ARB/ML-93-032

Evaluation Test on Two Propane Fired Crematories at Camellia Memorial Lawn Cemetery

October 1992

CALIFORNIA AIR RESOURCES BOARD

MONITORING AND LABORATORY DIVISION
1927 13TH STREET, SACRAMENTO, CA 95814

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State of California
Air Resources Board

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Test Report No. C-90-004

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Engineering Evaluation Branch
Monitoring and Laboratory Division

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Approved:

H.C. Jenkins, Project Engineer
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EVALUATION OF COMBUSTION PROCESSES

This report presents an evaluation of emissions and processes based on data from tests performed by the Air Resources Board (ARB) staff and chemical analysis of samples conducted by the Department of Health Services, ARB and commercial laboratories. This emissions test conducted by the ARB staff is part of the Board's program to assess emissions from stationary sources. The data have been reviewed by ARB staff and are believed to be accurate. However, the emission characteristics are affected by process variables and these relationships are among the subjects of this study. The data should not, therefore, be necessarily considered typical of a specific source or industry unless the effects of such variables are taken into account.

ACKNOWLEDGEMENTS

Chemical analyses were performed by the Department of Health Services' Air and Industrial Hygiene Laboratory and Hazardous Materials Laboratory (Berkeley, California). Semi-volatile compound analyses were performed by ENSECO CAL LABS (Sacramento, California). Volatile organic compound analyses were performed by Air Resources Board Southern Laboratory Branch. Trace Metals preparation was performed by BC Analytical (Emeryville, California) for subsequent AIHL analysis.

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I DESCRIPTION OF PROJECT

On November 20, 1989 Honorable LLoyd G Connelly, California State Assembly, State Capitol wrote to the Air Resources Board (ARB) regarding the requirements for crematory facilities to inventory toxic emissions to atmosphere required by the Criteria and Guidelines Regulation for the Air Toxics "Hot Spots" Information and Assessment Act. On December 8, 1989, James D. Boyd, ARB Executive Officer, responded to Assemblyman Connelly stating that ARB recognizes and appreciates the difficulties faced by the relatively few, small facilities currently being required to perform source testing for dioxins and other toxic substances. Additionally, ARB has reason to believe that this type of facility presents a health risk to the local population.

On January 3, 1990, Assemblyman Connelly wrote to ARB thanking them for their thorough and timely response to his inquiry regarding the impact of AB 2588 on crematory facilities in California, and expressed appreciation for the efforts of Mr. Boyd and his staff to develop a workable solution to this difficult problem.

The ARB Monitoring and Laboratory Division's (MLD) Engineering Evaluation Branch (EEB) staff performed evaluation tests of two crematories operated by Camellia Memorial Lawn located in Sacramento. The tests were performed over a two week period beginning on October 22, 1990. The tests were conducted on two similar incinerators fired with propane gas.

The evaluation tests were performed through a cooperative effort with the Sacramento Metropolitan Air Quality Management District (SMAQMD) to determine emissions of toxic substances from a crematory. At this time, crematories located in the state are subject to the testing requirements of the "Criteria and Guidelines Regulation for the Air Toxic "Hot Spots" Information and Assessment Act." Because of the economic burden and limited number of crematory facilities affected by this requirement, the ARB staff agreed to provide technical assistance and perform an evaluation test to determine emissions to atmosphere and to help crematory facilities' meet the costs of these regulatory requirements.

On September 14, 1990, EEB personnel conducted a pre-test site inspection and performed pre-test velocity and moisture determinations on one of the two crematories at Camellia. Part of the pre-test inspection involved observing the cremation of a body at one hour and two hour intervals. At the end of two hours there was no evidence of readily available combustible material. The body skeleton had the appearance of chalky bone. This was borne out during the October 22, 1990, series of tests.

II UNIT DESCRIPTION AND OPERATION

Camellia Memorial Lawn operates two crematories at their Sacramento facility. A schematic of the crematory is included in Figure 1. The units are Model L- 1701 retorts manufactured by ALL CREMATORY CORPORATION, CLEVELAND, OHIO. The first unit (No.1) at Camellia was installed in 1973 and the second unit (No.2) was installed in 1988. Both units are equipped with propane fired Eclipse Burners (Afterburner and Ignition) rated at 2,115,000 British Thermal Units per hour (BTU per hour) capacity. However, the units are presently calibrated to operate at a maximum of 1,450,000 BTUs/Hr. The major difference between the old (No. 1) and new (No. 2) retorts is that the new unit is equipped with a modulating ignition burner. When afterburner temperatures reach 1800°F, the ignition burner modulates to a low-fire mode that will reduce the BTUs per hour usage.

The retorts are heated to 1250° F using the afterburner. The body container is then placed on the combustion chamber grate and the ignition burner fired to attain a target combustion temperature sufficient for the proper reduction of human remains.

Typical crematory operation procedures yields the following time/temperature profiles:

	Time	Temperature °F
Chamber preheat by afterburner	30-45 min.	1250
Container introduced into combustion chamber, ignition burner ignited, and start of cremation	2 hrs.	1600-1800
Rake remains towards ignition burner	1 - 2 min.	
Cooldown	45 min - 1 1/2 hrs.	

It is estimated by ALL Crematory Corp. personnel that it took approximately two to three minutes for the flame to burn through the body container material and impinge onto the body proper after the body container was inserted into the crematory and the loading door closed.

During normal operation three bodies per day are cremated in each retort. During the evaluation test two bodies per day were cremated in each retort. The cremation schedule, body weights, and container information are presented in Table 1. Body weights were supplied by the contributing agencies. The weights of the cardboard boxes and, where applicable, cardboard boxes with wooden stiffeners were provided by Camellia personnel. The inside of the body containers are not usually inspected by Camellia personnel prior to cremation.

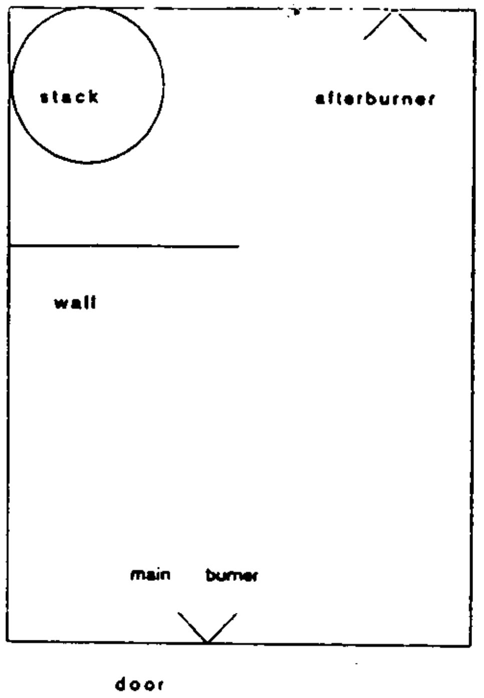
The average composition of adult man shown in reference 2 is as follows :

Component	Percent Dry Weight
CARBON	48.43
OXYGEN	23.70
NITROGEN	12.85
HYDROGEN	6.60
CALCIUM	3.45
SULFUR	1.60
PHOSPHOROUS	1.58
SODIUM	0.65
POTASSIUM	0.55
CHLORINE	0.45
MAGNESIUM	0.10
OTHER	0.04

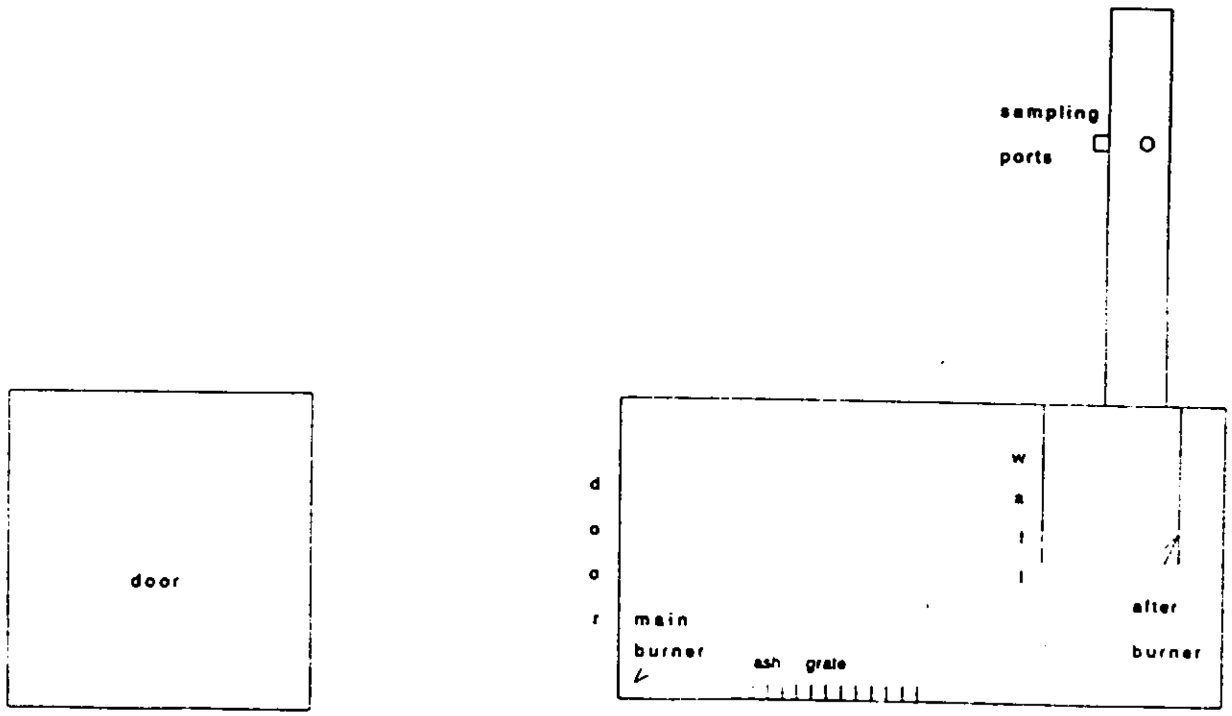
Reference 2 - Britannica Encyclopedia, 10-127d
Britannica Encyclopedia, Inc., NY 1971

FIGURE 1

Crematory System Operated at Camellia Memorial Lawn



TOP VIEW



FRONT VIEW SIDE VIEW

TABLE 1
PROCESS WEIGHT RATES

DATE	RUN NO.	LOCAL TIME START	PROCESS WEIGHT RATES PER CREMATION, LBS CREMATORY 1 NORTH (A)			CREMATORY 2 SOUTH (B)		
			BODY	CdBd	Wd	BODY	CdBd	Wd
10-23-90	TM-1A	1115	100	4	0			
	TM-2B	1030				120	4	0
	TM-1A	1515	125	4	0			
	TM-2B	1500				178	4	6
10-24-90	TM-3A	0937	125	4	6			
	DT-1B	0935				188	4	0
	TM-3A	1400	125	4	0			
	DT-1B	1400				154	4	0
10-25-90	DT-2A	0930	130	4	0			
	DT-1B	0930				125	4	6
	DT-2A	1340	140	4	6			
	DT-3B	1340				140	4	0
10-26-90	DT-2A	0930	160	4	6			
	DT-3B	0935				175	4	0
	M5-1A	1405	95	4	0	P/		
	DT-3B	1355				175	4	0
10-29-90	HCL-1A	0945	175	4	0			
	M5-2B	0940				150	4	0
	HCL-2A	1425	170	4	0			
	M5-3B	1430				110	4	0
10-30-90	-	-	135	4	6			
	HCL-3B	0900				145	4	0
	ALD-1A	1420	160	4	6			
	ALD-2B	1423				195	4	0
10-31-90	RT-1A	0945	110	4	6			
	RT-2B	0945				130	4	0
	RT-1A	1400	190	4	6			
	RT-2B	1400				195	4	0
	ALD-3A	1400						
	ALD-4A	1400						
11-1-90	RT-3A	0907	105	4	6			
	CR-1B	0910				130	4	0
	RT-3A	1330	115	4	0			
	CR-1B	1325				160	4	0
11-2-90	CR-2A	0900	110	4	6			
	CR-3B	0900				150	4	0
	CR-2A	1410	135	4	0			
	CR-3B	1410				150	4	0

NOTE: Body weights were provided by the contributing agency.
Cardboard and wood weights were provided by Camellia personnel.
CdBd Cardboard
Wd Wood
P Excessive plastic wrap C-90-004

III SAMPLING LOCATION and METHODS

The crematory exhaust stacks extended through the roof of the building and required stack extensions to be installed due to lack of (a) adequate stack height and (b) proper sampling ports. The stack extensions used for the test were 42 inches tall with an inside diameter of 20 inches. Two three inch diameter sampling ports located 90 degrees apart were installed on each of the two stack extensions. The distance from the stack / stack extension flange interface to the bottom of the sample port nipple was 6 inches.

Samples of the crematory exhaust gas were collected from the stack extension through two 3 - inch diameter sample ports located 90 degrees apart on the exterior of the stack extension. The elevation of the stack exit from ground level for each retort is 15 feet.

When the crematory reached an operating temperature of 1250°F, the body and body container were placed inside the crematory's chamber on the grate and the ignition burner turned on. The first two minutes of each burn was devoted to performing a velocity traverse on both axes before sampling started. Single point stack temperatures were measured at the stack center in a plane just above the sample ports. Pollutant sampling rates were based upon this velocity traverse because the high temperature stack gas required the use of bare quartz probes with fixed diameter nozzles. The probes did not have a pitot tube assembly with which to instantaneously measure stack gas velocity pressure allowing simultaneous adjustment of the sample flow rate. Based on conversations with ALL CREMATORY CORPORATION, flame impingement on the body takes two to three minutes; therefore, target analytes were not missed during the initial part of cremation when velocity traverses were conducted.

High exhaust gas temperatures necessitated the use of bare quartz glass probes when sampling for trace metals, semi-volatile and volatile toxic air contaminants. Each probe had a 0.5 inch diameter quartz nozzle fused to the end of the probe. A metal probe assembly with an S-type pitot tube and thermocouple was not used simultaneously during the sampling test runs due to anticipated thermal damage. However, an inconel S-type pitot tube was used to perform a one minute velocity traverse on each sampling axis when the ignition burner was fired. Pollutant sampling commenced after the one minute velocity traverses were completed on each axis. Midway through each test, during the sampling port traverse change, the stack gas velocity profile was checked with a metal S-type pitot tube for magnitude and uniformity. During sample collection, isokinetic sampling parameters were maintained based on the velocity pressures determined prior to sampling.

Gas sampling was performed by draping the Method 100 sample probe over the top of the stack extension into the exhaust gas stream. The gaseous criteria pollutant sampling periods varied in duration and coincided with the duration of each test day. The gas sampling probe was alternated daily from crematory No.1 to crematory No.2 to obtain representative gaseous emissions data for both crematories.

TEST METHODS

A. GASEOUS CRITERIA POLLUTANTS

Sampling for total hydrocarbons (THC), oxygen (O2), oxides of nitrogen (NOx), sulfur dioxide (SO2), carbon monoxide (CO), and carbon dioxide (CO2) was performed in accordance with the procedures specified by the Air Resources Board Method 100, "Procedure for Continuous Emissions Stack Sampling" (Section 94114, Title 17 of the California Code of Regulations).

The Method 100 sampling assembly consists of a stainless steel probe with a stainless steel mesh screen filter protected by a stainless steel sheath on the front half. Process gas is drawn into the probe through the filter and routed through a heated Teflon-lined flexible tube to a Thermo Electron (TECO) Model 600 sample gas conditioner. Upon exiting the conditioner, the conditioned (dry) sample is routed to a manifold from which continuous gas analyzers, arranged in parallel, draw their respective samples. A rotameter to measure sample flow to each gas analyzer is placed in each sample line between the manifold and gas analyzers.

The model of the continuous gas analyzers used and the particular compound continuously monitored by each is listed below:

Western Research Model 771 (ultraviolet photometry) for SO2;
TECO Model 10 (chemiluminescence) for NOx;
Horiba Model PIR 2000 (non-dispersive infrared spectroscopy (NDIR) for CO2;
Horiba Model PIR 2000 (NDIR) for CO;
Beckman Model 755 (paramagnetic) for O2;
Beckman Model 400 (flame ionization detection) for total hydrocarbon.

The flow rate of conditioned sample gas to each analyzer is controlled with a rotameter specific to the particular analyzer.

The continuous emission data were recorded on strip charts. The analyzers were calibrated at the ARB Engineering Evaluation Branch facility in Sacramento prior to the evaluation test. The analyzers were also checked for zero and span accuracy before and after each Method 100 test period. A Schematic of the Method 100 apparatus is shown in Figure 2.

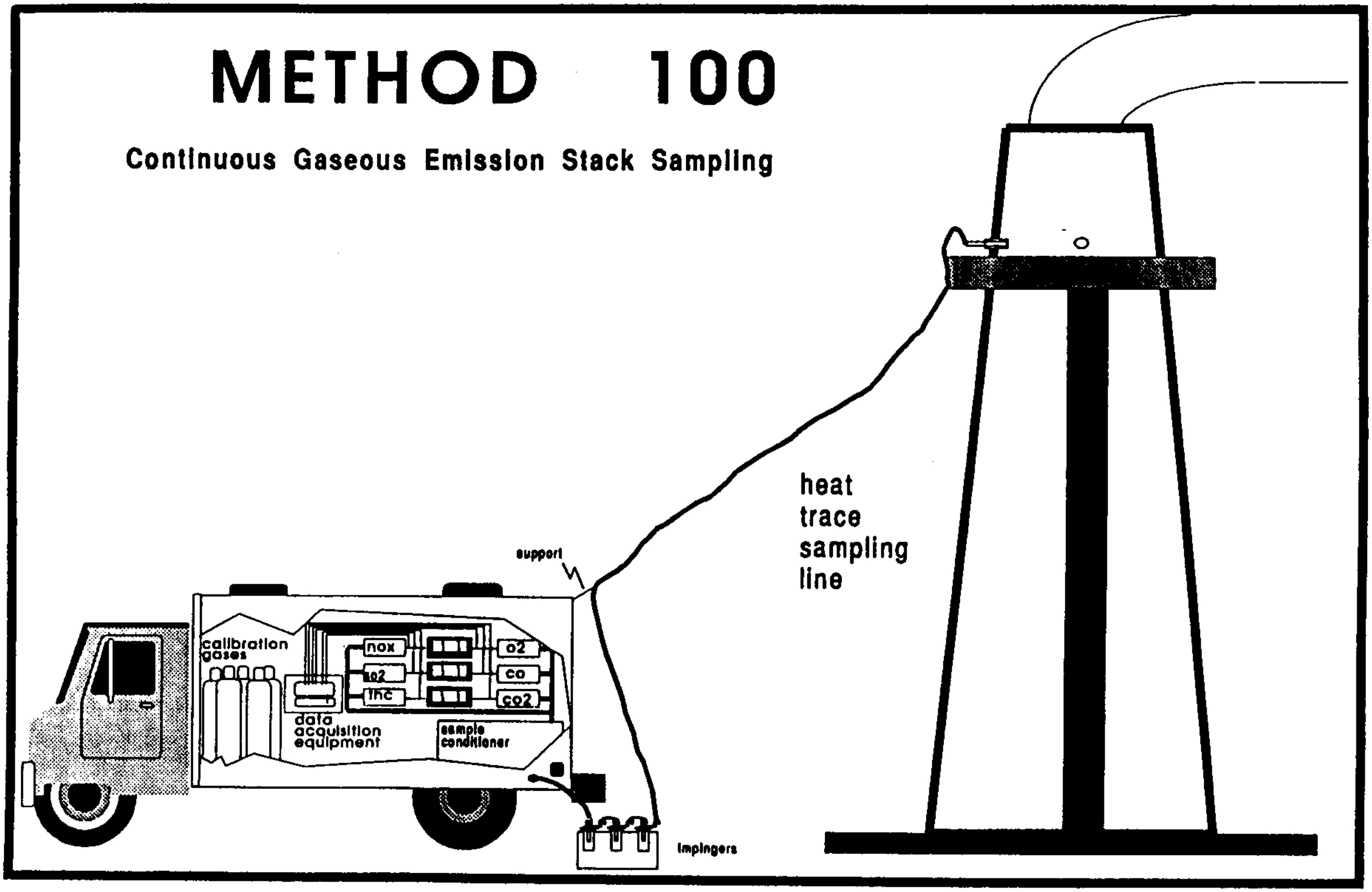

METHOD 100
Continuous Gaseous Emission Stack Sampling
heat trace sampling line
support
calibration gases
nox
so2
thc
o2
co
co2
data acquisition equipment
sample conditioner
impingers

FIGURE 2

B. PARTICULATE MATTER

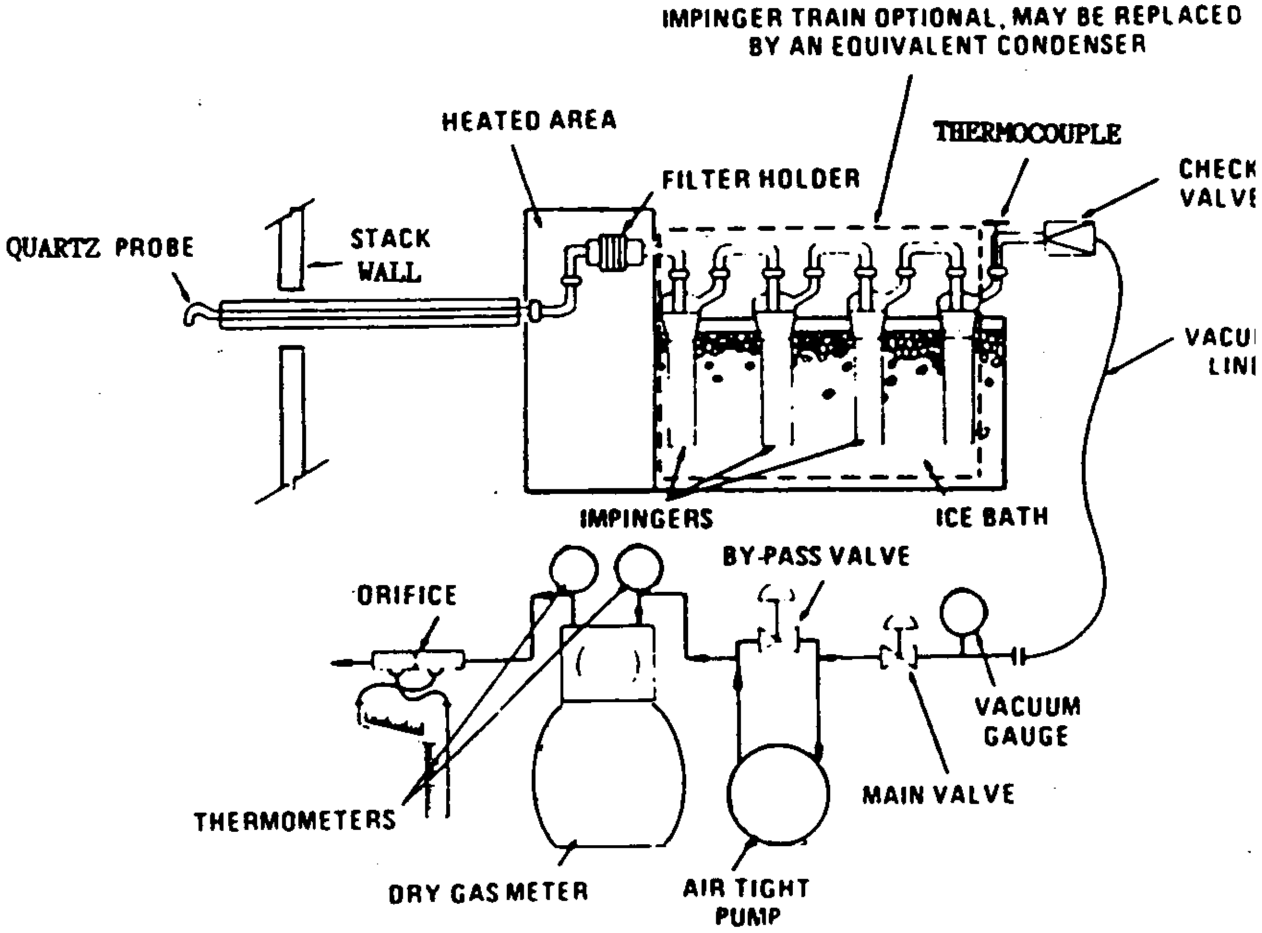
Stack gas velocity, volumetric flow rate, molecular weight (wet and dry), moisture content, and temperature were determined at the crematory stack sample locations using the procedures established in ARB Test Methods 1 through 4 (Sections 94101-94104, Title 17 of the California Code of Regulations). However, the excessively high stack temperatures required a procedural change that involved separating the stack gas moisture runs and velocity traverse runs from the stack gas sampling runs. Metal pitot tubes and metal sampling tubes were used for the separate velocity traverses and moisture trains. A velocity traverse was conducted prior to the start of the sampling runs to verify the uniformity of velocity head pressures and temperatures at each traverse point. This was followed by a moisture train. The probes used for sampling were bare quartz probes with a fixed diameter nozzle. Metal pitot tubes were deliberately removed from the probe assembly because of anticipated thermal damage due to prolonged exposure to the hot stack gas. Therefore, the absence of the pitot tube from the probe assembly required that sampling be performed at a constant rate. The probe (with fixed nozzle) selection and the sampling parameters to conduct constant rate sampling were determined from the pretest velocity traverse data and moisture runs. A mid-test velocity traverse was repeated between port changes.

Particulate matter was collected using the procedures established in ARB Method 5 (Section 94105, Title 17 of the California Code of Regulations). Each particulate matter sampling train was run for two hours (i.e. one body) at a constant rate based upon the average velocity pressure measurement determined prior to particulate sampling. Because of high stack gas temperatures, the Method 5 sampling train was modified by replacing the probe assembly with a bare quartz probe with a fixed diameter nozzle. A schematic of the Method 5 sampling train is shown in Figure 3.

Stack gas sample is withdrawn by a vacuum pump through the quartz glass probe, a heater box containing a filter holder, and impinger train. The solid phase particulate matter in the sampled gas are collected on the filter mounted within the filter holder.

Condensible particulates were collected in the impinger train which consists of four glass impingers (bottles) connected in series and immersed in an ice bath. The first two impingers each contained 100 milliliters of distilled and de-ionized water; the third and fourth impingers were empty. The condensible particulate fraction is determined by gravimetric analysis of the solutions contained in the first two impingers. A silica gel cartridge (used to remove any remaining moisture in the sampled process gas) is installed between the fourth impinger and the sampling console, which is used to draw and monitor the sampled gas.

FIGURE 3



Schematic of Method 5 sampling train.

C. HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE

The ARB draft Method 421 for Hydrogen Chloride (HCl) and Hydrogen Fluoride (HF) requires a sampling train and procedure similar to Method 5 (Figure 3) with minor changes to accommodate sampling for these specific compounds. A sodium carbonate and sodium bicarbonate solution replaces water as the impinger reagents in the Method 5 sample train. The HCL/HF sample train was also modified by replacing the probe assembly with a bare quartz probe with a fixed diameter nozzle. Sample volumes were taken at an average rate based on velocity pressure measurements determined prior to the start of source sampling. The draft method is contained in Appendix I. Each HCl and HF sampling train was run for two hours (i.e. one body).

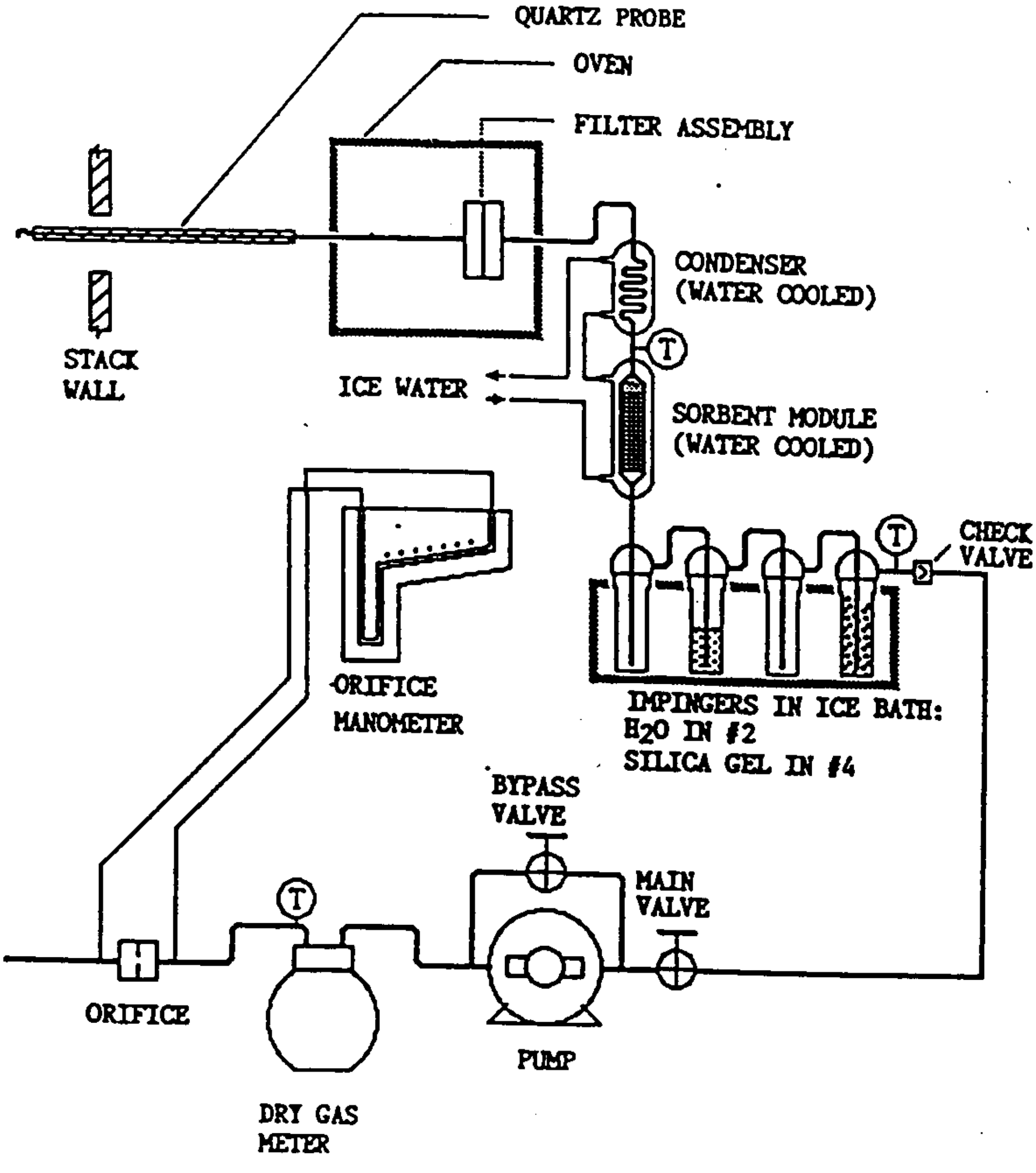
D. POLYCHLORINATED DIBENZODIOXINS (PCDD) and POLYCHLORINATED DIBENZOFURANS (PCDF)

PCDD and PCDF sampling, recovery, and analysis were performed in accordance with ARB Method 428 (Section 94139, Title 17 of the California Code of Regulations). PCDD and PCDF samples, collected at the crematory stack sampling locations shown in Figure 1 were run for six hours (i.e. three bodies).

Method 428 sampling is based on the use of a Modified Method 5 train, shown in Figure 4, in which a water-cooled condenser and resin cartridge, containing XAD-2 resin, are inserted between the filter holder and impinger system. The PCDD/PCDF sampling train probe assembly specified in Method 428 was replaced with a bare quartz probe with a fixed diameter nozzle. Sample volumes were taken at an average rate based on velocity pressure measurements determined prior to the start of source sampling. The impingers are kept in an ice bath and collect residual condensed moisture. The first impinger is empty, the second contains 100 ml of Type II water, and the third impinger is empty. The impinger catch is included in the sampling train composite for PCDD and PCDF analysis. The condenser is designed for continuous cold water circulation during the entire sampling period. Although not required by Method 428, the filters were recovered and kept on dry ice for storage and transport.

Prior to field use the Method 428 sample trains were specially cleaned and prepared by ENSECO Cal Labs. At the completion of each Method 428 sample period, the spent sample trains were dismantled, sealed, and transported to ENSECO Laboratory by Department of Health Services' Air and Industrial Hygiene Laboratory (AIHL) personnel. Sample train recovery was performed by ENSECO Laboratory personnel and the samples analyzed for the PCDD and PCDF compounds listed in Table 2.

FIGURE 4



PCDD/PCDF SAMPLING TRAIN

TABLE 2

Polychlorinated Dibenzodioxins (PCDD) and
Polychlorinated Dibenzofurans (PCDF)
Analyzed for in samples from the Method 428 Train

	Dioxins	Furans
Tetrachloro	2,3,7,8 Total	2,3,7,8 Total
Pentachloro	1,2,3,7,8 Total	1,2,3,7,8 2,3,4,7,8 Total
Hexachloro	1,2,3,4,7,8 1,2,3,6,7,8 1,2,3,7,8,9 Total	1,2,3,4,7,8 1,2,3,6,7,8 1,2,3,7,8,9 2,3,4,6,7,8 Total
Heptachloro	1,2,3,4,6,7,8 Total	1,2,3,4,6,7,8 1,2,3,4,7,8,9 Total
Octachloro	Total	Total

E. POLYCYCLIC AROMATIC HYDROCARBONS (PAH)

Polycyclic aromatic hydrocarbon (PAH) sampling, recovery and analysis was performed in accordance with the procedures established in ARB Method 429 "Determination of Polycyclic Aromatic Hydrocarbons (PAH) Emissions From Stationary Sources" (Section 94141, Title 17 of the California Code of Regulations). The sampling train was modified by replacing the probe assembly with a bare quartz probe with a fixed diameter nozzle. The first impinger contained water, the second impinger was empty and the third impinger contained silica gel. Sample volumes were taken at an average rate based on velocity pressure measurements determined prior to the start of source sampling. Each PAH sampling train was run for four hours (i.e. two bodies).

At the completion of each sample period, the spent sampling train was dismantled in the field, sealed, and transported to ENSECO Cal Labs by AIHL personnel. The PAH filters were kept on dry ice for storage and transport. Sample train recovery was performed by ENSECO

Laboratory personnel and the samples analyzed for the compounds specified in Table 3.

FIGURE 5

PAH Sampling Train

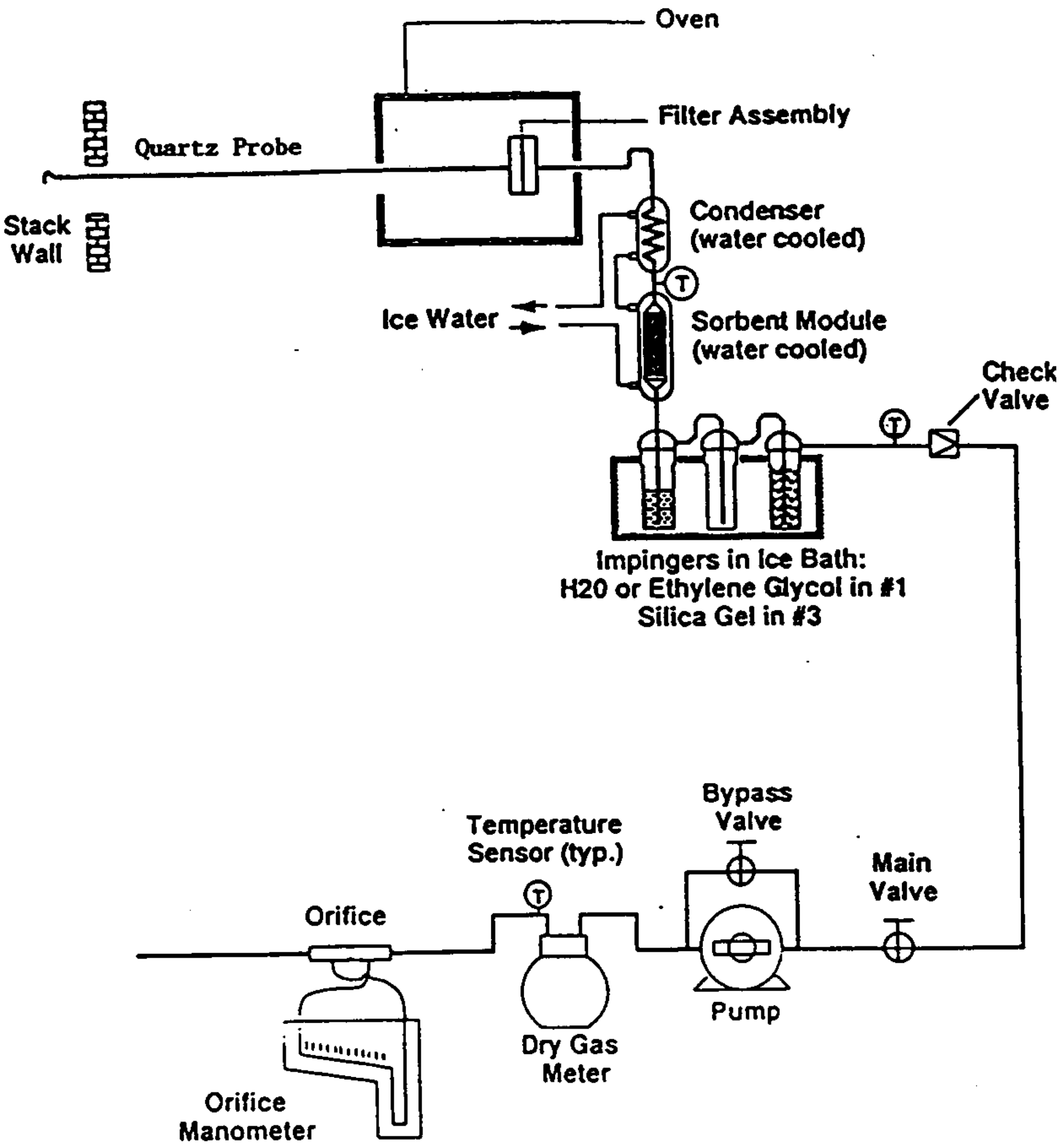


Table 3

Target PAH Analytes

PAH
Naphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benz[a]anthracene
Chrysene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo(a)pyrene
Benzo(g,h,i)perylene
Indeno[1,2,3-cd]pyrene
Dibenzo[ah]anthracene

F. TRACE METALS

The ARB draft multiple metals test Method 436 was used to determine emissions of selected trace metals. A copy of the draft method is contained in Appendix II. Metals samples were collected at the crematory stack sampling locations shown in Figure 6. Sample volumes were taken at an average rate based on velocity pressure measurements determined prior to the start of sampling. Each trace metal sampling train was run for four hours (i.e. two bodies). Samples were recovered/analyzed using procedures established in the draft ARB multiple metals test method. The metals samples were analyzed using atomic absorption and inductively coupled plasma spectroscopy to determine the presence of the target metals listed in Table 4.

The sampling apparatus for metals is based on a Method 5 sample train with the following modifications: (1) A high purity glass fiber filter was used instead of a standard Method 5 glass fiber filter (2) the probe assembly was replaced with a bare quartz probe with a fixed diameter nozzle and, (3) the first impinger was empty, the second and third impingers contained a solution of 5% HNO_3/10% H_2O_2, the fourth impinger was empty and the fifth and sixth impingers contained a solution of 4% $KMnO_4$/10% H_2SO_4.

Sample volumes were taken at an average rate based on velocity pressure measurements determined prior to the start of sampling. Each trace metal sampling train was run for four hours (i.e. two bodies).

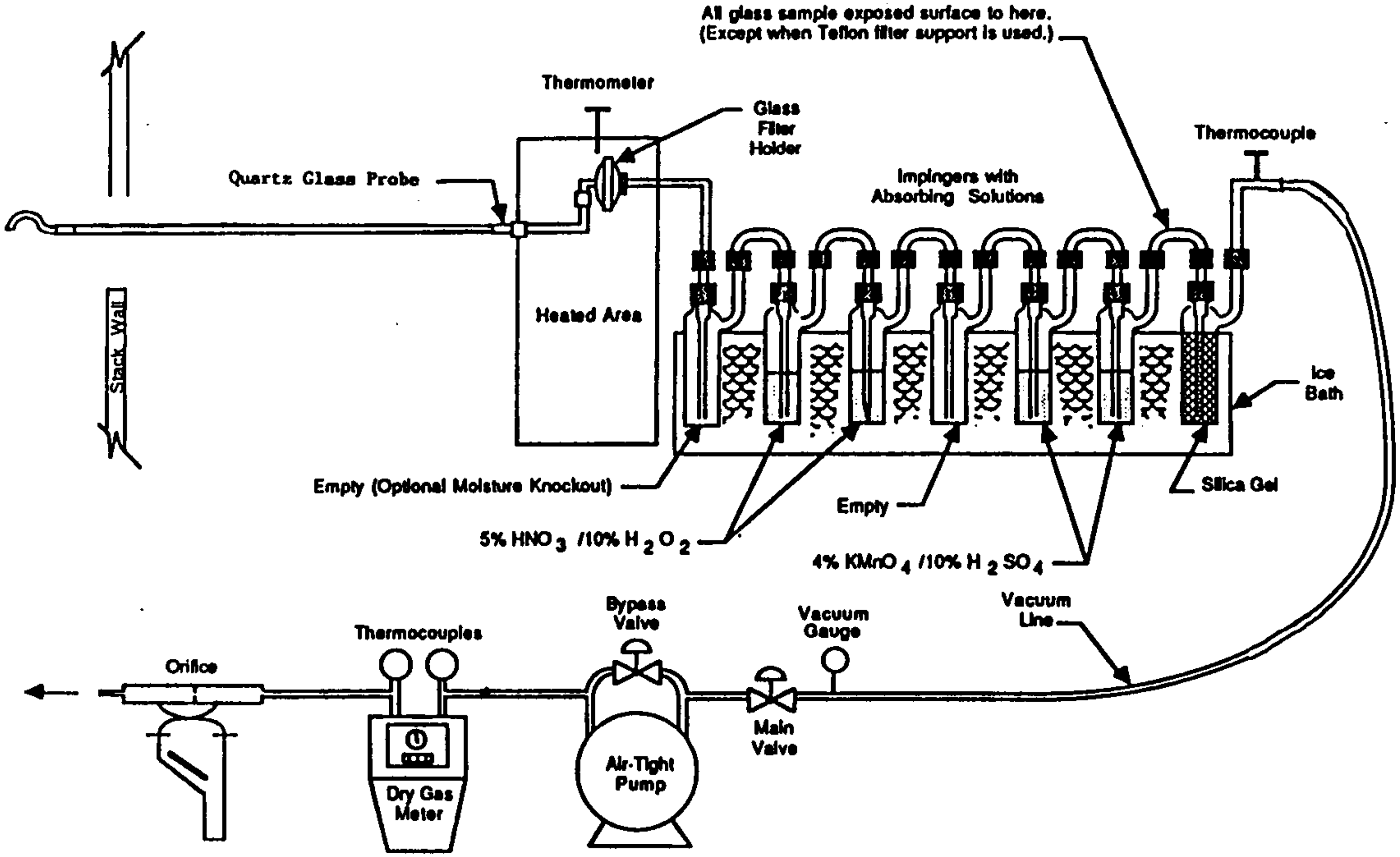


Figure 6 . Schematic of multiple metals sampling train configuration.

Table 4

Target Metals Analyzed

- Arsenic
- Mercury
- Cadmium
- Cobalt
- Antimony
- Nickel
- Zinc
- Copper
- Chromium
- Molybdenum
- Selenium
- Barium
- Lead
- Beryllium
- Vanadium
- Silver
- Thallium

G. HEXAVALENT AND TOTAL CHROMIUM

Hexavalent and total chromium mass emission rates were determined at the crematory stack sampling locations shown in Figure 1 using the procedures contained in ARB Method 425 (Section 94135, Title 17 of the California Code of Regulations).

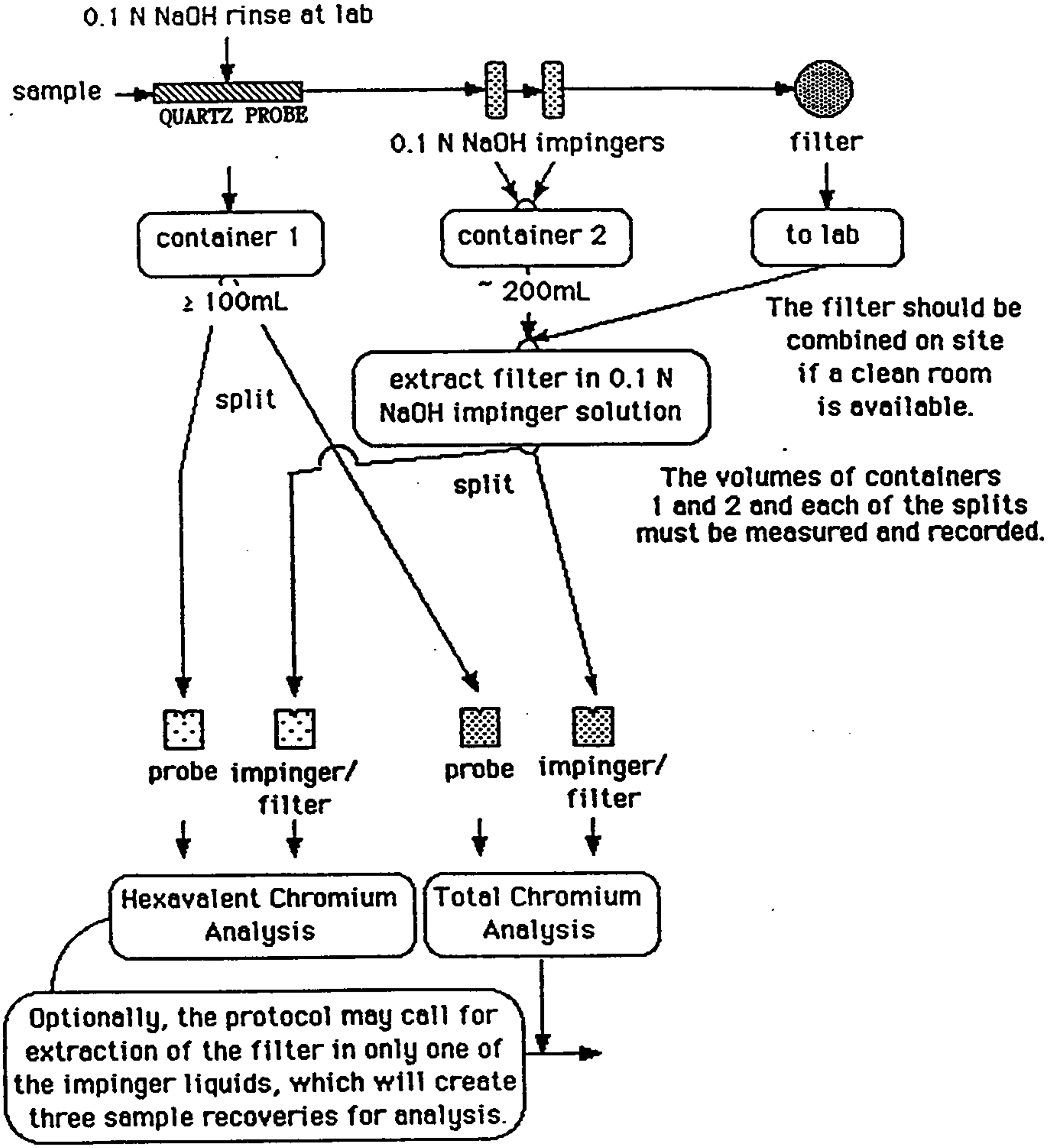
The hexavalent and total chromium sampling train shown in Figure 7 was modified by replacing the probe assembly with a bare quartz probe with a fixed quartz nozzle. Sample volumes were taken at an average rate based on velocity pressure measurements determined prior to the start of sampling.

Hexavalent chromium samples were taken at an average volumetric rate during a four hour sample period through the quartz probe/nozzle and a series of three glass impingers. The first two impingers each contain 100 milliliters of 0.1N sodium hydroxide (NaOH) and the third impinger is dry. The third impinger is followed by a high purity, Teflon coated, glass fiber filter and a silica gel cartridge.

The impinger solutions, filter and rinses recovered from the chromium sample train were analyzed for hexavalent chromium using a diphenylcarbazide (DPC) technique and for total chromium using furnace type atomic absorption spectroscopy.

FIGURE 7

Sample Collection and Recovery for Hexavalent and Total Chromium



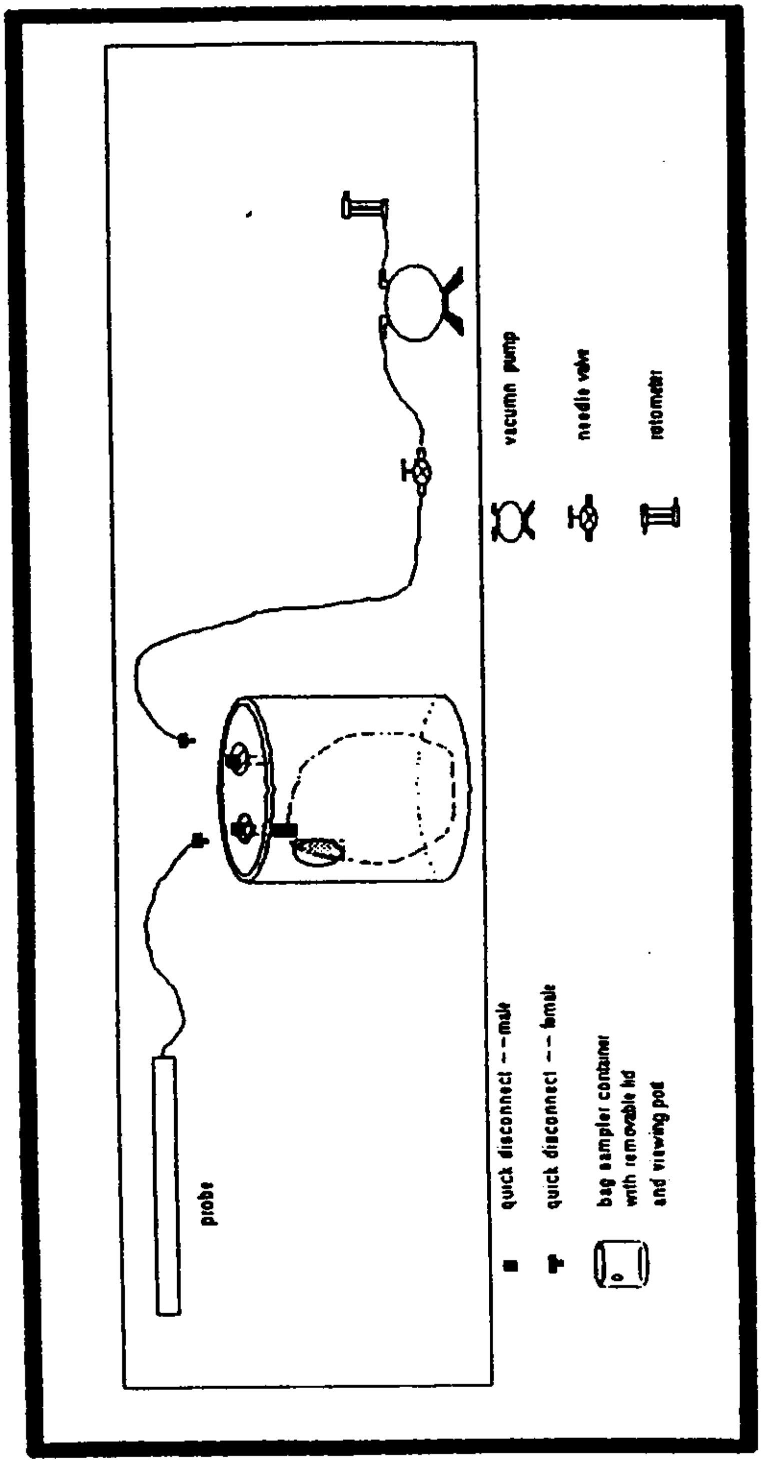
H. HALOGENATED AND AROMATIC ORGANIC COMPOUNDS

Grab samples of the process gas at the incinerator stack sample locations were collected into Tedlar bags in accordance with ARB Method 422 (Section 94132, Title 17 of the California Code of Regulations). The samples were analyzed by gas chromatography using electron capture detector (GC/ECD) for all halogenated compounds and gas chromatography using photoionization detector (GC/PID) for vinyl chloride and benzene.

The Tedlar bag sample train consists of a quartz sample probe, Teflon sample line, rotameter, vacuum pump, and the sample drum which contains the Tedlar bag. The vacuum pump is used to evacuate the inside of the sample drum containing a clean Tedlar bag. The differential pressure created between the interior of the sample drum and the Tedlar bag draws a sample of process gas into the Tedlar bag through the probe and Teflon sample line. Eight liters of sample were collected at the rate of two liters per minute. A schematic of the bag sampling train is shown in Figure 8. The sample flow rate is maintained by a rotameter and needle valve.

FIGURE 8

Bag Sampling Train



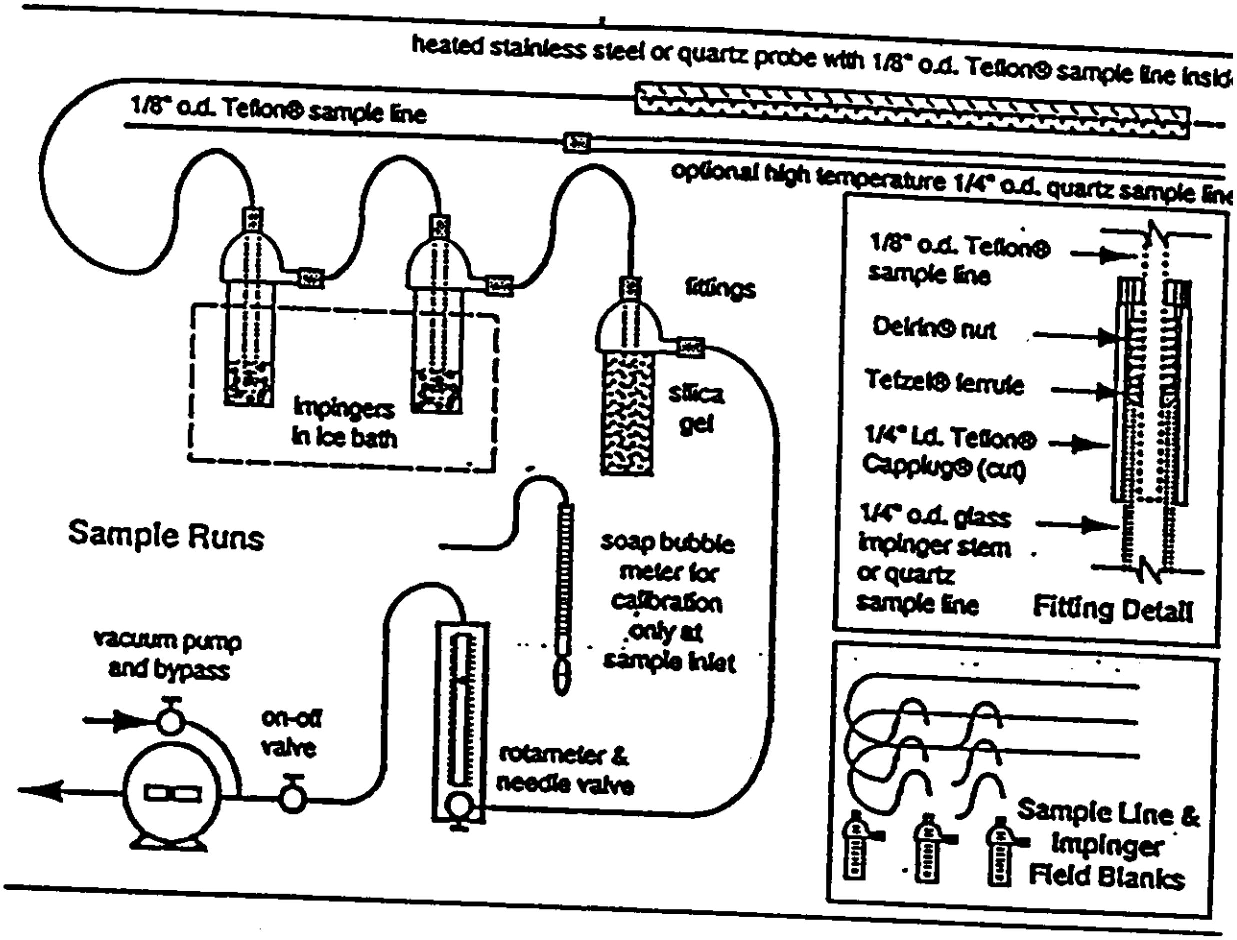
I. FORMALDEHYDE AND ACETALDEHYDE

Formaldehyde and acetaldehyde emissions were determined by ARB draft Method 430 shown in Appendix III.

Each aldehyde sample was drawn through a 1/4-inch diameter quartz probe, a Teflon sample line and two 35 milliliter impingers in series. Each impinger contained a 10 milliliter aqueous acidic solution of 2,4-dinitrophenyl-hydrazine (DNPH). The sampling time was for a period of 1 hour. A schematic of the sample train is shown in Figure 9.

FIGURE 9

Aldehyde Sampling Train



J. PROCESS PARAMETERS

Process parameters were provided by Camellia personnel.

Crematory

primary air temperature (ambient), 50 to 85 F

fuel heating value (propane), 2,516 BTUs/FT^3

ignition burner heat rate, 493,000 BTUs/HR

afterburner heat rate, 957,000 BTUs/HR

total calibrated crematory heat rate, 1,450,000 BTUs/HR

crematory temperature range, 1600 to 1800 F

Facility

Body weight and packaging type, Table 1

The process parameters were used to determine typical or normal variations of the facility's operation. Additionally, recorded process parameters may be used to establish pollutant emission factors (e.g., pounds of air contaminant emitted per pound of material burned, etc.)

IV **DISCUSSION**

General Observations

Emissions testing was performed over a two week period from October 22, to November 2, 1990. Thirty-six human bodies were cremated during the test period. This equates to two bodies per crematory per day for nine days. Bodies were placed into each crematory commensurate with Camellia's standard operating procedure. Bodies were not selected for a crematory based on any apparent characteristic such as body weight, type of body wrap, or container type. The body, cardboard and wood process weight rates for each test per crematory are shown in Table 1.

Air Resources Board staff met with members of the Crematory Emissions Test Pool and the Sacramento Metropolitan Air Quality Management District to discuss the purpose and scope of the emissions test at the two Camellia Memorial Lawn crematories. Concerns were expressed about the duration of sampling time, specifically that the toxic compounds of interest would be released to atmosphere within the first twenty minutes of the cremation process and stack sampling continued after this initial twenty minute period would dilute the compounds of interest with propane-only combustion gases. However, sample run times of twenty minutes were also recognized as impractical, especially for trace metals and semi-volatile organic sampling tests that are six hours in duration to obtain the adequate sample volume necessary for laboratory analysis. Therefore, a consensus was reached where 1) samples would be collected during the cremation process; 2) the cremation process would begin when the body was placed onto the retort of the crematory; 3) the duration of the cremation process would be defined as two hours; 4) sampling would coincide with the two hour cremation process.

Sampling would stop at the end of a two hour cremation process and, if required, resume when the next cremation began. Based upon this agreement, two 2-hour cremations for each crematory were scheduled each day.

On September 28, 1990, EEB personnel performed a pre-test stack gas velocity and moisture test. This pre-test was conducted to obtain stack gas information with which to size the nozzle for the quartz probes. Results from each test day's pre-sampling velocity traverse were compared to the September 28th velocity traverse data for consistency. On September 28, 1990, the two sets of velocity traverses on crematory No. 2 showed the stack gas velocity head pressure ranged from 0.01 to 0.07 inches of water across the stack diameter and the two moisture trains yielded 8 and 10 percent moisture. During the main test in October, the crematory No. 2 stack gas velocity head pressure ranged from 0.01 to 0.06 inches of water across the stack diameter and the stack gas moisture content ranged from 6.7 to 8.8 percent.

During the October 22, to November 2, 1990 test, the afterburner was used to achieve the required crematory preheat temperature of 1250°. When the crematory reached 1250° F, the body was inserted and the ignition burner turned on. The first two minutes of each burn was devoted to performing a velocity traverse on both axes before sampling started for isokinetic sampling consideration since the nozzle diameter was fixed at one-half inch. Since flame impingement on the body does not occur for two to three minutes, substantial emissions of target analytes were not missed during the initial part of cremation.

Upon completion of each two-hour test segment, the sampling apparatus was removed from the stack and the crematory operator would then rake the skeletal remains toward the ignition burner for improved friability of the skeleton. This raking operation was performed after the two hour sampling period was completed and it was noted that a small quantity of light gray fly ash exited the stack for a few seconds. This ash was not sampled.

Stack gas moisture was determined for each run except for the PAH trains. The ENSECO Cal Lab analytical laboratory overlooked recording the impinger moisture catch for these trains. Since stack gas volumetric flow rates are moisture content dependent, the calculated values for the stack gas moisture content of the RT trains affected are shown in Appendix IV. As shown in Appendix IV all measured moisture values for a specific retort were time weighted and averaged to yield a percent moisture value which was assigned to these trains that was run on that specific retort. The stack testing parameters are shown in Appendix V.

The ARB test Method 100 sampling probe was alternated daily between crematories No. 1 and No. 2.

The stack gas flow conditions for each crematory are shown in Table 5.

Specific Observations for Each Test Conducted

1. Gaseous Emissions and Particulate Matter

The stack gas concentrations of oxygen, carbon dioxide and carbon monoxide in the stack gas (Table 11) averaged over the two week evaluation test were used to calculate the stack gas molecular weight for crematory No. 1 and from crematory No. 2. The stack gas molecular weights are used for calculating average stack gas volumetric flow rates and emission rates. This concentration data is also used to perform volume corrections. The hourly average gaseous emission concentrations for both crematories are shown in Tables 6 through 9. The daily average concentrations of oxygen, carbon dioxide and carbon monoxide are shown in Table 10.

No anomalies were observed during the particulate matter sample runs. Particulate matter (PM) catch includes particulate matter recovered from the nozzle and probe rinse, filter catch, after filter rinse and impinger catch. The sample weight of the PM catch is determined by the Air & Industrial Hygiene Laboratory and the data forwarded to ARB for emissions computations. The PM sample weights are shown in Appendix V. The PM sample weights are combined with their corresponding sample volumes (Appendix V) to yield the PM concentration (grain loading) shown in Tables 6 and 8. The PM concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Tables 7 and 9. The PM mass emission rates shown in Tables 12 and 13 are determined by utilizing the PM concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

2. Hydrogen Chloride and Hydrogen Fluoride

No anomalies were observed during the hydrogen chloride (HCL)/hydrogen fluoride (HF) sample runs. HCl and HF laboratory data are shown in Appendix VI. The sample weights of HCl and HF are determined by the Air & Industrial Hygiene Laboratory and the data forwarded to ARB for emissions computations. The HCl and HF sample weights are shown in Appendix VI. The HCl and HF sample weights are combined with their respective standardized sample volumes (Appendix V) to yield the HCl and HF concentrations shown in Appendix VI. The HCl and HF concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 14. The HCl and HF mass emission rates shown in Table 15 are determined by utilizing the HCl and HF concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

3. Polychlorinated dibenzo-p-dioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF)

Polychlorinated dibenzo-p-dioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) were detected in all PCDD/PCDF samples collected. The laboratory analytical data are reported in Appendix VII.

The sample weights of the PCDD and PCDF are determined by ENSECO CAL Laboratory and the data forwarded to ARB for emissions computations. The PCDD and PCDF sample weights are shown in Appendix VII. The PCDD and PCDF sample weights are combined with their respective standardized sample volumes (Appendix V) to yield the PCDD and PCDF concentrations shown in Appendix VII. The PCDD and PCDF concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 16. The PCDD and PCDF mass emission rates shown in Table 17 are determined by utilizing the PCDD and PCDF concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V. Field blank values for PCDD and PCDF shown in Table 32 were not used to adjust/correct test results or sample values.

The 2,3,7,8 TCDD toxic equivalent concentrations, corrected to 12% CO2, and mass emission rates using the California Department of Health Services "Weighting Scheme" are summarized in Tables 18 and 19.

For the individual PCDD/PCDF runs shown in Tables 16 through 19, there are three lines of summary data at the bottom of each column of emissions data. In calculating the totals in the first line, those compounds reported as less than the indicated minimum detection limit (MDL) were assigned the value of the MDL. The total in the second line includes only amounts of PCDD/PCDF detected above the MDL. The calculation of this total assumes zero concentration for those compounds not detected at levels above the MDL. The first two lines represent a range of possible values for each column total, and the entries in the two lines are identical when all of the compounds are detected at concentrations greater than the MDL. The method of calculation of the data in the third line assigns a value of MDL/2 to those compounds reported as less than the given MDL. This assumes a uniform distribution between zero and the MDL with an expected value of MDL/2. The MDL/2 values are added to the amounts of PCDD/PCDF detected above the MDL. This method is recommended by the CAPCOA Resource Recovery Subcommittee.

On October 24, 1990, 100 ml of Type 2 (deionized and distilled) water was added to sample train DT-1B because the laboratory that assembled the sample train inadvertently installed a short downspout in the second, or middle, impinger. As shown in Figure 4, the function of the second impinger is to allow the sample gas stream to bubble through water to entrain any PCDD/PCDF which may have passed through the resin cartridge. Given the small amount of PCDD/PCDF captured in the entire sampling train, it is unlikely that any PCDD/PCDF made it through the resin cartridge. Addition of 100 ml of water covered the bottom of the short downspout as originally intended in the method. On October 25, 1990, 100 ml of Type 2 water had to be added to sample trains DT-2A and DT-3B because of the same sample train assembly problem; short impinger downspouts in the same middle impinger location. The water was added to sample train DT-2A two hours into the six-hour sampling run and to DT-3B before the sampling run started. As shown in Table 17 the mass emission rates of PCDDs/PCDFs reported for test run DT-1B were considerably higher than those reported for test runs DT-2A and DT-3B. Review of field operating data forms, field test procedures and laboratory analytical data indicate no other procedural errors for the three PCDD/PCDF runs.

On the afternoon of October 26, 1990 at the start of the third segment of test run DT-3B, excessive smoke was noted exiting the No. 2 retort stack for 5 to 10 seconds. The contributing agency was contacted and it was found that the body had been excessively wrapped in plastic.

4. Polycyclic Aromatic Hydrocarbons (PAH)

The sample weights of the PAH are determined by ENSECO CAL Laboratory and the data forwarded to the ARB for emissions computations. The PAH sample weights are shown in Appendix VIII. The PAH sample weights are combined with their respective standardized sample volumes (Appendix V) to yield the PAH concentrations shown in Appendix VIII. The PAH concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 20. The PAH mass emission rates shown in Table 21 are determined by utilizing the PAH concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

For the individual PAH runs shown in Tables 20 and 21, there are three lines of summary data at the bottom of each column of emissions data. In calculating the totals in the first line, those compounds reported as less than the indicated minimum detection limit (MDL) were assigned the value of the MDL. The total in the second line includes only amounts of PAH detected above the MDL. The calculation of this total assumes zero concentration for those compounds not detected at levels above the MDL. The first two lines represent a range of possible values for each column total, and the entries in the two lines are identical when all of the compounds are detected at concentrations greater than the MDL. The method of calculation of the data in the third line assigns a value of MDL/2 to those compounds reported as less than the given MDL. The MDL/2 values are added to the amounts of PAH's detected above the MDL. This assumes a uniform distribution between zero and the MDL with an expected value of MDL/2. This is the method recommended by the CAPCOA Resource Recovery Subcommittee.

The PAH concentrations and mass emission rates cited do not include naphthalene because naphthalene is used in the manufacture and preparation of XAD-2 resin and is an inherent contaminant in the resin when shipped to analytical laboratories. The PAH laboratory data are shown in Appendix VIII.

5. Trace Metals

The metals samples were analyzed by the Air & Industrial Hygiene Laboratory using atomic absorption and inductively coupled plasma spectroscopy to determine the presence of the target metals listed in Table 4. The atomic absorption technique utilizes manual dialing of frequencies for desired metal analysis. The inductively coupled plasma spectroscopy technique automatically changes frequencies for a rapid wide range of metals analyses.

The ARB draft method allows for reagent blank corrections. Reagent blanks were not collected in the field for this test. B C Analytical provided a digestion blank which was analyzed by AIHL and the results were used to correct the silver (Ag) and beryllium (Be) data. The majority of the metals were not found significantly above field blank train levels. The field blank or field blank detection limits were greater than 50 percent of the average sample value for silver (Ag), arsenic (As), Barium (Ba), beryllium (Be), cobalt (Co), chromium (Cr), nickel (Ni), lead (Pb), antimony (Sb) and vanadium (V). The field blank or field blank detection limits were less than 50 percent of the average sample value for cadmium (Cd), copper (Cu), zinc (Zn) and mercury (Hg).

The sample weights of the trace metals are determined by the analytical laboratory and the data are forwarded to ARB for use in emissions computations. The analytical laboratory internal trace metal blank weights are subtracted from the trace metal sample weights before the trace metal sample weights are forwarded to ARB. The trace metal sample weights are shown in Appendix IX. The trace metal sample weights are combined with their respective standardized sample volumes (Appendix V) to yield the trace metal concentrations shown in Appendix IX. The trace metal concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 22. The trace metal mass emission rates shown in Table 23 are determined by utilizing the trace metal concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

On October 23, 1990, and October 24, 1990, sample trains TM-1A, TM-2B and TM-3A contained four impingers instead of six as shown in Figure 6. The first and fourth impingers were not included in the sample trains. In the six impinger configuration, the first impinger is empty to catch moisture from wet stack plumes and the fourth impinger is used to prevent carryover of nitric acid into the permanganate impinger during sampling upsets. Conversely, the fourth impinger can prevent permanganate solution from entering the nitric acid impinger when an upset in the sample train leakcheck occurs. Additionally, hydrogen peroxide was not included in the two 0.1 normal nitric acid impingers in all three trains. Hydrogen peroxide is added to the nitric acid impingers when high metals concentrations are anticipated to maintain an elevated oxidizing environment in the impinger. AIHL did not modify the nitric acid impinger catches before analysis. No other procedural anomalies were noted tha would affect the test results in Tables 22 and 23. The test results listed in Tables 22 and 23 are considered valid. The tabulated laboratory analytical results are shown in Appendix IX.

6. Chromium and Hexavalent Chromium

The total chromium found in the trace metal sample trains was determined by AIHL using the Inductively Coupled Argon Plasma technique. The laboratory analytical data from the trace metal trains are shown in Appendix IX.

In the analyses of the chromium sample trains, total chromium was determined using atomic absorption and the hexavalent chromium was determined using the diphenylcarbazide colorometric method. The Cr and Cr+6 laboratory data are shown in Appendix X.

The sample weights of the Cr and Cr+6 are determined by the analytical laboratory and the data forwarded to the ARB for emissions computations. The Cr and Cr+6 sample weights are shown in Appendices IX and X. The Cr and Cr+6 sample weights are combined with their respective standardized sample volumes (Appendix V) to yield the Cr and Cr+6 concentrations shown in Appendix X. The Cr and Cr+6 concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 24. The Cr and Cr+6 mass emission rates shown in Table 25 are determined by utilizing the Cr and Cr+6 concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

7. Volatile Organic Compounds (VOC)

Of the four compounds analyzed, toluene was the only compound with consistent positive responses. The toluene blank values were not used to correct analytical results. Concentrations of halogenated and aromatic VOC including blank values, not adjusted to 12% CO2, are shown in Appendix XI.

The sample concentrations of VOC are determined by the analytical laboratory and the data forwarded to the ARB for emissions computations. The VOC concentrations are shown in Appendix XI. The VOC concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 26. The VOC mass emission rates shown in Table 27 are determined by utilizing the VOC concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

8. Aldehydes

The Aldehyde (Formaldehyde and Acetaldehyde) test runs did not meet the ARB draft Method 430 sample/blank ratio performance criterion of five (5) so the data shown in Tables 28, 29 and Appendix III should be considered qualitative in nature only.

The stack gas volumetric flow rate used for determining the formaldehyde and acetaldehyde mass emission rates in test run ALD-1A was the arithmetic average of all volumetric flow rates determined for crematory A during the entire test program. A similar technique was used for test run ALD-2B at crematory B. Aldehyde test runs ALD-3A and ALD-4A were parallel runs performed in the crematory A stack simultaneous with test run RT-1A (Table 2) and were assigned the same stack gas volumetric flow rate as test run RT-1A. The aldehyde laboratory data are shown in Appendix III.

The sample weights and the blank weights of the aldehydes are determined by AIHL and the data forwarded to the ARB for emissions computations. The blank weights are subtracted from the sample weights by ARB. The blank-corrected aldehyde sample weights are shown in Appendix III. The aldehyde sample weights are combined with their respective standardized sample volumes (Appendix V) to yield the aldehyde concentrations shown in Appendix III. The aldehyde concentrations are adjusted to 12% CO2 by using the CO2 values listed in Table 11 and the adjusted values are shown in Table 28. The aldehyde mass emission rates shown in Table 29 are determined by utilizing the aldehyde concentrations and their respective stack gas volumetric flow rates shown in Table 5 and Appendix V.

V TEST RESULTS

Tabulated data collected from stack gas measurement activities and from each of the nine types of tests performed during the evaluation program are presented in summary form in this section. In some instances, ancillary tabulated data may be found in the appropriate appendix. A discussion of the test procedures and any modifications to these procedures are presented in previous sections. Additionally, where applicable, field observations discussed in these previous sections are included as footnotes to the applicable summary table in this section.

TABLE 5

Crematory No. 1 (A)

And

Crematory No. 2 (B)

Note: Gas Flow Conditions

TABLE 5

CREMATORY NO. 1 (A) (Upper half of Table)
AND
CREMATORY NO. 2 (B) (Lower half of Table)
GAS FLOW CONDITIONS

DATE	RUN NO.	TIME	STACK GAS VELOCITY (FT/SEC)	STACK GAS FLOW RATE (DSCFM)	MOISTURE CONTENT_1/ (% BY VOL.)	STACK GAS TEMPERATURE (DEG. F)
10-23-90	TM-1A	1115-1730	21.26	865	6.8	1127
10-24-90	TM-3A	0937-1700	14.98	646	7.4	1030
10-25-90	DT-2A	0930-1600	-	-	-	-
10-26-90	DT-2A	0930-1130	14.23	598	7.3	1070
10-26-90	M5-1A	1405-1615	16.74	657	6.5	1193
10-29-90	HCL-1A	0945-1200	13.18	562	7.6	1043
10-29-90	HCL-2A	1425-1615	14.90	566	8.8	1206
10-30-90	ALD-1A	1420-1520	-	676	-	-
10-31-90	RT-1A	0945-1610	13.74	533	7.0	1162
10-31-90	ALD-3A	1355-1455	-	533	-	-
10-31-90	ALD-4A	1355-1455	-	533	-	-
11-01-90	RT-3A	0907-1540	19.27	789	7.0	1123
11-02-90	CR-2A	0900-1615	19.52	865	5.6	1022
10-23-90	TM-2B	1030-1700	15.60	788	6.7	821
10-24-90	DT-1B	0935-1600	-	-	-	-
10-25-90	DT-1B	0930-1130	16.76	647	8.3	1188
10-25-90	DT-3B	1340-1545	-	-	-	-
10-26-90	DT-3B	0935-1600	16.48	663	7.2	1141
10-29-90	M5-2B	0940-1145	14.99	639	8.7	1024
10-29-90	M5-3B	1430-1630	16.10	676	7.8	1062
10-30-90	HCL-3B	0900-1110	13.00	647	8.8	810
10-30-90	ALD-2B	1423-1523	-	703	-	-
10-31-90	RT-2B	0945-1615	14.59	577	7.8	1140
11-01-90	CR-1B	0910-1545	20.17	821	8.3	1106
11-02-90	CR-3B	0900-1620	20.91	873	7.6	1080

NOTE : _1/ RT Train Moisture Calculated (See Appendix II)

NOTE : Stack gas volumetric flow rates were calculated utilizing the average O2, CO2, and CO values for the entire test.

NOTE : Stack gas volumetric flow rates for aldehyde sampling runs ALD-1A and Ald-2B are calculated averages from their respective crematories. Stack gas volumetric flow rates for aldehyde sampling runs ALD-3A and ALD-4A are the same as sampling run RT-1A.

TABLE 6
HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO. 1 STACK GAS

TABLE 7
HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO. 1 STACK GAS (CORRECTED TO 12% CO2)

TABLE 8
HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO. 2 STACK GAS

TABLE 9
HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO. 2 STACK GAS (CORRECTED TO 12% CO2)

TABLE 6

HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO.1 STACK GAS

				a/	a/	a/			b/
DATE	RUN NO.	TIME	PM	O2	CO2	CO	NOX	SO2	HC
			GR/DSCF	%	%	PPMV	PPMV	PPMV	PPMV
10-23-90	TM-1A	1115-1215	-	15.5	3.5	250	60	< 1	< 1
	TM-1A	1215-1315	-	15.0	4.0	60	50	< 1	< 1
	TM-1A	1515-1615	-	12.0	6.0	20	90	10	< 1
	TM-1A	1615-1715	-	15.5	3.5	30	55	2	< 1
10-24-90	TM-3A	0937-1037	-	-	-	-	-	-	-
	TM-3A	1037-1137	-	-	-	-	-	-	-
	TM-3A	1400-1500	-	-	-	-	-	-	-
	TM-3A	1500-1700	-	-	-	-	-	-	-
10-25-90	DT-2A	0930-1030	-	15.5	4.0	25	60	5	< 1
	DT-2A	1030-1130	-	16.5	3.0	50	35	< 1	< 1
	DT-2A	1340-1440	-	13.5	5.5	15	70	10	< 1
	DT-2A	1440-1540	-	16.5	3.0	20	40	< 1	< 1
10-26-90	DT-2A	0930-1030	-	-	-	-	-	-	-
	DT-2A	1030-1130	-	-	-	-	-	-	-
	M5-1A	1405-1505		-	-	-	-	-	-
	M5-1A	1505-1605	0.008	-	-	-	-	-	-
10-29-90	HCL-1A	0945-1045	-	14.5	4.5	30	70	5	< 1
	HCL-1A	1045-1145	-	15.0	3.5	75	65	2	< 1
	HCL-2A	1425-1525	-	13.0	6.5	20	100	50	< 1
	HCL-2A	1525-1625	-	14.5	4.5	25	80	35	< 1
10-30-90	ALD-1A	1420-1520	-	-	-	-	-	-	-
10-31-90	RT-1A	0945-1045	-	14.0	5.5	35	75	4	< 1
	RT-1A	1045-1145	-	15.5	3.5	50	45	< 1	< 1
	RT-1A	1400-1500	-	11.0	8.0	20	120	20	< 1
	RT-1A	1500-1600	-	15.0	4.0	25	50	1	< 1
	ALD-3A	1355-1455	-	-	-	-	-	-	-
	ALD-4A	1355-1455	-	-	-	-	-	-	-
11-01-90	RT-3A	0907-1007	-	-	-	-	-	-	-
	RT-3A	1007-1107	-	-	-	-	-	-	-
	RT-3A	1330-1430	-	-	-	-	-	-	-
	RT-3A	1430-1530	-	-	-	-	-	-	-
11-02-90	CR-2A	0900-1000	-	14.5	5.5	45	90	5	< 1
	CR-2A	1000-1100	-	15.5	3.5	60	50	2	< 1
	CR-2A	1410-1510	-	14.0	4.5	30	90	5	< 1
	CR-2A	1510-1610	-	NA	NA	NA	NA	NA	NA

a/ O2,CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

b/ HC data reported as propane.

Symbol (<) indicates below detectable limit.

NA- Stack gas analyzers inoperative.

C-90-004

TABLE 7

HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO.1 STACK GAS

DATE	RUN NO.	TIME	a/ PM	b/ O2	b/ CO2	ab/ CO	a/ NOX	a/ SO2	ac/ HC
			GR/DSCF	%	%	PPMV	PPMV	PPMV	PPMV
10-23-90	TM-1A	1115-1215	-	15.5	3.5	857	206	< 3	< 3
	TM-1A	1215-1315	-	15.0	4.0	180	150	< 3	< 3
	TM-1A	1515-1615	-	12.0	6.0	40	180	20	< 2
	TM-1A	1615-1715	-	15.5	3.5	103	189	7	< 3
10-24-90	TM-3A	0937-1037	-	-	-	-	-	-	-
	TM-3A	1037-1137	-	-	-	-	-	-	-
	TM-3A	1400-1500	-	-	-	-	-	-	-
	TM-3A	1500-1700	-	-	-	-	-	-	-
10-25-90	DT-2A	0930-1030	-	15.5	4.0	75	180	15	< 3
	DT-2A	1030-1130	-	16.5	3.0	200	140	< 4	< 4
	DT-2A	1340-1440	-	13.5	5.5	33	153	22	< 2
	DT-2A	1440-1540	-	16.5	3.0	80	160	< 4	< 4
10-26-90	DT-2A	0930-1030	-	-	-	-	-	-	-
	DT-2A	1030-1130	-	-	-	-	-	-	-
	M5-1A	1405-1505		-	-	-	-	-	-
	M5-1A	1505-1605	0.021	-	-	-	-	-	-
10-29-90	HCL-1A	0945-1045	-	14.5	4.5	80	187	13	< 3
	HCL-1A	1045-1146	-	15.0	3.5	257	223	7	< 3
	HCL-2A	1425-1525	-	13.0	6.5	37	185	92	< 2
	HCL-2A	1525-1625	-	14.5	4.5	67	213	93	< 3
10-30-90	ALD-1A	1420-1520	-	-	-	-	-	-	-
10-31-90	RT-1A	0945-1045	-	14.0	5.5	76	164	9	< 2
	RT-1A	1045-1145	-	15.5	3.5	171	154	< 3	< 3
	RT-1A	1400-1500	-	11.0	8.0	30	180	30	< 2
	RT-1A	1500-1600	-	15.0	4.0	75	150	3	< 3
	ALD-3A	1355-1455	-	-	-	-	-	-	-
	ALD-4A	1355-1455	-	-	-	-	-	-	-
11-01-90	RT-3A	0907-1007	-	-	-	-	-	-	-
	RT-3A	1007-1107	-	-	-	-	-	-	-
	RT-3A	1330-1430	-	-	-	-	-	-	-
	RT-3A	1430-1530	-	-	-	-	-	-	-
11-02-90	CR-2A	0900-1000	-	14.5	5.5	98	196	11	< 2
	CR-2A	1000-1100	-	15.5	3.5	206	171	7	< 3
	CR-2A	1410-1510	-	14.0	4.5	80	240	13	< 3
	CR-2A	1510-1610	-	NA	NA	NA	NA	NA	NA

a/ Concentration reported is corrected to 12% CO2

b/ O2,CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

c/ HC data reported as propane.

Symbol (<) indicates below detectable limit.

NA- Stack gas analyzers inoperative. C-90-004

TABLE 8

HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO.2 STACK GAS

DATE	RUN NO.	TIME	PM	a/ O2	a/ CO2	a/ CO	NOX	SO2	b/ HC
			GR/DSCF	%	%	PPMV	PPMV	PPMV	PPMV
10-23-90	TM-2B	1030-1130	-	-	-	-	-	-	-
	TM-2B	1130-1230	-	-	-	-	-	-	-
	TM-2B	1500-1600	-	-	-	-	-	-	-
	TM-2B	1600-1700	-	-	-	-	-	-	-
10-24-90	DT-1B	0935-1035	-	NA	NA	NA	85	< 1	< 1
	DT-1B	1035-1135	-	16.5	3.0	30	35	< 1	< 1
	DT-1B	1400-1500	-	11.5	7.0	20	110	30	< 1
	DT-1B	1500-1700	-	15.5	3.5	50	60	< 1	< 1
10-25-90	DT-1B	0930-1030	-	-	-	-	-	-	-
	DT-1B	1030-1130	-	-	-	-	-	-	-
	DT-3B	1340-1440	-	-	-	-	-	-	-
	DT-3B	1440-1540	-	-	-	-	-	-	-
10-26-90	DT-3B	0935-1035	-	13.5	5.0	50	70	5	< 1
	DT-3B	1035-1135	-	16.5	3.0	90	40	< 1	< 1
	DT-3B	1355-1455	-	13.0	5.0	30	90	10	< 1
	DT-3B	1455-1555	-	16.0	3.0	75	35	< 1	< 1
10-29-90	M5-2B	0940-1040		-	-	-	-	-	-
	M5-2B	1040-1140	0.008	-	-	-	-	-	-
	M5-3B	1430-1530		-	-	-	-	-	-
	M5-3B	1530-1630	0.008	-	-	-	-	-	-
10-30-90	HCL-3B	0900-1000	-	13.0	6.0	20	85	7	< 1
	HCL-3B	1000-1100	-	15.5	3.5	120	50	< 1	< 1
	ALD-2B	1423-1523	-	7.0	10.0	20	NA	NA	< 1
10-31-90	RT-2B	0945-1045	-	-	-	-	-	-	-
	RT-2B	1045-1145	-	-	-	-	-	-	-
	RT-2B	1400-1500	-	-	-	-	-	-	-
	RT-2B	1500-1600	-	-	-	-	-	-	-
11-01-90	CR-1B	0910-1010	-	11.5	7.0	40	75	30	< 1
	CR-1B	1010-1110	-	16.5	3.0	75	30	1	5
	CR-1B	1325-1425	-	12.5	6.0	40	85	15	< 1
	CR-1B	1425-1525	-	15.5	3.5	70	55	5	3
11-02-90	CR-3B	0900-1000	-	-	-	-	-	-	-
	CR-3B	1000-1100	-	-	-	-	-	-	-
	CR-3B	1410-1510	-	-	-	-	-	-	-
	CR-3B	1510-1610	-	NA	NA	NA	NA	NA	NA

a/ O2,CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

b/ HC data reported as propane.

Symbol (<) indicates below detectable limit.

NA- Stack gas analyzers inoperative.

C-90-004

TABLE 9

HOURLY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, CARBON MONOXIDE, OXIDES OF NITROGEN, SULFUR DIOXIDE, TOTAL HYDROCARBONS AND PARTICULATE MATTER IN THE CREMATORY NO.2 STACK GAS

			a/	b/	b/	ab/	a/	a/	ac/
DATE	RUN NO.	TIME	PM	O2	CO2	CO	NOX	SO2	HC
			GR/DSCF	%	%	PPMV	PPMV	PPMV	PPMV
10-23-90	TM-2B	1030-1130	-	-	-	-	-	-	-
	TM-2B	1130-1230	-	-	-	-	-	-	-
	TM-2B	1500-1600	-	-	-	-	-	-	-
	TM-2B	1600-1700	-	-	-	-	-	-	-
10-24-90	DT-1B	0935-1035	-	NA	NA	NA	NA	NA	NA
	DT-1B	1035-1135	-	16.5	3	120	140	< 4	< 4
	DT-1B	1400-1500	-	11.5	7	34	189	51	< 2
	DT-1B	1500-1700	-	15.5	3.5	171	206	< 3	< 3
10-25-90	DT-1B	0930-1030	-	-	-	-	-	-	-
	DT-1B	1030-1130	-	-	-	-	-	-	-
	DT-3B	1340-1440	-	-	-	-	-	-	-
	DT-3B	1440-1540	-	-	-	-	-	-	-
10-26-90	DT-3B	0935-1035	-	13.5	5.0	120	168	12	< 2
	DT-3B	1035-1135	-	16.5	3.0	360	160	< 4	< 4
	DT-3B	1355-1455	-	13.0	5.0	72	216	24	< 2
	DT-3B	1455-1555	-	16.0	3.0	300	140	< 4	< 4
10-29-90	M5-2B	0940-1040		-	-	-	-	-	-
	M5-2B	1040-1140	0.019	-	-	-	-	-	-
	M5-3B	1430-1530		-	-	-	-	-	-
	M5-3B	1530-1630	0.019	-	-	-	-	-	-
10-30-90	HCL-3B	0900-1000	-	13.0	6.0	40	170	14	< 2
	HCL-3B	1000-1100	-	15.5	3.5	411	171	< 3	< 3
	ALD-2B	1423-1523	-	7.0	10.0	24	NA	NA	< 1
10-31-90	RT-2B	0945-1045	-	-	-	-	-	-	-
	RT-2B	1045-1145	-	-	-	-	-	-	-
	RT-2B	1400-1500	-	-	-	-	-	-	-
	RT-2B	1500-1600	-	-	-	-	-	-	-
11-01-90	CR-1B	0910-1010	-	11.5	7.0	69	129	51	< 2
	CR-1B	1010-1110	-	16.5	3.0	300	120	4	20
	CR-1B	1325-1425	-	12.5	6.0	80	170	30	< 2
	CR-1B	1425-1525	-	15.5	3.5	240	189	17	10
11-02-90	CR-3B	0900-1000	-	-	-	-	-	-	-
	CR-3B	1000-1100	-	-	-	-	-	-	-
	CR-3B	1410-1510	-	-	-	-	-	-	-
	CR-3B	1510-1610	-	NA	NA	NA	NA	NA	NA

a/ Concentration reported is corrected to 12% CO2

b/ O2,CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

c/ HC data reported as propane.

Symbol (<) indicates below detectable limit.

NA- Stack gas analyzers inoperative.

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TABLE 10
DAILY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, AND CARBON MONOXIDE IN STACK GAS FOR CREMATORIES NO. 1 AND NO. 2

TABLE 11
AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE AND CARBON MONOXIDE IN STACK GAS FOR ENTIRE TEST

TABLE 12
DAILY AVERAGE CRITERIA POLLUTANT EMISSIONS RATE (LBS/HR)
CREMATORY NO. 1

TABLE 13
DAILY AVERAGE CRITERIA POLLUTANT EMISSIONS RATE (LBS/HR)
CREMATORY NO. 2

TABLE 10

DAILY AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE, AND CARBON MONOXIDE IN STACK GAS FOR CREMATORIES NO.1 AND NO.2

			CREMATORY NO.1			CREMATORY NO.2		
DATE	RUN NO.	TIME	a/ O2 %	a/ CO2 %	a/ CO PPMV	a/ O2 %	a/ CO2 %	a/ CO PPMV
10-23-90	TM-1A	1115-1715	14.5	4.3	90	-	-	-
10-23-90	TM-2B	1030-1700	-	-	-	-	-	-
10-24-90	TM-3A	0937-1700	-	-	-	-	-	-
10-24-90	DT-1B	0935-1700	-	-	-	14.5	4.5	33
10-25-90	DT-2A	0930-1540	15.5	3.9	28	-	-	-
10-25-90	DT-1B	0930-1130	-	-	-	-	-	-
10-25-90	DT-3B	1340-1540	-	-	-	-	-	-
10-26-90	DT-2A	0930-1605	-	-	-	-	-	-
10-26-90	DT-3B	0935-1555	-	-	-	14.8	4.0	61
10-29-90	HCL-1A	0945-1625	14.3	4.8	38	-	-	-
10-29-90	M5-2B	0940-1140	-	-	-	-	-	-
10-29-90	M5-3B	1430-1630	-	-	-	-	-	-
10-30-90	ALD-1A	1420-1520	-	-	-	-	-	-
10-30-90	HCL-3B	0900-1100	-	-	-	11.6	6.9	48
10-30-90	ALD-2B	1423-1523	-	-	-	-	-	-
10-31-90	RT-1A	0945-1600	13.9	5.3	33	-	-	-
10-31-90	ALD-3A	1355-1455	-	-	-	-	-	-
10-31-90	ALD-4A	1355-1455	-	-	-	-	-	-
10-31-90	RT-2B	0945-1600	-	-	-	-	-	-
11-01-90	RT-3A	0907-1530	-	-	-	-	-	-
11-01-90	CR-1B	0910-1525	-	-	-	14.0	4.9	56
11-02-90	CR-2A	0900-1610	14.7	4.5	45	-	-	-
11-02-90	CR-3B	0900-1610	-	-	-	-	-	-

NOTE: The Method 100 gas van sample probe was dedicated to one retort per day.

a/ O2, CO2 and CO values were used to determine the molecular weight of the stack gas and mass emission rates.

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 11

AVERAGE CONCENTRATIONS OF OXYGEN, CARBON DIOXIDE AND CARBON MONOXIDE IN STACK GAS FOR ENTIRE TEST

	CREMATORY NO.1			CREMATORY NO.2		
DATE	O2 %	CO2 %	CO PPMV	O2 %	CO2 %	CO PPMV
10-23-90 THRU 11-02-90	14.58	4.56	47	13.73	5.08	50

NOTE: The Method 100 gas van sample probe was dedicated to one retort per day. The average values shown in this table were used for all concentration and mass emission rates for the respective crematories.

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TABLE 12

DAILY AVERAGE CRITERIA
POLLUTANT EMISSIONS RATE (LBS/HR) 1/
CREMATORY NO.1

DATE	CO	NOx 2/	THC 3/	SO2	PM
10-23-90	0.34	0.40	<0.006	0.03	-
10-25-90	0.07	0.22	<0.004	0.02	-
10-26-90	-	-	-	-	0.04
10-29-90	0.09	0.32	<0.004	0.13	-
10-31-90	0.08	0.28	<0.004	0.04	-
11-02-90	0.17	0.48	<0.006	0.03	-

1/ Mass emission rates based on two
2-hour body cremations per day

2/ reported as NO2

3/ reported as propane C-90-004

TABLE 13

DAILY AVERAGE CRITERIA
POLLUTANT EMISSIONS RATE (LBS/HR) 1/
CREMATORY NO.2

DATE	CO	2/ NOx	3/ THC	SO2	PM
10-24-90	0.09	0.34	<0.004	0.05	-
10-26-90	0.18	0.28	<0.005	0.03	-
10-29-90	-	-	-	-	0.045
10-30-90	0.14	0.32	<0.004	0.03	-
11-01-90	0.20	0.36	0.011	0.11	-

1/ Mass emission rates based on two 2-hour body cremations per day

2/ reported as NO2

3/ reported as propane

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TABLE 14
HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE CONCENTRATIONS (CORRECTED TO 12% CO2) (MG/DSCM)

TABLE 15
HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE MASS EMISSION RATES, MG/SEC

TABLE 14

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE CONCENTRATIONS (CORRECTED TO 12% CO2)
(mg/dscm)

SAMPLE ID	HCL-1A	HCL-2A	HCL-3B
HCl	25.13	58.70	39.87
HF	0.063	0.875	0.222

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

TABLE 15

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE MASS EMISSION RATES, mg/sec

SAMPLE ID	HCL-1A	HCL-2A	HCL-3B
HCl	2.53	5.96	5.15
HF	0.006	0.089	0.029

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 16
PCDD/PCDF CONCENTRATIONS (CORRECTED TO 12% CO2) (NG/DSCM)

TABLE 17
PCDD/PCDF MASS EMISSION RATES (NG/SEC)

TABLE 18
PCDD/PCDF TOXIC EQUIVALENT CONCENTRATION USING CA DOHS WEIGHTING SCHEME (CORRECTED TO 12% CO2), NG/DSCM

TABLE 19
PCDD/PCDF TOXIC EQUIVALENT MASS EMISSION RATES USING CA DOHS WEIGHTING SCHEME (NG/SEC)

TABLE 16

PCDD/PCDF CONCENTRATIONS
(CORRECTED TO 12% CO2)
(ng/dscm)

	CREMATORY STACK		
	DT-1B	DT-2A	DT-3B
DIOXINS			
2,3,7,8-TCDD	0.074	0.016	0.020
Total TCDD	1.471	0.163	0.453
1,2,3,7,8-PeCDD	0.215	0.033	0.093
Total PeCDD	2.489	0.401	0.349
1,2,3,4,7,8-HxCDD	0.305	0.045	0.058
1,2,3,6,7,8-HxCDD	0.464	0.048	0.076
1,2,3,7,8,9-HxCDD	0.622	0.037	0.070
Total HxCDD	6.222	0.883	1.278
1,2,3,4,6,7,8-HpCDD	4.073	0.333	1.162
Total HpCDD	8.485	0.748	2.731
Total OCDD	4.978	0.605	3.312
TOTAL PCDD:			
INCLUDING MDLs	23.644	2.800	8.124
EXCLUDING MDLs	23.644	2.800	8.124
MID RANGE	23.644	2.800	8.124
FURANS			
2,3,7,8-TCDF	0.390	0.367	0.071
Total TCDF	12.444	2.107	1.801
1,2,3,7,8-PeCDF	0.328	0.082	< 0.070
2,3,4,7,8-PeCDF	0.848	0.479	< 0.087
Total PeCDF	7.919	1.563	0.169
1,2,3,4,7,8-HxCDF	0.962	0.313	0.163
1,2,3,6,7,8-HxCDF	0.962	0.163	0.151
1,2,3,7,8,9-HxCDF	1.810	0.353	0.325
2,3,4,6,7,8-HxCDF	0.362	0.090	0.064
Total HxCDF	12.444	2.039	1.743
1,2,3,4,6,7,8-HpCDF	5.600	0.680	< 0.988
1,2,3,4,7,8,9-HpCDF	0.379	< 0.039	< 0.026
Total HpCDF	6.788	0.748	< 0.988
Total OCDF	1.301	0.353	0.755
TOTAL PCDF:			
INCLUDES MDLs	40.895	6.809	5.457
EXCLUDES MDLs	40.895	6.809	4.469
MID RANGE	40.895	6.809	4.963

NOTES

dscm	dry standard cubic meter at 68 F and one atmosphere
<	Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B) C-90-004

TABLE 17

PCDD/PCDF MASS EMISSION RATES

(ng/sec)

	CREMATORY STACK		
	DT-1B	DT-2A	DT-3B
DIOXINS			
2,3,7,8-TCDD	0.010	0.002	0.003
Total TCDD	0.190	0.017	0.060
1,2,3,7,8-PeCDD	0.028	0.004	0.012
Total PeCDD	0.322	0.043	0.046
1,2,3,4,7,8-HxCDD	0.039	0.005	0.008
1,2,3,6,7,8-HxCDD	0.060	0.005	0.010
1,2,3,7,8,9-HxCDD	0.080	0.004	0.009
Total HxCDD	0.804	0.095	0.169
1,2,3,4,6,7,8-HpCDD	0.526	0.036	0.154
Total HpCDD	1.097	0.080	0.362
Total OCDD	0.643	0.065	0.439
TOTAL PCDD			
INCLUDES MDLs	3.056	0.300	1.076
EXCLUDES MDLs	3.056	0.300	1.076
MID RANGE	3.056	0.300	1.076
FURANS			
2,3,7,8-TCDF	0.050	0.039	0.009
Total TCDF	1.609	0.226	0.239
1,2,3,7,8-PeCDF	0.042	0.009	<0.009
2,3,4,7,8-PeCDF	0.110	0.051	<0.012
Total PeCDF	1.024	0.168	0.022
1,2,3,4,7,8-HxCDF	0.124	0.034	0.022
1,2,3,6,7,8-HxCDF	0.124	0.017	0.020
1,2,3,7,8,9-HxCDF	0.234	0.038	0.043
2,3,4,6,7,8-HxCDF	0.047	0.010	0.008
Total HxCDF	1.609	0.219	0.231
1,2,3,4,6,7,8-HpCDF	0.724	0.073	<0.131
1,2,3,4,7,8,9-HpCDF	0.049	<0.004	<0.003
Total HpCDF	0.877	0.080	<0.131
Total OCDF	0.168	0.038	0.100
TOTAL PCDF:			
INCLUDES MDLs	5.286	0.730	0.723
EXCLUDES MDLs	5.286	0.730	0.592
MID RANGE	5.286	0.730	0.657

NOTES

< Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

TABLE 18

PCDD/PCDF TOXIC EQUIVALENT CONCENTRATION USING CA DOHS WEIGHTING SCHEME (CORRECTED TO 12% CO2), ng/dscm

		CREMATORY STACK		
	Toxic Equivalence Factor	DT-1B	DT-2A	DT-3B
DIOXINS				
2378 TCDD	1.00	0.0735	0.0156	0.0198
123478 PeCDD	1.00	0.2149	0.0333	0.0930
123478 HxCDD	0.03	0.0092	0.0013	0.0017
123678 HxCDD	0.03	0.0139	0.0014	0.0023
123789 HxCDD	0.03	0.0187	0.0011	0.0021
1234678 HpCDD	0.03	0.1222	0.0100	0.0349
TOTAL PCDD				
INCLUDES MDLs		0.4524	0.0628	0.1537
EXCLUDES MDLs		0.4524	0.0628	0.1537
FURANS				
2378 TCDF	1.00	0.3903	0.3670	0.0715
12378 PeCDF	1.00	0.3281	0.0815	< 0.0697
23478 PeCDF	1.00	0.8485	0.4791	< 0.0872
123478 HxCDF	0.03	0.0288	0.0094	0.0049
123678 HxCDF	0.03	0.0288	0.0049	0.0045
123789 HxCDF	0.03	0.0543	0.0106	0.0098
234678 HxCDF	0.03	0.0109	0.0027	0.0019
1234678 HpCDF	0.03	0.1680	0.0204	< 0.0296
1234789 HpCDF	0.03	0.0114	< 0.0012	< 0.0008
TOTAL PCDF:				
INCLUDES MDLs		1.8690	0.9767	0.2799
EXCLUDES MDLs		1.8690	0.9756	0.0926
Total Toxic Equivalent (2,3,7,8-TCDD Equivalents)				
INCLUDES MDLs		2.3214	1.0396	0.4336
EXCLUDES MDLs		2.3214	1.0384	0.2463
MID RANGE		2.3214	1.0390	0.3399

NOTES

dscm dry standard cubic meter at 68 F and one atmosphere

< Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE 19

PCDD/PCDF TOXIC EQUIVALENT MASS EMISSION RATES USING CA DOHS WEIGHTING SCHEME (ng/sec)

		CREMATORY STACK		
	Toxic Equivalence Factor	DT-1B	DT-2A	DT-3B
DIOXINS				
2378 TCDD	1.00	0.0095	0.0017	0.0026
123478 PeCDD	1.00	0.0278	0.0036	0.0123
123478 HxCDD	0.03	0.0012	0.0001	0.0002
123678 HxCDD	0.03	0.0018	0.0002	0.0003
123789 HxCDD	0.03	0.0024	0.0001	0.0003
1234678 HpCD	0.03	0.0158	0.0011	0.0046
TOTAL PCDD:				
INCLUDES MDLs		0.0585	0.0067	0.0204
EXCLUDES MDLs		0.0585	0.0067	0.0204
FURANS				
2378 TCDF	1.00	0.0505	0.0394	0.0095
12378 PeCDF	1.00	0.0424	0.0087	< 0.0092
23478 PeCDF	1.00	0.1097	0.0514	< 0.0115
123478 HxCDF	0.03	0.0037	0.0010	0.0006
123678 HxCDF	0.03	0.0037	0.0005	0.0006
123789 HxCDF	0.03	0.0070	0.0011	0.0013
234678 HxCDF	0.03	0.0014	0.0003	0.0003
1234678 HpCD	0.03	0.0217	0.0022	< 0.0039
1234789 HpCD	0.03	0.0015	< 0.0001	< 0.0001
TOTAL PCDF				
INCLUDES MDLs		0.2416	0.1048	0.0371
EXCLUDES MDLS		0.2416	0.1046	0.0123
TOTAL TOXIC EQUIVALENTS (2,3,7,8-TCDD Equivalents)				
INCLUDES MDLs		0.3001	0.1115	0.0574
EXCLUDES MDLs		0.3001	0.1114	0.0326
MID RANGE		0.3001	0.1114	0.0450

NOTES

< Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE 20
PAH CONCENTRATIONS
(CORRECTED TO 12% CO2)
(NG/DSCM)

TABLE 21
PAH MASS EMISSION RATES (NG/SEC)

TABLE 20
PAH CONCENTRATIONS
(CORRECTED TO 12% CO2)
(ng/dscm)

	CREMATORY STACK		
RUN #	RT-1A	RT-2B	RT-3A
Naphthalene	41941 s	39362 s	30165 s
Acenaphthylene	55.18	112.4	32.54
Acenaphthene	73.94	55.29	51.59
Fluorene	209.7	318.6	150.8
Phenanthrene	596.0	2249.	793.8
Anthracene	110.3	299.9	111.1
Fluoranthene	54.08	206.1	67.47
Pyrene	61.80	121.8	73.03
Benzo(a)anthracene	<4.856 w	10.30	<5.794 w
Chrysene	<13.24 w	74.03	<13.49 w
Benzo(b)fluoranthene	<12.14 w	<9.090 w	<5.318 w
Benzo(k)fluoranthene	<9.602 w	<8.903 w	<5.080 w
Benzo(a)pyrene	<12.14	<13.12	29.37
Dibenzo(a,h)anthracene	<8.940	<7.778	<4.445
Benzo(g,h,i)perylene	<14.34	<13.12	<18.25 w
Indeno(1,2,3-c,d)pyrene	<9.602	<11.24	<4.762
TOTAL PAHs			
Not including naphthalene			
INCLUDES MDLs	1245.	3511.	1366.
EXCLUDES MDLs	1161.	3447.	1309.
MID RANGE	1203.	3479.	1338.
Including naphthalene	43187 *	42873 *	31532 *

NOTES

dscm - dry standard cubic meter at 68 F and one atmosphere

< indicates below reporting limit

* - Total includes reporting limits for compounds not detected

s Secondary ion used for quantitation.

w MPC - Maximum Possible Concentration.

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 21
PAH MASS EMISSION RATES (ng/sec)

	CREMATORY STACK		
	RT-1A	RT-2B	RT-3A
Naphthalene	4084 s	4577 s	4258 s
Acenaphthylene	5.374	13.077	4.594
Acenaphthene	7.201	6.430	7.283
Fluorene	20.422	37.052	21.288
Phenanthrene	58.040	262	112
Anthracene	10.748	34.872	15.686
Fluoranthene	5.267	23.975	9.524
Pyrene	6.019	14.167	10.308
Benzo(a)anthracene	< 0.473 w	1.199	< 0.818 w
Chrysene	< 1.290 w	8.609	< 1.905 w
Benzo(b)fluoranthene	< 1.182 w	< 1.057 w	< 0.751 w
Benzo(k)fluoranthene	< 0.935 w	< 1.035 w	< 0.717 w
Benzo(a)pyrene	< 1.182	< 1.526	4.146
Dibenzo(a,h)anthracene	< 0.871	< 0.905	< 0.627
Benzo(g,h,i)perylene	< 1.397	< 1.526	< 2.577 w
Indeno(1,2,3-c,d)pyrene	< 0.935	< 1.308	< 0.672
TOTAL PAHs			
Not including naphthalene			
INCLUDES MDLs	121	408	193
EXCLUDES MDLs	113	401	185
MID RANGE	117	405	189
Including naphthalene	4206 *	4985 *	4451 *

NOTES

< indicates below reporting limit

* - Total includes reporting limits for compounds

s Secondary ion used for quantitation.

w MPC - Maximum Possible Concentration.

CREMATORY STACK LETTER DESIGNATION:

CREMATORY NO.1 (A)

TABLE 22
TRACE METAL CONCENTRATIONS
(CORRECTED TO 12% CO2)
(UG/DSCM)

TABLE 23
TRACE METAL MASS EMISSION RATES
(UG/SEC)

TABLE 22

TRACE METAL CONCENTRATIONS
(CORRECTED TO 12 % CO2)
(ug/dscm)

		CREMATORY STACK		
SAMPLE ID		TM-1A	TM-2B	TM-3A
Ag	*	5.0	2.5	1.8
As		25.1	< 11.5	< 14.9
Ba		10.6	11.3	9.8
Be	*	1.0	0.3	0.4
Cd		3.8	5.4	5.5
Co		0.7	0.7	< 7.3
Cr		9.3	12.2	19.8
Cu		11.9	9.7	15.5
Hg		1934.0	55.3	2708.5
Mo		< 7.1	< 6.9	< 8.9
Ni		15.4	16.7	18.8
Pb		25.6	29.4	33.9
Sb		< 13.3	15.8	19.0
Se		< 18.2	< 17.8	< 22.9
Tl		< 35.5	< 34.6	< 44.6
V		23.9	23.0	31.2
Zn		116.8	147.2	220.4

(<) Below limit of detection.
(*) corrected for laboratory digestion blank:
Ag: laboratory blank 49% to 77% of uncorrected sample value
Be: laboratory blank 70% to 89% of uncorrected sample value

(**) Field blanks or field blank detection limit:
(>) 50% for Ag, As, Ba, Be, Co, Cr, Ni, Pb, Sb, V
(<) 50% for Cd, Cu, Zn, Hg

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 23

TRACE METAL MASS EMISSION RATES
(ug/sec)

	CREMATORY STACK		
SAMPLE ID	TM-1A	TM-2B	TM-3A
Ag	* 0.78	0.39	0.21
As	3.90	< 1.82	< 1.72
Ba	1.64	1.78	1.13
Be	* 0.16	0.05	0.05
Cd	0.60	0.86	0.64
Co	0.11	0.11	< 0.84
Cr	1.44	1.92	2.29
Cu	1.85	1.52	1.80
Hg	300.03	8.71	313.79
Mo	< 1.10	< 1.09	< 1.03
Ni	2.40	2.64	2.18
Pb	3.97	4.62	3.93
Sb	< 2.06	2.49	2.20
Se	< 2.82	< 2.79	< 2.65
Tl	< 5.50	< 5.45	< 5.17
V	3.70	3.62	3.62
Zn	18.11	23.17	25.53

(<) Below limit of detection.
(*) corrected for laboratory digestion blank:
Ag: laboratory blank 49% to 77% of uncorrected sample value
Be: laboratory blank 70% to 89% of uncorrected sample value

(**) Field blanks or field blank detection limit:
(>) 50% for Ag, As, Ba, Be, Co, Cr, Ni, Pb, Sb, V
(<) 50% for Cd, Cu, Zn, Hg

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 24
CHROMIUM AND HEXAVALENT CHROMIUM CONCENTRATION, CORRECTED TO 12% CO2 (UG/DSCM)

TABLE 25
CHROMIUM AND HEXAVALENT CHROMIUM MASS EMISSION RATES, UG/SECOND

TABLE 24

CHROMIUM AND HEXAVALENT CHROMIUM CONCENTRATION, CORRECTED TO 12% CO_2 (ug/dscm)

	CREMATORY STACK		
SAMPLE ID	CR-1B	CR-2A	CR-3B
Cr	< 12.4	< 14.7	< 15.4
Cr+6	7.52	3.506	4.49

< Indicates below limit of detection (MDL)
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 25

CHROMIUM AND HEXAVALENT CHROMIUM MASS EMISSION RATES, ug/second

	CREMATORY STACK		
SAMPLE ID	CR-1B	CR-2A	CR-3B
Cr	< 2.0	< 2.3	< 2.7
Cr+6	1.23	0.54	0.78

< Indicates below limit of detection (MDL)
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 26
HALOGENATED AND AROMATIC VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS (CORRECTED TO 12% CO2)

TABLE 27
HALOGENATED AND AROMATIC ORGANIC COMPOUNDS MASS EMISSION RATES, MG/SEC

TABLE 26

HALOGENATED AND AROMATIC VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS (CORRECTED TO 12% CO2)

		BENZENE	TOLUENE	XYLENES	VINYL-Cl
DATE	SAMPLE ID	ppbC	ppbC	ppbC	ppb
10-25-90	BS1A	*	263	*	**
	BS2A	*	71	*	**
	BLANK	*	55	29	**
10-29-90	BS3B	*	57	*	**
	BS4B	*	*	*	**
	BLANK	*	*	*	**
10-30-90	BS5B	*	45	*	**
	BS6B	*	*	*	**
	BLANK	*	94	47	**
10-31-90	BS7B	*	1890	2	**
	BS8B	54	54	*	**
	BLANK	*	*	*	**
	Spike, low	NA	NA	NA	a NA
	Spike, high	NA	NA	NA	a NA

NOTES: * Below limit of quantitation (LOQ) of 10 ppbC.
** Below LOQ of 3 ppb.
a Average of three runs.
NA Not applicable.
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

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TABLE 27

HALOGENATED AND AROMATIC ORGANIC COMPOUNDS MASS EMISSION RATES, mg/sec

DATE	SAMPLE ID	BENZENE	TOLUENE	XYLENES		VINYL-Cl
		ppbC	ppbC	ppbC		ppb
10-25-90	BS1A	*	0.11	*		**
	BS2A	*	0.03	*		**
	BLANK	*	0.02	0.014		**
10-29-90	BS3B	*	0.03	*		**
	BS4B	*	*	*		**
	BLANK	*	*	*		**
10-30-90	BS5B	*	0.02	*		**
	BS6B	*	*	*		**
	BLANK	*	0.05	0.027		**
10-31-90	BS7B	*	0.83	0.103		**
	BS8B	0.02	0.02	*		**
	BLANK	*	*	*		**
	Spike, low	NA	NA	NA	a	NA
	Spike, high	NA	NA	NA	a	NA

NOTES: * Below limit of quantitation (LOQ) of 10 ppbC.
** Below LOQ of 3 ppb.
a Average of three runs.
NA Not applicable.
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE 28
ALDEHYDE CONCENTRATIONS (CORRECTED TO 12% CO2) (UG/DSCM)

TABLE 29
ALDEHYDE MASS EMISSION RATES (UG/SEC)

TABLE 28

ALDEHYDE CONCENTRATIONS
(CORRECTED TO 12 % CO2)
(ug/dscm)

	CREMATORY STACK			
SAMPLE ID	ALD-1A	ALD-2B	ALD-3A	ALD-4A
FORM	15.4	9.0	< 8.8	34.9
ACET	72.5	11.5	< 15.0	147.7

(<) Blank value larger than sample value.
CREMATORY STACK LETTER DESIGATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)
(FORM)-FORMALDEHYDE
(ACET)-ACETALDEHYDE

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TABLE 29

ALDEHYDE MASS EMISSION RATES
(ug/sec)

	CREMATORY STACK			
SAMPLE ID	ALD-1A	ALD-2B	ALD-3A	ALD-4A
FORM	1.9	1.3	< 0.8	3.3
ACET	8.8	1.6	< 1.4	14.1

(<) Blank value larger than sample value.
CREMATORY STACK LETTER DESIGATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)
(FORM)-FORMALDEHYDE
(ACET)-ACETALDEHYDE

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VI QUALITY ASSURANCE/QUALITY CONTROL

Procedures to document the accuracy of reported sampling and analytical results have been established by ARB for most of the sampling procedures used: "Air Monitoring Quality Assurance , Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring and Testing." These Quality Assurance (QA) procedures include the use of referee audit samples provided by independent laboratories, field and laboratory blank samples, surrogate field spikes and multi-point calibration of continuous gas monitors.

CHAIN OF CUSTODY

All sample labels contain the job number, the time and date the sample was taken, the sample or run number, the sample location, the type of sample, the log number for the person labeling the sample and the labeler's initials.

Each sample custodian is responsible for ensuring sample integrity until the sample is transferred to another person. The following people are required to maintain log books: ARB field engineer, AIHL field chemists and all laboratory receivers; also each laboratory is required to maintain its own internal chain-of custody record for all samples received for the project.

When the field engineer turns over the samples to the sample transporter, the transporter initials the field engineer's log book for all samples received. If any samples are damaged or the integrity is questionable, a note is to be made and initialed by the person delivering the sample on the receiver's log book.

1. Gaseous Compounds and Particulate Matter

All Method 100 gas analyzers are checked for linearity continuity annually, and zeroed and spanned before, during and after each evaluation test. The gases used for calibration are National Institute of Science and Technology traceable. The particulate matter data include the nozzle and probe rinse, filter catch, after filter rinse and impinger catch. Blank Method 5 particulate matter sample trains are transported into the field assembled, leak checked, disassembled and returned to the laboratory for analysis as a check for background contamination. These blank trains are not directly exposed to the stack gas.

2. Hydrogen Chloride/Hydrogen Fluoride

The hydrogen chloride and hydrogen fluoride blank analyses are shown in Table 30. The carbonate and bicarbonate impinger solutions were prepared by AIHL chemists.

3. PCDD/PCDF

The PCDD and PCDF percent recoveries of internal standards and surrogate standards are presented in Table 31.

The PCDD and PCDF analyses of blank sampling trains are presented in Table 32.

Dioxin and Furan Surrogate Standards

All Method 428 sample trains were spiked with isotopically labeled $^{37}Cl_4$-2,3,7,8-TCDD, $^{13}C_{12}$-2,3,4,7,8-PeCDF, $^{13}C_{12}$-1,2,3,6,7,8-HxCDF, and $^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF. The spiking of the resin cartridge is used to estimate the recovery of analytes collected on the resin.

A blank spike Method 428 sample train was taken into the field and kept with typical Method 428 sample trains. The blank sample train was assembled, leak checked, disassembled and recovered like an operating train. An additional travel blank spike resin cartridge was prepared and sealed by Cal Labs and transported to the test site with the other Method 428 sample trains. The travel blank remained sealed for the duration of the emissions test and was returned to Cal Labs with the other Method 428 sample trains at the conclusion of the emissions test. The blank samples were extracted and analyzed by Cal Labs in the exact manner as the spent sample trains. The blank samples provided information on the effects transport and handling have on the sample trains.

4. PAH

Recoveries were high for a number of the PAH internal standards, particularly in the method blank. Enseco Cal Labs re-analyzed the samples and checked all of the calculations. No explanation for the high recoveries could be found.

Resin cartridge blanks were taken into the field and were kept with the operating and blank sampling trains. The PAH blank train was assembled, leak checked, disassembled and recovered like an operating train. The travel blank resin cartridge was prepared and sealed at Cal Labs for transport to the test site with the other sample trains. The travel blank remained sealed for the duration of the emissions test and was returned to Cal Labs with the other PAH sample trains at the conclusion of the emissions test. The sample extracts from the recovered blank train were analyzed by Cal Labs. The blank samples provided information on the effects transport and handling have on the sample trains.

The PAH analyses of the blank trains are shown in Table 33.

5. Trace Metals

The trace metal analyses of the blank sampling train are presented in Table 34. The ICAP analyzer was calibrated in the AIHL laboratory with known concentrations of 1.00 and 10.0 ug/ml.

6. Hexavalent and Total Chromium

The hexavalent chromium analytical equipment was calibrated at an absorbance of 540 nm (5 cm CELL) using the diphenylcarbazide colorimetric method. The hexavalent chromium and total chromium blank analyses are shown in Table 35.

7. Volatile Organic Compounds

Bag Samples, Blank and Spike

The following were procedures undertaken to ensure that bag sampling data met the ARB's requirements for accuracy, precision, representativeness, and completeness.

a. New bags were fabricated by ARB staff and prior to taking the bags into the field, they were subjected to leak checks and contamination checks as required by ARB Method 422. To check for contamination, each new bag was filled with 99.999% nitrogen and then analyzed for the targeted analytes using a GC/ECD for halogenated compounds and GC/PID for aromatics and vinyl chloride. The sequence of purging followed by analysis was repeated until the concentration of the target analytes was reduced to the concentration for which the bags are certified. ARB staff certifies all new bags as containing less than one part per billion (ppb) of the ten targeted analytes except trichlorofluoromethane (Freon 11) for which the bags are certified as containing less than 10 ppb and 1,2-dichloroethane for which the bags are certified as containing less than 20 ppb or 100 ppb depending on the method used.

b. Detection limits of each certified bag were recorded and each bag was assigned a number. Chain-of-custody procedures allowed tracking of each bag through sampling and analysis.

c. A blank bag was prepared in accordance with the procedure mentioned in item a. and was left partially inflated with nitrogen. The bag was transported to the test site, where it was filled with 99.999% nitrogen. Otherwise, the blank bag was subjected to the same conditions as the Tedlar bags used for sample collection.

d. The Engineering Evaluation Branch has National Institute of Standards and Technology (NIST) traceable standards for all of the target analytes. This provides the necessary documentation on the accuracy of the concentration and traceability to NIST reference standards.

e. Sampling and analytical dates were recorded on the log sheets maintained by field and laboratory personnel. The gas samples were not stored in the bags for a period longer than 72 hours between sampling and analysis. Stability studies conducted by between sampling and analysis. Stability studies conducted by the ARB staff have demonstrated that during this 72 hour period, the losses for all analytes except vinyl chloride are less than ten percent.

f. After collecting the gas samples, the bags were stored in a container to avoid exposure to sunlight. The bag samples were analyzed by ARB's Southern Laboratory Branch to determine the presence of the compounds listed in Tables 26 and 27.

Halogenated and Aromatic Organic Compounds Determined by bag Sampling Method

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1,1,1-Trichloroethane
Tetachloromethane
Trichlorofluoromethane
Trichloromethane
1.2-Dichloroethane
Trichloroethene
Vinyl Chlorode
Benzene
1,2-Dibromoethane
Tetachloroethane

8. Aldehydes

The Aldehyde (Formaldehyde and Acetaldehyde) test runs did not meet the ARB draft Method 430 sample/blank ratio performance criterion of five (5) so the data shown in Tables 28, 29 and Appendix III should be considered qualitative in nature only.

Field blanks consisted of an impinger and sample line and were handled in a manner similar to that of the sampling trains except that they were not exposed to the sample gas. The aldehyde blank analyses are shown in Table 36.

QA/QC DISCUSSION:

Dioxin/Furan

In August of 1990 ARB requested ENSECO Cal Labs to dioxin-clean and spike sample trains for the Camellia evaluation test. The request was based on the requirements of Test Method 428 adopted March 23, 1988. However, on September 12, 1990, six weeks before the test, a revised version of Test Method 428 was adopted leading to speculation that the spiking compounds used in the sample trains might be duplicates of laboratory internal and recovery standard compounds. This would have resulted in over-spiking. After Cal Labs discovered that the request form was outdated, the results were re-calculated using the proper internal and recovery standards per the most recent adopted method. Additionally, the outdated laboratory request had asked for PCB analysis. This led to confusion as to whether or not the samples had been split two or three ways. After extensive review of laboratory records, it was determined that the samples had been split three ways. With the resolution of the spiking and splitting problems, the PCDD/PCDF data reported herein is considered valid. The ARB Test Method 428 performance standards of 100 ± 40 percent recovery of laboratory internal standards or an analyte signal to noise ratio of 10 or greater were met in all cases. All field data sheets, chain-of-custody and laboratory data sheets are on file for inspection at the ARB Engineering Evaluation Branch office. Also, all correspondence between ARB and Enseco Cal Labs are included in Appendix VII and Appendix VIII of this report.

On October 24, 1990, 100 ml of Type 2 (deionized and distilled) water was added to sample train DT-1B because the laboratory that assembled the sample train inadvertently installed a short downspout in the second or middle impinger. The impinger configuration shown in Figure 4 requires the first impinger to be dry for wet gas streams and have a long downspout, and the second impinger should have a long downspout and contain 100 ml of water. Addition of 100 ml of water covered the bottom of the short downspout. The function of the second impinger is to allow the sample gas stream to bubble through water to entrain any PCDD/PCDF which may have passed through the resin cartridge. Given the small amount of PCDD/PCDF captured in the entire sampling train, it is unlikely that any PCDD/PCDF made it through the resin cartridge. On October 25, 1990, 100 ml of Type 2 water had to be added to sample trains DT-2A and DT-3B because of the same problem; namely, short impinger downspouts in the same middle impinger location. The water was added to sample train DT-2A two hours into the six-hour sampling run and to DT-3B before the test run started. As shown in Table 17 the mass emission rates of PCDDs/PCDFs reported for test run DT-1B were considerably higher than those reported for test runs DT-2A and DT-3B. Review of field operating data forms, field test procedures and laboratory analytical data indicated the higher values found in run DT-1B were not due to procedural errors.

Polycyclic Aromatic Hydrocarbons

The ARB Test Method 429 performance standards of 100 ± 40 percent recovery of laboratory internal standards or an analyte signal to noise ratio of 10 or greater were met in all cases. Recoveries were high for a number of the PAH internal standards, particularly in the method blank. Enseco Cal Labs re-analyzed the samples and checked all of the calculations. No explanation for the high recoveries could be found.

No anomalies were noted by either the chemists performing the extraction and analysis nor the spike witness.

ARB verbally requested Cal Labs spike the PAH trains with four surrogate compounds. Due to miscommunication, only one surrogate spike was used, 2-Methylnaphthalene. All internal standard recoveries were calculated using 2,2'-Difluorobiphenyl as a recovery standard. With the resolution of these problems data reported herein is considered valid. All field data sheets, chain-of-custody and laboratory data sheets are on file for inspection at the ARB Engineering Branch office. Also, all correspondence between ARB and Enseco Cal Labs are included in Appendix VII and Appendix VIII of this report.

Trace Metals

The EPA draft method allows for reagent blank corrections. Reagent blanks were not collected for this test. B C Analytical provided a digestion blank which was analyzed by AIHL and the results were used to correct the silver (Ag) and beryllium (Be) data. The majority of the metals were not found significantly above field blank train levels. The field blank or field blank detection limits were greater than 50 percent of the average sample value for silver (Ag), arsenic (As), Barium (Ba), beryllium (Be), cobalt (Co), chromium (Cr), nickel (Ni), lead (Pb), antimony (Sb) and vanadium (V). The field blank or field blank detection limits were less than 50 percent of the average sample value for cadmium (Cd), copper (Cu), zink (Zn) and mercury (Hg).

On October 23, 1990, and October 24, 1990, the first and fourth empty impingers were not used in sample trains TM-1A, TM-2B and TM-3A so the trains contained four impingers instead of six as shown in Figure 6. In the six impinger configuration the first impinger is empty to catch moisture from wet stack plumes and the fourth impinger is used to prevent carryover of nitric acid into the permanganate impinger during sampling upsets. Conversely, the fourth impinger can prevent permanganate solution from entering the nitric acid impinger during sample train leakcheck upsets. Additionally, hydrogen peroxide was not included in the two 0.1 normal nitric acid impingers. AIHL did not modify these two impinger catches before analysis. No anomalies were noted that would affect the test results in Tables 22 and 23. The tabulated laboratory analytical results are shown in Appendix IX.

TABLE 30

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE BLANK ANALYSIS

TABLE 30

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE BLANK ANALYSIS, (HCL, mg), (HF, ug)

HCL	HF
< 0.2	< 4

NOTE:
TOTAL Cl EXPRESSED AS HCL
TOTAL F EXPRESSED AS HF

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TABLE 31

PERCENT RECOVERY OF PCDD/PCDF INTERNAL STANDARDS AND FIELD SPIKES

TABLE 31

PERCENT RECOVERY OF PCDD/PCDF INTERNAL STANDARDS AND SURROGATE STANDARDS

CREMATORY STACK

INTERNAL STANDARDS	DT-1	DT-2	DT-3	DT-4C	DT-1FB
13C-2378-TCDF	27	63	73	68	60
13C-2378-TCDD	19	43	56	48	37
13C-12378-PeCDF	20	43	66	50	39
13C-12378-PeCDD	29	55	90	65	48
13C-123478-HxCDF	16	31	53	42	31
13C-123678-HxCDD	23	38	57	49	34
13C-1234678-HpCDF	14	26	40	35	23
13C-1234678-HpCDD	21	36	61	45	31
13C-OCDD	16	28	41	38	24
FIELD SPIKES 1/					
37Cl-2378-TCDD	99	84	98	91	120
13C-23478-PeCDF	96	85	85	87	110
13C-123678-HxCDF	72	61	56	60	90
13C-1234789-HpCDF	77	59	56	59	92

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)
1/ All compounds were pre-spiked into resin at 1 ng.
2/ Complete sampling train.
3/ Resin cartridge only.
NA Not applicable.

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TABLE 32

PCDD/PCDF ANALYSIS OF BLANK SAMPLES

TABLE 32

PCDD/PCDF ANALYSIS OF BLANK SAMPLES

	CREMATORY (ng/sample)	
	DT-4C COMPLETE TRAIN	DT-1FB RESIN CARTRIDGE ONLY
DIOXINS		
2,3,7,8-TCDD	< 0.0095	< 0.021
Total TCDD	0.025	< 0.021
1,2,3,7,8-PeCDD	< 0.0075	< 0.014
Total PeCDD	0.100	< 0.014
1,2,3,4,7,8-HxCDD	< 0.020	< 0.031
1,2,3,6,7,8-HxCDD	< 0.028	< 0.022
1,2,3,7,8,9-HxCDD	< 0.017	< 0.019
Total HxCDD	0.230	< 0.031
1,2,3,4,6,7,8-HpCDD	0.180	< 0.054
Total HpCDD	0.380	< 0.096
Total OCDD	0.810	< 0.240
FURANS		
2,3,7,8-TCDF	< 0.011	< 0.016
Total TCDF	0.061	< 0.016
1,2,3,7,8-PeCDF	< 0.0094	< 0.015
2,3,4,7,8-PeCDF	< 0.026	< 0.022
Total PeCDF	0.170	< 0.032
1,2,3,4,7,8-HxCDF	< 0.037	< 0.013
1,2,3,6,7,8-HxCDF	< 0.027	< 0.016
1,2,3,7,8,9-HxCDF	< 0.045	< 0.020
2,3,4,6,7,8-HxCDF	< 0.016	< 0.015
Total HxCDF	0.300	< 0.300
1,2,3,4,6,7,8-HpCDF	0.300	< 0.048
1,2,3,4,7,8,9-HpCDF	< 0.016	< 0.013
Total HpCDF	0.300	< 0.048
Total OCDF	0.290	< 0.110

NOTES

< Indicates below limit of detection (MDL)
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE 33

PAH, BLANK ANALYSIS

TABLE 33

PAH, BLANK ANALYSIS, ng/sample

	RT-4C	RT-1FB
Naphthalene	44000 s	29000 s
Acenaphthylene	< 11 w	5.5
Acenaphthene	27	14
Fluorene	38	18
Phenanthrene	150	93
Anthracene	37	< 9.9 w
Fluoranthene	22	17
Pyrene	36	26
Benzo(a)anthracene	< 5.2 w	< 6.3 w
Chrysene	< 8.8 w	< 5.7 w
Benzo(b)fluoranthene	< 8.5 w	< 2.9 w
Benzo(k)fluoranthene	< 8.0 w	< 3.1 w
Benzo(a)pyrene	< 17 w	< 18 w
Dibenzo(a,h)anthracene	< 9.4	< 9.9 w
Benzo(g,h,i)perylene	< 5.5	< 11
Indeno(1,2,3-c,d)pyrene	< 5.3	< 10

<- Indicates below reporting limit.
s - Secondary ion used for quantitation.
w - MPC - Maximum Possible Concentration.
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

TABLE 34

TRACE METALS BLANK ANALYSIS

TABLE 34

TRACE METALS FIELD AND DIGESTION BLANKS, ug/sample

SAMPLE ID	FIELD BLANK **	DIGESTION BLANK
Ag *	< 6.60	6.64
As	< 16.0	< 12.0
Ba	8.39	< 1.2
Be *	3.62	3.21
Cd	< 1.20	< 1.2
Co	< 7.80	< 7.8
Cr	13.9	< 10.2
Cu	1.00	< 9.0
Hg	< 13.3	NA
Mo	< 9.60	< 9.6
Ni	11.2	< 8.4
Pb	21.0	< 15.0
Sb	18.6	< 18.0
Se	< 24.6	< 24.6
Tl	< 48.0	< 48
V	33.1	< 7.2
Zn	16.9	< 5.4

(<) Below limit of detection.
(*) corrected for laboratory digestion blank:
Ag: laboratory blank 49% to 77% of uncorrected sample value
Be: laboratory blank 70% to 89% of uncorrected sample value

(**) Field blanks or field blank detection limit:
(>) 50% for Ag, As, Ba, Be, Co, Cr, Ni, Pb, Sb, V
(<) 50% for Cd, Cu, Zn, Hg

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

TABLE 35

HEXAVALENT CHROMIUM BLANK ANALYSIS

TABLE 35

HEXAVALENT CHROMIUM BLANK ANALYSIS, ug

TRAIN		PROBE RINSE		IMPINGER/FILTER
Cr-4C-P	<	1.4		
Cr-4C-IF			<	2.0
Cr-5C-P	<	1.0		
Cr-5C-IF			<	2.0

TOTAL CHROMIUM BLANK ANALYSIS, ug

TRAIN		PROBE RINSE		IMPINGER/FILTER
Cr-4C-P	<	8.1		
Cr-4C-IF			<	12.0
Cr-5C-P	<	10.0		
Cr-5C-IF			<	12.0

P Probe Rinse
IF Impinger/Filter
< Indicates below limit of detection (MDL)

C-90-004

TABLE 36

ALDEHYDE BLANK ANALYSIS

TABLE 36

ALDEHYDE BLANK ANALYSIS, ug/sample

SAMPLE ID	1	2	3	4	5	6	7
FORM	0.102	0.123	0.095	0.059	0.054	0.000	0.000
ACET	0.410	0.456	0.507	0.300	0.293	0.000	0.000

SAMPLES 1, 2, 3 - LAB STORAGE BLANK
SAMPLES 4, 5 - FIELD 0.05 % DNPH REAGENT
SAMPLES 6, 7 - 70 % HEXANE TO 30 % DICHLOROMETHANE BLANK

(FORM)-FORMALDEHYDE
(ACET)-ACETALDEHYDE C-90-004

APPENDIX I

DRAFT ARB TEST METHOD 421

A copy of Draft ARB Test Method 421 is on file for inspection at the ARB Engineering Evaluation Branch office.

APPENDIX II

DRAFT ARB TEST METHOD 436

A copy of Draft ARB Test Method 436 is on file for inspection at the ARB Engineering Evaluation Branch office.

APPENDIX III

ALDEHYDES

A copy of Draft ARB Test Method 430 is on file for inspection at the ARB Engineering Evaluation Branch office.

TABLE

ALDEHYDES, ug/sample

	CREMATORY STACK			
SAMPLE ID	ALD-1A	ALD-2B	ALD-3A	ALD-4A
FORM	0.088	0.057	<0.050	0.199
ACET	0.413	0.073	<0.086	0.842

(<) Blank value larger than sample value.
CREMATORY STACK LETTER DESIGATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)
(FORM)-FORMALDEHYDE
(ACET)-ACETALDEHYDE

TABLE

ALDEHYDE CONCENTRATIONS
(ug/dscm)

	CREMATORY STACK			
SAMPLE ID	ALD-1A	ALD-2B	ALD-3A	ALD-4A
FORM	5.9	3.8	< 3.3	13.3
ACET	27.5	4.9	< 5.7	56.1

(<) Blank value larger than sample value.
CREMATORY STACK LETTER DESIGATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)
(FORM)-FORMALDEHYDE
(ACET)-ACETALDEHYDE

C-90-004

APPENDIX IV

TABULATED MOISTURE FOR RESIN TRAIN RUNS

TABLE
TABULATED H2O FOR SAMPLE TRAINS

RUN NO.	PERCENT H2O	NUMBER OF 2 HOUR INCREMENTS	WEIGHTED H2O %
TM-1A	6.8	2	13.6
TM-3A	7.4	2	14.8
DT-2A	7.3	3	21.9
M5-1A	6.5	1	6.5
HCL-1A	7.6	1	7.6
HCL-2A	8.8	1	8.8
RT-1A	7.0 *	NA	NA
RT-3A	7.0 *	NA	NA
CR-2A	5.6	2	11.2
CREMATORY NO. 1 AVG. H2O, %			7.0
TM-2B	6.7	2	13.4
DT-1B	8.3	3	24.9
DT-3B	7.2	3	21.6
M5-2B	8.7	1	8.7
M5-3B	7.8	1	7.8
HCL-3B	8.8	1	8.8
RT-2B	7.8 *	NA	NA
CR-1B	8.3	2	16.6
CR-3B	7.6	2	15.2
CREMATORY NO. 2 AVG. H2O, %			7.8

* : CALCULATED FROM MEASURED AND WEIGHTED H2O FROM ALL OTHER SAMPLE TRAINS
NA : H2O CATCH IN RESIN TRAINS NOT RECORDED
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

APPENDIX V

STACK TESTING PARAMETERS

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: TM-1A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	117.44	cubic feet
Vm Meter Cal. Factor (Y)	1.05	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	29.98	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.930	inches H2O
Pb + dH avg:	30.05	inches Hg.
O2 in Stack (%O2):	14.58	percent
CO in Stack (%CO):	0.0047	percent
CO2 in Stack (%CO2):	4.56	percent
N2 in Stack (%N2):	80.86	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.22	/(inches H2O)
Stack Temperature (Ts)	1587	deg. R
Static Pressure	0.05	inches H2O
Absolute Stack Pressure (Ps)	29.98	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	193.4	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	125.75	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	6.8	percent by volume
Stack Gas Molecular Wt, Dry (Md):	29.31	lb/lbmole
Stack Gas Molecular Wt, Wet	28.55	lb/lbmole
Stack Gas Velocity (Vs):	21.26	feet/second
Stack Gas Flow Rate (Qs):	865	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	97.0	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:______________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: TM-2B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	109.96 cubic feet
Vm Meter Cal. Factor (Y)	1.03
Meter Temperature (Tm):	520 deg. R
Barometric Pressure (Pb):	30.02 inches Hg
Avg. delta H Orifice Press. (dH avg):	0.800 inches H2O
Pb + dH avg:	30.08 inches Hg.
O2 in Stack (%O2):	13.73 percent
CO in Stack (%CO):	0.0050 percent
CO2 in Stack (%CO2):	5.08 percent
N2 in Stack (%N2):	81.19 percent
Pitot Tube Factor (Cp)	0.83
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.18 /(inches H2O)
Stack Temperature (Ts)	1281 deg. R
Static Pressure	0.04 inches H2O
Absolute Stack Pressure (Ps)	30.02 inches Hg
Stack Dimensions	20 inches dia.
Stack Area (As)	2.182 square feet
H2O in Impingers and Silica Gel (Vlc):	176.8 milliliters
Sampling Time (t):	240 minutes
Nozzle Diameter (Dn):	0.5 inches
Pollutant Mass Collected (Mn):	0 milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	115.61 DSCF (68 deg.F)
Water Vapor in Stack (Bws):	6.7 percent by volume
Stack Gas Molecular Wt, Dry (Md):	29.36 lb/lbmole
Stack Gas Molecular Wt, Wet	28.60 lb/lbmole
Stack Gas Velocity (Vs):	15.60 feet/second
Stack Gas Flow Rate (Qs):	788 DSCFM(68 deg.F)
Isokinetic Ratio (%I):	97.9 percent
Pollutant Mass Conc. (Cs):	0 grains/dscf
Mass Emission Rate (Wm):	0.00 lb/hr

Verified by:______________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: TM-3A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	93.18 cubic feet
Vm Meter Cal. Factor (Y)	1.05
Meter Temperature (Tm):	520 deg. R
Barometric Pressure (Pb):	30.06 inches Hg
Avg. delta H Orifice Press. (dH avg):	0.565 inches H2O
Pb + dH avg:	30.10 inches Hg.
O2 in Stack (%O2):	14.58 percent
CO in Stack (%CO):	0.0047 percent
CO2 in Stack (%CO2):	4.56 percent
N2 in Stack (%N2):	80.86 percent
Pitot Tube Factor (Cp)	0.83
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.16 /(inches H2O)
Stack Temperature (Ts)	1490 deg. R
Static Pressure	0.04 inches H2O
Absolute Stack Pressure (Ps)	30.06 inches Hg
Stack Dimensions	20 inches dia.
Stack Area (As)	2.182 square feet
H2O in Impingers and Silica Gel (Vlc):	170.5 milliliters
Sampling Time (t):	240 minutes
Nozzle Diameter (Dn):	0.5 inches
Pollutant Mass Collected (Mn):	0 milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	99.95 DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.4 percent by volume
Stack Gas Molecular Wt, Dry (Md):	29.31 lb/lbmole
Stack Gas Molecular Wt, Wet	28.47 lb/lbmole
Stack Gas Velocity (Vs):	14.98 feet/second
Stack Gas Flow Rate (Qs):	646 DSCFM(68 deg.F)
Isokinetic Ratio (%I):	103.2 percent
Pollutant Mass Conc. (Cs):	0 grains/dscf
Mass Emission Rate (Wm):	0.00 lb/hr

Verified by:____________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: M5-1A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	43.75 cubic feet
Vm Meter Cal. Factor (Y)	1.05
Meter Temperature (Tm):	520 deg. R
Barometric Pressure (Pb):	30.04 inches Hg
Avg. delta H Orifice Press. (dH avg):	0.480 inches H2O
Pb + dH avg:	30.08 inches Hg.
O2 in Stack (%O2):	14.58 percent
CO in Stack (%CO):	0.0047 percent
CO2 in Stack (%CO2):	4.56 percent
N2 in Stack (%N2):	80.86 percent
Pitot Tube Factor (Cp)	0.83
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.17 /(inches H2O)
Stack Temperature (Ts)	1653 deg. R
Static Pressure	0.04 inches H2O
Absolute Stack Pressure (Ps)	30.04 inches Hg
Stack Dimensions	20 inches dia.
Stack Area (As)	2.182 square feet
H2O in Impingers and Silica Gel (Vlc):	69.6 milliliters
Sampling Time (t):	120.7 minutes
Nozzle Diameter (Dn):	0.5 inches
Pollutant Mass Collected (Mn):	24.00 milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	46.89 DSCF (68 deg.F)
Water Vapor in Stack (Bws):	6.5 percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.31 lb/lbmole
Stack Gas Molecular Wt, Wet	28.57 lb/lbmole
Stack Gas Velocity (Vs):	16.74 feet/second
Stack Gas Flow Rate (Qs):	657 DSCFM(68 deg.F)
Isokinetic Ratio (%I):	94.7 percent
Pollutant Mass Conc. (Cs):	0.008 grains/dscf
Mass Emission Rate (Wm):	0.04 lb/hr

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MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: M5-2B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	47.63	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.00	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.540	inches H2O
Pb + dH avg:	30.04	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.16	/(inches H2O)
Stack Temperature (Ts)	1484	deg. R
Static Pressure	0.04	inches H2O
Absolute Stack Pressure (Ps)	30.00	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	101.5	milliliters
Sampling Time (t):	120	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	25.80	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	50.01	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	8.7	percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.37	lb/lbmole
Stack Gas Velocity (Vs):	14.99	feet/second
Stack Gas Flow Rate (Qs):	639	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	104.4	percent
Pollutant Mass Conc. (Cs):	0.008	grains/dscf
Mass Emission Rate (Wm):	0.04	lb/hr

Verified by:______________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: M5-3B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	47.86	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.00	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.560	inches H2O
Pb + dH avg:	30.04	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.17	/(inches H2O)
Stack Temperature (Ts)	1522	deg. R
Static Pressure	0.05	inches H2O
Absolute Stack Pressure (Ps)	30.00	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	89.8	milliliters
Sampling Time (t):	120	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	26.30	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	50.26	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.8	percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.48	lb/lbmole
Stack Gas Velocity (Vs):	16.10	feet/second
Stack Gas Flow Rate (Qs):	676	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	99.2	percent
Pollutant Mass Conc. (Cs):	0.008	grains/dscf
Mass Emission Rate (Wm):	0.05	lb/hr

Verified by:______________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.:	90-004
PROJECT NAME:	CAMELLIA CREMATORY
RUN NO.:	HCL-1A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	41.47 cubic feet
Vm Meter Cal. Factor (Y)	1.05
Meter Temperature (Tm):	520 deg. R
Barometric Pressure (Pb):	30.00 inches Hg
Avg. delta H Orifice Press. (dH avg):	0.440 inches H2O
Pb + dH avg:	30.03 inches Hg.
O2 in Stack (%O2):	14.58 percent
CO in Stack (%CO):	0.0047 percent
CO2 in Stack (%CO2):	4.56 percent
N2 in Stack (%N2):	80.86 percent
Pitot Tube Factor (Cp)	0.83
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.14 /(inches H2O)
Stack Temperature (Ts)	1503 deg. R
Static Pressure	0.03 inches H2O
Absolute Stack Pressure (Ps)	30.00 inches Hg
Stack Dimensions	20 inches dia.
Stack Area (As)	2.182 square feet
H2O in Impingers and Silica Gel (Vlc):	77.7 milliliters
Sampling Time (t):	120 minutes
Nozzle Diameter (Dn):	0.5 inches
Pollutant Mass Collected (Mn):	0 milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	44.38 DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.6 percent by volume
Stack Gas Molecular Wt, Dry (Md):	29.31 lb/lbmole
Stack Gas Molecular Wt, Wet	28.45 lb/lbmole
Stack Gas Velocity (Vs):	13.18 feet/second
Stack Gas Flow Rate (Qs):	562 DSCFM(68 deg.F)
Isokinetic Ratio (%I):	105.4 percent
Pollutant Mass Conc. (Cs):	0 grains/dscf
Mass Emission Rate (Wm):	0.00 lb/hr

Verified by:________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.:	90-004
PROJECT NAME:	CAMELLIA CREMATORY
RUN NO.:	HCL-2A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	39.5 cubic feet
Vm Meter Cal. Factor (Y)	1.05
Meter Temperature (Tm):	520 deg. R
Barometric Pressure (Pb):	30.00 inches Hg
Avg. delta H Orifice Press. (dH avg):	0.390 inches H2O
Pb + dH avg:	30.03 inches Hg.
O2 in Stack (%O2):	14.58 percent
CO in Stack (%CO):	0.0047 percent
CO2 in Stack (%CO2):	4.56 percent
N2 in Stack (%N2):	80.86 percent
Pitot Tube Factor (Cp)	0.83
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.15 /(inches H2O)
Stack Temperature (Ts)	1666 deg. R
Static Pressure	0.035 inches H2O
Absolute Stack Pressure (Ps)	30.00 inches Hg
Stack Dimensions	20 inches dia.
Stack Area (As)	2.182 square feet
H2O in Impingers and Silica Gel (Vlc):	86.5 milliliters
Sampling Time (t):	120 minutes
Nozzle Diameter (Dn):	0.5 inches
Pollutant Mass Collected (Mn):	0 milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	42.27 DSCF (68 deg.F)
Water Vapor in Stack (Bws):	8.8 percent by volume
Stack Gas Molecular Wt, Dry (Md):	29.31 lb/lbmole
Stack Gas Molecular Wt, Wet	28.32 lb/lbmole
Stack Gas Velocity (Vs):	14.90 feet/second
Stack Gas Flow Rate (Qs):	566 DSCFM(68 deg.F)
Isokinetic Ratio (%I):	99.7 percent
Pollutant Mass Conc. (Cs):	0 grains/dscf
Mass Emission Rate (Wm):	0.00 lb/hr

Verified by:______________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: HCL-3B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	48.17 cubic feet
Vm Meter Cal. Factor (Y)	1.03
Meter Temperature (Tm):	520 deg. R
Barometric Pressure (Pb):	30.03 inches Hg
Avg. delta H Orifice Press. (dH avg):	0.550 inches H2O
Pb + dH avg:	30.07 inches Hg.
O2 in Stack (%O2):	13.73 percent
CO in Stack (%CO):	0.0050 percent
CO2 in Stack (%CO2):	5.08 percent
N2 in Stack (%N2):	81.19 percent
Pitot Tube Factor (Cp)	0.83
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.15 /(inches H2O)
Stack Temperature (Ts)	1270 deg. R
Static Pressure	0.040 inches H2O
Absolute Stack Pressure (Ps)	30.03 inches Hg
Stack Dimensions	20 inches dia.
Stack Area (As)	2.182 square feet
H2O in Impingers and Silica Gel (Vlc):	103.8 milliliters
Sampling Time (t):	120 minutes
Nozzle Diameter (Dn):	0.5 inches
Pollutant Mass Collected (Mn):	0 milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	50.63 DSCF (68 deg.F)
Water Vapor in Stack (Bws):	8.8 percent by volume
Stack Gas Molecular Wt, Dry (Md):	29.36 lb/lbmole
Stack Gas Molecular Wt, Wet	28.36 lb/lbmole
Stack Gas Velocity (Vs):	13.00 feet/second
Stack Gas Flow Rate (Qs):	647 DSCFM(68 deg.F)
Isokinetic Ratio (%I):	104.3 percent
Pollutant Mass Conc. (Cs):	0 grains/dscf
Mass Emission Rate (Wm):	0.00 lb/hr

Verified by:______________________________ Date: 11-26-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: CR-1B (Cr+6)

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	119.03	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.08	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.880	inches H2O
Pb + dH avg:	30.14	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.21	/(inches H2O)
Stack Temperature (Ts)	1566	deg. R
Static Pressure	0.05	inches H2O
Absolute Stack Pressure (Ps)	30.08	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	239.8	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0.0113	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	125.42	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	8.3	percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.42	lb/lbmole
Stack Gas Velocity (Vs):	20.17	feet/second
Stack Gas Flow Rate (Qs):	821	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	101.9	percent
Pollutant Mass Conc. (Cs):	0.000001	grains/dscf
Mass Emission Rate (Wm):	0.00001	lb/hr

Verified by:______________________ Date: 11-28-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: CR-2A (Cr+6)

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	118.33	cubic feet
Vm Meter Cal. Factor (Y)	1.05	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.11	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.880	inches H2O
Pb + dH avg:	30.17	inches Hg.
O2 in Stack (%O2):	14.58	percent
CO in Stack (%CO):	0.0047	percent
CO2 in Stack (%CO2):	4.56	percent
N2 in Stack (%N2):	80.86	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.21	/(inches H2O)
Stack Temperature (Ts)	1482	deg. R
Static Pressure	0.07	inches H2O
Absolute Stack Pressure (Ps)	30.12	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	161.5	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0.0048	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	127.23	DSCF (68 deg.F
Water Vapor in Stack (Bws):	5.6	percent by vol
Stack Gas Molecular Wt, Dry (Md):	29.31	lb/lbmole
Stack Gas Molecular Wt, Wet	28.67	lb/lbmole
Stack Gas Velocity (Vs):	19.52	feet/second
Stack Gas Flow Rate (Qs):	865	DSCFM(68 deg.F
Isokinetic Ratio (%I):	98.2	percent
Pollutant Mass Conc. (Cs):	0.000001	grains/dscf
Mass Emission Rate (Wm):	0.000004	lb/hr

Verified by:______________________________ Date: 11-28-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: CR-3B (Cr+6)

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	123.26	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.11	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.930	inches H2O
Pb + dH avg:	30.18	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.22	/(inches H2O)
Stack Temperature (Ts)	1540	deg. R
Static Pressure	0.06	inches H2O
Absolute Stack Pressure (Ps)	30.11	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	225.9	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0.007	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	130.02	DSCF (68 deg.F
Water Vapor in Stack (Bws):	7.6	percent by vol
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.50	lb/lbmole
Stack Gas Velocity (Vs):	20.91	feet/second
Stack Gas Flow Rate (Qs):	873	DSCFM(68 deg.F
Isokinetic Ratio (%I):	99.3	percent
Pollutant Mass Conc. (Cs):	0.000001	grains/dscf
Mass Emission Rate (Wm):	0.000006	lb/hr

Verified by:______________________________ Date: 11-28-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: DT-1B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	140.22	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.05	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.550	inches H2O
Pb + dH avg:	30.09	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.17	/(inches H2O)
Stack Temperature (Ts)	1648	deg. R
Static Pressure	0.04	inches H2O
Absolute Stack Pressure (Ps)	30.05	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	282.7	milliliters
Sampling Time (t):	360	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	147.48	DSCF (68 deg.F
Water Vapor in Stack (Bws):	8.3	percent by vol
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.42	lb/lbmole
Stack Gas Velocity (Vs):	16.76	feet/second
Stack Gas Flow Rate (Qs):	647	DSCFM(68 deg.F
Isokinetic Ratio (%I):	101.3	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:____________________________ Date: 12-20-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: DT-2A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	127.65	cubic feet
Vm Meter Cal. Factor (Y)	1.05	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.03	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.460	inches H2O
Pb + dH avg:	30.06	inches Hg.
O2 in Stack (%O2):	14.58	percent
CO in Stack (%CO):	0.0047	percent
CO2 in Stack (%CO2):	4.56	percent
N2 in Stack (%N2):	80.86	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.15	/(inches H2O)
Stack Temperature (Ts)	1530	deg. R
Static Pressure	0.04	inches H2O
Absolute Stack Pressure (Ps)	30.03	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	229.7	milliliters
Sampling Time (t):	360	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	136.75	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.3	percent by vol
Stack Gas Molecular Wt, Dry (Md):	29.31	lb/lbmole
Stack Gas Molecular Wt, Wet	28.48	lb/lbmole
Stack Gas Velocity (Vs):	14.23	feet/second
Stack Gas Flow Rate (Qs):	598	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	101.7	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:______________________ Date: 12-20-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: DT-3B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	136.53	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.04	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.530	inches H2O
Pb + dH avg:	30.08	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.17	/(inches H2O)
Stack Temperature (Ts)	1601	deg. R
Static Pressure	0.04	inches H2O
Absolute Stack Pressure (Ps)	30.04	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	237.4	milliliters
Sampling Time (t):	360	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	143.55	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.2	percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.54	lb/lbmole
Stack Gas Velocity (Vs):	16.48	feet/second
Stack Gas Flow Rate (Qs):	663	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	96.3	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:______________________________ Date: 12-20-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: RT-1A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	78.72	cubic feet
Vm Meter Cal. Factor (Y)	1.05	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	29.99	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.380	inches H_2O
Pb + dH avg:	30.02	inches Hg.
O_2 in Stack (%O_2):	14.58	percent
CO in Stack (%CO):	0.0047	percent
CO_2 in Stack (%CO_2):	4.56	percent
N_2 in Stack (%N_2):	80.86	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.14	/(inches H_2O)
Stack Temperature (Ts)	1622	deg. R
Static Pressure	0.03	inches H_2O
Absolute Stack Pressure (Ps)	29.99	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H_2O in Impingers and Silica Gel (Vlc):	0	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	84.20	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.0	percent by volum
Stack Gas Molecular Wt, Dry (Md):	29.31	lb/lbmole
Stack Gas Molecular Wt, Wet	28.52	lb/lbmole
Stack Gas Velocity (Vs):	13.68	feet/second
Stack Gas Flow Rate (Qs):	543	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	103.4	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:______________________________ Date: 12-20-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: RT-2B

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	84.82	cubic feet
Vm Meter Cal. Factor (Y)	1.03	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	29.99	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.430	inches H2O
Pb + dH avg:	30.02	inches Hg.
O2 in Stack (%O2):	13.73	percent
CO in Stack (%CO):	0.0050	percent
CO2 in Stack (%CO2):	5.08	percent
N2 in Stack (%N2):	81.19	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.15	/(inches H2O)
Stack Temperature (Ts)	1600	deg. R
Static Pressure	0.04	inches H2O
Absolute Stack Pressure (Ps)	29.99	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	0	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	89.01	DSCF (68 deg.F)
Water Vapor in Stack (Bws):	7.8	percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.36	lb/lbmole
Stack Gas Molecular Wt, Wet	28.48	lb/lbmole
Stack Gas Velocity (Vs):	14.57	feet/second
Stack Gas Flow Rate (Qs):	582	DSCFM(68 deg.F)
Isokinetic Ratio (%I):	102.1	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:______________________ Date: 12-20-90

MONITORING & LABORATORY DIVISION
ENGINEERING EVALUATION BRANCH

TEST SUMMARY AND RESULTS
(FOR FIELD DATA RECORD)

FILE NO.: 90-004
PROJECT NAME: CAMELLIA CREMATORY
RUN NO.: RT-3A

SUMMARY OF TEST DATA

Volume of Gas Sampled (Vm):	109	cubic feet
Vm Meter Cal. Factor (Y)	1.05	
Meter Temperature (Tm):	520	deg. R
Barometric Pressure (Pb):	30.08	inches Hg
Avg. delta H Orifice Press. (dH avg):	0.820	inches H2O
Pb + dH avg:	30.14	inches Hg.
O2 in Stack (%O2):	14.58	percent
CO in Stack (%CO):	0.0047	percent
CO2 in Stack (%CO2):	4.56	percent
N2 in Stack (%N2):	80.86	percent
Pitot Tube Factor (Cp)	0.83	
Avg. of Sqrt. of Pitot Press. (/dP avg):	0.20	/(inches H2O
Stack Temperature (Ts)	1583	deg. R
Static Pressure	0.05	inches H2O
Absolute Stack Pressure (Ps)	30.08	inches Hg
Stack Dimensions	20	inches dia.
Stack Area (As)	2.182	square feet
H2O in Impingers and Silica Gel (Vlc):	0	milliliters
Sampling Time (t):	240	minutes
Nozzle Diameter (Dn):	0.5	inches
Pollutant Mass Collected (Mn):	0	milligrams

CALCULATED RESULTS

Corrected Sample Volume (Vm std):	117.07	DSCF (68 deg.F,
Water Vapor in Stack (Bws):	7.0	percent by volu
Stack Gas Molecular Wt, Dry (Md):	29.31	lb/lbmole
Stack Gas Molecular Wt, Wet	28.52	lb/lbmole
Stack Gas Velocity (Vs):	19.28	feet/second
Stack Gas Flow Rate (Qs):	787	DSCFM(68 deg.F
Isokinetic Ratio (%I):	99.2	percent
Pollutant Mass Conc. (Cs):	0	grains/dscf
Mass Emission Rate (Wm):	0.00	lb/hr

Verified by:______________________________ Date: 12-20-90

APPENDIX VI

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE LABORATORY DATA

TABLE

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE TOTAL MILLIGRAMS PER SAMPLE AS HCL AND HF

SAMPLE ID	HCL-1A	HCL-2A	HCL-3B
HCl	12.0	26.7	24.2
HF	0.030	0.398	0.135

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

TABLE

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE CONCENTRATIONS, mg/dscm

SAMPLE ID	HCL-1A	HCL-2A	HCL-3B
HCl	9.549	22.306	16.879
HF	0.024	0.333	0.094

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

TABLE

HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE MASS EMISSION RATES, lbs/hr

SAMPLE ID	HCL-1A	HCL-2A	HCL-3B
HCl	0.020	0.047	0.041
HF	0.0001	0.001	0.0002

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

C-90-004

APPENDIX VII

DIOXIN/FURAN LABORATORY DATA AND ANCILLARY REDUCED DATA TABLES

TABLE

TOTAL PCDD/PCDF IN GAS SAMPLES

(ng/sample)

	CREMATORY STACK		
	DT-1B	DT-2A	DT-3B
DIOXINS			
2,3,7,8-TCDD	0.130	0.023	0.034
Total TCDD	2.600	0.240	0.780
1,2,3,7,8-PeCDD	0.380	0.049	0.160
Total PeCDD	4.400	0.590	0.600
1,2,3,4,7,8-HxCDD	0.540	0.066	0.099
1,2,3,6,7,8-HxCDD	0.820	0.071	0.130
1,2,3,7,8,9-HxCDD	1.100	0.054	0.120
Total HxCDD	11.000	1.300	2.200
1,2,3,4,6,7,8-HpCDD	7.200	0.490	2.000
Total HpCDD	15.000	1.100	4.700
Total OCDD	8.800	0.890	5.700
FURANS			
2,3,7,8-TCDF	0.690	0.540	0.123
Total TCDF	22.000	3.100	3.100
1,2,3,7,8-PeCDF	0.580	0.120	<0.120
2,3,4,7,8-PeCDF	1.500	0.705	<0.150
Total PeCDF	14.000	2.300	0.290
1,2,3,4,7,8-HxCDF	1.700	0.460	0.280
1,2,3,6,7,8-HxCDF	1.700	0.240	0.260
1,2,3,7,8,9-HxCDF	3.200	0.520	0.560
2,3,4,6,7,8-HxCDF	0.640	0.132	0.110
Total HxCDF	22.000	3.000	3.000
1,2,3,4,6,7,8-HpCDF	9.900	1.000	<1.700
1,2,3,4,7,8,9-HpCDF	0.670	< 0.057	<0.045
Total HpCDF	12.000	1.100	<1.700
Total OCDF	2.300	0.520	1.300

NOTES

< Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE

PCDD/PCDF CONCENTRATIONS

(ng/dscm)

	CREMATORY STACK		
	DT-1B	DT-2A	DT-3B
DIOXINS			
2,3,7,8-TCDD	0.031	0.006	0.008
Total TCDD	0.623	0.062	0.192
1,2,3,7,8-PeCDD	0.091	0.013	0.039
Total PeCDD	1.054	0.152	0.148
1,2,3,4,7,8-HxCDD	0.129	0.017	0.024
1,2,3,6,7,8-HxCDD	0.196	0.018	0.032
1,2,3,7,8,9-HxCDD	0.263	0.014	0.030
Total HxCDD	2.834	0.336	0.541
1,2,3,4,6,7,8-HpCDD	1.724	0.127	0.492
Total HpCDD	3.592	0.284	1.156
Total OCDD	2.107	0.230	1.402
TOTAL PCDD:			
INCLUDING MDLs	10.009	1.064	3.439
EXCLUDES MDLs	10.009	1.064	3.439
MID RANGE	10.009	1.064	3.439
FURANS			
2,3,7,8-TCDF	0.165	0.139	0.030
Total TCDF	5.268	0.801	0.763
1,2,3,7,8-PeCDF	0.139	0.031	< 0.030
2,3,4,7,8-PeCDF	0.359	0.182	< 0.037
Total PeCDF	3.352	0.594	0.071
1,2,3,4,7,8-HxCDF	0.407	0.119	0.069
1,2,3,6,7,8-HxCDF	0.407	0.062	0.064
1,2,3,7,8,9-HxCDF	0.766	0.134	0.138
2,3,4,6,7,8-HxCDF	0.153	0.034	0.027
Total HxCDF	5.268	0.775	0.738
1,2,3,4,6,7,8-HpCDF	2.371	0.258	< 0.418
1,2,3,4,7,8,9-HpCDF	0.160	< 0.015	< 0.011
Total HpCDF	2.873	0.284	< 0.418
Total OCDF	0.551	0.134	0.320
TOTAL PCDF:			
INCLUDES MDLs	17.312	2.588	2.310
EXCLUDES MDLs	17.312	2.588	1.892
MID RANGE	17.312	2.588	2.101

NOTES

dscm dry standard cubic meter at 68 F and one atmosphere

< Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE

PCDD/PCDF TOXIC EQUIVALENT CONCENTRATION
USING CA DOHS WEIGHTING SCHEME
(ng/dscm)

		CREMATORY STACK		
	Toxic Equivalence Factor	DT-1B	DT-2A	DT-3B
DIOXINS				
2378 TCDD	1.00	0.0311	0.0059	0.0084
123478 PeCDD	1.00	0.0910	0.0127	0.0394
123478 HxCDD	0.03	0.0039	0.0005	0.0007
123678 HxCDD	0.03	0.0059	0.0006	0.0010
123789 HxCDD	0.03	0.0079	0.0004	0.0009
1234678 HpCDD	0.03	0.0517	0.0038	0.0148
TOTAL PCDD:				
INCLUDES MDLs		0.1915	0.0239	0.0651
EXCLUDES MDLs		0.1915	0.0239	0.0651
FURANS				
2378 TCDF	1.00	0.1652	0.1395	0.0303
12378 PeCDF	1.00	0.1389	0.0310	< 0.0295
23478 PeCDF	1.00	0.3592	0.1821	< 0.0369
123478 HxCDF	0.03	0.0122	0.0036	0.0021
123678 HxCDF	0.03	0.0122	0.0019	0.0019
123789 HxCDF	0.03	0.0230	0.0040	0.0041
234678 HxCDF	0.03	0.0046	0.0010	0.0008
1234678 HpCDF	0.03	0.0711	0.0077	< 0.0125
1234789 HpCDF	0.03	0.0048	< 0.0004	< 0.0003
TOTAL PCDF				
INCLUDES MDLs		0.7912	0.3712	0.1185
EXCLUDES MDLs		0.7912	0.3707	0.0392
TOTAL TOXIC EQUIVALENTS (2,3,7,8-TCDD Equivalents)				
INCLUDES MDLs		0.9827	0.3950	0.1836
EXCLUDES MDLs		0.9827	0.3946	0.1043
MID RANGE		0.9827	0.3948	0.1439

NOTES

dscm dry standard cubic meter at 68 F and one atmosphere

< Indicates below limit of detection (MDL)

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

California Analytical
Laboratory

Enseco
A CORNING Company

March 26, 1991
Lab ID: 055403

Al Jenkins
California Air Resources Board
1309 T Street
Sacramento, CA 95814

Dear Mr. Jenkins:

Enclosed is the report for the ten sample trains which were received at Enseco-Cal Lab on 25 October 1991.

The report consists of the following sections:

I Sample Description
II Analysis Request
III Quality Control Report
IV Analysis Results

Please note that recoveries are high for a number of the PAH internal standards, particularly in the method blank. We have re-analyzed the samples and checked all of the calculations. We have no explanation for this.

We were only able to obtain pre-spike recoveries for the 13C-2,3,4,7,8-Pentachlorodibenzofuran. The other pre-spike compounds were identical to internal standards and recovery standards used by the laboratory and spiked into the samples prior to extraction. These compounds were not used in calculating any of the results.

If you have any questions, please feel free to call.

Sincerely,

Kathleen A. Gill
for
Michael J. Miille, Ph.D.
Division Director

mow

Enseco Incorporated
2544 Industrial Boulevard
West Sacramento, California 95691
916 372-1393 Fax 916-372-1768

California Analytical
Laboratory

Enseco
A CORNING Company

May 6, 1991
Lab ID: 055403
AMENDED

Al Jenkins
California Air Resources Board
1309 T Street
Sacramento, CA 95814

Dear Mr. Jenkins:

Enclosed is the amended report for the five dioxin sample trains which were received at Enseco-Cal Lab on 25 October 1991.

The report consists of the following sections:

I Sample Description
II Analysis Request
III Quality Control Report
IV Analysis Results

If you have any questions, please feel free to call.

Sincerely,

Michael S. Filigenzi
for

Kathleen A. Gill

Michael J. Miille, Ph.D. Regional General Manager Special Services	Kathleen A. Gill Program Administrator

mow

Enseco Incorporated
2544 Industrial Boulevard
West Sacramento, California 95691
916 372-1393 Fax 916 372-7768

STATE OF CALIFORNIA PETE WILSON, Go

AIR RESOURCES BOARD
1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812

August 1, 1991

Michael J. Miille, Ph.D.
Regional General Manager
Special Services
Enseco Incorporated
2544 Industrial Boulevard
West Sacramento, CA 95691

Dear Dr. Miille:

<u>Camellia Memorial Lawn Crematory</u>

<u>Dioxin, Furan and PAH Laboratory Data</u>

On March 26, 1991 we received a laboratory report for the analysis of ten sample trains submitted by the Air Resources Board to Enseco-Cal Laboratory on October 25, 1990. These sample trains were prepared by Enseco-Cal Laboratory chemists for field use by ARB source test staff to sample for Polychlorinated Dibenzo-p-Dioxin (PCDD), Polychlorinated Dibenzo Furan (PCDF), and Polynuclear Aromatic Hydrocarbons (PAH) in stack emissions from emission testing at Camellia Memorial Lawn.

Upon review of Enseco-Cal Laboratory's report, questions were raised such as types of surrogate standards used, laboratory recovery procedures followed and whether or not high resolution GC/MS procedures were utilized.

On May 16, 1991 we received an amended laboratory report which still did not completely address our concerns.

When referring to field spikes we will use the term, "surrogate standards" adopted by the EPA in Method 23, and by the ARB in the amended Method 428 (date of amendment, September 12, 1990).

We are requesting that Enseco-Cal Labs respond specifically to the comments and questions shown in the attachment. In addition we are also requesting that you provide us with a narrative that describes in detail

a) the history of your involvement in this project, from the first request for analytical services (state whether oral or written) to the preparation of the reports, and

b) the procedures used at all stages of the project, including those followed prior to analysis of the samples.

For each portion of the narrative that is supported by written records, please submit copies of such records.

If you have any questions, please call me at (916) 445-0657 or have your staff contact Al Jenkins or Gloria Lindner of my staff at (916) 323-1476 or (916) 323-1165.

Sincerely,

George Lew

George Lew, Chief
Engineering Evaluation Branch
Monitoring and Laboratory Division

Attachment

cc: George Prather
Dick Johnson

bcc: Gloria Lindner
Catherine Lentz
Linda Murchison
Susan Huscroft

ATTACHMENT

COMMENTS AND QUESTIONS CONCERNING THE PCDD/PCDF ANALYTICAL DATA

1. Sample analytical results: Comparison of original and amended report

The amended data submitted under a cover letter dated May 16, 1991 show differences from the March 26 report that must be explained. In a conversation on May 1, 1991 with Gloria Lindner of my staff, Mike Filigenzi of Enseco Cal Labs stated that the native analyte levels in the sample and the internal standard recoveries had been miscalculated in the March 26 report. It seems that the analyst believed that the sample extract had been divided into three portions (one for dioxin/furan analysis, one for PAH analysis, and one to be archived), whereas it had really been divided into two portions; one to be analyzed for dioxins and furans, and the other to be archived. The PAH analysis was actually done on a sample from a separate PAH sampling train.

To achieve the target internal standard level in any sample extract injected in the GC/MS, the amount of internal standard added to the sample before extraction is usually increased by a factor equal to the number of portions into which the sample extract will be divided before the GC/MS analysis. This means that the amount of internal standard added to a sample that is expected to be divided into three portions before GC/MS analysis will be three times the amount added to a sample that will not be divided before GC/MS analysis.

According to Mike Filigenzi, the calculations for the March report were based on the assumption that the samples were spiked at three times the single sample level, whereas the samples were actually spiked at two times the single sample level. Based on this information, we expected the revised (May) report to show analyte levels that would be two-thirds of those reported in March. We have compared the two sets of data and calculated the ratio of the concentrations reported on May 6 to those reported on March 26. These are summarized in Appendix A. We have identified all of the analytes for which this ratio was different from the 2/3 ratio that we expected. ***Please account for these deviations.*** In addition, the May 6 report for the blank train DT-4CS (Lab ID # 055403-0002-SA) listed detected amounts for several analytes that were reported as undetected in March. ***Please explain this difference. Also, please explain how the May data were generated for all of the samples. The same date of analysis, 18 Feb 91, appears on both reports. Were the chromatograms generated in March used to recalculate the data for the May report?***

2. Internal standard recoveries: Comparison of original and amended report

Our expectation of the effect of the revision on the internal standard recoveries is the opposite of that for the analyte levels in the sample. Internal standard recoveries in the May report should be 3/2 times the recoveries reported in March. We have calculated the ratio of the May recoveries to the March recoveries and summarized these on page A-4. Most of the ratios were approximately 1.5 as expected. ***Please explain why some of the ratios deviate from this expected value. How were the internal standard recoveries recalculated?***

Revised report

3. Internal Standards used for Quantifying PCDD and PCDF

Both the May and the March reports list percent recoveries for only six internal standards instead of the nine that were requested for the HRMS analysis for this project. The missing recoveries are for the penta- hexa- and hepta-chlorinated furan internal standards. We understood, from a May 1, 1991 conversation between Gloria Lindner and Mike Filigenzi, that Enseco used the nine internal standards required by Method 428 for HRMS analysis, and that the amended report would list the recoveries for all of these HRMS standards. This change has not been made.

Please report percent recoveries for the nine required internal standards. Also please explain why this was not done in either of the reports. Please specify the recovery standards that were affected by the conflict referred to in your March 26 cover letter. How did this affect the calculation of internal standard recoveries? How were the native concentrations in the sample calculated? What were the assumptions involved?

Mike Filigenzi, in an earlier telephone conversation with Gloria Lindner on April 16, 1991, gave this explanation for the listing of only six internal standard recoveries in the March report.

1. He did not know that the surrogate standards had been added to the resin cartridges by Enseco's preparation lab.
2. The list of surrogate standards was unfamiliar to him.
3. He thought that the three labeled furan standards were added to the sample twice, first with the surrogate standards to the resin prior to sampling, and then again with the internal standard mix prior to extraction of the sample.

If the last were true, he could not have used the labeled penta- to hepta-chlorinated furan internal standards to quantitate the furans in the sample because there would be no means of distinguishing these three internal standards from the labeled furan surrogate standards. For the same reason, he could not have calculated recoveries for these labeled compounds as either internal standards or surrogate standards. Yet, the March report did list percent recovery for the pentachlorinated furan surrogate standard (^{13}C-2,3,4,7,8-PeCDF) accompanied by a note that the results were calculated using the ^{13}C-pentachlorodibenzofuran internal standard assuming a response factor of 1. *Why was the PeCDF internal standard recovery not reported then?*

4. Surrogate standard results

The surrogate standards were supplied by Enseco. Therefore we did not expect any of the conflicts reported in your March 26 cover letter and discussed by Mike Filigenzi in telephone conversations with ARB staff. *Please identify all labeled compounds that you are now certain were added to the sample twice. Please explain why there was so much confusion surrounding the pre-test preparation and subsequent analysis of these samples.*

The table on page A-4 shows the differences between the list of requested surrogate standards and the list of surrogate standards for which recoveries were reported. The May 6 report contains percent recoveries that the March 26 report did not.

Please explain why this conflict occurred. What were the internal standards used to calculate the surrogate recoveries for the May 6 report? Why was the HxCDD surrogate standard recovery not reported? Why was the $^{37}Cl_4$-TCDD surrogate standard recovery not reported in March?

COMMENTS AND QUESTIONS REGARDING THE PAH DATA

1. Internal standard recoveries

The internal standard recoveries were high for a number of internal standards. Recoveries were 152 to 308 percent for all internal standards in the method blank with molecular weight higher than that of d_{10}-Anthracene. You stated in your cover letter that you do not have an explanation for this. This is unacceptable.

Please provide a detailed explanation that includes a narrative and documentation of your investigation of this problem. Document all checks that were satisfactory, and all that weren't. Did you use the archive extract for the re-analysis? Was the re-analysis done on a different day and on a different GC/MS system? Was the behaviour of the recovery standards consistent from one sample to the next? We would like this information as the problem of high internal standard recoveries was not common to all of the samples. Please identify the recovery standards that were used and the method of calculating percent recovery of the internal standards in all of the samples.

Please supply the recovery data for the Indeno(1,2,3-cd)pyrene internal standard and explain why they were not reported earlier.

2. Reporting surrogate standard recoveries

There were no PAH surrogate standard recoveries reported by ENSECO. The request for analytical services (see attached) indicates that four surrogates were requested. Al Jenkins was informed by Keri Aboulhausen in April that only d_{10}-2-Methyl naphthalene was added to the resin. Gloria Lindner subsequently asked Steve Rogers to supply the recovery data, but we have not yet received it.

Please supply the 2-Methyl naphthalene surrogate standard recovery data. Why were the other surrogate standards not added to the resin? Please indicate as accurately as possible the date that you received the request for analytical services?

COMPARISON OF MAY 6 AND MARCH 26 REPORTS

	pg/sampling train		Ratio	Different from expected
	May 6	March 26	May 6 : March 26	
LAB ID: 055403-0001-SA **ARB ID: DT-1B**				25/25[a]
DIOXINS				
2,3,7,8-TCDD	180	130	1.38	
Total TCDD	3500	2600	1.35	
1,2,3,7,8-PeCDD	510	380	1.34	
Total PeCDD	5900	4400	1.34	
1,2,3,4,7,8-HxCDD	710	540	1.31	
1,2,3,6,7,8-HxCDD	1100	820	1.34	
1,2,3,7,8,9-HxCDD	1500	1100	1.36	
Total HxCDD	15000	11000	1.36	
1,2,3,4,6,7,8-HpCDD	9700	7200	1.35	
Total HpCDD	21000	15000	1.40	
OCDD	12000	8800	1.36	
FURANS				
2,3,7,8-TCDF	450	230	1.96	
Total TCDF	29000	22000	1.32	
1,2,3,7,8-PeCDF	770	580	1.33	
2,3,4,7,8-PeCDF	2000	1500	1.33	
Total PeCDF	6800	14000	0.48	
1,2,3,4,7,8-HxCDF	2300	1700	1.35	
1,2,3,6,7,8-HxCDF	2300	1700	1.35	
1,2,3,7,8,9-HxCDF	510	3200	0.16	
2,3,4,6,7,8-HxCDF	6900	640	10.78	
Total HxCDF	29000	22000	1.32	
1,2,3,4,6,7,8-HpCDF	13000	9900	1.31	
1,2,3,4,7,8,9-HpCDF	890	670	1.33	
Total HpCDF	16000	12000	1.33	
OCDF	3000	2300	1.30	
LAB ID: 055403-0003-SA **ARB ID: DT-2A**				3/25[a]
DIOXINS				
1,2,3,7,8,9-HxCDD	29	54	0.54	
FURANS				
2,3,7,8-TCDF	370	180	2.06	
2,3,4,6,7,8-HxCDF	330	130	2.54	

---

[a] NOTES
There were 25 target analytes for all of the samples.
For sample DT-1B, the ratio for all of the 25 target analytes were different from 0.67. Most ranged from 1.30 to 1.40.
For sample DT-2A, the ratio ranged from 0.63 to 0.78 for 22 of the 25 target analytes. Only the three shown above were different from 0.67.

COMPARISON OF MAY 6 AND MARCH 26 REPORTS (CONT)

	pg/sampling train		Ratio	Different from expected
	May 6	March 26	May 6 : March 26	
LAB ID: 055403-0004-SA **ARB ID: DT-3B**				6/25[a]
DIOXINS				
1,2,3,7,8-PeCDD	260	160	1.63	
Total PeCDD	260	160	1.67	
FURANS				
1,2,3,6,7,8-HxCDF	110	260	0.42	
2,3,4,6,7,8,-HxCDF	610	110	5.55	
1,2,3,7,8,9-HxCDF	43	560	0.08	
1,2,3,4,7,8,9-HpCDF	<46	<45	1.02	
LAB ID: 055403-0008-SA **ARB ID: DT-1FB**				9/25[a]
DIOXINS				
1,2,3,7,8-PeCDD	<23	<14	1.64	
Total PeCDD	<23	<14	1.64	
FURANS				
1,2,3,7,8-PeCDF	<25	<15	1.67	
2,3,4,7,8-PeCDF	<36	<22	1.64	
Total PeCDF	<54	<32	1.69	
1,2,3,7,8,9-HxCDF	<6.1	<20	0.31	
2,3,4,6,7,8-HxCDF	<22	<15	1.47	
Total HxCDF	<52	<300	0.17	
1,2,3,4,7,8,9-HpCDF	<6.1	<13	0.47	

---

[a] NOTES

There were 25 target analytes for all of the samples.

For sample DT-3B, the ratios for 6 of the 25 target analytes were different from 0.67. The ratios for the remaining 19 ranged from 0.63 to 0.78.

There were no dioxins or furans detected in sample DT-1FB. For 9 of the 25 target analytes, the ratio of the May to March reported detection limits were different from 0.67. For the other 16 target analytes, the detection limits reported in May were 65 to 69 percent of those reported in March.

COMPARISON OF MAY 6 AND MARCH 26 REPORTS (CONT)

	pg/sampling train		Ratio	Different from expected
	May 6	March 26	May 6 : March 26	
LAB ID: 055403-0002-SA **ARB ID: DT-4C**				**2/25[a]**
1,2,3,4,7,8-HxCDD	<18	<20	0.90	
1,2,3,4,7,8,9-HpCDF	<7.2	<16	0.45	
LAB ID: 055403-0002-SA[b] **ARB ID: DT-4C**				
1,2,3,6,7,8-HxCDD	18	<28		
1,2,3,7,8-PeCDF	6.2	<9.4		
2,3,4,7,8-PeCDF	17	<26		
1,2,3,4,7,8-HxCDF	25	<37		
1,2,3,6,7,8-HxCDF	18	<27		
1,2,3,7,8,9-HxCDF	6.5	<47		
2,3,4,6,7,8-HxCDF	48	<16		

[a] NOTES
There were 25 target analytes for all of the samples.

For sample DT-4C, the ratios of detection limits for 2 of the 25 target analytes were different from 0.67. For the other 23 target analytes, the detection limits and detected amounts reported in May were 63 to 70 percent of those reported in March.

[b] NOTES
The May report listed detected amounts for the seven target analytes shown above while the March report indicated that they were not detected in the sample.

SURROGATE STANDARDS DATA

Requested	Reported March 26	Reported May 6
^{37}Cl-2,3,7,8-TCDD		^{37}Cl-2,3,7,8-TCDD
^{13}C-2,3,4,7,8-PeCDF	^{13}C-2,3,4,7,8-PeCDF	^{13}C-2,3,4,7,8-PeCDF
^{13}C-1,2,3,7,8,9-HxCDD		
^{13}C-1,2,3,4,7,8-HxCDF		^{13}C-1,2,3,6,7,8-HxCDF
^{13}C-1,2,3,4,6,7,8-HpCDF		^{13}C-1,2,3,4,7,8,9-HpCDF

RATIO OF MAY 6 TO MARCH 26 REPORTED INTERNAL STANDARD RECOVERIES

Native PCDD/PCDF	DT-1B	DT-2A	DT-3B	DT-4C	DT-1FB
^{13}C-2,3,7,8-TCDD	1.53	1.49	1.50	1.60	1.61
^{13}C-1,2,3,7,8-PeCDD	1.48	1.61	0.60	1.51	1.52
^{13}C-1,2,3,6,7,8-HxCDD	1.70	1.97	1.61	1.71	1.50
^{13}C-1,2,3,4,6,7,8-HpCDD	1.67	1.87	1.62	1.73	1.48
^{13}C-OCDD	1.69	1.96	1.61	1.74	1.50
^{13}C-2,3,7,8-TCDF	1.52	1.71	1.51	1.53	1.60

Laboratory

Air Resources Board
RECEIVED
OCT 01 1991
Monitoring & Laboratory Division

Enseco
A CORNING Company

George Lew
California Air Resources Board
1309 T Street
Sacramento, CA 95814

Dear George,

This letter is in response to a request by Al Jenkins and Gloria Lindner of your staff regarding the Camellia Crematorium Project. On Sept. 11, 1991, several members of the staff of Enseco-Cal Labs met with Al, Gloria, George Prather, and Peter Ouchida to discuss this project. This meeting was called at the request of Enseco-Cal Labs to discuss the letter of August 1, 1991 from you to Michael Miille. This letter raised a number of questions regarding this project. With the meeting and this letter, we hope to have answered your questions. Included with this letter are revised data sheets for this project.

Enseco's involvement with this project began with the request for cleaned and spiked air trains to be provided to the California Air Resources Board for sampling and analysis of PAH, PCB, and PCDD/PCDF compounds. We were specifically requested to spike the trains according to the revision of Method 428 adopted on September 12, 1990. We did our best to comply with this request and provided the trains to Air Resources Board personnel for sampling. A number of delays were experienced with this project, and on October 25, 1990 the air trains were returned to us with a request form indicating that they were to be analyzed by the above method. The request form indicated that the trains had been spiked with PCDD isomers used by Cal Labs for internal and recovery standards. This was noticed after extraction of the trains had begun and, if true, would have resulted in over-spiking of the indicated internal and recovery standard compounds. It was therefore assumed that the spiking had been performed by someone outside of Cal Labs. Mis-communication between the chemists doing the pre-spiking and those doing the analysis prevented us from realizing that the request form was in error, that we had performed the pre-spiking of the trains, and that the indicated isomers were not the ones which had been pre-spiked into the samples. This was not recognized until some time after the first set of results for these samples was sent to the Air Resources Board. In order to calculate the first set of results, Cal Labs personnel felt that they would be unable to use the potentially over-spiked internal and recovery standards, and therefore calculated results using other internal and recovery standards. After it was discovered that the request form was in error, the results were re-calculated using the proper internal and recovery standards as per the method.

Enseco Incorporated
[illegible] Industrial Boulevard
West Sacramento, California [illegible]
916 372-1393 Fax 916 372-[illegible]

The analyses requested for these samples also led to confusion over methods of calculation. The aforementioned request form stated that of the ten sample trains received, five were to be analyzed for PAH compounds and five were to be analyzed for PCB's and PCDD/PCDF's. This would require the extracts from the trains for PCDD/PCDF analysis to be split three ways - one aliquot for PCDD/PCDF's, one for PCB's, and one for archiving purposes. This splitting, in turn, would require a three-fold increase in the amount of internal standard solution spiked into the samples. At some point after the initial extraction, we were told that this was an error and that these trains were to be analyzed for PCDD/PCDF's only. This later led to confusion over whether the samples were split two or three ways, and therefore whether the internal standard levels were increased by a factor of two or three. In the initial report sent on March 26, 1991, calculations were based on a three-fold internal standard increase. In the revised report of May 9, 1991, the results were re-calculated based on a two-fold increase. After extensive review of internal records concerning the preparation of these samples, it has been determined that they were in fact split three ways and that the internal standard levels were increased by a factor of three. The enclosed data sheets reflect this change.

A third question which arose over this data concerns the lack of a hexa-chlorinated dioxin pre-spike compound. Of the three labelled hexa-chlorinated dioxins, Cal Labs uses one as a recovery standard and one as an internal standard. At the time these samples were pre-spiked, the third was unavailable for pre-spiking. We did include labelled TCDD, and penta-, hexa-, and hepta-chlorinated furan pre-spikes as per the method.

In summary, it must be emphasized that none of the confusion which arose over these samples affected their analysis at the instrument level. All revisions to PCDD/PCDF data in this project were the result of re-calculations performed due to information received at various times throughout the project.

Questions also arose regarding the PAH data for this project. The first was in regards to potential anomalies in the PAH analytical procedure. Our spiking procedure requires the presence of a witness to any spiking performed in the preparation of samples. For this project, neither the chemists performing the extraction and analysis nor the spike witness could identify any anomalies in any part of the extraction or analysis other than those previously noted in the cover letter sent with the data.

A second question regarding the PAH data was in regards to the internal standard and surrogate spike compounds. A request was evidently made by the Air Resources Board for the lab to spike with four PAH surrogates. Due to miscommunications within the laboratory, 2-Methylnaphthalene was the only surrogate spike used. Recoveries for this compound are enclosed. Additionally, there was no Indeno(1,2,3-cd)pyrene internal standard available at the time of this analysis. All internal standard recoveries were calculated using 2,2'-Difluorobiphenyl as a recovery standard.

A third question asked was in regards to the internal standard recoveries for the PAH method blank. These recoveries were much higher than normal and were confirmed by re-analysis. Careful examination of the data reveals no obvious explanation for these high recoveries, however there are a number of possible explanations including mis-spiking of the internal or recovery standards or suppression of recovery standard response due to interfering compounds. We do not believe this significantly compromises the quality of data for the sample analyses.

I hope that we have been able to answer your questions to your satisfaction. We regret the various problems which occurred over the course of this project and do not believe that it reflects the quality of work currently being produced by our analytical groups. We hope to work with you in the future to prove this.

If you have any questions, please feel free to call

Sincerely,

Michael S. Filigenzi

Michael S. Filigenzi
Principle Scientist

APPENDIX VIII

POLYCYCLIC AROMATIC HYDROCARBON LABORATORY DATA AND ANCILLARY REDUCED DATA TABLES

TABLE

PAH ANALYSIS (TOTAL), ng/sample

	CREMATORY STACK		
	RT-1A	RT-2B	RT-3A
Naphthalene	38000 s	42000 s	38000 s
Acenaphthylene	50	120	41
Acenaphthene	67	59	55
Fluorene	190	340	190
Phenanthrene	540	2400	1000
Anthracene	100	320	140
Fluoranthene	49	220	85
Pyrene	56	130	92
Benzo(a)anthracene	< 4.4 w	11	< 7.3 w
Chrysene	< 12 w	79	< 17 w
Benzo(b)fluoranthene	< 11 w	< 9.7 w	< 6.7 w
Benzo(k)fluoranthene	< 8.7 w	< 9.5 w	< 6.4 w
Benzo(a)pyrene	< 11	< 14	37
Dibenzo(a,h)anthracene	< 8.1	< 8.3	< 5.6
Benzo(g,h,i)perylene	< 13	< 14	< 23 w
Indeno(1,2,3-c,d)pyrene	< 8.7	< 12	< 6.0
TOTAL:			
Including naphthalene	39128.9 *	45746.5 *	39722.0 *
Not including naphthalene	1128.9 *	3746.5 *	1722.0 *

NOTES

< indicates below reporting limit

* - Total includes reporting limits for compounds not detected

s Secondary ion used for quantitation.

w MPC - Maximum Possible Concentration.

CREMATORY STACK LETTER DESIGNATION:

CREMATORY NO.1 (A)

CREMATORY NO.2 (B)

C-90-004

TABLE

PAH CONCENTRATIONS, ng/dscm

	CREMATORY STACK		
	RT-1A	RT-2B	RT-3A
Naphthalene	15937 s	16663 s	11462 s
Acenaphthylene	20.97	47.60	<12.36
Acenaphthene	28.10	23.40	19.60
Fluorene	79.68	134.8	57.31
Phenanthrene	226.4	952.1	301.6
Anthracene	41.94	126.9	42.23
Fluoranthene	20.55	87.28	25.64
Pyrene	23.48	51.57	27.75
Benzo(a)anthracene	<1.845 w	4.364	<2.202 w
Chrysene	<5.032 w	31.34	<5.128 w
Benzo(b)fluoranthene	<4.613 w	<3.848 w	<2.021 w
Benzo(k)fluoranthene	<3.648 w	<3.769 w	<1.930 w
Benzo(a)pyrene	<4.613	<5.554	11.16
Dibenzo(a,h)anthracene	<3.397	<3.293	<1.689
Benzo(g,h,i)perylene	<5.452	<5.554	<6.938 w
Indeno(1,2,3-c,d)pyrene	<3.648	<4.760	<1.809
TOTAL PAHs			
Not including naphthalene			
INCLUDES MDLs	473.4	1486.	519.4
EXCLUDES MDLs	441.2	1459.	497.7
MID RANGE	457.3	1473.	508.5
Including naphthalene	16411 *	18150 *	11982 *

NOTES

dscm - dry standard cubic meter at 68 F and one atmosphere

< indicates below reporting limit

* - Total includes reporting limits for compounds not detected

s Secondary ion used for quantitation.

w MPC - Maximum Possible Concentration.

CREMATORY STACK LETTER DESIGNATION:

CREMATORY NO.1 (A)

CREMATORY NO.2 (B)

APPENDIX IX

TRACE METAL LABORATORY DATA AND ANCILLARY REDUCED DATA TABLES

TABLE

TRACE METALS, ug/sample

	CREMATORY STACK			
SAMPLE ID	TM-1A	TM-2B	TM-3A	FIELD BLANK **
Ag *	6.76	3.46	1.91	< 6.60
As	34.0	< 16.0	< 16.0	< 16.0
Ba	14.3	15.7	10.49	8.39
Be *	1.4	0.41	0.42	0.41
Cd	5.19	7.54	5.92	< 1.2
Co	1.00	1.00	< 7.80	< 7.8
Cr	12.6	16.9	21.3	13.9
Cu	16.1	13.4	16.7	1
Hg	2617	76.7	2913	< 13.3
Mo	< 9.60	< 9.60	< 9.60	< 9.6
Ni	20.9	23.2	20.2	11.2
Pb	34.6	40.7	36.5	21
Sb	< 18.0	21.9	20.4	18.6
Se	< 24.6	< 24.6	< 24.6	< 24.6
Tl	< 48.0	< 48.0	< 48.0	< 48.0
V	32.3	31.9	33.6	33.1
Zn	158	204	237	16.9

(<) Below limit of detection.

(*) corrected for laboratory digestion blank:

Ag: laboratory blank 49% to 77% of uncorrected sample value

Be: laboratory blank 70% to 39% of uncorrected sample value

(**) Field blanks or field blank detection limit:

(>) 50% for Ag, As, Ba, Be, Co, Cr, Ni, Pb, Sb, V

(<) 50% for Cd, Cu, Zn, Hg

CREMATORY STACK LETTER DESIGNATION:

CREMATORY NO.1 (A)

CREMATORY NO.2 (B)

TABLE

TRACE METAL CONCENTRATIONS
(ug/dscm)

CREMATORY STACK

SAMPLE ID	TM-1A	TM-2B	TM-3A
Ag *	1.9	1.1	0.7
As	9.5	< 4.9	< 5.7
Ba	4.0	4.8	3.7
Be *	0.4	0.1	0.1
Cd	1.5	2.3	2.1
Co	0.3	0.3	< 2.8
Cr	3.5	5.2	7.5
Cu	4.5	4.1	5.9
Hg	734.9	23.4	1029.2
Mo	< 2.7	< 2.9	< 3.4
Ni	5.9	7.1	7.1
Pb	9.7	12.4	12.9
Sb	< 5.1	5.7	7.2
Se	< 6.9	< 7.5	< 8.7
Tl	< 13.5	< 14.7	< 17.0
V	9.1	9.7	11.9
Zn	44.4	62.3	83.7

(<) Below limit of detection.

(*) corrected for laboratory digestion blank:
Ag: laboratory blank 49% to 77% of uncorrected sample value
Be: laboratory blank 70% to 89% of uncorrected sample value

(**) Field blanks or field blank detection limit:
(>) 50% for Ag, As, Ba, Be, Co, Cr, Ni, Pb, Sb, V
(<) 50% for Cd, Cu, Zn, Hg

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

APPENDIX X

CHROMIUM AND HEXAVALENT CHROMIUM LABORATORY DATA

TABLE

CHROMIUM AND HEXAVALENT CHROMIUM ANALYSIS,ug/sample

	CREMATORY STACK		
SAMPLE ID	CR-1B	CR-2A	CR-3B
Cr	< 18.6	< 20.1	< 24.0
Cr+6	11.3	4.8	7.0

< Indicates below limit of detection (MDL)
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

TABLE

CHROMIUM AND HEXAVALENT CHROMIUM CONCENTRATION, ug/dscm

	CREMATORY STACK		
SAMPLE ID	CR-1B	CR-2A	CR-3B
Cr	< 5.2	< 5.58	< 6.52
Cr+6	3.182	1.332	1.90

< Indicates below limit of detection (MDL)
CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)

APPENDIX XI

VOLATILE ORGANIC COMPOUNDS

TABLE

BAG SAMPLE CONCENTRATIONS OF HALOGENATED AND AROMATIC VOLATILE ORGANIC COMPOUNDS, ppbC

DATE	SAMPLE ID	BENZENE	TOLUENE	XYLENES	VINYL-Cl
		ppbC	ppbC	ppbC	ppb
10-25-90	BS1A	*	100	*	**
	BS2A	*	27	*	**
	BLANK	*	21	11	**
10-29-90	BS3B	*	24	*	**
	BS4B	*	*	*	**
	BLANK	*	*	*	**
10-30-90	BS5B	*	19	*	**
	BS6B	*	*	*	**
	BLANK	*	40	20	**
10-31-90	BS7B	*	800	86	**
	BS8B	23	23	*	**
	BLANK	*	*	*	**
	Spike, low	22	26	35 a	5
	Spike, high	450	580	730 a	99

NOTES: * Below limit of quantitation (LOQ) of 10 ppbC.
** Below LOQ of 3 ppb.
a Average of three runs.

CREMATORY STACK LETTER DESIGNATION:
CREMATORY NO.1 (A)
CREMATORY NO.2 (B)