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FINAL REPORT

**STUDY OF HALOCARBON CONCENTRATIONS
IN INDOOR ENVIRONMENTS**

for

**U. S. Environmental Protection Agency
Office of Research and Development
Washington, DC 20460**

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**WASHINGTON STATE UNIVERSITY
COLLEGE OF ENGINEERING
RESEARCH DIVISION**

STUDY OF HALOCARBON CONCENTRATIONS
IN INDOOR ENVIRONMENTS

FINAL REPORT

by

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ABSTRACT

This report presents data on concentrations of halocarbons in air samples collected in indoor environments and in the air that people breathe in their everyday lives. Data indicating that the automobile is a possible source of elevated levels of chloroform and methyl bromide in urban air are also reported. The procedure for sample collection and analysis is briefly described, and a listing of sampling locations and conditions is given.

SCOPE OF STUDY

During the fall of 1976, the Air Pollution Research section of the Department of Chemical Engineering at Washington State University collected 82 air samples from urban environments, representing the air that people breathe in their everyday lives. The samples were analyzed for all of the following halocarbons: CCl_2F_2 (dichlorodifluoromethane, F_{12}), $\text{CClF}_2\text{CClF}_2$ (dichlorotetrafluoroethane, F_{114}), CHCl_2F (dichlorofluoromethane, F_{21}), CCl_3F (fluorotrichloromethane, F_{11}), $\text{CClF}_2\text{CCl}_2\text{F}$ (trichlorotrifluoroethane, F_{113}), CHCl_3 (chloroform), CH_3CCl_3 (methyl chloroform), CCl_4 (carbon tetrachloride), $\text{CHCl}=\text{CCl}_2$ (trichloroethylene), and $\text{CCl}_2=\text{CCl}_2$ (tetrachloroethylene). Representative samples were also analyzed for CH_3Cl (methyl chloride) and CH_2Cl_2 (dichloromethane). Additionally, certain of the outdoor samples containing automobile exhaust were found to contain a peak which was identified as CH_3Br (methyl bromide). Reported below in Table 1 are all of the halocarbon data with the exception of the methyl bromide concentration data, which is summarized in Table 2. Table 3 presents a summary of chloroform concentration data in samples of automobile exhaust and of urban air containing automobile exhaust. Appendix A below gives detailed descriptions of these sampling locations and conditions.

Perhaps the most interesting data resulting from this study were the elevated concentrations of chloroform and methyl bromide found in urban air

samples containing traces of automobile exhaust. The rural location (Pullman, Washington) and well-established background concentration data for the two species precluded a marine source of these elevated concentrations. The apparent source of the greater-than-ambient levels of chloroform and of methyl bromide was exhaust from the automobile. Subsequent collection and analysis of automobile exhaust samples showed that gasoline engines not equipped with catalytic converters contained part-per-billion levels of these species, which could result in parts-per-trillion levels in urban air samples containing diluted exhaust. Two papers discussing these results have been submitted for publication (1,2), and Dr. Alan Carlin of EPA's Office of Research and Development in Washington, DC, has received copies of both papers.

EXPERIMENTAL METHODS

A detailed description of sampling locations and conditions is given in Appendix A below. Samples were collected by using a portable, 12-volt pump (Metal Bellows Model MB-41) to flush and fill one liter stainless steel sampling canisters incorporating a flow-through design. Halocarbons and methyl bromide analyses were accomplished by isothermal GC/ECD, utilizing a method very similar to that described in another EPA report (3). CH_3Cl and CH_2Cl_2 were analyzed by GC/MS in a manner described elsewhere (4). Quantification was accomplished by comparison with an artificially-prepared halocarbon standard gas mixture and by static dilution of commercially-prepared parts-per-million level gas mixtures.

REFERENCES

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3. Cronn, D. R., R. A. Rasmussen and E. Robinson, Report for Phase I of EPA Grant No. R0804033-01. National Environmental Research Center, Research Triangle Park, NC.
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TABLE 1

INDOOR HALOCARBON CONCENTRATIONS

All values parts per trillion (ppt)

ND - Not Detected, NA - Not Analyzed, AP - Analytical Problem, tr - Trace

Sample Source	Peak # Compound											
	1 F ₁₂	2 F ₁₁₄	3 CH ₃ Cl	4 F ₂₁	5 F ₁₁	6 F ₁₁₃	7 CH ₂ Cl ₂	8 CHCl ₃	9 CH ₃ CCl ₃	10 CCl ₄	11 C ₂ HCl ₃	12 C ₂ Cl ₄
<u>Dentist Office</u>												
Waiting Room	4,600	322	NA	5,800	1,220	38	NA	101	930	143	250	530
Dentist Chair	3,495	322	NA	tr	1,100	43	NA	98	885	140	215	500
Lobby of Building	3,790	215	550	tr	900	18	145	95	780	142	685	445
<u>Dry Cleaners</u>												
Work Area	305	ND	580	ND	151	28	300	110	245	143	116	1.0 x 10 ⁶
Counter	342	ND	NA	ND	154	44	NA	128	200	133	405	2.3 x 10 ⁵
Solvent Storage Area	271	ND	NA	ND	151	44	NA	195	250	152	390	6.4 x 10 ⁵
<u>Fabric Store</u>												
Polyester Knits	793	tr	NA	638	523	71	NA	59	2,340	178	146	5,000
"Blends"	757	tr	1,100	ND	523	73	3,760	52	2,300	184	161	6,505
Wools	740	ND	1,000	ND	534	66	NA	56	2,220	178	175	6,350
<u>Dana Hall</u>												
Room 202 PM	9,320	1,610	765	110	AP	200	480	790	710	600	935	AP
" " AM	3,740	148	1,335	27	185	100	400	134	744	544	850	AP
" " PM	1,964	ND	540		220	134	300	52	491	162	79	80
<u>Dept. Store</u>												
Shoes	823	ND	NA	ND	302	97	NA	89	234	132	55	40
Mens' Clothes	589	ND	NA	ND	266	47	NA	58	194	132	31	ND
Ladies' Clothes	725	ND	800	ND	350	44	2,350	58	1,943	132	82	ND
<u>Hardware Store</u>												
Paint Section	17,730	ND	1,520	182	AP	3,820	26,000	231	9,375	183	8,320	AP
Waxes, Cleaners	18,340	ND	NA	ND	20,820	3,550	NA	216	4,810	186	8,670	AP
Check Out	18,300	ND	NA	ND	21,090	3,800	NA	208	4,755	180	8,260	5,070

TABLE 1 Cont.

Sample Source	Peak # Compound											
	1 F ₁₂	2 F ₁₁₄	3 CH ₃ Cl	4 F ₂₁	5 F ₁₁	6 F ₁₁₃	7 CH ₂ Cl ₂	8 CHCl ₃	9 CH ₃ CCl ₃	10 CCl ₄	11 C ₂ HCl ₃	12 C ₂ Cl ₄
<u>Urban Street Corner</u>												
AM Early	1,360	ND	NA	ND	818	10	NA	8	260	131	32	137
Light Traffic	366	ND	1,000	ND	257	17	NA	20	242	149	85	ND
Rush Hour	654	ND	750	ND	1,155	20	670	14	121	147	906	ND
<u>Radio & TV Repair</u>												
Repair Area	10,730	245	4,000	ND	190,160	6,920	300	37	1,320	184	245	134
Counter	10,620	ND	NA	ND	186,600	5,000	NA	44	1,370	201	277	624
Display Floor	10,350	ND	NA	ND	183,040	5,000	NA	41	1,625	209	102	AP
<u>Automobile Dealership</u>												
Shop	1,960	ND	NA	ND	174	810	NA	15	1,635	133	22	100
Display Floor	5,650	ND	3,000	273	303	97	7,160	33	4,400	150	190	670
<u>Food Store</u>												
Produce Area	790,000	ND	1,200	ND	30,760	325	6,100	647	2,010	231	1,505	947
Cleaners	53,570	ND	NA	ND	30,140	272	NA	733	2,460	255	1,530	1,065
Frozen Food	52,390	ND	NA	1,090	30,020	283	NA	641	2,100	231	1,555	ND
<u>Laundromat</u>												
Washers	348	ND	570	547	162	89	50	67	790	150	100	111,400
Dryers	338	ND	1,000	90	179	47	NA	49	806	146	44	33,770
Dry Cleaners	633	ND	NA	ND	AP	AP	NA	49	714	140	67	121,200
<u>Apartment</u>												
Cleaning Bathroom	1,290	286	700	ND	1,410	52	800	134	1,325	178	1,770	tr
PM	738	215	525	ND	1,365	35	200	49	1,070	163	1,200	322
AM	831	90	NA	ND	920	44	NA	43	1,050	161	1,620	342
After shower, etc.	441,000	AP	NA	ND	162,100	AP	NA	61	1,260	280	2,190	390
Party	713	54	2,500	180	476	31	390	46	229	282	56	212
After smoking a Cigarette	3,210	430	20,000	ND	3,870	106	420	55	1,125	146	2,155	920
<u>Drive-In Restaurant</u>												
Dining Area, Inside	3,140	ND	NA	638	657	21	NA	300	198	172	255	7,000
Food Prep. Area	3,160	ND	NA	ND	623	26	NA	297	202	172	249	12,190
Order Window, Inside	3,190	ND	1,790	ND	597	AP	5,740	271	192	182	207	12,540

TABLE 1 Cont.

Sample Source	Peak # Compound											
	1 F ₁₂	2 F ₁₁₄	3 CH ₃ Cl	4 F ₂₁	5 F ₁₁	6 F ₁₁₃	7 CH ₂ Cl ₂	8 CHCl ₃	9 CH ₃ CCl ₃	10 CCl ₄	11 C ₂ HCl ₃	12 C ₂ Cl ₄
<u>Cocktail Lounge</u>												
Bar	11,270	ND	900	ND	8,000	283	8,000	213	225	177	36	46
Tables	10,990	ND	1,000	ND	8,060	319	NA	248	255	165	30	44
<u>Beauty Parlor</u>												
Waiting Area	278,000	7,670	1,320	ND	126,000	7,340	23,400	110	775	246	232	ND
Dryers	293,000	3,070	NA	ND	128,400	8,810	NA	115	985	273	244	ND
<u>Hair Styling</u>												
Waiting Area	25,250	ND	NA	ND	22,300	57	NA	283	185	149	151	2,675
Chairs	27,560	ND	NA	ND	23,560	92	NA	496	259	159	163	2,900
<u>Floor Covering Store</u>												
Carpet Storage	1,545	123	1,000	410	298	34	NA	17	2,400	305	151	125
Solvent Shelves	5,130	ND	1,100	ND	422	73	4,210	22	7,450	455	308	515
Tile Area	1,800	ND	2,000	ND	292	55	NA	23	3,410	357	424	305
<u>Automobile</u>												
New '76 Ford, Quiet	8,830	ND	2,000	364	263	154	NA	41	6,735	229	875	tr
1972 Rambler, Quiet	366	ND	NA	ND	817	26	NA	29	135	155	24	1,990
1972 Rambler with Heater on, Driving	431	ND	3,000	ND	1,230	29	NA	35	148	147	30	1,570
1975 Pinto, Quiet	446	ND	650	ND	746	ND	180	32	134	147	30	53
1973 Dodge, Quiet	434	ND	8,000	ND	160	29	64	20	198	144	56	205
1973 Dodge with Air Conditioner, Running	2,550	13	NA	ND	161	36	NA	23	257	144	33	279
1975 Pinto Exhaust	220	ND	700	ND	183	460	140	33	27	19	33	452
1972 Rambler Exhaust	1,760	ND	1,000	ND	78	185	91	5,600	2,150	131	3,480	470
<u>Drug & Variety Store</u>												
Cards & Candles Area	19,800	9,330	NA	ND	16,770	1,720	NA	337	3,970	175	3,970	5,125
Photo & Drug Area	22,700	9,820	NA	ND	19,150	1,890	NA	473	4,030	172	4,130	5,570
Cosmetics Area	21,400	11,290	1,100	ND	17,480	1,094	2,900	265	3,810	165	3,740	5,900

TABLE 1 Cont.

Sample Source	Peak # Compound											
	1 F ₁₂	2 F ₁₁₄	3 CH ₃ Cl	4 F ₂₁	5 F ₁₁	6 F ₁₁₃	7 CH ₂ Cl ₂	8 CHCl ₃	9 CH ₃ CCl ₃	10 CCl ₄	11 C ₂ HCl ₃	12 C ₂ Cl ₄
<u>Discount Store</u>												
Records & Automotive	1,100	ND	4,000	700	850	308	14,000	25	1,400	386	14,800	343
Plastic Wares	483	ND	1,500	130	324	34	NA	19	496	238	4,530	37
Shoes, Furniture	443	ND	1,500	ND	304	43	NA	22	438	256	4,030	146
<u>Restaurant</u>												
Tables, Booth	413	tr	1,450	ND	469	14	380	14	171	143	32	60
Counter	367	ND	NA	250	339	33	NA	36	171	143	27	58
Kitchen	733	ND	NA	700	1,190	55	NA	150	1,070	144	255	28
<u>Movie Theater</u>												
Lobby Before Show	2,430	ND	900	ND	693	42	850	37	349	155	555	1,810
Theater Before Show	2,530	110	700	ND	787	33	890	29	294	156	605	2,740
Lobby After Show	1,180	270	1,130	ND	379	ND	525	81	222	156	155	640
Theater After Show	1,240	320	2,500	180	159	20	525	78	222	191	255	720
<u>Body Shop</u>												
Paint Storage	1,770	ND	525	ND	1,100	40	570	27	452	154	37	91
Painting Room	1,955	ND	NA	ND	1,610	32	NA	16	192	162	48	107
<u>Offices, Classroom</u>												
Xerox Room, Dana 148	542	ND	760	1,000	291	36	170	104	11,100	236	2,410	9,080
Typing Room, Dana 152	372	7	905	180	236	43	160	35	914	211	1,315	632
Classroom, Dana 215	3,020	ND	650	ND	462	AP	185	190	684	326	1,640	125
<u>Air Terminal</u>												
Baggage/Ticket Area	1,100	236	1,240	180	1,175	33	190	29	396	152	64	670
Restaurant/Waiting	2,450	344	1,405	360	2,980	45	730	55	745	153	106	640
Concourse	1,620	172	1,400	tr	1,600	45	135	78	1,690	152	75	755
<u>Boeing 727</u>												
First Class	518	40	750	ND	882	320	340	47	280	210	680	AP
Coach, Front	475	54	1,260	ND	1,010	180	160	24	555	125	170	8,350
Coach, Rear	905	54	1,000	ND	2,250	240	110	38	580	122	47	9,440

TABLE 2

Concentrations of Methyl Bromide in Urban Air,
Auto Exhaust, Marine Air, and Rural Air Samples

Date	Sample Description	CH ₃ Br, ppt
9/13/76	Street corner, moderate traffic, 10 mph wind	< 10
9/13/76	Same, heavy traffic	< 10
10/1/76	Auto exhaust, leaded fuel, 1972 Rambler	55,000
10/1/76	Auto exhaust, nonleaded fuel, 1975 Ford Pinto	< 1,000
11/6/76	Street corner, light traffic, calm, early morning with heavy inversion	220
11/6/76	Same, heavy traffic, slight breeze	150
11/16/76	Street corner, light traffic, 5 mph wind	< 10
11/16/76	Same, heavy traffic	185
11/16/76	Auto exhaust, leaded fuel, 1972 Rambler	18,000
11/16/76	Auto exhaust, nonleaded, 1975 Ford Pinto	1,300
March 1976	Marine air, Alpha-Helix cruise off Ecuador coast	up to 10*
Mar-June 1976	Marine air, Lear Jet flights over Pacific Ocean	up to 10*
1976	Rural air (Klemgard), eastern Washington State	0.5 - 1.0

*Variable due to probable sample degradation

TABLE J
Concentrations of Chloroform in Urban Air,
Auto Exhaust, and Rural Air Samples

Date	Sample Description	CHCl ₃ ,ppt
9/13/76	Urban air, light traffic	20
9/13/76	Urban air, heavy traffic, moderate breeze	14
9/17/76	Urban air, early morning	8
9/29/76	1972 Rambler exhaust	5,600
9/29/76	1975 Pinto exhaust	66
11/9/76	Urban air, moderate traffic	19
11/9/76	Urban air, heavy traffic	26
11/16/76	1972 Rambler exhaust	6,800
11/16/76	1975 Pinto exhaust	91
11/16/76	Urban air, heavy traffic, no breeze	88
1976	Rural air eastern Washington State	9

NOTE: The 1975 Pinto was equipped with a catalytic converter; the 1972 Rambler was not.

APPENDIX A

DESCRIPTIONS AND LOCATIONS OF INDOOR ENVIRONMENT SAMPLES

Unless otherwise noted, all samples were taken in Pullman, Washington. Sampling dates are given and weather conditions are noted when they may have affected the samples. Fall weather in Pullman is generally fair with light winds, daytime highs of 70-80°F., and lows of 30-40°F. In most instances, three samples were taken at each location. Samples were generally taken at a height of 4-5 feet from the floor. Floors described as "tiled" with no other explanation were covered with standard, square asphalt-type floor tiles.

The order of the locations given below is the same as that in Table 1. The sampling locations are, in some cases, quite vague to preserve the anonymity of the business establishment. Each business establishment was sent a form letter describing the sampling program and thanking them for their cooperation. The letter included concentration data for the samples which had been collected in their particular establishment.

In general, CH_3Cl and CH_2Cl_2 were not analyzed in these initial three samples because the GC/MS was not available. A special sample was taken in most business places on 9/23-25/76, at one of the three original sample locations, for these analyses.

Dentist Office

Sampled on 9/2/76. The office is located in a two-story professional building which is about 10 years old. Tarring of the roof of the building was in progress, but there was no noticeable odor inside. The building's air conditioner was on. The waiting room had a shag carpet, and the dentist's chair area had a linoleum floor and a strong, characteristic "dentist" smell. The lobby of the building was also shag-carpeted and a slight tar odor was noticed.

Dry Cleaners

Sampled on 9/2/76 on a warm afternoon, about 1.5 hours after the last dry cleaning machine had been used. The building was well-ventilated with a "swamp cooler" and fan mounted in the ceiling. There were racks of cleaned garments hanging near the counter area. The work area sample was taken near the pressing tables. The solvent storage sample was taken in an area to the rear of the building near the dry cleaning machines, with several drums of solvent and many smaller cans and bottles of solvents visible. The building is approximately 10-20 years old.

Fabric Store

Sampled on 9/9/76 on a warm, sunny morning with little wind. The entire store was carpeted with a short-pile carpet and it is more than 30 years old. Bolts of fabric were piled on display tables, sorted according to fabric type. A small room air conditioner mounted over the front door was not in operation. One of the salespersons mentioned that there are occasionally complaints of eye irritation from customers, especially in the polyester section. Samples were taken in the polyester (double knit) section, the "blends" section, and in the woolen fabric section near the zippers and thread displays.

Dana Hall

Sampled on 7/18/76 (p.m.), 7/19/76 (a.m.), and 9/1/76 (p.m.) on very warm days. Parts of Dana Hall are air-conditioned but Room 202 itself is not. A small fan

provided some ventilation from an open window. Room 202 is the Air Pollution Research GC/ECD analytical laboratory and contains desk space and three gas chromatographs. Dana Hall is the Engineering building at Washington State University and contains offices, shops, and laboratories for the College of Engineering, Department of Chemical Engineering, Air Pollution Research, and the Department of Materials Science. It was built in 1946. Floors in most of the rooms are tile; floors in the hallways are synthetic stone.

Department Store

Sampled on 8/31/76 on a very hot, calm afternoon. The two-story building contains a shoe department and clothing store on the first floor and a fabric store on the second floor. Building air conditioning was on. The shoe department had a tile floor, and there was a noticeable breeze from an overhead air-conditioning vent near the shoe display where a sample was taken. The men's section had a shag carpet and the sample was taken near a leather coat rack. Ladies' clothing was shag-carpeted and the sample was taken near the dressing rooms. The second-story fabric department was not sampled. The building is more than 30 years old.

Hardware Store

Sampled on 8/31/76 on a very hot afternoon. A building air-conditioning unit was on, and the entire store had a linoleum floor. The paint section contained shelves of paint and spray cans. The second sample location was in an aisle containing car and floor waxes, household cleaners, and plastic housewares. The third location was near the checkout counters at the front of the store. The store is more than 30 years of age.

Urban Street Corner

The early morning sample was taken at 7 a.m. on 9/17/76 on a clear, calm morning. The sampling location was at the corner of Main and Grand Streets. Samples of

air during light traffic and rush hour conditions were taken at the same location on 9/13/76 on a clear, warm afternoon with a moderate breeze.

Radio and TV Repair

Sampled on 9/9/76 near mid-day on a warm, sunny day. The door at the rear of the repair area was open and the room was well-ventilated. The repair area had a wooden floor. The owner indicated that "freons" are used to clean certain contact points in electronic equipment in the repair area. The counter area is located between the repair area and the display floor, and the entire front area of the establishment has a linoleum floor. The building is not air-conditioned. The sample of air in the display area was taken in the vicinity of the stereo speaker and TV console display models. The building is more than 30 years of age.

Automobile Dealership

Sampled on the afternoon of 9/9/76. The building is less than 10 years old and contains a display area and service shop. The display area is air-conditioned, and the shop was well-ventilated by air moving through large doors at both ends of the building. The shop was sampled in an empty service bay with undercoating of an automobile in progress nearby, utilizing a compressed air, spray-type system emitting noticeable odors. The display area contained several new automobiles and is shag-carpeted, and the sample was taken near the door of a sales office.

Food Store

Sampled on the evening of 9/9/76. The store is approximately 10 years old and air-conditioned, with tile floors. Samples were taken midway between the front and rear of the store in the produce aisle, an aisle containing household cleaners and detergents, and in the frozen food section. The produce and frozen food aisles were noticeably cooler than the rest of the store. A conversation with a manager later revealed that there had been recent refrigeration leaks in the produce cooler system.

Laundromat

Sampled on the evening of 9/9/76. The area has linoleum floors and no air conditioning. Self-service dry cleaning equipment is located in the same building, but it was not in service for the entire summer and fall. The building is more than 30 years of age and had contained a dry cleaning establishment which had closed approximately a year earlier and was vacant. Samples were taken in the vicinity of an operating clothes washer, in the clothes dryer section, and in the area containing the self-service dry cleaning equipment. Moving ventilation air could be felt in the washer section.

Apartment

The apartment was a small, two-room apartment in one part of the basement of a house which had been converted to an apartment house, with four apartments on the two upper floors. There is no air conditioning, but the apartment contains a small refrigerator. The apartment house is more than 30 years of age. The p.m. sample was taken on 9/9/76 in the evening after the apartment had been closed and unoccupied all day. The bathroom sink was then cleaned with a scouring powder (Ajax) and the toilet bowl with a crystal cleaner (Vanish), and the bathroom air was sampled. The a.m. sample was taken on the morning of 9/10/76. After a shower was taken and a shave cream (Foamy) and an aerosol deodorant (Sure) were used, another sample was taken. The apartment was again sampled on the evening of 9/28/76 after a single cigarette had been smoked in the apartment. The party sample was taken in another apartment located on the ground floor of a three-story six-plex apartment house between 10 and 20 years of age. A party was in progress in the living room, which was well ventilated, but an odor of cigarette smoke was noticeable in the room.

Drive-In Restaurant

A fast-food drive-in with a dining area, built less than two years ago, was sampled on 9/13/76. The dining area was air conditioned; the food preparation area was not. The floors were linoleum. Samples were taken in the dining area, in the food preparation area, and in a corner of the dining area near the order window.

Cocktail Lounge

A small cocktail lounge in a recently remodeled restaurant was sampled on 9/13/76. Building air conditioning was in operation, and samples were taken in the drink preparation area and near a table in the lounge. The floor was shag-carpeted.

Beauty Parlor

Sampled on the morning of 9/14/76; a cool, sunny day. Air conditioning was in operation. The waiting area is shag-carpeted; the dryer area has linoleum flooring. The high CH_2Cl_2 value in the waiting area was confirmed by a total-ion mass scan with the GC/MS system. The building is 10-20 years old and is highly decorated.

Hair Styling

Sampled on the morning of 9/14/76. A room-sized air conditioner mounted above the door was not in operation. Aerosol cans of hair care products were on display. The waiting area is shag-carpeted; the chair or work area has linoleum flooring. The building is small and was recently remodeled but is at least 30 years old.

Floor Covering Store

Sampled on the morning of 9/14/76. The store is more than 30 years old. The rear door of the store was open and there was a cool breeze blowing into the store. There were two smokers in the area at the time of sampling. Samples were taken in the area where rolls of carpet were stored, in the area where tile and linoleum were kept and displayed, and near the shelves of paste and solvent. There is no air conditioner in the store. The flooring material was both carpet and linoleum.

Automobile

The new 1976 Ford was sampled on 9/9/76 while sitting inside a building and with the engine off. The 1972 Rambler station wagon was sampled on 9/13/76 as it sat in a parking lot. The windows had been shut all day and the sun had shone on it. The Rambler was then started for 5 minutes with the heater on and a sample was collected while driving. A 1975 Pinto was sampled as it sat parked along a street in a quiet residential neighborhood. Its window had been shut all day and it had sat in alternate shade and sun during the day. A 1973 Dodge station wagon was sampled on 9/17/76 after it had sat in a closed garage all day. It was then started, backed out of the garage, run for 5 minutes with the air conditioner on, and sampled once again. The exhausts from the 1972 Rambler and the 1975 Pinto were sampled on 9/29/76 after they had each been started, idled for 5 minutes, and the warm-up idle had been disengaged. Other exhaust samples were taken on 10/1/76 and 11/16/76 for CH_3Br and CHCl_3 analyses. The 1972 Rambler burned conventional "leaded" gasoline and did not have a catalytic converter. The 1975 Pinto operated on "non-leaded" gasoline and was equipped with a catalytic converter.

Drug and Variety Store

Sampled on 9/4/76, a cool, sunny day. The store is more than 30 years old and is carpeted with indoor/outdoor carpet, and the building's air conditioning unit was operating. Samples were taken in the gift (cards and candles) area, near the drug prescription and photo counters, and in the area of the cosmetics displays.

Discount Store

This store is located in Moscow, Idaho, 8 miles east of Pullman, Washington. It was sampled on 9/17/76, a cool and partly cloudy morning. The store is 20-30 years old, has tiled floors, and had outside air flowing through the ventilation system but no air conditioning. Samples were taken in the automotive/hardware/

stereo records area, in the foam and plastic-wares section, and in the shoe/furniture area.

Restaurant

This establishment is also located in Moscow, Idaho, and was sampled on 9/17/76. The dining area is carpeted, but the food preparation area and the counter area are tiled with small, ceramic, in-laid tile. Samples were taken in the booth/table area, behind the counter, and in a corner of the kitchen near the walk-in freezer. The restaurant is about 2 years old.

Movie Theater

Sampled the evening of 9/17/76 at 6:30 p.m. (before the first show) and 11 p.m. (after the second show). The theater is more than 30 years of age and has ventilation fans but no air conditioning. The lobby is carpeted and the theater section has concrete floors. The theater had been closed and ventilation turned off all day. Samples were taken in the lobby and in the theater section before the theater opened and then after the patrons had exited the last show. The theater was poorly attended; less than 1/4 full. There was an odor of cigarette smoke in the theater after the showings.

Body Shop

Sampled on the morning of 9/17/76, a cool and partly cloudy day. Windows and a rear door were open and there was good ventilation. The shop is located on the second floor of an auto dealership and service area. Samples were taken near the paint storage shelves and in a closed and unoccupied painting room. There was no painting or other activity in progress at the time of the sampling.

Offices, Classroom

Three rooms in Dana Hall (see description of Dana Hall above) were sampled on 9/17/76. The "xerox" room contained two copiers which were being used at the time. The typing area which was sampled had been recently remodeled and had