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LEAD-FREE GASOLINE REGULATIONS  
MONITORING PROGRAM

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ABSTRACT

This report describes the lead-free gasoline monitoring program conducted in British Columbia during 1986. Samples of lead-free gasoline were purchased and analyzed to check the lead content of lead-free gasoline and verify compliance with the Lead-Free Gasoline Regulations published pursuant to the Clean Air Act.

Also two surveys were 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.

## RÉSUMÉ

Ce rapport décrit le programme de surveillance de l'essence sans plomb mené en Colombie Britannique en 1986. Les échantillons d'essence sans plomb ont été achetés et analysés pour contrôler le contenu en plomb de l'essence sans plomb et en vérifier la conformité avec les règlements sur l'essence sans plomb publiés selon la loi sur la qualité de l'air.

Deux 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 sans plomb tandis que l'autre examinait les pratiques des automobilistes remplissant leurs véhicules conçus pour de l'essence sans plomb avec une essence non désignée.

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SUMMARY

The Pacific and Yukon Regional office of Environmental Protection, Environment Canada monitors the lead level in lead-free gasoline sold in British Columbia to ensure compliance with the federal Lead-Free Gasoline Regulations under the Clean Air Act. The data show a continuing trend towards improved compliance with respect to the rates of lead-free gasoline contamination, nozzle switching on dispensing pumps and vehicle misfueling.

In the 1986 compliance monitoring program, 358 samples of lead-free gasoline were purchased from 205 gasoline retail outlets. Five (5) samples contained lead in excess of the allowable lead content of 0.013 grams per litre and hence the non-compliance rate was 1.4%.

Nozzles of leaded gasoline pumps were also checked, and 49 out of 781 nozzles were undersized. The nozzle switching rate was therefore 6.3%.

In a survey of misfueling practices at 7 Vancouver area retail outlets, a total of 544 vehicle refuelings were observed and 296 of these were cars designed to burn lead-free gasoline. Fifteen (15) motorists out of the 296 lead-free burning cars refueled with leaded gasoline. Consequently 5.1% of the lead-free burning cars were misfueled. This rate is considerably below the 13% reported in the 1984 study of misfueling practices in Vancouver by Optima Applied Social Research Inc.

A summary of the survey results from the lead content and nozzle switching surveys is presented in the following table.

YEAR	TOTAL GASOLINE SAMPLES	CONTAMINATIONS	RATE OF CONTAMINATIONS	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 %

1 INTRODUCTION

Motor vehicle emissions are the main source of atmospheric emissions of hydrocarbons, carbon monoxide and nitrogen oxides. Environment Canada's Nationwide Inventory of Air Contaminants shows that the emissions of carbon monoxide (CO) from automobiles in British Columbia is responsible for 45% of all CO emissions in the province, 30% of all hydrocarbons (HC) and 29% of all nitrogen oxides (NOx).

TABLE 1 HYDROCARBONS, CARBON MONOXIDE AND NITROGEN OXIDE EMISSIONS FROM AUTOMOBILES IN BRITISH COLUMBIA

	CO EMISSION IN THOUSAND TONNES (percent of total emissions)	HC EMISSION IN THOUSAND TONNES (percent of total emissions)	NOx EMISSION IN THOUSAND TONNES (percent of total emissions)
1970	1318 (64%)	202 (60%)	64 (57%)
1972	1177 (66%)	160 (58%)	89 (46%)
1974	1140 (63%)	145 (56%)	90 (40%)
1976	936 (57%)	112 (46%)	67 (34%)
1978	774 (51%)	87 (30%)	62 (36%)
1980	840 (45%)	77 (30%)	58 (29%)

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.

Catalytic converters cannot tolerate contaminants such as lead in gasoline. When burned in the combustion chamber of a car, 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. 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. This year, an additional survey was conducted to investigate the misfueling practices of motorists. This report presents the 1986 results from all these surveys.

## 2 LEAD-FREE GASOLINE MONITORING

The lead-free gasoline survey is based on a random check of retail outlets in several geographical areas in B.C., typically the Vancouver area, Okanagan area, and the Victoria 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 test result.

## 3 NOZZLE SWITCHING SURVEY

The nozzle 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).

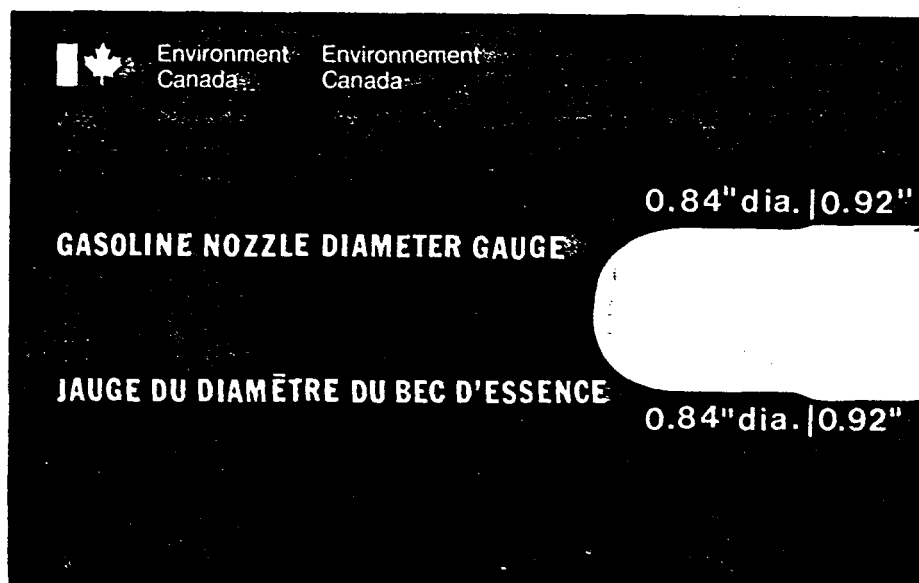


FIGURE 1 PLASTIC TEMPLATE FOR NOZZLE SIZE MEASUREMENT

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 <u>forcing</u> the nozzle into the receptor neck.

#### 4 MISFUELING SURVEY

A separate survey was conducted in Vancouver to assess the practice of misfueling cars. In this survey, a technician observed vehicle refueling and interviewed motorists at 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 gas. A copy of the survey data sheet is included in Appendix I.

## 5 RESULTS

### 5.1 Monitoring

A total of 358 lead-free gasoline samples from 17 brands were purchased from retail outlets in 36 municipalities in the Lower Mainland, Fraser Valley, Okanagan area and Vancouver Island. A total of 5 samples exceeded the allowable lead content of 0.013 grams per litre. All non-compliance occurred in the Okanagan area and were related to 3 brands. This yields non-compliance rates of 1.4% as the provincial average; 0% in Vancouver and Victoria; and 5.3% in the Okanagan area. Further details on the results are tabulated in Tables 3 and 4.

### 5.2 Nozzle Survey

A total of 781 nozzles on leaded gas pumps were measured and 49 were undersized. This yields a nozzle switching rate of 6.3% as a B.C. average; 2.3% in Vancouver; 14.3% in the Okanagan area; and 12.3% in Victoria. 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. On Vancouver Island the rate increased to 12.3% this year. The results of the survey are shown in Tables 5, 6, 7 and 8.

### 5.3 Misfueling Survey

The survey was conducted at 7 gas stations of different brands in the Vancouver 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.

A total of 544 vehicle refuelings were observed, of which 281 (52%) cars were refueled with unleaded gasoline and 263 (48%) cars with leaded grade. A total of 200 motorists using leaded gasoline were interviewed, and 15 of them were driving cars designed for unleaded gasoline. All 15 cars showed evidence of tampering with the fuel inlet restrictors, either by

widening the restrictor or by removing it completely. Among these 15 misfuelers, 14 stated that the catalytic converters on their vehicles had been removed; the remaining misfueler did not know if the catalytic converter was present or not. Eighty percent (12 out of 15) of the misfuelers admitted that they always refuel with leaded gasoline and the primary reason was its cheaper price.

During the survey, 5 motorists refused to be interviewed giving the reason that they did not have time. The interviewer was unable to interview 58 leaded gasoline users since the cars were refueling while he was conducting an interview with another motorist. Taking the "missed" cars into account, the survey actually identified 15 misfuelers from a total of 296 cars designed for lead-free gas, yielding a misfueling rate of 5.1%.

Two of the stations each had an undersized nozzle at one of their leaded gas dispensing pumps. A total of 96 motorists refueled with leaded gasoline from these 2 stations, and 28 used these two undersized nozzles. None of these 28 motorists used the small nozzles to misfuel their unleaded cars fitted with fuel inlet restrictors.

Among the 263 users of leaded gasoline, none used an adaptor to refuel leaded gasoline to an unleaded car.

The survey also found that among the 15 misfuelers, 4 resided in Burnaby, 3 in North Vancouver, 3 in Tsawwassen, 2 in Vancouver, 1 in Richmond and 2 resided outside the Lower Mainland.

The misfueling rate with respect to the brand name and location of gas station are summarized below:

<u>Brand</u>	<u>Location</u>	<u>Misfueling Rate</u>
J	Burnaby	13.2%
I	North Vancouver	8.3%
A	Tsawwassen	5.0%
B	Vancouver	2.8%
C	Vancouver	2.3%
E	Vancouver	0%
F	Vancouver	0%

Among the 200 leaded gasoline users who were interviewed, the car size distribution was as follows:

<u>Class</u>	<u>No. of Vehicles</u>	<u>Percent</u>
4 Cylinders	80	40%
6 Cylinders	24	12%
8 Cylinders	62	31%
8 Cylinders (van or truck)	31	15.5%
Other (3, 5, 12 Cylinders)	3	1.5%

Among the 200 leaded gasoline users who were interviewed, the car age distribution was:

<u>Model Year</u>	<u>No. of Vehicles</u>	<u>Percent</u>
1962-1974	80	40%
1975-1980	92	46%
1981-1985	25	12.5%
1986	3	1.5%

The survey results are summarized in Table 9.

## 6 DISCUSSION

The rate of lead-free gasoline contamination improved this year with a 1.4% non-compliance rate as compared to 2.6% in 1985. In Vancouver and Victoria no contaminations were found among the 264 spot samples. This reflects a positive and notable improvement in the gasoline marketing system and reflects improved quality control efforts by the petroleum industry. Since the summer of 1986 was the period for Expo with a substantial influx of USA motorists, the catalytic converters on the foreign vehicles had little chance of being damaged from excess lead in lead-free gasoline. The results also show that lead contamination can be prevented entirely in the marketing system if a good quality control program is in place.

The nozzle switching practice as a provincial average, has also improved to 6.3% in 1986 from 9% in 1985. In Vancouver the rate was 2.3% as compared to 4.3% in 1985.

The vehicle misfueling survey showed none of the 296 motorists searched for an undersized nozzle to dispense leaded gas into their lead-free cars. Other than the determined vehicle misfuelers who removed the fuel inlet restrictor on their cars, there were no incidences of misfueling attributed to undersize nozzles. The public awareness efforts of the federal and provincial governments and industry appear to have had a positive effect on the public. No doubt the removal of undersized nozzles on leaded gas pumps, has also played a significant part in discouraging motorists from misfueling since vehicle owners have to resort to deliberate tampering of the fuel inlet restrictor in order to conveniently and consistently misfuel their vehicles.

Among the 200 motorists who refueled their cars with leaded gasoline and were interviewed in our survey, 15 had tampered with the fuel inlet restrictors on their cars such that misfueling can be performed easily. In addition, 14 of these 15 cars were operating with the catalytic converters removed. These results indicate that 7.5% of leaded gasoline users are regular misfuelers and have either removed the catalytic converters or rendered the catalytic converters on their cars inoperative. These cars will continue to operate with excessively high exhaust emissions.

**TABLE 3 LEAD-FREE GASOLINE MONITORING - AREAS SAMPLED**

AREA SAMPLED	DATE(S) SAMPLED	# OF STATIONS	# OF SAMPLES	NON-COMPLIANCES	
				#	%
<b>A. Lower Mainland</b>					
Vancouver	May 15, 20	28	54	0	0
West Vancouver	May 22	10	19	0	0
Burnaby	May 20, 26	25	43	0	0
Richmond	May 28	21	40	0	0
North Vancouver	June 16	25	46	0	0
White Rock	June 19	5	8	0	0
Surrey	"	13	21	0	0
		<u>127</u>	<u>231</u>	<u>0</u>	<u>0</u>
<b>B. Okanagan</b>					
Sardis	July 28	1	2	0	-
Princeton	"	2	4	0	-
Keremeos	"	3	4	0	-
Osoyoos	"	5	8	2	25.0
Oliver	"	3	4	1	25.0
Okanagan Falls	"	2	2	0	-
Kaleden	"	1	2	0	-
Penticton	July 29	6	9	0	-
Summerland	"	2	2	0	-
Peachland	"	1	2	0	-
Westbank	"	1	1	0	-
Kelowna	"	5	10	0	-
Winfield	"	2	2	0	-
Oyama	"	1	1	1	100.0
Vernon	"	6	11	1	9.1
Armstrong	"	3	4	0	-
Enderby	"	1	1	0	-
Salmon Arm	"	3	5	0	-
Tappen	"	1	1	0	-
Sorrento	"	1	1	0	-
Chase	"	1	2	0	-
Kamloops	July 30	6	12	0	-
Merritt	"	2	4	0	-
		<u>59</u>	<u>94</u>	<u>5</u>	<u>5.3</u>
<b>C. Vancouver Island</b>					
Sidney	August 1	1	2	0	0
Victoria	"	8	15	0	0
Mill Bay	"	1	2	0	0
Duncan	"	2	4	0	0
Ladysmith	"	1	1	0	0
Nanaimo	"	6	9	0	0
		<u>19</u>	<u>33</u>	<u>0</u>	<u>0</u>
<b>GRAND TOTAL</b>		<b>205</b>	<b>358</b>	<b>5</b>	<b>1.4</b>



**TABLE 4 LEAD-FREE GASOLINE MONITORING - NON-COMPLIANCES**

SAMPLE #	QUICK TEST (g/l)	AA TEST (g/l)	BRAND	TYPE	LOCATION	SAMPLING DATE
OK-011	> 0.0250	0.1100	F	R	Osoyoos	86/07/28
OK-018	> 0.0250	0.0771	D	R	Osoyoos	86/07/28
OK-021	0.0250	0.0229	F	R	Oliver	86/07/28
OK-053	0.0153	0.0160	E	R	Oyama	86/07/29
OK-055	0.0208	0.0197	D	R	Vernon	86/07/29

**TABLE 5 NOZZLE SURVEY - BRITISH COLUMBIA**

BRAND	NUMBER OF LEADED NOZZLES				NUMBER OF INCORRECT NOZZLES				PER-CENTAGE
	L.M.	OKG.	V.I.	TOTAL	L.M.	OKG.	V.I.	TOTAL	
A	126	43	8	177	0	4	0	4	2.3
C	94	30	10	134	2	7	1	10	5.2
B	63	22	7	92	1	2	0	3	3.3
E	70	21	12	103	0	0	0	0	-
F	36	12	10	58	0	3	0	3	5.2
D	34	14	2	50	0	1	0	1	2.0
G	17	11	0	28	0	2	0	2	7.1
I	18	6	0	24	1	0	0	1	4.2
H	10	11	2	23	0	3	1	4	17.1
J	9	11	0	20	6	5	0	11	55.0
M	8	8	0	16	0	1	0	1	6.3
S	8	0	0	8	0	0	0	0	-
N	5	3	0	8	2	0	0	2	25.0
K	8	4	0	12	0	0	0	0	-
O	6	0	0	6	0	0	0	0	-
L	0	0	18	18	0	0	7	7	38.9
W	0	0	4	4	0	0	0	0	-
	512	196	73	781	12	28	9	49	6.3

**TABLE 6 NOZZLE SURVEY - LOWER MAINLAND**

Total Number of Stations Surveyed : 127  
 Total Number of Leaded Nozzles Measured : 512  
 Total Number of Undersized Nozzles : 12 or 2.3%

BRAND	NO. OF STATIONS	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENTAGE
A	26	126	0	-
C	22	94	2	2.1
B	18	63	1	1.6
E	16	70	0	-
F	12	36	0	-
D	8	34	0	-
G	5	17	0	-
I	5	18	1	5.6
H	3	10	0	-
J	3	9	6	66.7
M	2	8	0	-
S	2	8	0	-
N	2	5	2	40.0
K	2	8	0	-
O	1	6	0	-
AREA				
Vancouver	28	133	0	-
Burnaby	25	106	2	1.9
North Vancouver	25	100	2	2.0
Richmond	21	82	0	-
Surrey	13	47	5	10.6
West Vancouver	10	32	0	-
White Rock	5	12	3	25.0
TOTAL	127	512	12	2.3

**TABLE 7**      **NOZZLE SURVEY - OKANAGAN**

Total Number of Stations Surveyed           : 59  
 Total Number of Leaded Nozzles Measured   : 196  
 Total Number of Undersized Nozzles        : 28 or 14.3%

BRAND	NO. OF STATIONS	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENTAGE
A	8	43	4	9.3
C	10	30	7	23.3
B	8	22	2	9.1
E	6	21	0	-
F	6	12	3	25.0
D	5	14	1	7.1
G	3	11	2	18.2
I	2	6	0	-
H	3	11	3	27.3
J	4	11	5	45.5
M	2	8	1	12.5
N	1	3	0	-
K	1	4	0	-
	59	196	28	14.3
AREA				
Kelowna	5	24	2	8.3
Kamloops	6	23	1	4.3
Penticton	6	21	1	4.8
Vernon	6	19	3	15.8
Salmon Arm	3	13	0	-
Osoyoos	5	11	5	45.5
Princeton	2	14	1	7.1
Armstrong	3	9	4	44.4
Merritt	2	8	0	-
Keremeos	3	6	2	33.3
Summerland	2	6	0	-
Oliver	3	5	2	40.0
Winfield	2	6	1	16.7
Okanagan Falls	2	6	2	33.3
Sardis	1	4	0	-
Kaleden	1	3	1	33.3
Peachland	1	2	0	-
Westbank	1	3	1	33.3
Enderby	1	3	1	33.3
Tappen	1	2	1	50.0
Oyama	1	2	0	-
Sorrento	1	2	0	-
Chase	1	4	0	-
TOTAL	59	196	28	14.3

TABLE 8 NOZZLE SURVEY - VANCOUVER ISLAND

Total Number of Stations Surveyed : 15  
 Total Number of Leaded Nozzles Measured : 73  
 Total Number of Undersized Nozzles : 9

BRAND	NO. OF STATIONS	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENTAGE
L	3	18	7	38.5
E	3	12	0	-
C	3	10	1	10.0
F	3	10	0	-
A	2	8	0	-
B	2	7	0	-
D	1	2	0	-
H	1	2	1	50.0
W	1	4	0	-
	19	73	9	12.3
AREA				
Victoria	8	34	5	14.7
Nanaimo	6	21	2	9.5
Duncan	2	12	2	16.7
Sidney	1	2	0	-
Ladysmith	1	2	0	-
Mill Bay	1	2	0	-
	19	73	9	12.3

TABLE 9 DATA FOR MISFUELED CARS

ID	YEAR	MAKE	MODEL	NO. OF CYLINDERS	RESIDENCE AREA (Refuel Location)	FREQUENCY OF MISFUEL	LEAD-FREE LABEL	TAMPED RESTRICTOR	CC REMOVED	TUNE	GAS MILEAGE	REASON GIVEN FOR MISFUELING
15	77	GMC	Sierra G.	8	N. Van. (N. Van.)	sometimes	N	Y	Y	2 x/yr	20	old engine
18	77	Merc.	Marquis	8	Quadra Is. (N. Van.)	always	N	Y	Y	1/4 mo.	8	cheaper
26	77	Chev.	Corvette	8	N. Van. (N. Van.)	always	N	Y	Y	1/yr.	15	cheaper
54	85	Dodg.	Ram	8	N. Van. (N. Van.)	always	N	Y	Y	?	13	cheaper
73	77	Ford	F100	8	Bby. (Bby.)	always	N	Y	Y	1/yr.	12	cheaper
87	76	Ford	Elite	8	Bby. (Bby.)	regularly	N	Y	Y	1/yr.	15	cheaper
92	75	Ford	Mustang	6	Bby. (Bby.)	always	Y	Y	Y	2 x/yr.	20-28	cheaper
93	79	Chev.	Camaro	8	Vcr. (Bby.)	always	N	Y	Y	1/8-10 mo.	18-25	car modified
95	80	Dodg.	Custom	6	Bby. (Bby.)	always	Y	Y	Y	1/yr.	?	cheaper
97	75	Chev.	Malibu	8	Vcr. (Vcr.)	always	Y	Y	Y	1-2 x/yr.	9	what car takes
102	79	Ford	Mustang	4	Rmd. (Vcr.)	always	N	Y	Y	1/yr.	19-20	cheaper
157	77	Pont.	Firebird	8	Socke (Vcr.)	always	Y	Y	Y	when req'd.	21-22	cheaper
176	77	Linc.	Mark V	8	Tsaw. (Tsaw.)	often	N	Y	Y	2 x/yr.	15	cheaper
188	76	Chev.	Chevelle	8	(Tsaw.) (Tsaw.)	always	Y	Y	Y	1/yr.	?	cheaper
195	80	Chev.	Impala	8	(Tsaw.) (Tsaw.)	always	Y	?	?	reg.	?	told by car owner

APPENDIX I

DATA RECORDING FORMAT  
FOR THE MISFUELLING 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 of fuel use and car maintenance of your car. This is a survey program by the Federal Department of Environment. The collected information will be used to assess 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 GASOLINE USAGE:  
Always \_\_\_\_\_ Often \_\_\_\_\_ Regularly \_\_\_\_\_  
Sometimes \_\_\_\_\_ Rarely \_\_\_\_\_
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 gasoline in your vehicle rather than unleaded?" \_\_\_\_\_  
\_\_\_\_\_



APPENDIX II

HISTORICAL DATA ON  
LEAD-FREE GASOLINE CONTAMINATION

APPENDIX II

TABLE 1 NUMBER OF CONTAMINATED SAMPLES (1974-1986)

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
TOTAL	13	18	19	27	15	3	9	6	13	3970/123

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