developed to satisfy these objectives, the idle mode test and the loaded mode test. The idle mode test involves measuring the tailpipe emissions with the vehicle in a neutral gear and the engine at idle. In a two-speed idle test, a second tailpipe emission test is added while the vehicle is at a higher-speed idle of approximately 2,500 rpm. The idle mode test is adequate for the measurement of carbon monoxide and hydrocarbons. Since there are little or no nitrogen oxides emitted from a gasoline-fueled vehicle at idle, nitrogen oxides cannot be characterized by the idle test. The loaded mode test was developed for this purpose. In the loaded mode test, the vehicle is operated on a chassis dynamometer which simulates the engine load conditions during a typical driving schedule. The loaded mode test can be of two types; the transient test which simulates a standard driving cycle, and the steady-state test in which the vehicle is driven at one speed without acceleration/deceleration loading. The Task Force concluded that more information is needed on the costs and benefits of these two test

mode alternatives before either is selected, and therefore recommends that this issue be assessed further in the detailed design phase and considered as an option in the contract tendering process.

8. EMISSION ANALYSIS - Emission tests are carried out with exhaust gas analytical instruments which are designed to be accurate and reliable. The Task Force agreed that tailpipe emission tests should include analysis of oxygen, carbon monoxide, carbon dioxide, and hydrocarbon concentrations, and also should include a check of visual opacity. Nitrogen oxides emission analysis will be required if the loaded mode test is adopted (see item 7 above).

9. EMISSION STANDARDS - A desired I/M program stringency level can be set by selecting the pass/fail emission concentration limit based on the characteristics of the in-use vehicle fleet covered by the program. A failure rate, defined as the percent of vehicles which fail the annual test and are directed to carry out repairs, is set to satisfy criteria for adequate emission reduction, for the capability of the motor vehicle service industry to carry out repairs, and for the inconvenience and cost that the public are willing to accept. A failure rate of 30 percent is fairly common in U.S. I/M programs. The emission standards and failure rate should be set following a careful analysis of vehicle emissions in the I/M coverage area.

10. TAMPERING INSPECTION - A tampering inspection includes a visual check to ensure that emission control equipment is still fitted on the vehicle according to the manufacturer's original specification, and, where possible, a functional test to determine whether certain components are working. In the United States, all manufacturers must submit specifications to the federal government for emission control equipment fitted on each vehicle model, and also must attach a label on the vehicle with this information. The Canadian federal government does not have a similar requirement, therefore I/M programs in this country will encounter difficulty in comparing pollution control equipment on in-use vehicles with original manufacturer's specifications. Because of the present difficulties with emission control component identification, the Task Force was not able to recommend a full tampering inspection as part of the normal emission inspection at this time. However, the tampering inspection option should be reviewed at the detailed design phase, and

could be included as an option in the contract tendering phase. It should be stressed that tampering is illegal, and that all vehicles should undergo a full tampering inspection at change of ownership. The I/M program administrative agency should work with the federal government to impose pollution control equipment labelling requirements in Canada.

11. MISFUELING CHECK - Several United States I/M programs include a check of the fuel tank inlet restrictor to ensure that the vehicle has not been misfueled, and require that the converter catalyst be replaced if the inlet restrictor is found to have been tampered with. The recent equalization of leaded and non-leaded gasoline prices in British Columbia has removed the cost incentive for misfueling. Also, the federal government has banned the sale of leaded gasoline in Canada effective December 1, 1990. These steps should eliminate misfueling, and therefore an I/M program in the GVRD / Lower Mainland may not need to include a misfueling check.

12. REPAIR COST WAIVER - A repair cost waiver is an upper limit on the cost of emission-related repairs for a vehicle after failing an emission test. If, at failing a retest, the owner submits a valid emissions component repair bill showing a cost greater than the waiver amount, then they receive an exemption from further repair requirements which enables them to relicence the vehicle. Typical repair cost waivers in U.S. programs vary from $50 to $300. The waiver does not normally apply if the emission control problem was caused by tampering. The repair cost waiver is an important factor which will have a major influence on both the success of the emission reduction objectives for the I/M program and the public acceptance of the program. The Task Force suggests that this issue be addressed in the detailed design phase.

13. ENFORCEMENT - The only effective I/M program enforcement mechanism is to make annual licencing of a motor vehcle conditional on having completed all requirements for vehicle emissions testing and repair. The Task Force has held preliminary discussions with the provincial Motor Vehicle Licence Division and the Insurance Corporation of British Columbia, and both of these agencies have indicated a willingness to cooperate with I/M program enforcement needs. If the I/M program data handling system is computerized, then an on-line record of each vehicle's I/M status could be incorporated into the ICBC computer database after each I/M test is carried out.

14. REPAIR MECHANIC TRAINING AND CERTIFICATION - The training and certification of private garage mechanics is necessary to ensure that they are able to carry out repairs on vehicle pollution control systems. Voluntary training courses could be offered by trade schools or community colleges. Those successfully completing such courses would receive a certificate, and I/M program operators could provide motorists needing emission-related repair services with a list of certified vehicle pollution control system repair mechanics in the area.

15. REFEREE SERVICES - Referee services are necessary to make decisions on non-standard motor vehicles, to resolve disagreements between motorists and the I/M operator resulting from vehicle inspections or emission analyses, and to mediate disputes regarding emission-related vehicle repairs and repair cost waivers. This service is most appropriately provided by the government agency which administers the I/M program.

16. TEST PROCEDURE AND ANALYSER QUALITY ASSURANCE - Quality assurance refers to the practices and procedures of the administrative agency to check the accuracy of the test procedures and the analyser operation and calibration. Good test and analyser audit procedures are critical to the success of an I/M program. In one I/M program without adequate quality assurance it was discovered that 30 percent of the vehicles that failed an initial emission test were able to pass a second test without any repairs being performed.[2]

17. I/M TEST STATION INSPECTION - Another aspect of I/M program quality assurance entails visits to the inspection station to see that all program rules and regulations are being followed. Some I/M quality assurance programs also include undercover operations in which a motor vehicle with predetermined emission problems is run through the I/M program to check the effectiveness of the inspection station at detecting a non-compliance situation.

18. GOVERNMENT ADMINISTRATIVE ROLE - The government administraive agency responsible for the I/M program has the prime responsibility to manage the program contract and track the program performance through the assessment of records and data. Reports on the effectiveness of the

I/M program at reducing excess motor vehicle emissions and improving air quality will also be required from time to time. Proposals for program improvements will have to be evaluated and implemented.

19. CONTRACTOR DATA REPORTS - The contract operator should be required to submit periodic reports to demonstrate that contract conditions are being achieved and to assist the program administrative agency in management and performance reporting tasks.

20. MOTOR VEHICLE SAFETY INSPECTION - This design factor is included here only to recognize the fact that the I/M program and a motor vehicle safety inspection program could easily be integrated in one inspection facility. The I/M Implementation Task Force was advised that a safety inspection program for light duty motor vehicles was under consideration by the Motor Vehicle Branch.

21. TEST FACILITY OWNERSHIP - The I/M Implementation Task Force believes that the I/M program contract should include provisions to ensure that competitive bidding will be possible for subsequent contracts after the first five year term of operation is completed. Whether there is any advantage to the government owning, or having an option under the I/M contract to purchase, I/M sites and buildings should be assessed at the detailed design phase.

6.4 Phased Approach

The I/M Implementation Task Force supports the concept of phasing the implementation of an I/M program in the GVRD and the Lower Mainland, such that the initial program is designed to have a reasonable balance between stringency and public acceptability. Following the initial five year program period, the success and the deficiencies of the program can be assessed, and modifications can be implemented to improve both public acceptability and emission reduction effectiveness. Program design factor recommendations highlighted in Table 6-1 reflect this concept.

7 I/M PROGRAM IMPLEMENTATION

7.1 Legislative and Administrative Aspects

There appear to be two routes to providing the necessary legislation and/or regulations for the implemention of an I/M program in the GVRD / Lower Mainland. One involves the provincial government applying its jurisdiction under the Motor Vehicle Act, or enacting regulations under associated provincial environmental legislation. The second is for the Greater Vancouver Regional District to implement a regional bylaw under its Waste Management Act authority to control air pollution in the District, or for the GVRD to obtain additional Letters Patent specific to motor vehicle emission testing.

The I/M Implementation Task Force held general discussions on both legislation/regulations options. It was decided that the appropriate procedure to come to a consensus on this issue was to submit this report to the management and executive of the various agencies represented on the Task Force, and to recommend that an agreement be concluded early in 1990 during the detailed design phase and prior to issuing a call for proposals or tender documents for the proposed centralized contractor-operated I/M program.

The implementation of an I/M program will require the cooperation and support of all agencies represented on the Task Force, regardless of the legislation/regulation route selected. The Task Force received indications from each of the agencies that such support could be provided to ensure the success of the proposed I/M program.

In addition to setting up the enabling legislation/regulations for the program, a lead administrative agency will have to be determined. This agency should be in place by the spring of 1990 with sufficient staff and resources to coordinate the call for proposals, evaluate the submissions received, and proceed with issuing contracts.

The staff resources that this lead agency will ultimately require to administer the I/M program, manage the operator's contract, provide quality assurance and inspection station audits, maintain referee services, and coordinate public information activities have not yet been evaluated. The centralized contractor-operated program in Seattle has approximately 18 FTE state employees carrying out contract management and quality assurance tasks (a ratio of 25 government staff per million vehicles covered), whereas the California decentralized program has a ratio of about 60 government staff per million vehicles covered. The Seattle experience would appear to be the more appropriate to review with respect to GVRD/Lower Mainland requirements.

7.2 Detailed Design and RFP Preparation

While establishing an agreement on the lead administrative agency and instituting appropriate legislation/regulations is the most important task in expediting the implementation of the proposed I/M program, the Task Force believes that detailed program design work should go ahead immediately and that a draft Request for Proposal (RFP) document for a five year contract operation should be prepared. The lead agency would then review and approve the program specifications and contract documents prior to initiating the tendering process. This detailed design work and draft RFP preparation should be carried out by a consultant with specific expertise in I/M program design and operation. The consultant could work under the direction of the I/M Implementation Task Force.

7.3 Public Information Program

The successful implementation of the proposed I/M program will depend on public support. A public information program is required to explain the purpose, objectives and benefits of the program. Information about program requirements, test procedures, station locations and inspection times, and consumer protection measures must be communicated to the public.

Experience from existing I/M programs shows that a public information program should be started six months to one year in advance of the start date for mandatory testing. In addition, a voluntary maintenance phase

prior to the enforcement of repair and retest requirements can assist in familiarizing the public with the program requirements and building public support.

7.4 Program Costs

The proposed centralized contractor-operated I/M program can be set up and operated at no net cost to government if the test fee is established at a level to cover costs of both the contract operator and the administrative activities. Seed funds would be required to finance the public information and implementation phase when no test fee income will be realized, however these up front costs could be repayed once I/M program income was established.

Table 7-1 indicates that there are approximately 775,200 light duty passenger vehicles and 225,000 light duty trucks and vans licensed in the Lower Mainland. The GVRD accounts for about 885,000 of these motor vehicles, with the balance of approximately 115,000 licensed in the Lower Mainland to the east of the GVRD.

A 1987 Environment Canada report[2] suggests that, from the experience of self-financing I/M programs in the United States, an I/M program in Canada would most likely have a test fee ranging from $10 to $15. Using a test fee in the middle of this range, and assuming that the proposed program would cover all of the one million light duty motor vehicles in the Lower Mainland, the I/M program annual budget would be in the order of $12.5 million. An emission test failure rate of 30 percent and an average emission-related repair cost of $50 would result in an annual repair cost associated with the I/M program of about $15 million.

TABLE 7-1

Distribution of Licenced Passenger Vehicles in the Lower Mainland

Motor Vehicle Branch Office		No. of Passenger Vehicles Licensed as of Dec. 1988
Greater Vancouver Regional District		
Burnaby		81,300
Cloverdale		41,800
New Westminster		79,100
North and West Vancouver		79,700
Richmond		104,300
Surrey		88,900
Vancouver		211,400
	Subtotal	686,500
Lower Mainland Areas to the East of GVRD		
Abbottsford		30,600
Aldergrove		9,900
Chilliwhack		21,800
Haney		24,000
Hope		2,400
	Subtotal	88,700
	TOTAL, LOWER MAINLAND	775,200

Note: The above data refers to light duty passenger vehicles only. In addition, there are about 225,000 pick-up trucks and vans licenced in the Lower Mainland.

8 CONCLUSIONS

Motor vehicle emission inspection and maintenance programs have been implemented in almost every major urban area in the United States as a method of reducing excess emissions from light duty vehicles and improving ambient air quality. An I/M program should be established in the Greater Vancouver Regional District and the Lower Mainland to the east of the GVRD as one of a number of emission control strategies to deal with periodic high levels of carbon monoxide and ozone.

Of the three basic I/M program operation options, centralized government-operated, centralized contractor-operated and decentralized, the centralized contractor-operated program similar to the Seattle I/M program is the option that the Task Force believes would be the most suitable for the Lower Mainland area.

The effectiveness of the I/M program is dependent to a large extent on the design criteria adopted for the program. The quality assurance program and the training of inspection staff and repair mechanics are also critical to the success of the I/M program.

9 RECOMMENDATIONS

The I/M Implementation Task Force presents the following recommendations resulting from its review of the merits of the various options for a motor vehicle inspection and maintenance program in the Greater Vancouver Regional District and in the Lower Mainland:

1. A motor vehicle inspection and maintenance (I/M) program should be implemented as soon as possible in the B.C. Lower Mainland as one of the air quality management strategies meet the National Ambient Air Quality Objectives.

2. The I/M program should be a centralized, contractor-operated system, which includes an administrative and quality assurance function carried out by a lead government agency or agencies, centralized inspection stations located at a small number of strategically-located sites and operated by a contractor with specialized expertise in vehicle testing, and vehicle repairs carried out by the existing automotive repair industry.

3. The I/M program should be implemented in the Greater Vancouver Regional District and the Lower Mainland to the east of the GVRD for an initial five year contract period. The success of the program in reducing motor vehicle emissions should be reviewed before the end of the each five year program term, and appropriate improvements incorporated in the successive five year term contract.

4. The I/M program should be designed for the effective reduction of excess motor vehicle emissions. Inspection and testing requirements for the initial five year term should include an annual test for all light duty motor vehicles and heavy duty gasoline vehicles from the 1975 model year and later. Enforcement should be a condition of vehicle licensing, such that proof of compliance with I/M test and inspection requirements must be submitted to the licensing agency before the annual motor vehicle license is issued or renewed.

5. The I/M program should be self-financing, with test fees set to cover all costs of administering and operating the program.

6. Emissions from heavy duty diesel vehicles should be regulated as a component of the existing B.C. Motor Vehicle Branch safety test program for commercial vehicles.

7. A consultant with specific expertise in I/M program design and operation should be retained to complete the detailed design of the program and prepare a draft Request for Proposals for contract operation of the inspection stations.

8. Discussions should be held among the several agencies of the regional and provincial governments to determine the appropriate role of each in the implementation, management, and operation of the I/M program.

9. On approval of the final design and the draft Request for Proposals for the I/M program, a public information program should be developed and implemented at the earliest opportunity. A pre-implementation voluntary test program using a mobile test facility should be considered as a component of the public information program. Environment Canada should be requested to assist in this task.

10. A program for the training and certification of repair mechanics in the special skills involved in diagnosing and repairing vehicle pollution control systems should be developed and implemented as soon as possible. The training course could be offered through technical schools or Community Colleges.

11. The I/M Implementation Task Force should continue in a coordinating role during the next phase of I/M program implementation

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APPENDIX A

Notes of Task Force Review of Motor Vehicle Emission Inspection and Maintenance Programs in Washington, Oregon and California

NOTES OF THE I/M TASK FORCE VISIT TO PORTLAND, OREGON, ON MAY 18, 1989

On May 18, 1989 the members of the Task force on Motor Vehicle Emissions I/M Program visited the offices of the Vehicle Inspection Program, Department of Environmental Quality (DEQ) of the State of Oregon in Portland. Mr. Stan Sumich, Program Operations Supervisor and Mr. William P. Jasper, Jr., Engineering Coordinator provided the details of the program. Later the team visited an inspection station in the area. A brief overview of the program and some observations are provided below.

Program Overview

DEQ has two I/M programs operating in the State; one in the greater Portland metropolitan and another in Medford (Rogue Valley). The program in Portland started in 1975, and that in the Rogue Valley was added in 1986. The Portland program is the second oldest program in the U. S. A., and it has been the subject of an extensive study of I/M program effectiveness by the Environmental Protection Agency (EPA). The major features of the program are:

Program Type	- Centralized state-run, biennial inspections, and registration-enforced.
Program Start	- The program started in 1975 in Portland area with two mobile stations on a voluntary basis.
Present Status	- There are 6 testing stations with 20 lanes in the Portland area, and 1 testing station with 4 lanes in Medford.
Vehicles Included	- Last 20 years models; all vehicles.
Vehicles Exempted	- Motorcycles and diesel vehicles over 8500 lbs gross vehicle weight.

Frequency of Test	- Passenger cars and light duty trucks are tested every two years. Heavy duty trucks, government-owned and permanent fleet vehicles are tested annually.
Vehicles Tested	- Approximately 400,000 light duty and 13,500 heavy duty vehicles are tested each year.
Tests	- Emission test, some anti-tampering (ATP) checks, and noise level. Emission test consists of short idle test for pre-1981 vehicles, and two-speed idle for 1981+ vehicles. ATP checks are visual only for 10 components of 1980+ vehicles, and 2 components of 1975-1979 vehicles. No lead test (Plumbtesmo) is done.
Emission Standards	- Cutpoints are established by model year and make.
Test Analyzer	- Emission test analyzers (SUN) are old and apparently do not meet the current EPA standards. They have been modified and upgraded.
Test Time	- Inspection stations are open on Tuesday to Saturday from 10 AM to 6 PM. It takes approximately 3 minutes to test a vehicle. The vehicle waiting period at the station ranges from 12 to 15 minutes; however, it could be up to 35 minutes on Tuesday and at the beginning of the month.

Referee System	- Initial complaints are handled by the program's engineering and supervisory staff directly either through person-to-person or by telephone. The next step consists of further testing of the vehicle at the program's Technical Centre in Portland or at the Rogue Valley station.
Data Collection	-Manually recorded on individual sheets for each testing.
Inspection Fee	- $ 7 at the time of passing of the vehicle only. The fee has a legislated ceiling of $10.
Repair Cost	- In 1986 the average repair cost in the spring was $50.68 and $57.02 in the fall.
Waiver	- There is no repair cost waiver.
Agency Staff	- Presently the total staff for the program is 54 FTEs.

Observations: Portland area program was initiated because of the non-attainment of CO and O_3 standards, while the Rogue Valley program was started to alleviate the CO non-attainment problem. It is reported that the Portland area has been attaining the CO standards for the last 3 years, but the attainment for O_3 in the area has been marginal. The I/M program in the Rogue Valley area was started in 1986 as the last element in the control action plan for CO. It was anticipated that the area would be in compliance by the end of 1987. To date no air quality data for the years 1987 onwards are available.

The original program was designed by a Technical Advisory Committee with representatives from the DEQ, Auto Service

Industry and the EPA; however, reportedly the politics played some roles in the final decision. The State provided $ 1.5 million to start the program on a voluntary basis. This money has been paid back, and the program is presently self-supporting.

There is an on-going public information program on motor vehicle emissions and the need for inspection and proper maintenance of vehicles.

DEQ provides training for the inspection staff and fleet inspectors. All inspectors are required to complete a 6-month trial service period satisfactorily and must be able to meet licensing requirements. Previously licensed fleet inspectors are required to be recertified every two years. The vehicle repair mechanics are not required to be licensed by the State.

Over the years several modifications to the original program have been made at the suggestion of the program staff. However, any significant changes to the program require legislative amendments. The program still appears to have several major deficiencies:

- Despite the O_3 problem in the Portland area, the program does not address the evaporative HC and NO_x emissions, as the idle emission testing and the visual ATP testing do not provide any information on emissions of these two contaminants.

- The program lacks overall quality control, as there is no auditing of the program by the State, since it runs the program, and the EPA's audits do not involve "blind vehicles", "covert operation", etc.

- Emission test analyzers are not up-to-date, and the data handling is mostly manual.

- The program has not addressed the subjects of aftermarket catalysts and the increasing use of on-board diagnostics systems by the vehicle manufacturers.

NOTES OF THE I/M TASK FORCE VISIT TO SEATTLE, WASHINGTON ON MAY 19, 1989

On May 19, 1989 the members of the Task force on Motor Vehicle Emissions I/M Program met with Mr. John Raymond, Head of the Vehicle Test Program, Washington State Department of Ecology (DOE). Later the members visited the offices of the Vehicle Test Technology, Inc. (VTT), and met with Mr. John T. Grumblatt, General Manager, Mr. Donald R. Hilyard, Test Operations Manager, and Mr. Leo Carroll, Regional Marketing Manager of Systems Control (SC). Both VTT and SC are subsidiaries of Sun Electric Corp., the manufacturers of SUN emission analyzers. A visit to a vehicle inspection station was also made. A brief overview of the program and some observations are provided below.

Program Overview

DOE has two I/M programs operating in the State; one in the Seattle metropolitan area and another in Spokane. The program in Seattle started in 1982, and that in Spokane was added in mid-1985. Both programs were initiated at the insistence of the EPA because of the non-attainment of air quality with respect to carbon monoxide (CO). The major features of the Seattle program are:

Program Type - Centralized contractor-operated, annual inspections, and registration-enforced.

Program Start - The actual mandatory program started on January 2, 1982 for a five-year period.

Subsequent amendments to the sunset clause have extended the program to the end of 1989, and a further extension is expected to be authorized. However, comprehensive public information activities were conducted in four phases: Prevoluntary (June 1980 - June 1981), Voluntary (July 1981 - December 1981), Premandatory (October 1981 - December 1981), and Mandatory.

Present Status	- There are 6 testing stations with a total of 17 lanes.
Vehicles Included	- Last 13 years models; all vehicles.
Vehicles Exempted	- Vehicles 14 years old and older; diesel vehicles; motorcycles and mopeds; electric vehicles; vehicles licensed solely for off-highway use; vehicles outside the testing area for more than six months; vehicles fuelled exclusively by natural gas or propane; farm vehicles and vehicles powered by two-cycle engines.
Frequency of Testing	- Passenger cars and light duty trucks are tested every year. Government-owned vehicles, fleets and used car dealers in the State are authorized to do their own testing and to issue certificates.
Vehicles Tested	- Approximately 700,000 vehicles are tested each year, which consists of about 85% of the light duty vehicles driven in the area.
Tests	- Only emission test consisting of short idle test after a preconditioning of approximately 15 seconds at 2500 rpm is conducted, and CO, HC and CO_2 (for exhaust dilution check) are measured. No ATP or misfuelling checks are done, even by opening the hood of the vehicle.
Emission Standards	- Cutpoints are established by model year and make.

Test Analyzer	- Modern SUN analyzers are used for emission testing. Analyzers are encased in a metal box with no controls for the inspector. Analyzers are calibrated automatically on start-up and once per hour with standard gases fed from a conditioned room isolated from the inspection area.
Test Time	- Inspection stations are open on Tuesday to Friday from 10 AM to 8 PM and on Saturday from 9 AM to 5 PM. It takes approximately 3 minutes to test a vehicle. The vehicle waiting period at the station is reported to be only a few minutes in most days; however, there is a tradition of station overloading, resulting in long lines, during the last week of the month. This is because the vehicle owners wait until the "last minute" to get their tests, despite various efforts by the DOE through the public information program.
Referee System	- There is no formal referee system. The DOE maintains a telephone "hotline", and investigates any written complaints received from the public directly or through complaint forms available at the test stations. Some complaints do require investigation by the DOE's experienced mechanics.
Data Collection	- The data collection system is automated, computerized and connected on-line to a mainframe computer in VTT's headquarters. All test data are submitted to DOE in a computer tape on a monthly basis.

Inspection Fee - The test fee is $9, and it includes one free test for vehicles failing the initial test.

Repair Cost - No current information on repair cost is available. In 1982 the average repair cost for vehicles passing a retest was $48, and for those vehicles issued repair waivers it averaged $68.

Waiver - If a vehicle fails a retest, a repair waiver (Certificate of Acceptance) may be issued by the contractor to the vehicle owner, if more than $50 has been spent solely to meet emission standards after failing the initial test. VTT provides DOE with a copy of each certificate issued along with the test reports and the receipts presented to prove that more than $50 was spent.

Agency Staff - At the beginning of the program 18.5 FTEs were allocated; however, the resource allocation has since been gradually reduced. No information on the DOE full-time staff presently dedicated for the I/M program is available. The staff who currently handle the I/M related tasks have other functions in the department.

Observations: Seattle area program was initiated primarily because of the non-attainment of CO standard, and also due to occasional O_3 standard non-attainment in the Puget Sound region. It is reported that the air quality in the I/M area is improving with respect to both contaminants.

The original program was funded by the State and a supplemental grant from the EPA. A total seed money of approximately $1.7 million for a two-year period was allocated to start the program. The State funding has been gradually cut, as the program is operating on a philosophy of keeping expenditures within revenues. A part of the test fee is deposited in the State General Fund, after the payments of the contractor's fee.

The department has an on-going public information program on motor vehicle emissions and the need for inspection and proper maintenance of vehicles.

Under the legislation, the DOE introduced an Emission Specialist Certification program in January 1984 for granting certificates to persons who successfully complete a course of study in the maintenance of motor vehicle engines, the use of engine and exhaust analysis equipment, and the repair and maintenance of emission control devices. The department lists the mechanic's name and the name and address of the repair facility in brochures distributed to motorists whose vehicles fail the emission test.

The contractor operated program appears to be running effectively, particularly in the area of various data handling aspects because of automation. However, the major difficulties reported with this type of program is in the area of contract management, as any necessary changes in the program elements, even of a minor nature, are subject to renegotiation. Problems may also arise during rebidding for a new contract at the expiry of the current one.

The legislation is presently being amended to continue the program for another 5 years but with biennial inspection at a fee of $16. A new contract to run the program is being negotiated.

The program appears to have several major deficiencies:

- The legislation has a sunset clause and it is being amended as necessary. This may be a hindrance to any long-range planning of an I/M program and to keep up with the changes in technology.

- Despite the potential O_3 problem in the Puget Sound Region, the program does not address the evaporative HC and NO_x emissions, as the idle emission test does not provide any information on emissions of these two contaminants.

- Although the legislation requires monitoring of the operation of each testing station to check the calibration and maintenance of emission analyzers, test procedures and records, it is not known how effectively this quality control task is carried out by the DOE. The program does not seem to have much activity in the area of auditing of the repair services by the State.

- The program has not addressed the subjects of aftermarket catalysts and the use of on-board diagnostics systems being introduced by the vehicle manufacturers.

NOTES OF THE I/M TASK FORCE VISIT TO CALIFORNIA ON AUGUST 29, 1989

On August 29, 1989 some members of the Task Force on Motor Vehicle Emissions I/M Program visited California Air Resources Board (CARB) in Sacramento and met with Mr. Tom Cackette, Deputy Executive Officer, who provided an outline of the State I/M program and the of roles played by various agencies and the local Air Pollution Control Districts. The regulatory functions for the program are administered by the Bureau of Automotive Repair (BAR), Department of Consumer Affairs. There are over 700 FTEs within the BAR INVOLVED in I/M related activities. The primary role of CARB is to review the I/M program results and impacts on the air quality, as well as to formulate the State policies. For the I/M program only, CARB has about 5 FTEs and a testing crew at the headquarters. In addition, there are also 1 or 2 state employees in each of the 21 counties with an I/M program.

On August 30, 1989 the members visited the BAR offices in Sacramento and met with Mr. Gary Hunter, Chief of Field Operations, Compliance Division, and had a full-day agenda to discuss various aspects of the program with the BAR staff, as well as to visit an inspection station and a referee station in the area. Only a brief overview of the program and some observations are provided below.

Program Overview

The I/M program, commonly known as "Smog Check", currently in place in California was implemented in March 1984. This is the third basic program for the State.

The first State program, called "Blue Shield" and a "decentralized" one, was initiated in 1964 and operated in some areas for about 20 years. All vehicles at the time of change of ownership were required to be inspected at licensed private garages. The inspection was supposed to consist of: determination that the vehicle had all pollution control devices installed and functioning properly; it had no ignition misfiring; and it was adjusted properly for low idle emissions.

Subsequent evaluation of the program by CARB identified that the program was ineffective in reducing emissions, mainly due to poor quality of inspections and repairs carried out by the garages and mechanics involved in the program.

The second program, a "centralized contractor" operated, was conducted from 1979 through March 1984 in the Greater Metropolitan Los Angeles area. Initially a pilot program was run at Riverside, in the eastern part of Los Angeles, with 2 inspection stations for about two and a half years. It was an annual inspection on a voluntary basis, and the tests included exhaust emissions, ATP (visual and functional), tuning, etc.. Idle and loaded-mode dynamometer tests were performed for CO, HC and NO_x analysis.

As a result of the pilot program, the legislation was passed to start a centralized program for 5 years in five counties of the South Coast Air Quality Management District. The State-run program was operated by a contractor in 17 stations, and the tests included all features of the pilot program. Vehicles undergoing change of ownership and new vehicles were inspected at an inspection station, and the failed vehicles were required to be repaired at any private facility of the vehicle owners' choice. An assessment by the CARB in 1982 indicated that the program was much more effective than the Blue Shield program. It was recommended that the centralized program, bolstered by more inspection, be expanded to all areas of the State, and a Senate Bill was introduced in the Legislature. However, the current decentralized "Smog Check" program was implemented in March 1984 as a compromise, because of "fierce" opposition to a centralized program by the automotive service industry.

The major features of the current program are:

Program Type - Decentralized, BAR-licensed private garage-operated, Biennial inspections, and Registration-enforced.

Program Start - The present program started in March 1984. It expires on January 1, 1999 unless extended.

Present Status - There are two types of BAR-licensed testing stations: inspection-only stations and inspection-and-repair stations. A registered auto repair dealer is required to submit an application with a fee of $10 for a station license, subject to meeting Smog Check station standards. The license is valid for one year, and is renewable. As of June 30, 1988, there were 8,359 licensed stations in the State.

Vehicles Included - All gasoline-powered automobiles and light-duty trucks (GVW to 8,500 lbs) 20 years old or newer, registered and garaged within the designated non-attainment areas, are subject to inspection under the program.

Legislation has been passed to include heavy-duty gasoline-powered vehicles; LPG-, CNG-, and methanol-fuelled vehicles; public agency fleet vehicles; and vehicles registered in program areas, regardless of where garaged, except fleet vehicles garaged outside program areas, effective January 1, 1990.

Vehicles Exempted - Vehicles 21 years old and older; motorcycles and mopeds.

Frequency of Testing - Each vehicle included in the program is tested every second year. Fleet operators, which include government agencies and public utilities, businesses owning 500 or more

fleet vehicles registered as permanent fleets, and businesses that own 15 or more vehicles, may choose to inspect and repair their own affected fleet vehicles.

Vehicles Tested

- Approximately 5.7 and 6.1 million vehicle were subject to inspection in 1987 and 1988 respectively.

Tests

- The tailpipe emission test measures CO and HC at idle and at two speed idle (2500 RPM). Visual underhood inspection of pollution control systems is carried out for ATP and misfuelling check. In addition, functional tests are used to check the exhaust gas recirculation (EGR) system, ignition timing, and emission warning lights, primarily for identification of faulty systems designed to reduce NO_x emission.

  Recently regulatory requirement for the use of on-board diagnostic (OBD) systems has been passed, and it is applicable to all light- and medium-duty vehicles equipped with three-way catalytic converter and feedback fuel control. The regulation is being phased-in beginning with the 1988 MY and will be implemented on all vehicles by the 1991 MY.

Emission Standards

- Cutpoints for the emissions test vary, and are established according to the pollution control system configuration and the model year.

Test Analyzer	- BAR-approved Test Analyzer System (TAS) is required for use in inspection stations. The present BAR-84 TAS is the fourth generation analyzers developed in the last 15 years. The analyzers are tamper-proof and computerized. A gas calibration is done every 7 days. Real-time data are stored in the computer, which also allows the analyzers to make the pass/fail decision automatically, to detect analyzer tampering and to provide special instructions to the customer. A new modified TAS, BAR-90, will be required to be in use in the Smog Check and other inspection stations from July 1990 onwards in a phase-wise manner. BAR-90 is more sophisticated and highly computerized. Its exhaust gas analyzer will have provisions for measuring CO, HC, CO_2 and NO_x.
Test Time	- Because of the decentralized nature of the program involving numerous private garages, no definite information on the test time is readily available.
Referee System	- BAR maintains a toll-free telephone system to handle consumer inquiries and complaints. A vehicle owner experiencing a problem with an inspection station or a repair mechanic may file a complaint with the BAR. To resolve the problem, the BAR contacts both parties in the dispute to determine if there have been any violation of laws or regulations. In the event of confirmation of any violation, the BAR issues a notice or

takes other appropriate action. Certain disputes are resolved by BAR through the use of referee stations, where consumers can get a second opinion and answers to technical questions. The legislation requires the BAR to contract for enough referee stations to accommodate at least 2% of the vehicle population under the program. The contracted referee stations inspected 73,657 vehicles or 1.25% of the total vehicles inspected during the fiscal year 1987-88.

Data Collection -A computerized system for handling TAS data has been developed by BAR, which evaluates the performance of each station and its individual mechanics. The system allows the BAR to identify stations and mechanics that may be potential violators for further enforcement actions. The contractor for quality assurance collects the TAS records from all inspection stations and submits them to the BAR on quarterly basis.

Quality Control -The legislation requires the BAR to contract for "consumer-oriented" quality assurance (QA) activities. The QA contractors audit each Smog Check station quarterly to check the accuracy and condition of the TAS, verify the calibration gases, ensure that the prescribed inspection procedures are being followed, and to audit supplies of certificates.

Mechanics Training - Vehicle inspection and repairs must be performed by BAR-certified mechanics. The

BAR has trained staff involved in developing the course, holding examination, etc. There are approved training institutions and instructors that teach the course to mechanics seeking the certificate, but the students must pass the examination conducted by BAR for the certificate. A mechanic must successfully pass the retraining course held by BAR and get recertified every two years.

As of June 30, 1988 there were 22,279 licensed inspectors and 23,377 qualified repair mechanics.

Enforcement - The BAR is primarily responsible for regulating the program and it has a number of enforcement activities including an elaborate covert operation by using documented vehicles. In addition, the BAR issues "notices of violation", holds "education and office conferences" with inspection station staff, issues "citations" against a station and any particular mechanic at the station, and pursues "formal administrative action" to suspend or revoke a station's license. In the event of severe violations, BAR may pursue civil or criminal case against the party(ies) involved through the local district attorney or the State attorney general.

Approximately $6 million dollars were spent on undercover operations in 1988. Citations are issued to garages that fail to detect that a vehicle has an "induced" defect. The penalty

for proven citation increases with repeated offenses. In 1988 $2.125 million dollars were received through citations.

Inspection Fee - The Smog Certificate fee was $6 at the start of the program in 1984, and effective May 1,1986 it was reduced to $5. Since March 1, 1989 it has been raised to $6 again. The certificate is purchased by the vehicle owner after the vehicle passes the inspection.

The cost of inspection varies from station to station; however, the January 1988 survey showed an average inspection cost was $21.45, excluding the certificate cost.

Repair Cost - The TAS data indicate that during fiscal year 1987-88, the average repair cost paid by vehicle owners was $22.34.

Waiver - If a vehicle fails an inspection, a waiver is issued when a vehicle cannot be repaired sufficiently within $50 cost limit to correct defects which are unrelated to tampering.

Effective January 1, 1990 the waiver cost limit will be applied on a sliding scale, depending on the vehicle model year, with a minimum of $50 to a maximum of $300. In addition, vehicles which cannot be brought

into compliance within the applicable cost limit for the category will be verified at a referee station or by BAR prior to the issuance of a waiver certificate.

BAR Staff - The BAR has over 700 staff to administer and enforce the program. The major functions include: public information, quality assurance and consumer protection, mechanics training, TAS development and approval, audit and enforcement,data analysis and program evaluation, and various contract management.

Observations: The air quality in several urban areas of California is the worst in the U.S.A., and because of frequent violations of the federal air quality standards for CO and O_3, an I/M program was initiated as one of the control measures. Although the air quality has been showing some improvement, it appears that the program will be continued in the foreseeable future.

The State of California has its own emission standards for new vehicles which are more stringent than that of the US Federal Govt., except that for CO. California also has its own requirement for vehicle labelling of pollution control devices, and has policies on aftermarket catalysts and vehicle warranty.

Although the current program is decentralized and private garages are inspecting the vehicles, an extensive State involvement through its agencies has become necessary. The program is reported to be self-sufficient with a revenue generation from the test fee and citations of approximately $36 to $42 million dollars.

Despite continuous efforts and some major accomplishments by CARB and BAR, the current decentralized program seems to be ineffective in many respects because of the nature of the program, evolving technology and various geo-political factors. The I/M Review Committee has recommended several measures to improve the effectiveness of the program, and some of them are planned to be implemented in stages.

Among the measures recommended by the committee are:

- improved mechanic training and qualification criteria;
- more visual/functional checks to identify defects other than tampering;
- advanced test methods for newer model vehicles;
- new I/M equipment that will incorporate computer-assisted diagnosis and repair; and
- loaded mode testing.

However, the major emphasis is now being placed on a well-designed OBD system which will virtually replace the current emissions testing. An OBD system not only can detect a malfunction of a component under actual driving conditions, but it can also identify the source of the malfunction.

The major deficiencies in the current program are:

- Unless there is a massive involvement by the regulatory agency, particularly in mechanics training, quality control, auditing and enforcement, a decentralized program does not appear to be a viable option.

- The cost of an agency involvement to such an extent is high, and if the program has to be self-sufficient the test fee has to be high, unless it is subsidized otherwise. California's unique situation with respect to vehicle population probably allows it to set its test fee at $6, which may be too little in other urban areas.

- Despite the mechanics/inspectors training, certification and recertification, one of the major problems identified by BAR is the low visual inspection failure rates of emission control devices detected at the garages.

- Idle emission test does not detect NO_x. Although functional check of the EGR valve is carried out as a measure to detect excess NO_x emission, the EGR flow rate is not monitored. Many EGR system problems are reportedly related to clogging of the EGR lines, even though the valve may be functioning properly.

APPENDIX B

Outline of Provincial Legislation and Enforcement Programs Related to Vehicle Emissions

DRAFT
BROUILLON

OUTLINE OF PROVINCIAL LEGISLATION AND ENFORCEMENT PROGRAMS RELATED TO VEHICLE EMISSIONS

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Transportation Systems Division
Industrial Programs Branch
Environmental Protection Directorate
Environment Canada

October 12, 1989

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This unedited version of the report is undergoing limited distribution to transfer information to people working in related studies. Any comments concerning the content of the report should be directed to:

Industrial Programs Branch
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INTRODUCTION

The federal government in Canada establishes emissions standards for new vehicles by regulation under the Motor Vehicle Safety Act. However, once a vehicle is in use on the roads and highways its emissions are considered the responsibility of the provincial governments and territories.

The emissions control equipment installed on new vehicles is designed to keep the levels of emissions of hydrocarbons, carbon monoxide, oxides of nitrogen and particulate matter at or below the new vehicle standards for the "useful life" of the vehicle. The useful life in the present regulations is defined a 5 years or 50,000 miles and a vehicle which is maintained according to the manufacturer's maintenance schedule should have low emissions for at least that period. Recent research has shown that emissions control equipment that has not been damaged or tampered will perform with a high level of efficiency for a much longer period. These findings have prompted investigations into extending the useful life requirement in the regulations to 100,000 miles.

However, although emissions control equipment is designed to keep vehicle emissions within specification, surveys conducted both in Canada and the United States have shown that many in-use vehicles are emitting pollutants at levels far higher than their design specifications. Although some emissions changes are a result of design or manufacturing faults with individual components, higher pollution levels result primarily from a combination of: lack of adequate maintenance; tampering with emissions control equipment; and/or the misfuelling of "unleaded gasoline only" vehicles with leaded fuel.

One way to address the problem of tampering and misfuelling is to enact legislation which makes such acts illegal. This report outlines the status of anti-tampering and anti-misfuelling legislation in Canada.

To ensure that anti-tampering/anti-misfuelling legislation is effective, some form of enforcement program is recommended. An enforcement program will not only deter tampering but will also ensure better vehicle maintenance throughout the fleet. Generally, owners will take better care of their vehicles to avoid penalties when they are inspected. This report also presents the situation with regard to vehicle emissions legislation enforcement programs in each province.

Four provinces, Newfoundland, Quebec, Ontario and British Columbia, have anti-tampering legislation and three others, Nova Scotia, New Brunswick, and Alberta plus the two territories are either actively investigating or are planning some form anti-tampering legislation and enforcement program.

Even though the desire to reduce tampering and its impacts is strong in Ontario and Quebec, the agencies involved with administering the programs in both provinces have suffered significant funding reductions in recent years and, as of the date of writing this report, the in-use vehicle anti-tampering enforcement programs in those provinces are far less extensive than they were two to three years ago.

Table 1 summarizes the legislation and enforcement programs for the ten provinces and two territories. The twelve pages following table 1 present the details for each province.

Table 1 FOR IN-USE VEHICLES - STATUS OF PROVINCIAL VEHICLE EMISSIONS RELATED LEGISLATION
October 1989

Province	NFLD	PEI	NS	NB	QUE	ONT	MAN	SASK	ALTA	BC	YUK	NWT
EMISSION CONTROL EQUIPMENT												
Anti-Tampering												
Legislation -----	Y	N	I	P	Y	Y	N	N	I	Y	I	I
Possible Date -				1990								
Idle Emissions Specs	N	N	N	N	N	Y	N	N	N	##	N	N
Aftermarket Catalyst												
Legislation -----	N	N	N	I	N	Y	N	N	N	I	N	N
Enforcement Program												
Annual I/M	N	N	N	I	N	I#	N	N	I	P	N	N
Spot Checks	N	N	N		N	Y	N	N	N	P	N	N
On Resale	N	N	N		N	P*	N	N	N	I	N	N
Possible Date			?	?		#93/95 *1990				90/91		
Anti-Misfuelling												
Legislation -----	Y	N	I	I	N	Y	N	N	N	N	N	N
INLET RESTRICTOR Leg	Y	N	N	P	Y	Y	N	N	N	N	N	N
Enforcement Program	N	N	N	I	N	S	N	N	N	I	N	N
NOZZLE Tampering Leg	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
Enforcement Program	S	S	Y	Y	Y	Y	N	L	N	L	N	N
VISIBLE OR SMOKE Emissions Legislation												
LDV	N	N	?	Y	N	Y	Y	Y	N	N	?	N
HDV	N	N	N	Y	N	Y	Y	Y	N	Y	N	N
Enforcement Program	N	N	N	N	N	L	?	**	N	L	N	N
SAFETY CHECK												
Existing Legislation	Y	Y	Y	Y	Y	Y	Y	?	I	(C)	Y	N
Enforcement Program												
On Resale			N		N	Y	N	N	N	N	N	N
Spot Checks					Y	Y	Y	N	N	(C)	(C)	N
Annual	Y	Y	Y	Y	N	N	N	***	I	(C)	N	L
GASOLINE QUALITY												
CGSB Standards	N	Y	Y	N	N	Y	N	F	Y	F	F	N
Other	I				Y		Y			N		Y
RVP Standards	I		I	P		Y		F		I		

LEGEND

Y = YES N = NO I = INVESTIGATING
P = PLANNED S = SPOT CHECKS L = LIMITED PROGRAM
? = UNKNOWN AT THIS TIME (C) = COMMERCIAL VEHICLE ONLY
** = has never been applied to mobile sources
*** = program axed in 1984
F = INDUSTRY REPORTED TO FOLLOW CGSB
= No idle specs., but list federal FTP standards in legislation

NEWFOUNDLAND

Vehicle Emissions Legislation and Enforcement - information from P. Blagden, NFLD DOEL, 20 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **Yes. Specifies Light Duty Vehicles**
  - Idle emissions specifications? **No.**
  - After-Market Catalyst Policy? **No.**
  - To what model years does this legislation apply?
    - **Any LDV originally equipped with emissions controls.**
  - What are the province's present enforcement programs?
    - **None.**
  - What are the province's plans for enforcement programs?
    - **None at present.**
- Visible or Smoke Emissions?
  LDV - Legislation. **No** Enforcement. **No**
  HDV - Legislation. **No** Enforcement. **No**
- Does province have ANTI-MISFUELLING legislation? **Yes**
  - enforcement? **No**
  - Specify anti-inlet restrictor tampering? **Yes**
    - enforcement? **No**
  - anti-nozzle switching legislation? **Yes**
    - enforcement? **Spot checks**
- Does province have a SAFETY CHECK requirement?
  - on resale?
  - spot checks?
  - annual? **Yes, but new vehicles are exempt from an annual inspection for the first three years.**
- Standards for GASOLINE QUALITY?
  - CGSB? **No**
  - OTHER? **No, but investigating new gasoline quality regulations.**
  - RVP STANDARDS? **No, but investigating new RVP standards.**

PEI

Vehicle Emissions Legislation and Enforcement - information from

G. Ternan, EC Regional Office, September 25, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **No.**

  - Idle emissions specifications? **No.**
  - After-Market Catalyst Policy? **No.**
  - To what model years does this legislation apply?

  - What are the province's present enforcement programs?
    - **None.**

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? ?
  - What are the province's plans for enforcement programs?
    - ?

  - Visible or Smoke Emissions?
    LDV - Legislation. **No** Enforcement. **No**
    HDV - Legislation. **No** Enforcement. **No**

- Does province have ANTI-MISFUELLING legislation? **No**
  - enforcement? **No**
  - Specify anti-inlet restrictor tampering? **No**
    - enforcement? **No**
  - anti-nozzle switching legislation? Yes
    - enforcement? **conduct spot checks with Environment Canada regional staff.**

- Does province have a SAFETY CHECK requirement?
  - on resale? ?
  - spot checks? ?
  - annual? **Yes**

- Standards for GASOLINE QUALITY?
  - CGSB? **Yes**
  - OTHER?
  - RVP STANDARDS?

NOVA SCOTIA

Vehicle Emissions Legislation and Enforcement - information from

J. Underwood, NS DOE, 20 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **No.**

  - Idle emissions specifications? **No.**
  - After-Market Catalyst Policy? **No.**
  - To what model years does this legislation apply?

  - What are the province's present enforcement programs?
    - **None.**

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? **Anti-tampering legislation and enforcement options are presently under active investigation.**

  - What are the province's plans for enforcement programs?
    - Under investigation. Could possibly add a tampering inspection to annual vehicle safety check requirement.

  - Visible or Smoke Emissions?
    LDV - Legislation. **?** Enforcement. **?**
    HDV - Legislation. **No** Enforcement. **No**

- Does province have ANTI-MISFUELLING legislation? **No, but investigating as part of anti-tampering package.**
  - enforcement? **No.**
  - Specify anti-inlet restrictor tampering? **No**
    - enforcement? **No.**
  - anti-nozzle switching legislation? **Yes**
    - enforcement? **Yes**

- Does province have a SAFETY CHECK requirement?
  - on resale? **No**
  - spot checks?
  - annual? **Yes, all vehicles.**

- Standards for GASOLINE QUALITY?
  - CGSB? **Yes**
  - OTHER?
  - RVP STANDARDS? **Investigating new RVP standards.**

NEW BRUNSWICK

Vehicle Emissions Legislation and Enforcement - information from J. Knight, NB DMAE, 20 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? No.

  - Idle emissions specifications? No.
  - After-Market Catalyst Policy? No.
  - To what model years does this legislation apply?

  - What are the province's present enforcement programs?
    - None.

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? Yes, possibly in 1990. Options are under active investigation.

  - What are the province's plans for enforcement programs?
    - plan to add catalytic converter and inlet restrictors to annual safety check. No plans for emissions testing or idle specifications.

  - Visible or Smoke Emissions?

  LDV - Legislation. Yes, in Vehicle Act. Enforcement. No
  HDV - Legislation. Yes, in Vehicle Act. Enforcement. No

- Does province have ANTI-MISFUELLING legislation? No
  - enforcement? Legislation and enforcement are part of the investigations into anti-tampering legislation.
  - Specify anti-inlet restrictor tampering? No, but being considered as part of the anti-tampering proposal.
    - enforcement? None to date.
  - anti-nozzle switching legislation? Yes, the province used its fire prevention legislation.
    - enforcement? Yes, province sent letters to all companies advising them of legislation against nozzle switching.

- Does province have a SAFETY CHECK requirement?
  - on resale?
  - spot checks?
  - annual? Yes.

- Standards for GASOLINE QUALITY?
  - CGSB? No
  - OTHER?
  - RVP STANDARDS? RVP regulation planned for 1990.

COMMENTS

Anti-tampering legislation is planned and the province hopes to have a component inspection included as part of the annual safety check requirement. Will specifically include the catalytic converter and the inlet restrictor. Legislators have been advised by DMAE that after-market catalyst legislation will be required.

QUEBEC

Vehicle Emissions Legislation and Enforcement - information from G. Taschereau, Quebec MOE, September 25, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **Yes**
  - Idle emissions specifications? **No**
  - After-Market Catalyst Policy? **No**
  - To what model years does this legislation apply?
    - **if someone is caught in the act of tampering then the legislation applies to all vehicles. However, for enforcement purposes during vehicle inspections, it is "grandfathered" to include only 1986 and newer vehicles.**
  - What are the province's present enforcement programs?
    - on resale? **No**
    - spot checks? **No**
    - annual I/M? **No**

  In 1985 the province mailed pamphlets to most households informing them of the new anti-tampering legislation. At the same time anti-tampering videos were sent to most vehicle and muffler service centres to educate the industry regarding the new legislation. There has been little or no enforcement activity in the province since 1985.

  - What are the province's plans for enforcement programs?

  The province had planned to involve police in a spot check style of enforcement program, but to date no funds have been allocated to begin such a program.

  - Visible or Smoke Emissions?
    LDV - Legislation. **No.** Enforcement. **No**
    HDV - Legislation. **No.** Enforcement. **No**

  The Montreal Urban Community has a general smoke standard, but it has not been applied to mobile sources.

- Does province have ANTI-MISFUELLING legislation? **No, but the inlet restrictor provisions in the anti-tampering legislation are considered to cover misfuelling.**
  - enforcement? **No**
  - Specify anti-inlet restrictor tampering? **Yes**
    - enforcement? **No**
  - anti-nozzle switching legislation? **Yes**
    - enforcement? **Yes, The Energy & Resources Dept. employs inspectors.**

- Does province have a SAFETY CHECK requirement?
  - on resale? **No**
  - spot checks? **Yes**
  - annual? **No**

- Standards for GASOLINE QUALITY?
  - CGSB? **No**
  - OTHER? **Yes, similar to CGSB**
  - RVP STANDARDS?

COMMENTS

When police conduct a safety spot check they can order a vehicle repaired within 48 hours or that it be checked at a provincial inspection station.

ONTARIO

Vehicle Emissions Legislation and Enforcement - information from J. Jefferies, Ontario MOE, 19 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? Yes

  - Idle emissions specifications? Yes
  - After-Market Catalyst Policy? Yes
  - To what model years does this legislation apply?
    - all Light Duty Vehicles
  - What are the province's present enforcement programs?
    - on resale? No, but a program is planned.
    - spot checks? Yes, by police.
    - annual I/M? No, but under investigation.

  - What are the province's plans for enforcement programs?
  - a tampering inspection on resale of 6 emissions control components has been accepted in principal. An implementation date of 1 June, 1990 is planned, but may be delayed if emissions control component identification listings are not available. In theory the program would include both LDV and HDV, but component lists not available for the latter.
  - an annual I/M program has been proposed for implementation in the period 1993 to 1995.

  - Visible or Smoke Emissions?
    LDV - Legislation. Yes Enforcement. Spot checks
    HDV - Legislation. Yes Enforcement. Spot checks
    - the HDV smoke emissions legislation is vague and enforcement is difficult.

- Does province have ANTI-MISFUELLING legislation? Yes
  - enforcement? Yes
  - Specify anti-inlet restrictor tampering? Yes
    - enforcement? part of police spot checks
  - anti-nozzle switching legislation? Yes
    - enforcement? Yes, Consumer & Commercial Relations personnel handle enforcement.

- Does province have a SAFETY CHECK requirement?
  - on resale? Yes
  - spot checks? Yes
  - annual? No, although the Transport Department has discussed an annual inspection.

- Standards for GASOLINE QUALITY?
  - CGSB? Yes, province automatically adopts latest CGSB standards.
  - OTHER?
  - RVP STANDARDS? Yes

COMMENTS

Vehicle Test Centre personnel also check new and used car dealers. An extensive HDV smoke enforcement program was begun in 1987 when approximately 180 provincial police officers were trained. It was dropped because of funding cuts in 1988 and 1989. At present there are only 2 smoke inspectors for the province.

MANITOBA

Vehicle Emissions Legislation and Enforcement - information from

T. Youmans, Environment Canada, 20 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **No**

  - Idle emissions specifications? **No**
  - After-Market Catalyst Policy? **No**
  - To what model years does this legislation apply?
    -
  - What are the province's present enforcement programs?
    - None

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? **No**

  - What are the province's plans for enforcement programs?
    - None

  - Visible or Smoke Emissions?
    LDV - Legislation. **Yes** Enforcement. ?
    HDV - Legislation. **Yes** Enforcement. ?

- Does province have ANTI-MISFUELLING legislation? **No**
  - enforcement? **No**
  - Specify anti-inlet restrictor tampering? **No**
  - enforcement? **No**
  - anti-nozzle switching legislation? **No**
  - enforcement? **No**

- Does province have a SAFETY CHECK requirement?
  - on resale? **No**
  - spot checks? **Yes, random draw of registrations based on vehicle age**
  - annual? **No**

- Standards for GASOLINE QUALITY?
  - CGSB? **No**
  - OTHER? **Gasohol specifications**
  - RVP STANDARDS? **No**

SASKATCHEWAN

Vehicle Emissions Legislation and Enforcement - information from

L. Lechner, Saskatchewan MOE, 20 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **No**

  - Idle emissions specifications? **No**
  - After-Market Catalyst Policy? **No**
  - To what model years does this legislation apply?
    -
  - What are the province's present enforcement programs?
    - **None**

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? **No**

  - What are the province's plans for enforcement programs?
    - **None**

  - Visible or Smoke Emissions?
    LDV - Legislation. **Yes** Enforcement. **No**
    HDV - Legislation. **Yes** Enforcement. **No**
    There is a visibility standard in the environment act, but it has never been applied to mobile sources.

- Does province have ANTI-MISFUELLING legislation? **No**
  - enforcement? **None**
  - Specify anti-inlet restrictor tampering? **No**
    - enforcement? **None**
  - anti-nozzle switching legislation? **No**
    - enforcement? **Have conducted inspections in conjunction with Environment Canada District Office.**

- Does province have a SAFETY CHECK requirement?
  - on resale? **No**
  - spot checks? **No**
  - annual? **Not at present. A voluntary program was discontinued in 1984.**

- Standards for GASOLINE QUALITY?
  - CGSB? **No, but industry in the province is reported to be following the CGSB standards.**
  - OTHER?
  - RVP STANDARDS? **No, but it has been reported that the industry in the province has been monitored and is meeting an 11 psi standard.**

ALBERTA

Vehicle Emissions Legislation and Enforcement - information from D. Kupina, Alberta MOE, 19 September, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? No

  - Idle emissions specifications? No
  - After-Market Catalyst Policy? No
  - To what model years does this legislation apply?
    -
  - What are the province's present enforcement programs?
    - None

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? The provincial Ministry of the Environment is presently studying anti-tampering legislation and I/M program enforcement options.

  - What are the province's plans for enforcement programs?
    - None at present

  - Visible or Smoke Emissions?
    LDV - Legislation. No Enforcement. No
    HDV - Legislation. No Enforcement. No

- Does province have ANTI-MISFUELLING legislation? No
  - enforcement? None
- Specify anti-inlet restrictor tampering? No
  - enforcement? None
- anti-nozzle switching legislation? No
  - enforcement? None

- Does province have a SAFETY CHECK requirement?
  - on resale? No
  - spot checks? No
  - annual? No. The province once had a safety check program and recently there have been discussions regarding a return to vehicle safety checks. If safety checks return, an emissions component inspection could be included.

- Standards for GASOLINE QUALITY?
  - CGSB? Yes, but the province adopted the CGSB standard which was in effect when the legislation was passed. The Alberta standard has remained as per the older CGSB specifications and has not been updated as new standards were instituted by the CGSB.
  - OTHER?
  - RVP STANDARDS?

COMMENTS

A recent reorganization of the Provincial environment department has delayed activity with respect to automobile emissions and the investigation of I/M programs.

BRITISH COLUMBIA

Vehicle Emissions Legislation and Enforcement - information from K. Bhattacharyya, B.C. MOE, and C. Eraut, B.C. Motor Vehicle Branch, 28 September, 1989.

- Does Province have anti-tampering legislation for vehicle emissions control systems? Yes

  - Idle emissions specifications? No, but the legislation does list the federal FTP emissions standards.
  - After-Market Catalyst Policy? No, but under study.
  - To what model years does this legislation apply?
    - all vehicles
  - What are the province's present enforcement programs?
    - on resale? No
    - spot checks? No
    - annual I/M? No

  - What are the province's plans for enforcement programs?
    - an annual I/M program has been approved for the Greater Vancouver Regional District. A Task Force has been put in place to design an I/M program for GVRD. Implementation planned for 1990/1991.

  - Visible or Smoke Emissions?

LDV - Legislation.	No	Enforcement.	No
HDV - Legislation.	Yes	Enforcement.	Limited

- Does province have ANTI-MISFUELLING legislation? No
  - enforcement? None
  - Specify anti-inlet restrictor tampering? No
    - enforcement? will be included as part of I/M plan
  - anti-nozzle switching legislation? No
    - enforcement? Even though they had no legislation, the MOE sent letters to the gasoline distributors advising that they would enact same if companies did not take steps to eliminate nozzle switching.

- Does province have a SAFETY CHECK requirement?
  - on resale? No
  - spot checks? Yes, for commercial vehicles.
  - annual? Yes, for commercial vehicles there is a semi-annual and an annual requirement depending upon vehicle size. On 1 January, 1990 the Motor Vehicles Branch plans to introduce a voluntary safety check program with sticker identification for all older light duty vehicles. The province once had an annual safety check requirement but the program was dropped.

- Standards for GASOLINE QUALITY?
  - CGSB? No, but portions of the industry are reported to be following the CGSB standards.
  - OTHER?
  - RVP STANDARDS? Investigating

YUKON

Vehicle Emissions Legislation and Enforcement - information from

T. McTiernan, Yukon Government, September 25, 1989

- Does Province have anti-tampering legislation for vehicle emissions control systems? **No**

  - Idle emissions specifications? **No**
  - After-Market Catalyst Policy? **No**
  - To what model years does this legislation apply?

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? **A new environmental act is being drafted. Vehicle emissions related legislation is being considered for that new act.**

  - What are the province's present enforcement programs? **- None**

  - What are the province's plans for enforcement programs? **- None at present.**

  - Visible or Smoke Emissions?
    LDV - Legislation. ? Enforcement. ?
    HDV - Legislation. **No** Enforcement. **No**

- Does province have ANTI-MISFUELLING legislation? **No**
  - enforcement? **None**
  - Specify anti-inlet restrictor tampering? **No**
    - enforcement? **None**
  - anti-nozzle switching legislation? **No**
    - enforcement? **None**

- Does province have a SAFETY CHECK requirement?
  - on resale? **No**
  - spot checks? **Yes, for commercial vehicles, but private vehicles could be included in the program.**
  - annual? **No**

- Standards for GASOLINE QUALITY?
  - CGSB? **Industry reported as following CGSB standards.**
  - OTHER?
  - RVP STANDARDS?

NORTHWEST TERRITORIES

Vehicle Emissions Legislation and Enforcement - information from

M. Burke, EC District Office, September 25, 1989 and
H. Westerman, EC District Office, September 26, 1989.

- Does Province have anti-tampering legislation for vehicle emissions control systems? **No**

  - Idle emissions specifications? **No**
  - After-Market Catalyst Policy? **No**
  - To what model years does this legislation apply?
    -
  - What are the province's present enforcement programs?
    - None

- Does Province plan to adopt anti-tampering legislation for vehicle emissions control systems? **The territorial government is studying vehicle emissions control system anti-tampering legislation.**

  - What are the province's plans for enforcement programs?
    - None at present.

  - Visible or Smoke Emissions?
    LDV - Legislation. **No** Enforcement. **No**
    HDV - Legislation. **No** Enforcement. **No**

- Does province have ANTI-MISFUELLING legislation? **No**
  - enforcement? **None**
  - Specify anti-inlet restrictor tampering? **No**
    - enforcement? **None**
  - anti-nozzle switching legislation? **No**
    - enforcement? **None**

- Does province have a SAFETY CHECK requirement?
  - on resale? **No**
  - spot checks? **No**
  - annual? **No. The territory does not have a safety check requirement, however, yes, in that all automobiles 10 or more years old, and light duty trucks, 5 or more years old require a safety check for insurance purposes.**

- Standards for GASOLINE QUALITY?
  - CGSB? **No**
  - OTHER? **Yes, a NWT government department supplies fuel to the territory and that department has a winter gasoline specification.**
  - RVP STANDARDS?

APPENDIX C

Summary of the Results of a
June 1986 Motor Vehicle Test Clinic
in Richmond, B.C.

SUMMARY OF RESULTS

MOTOR VEHICLE EMISSION TEST CLINIC

RICHMOND, BRITISH COLUMBIA

JUNE 2-5 1986

D. POON
OCTOBER 24, 1989.

INTRODUCTION

A Motor Vehicle Emission Test Clinic, sponsored by the B.C. Ministry of Environment and Environment Canada was operated on June 2-5, 1986, at the Landsdowne Park Shopping Centre, No. 3 Road, Richmond, British Columbia.

The objective of the Test Clinic was to obtain emission data and tampering inspection data of in-use vehicles in the Vancouver area. The test was free to the interested public and the test result could be beneficial to the car owners for understanding the status of maintenance that had been achieved.

The testing work was contracted to the Automotive Department of Vancouver Community College, who performed measurements of hydrocarbon and carbon-monoxide gas emissions, as well as various visual checks of pollution control components.

TEST SITE

The Test Clinic was located at the Landsdowne Park Shopping Centre, Richmond, British Columbia, right beside the No.3 Road entrance to the west side of the shopping mall and next to the Beaver Service Station.

A tent of 40 ft. by 20 ft. provided shelter for the gas monitors and two testing lanes. Power was supplied by a portable power generator in a trailer. Two banners, each 2 ft. wide and 15 ft. long on top of the tent bearing the sign "FREE - Car Exhaust Clinic" provided advertisement and attraction on site.

Advertisements in newspapers and on radio were arranged to encourage volunteer motorists. A colourful hot air balloon was raised on site in the first morning which helped to draw attention from the public in the local area. Cars entered the shopping mall at the Woodward's entrance and followed directions to line up on the south side of the tent. Attendants directed the line-up traffic and advised motorists of what would happen. Printed information regarding motor vehicle emissions was handed out to motorists.

TESTING

Emissions of hydrocarbon and carbon-monoxide gases were measured with an EPA-75 SUN model analyzer. A team of four technicians for each test lane operated the gas analyzer, performed visual checks of pollution control components and the status of vehicle maintenance. The whole testing for one vehicle required 5-8 minutes. When the test was completed, the driver was advised of the status of maintenance. For cars that had met the emission standards, the driver was awarded with a printed colour bumper sticker bearing **"I'm in Tune"** as a result of a "Car Exhaust Clinic".

EMISSION STANDARDS AND TAMPERING INSPECTIONS

In-use vehicle emission standards are established on manufacturers specifications. Since there are many models, brands and vehicle ages, a simplified and generalized standard was used in this test clinic, as indicated in Table 1.

TABLE 1: SUGGESTED I/M EMISSION TEST STANDARDS

	2 500 RPM				IDLE			
	6 & 8 Cylinder		4 Cylinder		6 & 8 Cylinder		4 Cylinder	
Vehicle Age	CO	HC	CO	HC	CO	HC	CO	HC
0-1	1.0	200	1.5	200	1.5*	300	2.5*	300
2	1.1	230	1.6	230	1.6	330	2.6	330
3	1.2	260	1.7	260	1.7	360	2.7	360
4	1.3	290	1.8	290	1.8	390	2.8	390
5	1.4	320	1.9	320	1.9	420	2.9	420
6	1.5	350	2.0	350	2.0	450	3.0	450
7	1.6	380	2.1	380	2.1	480	3.1	480
8	1.7	410	2.2	410	2.2	510	3.2	510
9	1.8	440	2.3	440	2.3	540	3.3	540
10	1.9	470	2.4	470	2.4	570	3.4	570

* The existing MVSA new vehicle emission standards for the idle test.

Other parameters such as car model, year, odometer reading and licence plate were recorded. Pollution control components such as fuel inlet restrictor, catalytic converter, oxygen sensor, positive crankcase ventiltaion valve, air pump system, air aspiration system, evaporative control system, exhaust gas recirculation system, heated air intake, vacuum spark retard system, idle stop solenoid and sealed carburetor cap were examined and checked for function failure or tampering.

RESULTS

A total of 650 vehicles were tested in this event. There were 30 vehicles that could not be identified of their production year; and 57 of the rest were trucks. To consider the status of passenger vehicles, we therefore used a total test population of 563 cars as basis. Out of this 563 cars, 459 were of 1976-1986 model and 112 were of 1960-1975 model.

Our result summary is based on the 1976-1986 category which contains 451 vehicles (80% of total) as follows:

1)	Total fleet	-	563 vehicles
2)	1960-1975 fleet	-	112 vehicles
3)	1976-1986 fleet	-	451 vehicles
4)	Nominal vehicle age	-	7 years
5)	Year model distribution	-	presented in Fig.1: Distribution Tested Cars
6)	Vehicle size	-	presented in Fig.2: Vehicle Size Distribution
7)	10% Failure for HC Emissions at IDLE	-	presented in Fig.3: Failure Rate: HC Emissions at IDLE
8)	4.5% Failure for HC Emissions at 2500 RPM	-	presented in Fig.4: Failure Rate: HC Emissions at 2500 RPM
9)	21% Failure for CO Emissions at IDLE	-	presented in Fig.5: Failure Rate: CO Emissions at IDLE
10)	15% Failure for CO Emissions at 2500 RPM	-	presented in Fig.6: Failure Rate: CO Emissions at 2500 RPM
11)	Range of HC Emissions at IDLE	-	presented in Fig.7: HC Emissions at IDLE
12)	Range of HC Emissions at 2500 RPM	-	presented in Fig.8: HC Emissions at 2500 RPM
13)	Range of CO Emissions at IDLE	-	presented in Fig.9: CO Emissions at IDLE
14)	Range of CO Emissions at 2500 RPM	-	presented in Fig.10: CO Emissions at 2500 RPM
15)	3.5% failure on fuel inlet restrictor	-	presented in Fig.11: Tampering Inspection: Fuel Inlet Restrictors

16) 2.2% failure on catalytic converter - presented in Fig.12: Tampering Inspection: Catalytic Converters
17) 4.4% failure on EGR Valves - presented in Fig.13: Tampering Inspection: EGR Valves
18) 4.2% failure on evaporative control system - presented in Fig.14: Tampering Inspection: ECS
19) 0.9% failure on oxygen sensor - presented in Fig.15: Tampering Inspection: Oxygen Sensors
20) 2.4% failure on vacuum spark retard - presented in Fig.16: Tampering Inspection: Vacuum Spark Retard
21) 4.4% failure on heated air intake - presented in Fig.17: Tampering Inspection: Heated Air Intake
22) 0.2% failure on PCV - presented in Fig.18: Tampering Inspection: Positive Crankcase Ventilation.

This is only a summary of part of the data collected for the 1986 Car Test Clinic. Emission data anlysis and collation with tampering inspection results are yet to be undertaken. There are some 15 additional inspection results not yet presented here.

REFERENCE

(1) Draft: Vehicle Emissions and Pollution Control Equipment Inspection Clinic - Information Package - Environment Canada, May 5, 1986.

FIG 1 Distribution of Tested Cars

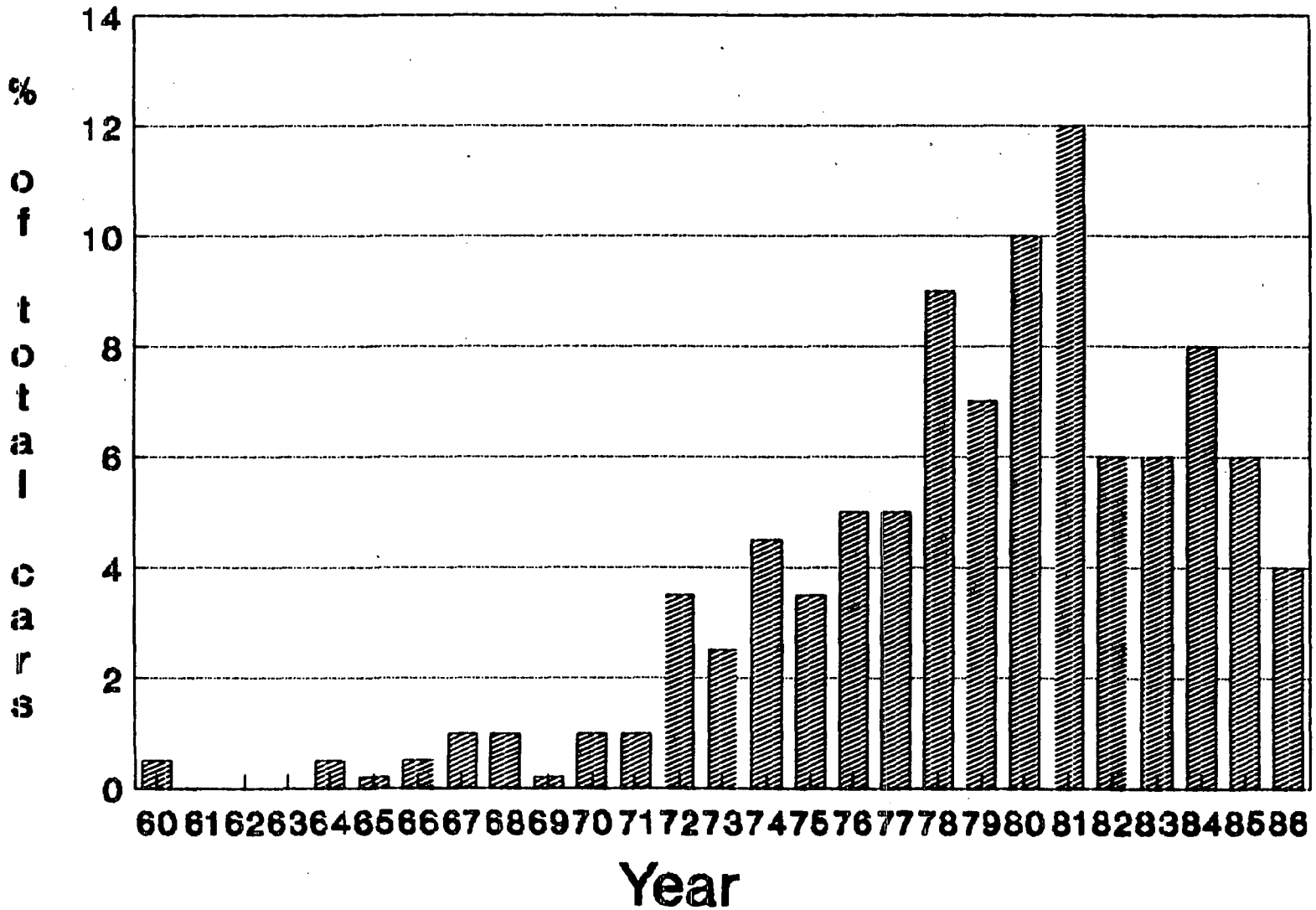

FIG 2 Vehicle Size Distribution

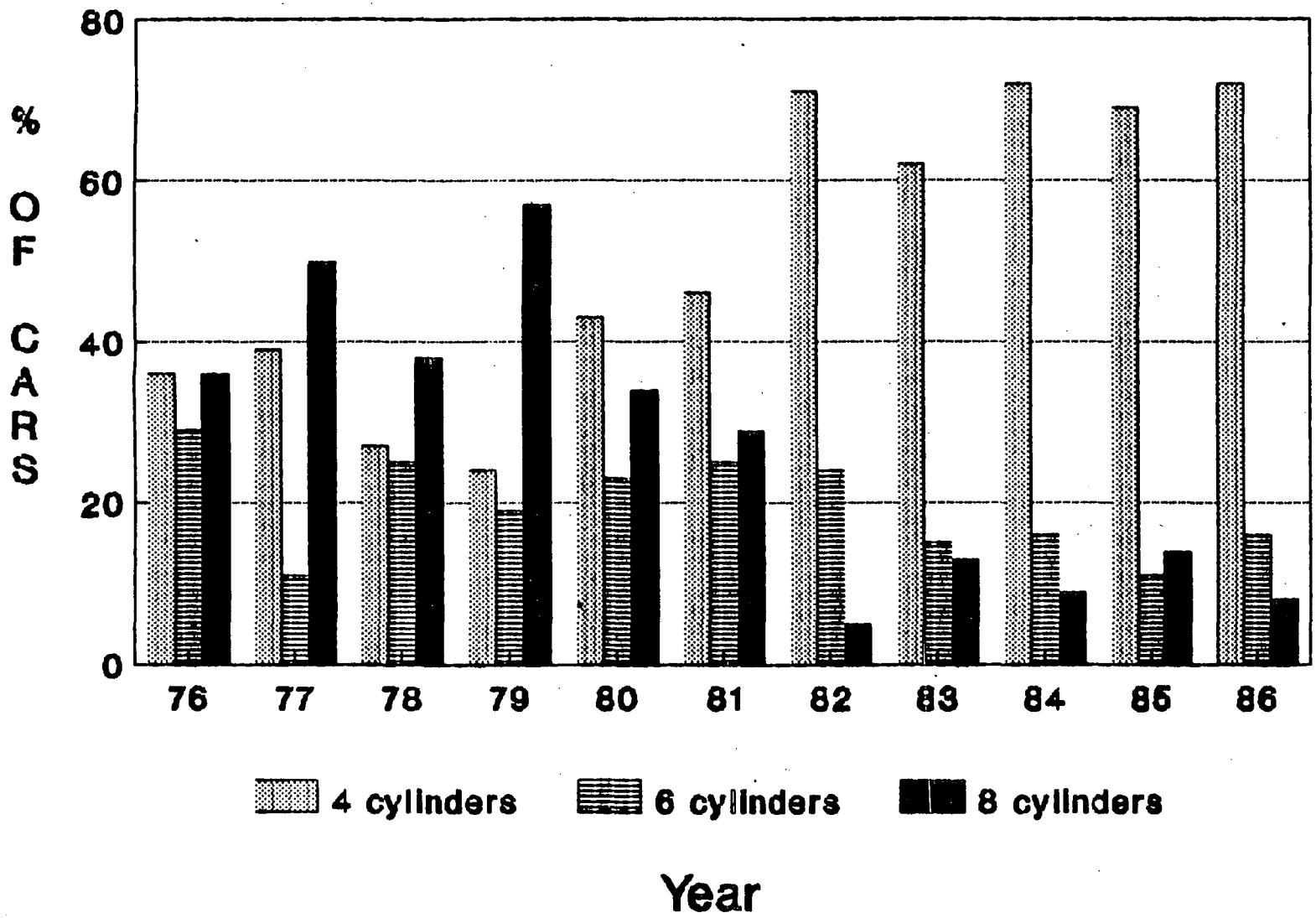

FIG 3 Failure Rate: HC Emissions at IDLE

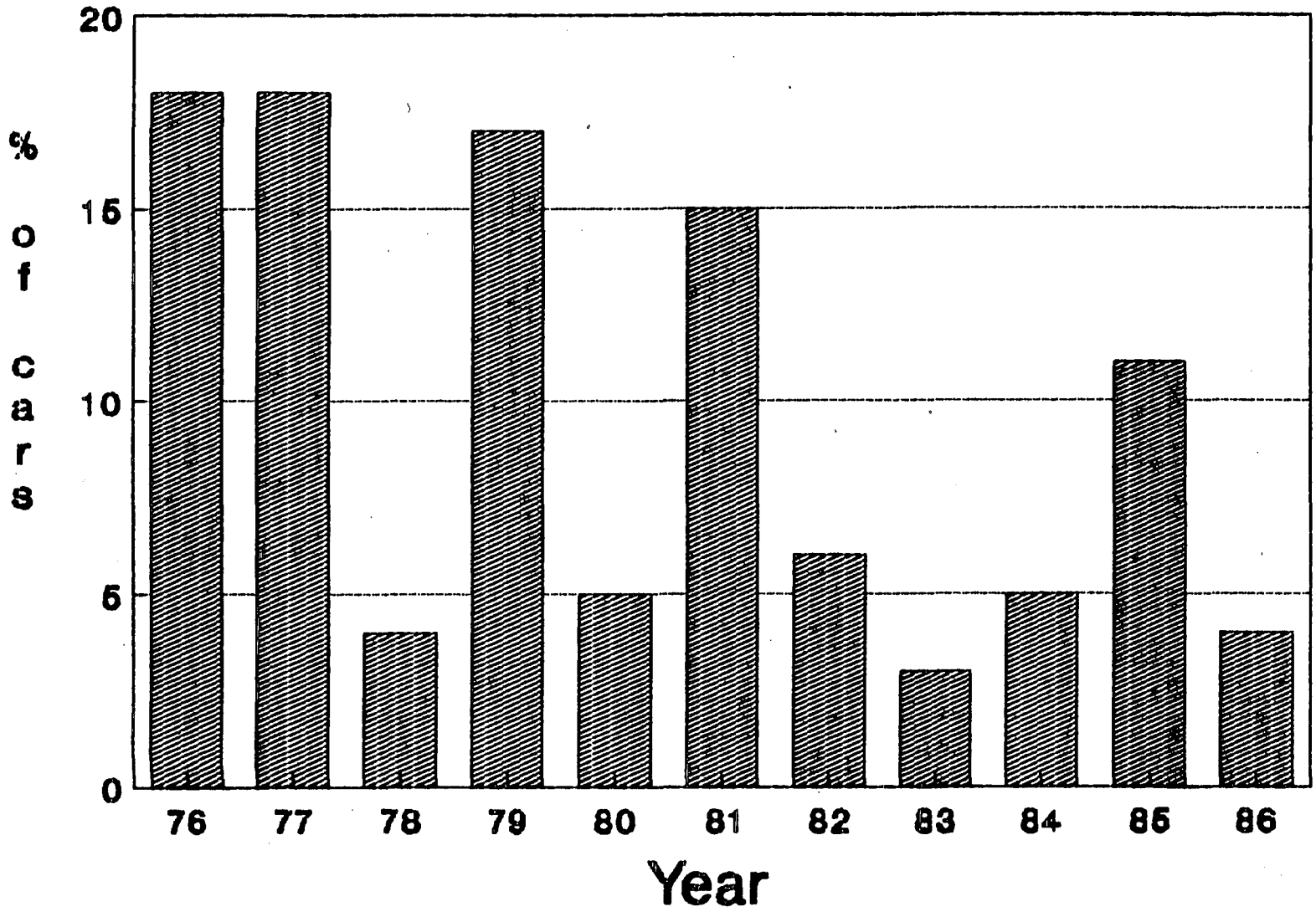

FIG 4 **Failure Rate: HC Emissions at 2500 RPM**

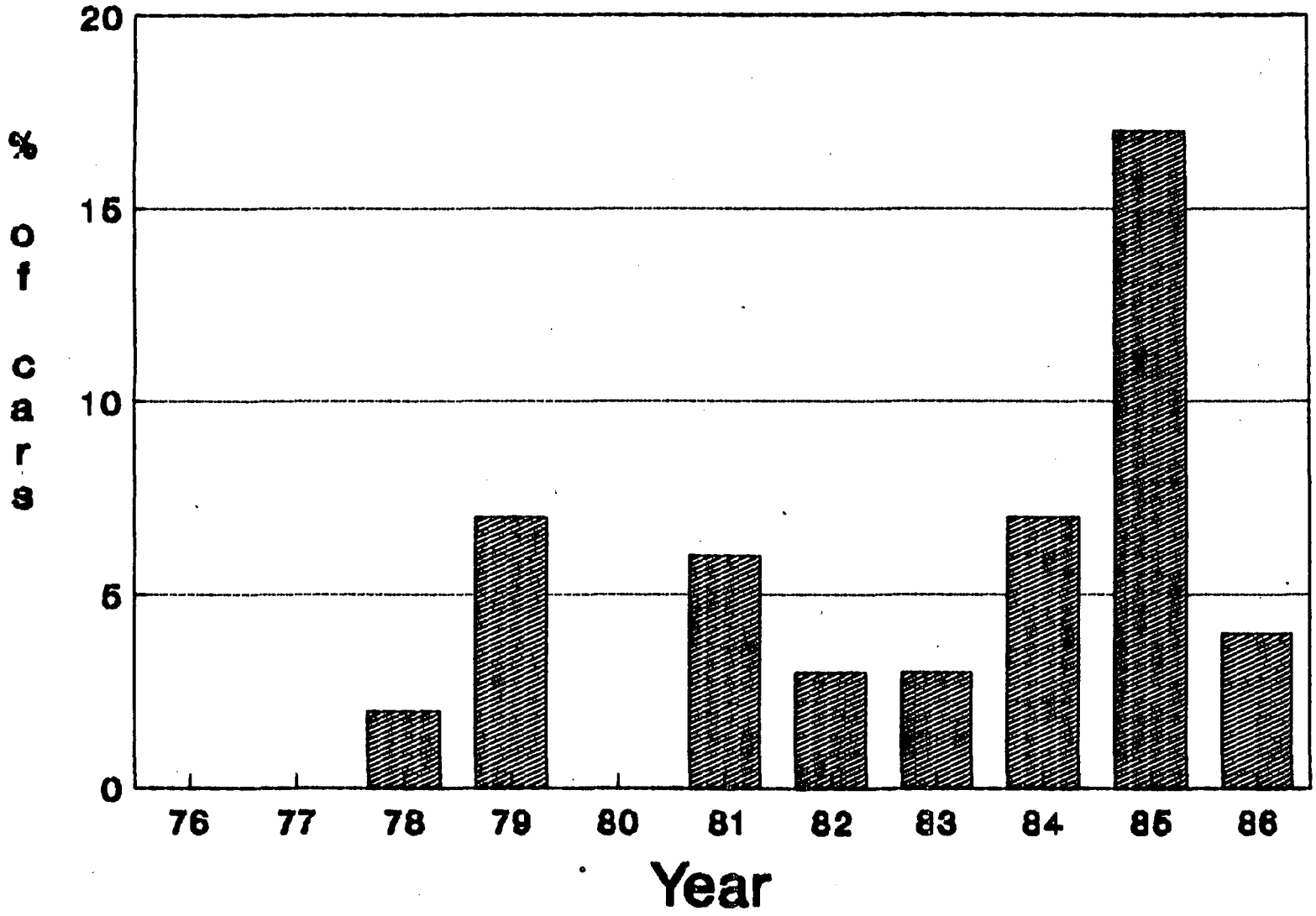

FIG 5 **Failure Rate: CO Emissions at IDLE**

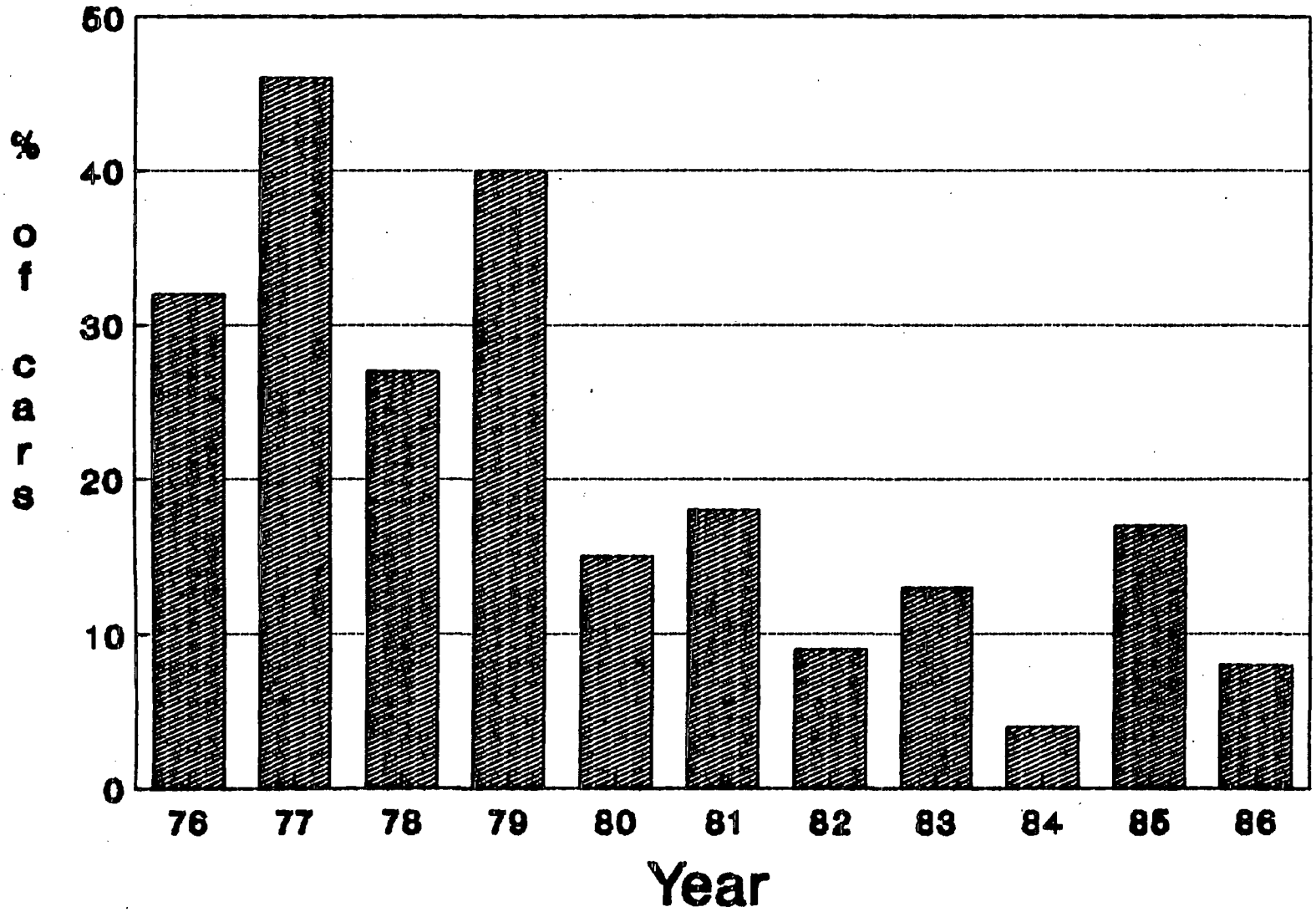

FIG 6 **Failure Rate: CO Emissions at 2500 RPM**

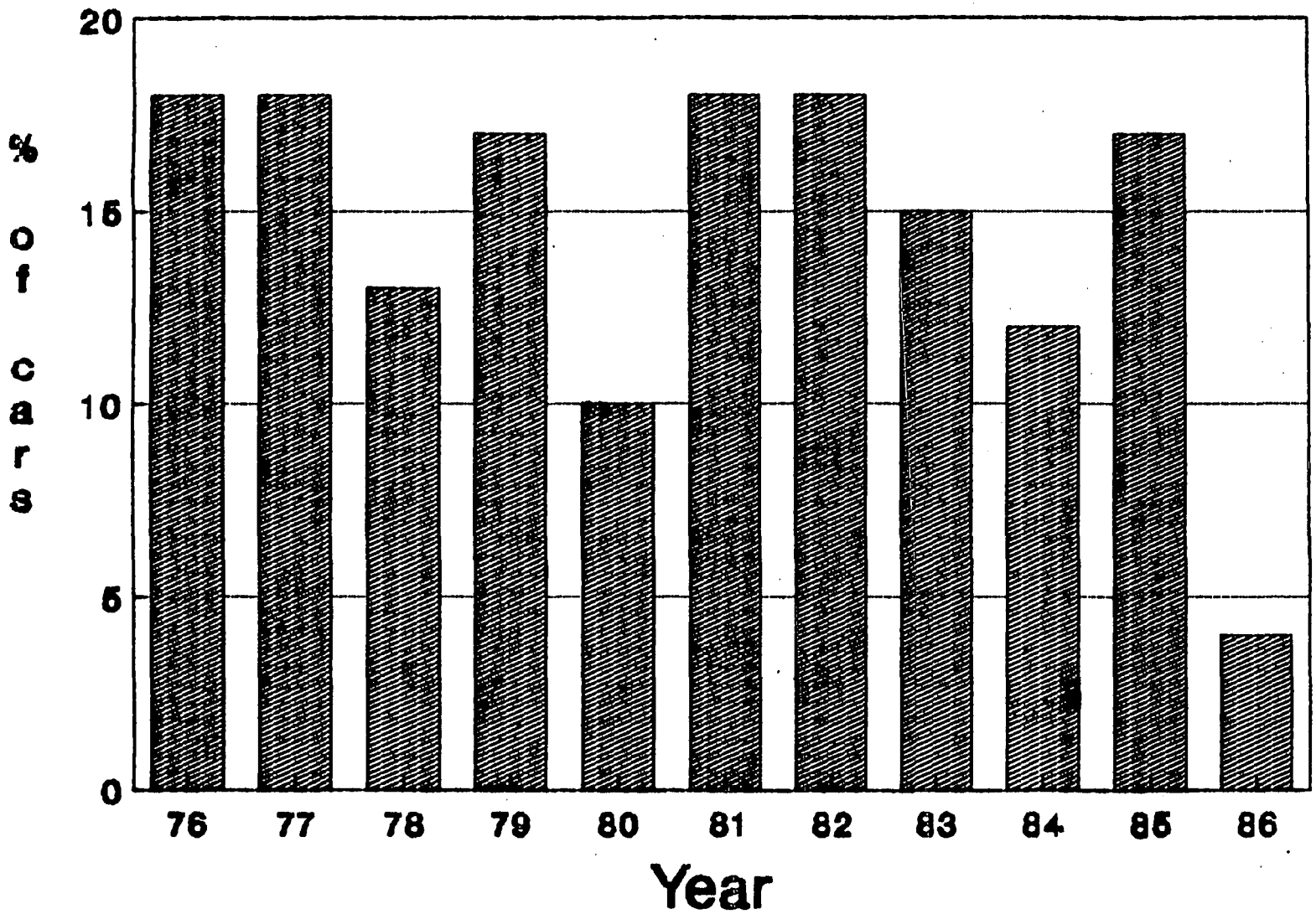

FIG 7 HC Emissions at IDLE

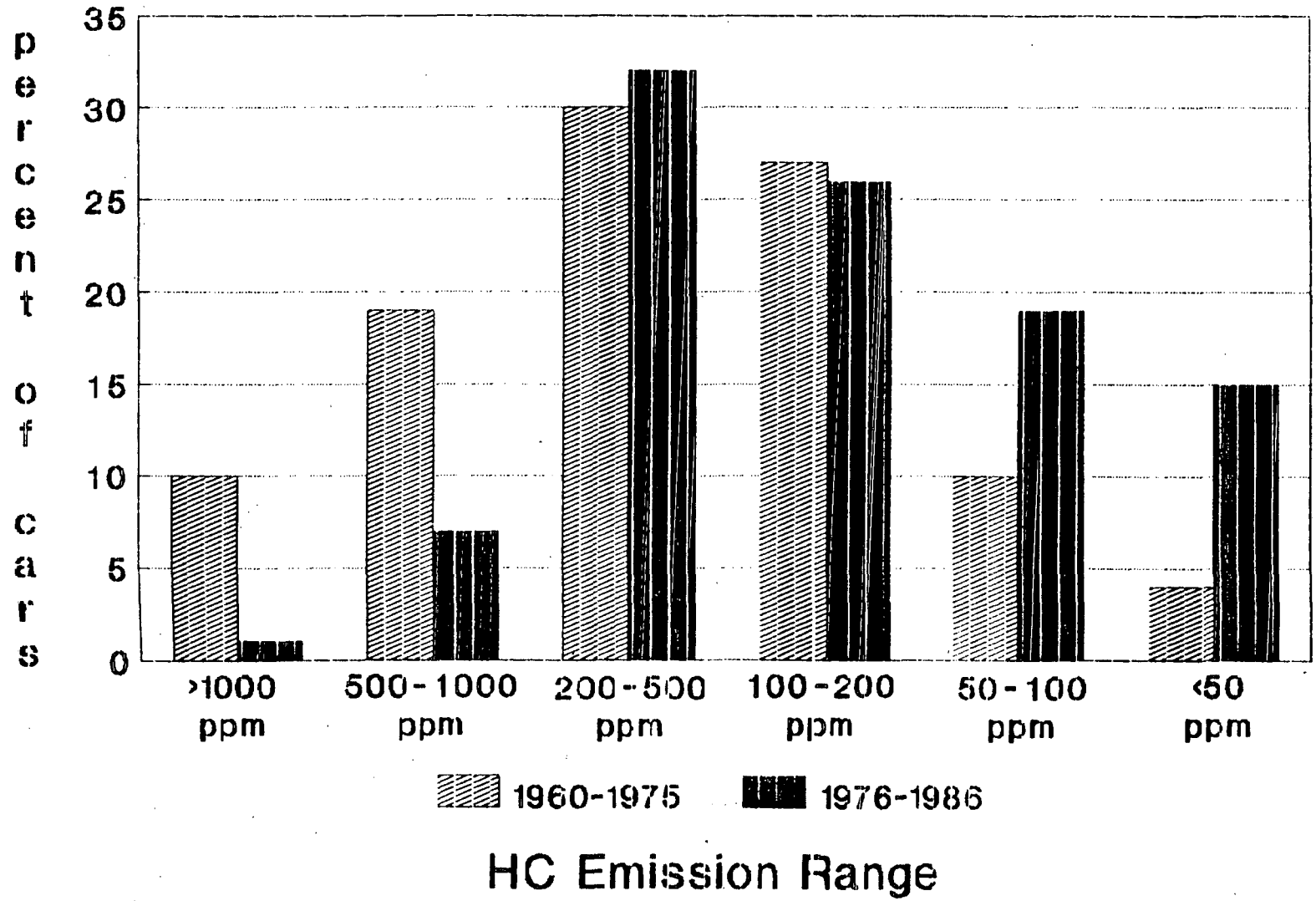

FIG 8 HC Emissions at 2500 RPM

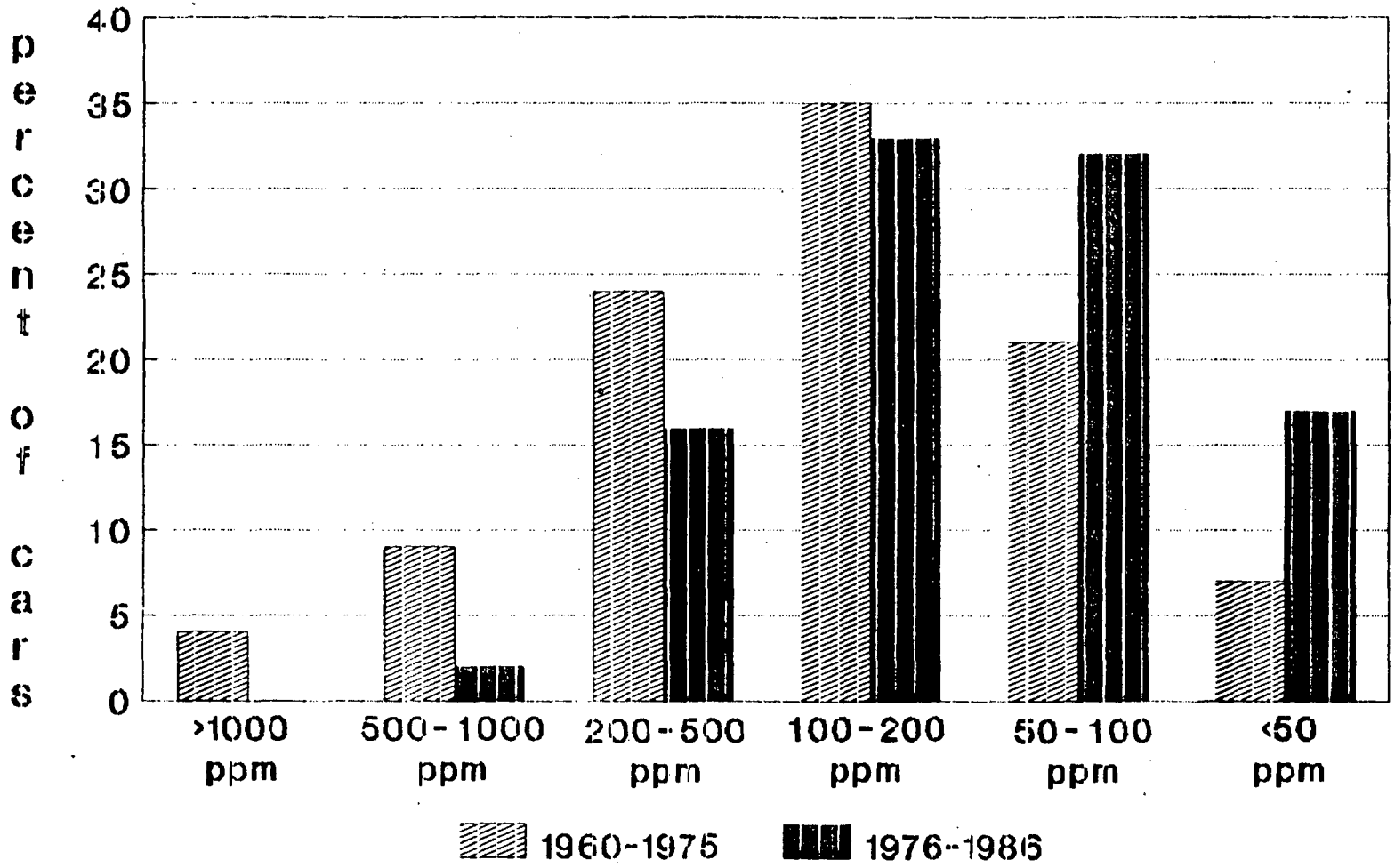

FIG 9 CO Emissions at IDLE

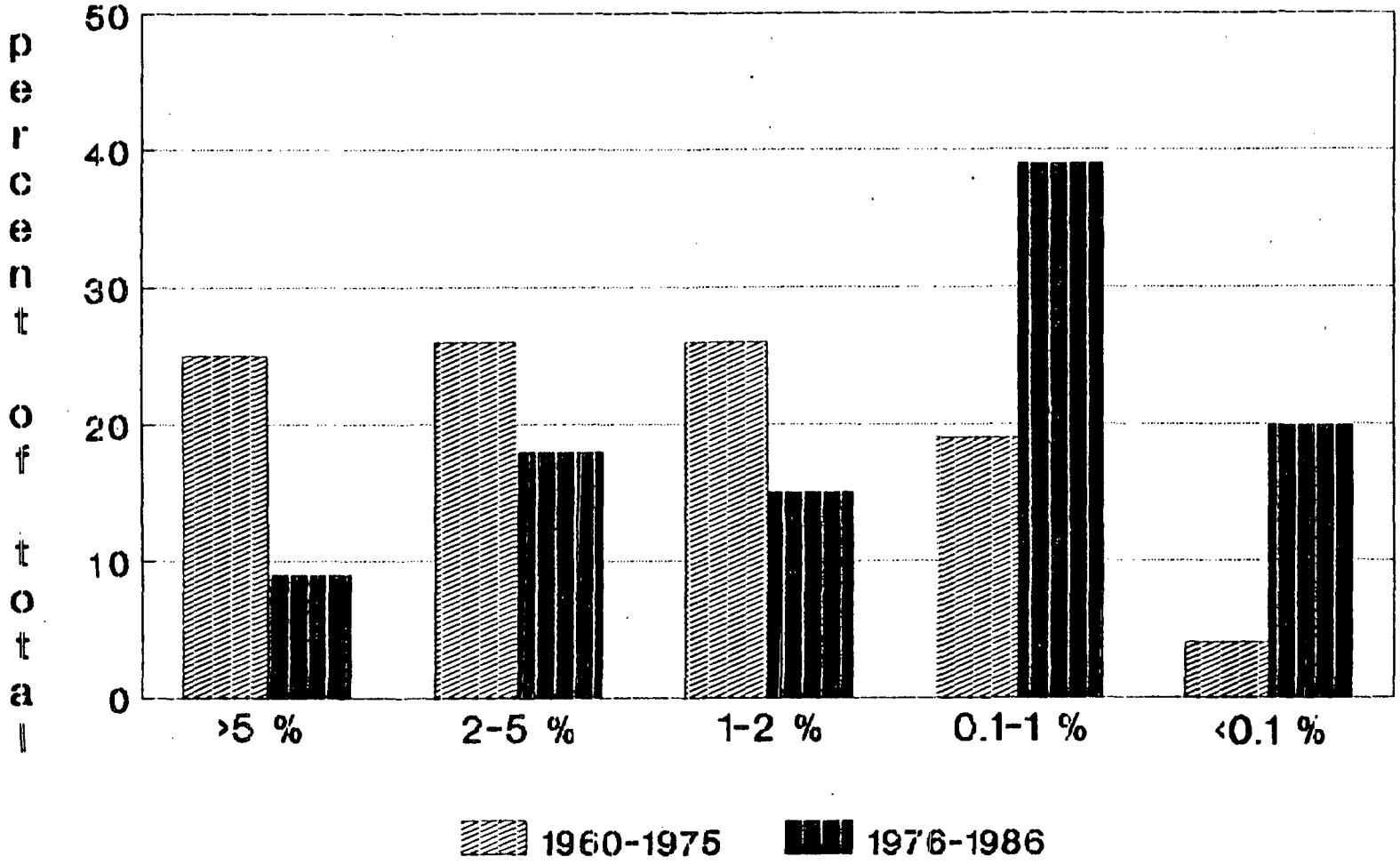

FIG 10 CO Emissions at 2500 RPM

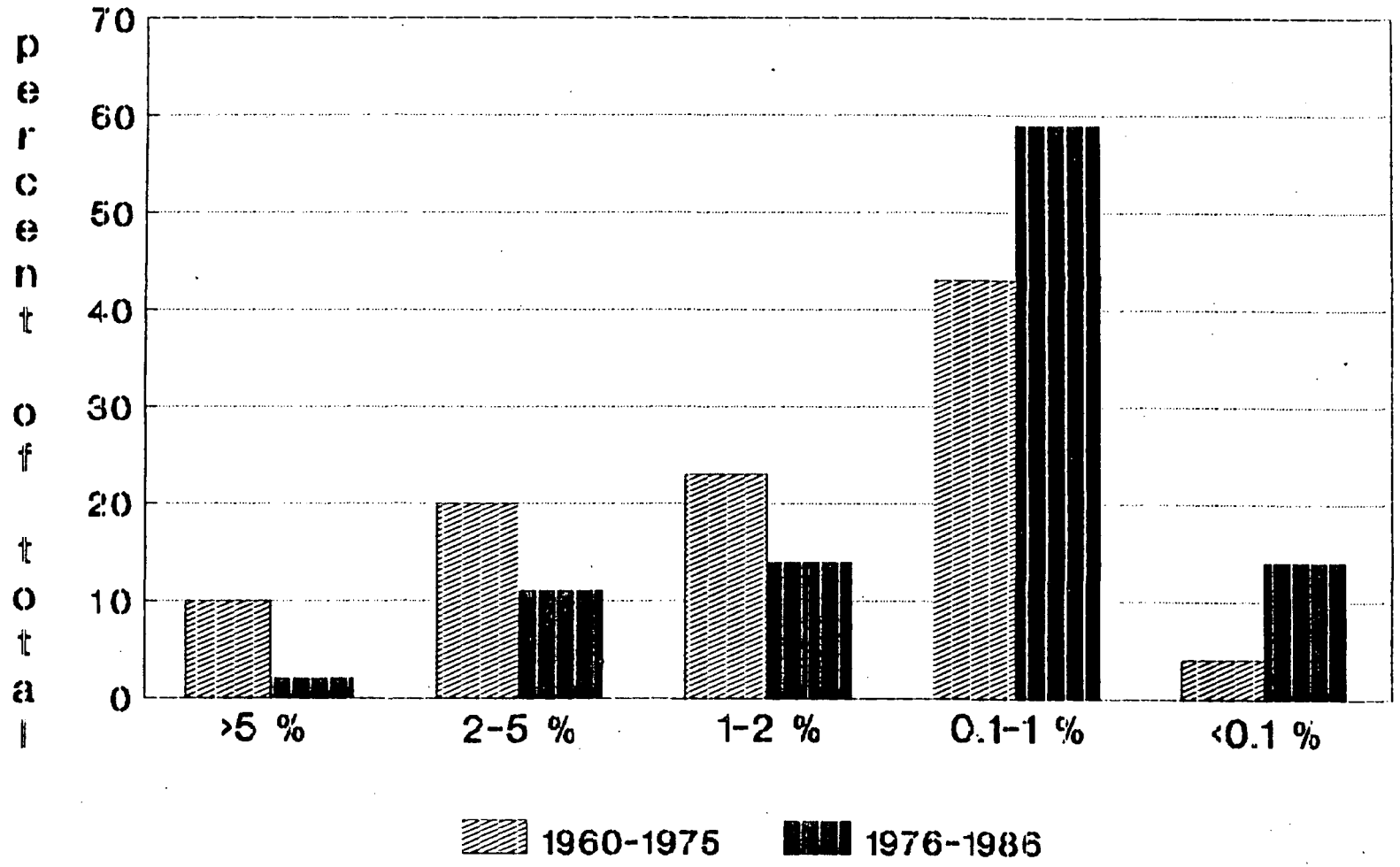

FIG 11 Tampering Inspection: Fuel Inlet Restrictors

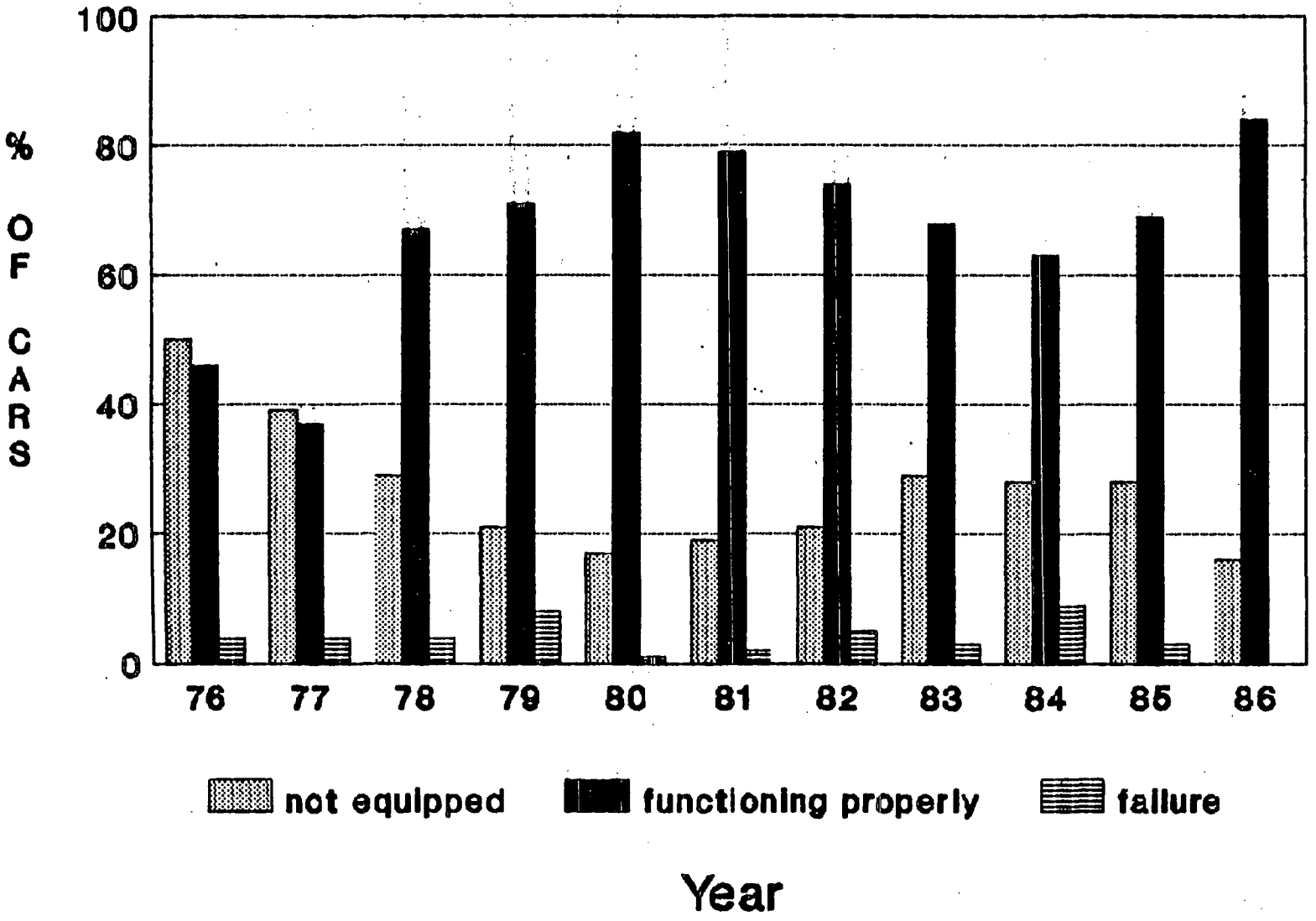

FIG 12 Tampering Inspection: Catalytic Converter

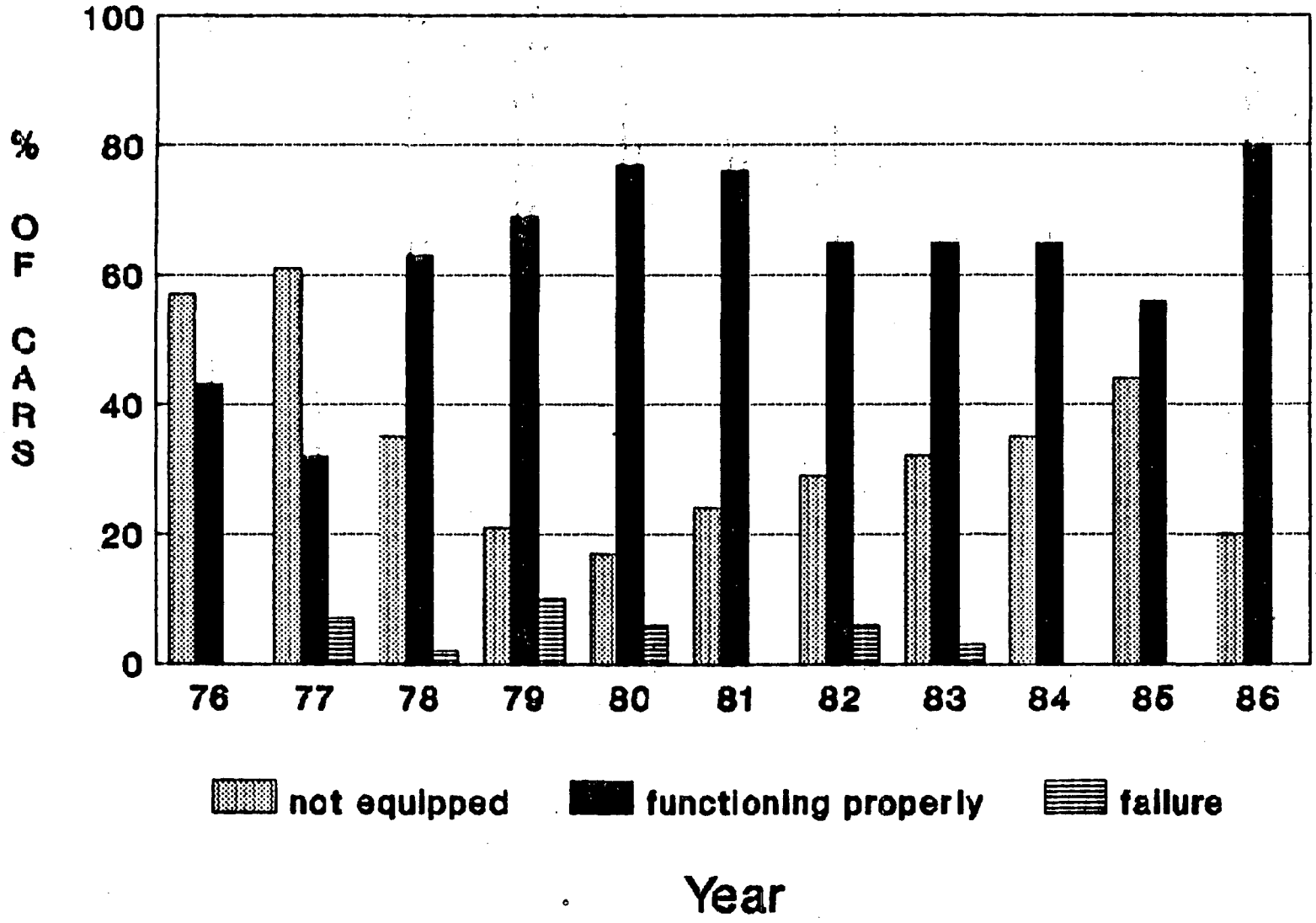

FIG 13 Tampering Inspection: EGR Valves

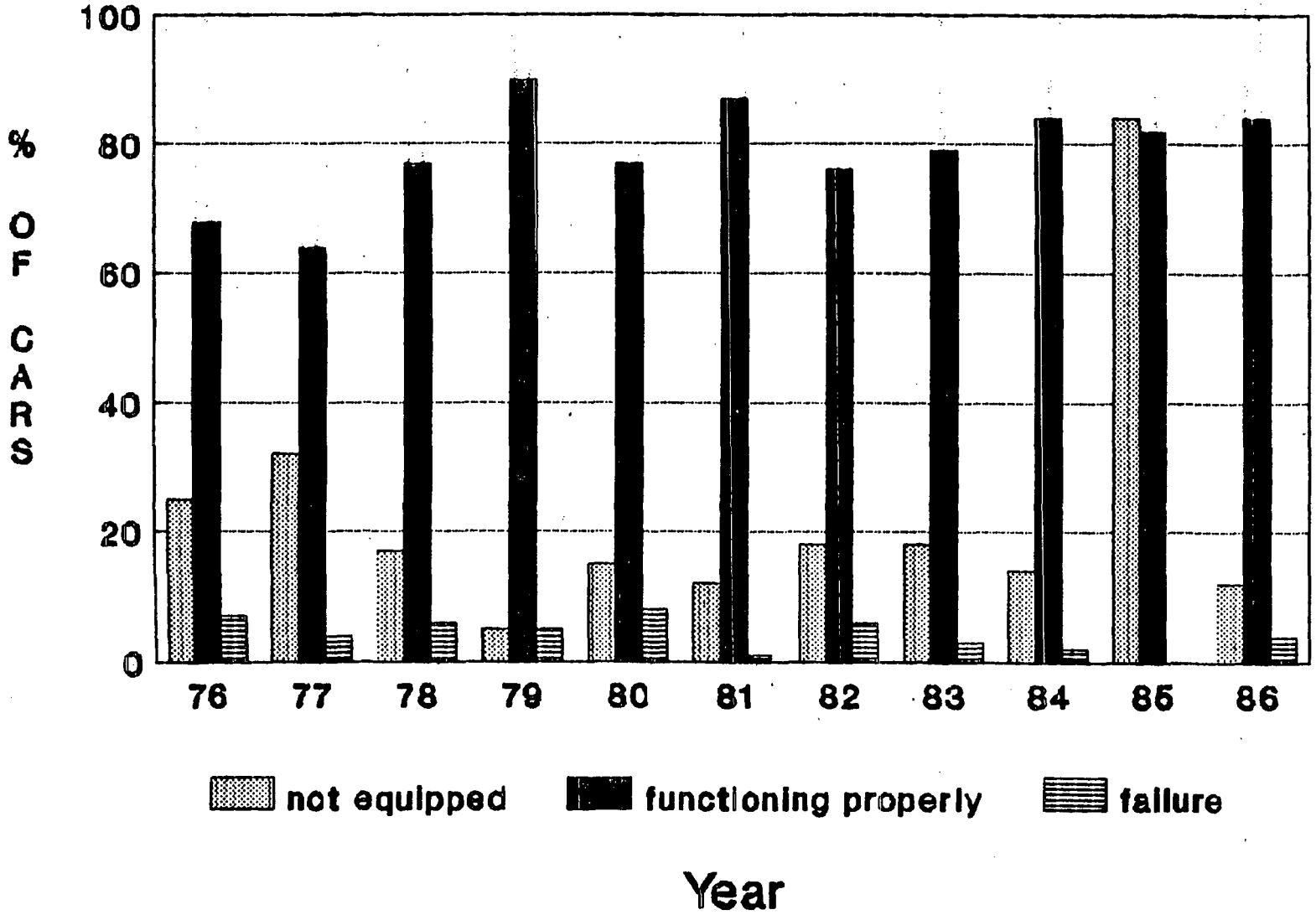

FIG 14 Tampering Inspection: Evaporative Control System

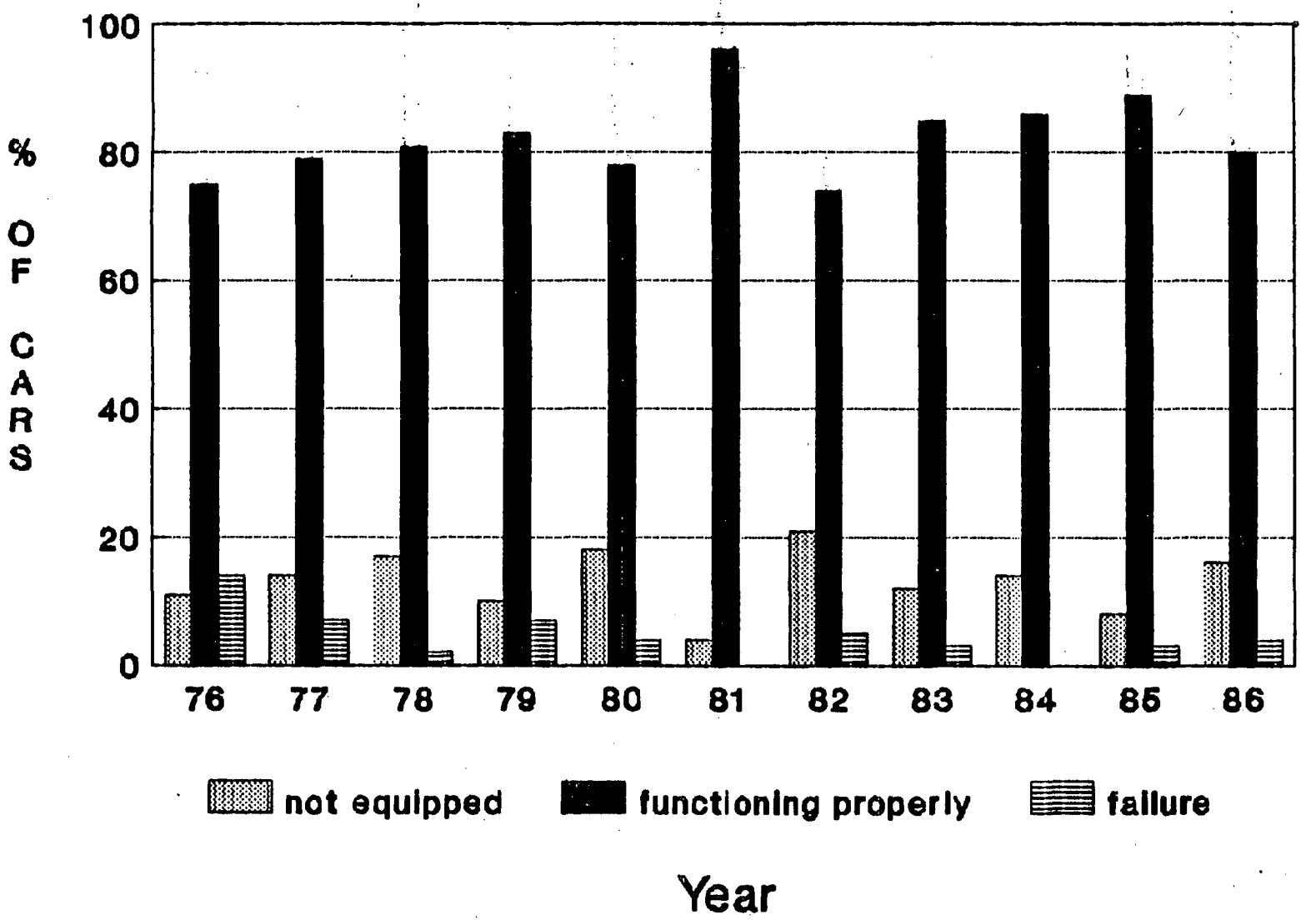

FIG 15 Tampering Inspection: Oxygen Sensors

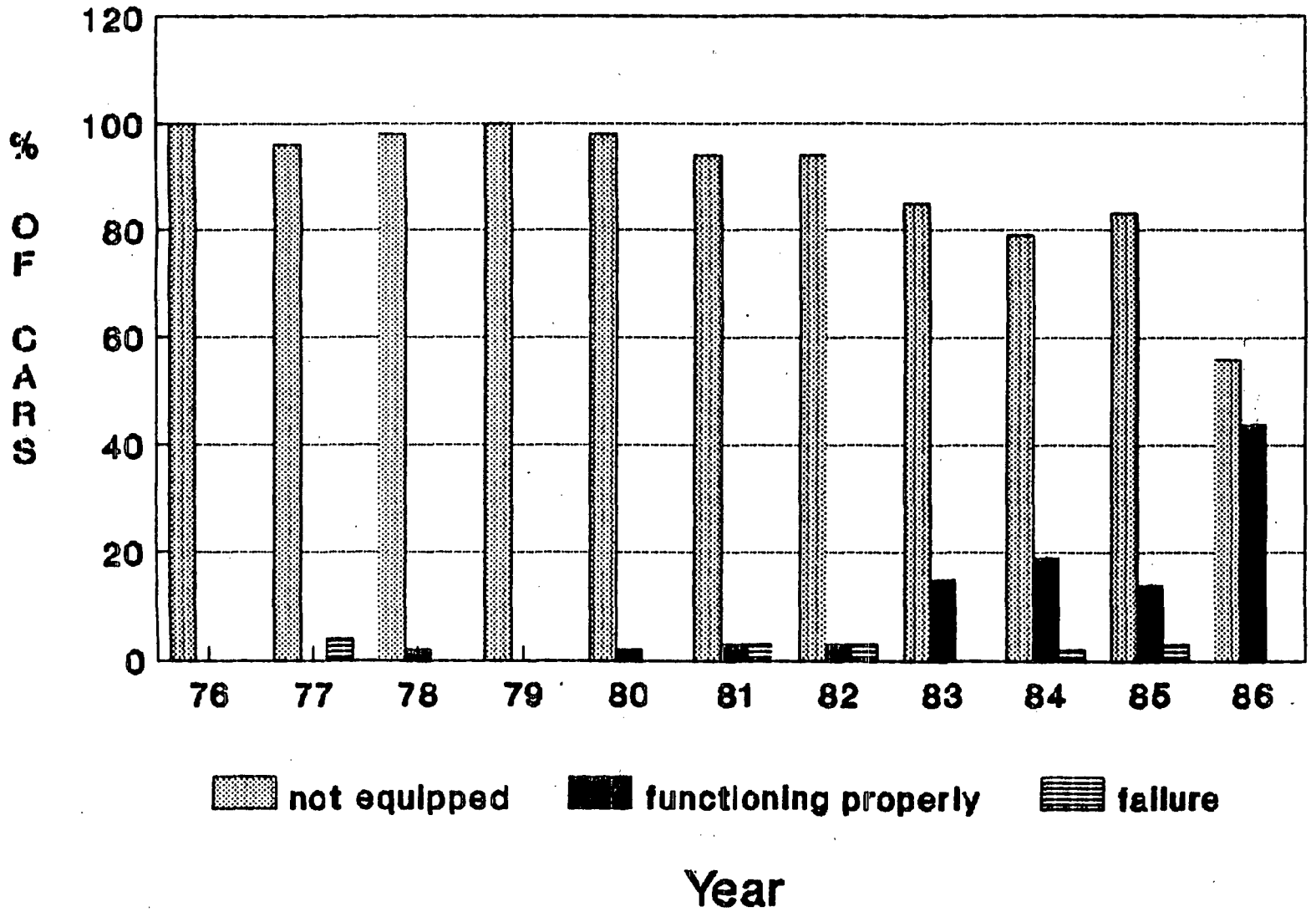

FIG 16 Tampering Inspection: Vacuum Spark Retard

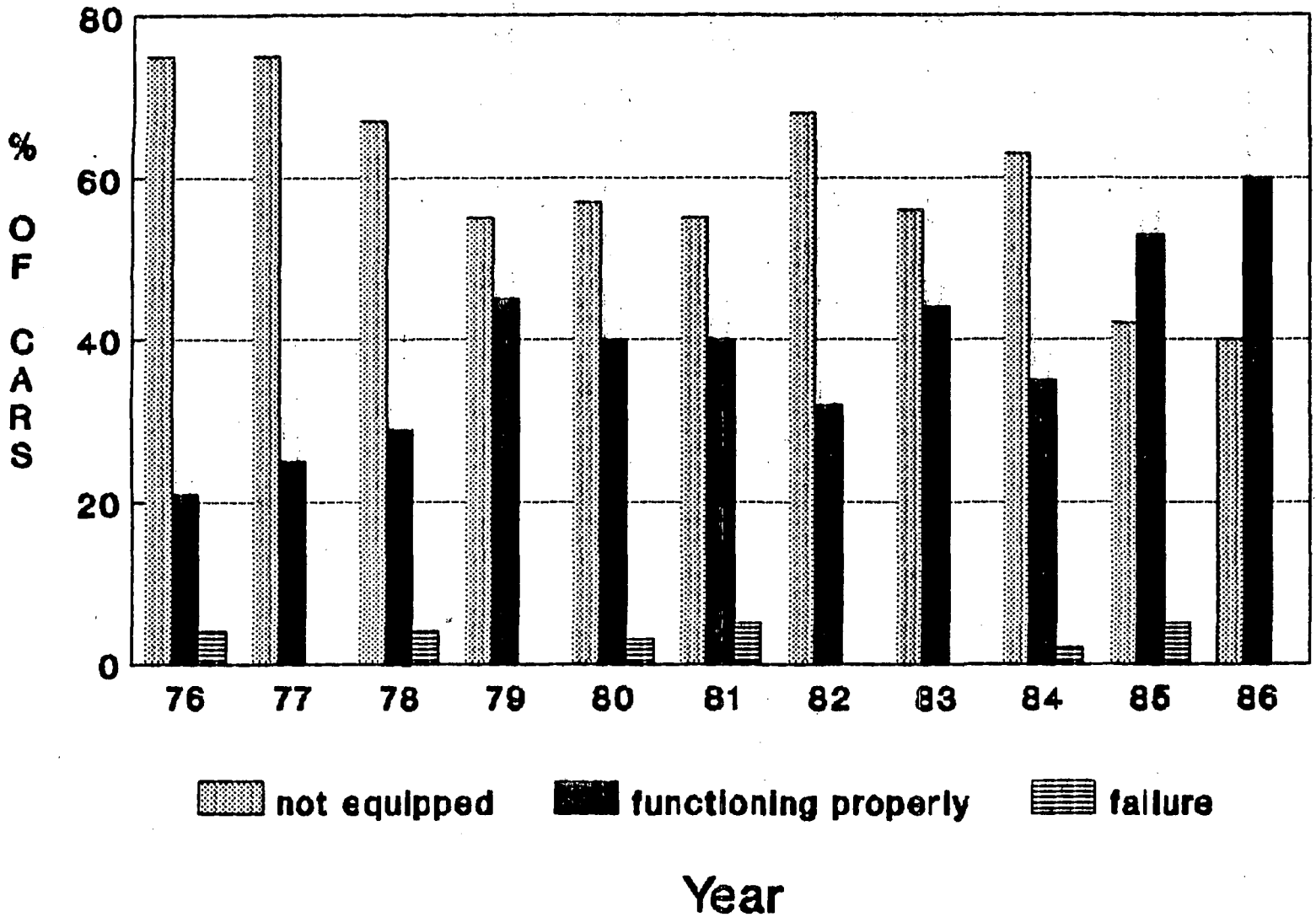

FIG 17 Tampering Inspection: Heated Air Intake

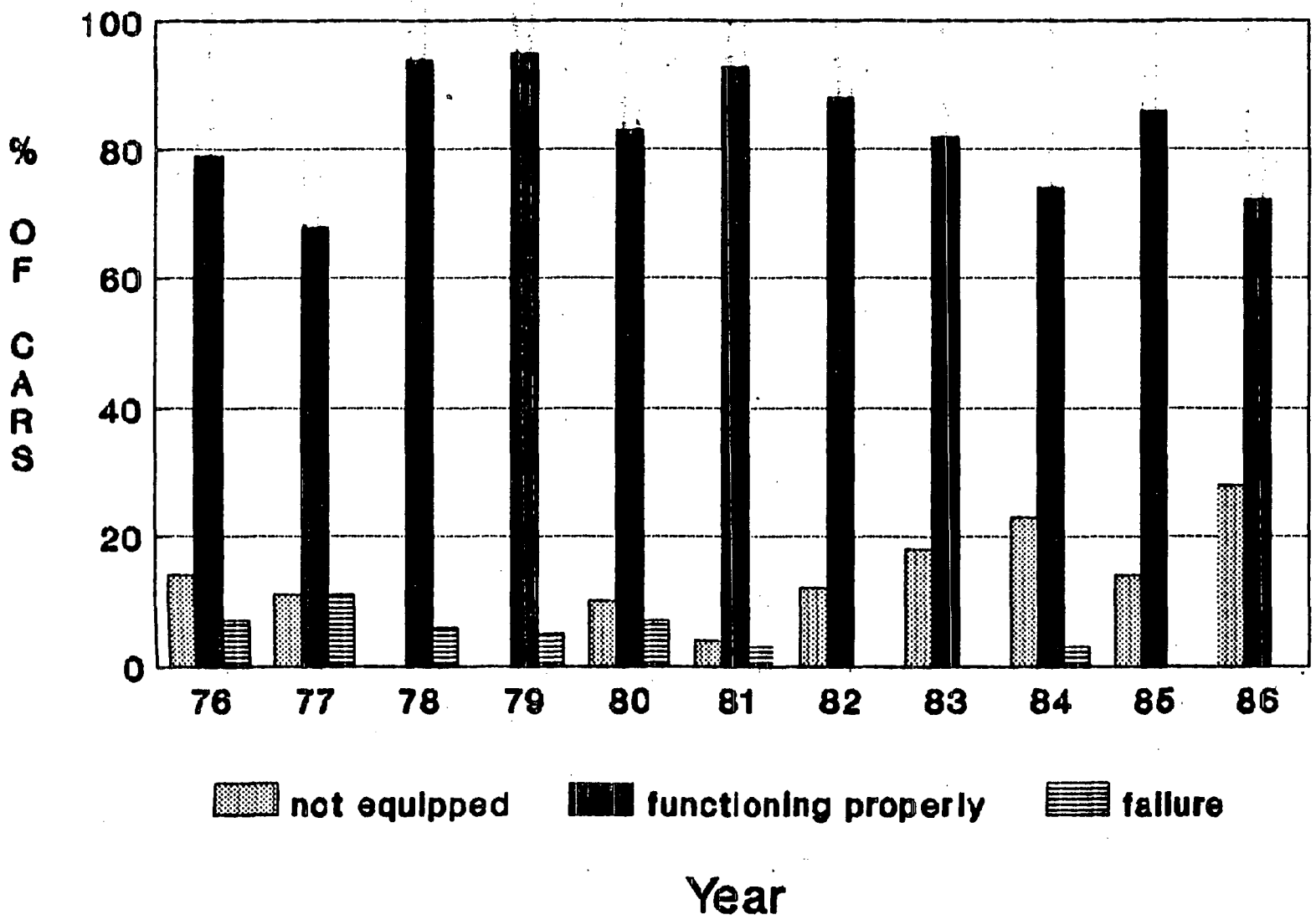

FIG 18 Tampering Inspection: PCV