ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION
PACIFIC AND YUKON REGION

1988 ANNUAL REPORT

LEADED AND LEAD-FREE GASOLINE REGULATIONS MONITORING PROGRAM

Regional Program Report - 88-04

By

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FEBRUARY 1989

ABSTRACT

This report describes the gasoline monitoring programs conducted in British Columbia during 1988. Samples of leaded and lead-free gasoline were collected and analyzed to check the lead content and verify compliance with the Leaded and Lead-Free Gasoline Regulations.

Surveys were also conducted to investigate the practice of nozzle switching on leaded gasoline dispensing pumps at retail outlets and the practice of motorists misfueling vehicles that are designed to use lead-free gasoline.

In 1988, the rate of compliance with the Lead-Free Gasoline Regulation, continued in a trend of improvement for the past 5 years, while the rates of misfueling and nozzle switching were similar to those in 1987.

RÉSUMÉ

Ce rapport décrit les programmes d'échantillonnage l'essence menés en Colombie Britannique en 1988. Des échantillons d'essence avec et sans plomb ont été recueillis et analysés pour vérifier le contenu en plomb et en vérifier la conformité avec les règlements sur l'essence sans plomb.

D'autres études furent aussi conduites. L'une visait à déterminer l'ampleur des pratiques de changement du bec verseur de pompes distribuant de l'essence avec plomb tandis que l'autre examinait les pratiques des automobilistes remplissant leurs véhicules conçus pour de l'essence sans plomb avec une essence non designée.

En 1988, le taux de conformité avec les lois sur l'essence sans plomb a continué dans la direction de l'amélioration durant les 5 dernières années, tandis que les taux d'utilisation d'essence non désignée et de modification du bec verseur furent similaires aux taux de 1987.

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SUMMARY

The Pacific and Yukon Regional office of Environmental Protection, Environment Canada monitors the lead levels in leaded and lead-free grades of gasoline in British Columbia to ensure compliance with the federal Leaded Gasoline and Lead-Free Gasoline Regulations. The 1988 monitoring results indicate that the petroleum refineries were in compliance with the Regulations; and that there is a continuing trend towards improved compliance with respect to the rates of lead-free gasoline contamination in the gasoline marketing system. In 1988, 501 samples of lead-free gasoline were collected from retail outlets. Three (3) samples contained lead in excess of the allowable lead content of 0.013 grams per litre and hence the non-compliance rate was 0.6%. This indicates a continuous improvement from 2.6% in 1985, 1.4% in 1986 and 0.8% in 1987.

Nozzles of leaded gasoline pumps were also checked; and 39 out of 893 nozzles were undersized. The nozzle switching rate was therefore 4.4%, which is a slight increase from 3.2% in 1987 but still below the rates of 9% and 6% of 1985 and 1986 respectively.

In a survey of misfueling practices at 7 Victoria area retail outlets, a total of 210 vehicle refuelings were observed. Four (4) motorists out of the 111 lead-free burning cars refueled with leaded gasoline. Consequently, 3.6% of the lead-free burning cars were misfueled.

A summary of the lead-free gasoline monitoring results and nozzle switching surveys is presented in Table 1.

SUMMARY

(continued)

TABLE 1 SURVEY RESULTS OF LEAD-FREE GASOLINE MONITORING AND NOZZLE SWITCHING

YEAR	TOTAL GASOLINE SAMPLES	CONTAMINA-TIONS	RATE OF CONTAMINA-TIONS	TOTAL NOZZLES SURVEYED	UNDER-SIZED NOZZLES	NOZZLE SWITCH RATE
1974	317	7	2.2 %			
1975	207	3	1.5 %			
1976	284	12	4.2 %			
1977	637	11	1.7 %			
1978	93	6	6.5 %			
1979	155	15	9.7 %			
1980	251	5	2.0 %	522	0	0 %
1981	311	9	3.0 %	434	43	10 %
1982	-	-	-	-	-	-
1983	331	6	1.8 %	626	457	73 %
1984	398	10	2.5 %	887	123	14 %
1985	567	15	2.6 %	1215	114	9 %
1986	358	5	1.4 %	781	49	6 %
1987	268	2	0.8 %	620	20	3.2 %
1988	501	3	0.6 %	893	39	4.4 %

1 INTRODUCTION

Lead is a toxic element to human health. Fortunately, advances in industrial hygiene have virtually eliminated acute lead poisoning. But chronic exposure to low levels of lead are known to interfere with haemoglobin synthesis and are suspected of causing neurophysiological and behaviorial effects, teratogenic effects, growth inhibition and hypertension. Children are thought to be particularly susceptible to the adverse effect of lead.

In 1973, Canadian emissions of lead from gasoline peaked at 14,360 tonnes accounting for approximately 70 per cent of total Canadian lead emissions to the atmosphere. In 1985, the total lead emissions was reduced to 6000 tonnes, but still account for 61 per cent of total lead emissions in Canada. Effective January 1, 1987, the maximum allowable lead content in leaded gasoline was reduced from 0.77 grams per litre to 0.29 grams per litre. The Minister of Environment has announced the goal to effectively phase out lead in gasoline by 1993. In September, 1988, the Minister announced that the Federal Government will advance the deadline by slightly more than two years, to December 1, 1990.

In order to reduce exhaust emissions, car manufacturers have used a device called a "catalytic converter" in many post 1975 automobiles. This device cleans the exhaust gas before emitting it to the atmosphere and is capable of reducing carbon monoxide and hydrocarbon emissions by 80% to 90%. The cleaning action of the catalytic converter is achieved by the action of special metal catalysts. The catalyst converts the harmful carbon monoxide and hydrocarbons into relatively harmless water vapour and carbon dioxide gas. Recently, a new 3-way catalyst can, at the same time, reduce the emissions of carbon monoxide and hydrocarbons as well as oxides of nitrogen. The 3-way catalyst is required to meet the new or more stringent car exhaust emission standards that became effective in September, 1987 for 1988 model year production vehicles.

Catalytic converters cannot tolerate contaminants such as lead in gasoline. When burned in the combustion chamber of an engine, the lead in gasoline becomes fine particles of metallic lead. These fine lead particles

form a coating over the catalyst and reduces its cleaning action by "poisoning" the catalyst. Several tank refills with leaded gasoline can poison the catalyst extensively and render the converter useless.

Federal Regulations were promulgated in 1974 to limit the maximum lead concentration to 0.013 grams per litre in lead-free gasoline to ensure that the platinum catalyst is protected from damage. Some provincial governments including Ontario, Nova Scotia and Quebec have passed regulations to prohibit nozzle switching at gasoline retail outlets. In April 1987, British Columbia added a 2¢ per litre sales tax to leaded gasoline, which resulted with price equalization for leaded and lead-free gasoline and has removed what appears to have been a major incentive of some motorists to misfuel their cars. At the same time, the petroleum refining industry designed and implemented strict procedures for gasoline handling to ensure that the lead-free gasoline products are not contaminated by lead.

The car manufacturing industry together with the petroleum industry sought to avoid misfueling of cars by introducing a special fuel inlet restrictor inside the fuel filling pipe on cars that are only compatible with a small diameter nozzle on lead-free gas dispensing pumps. A car requiring lead-free gasoline has an inlet restrictor that can only receive gasoline from a nozzle size of 20.6 mm (13/16 inch) outside diameter. All pump nozzles for dispensing leaded gasoline are larger and have an outside diameter of 23.8 mm (15/16inch) which prevents its use in any lead-free gas tank receptor.

If a small size nozzle (13/16" O.D.) is installed on a leaded gasoline pump, the retailer is providing an opportunity for dispensing leaded gasoline to a lead-free burning car, either intentionally or unintentionally. Some vehicle owners remove the inlet restrictor so that the vehicle can be deliberately misfueled. Both of these practices circumvent the intent of the emission control technology on cars and should be discouraged or prohibited.

The Pacific and Yukon Regional office of Environment Canada has been conducting surveys on the lead content in gasoline and nozzle switching practices for a number of years. In each of the past two years, an additional survey was conducted to investigate the misfueling practices by motorists. This report presents the 1988 results from all these surveys.

2 LEADED GASOLINE AND LEAD-FREE GASOLINE MONITORING

Samples of leaded gasoline were obtained from petroleum refineries and analyzed for lead concentration by the atomic absorption method.

The lead-free gasoline survey is based on a spot check of retail outlets in several geographical areas in B.C., typically the Vancouver area, the Vancouver Island and the Okanagan area. Gasoline retail outlets in urban centres were visited without predetermination of time, location or brand. A surveyed area would not be revisited in the same year unless a serious contamination problem had been identified.

Samples of lead-free gasoline were collected at retail outlets and were analyzed the following day using a quick test colorimetric analyzer. When a high lead concentration was detected by the quick test, the sample was then analyzed again using the atomic absorption method to confirm the quick test result.

3 NOZZLE SWITCHING SURVEY

The nozzle switching survey was conducted in conjunction with the gasoline sampling program. The size of nozzles on leaded gasoline pumps was checked with a plastic template (Figure 1).

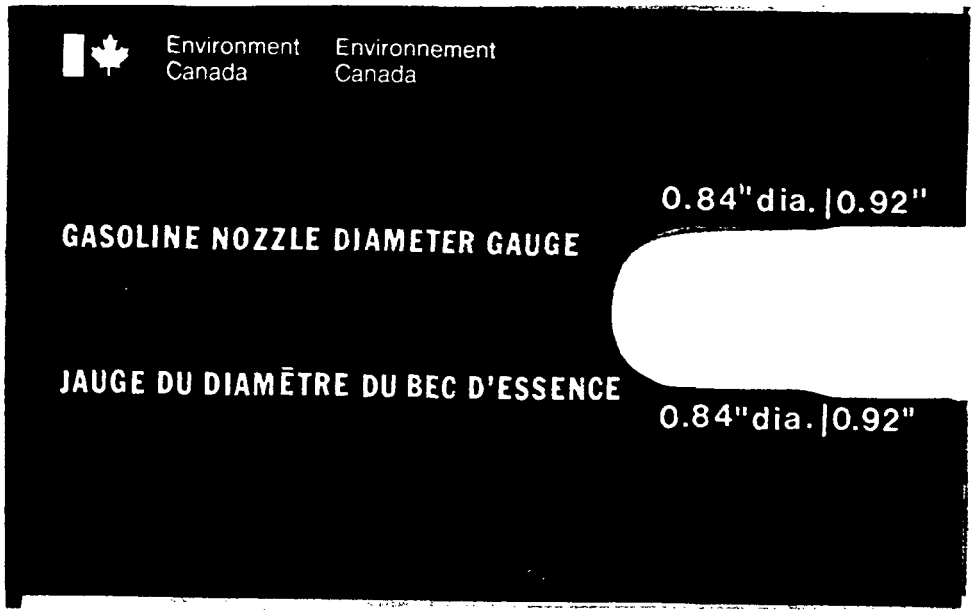

FIGURE 1 Plastic Template for Nozzle Size Measurement

The template can be used to quickly check nozzle size and identify undersized nozzles. Table 2 shows nozzle sizes that have been encountered.

TABLE 2 NOZZLE SIZE OF GASOLINE DISPENSING PUMPS

NOZZLE SIZE	OUTSIDE DIAMETER		INDICATION ON TEMPLATE	IMPLICATION
	mm	Inch		
Large	23.8	15/16	Does not fit into opening	Correct size to dispense leaded gasoline.
Small	20.6	13/16	Fits into inner opening	One can dispense leaded gasoline easily to cars requiring unleaded gasoline.
Medium	22.2	14/16	Fits into outer opening	One can dispense leaded gas to cars requiring lead-free gas by forcing the nozzle into the receptor neck.

4 MISFUELING SURVEY

A separate survey was conducted in Victoria to assess the practice of misfueling cars. In this survey, a technician observed vehicle refueling and interviewed motorists at 7 retail outlets, spending one day at each outlet. Information was recorded on the total number of vehicles refueled, type of fuel required for each vehicle, the presence or absence of the fuel inlet restrictor in the fill pipe, and the reason for using leaded or unleaded gas. A copy of the survey data sheet is included in Appendix I.

5 RESULTS

5.1 Leaded Gasoline Monitoring

All samples taken from petroleum refineries were in compliance with the Regulations. The results are listed in Table 3.

TABLE 3 LEAD CONCENTRATIONS IN LEADED GASOLINE SAMPLES FROM B.C. PRODUCTION PLANTS

	Lead Concentrations in gm/litre (Production Plant)		
1st Quarter 87	0.27(ESSO)	0.21(SHELL)	0.19 (HUSKY)
2nd Quarter 87	0.28(TAYLOR)	0.28(KAMLOOPS)	0.21 (CHEVRON)
3rd Quarter 87	0.23(ESSO)	0.20(SHELL)	0.16 (CHEVRON)
	0.20(P.MOODY)		
4th Quarter 87	0.24(SHELL)	0.20 (CHEVRON)	
1st Quarter 88	0.29(P.MOODY)		
3rd Quarter 88	0.23(ESSO)		
4th Quarter 88	0.15(SHELL)	0.21 (CHEVRON)	0.16 (CHEVRON)

5.2 Lead-Free Gasoline Monitoring

A total of 501 lead-free gasoline samples from 22 brands were collected from retail outlets in 58 municipalities in the Lower Mainland, the Fraser Valley, the Okanagan area and Vancouver Island. Three samples exceeded the allowable lead content of 0.013 grams per litre. Two non-compliance samples occurred in the Okanagan area and one occurred in Vancouver Island. This yields a non-compliance rate of 0.6% in B.C., 0% in Vancouver, 0.8% in Vancouver Island, and 2% in the Okanagan area. Further details of the results are tabulated in Tables 5 and 6.

5.3 Nozzle Survey

A total of 893 nozzles on leaded gas pumps were measured and 39 were undersized. This yields a nozzle switching rate of 4.4% as a B.C. average; 3.9% in the Lower Mainland, 3.3% in Victoria and 7.0% in the Okanagan area. Nozzle switching practices have generally decreased since 1985 when the switching rates were 9.4% as the B.C. average; 4.3% in Vancouver, and 18.0% in the Okanagan area. The results of the survey are presented in Tables 7 and 8.

Area	Total Nozzles Surveyed	Number of Undersized Nozzles	Percentage of Undersized Nozzles
Lower Mainland	413	16	3.9%
Victoria	182	6	3.3%
Other locations in Vancouver Island	113	4	3.5%
Okanagan	185	13	7.0%
B.C.	893	39	4.4%

5.4 Misfueling Survey

The survey was conducted at 7 gas stations of different brands in the Victoria area. The locations were selected to provide a reasonable geographic distribution. Approval from the respective retail outlet was obtained prior to the survey. All 7 stations offered both leaded and unleaded gas and 2 stations had one of their leaded gas pumps equipped with a small size nozzle. Our Headquarters office in Ottawa was conducting a national misfueling survey at the same time. The survey included the City of Vancouver and therefore the regional office did not conduct any misfueling survey in Vancouver to avoid duplication of work.

A total of 210 vehicle refuelings were surveyed, of which 113 were lead-free refuelings and 97 were leaded refuelings. Among the 99 cars that were designed to run on leaded fuel, 6 were refueled with unleaded gasoline. Among the 111 cars that were designed to use unleaded fuel, 4 were refueled with leaded gasoline. All of these 4 cars showed evidence of tampering with the fuel inlet restrictors, either by widening the restrictor or by removing it completely. Two misfuelers stated that the catalytic converters on their vehicles had been removed. All of the misfuelers admitted that they always refuel with leaded gasoline and the reasons given varied from a lower price (which is not correct since April 1987), "since last owner", to the vehicle "runs better". In April 1987, the provincial government added a 2¢ per litre sales tax to leaded gasoline which resulted in a price equalization between the regular grades of leaded and lead-free gasoline.

Among the 103 users of leaded gasoline, none used an adaptor to refuel leaded gasoline to an unleaded car.

The survey also found that among the 4 misfuelers, 2 resided in Victoria, 1 in Saanich, and 1 in Sooke.

Among the 210 motorists who were interviewed, the car size distribution was as follows:

Class	No. of Vehicles	Percent
4 Cylinders	102	48%
6 Cylinders	56	27%
8 Cylinders	52	25%

Among the 210 motorists who were interviewed, the car age distribution was as follows:

Model Year	No. of Vehicles	Percent
1961-1974	52	25%
1975-1980	73	35%
1981-1985	48	23%
1986-1988	37	17%

The details of the misfueled cars are summarized in Table 9.

6 DISCUSSION

The leaded gasoline production plants in B.C. were in compliance with the amended Regulations since January 1987 when the amended Regulations became effective. The lead contents in leaded gas samples from petroleum refineries were in the range of 0.15 - 0.29 grams per litre.

The rate of lead-free gasoline contamination improved this year with a 0.6% non-compliance rate as compared to 0.8% in 1987, 1.4% in 1986 and 2.6% in 1985. Only 3 contaminated samples were found in Vancouver Island and the Okanagan area among the 501 spot samples. There was no contaminated samples found in Vancouver. This reflects a positive and notable improvement in the gasoline marketing system and reflects improved quality control efforts by the petroleum industry.

The nozzle switching practice as a provincial average, increased slightly to 4.4% as compared to 3.2% in 1987, and remained improved from 6.3% in 1986 and 9% in 1985. In Vancouver the rate was 3.9% in 1988 as compared to 3.2% in 1987, 2.3% in 1986 and 4.3% in 1985. The nozzle switching rate in Victoria was 7.3% in 1988, which was an improvement from 14.7% in 1986 and 8.6% in 1985.

The vehicle misfueling survey in Victoria showed that other than the determined vehicle misfuelers who tampered with or completely removed the fuel inlet restrictors on their cars, there were no incidences of misfueling attributed to undersized nozzles. The public awareness efforts of the federal and provincial governments and industry continue to have had a positive effect on the public. In April 1987, the prices for regular grades of leaded and lead-free gasoline were equalized when the British Columbia government added a 2¢ per litre sales tax to leaded gasoline. This price equalization has removed what appears to have been a major incentive for some motorists to misfuel their cars.

Among the 103 motorists who refueled their cars with leaded gasoline and were interviewed in our survey, 4 had tampered with the fuel inlet restrictors on their cars such that misfueling can be performed easily. The catalytic converters of 2 of these 4 cars had also been removed. These results indicate that 4% of leaded gasoline users are regular misfuelers. Among the 111 motorists whose cars were designated for unleaded gasoline, 4 refueled with leaded gasoline resulting with a misfueling rate of 3.6%. A

misfueling survey was not conducted in Vancouver this year by this office because Ottawa was conducting a national survey in which Vancouver was included. The results of this national survey should be available in the spring of 1989.

As a result of public awareness and government action to reduce lead in gasoline, the demand and supply of lead-free gasoline has increased steadily in B.C., from a mere 5.2% of total gas production in 1975, to 50.3% in 1987, as indicated in Figure 2. Also, the increased use of lead-free gasoline by the general public has resulted with improvement in air quality. By using lead measurement data from 5 air monitoring stations in Vancouver, which have been operating since 1975, the lead in ambient air has been reduced to 25% of the 1975 level, from a 0.8 ug/m (micrograms per cubic meters) in 1975 to the 1987 level of 0.2 ug/m^3 as inicated in Figure 3.

Figure 2 Lead in Gasoline - Historical Trend for B.C.

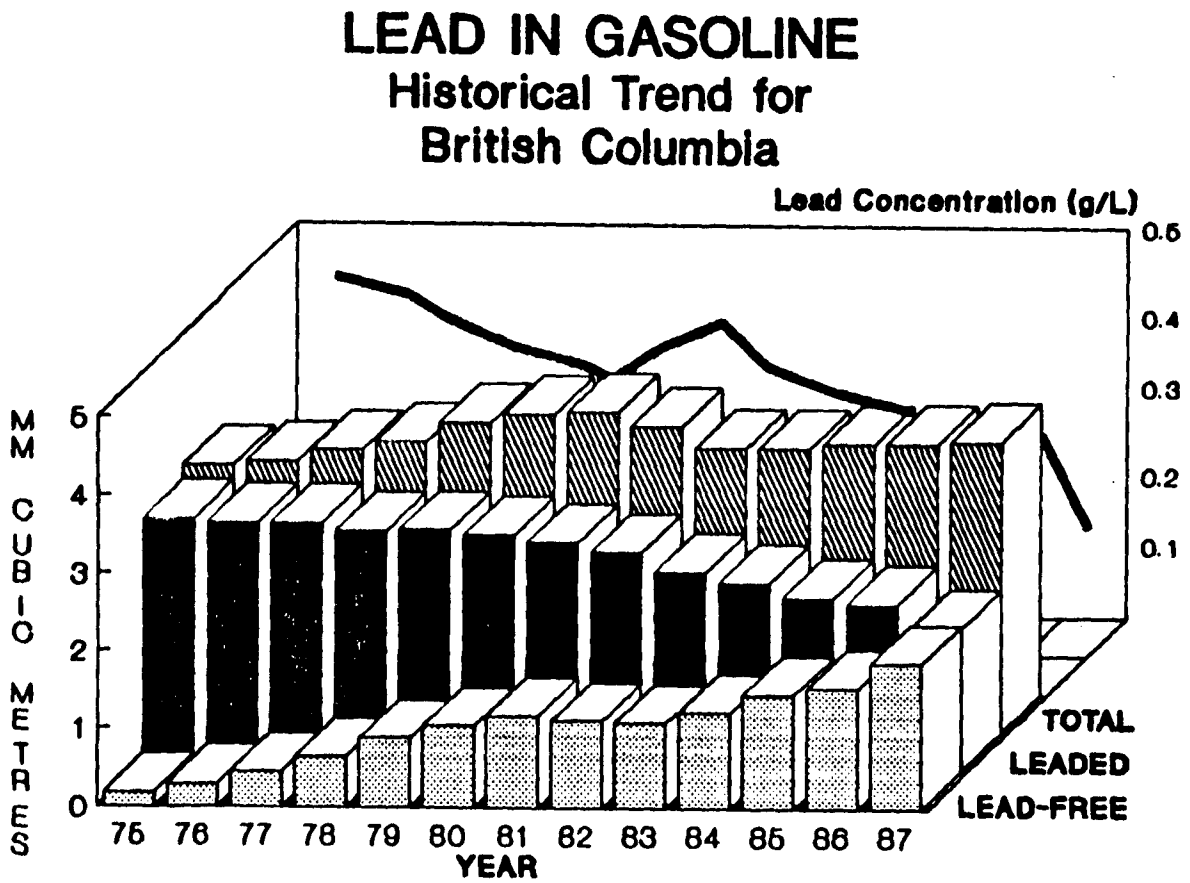

Figure 3 **Ambient Lead Concentration in Vancouver**

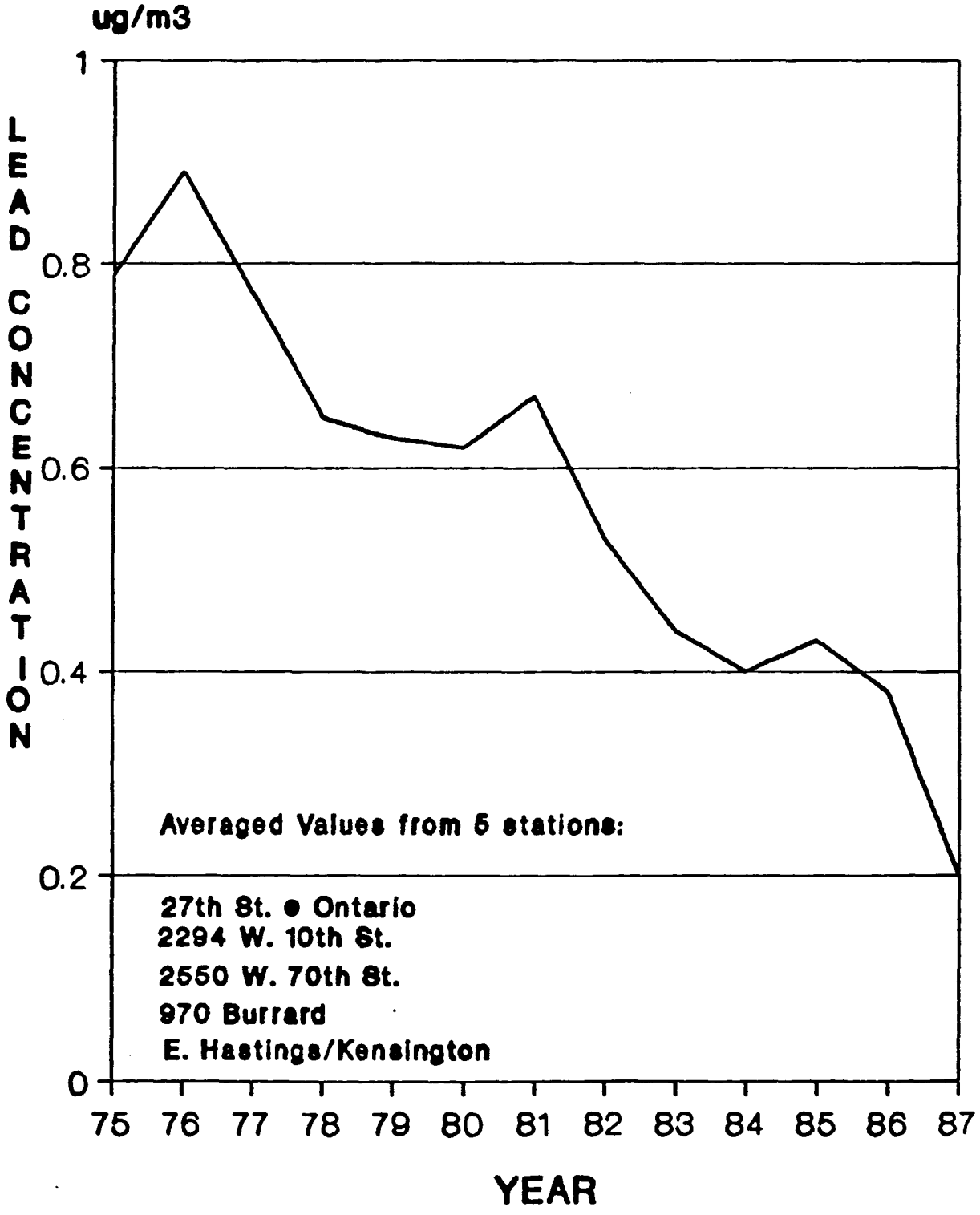

TABLE 4 LEAD-FREE GASOLINE MONITORING - AREAS SAMPLED

AREA SAMPLED	DATE(S) SAMPLED	# OF STATIONS	# OF SAMPLES	NON-COMPLIANCES	
				#	%
Lower Mainland					
Vancouver	July 6,7, 11,12	36	70	0	0
North Vancouver	May 9,12,13	35	67	0	0
West Vancouver	May 16	12	23	0	0
Richmond	Aug 4	15	28	0	0
New Westminster	Aug 5	7	14	0	0
Coquitlam	Aug 5	6	12	0	0
Surrey	June 2	3	5	0	0
White Rock	June 2	3	4	0	0
Delta	June 2	3	6	0	0
Burnaby	July 14	15	26	0	0
Port Moody	June 8	2	4	0	0
Maple Ridge	June 8	3	5		0
Mission	June 8	2	4	0	0
Pitt Meadows	June 8	2	2	0	0
Subtotal		144	270	0	0
Vancouver Island					
Sidney	May 24	4	7	0	0
North Saanich	May 24	3	4	1	25
Central Saanich	May 24	2	4	0	0
Saanich	May 24	2	4	0	0
Victoria	May 24,25	33	63	0	0
Mill Bay	May 25	4	8	0	0
Nanaimo	May 26	22	40	0	0
Subtotal		70	130	1	0.8

TABLE 4 LEAD-FREE GASOLINE MONITORING - AREAS SAMPLED (continued)

AREA SAMPLED	DATE(S) SAMPLED	# OF STATIONS	# OF SAMPLES	NON-COMPLIANCES	
				#	%
Interior					
Hope	June 13,24	4	7	1	14
Princeton	14	3	6	0	0
Hedley	14	1	1	0	0
Keremeos	14	2	3	0	0
Summerland	15	2	3	0	0
Peachland	15	1	2	0	0
Westbank	15	2	3	0	0
Kelowna	15	3	6	0	0
Rutland	15	1	2	0	0
Penticton	16	4	6	0	0
Vernon	17	3	5	0	0
Armstrong	17	2	4	0	0
Enderby	17	1	1	0	0
Salmon Arm	17	3	5	0	0
Okanagan Falls	19	2	2	0	0
Oliver	19	2	4	0	0
Osoyoos	19	3	4	0	0
Falkland	21	1	1	1	100
Monte Lake	21	1	1	0	0
Monte Creek	21	1	2	0	0
Kamloops	21	3	6	0	0
Merritt	22	2	4	0	0
Ashcroft	22	1	1	0	0
Spences Bridge	22	1	2	0	0
Cache Creek	22	2	3	0	0
Savona	22	1	1	0	0
Cherry Creek	22	1	1	0	0
Heffley Creek	23	1	2	0	0
Barriere	23	1	1	0	0
Little Fort	23	1	1	0	0
Clearwater	23	1	1	0	0
Vavenby	23	1	1	0	0
Litton	24	1	1	0	0
Boston Bar	24	1	2	0	0
Spuzzum	24	1	1	0	0
Yale	24	1	2	0	0
Chilliwack	24	2	3	0	0
Subtotal		63	101	2	2

TABLE 5 LEAD-FREE GASOLINE MONITORING: NON-COMPLIANCES

SAMPLE #	A.A. TEST (Pb) g/l	BRAND	GRADE	LOCATION	SAMPLING DATE
VI-099	0.019	Petro Can	R.U.	Sidney	88-05-24
Z-312	0.018	Petro Can	R.U.	Falkland	88-06-21
Z-346	0.025	Shell	R.U.	Hope	88-06-24

TABLE 6 NOZZLE SURVEY - BRITISH COLUMBIA

Total Number of Stations Surveyed : 277
Total Number of Leaded Nozzles Measured : 893
Total Number of Undersized Nozzles : 39 (4.4%)

BRAND	NO. OF STATIONS	NO. OF UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NO. UNDERSIZED	PERCENT UNDERSIZED
CHEVRON	43	2	4.7	167	2	1.2
SHELL	37	1	2.7	99	1	1.0
PETRO CAN	55	4	7.2	173	4	2.3
ESSO	47	2	4.3	142	5	3.5
TEXACO	29	4	13.8	81	4	4.9
SUPER SAVE	11	4	36.4	28	13	46.4
MOHAWK	9	2	2.2	36	2	5.6
DOMO	2	0	0	12	0	0
BEAVER	1	0	0	3	0	0
PAY'N SAVE	4	0	0	8	0	0
TURBO	3	0	0	9	0	0
REBEL	1	0	0	2	0	0
HUSKY	7	0	0	23	0	0
SAVE ON GAS	1	0	0	9	0	0
PAYLESS	13	2	15.4	60	2	3.3
7-11	2	0	0	8	0	0
CO-OP	2	1	50.0	8	1	12.5
DCOL	1	1	100.0	3	1	33.3
DISCOUNT	1	1	100.0	2	1	50.0
SEARS	2	0	0	7	0	0
INDEPENDENT	5	1	20.0	12	2	16.7
ULTRA FUEL	1	1	100.0	1	1	100.0
	277	26	9.4	893	39	4.4

TABLE 7 NOZZLE SURVEY - LOWER MAINLAND

Total Number of Stations Surveyed : 123
Total Number of Leaded Nozzles Measured : 413
Total Number of Undersized Nozzles : 16 (3.9%)

BRAND	NO. OF STATIONS	NO. W/ UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENT UNDERSIZED
A. BRAND						
INDEPENDENT	2	0	0	6	0	0
DCOL	1	1	100.0	3	1	33.3
SEARS	1	0	0	4	0	0
CHEVRON	20	1	4.0	76	1	1.3
SHELL	17	0	0	42	0	0
PETRO CAN	26	3	10.0	95	3	3.1
ESSO	20	0	0	74	0	0
TEXACO	14	3	17.6	39	3	7.7
SUPER SAVE	8	2	22.2	19	8	42.1
MOHAWK	4	0	0	12	0	0
GULF	3	0	0	11	0	0
DOMO	2	0	0	11	0	0
BEAVER	1	0	0	3	0	0
PAY'N SAVE	1	0	0	2	0	0
TURBO	2	0	0	6	0	0
REBEL	1	0	0	2	0	0
HUSKY	2	0	0	3	0	0
TEMPO	1	0	0	1	0	0
7-11	1	0	0	4	0	0
	123	10	8.1	413	16	3.9

TABLE 7 NOZZLE SURVEY - LOWER MAINLAND (continued)

BRAND	NO. OF STATIONS	NO. W/ UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENT UNDERSIZED
B. AREA						
BURNABY	15	1	6.7	59	3	5.1
VANCOUVER	36	2	5.6	154	7	3.9
N. VANCOUVER	14	1	7.1	30	1	3.3
RICHMOND	15	1	6.7	55	1	1.8
SURREY	3	0	0	8	0	0
W. VANCOUVER	12	1	8.3	29	0	3.4
N. WESTMINSTER	7	1	14.3	28	1	3.6
MAPLE RIDGE	3	1	33.3	7	1	1.0
MISSION	2	0	0	4	0	0
COQUITLAM	6	0	0	13	0	0
WHITE ROCK	3	0	0	6	0	0
DELTA	3	0	0	8	0	0
PORT MOODY	2	1	50.0	7	1	14.0
PITT MEADOWS	2	1	50.0	5	1	20.0
	123	10	8.1	413	16	3.9

TABLE 8 NOZZLE SURVEY - VICTORIA

Total Number of Stations Surveyed : 42
Total Number of Leaded Nozzles Measured : 182
Total Number of Undersized Nozzles : 6 (3.3%)

BRAND	NO. OF STATIONS	NO. W/ UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENT UNDERSIZED
PAYLESS	8	2	25.0	51	2	3.9
SAVE-ON-GAS	2	0	0	7	0	0
PETRO CAN	7	0	0	29	0	0
SHELL	6	0	0	20	0	0
ESSO	8	1	12.5	28	1	3.6
TEXACO	3	0	0	9	0	0
MOHAWK	1	0	0	8	0	0
CHEVRON	3	0	0	18	0	0
PAY & SAVE	1	0	0	4	0	0
CO-OP	1	1	100.0	2	1	50.0
OTHERS	2	2	100.0	6	2	33.0
	42	6	14.3	182	6	3.3

TABLE 9 INFORMATION ON MISFUELED CARS

ID	VEHICLE				AREA OF		FREQUENCY OF LEADED USEAGE	UN-LEADED LABEL	CAT. CONV. REMOVED	FREQ. TUNE-UP	MILEAGE	REASON GIVEN FOR MISFUELING
	YEAR	MAKE	MODEL	NO. OF CYLINDERS	RESIDENCE	SURVEY						
94	81	CHEV	1/2T VAN	6	VIC.	VIC.	ALWAYS	N	Y	1/2 yr.	17 MPG	Runs better
175	74	PONT	FORMULA	8	VIC.	VIC.	ALWAYS	Y	N	3-4 mo.	12-15 MPG	Runs smoother
194	78	GMC	JIMMY	8	SAANICH	VIC.	ALWAYS	N	Y	6 mo.	12 MPG	Always have
196	79	PONT	--	4	SOOKE	VIC.	ALWAYS	N	?	seldom	30 MPG	Was cheaper, now runs well

APPENDIX I

DATA RECORDING FORMAT
FOR THE MISFUELING SURVEY

SERVICE STATION RECORD

1. Service Station Brand Name: _____

2. Type of Service Station: Full Serve _____ Self Serve _____

   Both Full and Self Serve _____

3. Types of Gasoline Available: Leaded Only _____

   Lead-Free Only _____

   Both _____

4. Incidence of Nozzle Substitution:

   Number of Leaded Pump Nozzles _____ ID _____

   Number of Undersized Nozzles _____ ID _____

5. Total Number of Motorists using: Unleaded _____

   Leaded _____

   Total _____

6. Total Number of Motorists using Undersized Nozzles _____

7. Total Number of Unleaded Vehicles using Leaded Gas _____

8. Misfuelling Rate: _____%

SURVEY FORM NO. 2

CAR MAINTENANCE AND FUEL USE

We appreciate your cooperation in providing information on the type of fuel used in your car. This survey is being conducted by the Federal Department of Environment. The collected information will be helpful to assess the vehicle emissions contributed to air pollution in Vancouver.

1. ID NUMBER _____ PUMP NO. _____

2. MAKE _____ MODEL _____
   YEAR _____

3. SIZE CLASS: COMPACT (4 cylinders) _____
   MID-SIZE (6 cylinders) _____
   FULL-SIZE (8 cylinders) _____

4. AREA OF RESIDENCE: _____

5. FUEL DESIGNATION: UNLEADED _____ LEADED _____

6. FREQUENCY OF LEADED (UNLEADED) GASOLINE USAGE:
   Always _____ Often _____ Regularly _____
   Sometimes _____ Rarely _____ Never _____

7. UNLEADED LABEL: Yes _____ No _____

8. FUEL INLET RESTRICTOR: Present _____ Absent _____

9. CATALYTIC CONVERTER: Present _____ Absent _____

10. How often do you tune your car? _____

11. What is the gas mileage? _____

12. "I would like to ask you why you use leaded/unleaded gasoline in your vehicle rather then unleaded?" _____
    _____

APPENDIX II

HISTORICAL DATA ON
LEAD-FREE GASOLINE CONTAMINATION

APPENDIX II

TABLE 1 NUMBER OF CONTAMINATED SAMPLES (1974-1987)

YEAR	NO. OF CONTAMINATIONS IDENTIFIED IN EPS (Pacific & Yukon Region) MONITORING PROGRAM									TOTAL NO. OF SAMPLES
	C	B	D	A	E	H	F	G	OTHERS	
1974	1	1	2	2	1	0	0	0	0	317
1975	-	-	-	-	-	-	-	-	3	207
1976	0	2	1	2	3	0	0	1	3	284
1977	0	1	2	5	1	0	1	0	1	637
1978	0	0	1	3	2	0	0	0	0	93
1979	1	2	2	1	5	0	2	2	0	155
1980	1	3	2	2	0	0	1	0	0	273
1981	7	3	2	7	1	1	1	-	2	350
1982	-	-	-	-	-	-	-	-	-	-
1983	1	1	0	3	1	0	0	0	0	331
1984	0	3	2	0	0	1	1	1	2	398
1985	2	2	3	2	0	1	1	2	2	567
1986	0	0	2	0	1	0	2	0	0	358
1987	0	0	0	1	0	0	0	0	1	268
1988	0	1	0	0	2	0	0	0	0	501
TOTAL	13	19	19	28	17	3	9	6	14	4739/128

A = CHEVRON

B = SHELL

C = ESSO

D = GULF

E = PETRO CAN (Formerly PACIFIC and GULF)

F = TEXACO

G = MOHAWK

H = HUSKY

APPENDIX II

TABLE 2 LIST OF CONTAMINATED LEAD-FREE GASOLINE (1974-1981)

YEAR	LEAD CONCENTRATIONS (g/IG) IN THE IDENTIFIED CONTAMINATIONS								
	C	B	D	A	E	H	F	G	OTHERS
1974	0.950	0.230	0.123 0.076	0.064 0.068	0.072	- -	- -	- -	- -
1975	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.190 0.180 0.080
1976	-	0.110 0.070	0.090	0.090 0.070	0.090 0.070 0.150	-	-	2.000	0.420 0.320 0.080
1977	-	0.127	0.180 0.230	0.090 0.080 0.190 0.080 1.000	0.123	-	-	-	-
1978	-	-	0.062	0.163 0.079 0.149	0.089 0.064	-	-	-	-
1979	0.086	0.244 0.244	0.065 0.244	0.082	0.076 0.263 0.147 0.101 0.168	-	0.063 0.147	0.282 0.263	-
1980*	0.074	0.071 0.063 0.078	0.942	0.068 0.065 0.188	-	-	0.090	-	-
1981*	0.220 0.076 0.093 0.082 0.063 0.063 0.069	0.070 0.200 0.200	0.130 0.100	0.200 0.085 0.088 0.096 0.072 0.062 0.074	0.065	0.150	0.150		0.200 0.104

* Data of Whitehorse Branch included

APPENDIX II

TABLE 3 LIST OF CONTAMINATED LEAD-FREE GASOLINE (1982-1986)

YEAR	LEAD CONCENTRATIONS (g/l) IN THE IDENTIFIED CONTAMINATIONS								
	C	B	D	A	E	H	F	G	OTHERS
1982	-	-	-	-	-	-	-	-	-
1983	0.0172	0.0172	0	0.066 0.0273 0.048	0.026	0	0	0	0
1984	0	0.044 0.030 0.016	0.030 0.017	0	0	0.017	0.037	0.037	0.040 0.021
1985	0.018 0.030	0.040 0.028	0.015 0.014 0.031	0.028 0.021	0	0.042	0.023	0.018 0.030	0.014 0.015
1986	0	0	0.077 0.020	0	0.016	0	0.110 0.023	0	0
1987	0	0	0	0.021	0	0	0	0	0.014
1988	0	0.025	0	0	0.019 0.018	0	0	0	0