Background Report Reference

AP-42 Section Number: 11.6

Background Chapter: 4

Reference Number: 65

Title: Emissions Testing of a Precalciner Cement Kiln at Louisville, Nebraska

US EPA

November 1990

Emissions Testing of a Precalciner Cement Kiln at Louisville, Nebraska

U.S. Environmental Protection Agency
Office of Solid Waste
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November 1990

ACKNOWLEDGMENTS

This document was prepared by the EPA's Office of Solid Waste under the direction of Mr. J. Robert Holloway, Chief of the Combustion Section, Waste Treatment Branch, Waste Management Division, and Dwight Hlustick and Shiva Garg, also of the Combustion Section. Field testing and technical support in the preparation of this document were provided by Midwest Research Institute (MRI) under Contract No. 68-01-7287. MRI staff who assisted with field sampling, laboratory analysis, and preparation of the report were Dr. Andres Romeu, Dr. Alfred Meiners, Jon Onstot, Dr. George Scheil, Andrew Trenholm, and Deann Williams.

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SECTION 1

INTRODUCTION

The Environmental Protection Agency, Office of Solid Waste (EPA/OSW), is developing regulations to control emissions of products of incomplete combustion (PICs) from cement kilns. The emission parameters planned for use in this regulation are total hydrocarbons (HCs) and carbon monoxide (CO). To support the use of these parameters as surrogates for PICs, more information from full-scale testing of dry cement kilns is needed. As a part of this data-gathering effort, a test was conducted at the Ash Grove Cement Company precalciner kiln in Louisville, Nebraska.

The Ash Grove facility was selected for the test for two reasons. It has a precalciner as part of the cement-making process, a technology expected to be used for cement production more frequently in the future. The facility also burns both liquid and solid hazardous waste as supplementary fuels in the kiln.

The remaining sections of this Test Report present a detailed description of the test. Section 2 is a summary of the conclusions drawn from the test. Section 3 presents a description of the test project including the project objectives, facility operations, and test design. A discussion of the results of this study is provided in Section 4.

Three appendices contain additional information as follows: Appendix A presents a detailed discussion of the sampling and analysis methods used in the study, Appendix B provides the experimental data from the study, and Appendix C is a review of quality assurance/quality control (QA/QC) activities.

SECTION 2

CONCLUSIONS

This section contains brief statements of the major conclusions determined from analysis of the data generated during this project. Further discussion of these conclusions and other aspects of the data are presented in Section 4.

1. There was no detectable effect on the levels of total organic mass (TOM), hot total hydrocarbons (HC), or cold total hydrocarbon (HC) from burning waste versus coal in either the bypass or main ducts. Organic mass emissions in the main duct appear to be related to organic material in the process raw material and/or coal combustion in the pyroclone.

2. Low levels (near detection limits) of TOM and hot and cold HC prevented comparison of these measures of organic mass emissions in the bypass duct. Data for the main duct show that TOM and hot HC levels agreed well and that cold HC levels were about 70% of the other two measures.

3. Determination of the destruction and removal efficiency (DRE) of monochlorobenzene (MCB) was complicated by the formation of MCB as a PIC in the main duct emissions. Estimates of the DRE, discounting MCB formed as a PIC, were about 99.994%. However, this DRE could not be measured directly.

4. Formation of MCB as a PIC was related to high benzene levels in the main duct emissions and to the amount of chlorine input to the

kiln. In the presence of benzene, MCB concentrations increased as the input of chlorine increased.

5. The concentrations and identity of PICs measured, including dioxins and furans, were generally similar to those historically detected in hazardous waste incinerator gases.

6. Chloride emissions calculated as HCl were less than 4 lb/h and were about 1% of the chlorine input rate to the kiln.

7. Relatively high levels of ammonium ion compared to chloride ion were measured in the HCl sampling train. Evaluation of this result leads to a plausible interpretation of the data that the measured chloride was ammonium chloride, not HCl. Literature sources indicate that at the measured stack temperatures and stack gas concentrations, ammonium chloride would vaporize and be almost totally dissociated to HCl and ammonia.

SECTION 3.0

PROJECT DESCRIPTION

This section presents the project objectives, a description of the Ash Grove facility operations, the test design, and a summary of the sampling and analysis

3.1 PROJECT OBJECTIVES

The test at the Ash Grove kiln was designed to gather emission data for three modes of process operation: one using liquid and solid waste feed, a second with liquid waste feed only, and a third, a baseline mode, using no waste feed. The data-gathering objectives were to characterize these three operating modes as follows:

1. Measure and compare emission levels of THCs (using both a heated and unheated monitor system), and total organic mass (TOM).

2. Measure the levels of carbon monoxide (CO), carbon dioxide (CO_2), and oxygen (O_2) in the process exhaust gases.

3. Measure PIC emission, including dioxins and furans, for comparison to historical data from other hazardous waste combustion devices.

4. Determine the destruction and removal efficiency (DRE) of a hard-to-destruct Appendix VIII compound (monochlorobenzene) spiked into the solid hazardous waste feed.

5. Measure the emission levels of hydrogen chloride (HCl). Ammonium and potassium concentrations were also measured.

6. Obtain data on emission levels of nitrogen oxides (NO_x) monitored by the facility.

7. Measure the levels of total organic carbon (TOC) in the cement kiln raw material feed for comparison to historical data from other cement kilns and as a source of background data.

8. Obtain data from Ash Grove that characterizes the fossil fuel and hazardous waste fed to the kiln.

9. Obtain data on process operating conditions monitored by the facility.

3.2 PROCESS DESCRIPTION

The Ash Grove-Louisville facilities consist of the following: (1) quarries from which raw materials are extracted; (2) grinding and blending operations for preparing a homogeneous, properly proportioned mixture of raw materials; (3) an alkali bypass kiln and a precalciner kiln which convert the raw materials into cement clinker; (4) grinding mills in which the clinker is finely ground and mixed with gypsum to form the cement product; (5) storage, bagging, and materials transfer equipment; and (6) office, maintenance, dust disposal, and related areas. Figure 3-1 illustrates the general plant layout.

The test was conducted on the precalciner rotary kiln system. This system is designed to generate 1,800 tons of clinker per day at an energy use of 3.0 million Btu/ton. This system, shown in Figure 3-2, is essentially composed of the following subsystems:

- Rotary kiln
- Pyroclone precalciner
- Fuel feed

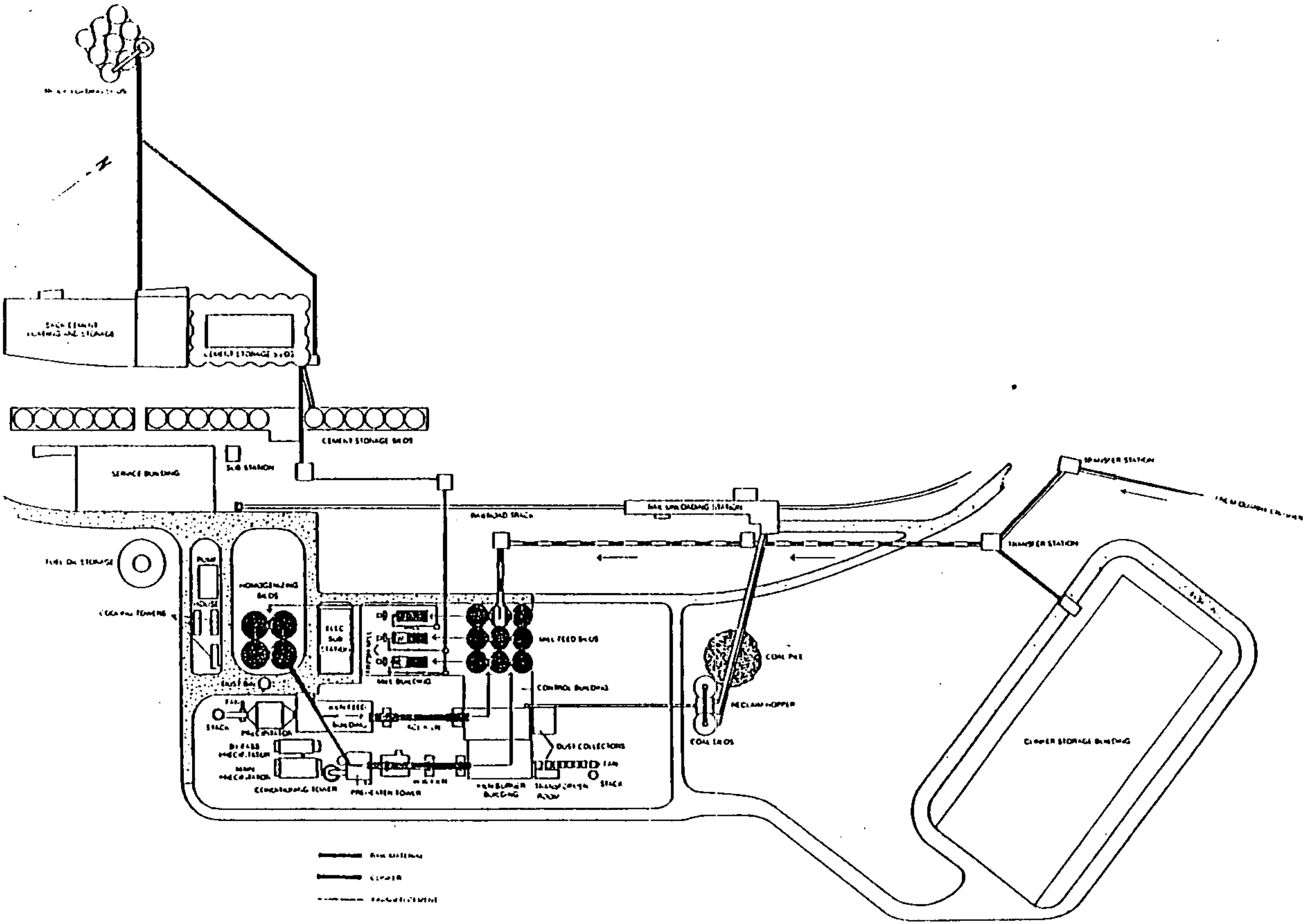

Figure 3-1. General plant layout.

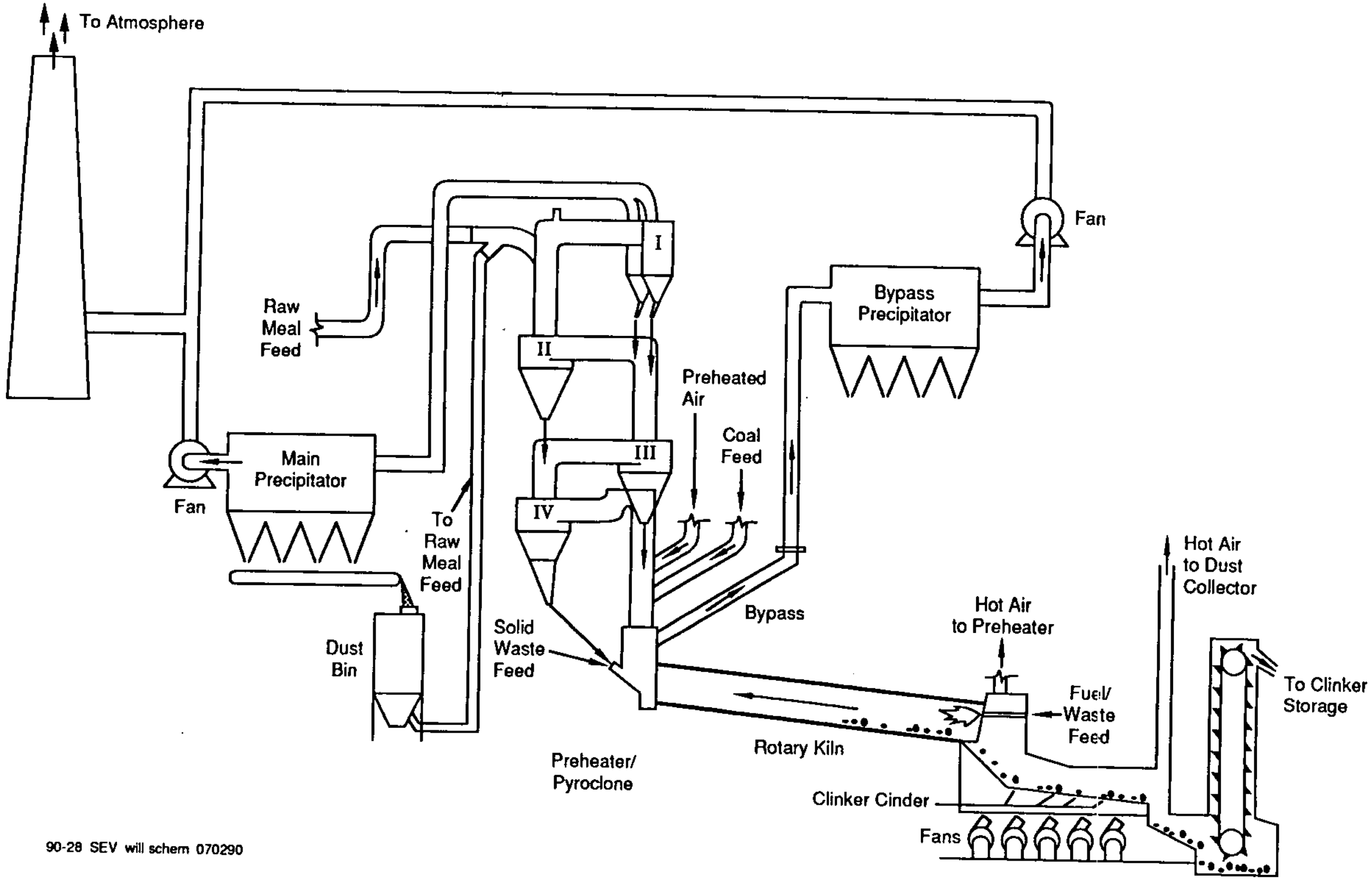

Figure 3-2. Process flow diagram.

- Emissions management
- Clinker handling systems
- Operational controls

3.2.1 Rotary Kiln

The Humboldt-Wedag (H-W) rotary kiln is a sloped cylinder, 12 1/2 ft in diameter and 164 ft long. At the downslope end, the kiln can be fired with No. 2 fuel oil, natural gas, pulverized coal, and/or liquid organic waste. Pulverized coal and/or solid waste can be fired near the upslope end of the kiln. Kiln temperatures are about 2800°F in the combustion zone and 1900°F at the gas exit.

Raw materials (i.e., homogenized limestone, clay-stone mix, and iron ore) are introduced to the kiln at the upslope end via a pyroclone precalciner (see Section 3.2.2). The kiln is operated as a countercurrent system; i.e., as the kiln rotates, solids gravitate toward the downslope end of the unit and hot combustion gases travel toward the upslope end. An average 4- to 5-s gas phase residence time is provided in the kiln.

At the upslope end of the kiln, combustion gases are channeled to either the pyroclone precalciner or a bypass system. In the bypass system, combustion gases are cooled with air and water sprays prior to release through an electrostatic precipitator.

3.2.2 Pyroclone Precalciner

The pyroclone precalciner is utilized to preheat and precalcinate raw material prior to introduction to the rotary kiln. Materials are approximately 60% prepared by the time they enter the upslope end of the rotary kiln. The pyroclone precalciner system can be subdivided into two primary components: a four-stage cyclone preheater and the pyroclone. Figure 3-3 illustrates the general configuration of the system.

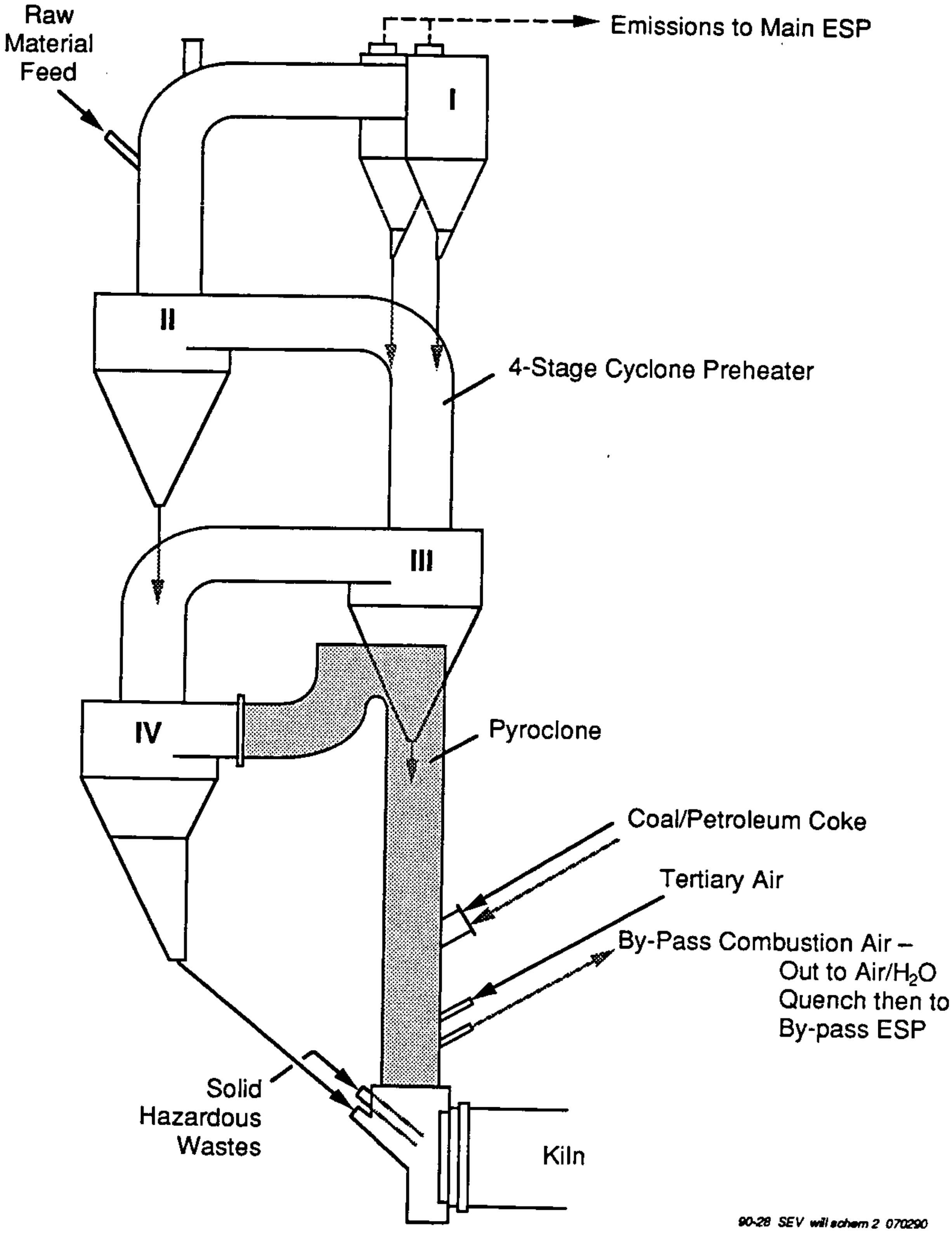

Figure 3-3. Pyroclone precalciner configuration.

3.2.2.1 Cyclone Preheater--

Raw materials are metered to the cyclone preheater from feed bins and enter the preheater at the vertical duct (riser duct) between the stage 1 and stage 2 cyclones. Raw materials are entrained in the gas stream from one stage to the next until they reach the pyroclone riser. Temperatures range from approximately 660°F in the stage 1 cyclone to 1630°F in the stage 4 cyclone.

3.2.2.2 Pyroclone--

The pyroclone is actually an extension of the riser between the kiln exhaust hood and stage 4 cyclone. As mentioned previously, hot combustion gases from the rotary kiln which do not escape to the bypass system are channeled to the pyroclone. Auxiliary fuel (in addition to the combustion gas heat) is added in the pyroclone by the introduction of a pulverized coal/petroleum coke fuel mix. By maintaining sufficient fuel in the pyroclone, a "flameless" combustion zone is created to preheat and calcine the materials entrained in the precalciner system.

Auxiliary preheated air is provided in the pyroclone precalciner through a tertiary air duct. Preheated combustion air from the downslope end of the kiln is introduced to the pyroclone via the tertiary air inlet duct, located below the coal/coal fuel inlet and above the kiln exhaust hood.

3.2.3 Fuel Systems

3.2.3.1 Pure Fuel Feed--

The precalciner kiln is brought up to operating temperature and operating temperatures are maintained by use of a "pure" fuel feed (i.e., No. 2 fuel oil, natural gas, and/or a pulverized coal and petroleum coke fuel mix).

No. 2 fuel oil and natural gas are introduced via burners in the downslope end of the kiln. The position and flame shapes in the downslope portion of the kiln allow for sufficient cooling of clinker product.

Coal/petroleum coke is fired via a burner in the downslope end of the kiln and in the pyroclone section of the precalciner. The coal/petroleum coke grinding system uses exhaust gas from clinker cooler as the source of heat and low oxygen gas for drying the coal.

3.2.3.2 Waste Feed--

Operating temperatures in the precalciner kiln may also be maintained by use of liquid and solid hazardous wastes. The physical and chemical properties of wastes will vary slightly from day to day. All waste fuels are physically and chemically characterized prior to acceptance at the facility to ensure that waste constituents can be appropriately managed through the precalciner kiln.

Preblended liquid organic wastes are stored in bulk tanks on the site. Liquid organic waste is introduced at the atomizing burner in the downslope end of the kiln. The burner position and flame shape allow for sufficient cooling of clinker product.

Containerized solids (i.e., 7-gal drums) are introduced to the rotary kiln via an enclosed drum feed mechanism, located along the kiln's exhaust hood. The drum feed mechanism is essentially composed of a drum elevator, conveyor, and pusher; a drum feed hopper with hopper door; a kiln charging door; and drum feed chute. The hopper door and kiln charging door are sequenced and interlocked to prevent flashbacks. The feed cycle is variable with a maximum number of cycles at two per minute. Each container is individually weighed prior to feeding to the kiln and the weight written on the container to record solids feed quantities.

3.2.4 Emissions Control

Bypass combustion gas emissions are controlled by the bypass electrostatic precipitator. Gases exhausted from the pyroclone precalciner are controlled by the main electrostatic precipitator. Most of the collected dust is recycled with kiln feed; a small part of the dust is utilized to backfill quarried properties.

Dust control for the clinker cooler is provided through baghouses. Collected dust is returned to the clinker handling system for subsequent processing.

An induced draft fan provides the motive power for the entire process train (i.e., rotary kiln, bypass, and main dust precipitators). The fan produces a system-wide negative pressure that prevents fugitive emissions. Treated exhaust gases from the bypass precipitator and main precipitator are vented to a common exhaust stack.

3.2.5 Clinker Handling System

Clinker is discharged from the kiln into the clinker cooler which uses a water tube heat exchanger to cool the product. Cooling air is discharged to the coal preheater, precalciner, and kiln. After cooling, clinker is mixed with gypsum and ground in a finish mill to make the final cement product.

3.2.6 Operational Controls

The precalciner kiln is operated with a computer-based control system. This system is configured to provide semiautomatic operation of the kiln, with operator manual adjustments to fine-tune performance. The system provides a visual display and hard copy record of monitoring parameters (e.g., kiln operating temperatures, CO and O_2 concentrations, HC concentrations, nitrogen oxide [NO_x], fuel feed rates, etc.).

3.3 TEST DESCRIPTION

This section provides a description of the test program. The test design, sampling and analysis activities, and facility monitoring activities are described. Data reduction methods and calculations are presented in Appendix A-4.

3.3.1 Test Design

The test program involved a matrix of five, 2-h test runs at three defined kiln operating conditions. The first test condition (Condition A) involved two duplicate test runs. The precalciner kiln was operated at stable conditions with liquid waste fired at the discharge end of the kiln and solid waste fired at the upslope end of the kiln. During this test condition, monochlorobenzene was poured into the solid waste feed drums and analyzed in the exhaust gas streams.

The second test condition (Condition B) involved a single test run and was conducted at baseline operating conditions. The precalciner kiln was operated at essentially stable conditions with no waste feed to the system.

The third test condition (Condition C) involved two duplicate test runs. The precalciner kiln was operated at stable conditions with liquid waste fired at the discharge end of the kiln.

During all test conditions, a crushed coal mixture was fed to the pyroclone precalciner.

3.3.2 Summary of MRI Sampling and Analysis Procedures

A summary of the frequency, number, type, and size (or quantity) of all samples collected during the test is presented in Table 3-1. The table also lists the sampling and analytical method(s) used for each sample. The matrix presented in Table 3-1 represents the sample collection scheme for one 2-h test run. Figure 3-4 notes the location of each sampling point. Summary descriptions of the sampling and analysis procedures are presented below. Appendix A-1 contains a full description of the sampling and analysis procedures utilized during the test.

TABLE 3-1. SUMMARY OF SAMPLING AND ANALYSIS ACTIVITIES

Sample	Sample location[a]	Sampling frequency for each run	Sampling method	Sample size (total)	Analytical parameters	Preparation method[b]	Analytical method[b]
Main and bypass precipitator exhaust ducts	1, 2	2-h composite per run	Method 0010	60-100 ft^3[c]	PCDD/PCDF[d]	Solvent extraction	GC/MS[e]
					> C17 organic mass	Solvent extraction	Gravimetric
					Organic screen	Solvent extraction	GC/MS
					Moisture	NA	Gravimetric
					Temperature	NA	Thermocouple
					Velocity	NA	Pitot tube
	1, 2	2-h composite per run	HCl train[f]	60-100 ft^3	HCl	NA	Ion chromatography (D4327-84)
					Potassium ion		ICP-AES[g]
					Ammonium ion		Selective ion measurement
	1, 2	Three trap pairs at 40 min per pair	VOST 0030[h]	20 L per train pair	Organic screen	Thermal desorption	GC/MS
					V POHC[i]	Thermal desorption	GC/MS
	1, 2	Sample injected every 10-15 min	Field GC	-	C1 - C17 Organic mass	NA	Field GC/FID[j]
	1, 2	One composite sample per run	EPA Reference Method 3	- 20 L	Oxygen, carbon dioxide	NA	Orsat
	1, 2	Continuous	Method 10	-	CO	NA	EPA Method 10
			MM25A[k]	-	THC (cold)	NA	EPA MM25A[k]
			Method 3A	-	CO_2	NA	EPA Method 3A
			Method 3A	-	O_2	NA	EPA Method 3A
			MM25A[k]	-	THC (hot)	NA	EPA MM25A[k]

(continued)

TABLE 3-1 (continued)

Sample	Sample location[a]	Sampling frequency for each run	Sampling method	Sample size (total)	Analytical parameters	Preparation method[b]	Analytical method[b]
Kiln fired materials (raw meal feed)	3	One grab sample taken every 30 min, composited into one sample per run	Scoop (S007)	500 g	Total organic carbon	-	Combustion with evolved CO_2 analysis
Liquid waste	4	One grab sample taken every 30 min, composited into one sample per run	Tap	600 mL	Heating value	NA	Calorimeter (D240)[m]
					Chlorine	--	Organic chlorine[m] (ASTM D1317-1318)
Solid waste	5	One grab sample taken every 15 min, composited into one sample per run	Scoop (S007)	500 g	Heating value	NA	Calorimeter (D240)[m]
					Chlorine		Organic chlorine[m] (ASTM D1317-1318)
					V-POHC	Dispersion/ purge and trap	GC/MS[m]
ESP dust	6, 7	One grab per run	Scoop	500 g	Archive	NA	NA

(continued)

TABLE 3-1 (continued)

Sample	Sample location[a]	Sampling frequency for each run	Sampling method	Sample size (total)	Analytical parameters	Preparation method[b]	Analytical method[b]
Coal fuel	8	One grab sample	Scoop	~ 500 g	Heating value	NA	Calorimeter (D240)[k]
					Chlorine	NA	Organic Cl$^-$ (D1316-1317)[k]

[a] Sample location referenced in Figure 3-4.

[b] Sample preparation and analytical methods, as referenced in the A. D. Little, EPA 600, and SW-846 methods. Also draft EPA HCl sample protocol.

[c] Exact volume of gas sampled dependent on isokinetic sampling rate.

[d] PCDD/PCDF--Polychlorinated dibenzodioxins/polychlorinated dibenzofurans collected during the baseline run, run 2 of test Condition A, and run 4 of test Condition B.

[e] GC/MS = gas chromatography/mass spectrometry.

[f] HCl train--HCl sampling train based on the EPA "Draft Method for the Determination of HCl Emissions from Municipal and Hazardous Waste Incinerators" (USEPA, QAD, July 1988).

[g] ICP/AES = inductively coupled plasma-atomic emission spectroscopy.

[h] Volatile organic sampling train.

[i] Volatile principal organic hazardous constituent; measured during test Condition B only (monochlorobenzene).

[j] GC/FID = gas chromatograph-flame ionization detector.

[k] MM25A--Modified Method 25A.

[l] E6-5--Galbraith Laboratories method for inorganic carbon analysis; ME-6, ME-7--Galbraith Labs method for total carbon analysis.

[m] Waste/fuel materials sampled and analyzed by Ash Grove to define chemical and physical characteristics.

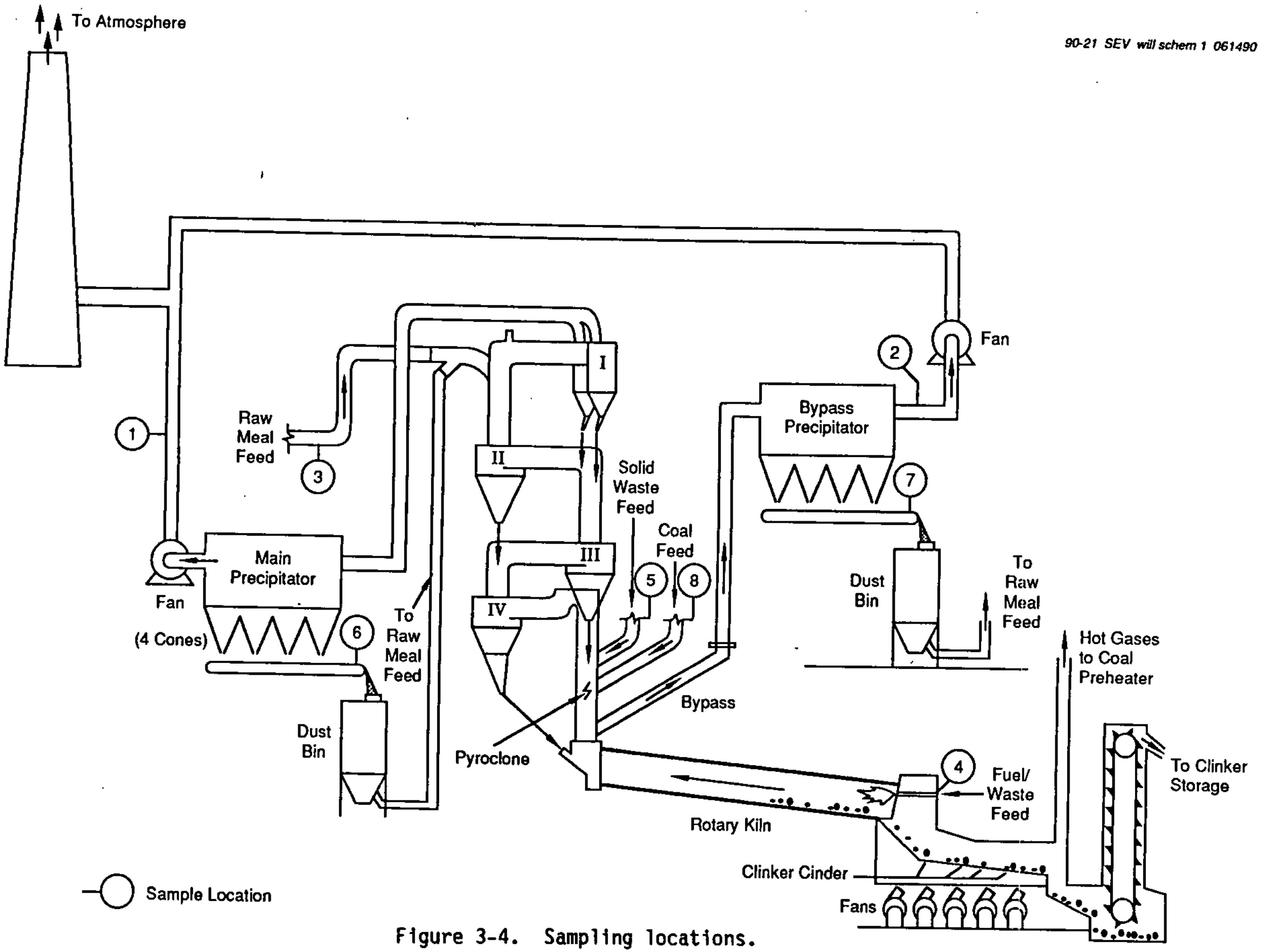

Figure 3-4. Sampling locations.

3.3.2.1 Combustion Gas--

Combustion gas was isokinetically sampled at the main and bypass electrostatic precipitator exhaust ducts. Samples were collected at a 30-ft elevation, through four sampling ports located across the width of each rectangular duct. Both ducts were sampled to detect any difference in emissions between the two exhaust streams. Exhaust gases are transferred from the separate ducts to a common stack; hence total emission quantities could be determined by combining the measured separate emission quantities.

Each type of combustion gas sampling and analysis is summarized below.

Total Hydrocarbon (HC) and Total Organic Mass (TOM)

HC emissions were measured using heated and unheated EPA Modified Method 25A (M25A) sampling systems, equipped with flame ionization detectors (FIDs). As a means of comparison, total organic carbon mass emissions were measured using a Method 0010 sampling train (i.e., SW-846 Method 0010) and a field gas chromatograph (GC). The GC, equipped with an FID, was used to determine C1 through C17 carbon fractions (up to 300°C boiling point). Samples from the Method 0010 train were analyzed gravimetrically to determine the carbon fraction greater than C17 (> 300°C boiling point). The gravimetric and GC fractions, together, provide a total organic mass (TOM) value which can be quantitatively compared to the Modified M25A THC values. This comparison was made on the basis of emissions calculated as propane. The organic mass sampling approach was developed from the existing EPA Level 1 testing protocols, as defined in the Level 1 Source Assessment Manual.

During the test, HC and TOM measurements were checked by measuring sample line bias. A nitrogen blank sample was analyzed by GC and the HC monitor at the conclusion of each test run to determine the potential for organics to desorb out of sample lines. Ambient air measurements were also made at the conclusion of each test run for comparison to the HC and TOM measurements.

Organic Screen

The organic screen was conducted to provide characterization of organic compounds, or PICs, present in exhaust gases. Volatile organics were determined using a volatile organic sampling train (VOST) as described in SW-846 Method 0030. VOST samples were analyzed by gas chromatography/mass spectrometry (GC/MS). Semivolatile organics were determined using the SW-846 Method 0010 sampling train (previously referenced for organic mass gravimetric determinations). These samples were analyzed by GC/MS. The screen was used to define compounds amenable to the analytical techniques described in Appendix A-4 including the five largest GC peaks.

As a part of the organic screen, total polychlorinated dibenzodioxin and polychlorinated dibenzofuran (PCDD/PCDF) concentrations were determined in exhaust gas during three of the five test runs. PCDDs/PCDFs were analyzed from a separate split of the extract from the above-referenced Method 0010 sample train.

Destruction and Removal Efficiency

The precalciner kiln was tested to determine the DRE of a volatile principal organic hazardous constituent (POHC) in the drummed waste fed to the kiln. The POHC for the test was monochlorobenzene (MCB). MCB is ranked 19th on the Thermal Stability (TSLo02) incinerability ranking system, and is one of the highest ranking (most difficult to destroy), fully evaluated Appendix VIII organic compounds.[1] A volatile compound was chosen to provide a worst case test of rapid volatilization of the POHC.

The VOST (as described for the organic screen) was used to sample for MCB. Appendix A-3 defines the analysis procedures used for volatiles determination. Section 3.3.3 describes the POHC spiking and waste analysis procedures for subsequent DRE determination.

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[1] Dellinger, B., M.D. Graham, and D. A. Tirey, "Predicting Emissions from the Thermal Processing of Hazardous Wastes," Hazardous Waste and Hazardous Materials, Vol. 3, No. 3, 1986.

Hydrogen Chloride (HCl), Ammonia, and Potassium

Total HCl was determined in exhaust gas for comparison to historical data from other cement kilns. Ammonium and potassium ion concentrations were also determined. HCl concentrations were analyzed by ion chromatography, ammonium concentrations were determined by selective ion measurement, and potassium concentrations were determined by inductively coupled atomic emission spectroscopy (ICP-AES). Samples were collected based on the EPA's "Draft Method for the Determination of HCl Emissions from Municipal and Hazardous Waste Incinerators" (USEPA, Source Branch Quality Assurance Division, July 1988).

Continuous Emissions Monitors (CEMs)

Carbon monoxide (CO), carbon dioxide (CO_2), and oxygen (O_2) were monitored throughout the test. CO was sampled and analyzed following EPA reference Method 10; CO_2 and O_2 were monitored using EPA reference Methods 3 and 3A. Appendix A-1 describes the MRI continuous emissions monitors, and Section 3.3.3.3 describes the Ash Grove monitoring system.

3.3.2.2 Raw Materials Sampling--

The raw materials feed (e.g., crushed limestone, clay, etc.) was sampled once every 30 min during each test run. These grab samples were then composited into a single sample for each run for TOC analysis. A metal trier was used for the collection of the raw feed samples. All samples were collected at the inlet feed chute, located adjacent to the precalciner.

3.3.2.3 Electrostatic Precipitator (ESP) Dust Sampling--

Dust discharged from the main and bypass electrostatic precipitators (ESPs) was sampled at the end of each run. These samples were archived for future analysis, if necessary.

3.3.3 Summary of Ash Grove Sampling/Analysis Activities

3.3.3.1 POHC Spiking--

During Runs 1 and 2 (i.e., Test Condition A), the precalciner kiln was tested to determine the destruction and removal efficiency (DRE) of monochlorobenzene (MCB) spiked into the solid waste feed. A 1-L quantity of MCB was poured into each solid waste charge (i.e., each 7-gal drum), prior to the test. Drums were loaded to the kiln at a rate of 40 drums/h, resulting in a MCB feed rate of 40 l/h (738 g/min).

The 7-gal drums were fitted with a vapor seal in the lid, preventing release of volatiles from the drum. Drums were sealed immediately following spiking. About 10% of the drums were opened for sampling immediately prior to feeding to the kiln.

3.3.3.2 Waste Feed Analysis--

The liquid waste was sampled by Ash Grove from a tap located in the waste feed line. Grab samples were collected and composited throughout the course of each run. Approximately 100 mL grab samples were collected, starting 15 min after the start of each test run and every 30 min thereafter. A total of 6 grab samples were collected, resulting in an approximate 600 mL composite sample for each run.

The solid waste was sampled by Ash Grove from the waste drums. Approximately 100 mL grab samples were collected every 15 min (every 10th drum) and composited to form a single sample for each run.

Waste samples were analyzed by Ash Grove and an independent laboratory to define the chemical and physical characteristics of the wastes burned during the test. This information included concentration of POHC present, heat of combustion (Btu value), and total chlorine. Section 4 provides additional information concerning the data compiled for wastes during the test. Appendix B contains copies of the laboratory analysis reports for the waste/fuel samples.

3.3.3.3 Process Monitors--

Process data measured by Ash Grove process monitors was recorded throughout each 2-h run. Specific parameters monitored are listed in Section 4.

Facility emissions monitors measured O_2, NO_x, CO and cold HC in the main and bypass ESP exhaust ducts. Oxygen was measured using a paramagnetic sensor. Nitrogen oxide was measured using a Thermo Electron Model 10 chemiluminescent monitor. Carbon monoxide was measured using a Fuji Model 3300 infrared analyzer, and total hydrocarbon was measured using a Ratfisch Model RS55 with FID. All data, including calibration data, were recorded for each 2-h run.

Figure 3-5 is a schematic of the facility CEM system. A gas sample is collected alternately from each duct every 7.5 min. The sampling system operates on a cycle, i.e., equilibration, back purge, prime, and sampling. The sampling portion of this cycle is 2.5 min. The gas sample is transferred via a heated (i.e., 250°F) Teflon sample line to a condenser which is operated at 28° to 34°F for H_2O removal. The sample is then split for THC, CO, O_2, and NO_x analysis.

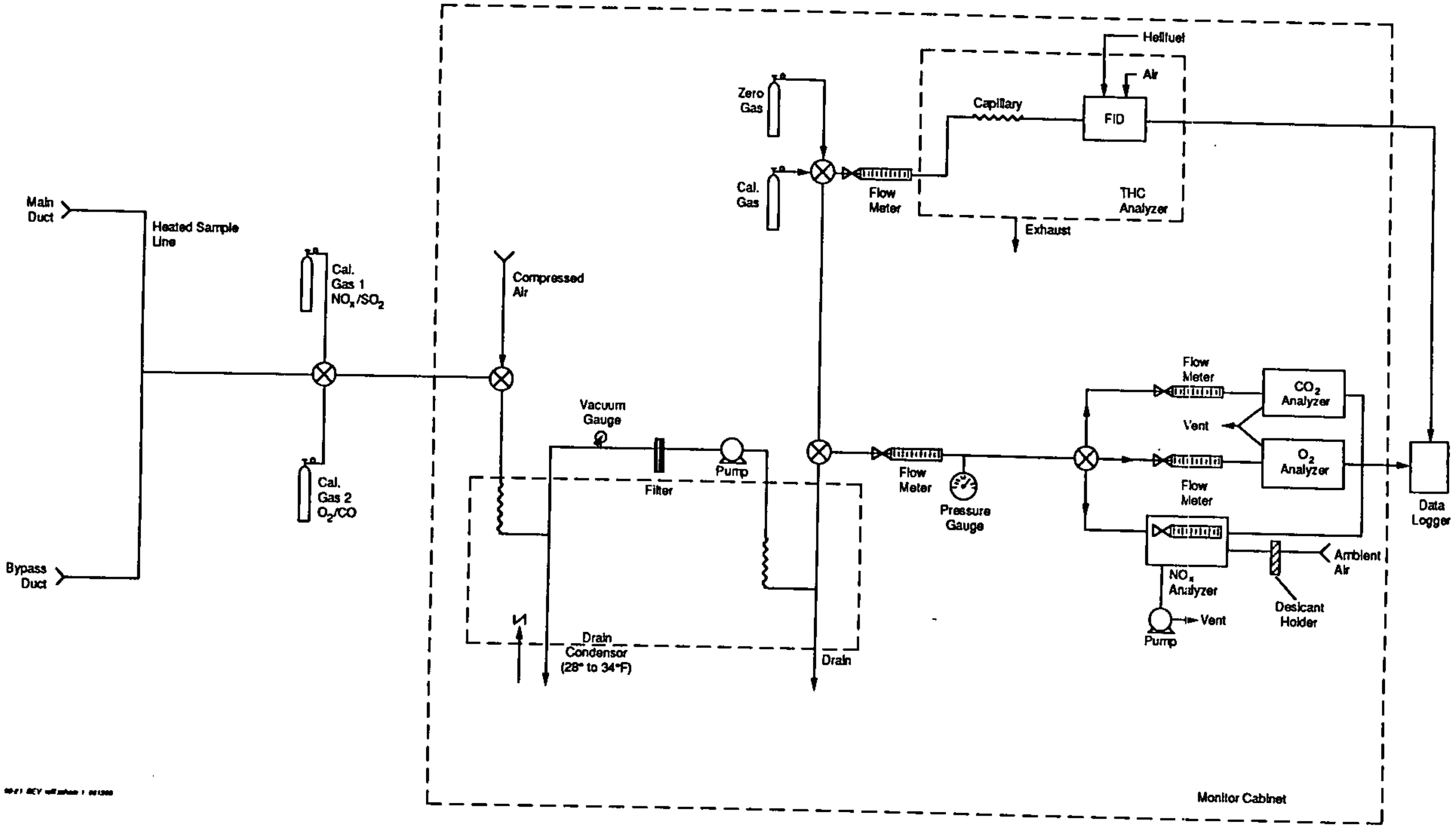

Figure 3-5. Ash Grove facility CEM system.

SECTION 4

DISCUSSION OF RESULTS

This section discusses the results of the test and analyzes the data relative to the project objectives. The section is divided into three subsections. The first discusses process data and operation of the precalciner kiln. The second subsection discusses organic compound emissions, and the third discusses inorganic compound emissions.

4.1 PROCESS OPERATION

Table 4-1 presents average values of the principal process operating parameters for each test run. Table 4-2 presents additional CEM data from the facility monitors. Process operation was replicated closely from run to run, except for planned variations in the feed of coal and waste to the kiln for each test condition. Process capacity, as measured by the raw material feed rate was within 95 to 98 tons/h for all runs. Kiln exit gas temperature (measured at the entrance to the precalciner where some cooling from infiltration air had occurred) was consistently within the range of 1830° to 1970°F. Inaccurate temperature data were obtained for Run 4, believed to result from a thermocouple problem.

Oxygen and carbon monoxide concentrations, and stack gas flow in the bypass duct are also indicative of kiln operation; however, the values of these parameters are heavily influenced by dilution from cooling air and water sprays. The higher oxygen concentration, slightly higher stack gas flow rate, and lower carbon dioxide concentration for Run 1 show this dilution effect.

TABLE 4-1. AVERAGE VALUES FOR PROCESS OPERATING PARAMETERS[a]

Parameter / Process condition:	Liquid + solid waste		Coal only	Liquid waste	
	Run 1	Run 2	Run 3	Run 4	Run 5
Raw material feed rate, ton/h	98	96	95	95	97
Kiln coal feed					
Rate, ton/h	1.0	1.0	5.1	0.0	0.0
Heating value, Btu/lb	12,300	12,300	12,300	12,300	12,300
Chlorine content, %	ND	ND	ND	ND	ND
Kiln liquid waste feed					
Rate, ton/h	2.9	3.6	ND	5.8	5.8
Heating value, Btu/lb	10,100	10,000	-	11.200	11.200
Chlorine content, %	2.0	2.2	-	1.7	1.7
Kiln solid waste feed					
Rate, ton/h	0.9	0.9	ND	ND	ND
Heating value, Btu/lb	8,600	8,400	-	-	-
Chlorine content, %	3.3	3.7	-	-	-
Kiln heat input, 10^6 Btu/h	108	124	138	143	143
Kiln chlorine input, lb/h	194	248	ND	217	215
Kiln exit gas temperature, °F	1970	1880	1940	b	1830
Raw meal kiln inlet temperature, °F	1567	1606	1599	1594	1589
Entrance kiln gas pressure, inHg	-0.112	-0.124	-0.142	-0.161	-0.139
Exit kiln gas pressure, inHg	-0.819	0.613	0.517	0.583	0.645
Kiln speed, rph	113.7	112.2	112.2	104.5	110.2
Kiln current, amps	178.2	228.1	244.2	226.2	258.9
Fourth stage cyclone temperature, °F	1567	1593	1520	1573	1571
ESP dust recycle, t/h	1.202	1.120	0.960	1.077	0.831
Pyroclone coal feed					
Rate, ton/h	8.0	7.7	7.3	7.4	7.2
Heating value, Btu/lb	12,300	12,300	12,300	12,300	12,300
Chlorine content, %	ND	ND	ND	ND	ND
Pyroclone temperature, °F	1600	1620	1620	1600	1600
Bypass duct O_2 concentration, %	18.3	17.5	16.4	16.8[c]	16.4
Bypass duct CO_2 concentration, %	1.8	2.2	4.2	3.4	3.2
Bypass duct CO concentration, ppmv	13	19	8	49	37
Bypass duct NO_x concentration, ppmv	310	720	1,170	470	770

(continued)

TABLE 4-1. (continued)

Parameter / Process condition:	Liquid + solid waste Run 1	Liquid + solid waste Run 2	Coal only Run 3	Liquid waste Run 4	Liquid waste Run 5
Bypass ESP inlet temperature, °F	700	700	700	700	710
Bypass ESP outlet temperature, °F	1567	1593	1520	1573	1571
Bypass ESP outlet pressure, inHg	-3.074	-2.567	-2.639	-2.908	-2.508
Bypass quench water, gpm	6.0	8.0	8.0	8.0	8.0
Bypass damper setting open, %	50.0	40.0	40.0	40.0	40.0
Bypass duct gas flow rate, dscf/min	25,130	23,600	24,500	24,300	23,100
Bypass ESP voltage, kV					
First stage	36.1	36.6	35.9	34.8	
Second stage	32.6	30.3	34.3	29.6	29.8
Third stage	27.2	27.8	27.5	28.1	28.1
Main duct O_2 concentration, %	4.2	4.0	4.4	4.3	4.0
Main duct CO_2 concentration, %	34	32	31	31	30
Main duct CO concentration, ppmv	790	830	240	950	560
Main duct NO_x concentration, ppmv	410	440	510	420	530
Main ESP inlet temperature, °F	740	760	720	740	740
Main ESP inlet pressure, in H_2O	-28.03	-28.04	-26.81	-28.08	-27.65
Main duct gas flow rate, dscf/min	51,600	51,700	52,700	53,400	51,600

ND = None detected.

[a] All data are from the facility process control computer except heating values and chlorine contents from facility analyses, gas flows from stack sampling, and O_2, CO_2, and CO concentrations from MRI monitors.

[b] Temperature was measured as 1570°F, but was judged inaccurate due to a thermocouple problem.

[c] Value is from facility monitor which agrees with Orsat analysis of the stack gas. Value from the MRI monitor was suspect. All other O_2, CO_2, and CO values were measured by MRI's monitors.

TABLE 4-2. FACILITY CEM AVERAGE DATA

Parameter	Units	Run 1	Run 2	Run 3	Run 4	Run 5
CEM Averages						
Main duct:						
O_2	%	5	5.3	4.7	4.6	4.3
NO_x	ppm	412	443	512	415	529
CO (dry, 7% O_2)	ppm	692	763	324	982	644
THC (dry, 7% O_2)	%	7	12	6	-1	6
Opacity	%	4	4	3	4	4
Bypass duct:						
O_2	%	18	17.5	16.5	16.8	16.9
NO_x	ppm	312	723	1,174	472	765.4
CO (dry, 7% O_2)	ppm	108	87	25	229	203.3
THC (dry, 7% O_2)	ppm	4	1	0	0	1.6
Opacity	%	4	4	3	4	4

During part of Run 1 the cooling water flow rate was higher, and damper settings allowed a higher flow of dilution air than for the remainder of the test. The dilution air damper setting was 50% open during test Run 1 and at 40% open during all other test runs. Also, a water flow rate of 6 gpm was established during test Run 1, and a flow rate of 8 gpm was established for all other test runs. The estimated amount of dilution air was generally about a factor of 5. The average carbon monoxide concentrations from run to run can still be viewed as reflective of kiln operation by adjusting the values to a common amount of CO_2 to account for dilution. The carbon dioxide concentration can be used as a relative indicator of the amount of dilution to adjust the CO values. Using this technique, the CO concentrations exiting the kiln were about the same during Runs 1, 2, 4, and 5. The concentration during Run 3 was about a factor of 5 lower than in all other runs.

Pyroclone operation was also very consistent, as shown by the lack of variation in coal feed rate, temperature, and stack gas flow rate and oxygen concentration in the main duct. Coal feed rate varied from 7.2 to 8.0 tons/h, temperature from 1600° to 1620°F, and oxygen concentration from 4.0% to 4.4%. Stack gas flow rate was about 52,000 dscf/min. Carbon monoxide concentration in the main duct, which reflects the pyroclone operation rather than the kiln, was also relatively consistent. The average CO concentration varied from 240 to 950 ppmv, with the lowest value occurring during Run 3.

Operation of both ESPs remained consistent. Inlet ESP temperatures remained within a range of 720° to 760°F for the main duct ESP and 700° to 710°F for the bypass duct ESP.

Heat load to the kiln was slightly lower during Runs 1 and 2, due to a lower feed rate of liquid waste introduced to the kiln. The heat load to the pyroclone was higher during Runs 1 and 2, due to a higher coal feed rate.

Chlorine load to the kiln varied with the solid and liquid waste feed rates and chlorine content. Coal was determined to have a negligible chlorine content, thus the pyroclone did not have a measurable chlorine input.

The spiked solid waste introduced during test Runs 1 and 2 was found to have a MCB concentration of 8.1% and 6.4% respectively. The anticipated concentration was 4.8%, based on a spike rate of 40 L/h MCB (1 L MCB/drum, charged at 40 drums/h) and an average solid feed rate of 2,036 lb/h (approximately 50 lb/drum). The measured MCB concentration was higher than the anticipated MCB concentration due to the difficulty of representative sampling of the drums. A disproportionate quantity of liquid MCB was probably collected with each sample to bias the results on the high side. Thus, the known quantity of MCB spiked to the drums was used to calculate MCB feed rates.

4.2 ORGANIC COMPOUND EMISSIONS

This subsection presents a discussion of organic compound emissions. Included are a description of: (1) total hydrocarbon (HC) and total organic mass (TOM) emissions; (2) emissions of the spiked principal organic hazardous constituent (POHC) and its destruction and removal efficiency (DRE); and (3) the emissions of products of incomplete combustion (PICs), including dioxin/furan emissions. This section also discusses the organic carbon content of the raw material feed (i.e., crushed limestone and shale).

4.2.1. TOM and HC Emissions

Organic carbon mass emissions were quantified within boiling point ranges which roughly equate to ranges in the number of carbon atoms in organic compounds. Organic mass was measured using a SW-846 Method 0010 sampling train for nonvolatiles and a field gas chromatograph (GC) for volatiles and semivolatiles. Samples from the Method 0010 train were analyzed gravimetrically to determine the carbon fraction greater than C17 (> 300°C boiling point). The GC, equipped with an FID, was used to determine the C1 through C17 carbon fraction (up to 300°C boiling point). GC samples were split off the hot HC (subsequently defined) sample line. Summed together, the gravimetric and GC fraction provided a total organic mass (TOM) value which was compared to total hydrocarbon (THC) data values. This comparison was made by converting the organic mass values to propane equivalent since HC emissions are measured as propane.

HC emissions were measured by two different techniques identified here as hot and cold HC. The primary difference was that the hot HC had a sample line and instrument heated to 150°C and the cold HC had an ice cooled condensate trap near the duct sampling port and an unheated sample line. Both used a flame ionization detector (FID) as did the organic GC analyses. Both techniques are described in Appendix A, along with the field GC technique. The cold HC technique is more closely representative of historical HC monitoring techniques. The hot HC technique is under consideration as a measurement technique for amended hazardous waste incinerator regulations.

The following discussions of total organic mass (TOM) and HC emission measurements is divided into three subsections. The first presents the total organic mass results determined by the gravimetric and GC sampling systems. The second and third presents the HC measurements and compares HC data to TOM measurements for the bypass and main ducts, respectively.

4.2.1.1 Total Organic Mass (TOM) Emissions--

Total organic mass (TOM) was determined as three major carbon fractions: C1-C7 volatile compounds, C7-C17 semivolatile compounds, and > C17 nonvolatile compounds. The average C1-C7 and C7-C17 fractions were calculated from individual GC samples. An average value for the > C17 fraction was generated from the gravimetric analysis of the Method 0010 sampling train. The reported total mass was calculated by summing the fractional carbon masses. All carbon masses were calculated on a dry basis. Appendix B contains the analytical data for each GC sample.

The average volatile and semivolatile data for the main duct may be biased high or low. A limited number of discrete GC samples were analyzed during each test run, which may or may not have corresponded in time to a representative number and size of emission peaks. Table 4-3 presents the analytical data for the samples collected during test Run 1. As illustrated in the table, two C1-C7 and C7-C17 spikes were measured at 69.54 ppm C1-C7 and 2.00 ppm (C7-C17) and 66.29 ppm C1-C7 and 3.75 ppm C7-C17. Together, these spikes more than doubled the volatile and semivolatile run averages. Later comparisons to the continuous HC data suggest this bias is probably small.

TABLE 4-3. ORGANIC MASS DATA FOR RUN 1

Sampling location	Run time (24-h)	Sample No.	Carbon fractions (ppm propane, dry)				Total mass (TOM)
			Time	C_1-C_7	C_7-C_{17}	> C_{17}	
Main duct							
	1548-2012	R1SS8	1557	69.54	2.00		
		R1SS9	1616	10.24	0.37		
		R1SS10	1645	9.74	0.50		
		R1SS11	1720	6.24	0.00		
		R1SS12	1739	7.24	0.37		
		R1SS13	1757	7.49	0.50		
		R1SS14	1815	66.29	3.75		
		R1SS15	1834	7.99	0.25		
		R1SS16	1852	7.87	0.62		
		R1SS17	1910	7.49	0.62		
		R1SS18	1930	9.24	0.75		
		R1SS19	2002	7.62	0.75		
		Run average:		18.08	0.87	0.39	19.35
Bypass duct							
	1548-2012	R1SS8	1557	1.41	0.43		
		R1SS9	1616	1.41	0.22		
		R1SS10	1645	1.62	0.12		
		R1SS11	1720	2.62	0.25		
		R1SS12	1739	1.30	0.11		
		R1SS13	1757	1.41	0.11		
		R1SS14	1815	2.25	0.37		
		R1SS15	1834	1.75	0.25		
		R1SS16	1852	1.50	0.12		
		R1SS17	1910	1.62	0.11		
		R1SS18	1930	1.30	0.11		
		R1SS19	2002	2.60	0.11		
		Run average:		1.73	0.19	0.01	1.93

Table 4-3 shows that similar high spikes did not occur in the bypass duct. This suggests that the spikes may be related to pyroclone coal combustion or variation in organic content of the raw material. A direct tie to solid or liquid waste feed combustion was not observed.

Table 4-4 shows the distribution of the TOM among the three fractions measured in all runs. The distribution was similar for both ducts with most of the mass in the volatiles fraction. The percent in the volatiles fraction was 85 to 93 for the main duct and 75 to 100 for the bypass duct. The semivolatile and nonvolatile fractions contributed about equally to the remaining mass. The data for the bypass duct was more scattered than for the main duct, which probably reflects a loss of precision in the measurements near detection levels.

Table 4-5 presents the average TOM determined for each process condition. No definite effect of waste burning on TOM emissions could be associated with the three process conditions. However, the TOM levels in the main duct were slightly higher during Runs 1 and 2 when the solid waste was fired in the kiln. These higher emissions mostly reflect an increase in the mass of the volatiles fraction. This increase is likely related to conditions in the pyroclone or preheater, not to solid waste burning. A similar trend was not noted in the bypass duct where the effects of combustion in the kiln should be most evident. The coal feed rate to the pyroclone during Runs 1 and 2 was higher than during the other three runs.

The higher TOM levels measured in the main duct versus the bypass duct are probably associated with two factors. One is the evolution of organic compounds from the raw material in the preheater. Very little organic matter is likely to be left in the calcined limestone by the time it reaches the kiln; therefore, the bypass duct emissions would not be similarly affected. The second factor is organic emissions from coal combustion in the pyroclone, which also does not affect the bypass duct emissions. Both of these factors probably contribute to the main duct organic compound emissions; however, the test data were not sufficient to separate these effects.

TABLE 4-4. CARBON MASS DISTRIBUTION

Sampling location and Run No.	Average carbon mass (dry, ppm propane) C_1-C_7	C_7-C_{17}	> C_{17}	Total mass (TOM)	Distribution percent of total mass C_1-C_7	C_7-C_{17}	> C_{17}
Main duct							
1	18.08	0.87	0.39	19.35	93	4	2
2	11.30	0.80	0.54	12.64	89	6	4
3	8.19	0.59	0.90	9.68	85	6	9
4	8.29	0.68	0.39	9.36	89	7	4
5	8.07	0.56	0.50	9.12	88	6	5
Bypass duct							
1	1.173	0.19	0.01	1.93	90	10	1
2	1.63	0.09	0.44	2.16	75	4	20
3	2.09	0.03	0.42	2.54	82	1	17
4	1.51	0.00	N	1.51	100	0	0
5	1.86	0.05	0.26	2.17	86	2	12

N = Negative quantity measured; value assumed to be 0.00.

TABLE 4-5. AVERAGE CARBON MASS FOR EACH TEST CONDITION

Process condition	Main duct Average carbon mass (dry, ppm propane)				Bypass duct Average carbon mass (dry, ppm propane)			
	C_1-C_7	C_7-C_{17}	> C_{17}	Total mass	C_1-C_7	C_7-C_{17}	> C_{17}	Total mass
Liquid plus solid waste (Runs 1 & 2)	14.69	0.84	0.47	16.00	1.68	0.14	0.23	2.05
Coal only (Run 3)	8.19	0.59	0.90	9.68	2.09	0.03	0.42	2.54
Liquid waste (Runs 4 & 5)	8.18	0.62	0.45	9.24	1.68	0.03	0.13	1.84

4.2.1.2 HC and TOM Emissions in the Bypass Duct--

Table 4-6 shows the results for HC and TOM emissions measured in the bypass duct. The results are shown for each of the three process conditions. The TOM results are presented as the mass in each of three fractions described earlier and as total mass. HC results are shown for both the hot and cold monitoring systems.

These results for the bypass duct do not provide any definitive conclusions about relationships between HC or TOM levels and other parameters. This is because of the low levels of organic emissions encountered during the test. HC levels were at or below the level they could be accurately quantified, and thus differences between runs or between the hot and cold HC are not significant. To further complicate the data interpretation, HC levels in the ambient air were also high enough to have contributed significantly to the measured duct levels. Most of the gas at the sampling point in the bypass duct is ambient dilution air used to cool the gas stream. Thus, much of the measured HC levels may have originated with the ambient air (0.6 ppmv). A nitrogen check on the monitor sampling lines was conducted by introducing pure nitrogen into the sample lines at the probe and monitoring for HC. This check showed about 0.2 ppmv, a bias which contributed to the measured levels.

The TOM levels measured in the bypass duct were also low, but slightly higher than the measured HC. Most of the TOM was in the C_1 to C_7 compound range. Again, it was not possible to reach definitive conclusions with these data, except that burning waste versus coal in the kiln did not result in any large increase in HC or TOM emissions.

4.2.1.3 HC and TOM Emissions in the Main Duct--

Table 4-6 shows the results for HC and TOM emissions measured in the main duct, presented in the same manner as for the bypass duct. The measured values were higher than those for the bypass duct and were, therefore, more amenable to evaluation of the emission levels. The nitrogen bias check of the main duct sampling line showed slightly higher results than for the bypass duct sampling line, but the values in this case were well below the sample values.

TABLE 4-6. HC AND TOM EMISSIONS

BYPASS DUCT

Process condition	Test run	TOM, ppmv dry as propane				HC, ppmv dry as propane	
		C_1-C_7 mass	C_7-C_{17} mass	> C_{17} mass	Total mass	Hot	Cold
Liquid plus solid waste	1	1.7	0.19	0.01	1.9	0.8	0.6
	2	1.6	0.09	0.44	2.2	0.7	1.8
Coal only	3	2.1	0.03	0.42	2.5	1.1	1.1
Liquid waste	4	1.5	ND	ND	1.5	0.1	0.7
	5	1.9	0.05	0.26	2.2	0.6	0.7

ND = Not detected.

MAIN DUCT

Process condition	Test run	TOM, ppmv dry as propane				HC, ppmv dry as propane	
		C_1-C_7 mass	C_7-C_{17} mass	> C_{17} mass	Total mass	Hot	Cold
Liquid plus	1	18.1	0.87	0.39	19.4	16.1	11.5
	2	11.3	0.80	0.54	12.6	16.6	11.8
Coal only	3	8.2	0.59	0.90	9.7	9.7	6.8
Liquid waste	4	8.3	0.68	0.39	9.4	10.6	6.7
	5	8.1	0.56	0.50	9.1	9.6	6.4

Figure 4-1 shows the TOM, hot HC, and cold HC values generally maintained a relatively consistent relationship to each other for all five test runs. The TOM and hot HC values agreed well with each other, indicating these two measurement techniques provided similar results for organic compound emissions. The cold HC results were consistently lower than the other two measures, with the cold HC being 70% of the hot HC. Loss of organic compounds in the condensate trap on the cold HC sampling line is the most likely explanation for the lower cold HC values. As was the case for the bypass duct measurements, the TOM consisted primarily of C_1 to C_7 compounds. About 90% of the TOM was found in this fraction.

As was discussed in Section 4.2.1.2 for TOM emissions in the bypass duct, no change in HC emissions could be associated with the three test conditions. The higher values during Runs 1 and 2 are probably associated with the pyroclone operating conditions as discussed in Section 4.2.1.

4.2.2 Destruction and Removal Efficiency

The DRE of monochlorobenzene (MCB) spiked into the solid waste drums was measured during Runs 1 and 2. MCB was chosen as the compound to spike because it ranked high among Appendix VIII compounds as difficult to incinerate. The choice of MCB, however, complicated interpretation of the DRE results because the data indicate formation of MCB in the pyroclone. Formation of MCB is discussed below, followed by discussion of alternative methods to estimate the DRE for MCB.

The data indicate that the formation of MCB in the pyroclone was related to high levels of benzene as a PIC (product of incomplete combustion) and to the chlorine input level to the kiln. Table 4-7 shows the emission concentrations measured for these two PICs and the chlorine input levels for each test run. First considering the main duct data, Table 4-7 shows that the benzene concentrations were relatively high during all five test runs. Benzene is known to be a common PIC of fossil fuel combustion, and its presence is likely related to the coal combustion in the pyroclone. The MCB concentration was also relatively high except during Run 3 when no chlorinated waste was burned. The MCB concentrations were also similar for Runs 4 and 5,

COMPARISON OF TOM AND HC LEVELS

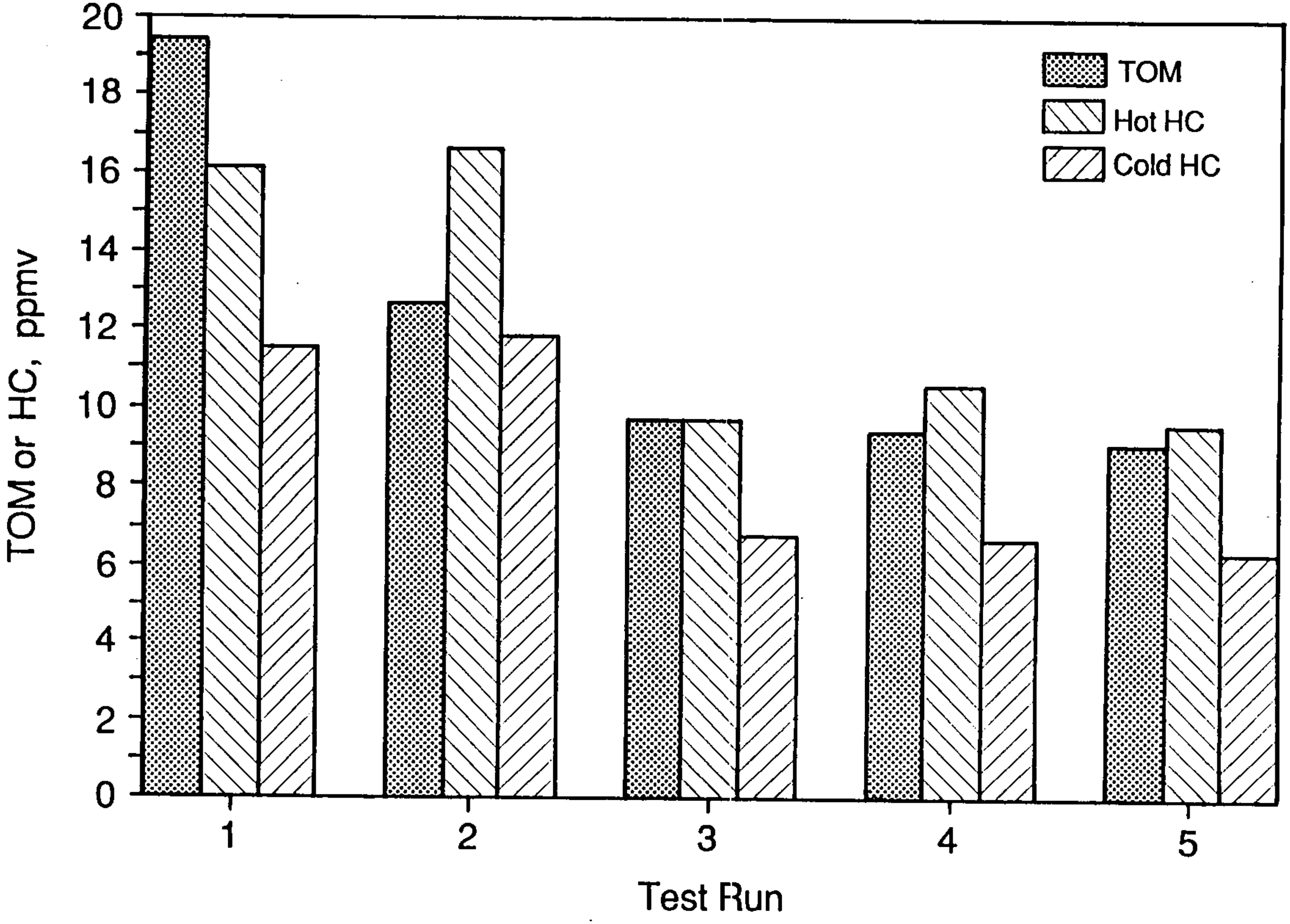

Figure 4-1

TABLE 4-7. MCB PIC FORMATION

Process condition	Test run	Chlorine input (lb/h)	Main duct concentrations (ng/L)		Bypass duct concentrations (ng/L)	
			Benzene	MCB	Benzene	MCB
Liquid plus solid waste	1	194	600	44	28	10
	2	248	700	72	63	15
Coal only	3	None detected	490	5	15	0.4
Liquid waste	4	217	500	66	7	0.5
	5	215	450	62	9	0.7

when chlorinated waste was burned, but no MCB was spiked into the waste (as for Runs 1 and 2 when MCB was spiked into the waste). Figure 4-2 shows more clearly how the MCB concentration in the main duct related to the level of chlorine input. As the level of chlorine input increased, the concentration of MCB increased. These data show that most of the MCB in the main duct was formed as a PIC and was not just the result of lack of destruction of the MCB spiked into the waste during Runs 1 and 2.

Data for the bypass duct support a different conclusion. The benzene and MCB concentrations were both much lower than in the main duct, and the MCB concentrations did not relate to the chlorine input levels. Rather, the MCB concentrations in the bypass duct appear to be related to the presence of MCB in the waste feed. The concentrations were over an order of magnitude higher when the MCB-spiked waste was burned than during the other runs, which included the chlorindated liquid waste in Runs 4 and 5. These data show that the MCB in the bypass duct reflected residual MCB that was not destroyed, and that MCB levels were not significantly related to PIC formation. Some MCB may have formed as a PIC, as in the main duct, but it appears that the lower benzene levels kept the PIC levels small compared to the levels of residual MCB from waste destruction.

Several alternative methods to calculate DRE were considered. The common approach is to use the total emission rate of MCB, main plus bypass duct, as the MCB output in the DRE equation, regardless of whether the MCB was due to PIC formation. This approach yields the result labeled as minimum DRE on Table 4-8. The maximum DRE shown on Table 4-8 is calculated by attributing all of the main duct emissions to PIC formation and using only the bypass duct emissions as the output in the DRE equation. Direct evaluation of the data only allows the conclusion that the actual DRE, defined as input MCB not destroyed, is between the minimum and maximum values. Actually some of the MCB in the main duct is probably related to lack of destruction.

Since neither the minimum or maximum values discussed above provided a very precise understanding of the DRE achieved, an alternate method was developed to provide a best estimate of the actual DRE. The basic assumptions were that the bypass duct data provide the best measure of the input MCB that

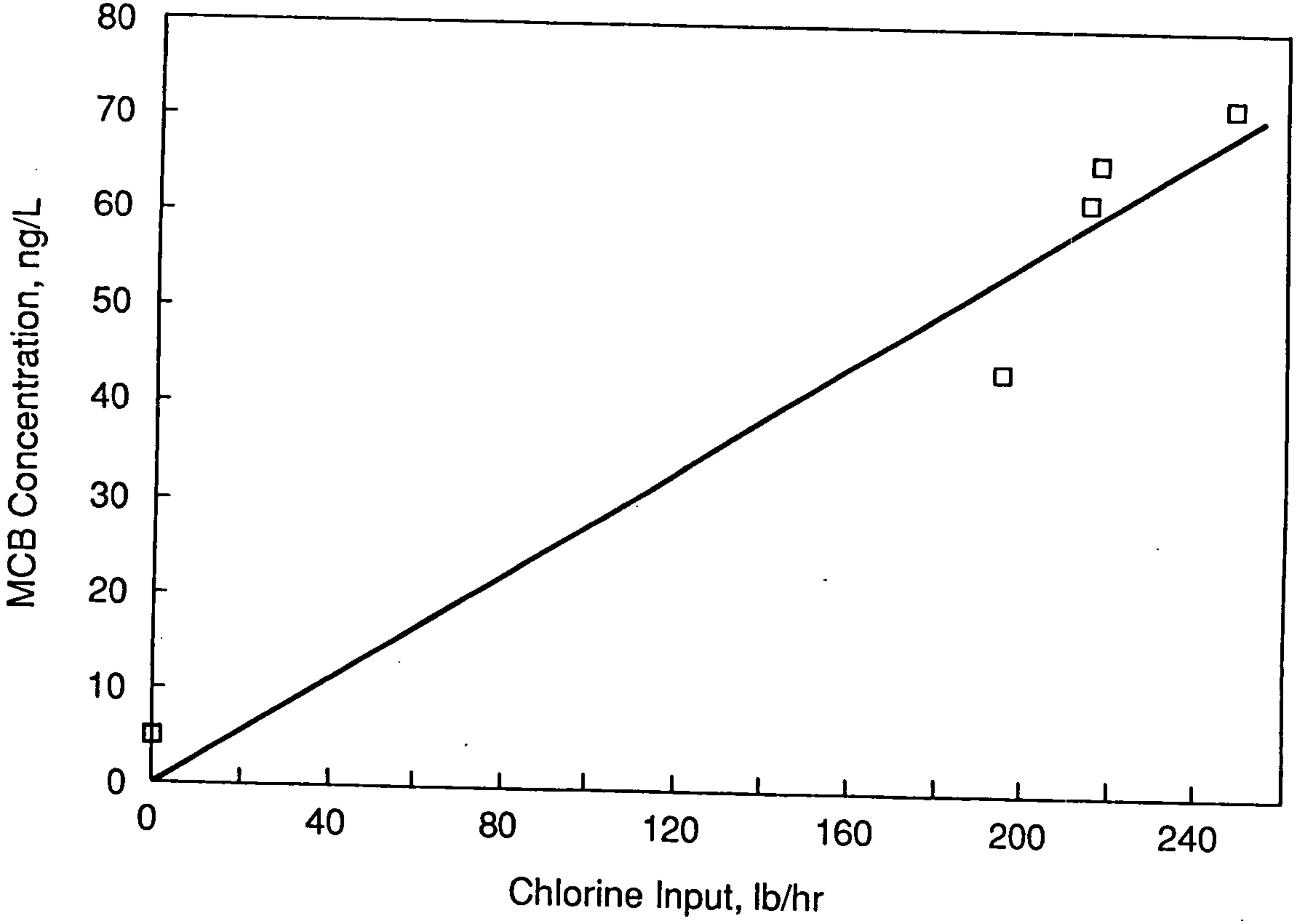

Figure 4-2. MCB concentration vs. chlorine input.

TABLE 4-8. DRE VALUES FOR MCB

DRE	Test run 1	Test run 2	Average
Minimum[a]	99.993	99.984	99.989
Maximum[b]	99.9994	99.9986	99.999
Best estimate[c]	99.9958	99.9914	99.9936

[a] Calculated using main duct plus bypass duct MCB emission rates.

[b] Calculated using bypass duct MCB emission rates, only. Main duct MCB emissions assumed to be from PIC formation.

[c] Calculated as defined in Appendix A-6.

was not destroyed (little influence from PIC formation) and that the undestroyed MCB at the kiln exit was apportioned between the main and bypass ducts relative to the split of total gas flow. The calculations for the alternate method required back calculation from the bypass duct measured stack gas flow to the bypass flow at the kiln exit, by correcting for dilution air, and a combustion mass balance calculation of the total combustion gas flow at the kiln exit (see Appendix A-6 for example calculations). The ratio of total gas flow at the kiln exit to the portion of the flow split to the bypass duct could then be determined. The output value for MCB in the DRE equation was then calculated as this gas flow ratio times the measured bypass MCB emission rate. This method yielded a best estimate of the actual DRE of 99.9936% for MCB spiked into drums that were fed at the gas exit end of the kiln. This estimating method does not provide an accurate determination of DRE as required during trial burns.

4.2.3 Emissions of PICs

This section covers the qualitative screening analysis for PICs and the quantitative analysis for dioxins and furans.

4.2.3.1 Organic Emissions Screen--

Qualitative screening analyses of the VOST Method 0030 and Method 0010 samples were conducted to characterize the organic compounds emitted as products of incomplete combustion (PIC) in both the main and bypass ducts. The GC/MS analyses were targeted to identify about 110 compounds listed in EPA Methods 624 and 625, commonly called the priority pollutants. The analyses were qualitative in that sample quantities were based on average response factors and not on specific standards. Tables 4-9 and 4-10 present the concentrations of compounds detected by these analyses. A blank entry on these tables indicates that the compound was not detected; detection levels are on the order of a few nanograms.

TABLE 4-9. BYPASS DUCT PIC SCREENING DATA

Process condition:	Stack gas concentrations, ng/L				
	Liquid + solid waste		Coal only	Liquid waste	
Compound	Run 1	Run 2	Run 3	Run 4	Run 5
Volatile compounds					
Acetone			61		
Benzene	28	63	15	7	9
1,1-Dichloroethene			2		
Ethylbenzene	2	3	1		1
Methylene chloride	1	2	17	4	8
Methyl ethyl ketone	68				1
Monochlorobenzene	10	15	1	1	1
Tetrachloroethene	2	1	1	1	1
Toluene	22	21	6	5	8
1,1,1-Trichloroethane			1		
Trichloroethene	2	1			
Trichlorofluoromethane	2	2	5		1
Semivolatile compounds					
Bis(2-ethylhexyl) phthalate	8		130	92	

TABLE 4-10. MAIN DUCT PIC SCREENING DATA

Process condition:	Stack gas concentrations, ng/L				
	Liquid + solid waste		Coal only	Liquid waste	
Compound	Run 1	Run 2	Run 3	Run 4	Run 5
Volatile compounds					
Benzene	600	700	490	500	450
Bromoform		1			
Ethylbenzene	100	130	74	85	77
Methylene chloride	66	89	260	54	64
Monochlorobenzene	44	72	5	66	62
1,1,2,2-Tetrachloroethane		1			
Tetrachloroethene	6	2	2		
Toluene	580	650	470	420	440
Trichloroethene	1		3		
Trichlorofluoromethane			35		
Semivolatile compounds					
Anthracene	10				
Bis(2-ethylhexyl) phthalate	16	15	62	45	92
Dibenzofuran	25	28			
Di-*n*-butyl phthalate		6			
Diphenyl	11	11			

Table 4-9 shows that a few PICs at relatively low concentrations were emitted from the bypass duct. The volatile species identified were all compounds commonly detected in combustion gas effluents. Very few semivolatile compounds were identified. The data show a general scatter from run to run, with only one trend evident. Higher levels of MCB during Runs 1 and 2 are likely associated with spiking of this compound into the solid waste feed during these runs. Section 4.2.2 provides further discussion of MCB emissions. Benzene and toluene concentrations were also higher during these two runs.

Table 4-10 shows the PICs detected in the main duct. The array of compounds found here was similar to that found in the bypass duct, but individual compound levels were higher. Benzene, toluene, and ethylbenzene were found at the highest concentrations and showed little variation in concentration from run to run. Benzene and toluene are known to be common PICs resulting from fossil fuel combustion and are, therefore, likely associated with coal combustion in the pyroclone.

These data also indicate that MCB was formed as a PIC. The formation was related to high levels of benzene and to the level of chlorine input to the kiln, and not to the spiking of MCB in the waste during Runs 1 and 2 (see Section 4.2.2).

Table 4-11 is a comparison of the PICs measured in the main and bypass ducts to the PICs historically detected in stack gases from hazardous waste incinerators. The incinerator data include the most common PICs that were detected during tests at eight incinerators. Comparison of any individual compound concentrations should be made with caution, since only one kiln test is compared to a series of incinerator tests. However, Table 4-11 does indicate that many compounds are common to combustion of waste in both kilns and incinerators. It also shows that the concentrations of PICs in both cases are generally in the same range.

4.2.3.2 Dioxins and Furans--

Table 4-12 shows the concentrations of dioxins and furans measured in the main and bypass ducts. Generally, little difference was noted between runs

TABLE 4-11. COMPARISON OF KILN AND INCINERATOR PICs

PIC	Range of concentrations, ng/L Kiln, main duct	 Kiln, bypass duct	 Incinerators[a]
Benzene	450-700	7-62	12-670
Bis(2-ethylhexyl) phthalate	15-62	8-130	
Bromodichloromethane			3-92
Bromoform			1-24
Chloroform			1-1300
Dibenzofuran	25-28		
Dibromochloromethane			1-12
Diphenyl	11		
Ethylbenzene	74-130	1-3	
Hexachlorobenzene			1-7
Methylene chloride	54-260	1-17	2-27
Methyl ethyl ketone		1-68	
Monochlorobenzene	5-72		1-10
Naphthalene			5-100
o-Nitrophenol			25-50
Phenol			4-22
Tetrachloroethylene	2-6	1-2	1-9
Toluene	440-650	5-22	2-25
1,1,1-Trichloroethane			1-2
Trichloroethylene	1-3	1-2	
Trichlorofluoromethane		1-5	

[a] "Performance Evaluation of Full-Scale Hazardous Waste Incinerators, Volume 2," EPA-600/2-84-181b, PB85-129518, November 1984.

TABLE 4-12. DIOXIN/FURAN CONCENTRATIONS

	Concentration, ng/dscm					
	Main duct			Bypass duct		
Homolog	Run 1	Run 3	Run 4	Run 1	Run 3	Run 4
Dioxins						
TCDD	ND	ND	0.16	ND	ND	ND
PeCDD	0.007	ND	0.21	0.017	ND	ND
HxCDD	0.041	0.10	0.46	0.044	0.043	0.020
HpCDD	0.10	0.13	0.52	0.082	0.07	0.085
OCDD	0.260	0.21	0.48	0.17	0.25	0.27
Total dioxins	0.41	0.44	1.8	0.31	0.37	0.38
Furans						
TCDF	0.046	0.066	1.1	0.48	0.043	0.25
PeCDF	0.081	0.084	1.1	0.21	0.024	0.10
HxCDF	0.03	0.069	0.90	0.15	0.046	0.12
HpCDF	ND	0.10	0.71	0.04	0.04	0.069
OCDF	0.071	0.23	0.43	0.12	0.16	0.13
Total furans	0.23	0.55	4.2	1.0	0.31	0.67

ND = Not detected.

except the levels of both the dioxins and furans were higher in the main duct during Run 4. An explanation for this increase in concentration was not found. The concentrations in Table 4-12 are on the low side of the range of concentrations that have been measured previously for hazardous waste incinerators.

4.2.4 Total Organic Carbon Concentrations in Raw Materials Feed

Composite samples of the raw materials feed (i.e., crushed limestone and shale) were collected and analyzed for total organic carbon (TOC), in order to allow comparison to the total hydrocarbon emissions from the stack. Samples were analyzed by combustion in a LECO furnace using Texas A&M Geochemical and Environmental Research Group SOP-8907. Appendices A-1 and A-5 describe the sampling and analysis methods, respectively.

The TOC, or organic carbon, input rates were compared to the stack emission or output of organic carbon based on the HC measurements. Percent TOC in the feed was converted into a mass input rate of carbon, while the hot HC emission rate (as ppm propane) was converted into carbon output rates. The ratio of carbon input to carbon output ranged from 27 to 44, as shown in Table 4-13. The carbon input was sufficient to potentially account for the HC output from the stack. Appendix B-4 provides copies of the laboratory analysis data.

4.3 Cl^- AND NO_x EMISSIONS

This section discusses the data collected on inorganic compound emissions. The discussion is divided into two sections on chloride and nitrogen oxide emissions.

4.3.1 Chloride Emissions

Table 4-14 shows the chloride data for both ducts assuming all chloride measured is emitted as HCl. The concentrations of HCl were relatively low, and the total emission rates were less than 4 lb/h for all test runs. The lower values for the bypass duct compared to the main duct are partly the result of the greater dilution of the gas stream in the bypass duct.

TABLE 4-13. ASH GROVE TOC/THC COMPARISIONS

Run	TOC in feed (%)	Raw meal feed rate (ton/h)	TOC input rate in raw meal (g/hr)	TOC input rate in raw meal (ton/h)
1	.10	98	89,000	0.0980
2	.10	96	87,200	0.0960
3	.04	95	34,500	0.0380
4	.07	95	60,400	0.0665
5	.06	97	52,800	0.0582

Run	THC (ppm)[a]	Conc. (μg/L)	Stack flow (dscm/min)	Emission (g/hr)
1	16.1	24	1500	2100
2	16.6	25	1460	2200
3	9.7	15	1490	1300
4	10.6	16	1510	1500
5	9.6	14	1460	1200

---

[a] ppm as propane, carbon fraction alone.

Run	Overall Summary Input (g/hr)	Overall Summary Output (g/hr)	Overall Summary Ratio (input/output)
1	89,000	2100	42
2	87,200	2200	40
3	34,500	1300	27
4	60,400	1500	40
5	52,800	1200	44

TABLE 4-14. CHLORIDE EMISSIONS

Process condition	Test run	Main duct emissions		Bypass duct emissions		Total emission rate (lb/h)
		Concentration (ppmv)	Emission rate (lb/h)	Concentration (ppmv)	Emission rate (lb/hr)	
Liquid plus solid waste	1	3.7	1.1	0.05	0.008	1.1
	2	2.4	0.7	0.29	0.04	0.7
Coal only	3	1.6	0.5	0.29	0.04	0.5
Liquid waste	4	7.1	2.2	0.38	0.05	2.3
	5	11.1	3.3	[a]	[a]	[a]

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[a] Data not available.

Table 4-15 compares the emission rate with the input chloride rate and shows that about 99% of the input chlorine was removed from the gas stream before it exited the stack. The chlorine reacts with raw material in the process to form chloride salts, mainly potassium chloride. However, the chloride emission rates did not appear to relate to the chloride input level.

The sampling and analysis method used for this program was developed to measure HCl emissions from incinerators. The method actually measures the amount of chloride ions collected in impingers located behind a filter and is typically considered adequate to determine the emissions of HCl from incinerators. Apparently, in these tests of cement kilns, an alternate plausible argument is that the measured chloride ion in the sampling train impingers is attributed to ammonium chloride, not HCl. Table 4-16 shows data on potassium, ammonium, and chloride ions in the impingers that support this argument.

The analysis of the impinger solutions for potassium ion show that it is unlikely that potassium chloride particles pass the filter. Formation of some potassium chloride would be expected due to the high potassium content of the raw material fed to the kiln relative to the chloride levels present. However, no significant potassium ion concentration was found in the sampling train impingers. Thus, any potassium salts in the stack gas must be solid particles that are captured on the filter in the sampling train. If salt particles do not penetrate the filter, then the ammonium ion levels shown on Table 4-16 must have passed the filter in vapor or gaseous form. Ammonia or ammonium chloride are two possibilities.

Any ammonia present in the gas stream would easily pass through the filter and be captured in the impingers. This is one possible way to explain the presence of ammonium ion in the impingers. However, ammonia and HCl are highly reactive, and if both were present in the gas stream, they would likely react to form ammonium chloride. A more reasonable explanation for the presence of ammonium ion in the impingers is that ammonium chloride vapor passes the filter. The vapor pressure of ammonium chloride at the filter

TABLE 4-15. CHLORIDE REMOVAL EFFICIENCY

Process condition	Test run	Chloride input (lb/h)	Chloride emissions (lb/h)	Chloride removal efficiency (%)
Liquid plus Solid waste	1	194	1.1	99.4
	2	248	0.7	99.7
Coal only	3	None detected	0.5	-
Liquid waste	4	217	2.3	98.9
	5	215	a	a

[a] Data not available.

TABLE 4-16. COMPARISON OF CHLORIDE LEVELS WITH POTASSIUM AND AMMONIUM LEVELS IN THE HCl SAMPLING TRAIN IMPINGERS

	Main duct				Bypass duct			
Test run	Chloride (mg)	Potassium (mg)[b]	Ammonium ion (mg)	Percent of chloride that may be NH_4Cl	Chloride (mg)	Potassium (mg)[b]	Ammonium ion (mg)	Percent of chloride that may be NH_4Cl
1	8.9	< 0.7	33	100	0.14	< 0.1	0.07	100
2	6.0	< 0.5	14	100	0.77	< 0.3	0.07	20
3	4.2	< 0.6	17	100	0.76	< 0.4	0.10	30
4	18.3	< 0.4	21	100	1.03	< 0.6	0.04	10
5	28.3	< 0.7	39	100	a	< 0.4	0.07	a

[a] Data not available.

[b] Potassium concentration determined to be < 1.0 mg/L in impinger solutions. Analytical results are in Appendix B-4.

temperature of 250°F is 0.089 mm of mercury.[2] This vapor pressure can account for the existence of up to 120 ppm of ammonium chloride, in the gas phase, in the sampled stream. Thus, it is possible for sufficient gas phase ammonium chloride to pass through the filter at levels well above those measured in the impingers. The percent of the measured chloride levels in the impingers that could be present as ammonium chloride is shown on Table 4-16.

The form of the chloride in the sampling train impingers does not necessarily indicate its form in the stack gases. Literature sources indicate that ammonium chloride is a crystalline solid which sublimes without melting and, is almost completely dissociated to ammonia and HCl in the vapor phase.[3] At average stack temperatures (300°F) and stack gas concentrations (2 to 10 ppm HCl; equivalent to 3 to 15 ppm NH_4Cl), all of the NH_4Cl would be in the vapor phase and, therefore, almost entirely dissociated to ammonia and HCl. The dissociated ammonia and HCl in the hot stack gases may recombine to NH_4Cl after the stack gases are emitted and cooled in the atmosphere.

4.3.2 Nitrogen Oxide Emissions

Nitrogen oxide (NO_x) emissions were measured in the main and bypass ducts using Ash Grove's continuous monitor. Table 4-17 lists the average NO_x values for each test run along with pyroclones and kiln operating temperatures. NO_x concentrations in the main duct were generally lower than those measured in the bypass duct. No relationship was evident between NO_x concentrations and pyroclone or kiln operating temperature.

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[2] International Critical Tables, Volume III, First Edition, McGraw Hill Publishers, p. 207, 1928.

[3] Sources include:

- Inorganic and Theoretical Chemistry, J. W. Mellor, Volume II, p. 566.
- Goldfinger, L., and G. Verhaegen, "Stability of Gaseous Ammonium Chloride Molecule,: *J. Chemical Physics*, 50(3), 1467 (1969).

TABLE 4-17. ASH GROVE NO_x DATA AND OPERATING TEMPERATURES

Test run	Main duct) NO_x (ppm)	Bypass duct NO_x (ppm)	Pyroclone temp. (°F)	Kiln exit gas temp. (°F)
1	412	312	1600	1970
2	443	723	1620	1880
3	512	1174	1620	1940
4	415	472	1600	a
5	529	765	1600	1831

[a] Data not available.

APPENDIX A

SAMPLING AND ANALYSIS METHODS

This appendix contains information concerning the sampling and analytical procedures used during the test at the Ash Grove precalciner kiln. Information is presented as follows:

APPENDIX A-1

SAMPLING PROCEDURES

APPENDIX A-1

SAMPLING PROCEDURES

Test objectives were met by the sampling and subsequent analysis of exhaust gas streams, raw meal feed, and waste feeds. This section summarizes the sampling procedures used during the test burn. Preparation of the sampling equipment and sampling procedures is addressed. Equipment calibration is briefly addressed; the Project QAP more specifically addresses equipment calibration. Sample handling (transport and storage) and sample analysis procedures are addressed in Section A-2.

1.0 EXHAUST GAS TESTING

The following sampling systems were used to collect exhaust gas samples during the test:

- Method 0010 sampling train--Used to determine PCDD/PCDF emission concentrations (during run 1 of test Condition A, run 3 of Condition B, and run 4 of test Condition C), to determine an organic mass fraction, and to screen for a specific array of semivolatile organics.
- HCl train--Used to determine HCl emission concentrations. Ammonium and potassium ion concentrations were also determined in these samples.
- VOST--Used to screen for a specific array of volatile organics. Also used to determine POHC emission concentrations during test Condition A.
- Field GC system--Equipped with FID. Used to determine an organic mass fraction.
- Orsat--Method 3 sampling system used to determine O_2 and CO_2 emission concentrations using an Orsat analyzer.
- Continuous emission monitors (CEMs)--Used to monitor hot and cold THCs using Modified Method 25A systems equipped with FIDs. CO, CO_2, and O_2 emission concentrations also measured following EPA Reference Methods 10, 3, and 3A.

These sampling systems are further defined in the subsequent discussion.

1.1 Method 0010 Train

The Method 0010 sampling train was used to measure carbon fractions greater than C17 (i.e., organic mass fraction) and to define specific semivolatile organics (i.e., organic screen analysis). The carbon fraction was determined by gravimetric analysis; semivolatile organics were determined by GC/MS analysis. During three test runs, this train was also used to measure PCDDs/PCDFs.

The sampling procedure consists of isokinetically sampling a volume of the exhaust gas (usually no less than 70 ft^3 corrected to dry standard conditions). In general, the sampling procedures parallel those specified in 40 CFR 60, Methods 1 through 5, for particulate analysis.

The design of the Method 0010 sampling train was based on the apparatus described in SW-846, Method 0010 (September 1986 edition). The train consists of a stainless steel nozzle, a heated borosilicate glass probe liner, and a borosilicate filter. The control module used to control the gas sampling rate and monitor the stack gas parameters contains a leakless vacuum pump; a dry gas meter; an orifice meter; and the appropriate valves, gauges, temperature controllers, and associated hardware. The impingers and their contents are described below:

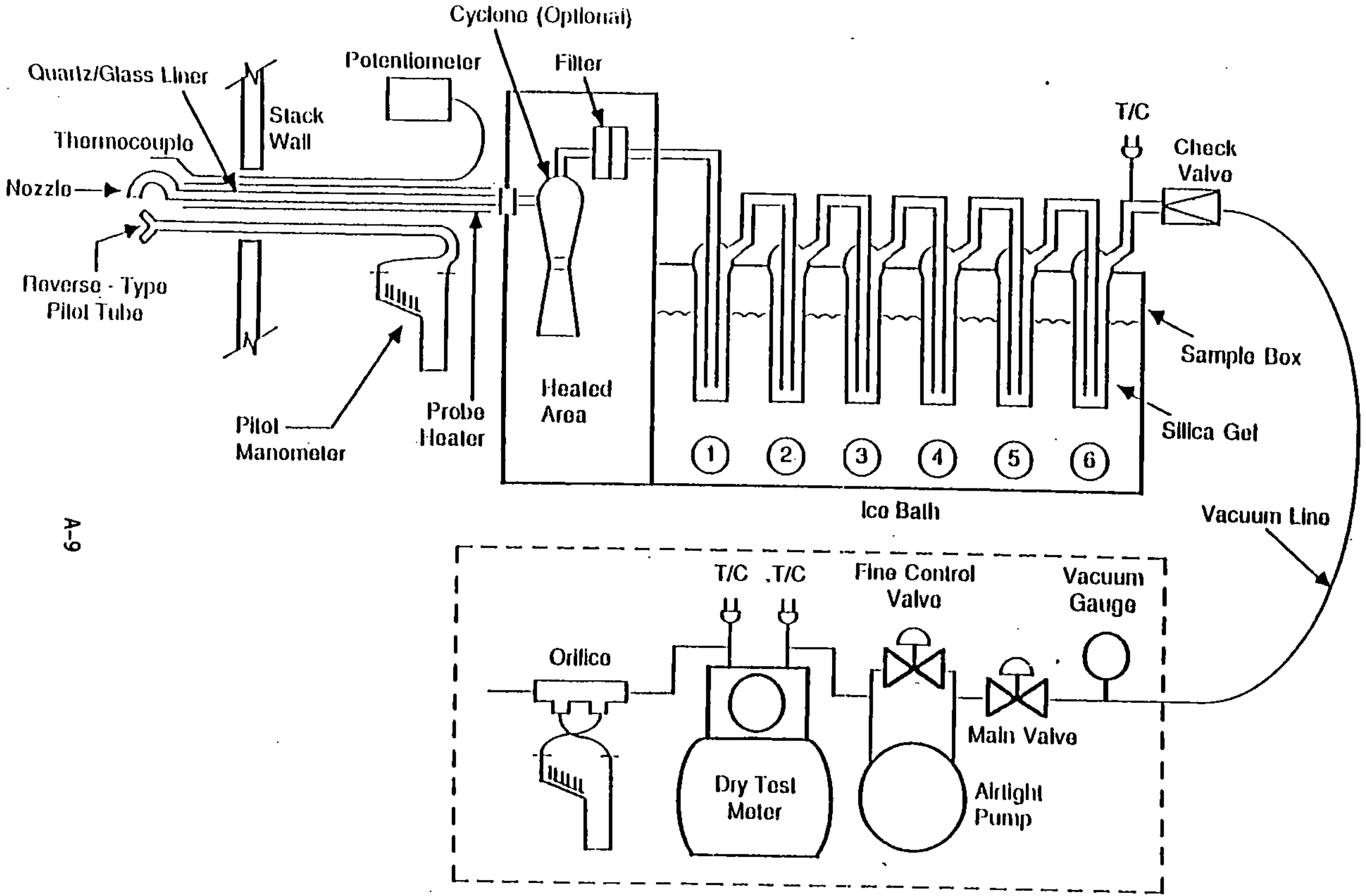
- The first impinger is a spiral condenser to cool the sample gas.
- The second impinger is an MRI-designed XAD module containing 70 g of XAD.
- The third impinger is an empty modified GBS to catch any carryover from the first two impingers.
- The fourth impinger is a GBS and will contain 100 mL of double distilled in glass H_2O.
- The fifth impinger is an empty modified GBS.
- The sixth impinger is a modified GBS, containing approximately 200 g of blue indicating silica gel.

All glass-to-glass connections are made from threaded glass and Teflon ferrules. Schematics of the train are shown in Figures A1-1 and A1-2.

Calibration--The sampling equipment will be calibrated, checked for proper operation, and cleaned for use prior to arrival on-site.

As a minimum, the following equipment will be calibrated:

1. Dry gas meter/orifice
2. Stack temperature thermocouple
3. Filter oven thermocouple



1. Condenser.
2. XAD module, 70 g XAD.
3. Modified Greenburg-Smith, empty.
4. Greenburg-Smith, 100-mL double-distilled H_2O.
5. Modified Greenburg-Smith, empty.
6. Modified Greenburg-Smith, silica gel.

Figure A1-1. Diagram of MM5 train.

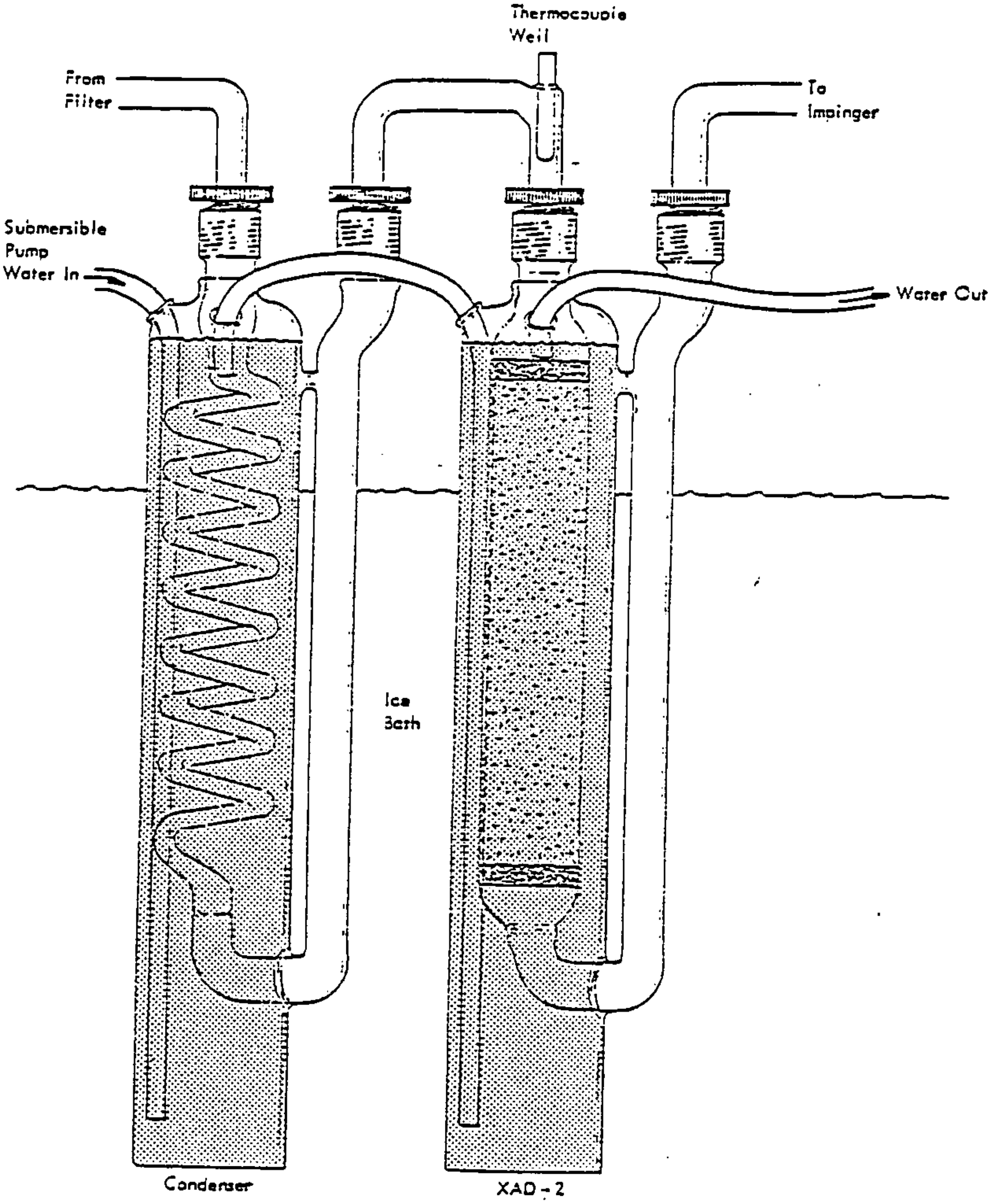


Figure A1-2. MM5 condenser and XAD resin cartridge.

4. Thermocouple and pyrometer for gas meter
5. Probe nozzles
6. Pitot tube (by comparison to pitot tube in wind tunnel)

Copies of all calibration data are offered in Appendix C. The calibration procedures used are from the "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III--Stationary Source Specific Methods," USEPA 600/4-77-027b.

All surfaces in the sampling train that came into contact with the sample gas stream were thoroughly cleaned. The cleaning procedure is discussed in more detail later in this section. To minimize the potential for contamination of sampling train glassware, all glassware components were sealed with aluminum foil prior to being packed for storage and transport. All remaining sampling train components were cleaned and prepared in accordance with EPA Method 5 procedures.

Sample collection--Sample collection, including leak-checking, was conducted in accordance with EPA Method 5 procedures. The samples were collected isokinetically over a complete traverse of each exhaust duct (i.e., the main precipitator and bypass precipitator exhaust ducts). Twenty traverse points were sampled using four sample ports located across the width of each duct. A minimum of 70 ft^3 was collected at a sampling rate of ~ 0.75 ft_3/min. Two-hour samples were collected.

Sample recovery--At the end of a test run after the final leak check, the sampling train was disassembled into two parts, the probe and the sample box, which were then transferred to the field laboratory for recovery. The inlet to the sample box was covered, and both ends of the probe were sealed to prevent sample loss and contamination. In a designated section of the field laboratory, sample components were recovered from the sample box and the nozzle. The sample component from the probe was recovered in a clean, ventilated area. All liquid sample components were transferred to tared bottles and reweighed after recovery to verify that no losses occurred during transport to the laboratory. Sample components were recovered as follows.

- Container 1--Filter. Use Teflon-coated or stainless steel forceps to recover the filter; place the filter in the labeled glass petri dish.

- Container 2--XAD-2 resin. Cap the XAD-2 resin module with threaded glass plugs (Teflon ferrules).

- Container 3--Front-half rinse. Rinse and brush the probe nozzle, probe, and all glassware up to and including the front-half of the filter with methanol, methanol/methylene chloride, and toluene; three time each. Retain the rinse.

- Container 4--Back-half rinse. Rinse all glassware from the filter back-half up to the XAD resin cartridge including the condenser with ethanol, methanol/methylene chloride, and toluene; retain the rinse.

- Container 5--Condensate. After weighing, collect the first, third, and fourth impinger condensates, then rinse with a known volume of water, adding it to the condensate container. Record the total final volume of condensate. Rinse all impingers three times with methanol, methanol/methylene chloride, and toluene, and add these rinses to the condensate container.

Cleaning glassware--All glass parts of the train including the empty XAD sorbent tube were cleaned in MRI's laboratory prior to use as follows:

1. Scrub and soak in hot "Alconox" soapy water.
2. Hot water rinse.
3. Distilled water rinse.
4. Methanol.
5. Methanol/methylene chloride rinse.
6. Toluene rinse.
7. Bake in 100°C oven until dry.
8. Cap ends in methanol/methylene chloride rinsed aluminum foil (dull side in).
9. Store.

Note: Chromic acid rinse to remove grease was not required because all fittings were designed as greaseless and were never to be used with grease.

Blank train--A blank train was fully assembled in the field, heated, and then a train blank sample recovered using the same procedures as a normal sample recovery.

1.2 HCl Sampling Train

HCl present in exhaust gas was collected using an HCl sampling train. The sampling procedure consisted of sampling a predetermined volume of stack gas using the proposed sampling procedures specified in EPA's "Draft Method for the Determination of HCl Emissions from Municipal and Hazardous Waste Incinerators" (USEPA, QAD, July 1988), adapted for use with an M5 train.

The HCl sampling train utilized a heated quartz fiber disc filter and glass borosilicate probe. A flow control module was used to permit control and monitoring of the gas sample. The module contains a leakless vacuum pump; a dry test meter; a surge tank; and the appropriate valves, gauges, temperature controllers, and associated hardware. The impingers and their contents are described on the following page.

- The first and second GBS impingers contain 100 mL of 0.1 N H_2SO_4 each. These impingers were used to collect condensate and HCl.
- The third and fourth modified impingers contain 100 mL of 0.1 N NaOH. These impingers were used to absorb Cl_2, which, if present, could damage the sample pump.
- The fifth modified impinger was filled with blue-indicating silica gel.

All glass-to-glass connections were glass and Teflon. A schematic of the HCl train is shown in Figure A1-3.

Calibration--The HCl sampling equipment was calibrated, checked for proper operation, and cleaned for use prior to arrival on-site.

As a minimum, the following equipment was calibrated:

1. Dry gas meter/orifice
2. Stack temperature thermocouple
3. Filter oven thermocouple
4. Thermocouple and pyrometer for gas meter
5. Probe nozzles
6. Pitot tube (by comparison to pitot tube in wind tunnel)

The calibration procedures used are from the "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III--Stationary Source Specific Methods," USEPA 600/4-77-027b, and/or from the previously referenced EPA draft method for the determination of HCl emissions.

All surfaces in the HCl sampling train that came into contact with the sample gas stream were thoroughly cleaned. The cleaning procedure is discussed in more detail later in this section. To minimize the potential for contamination of sampling train glassware, all glassware components were sealed with aluminum foil prior to being packed for storage and transport. All remaining sampling train components were cleaned and prepared in accordance with appropriate EPA reference procedures (i.e., EPA Method 5).

All glassware, rinse bottles, and associated apparatus used for in-field sampling and recovery were thoroughly cleaned and conditioned. All sample containers were glass with Teflon-lined lids or Nalgene and were rinsed with distilled water.

Cleaning glassware--All glass parts of the train were cleaned in MRI's laboratory prior to use as follows:

1. Scrub and soak in hot water with Alconox.

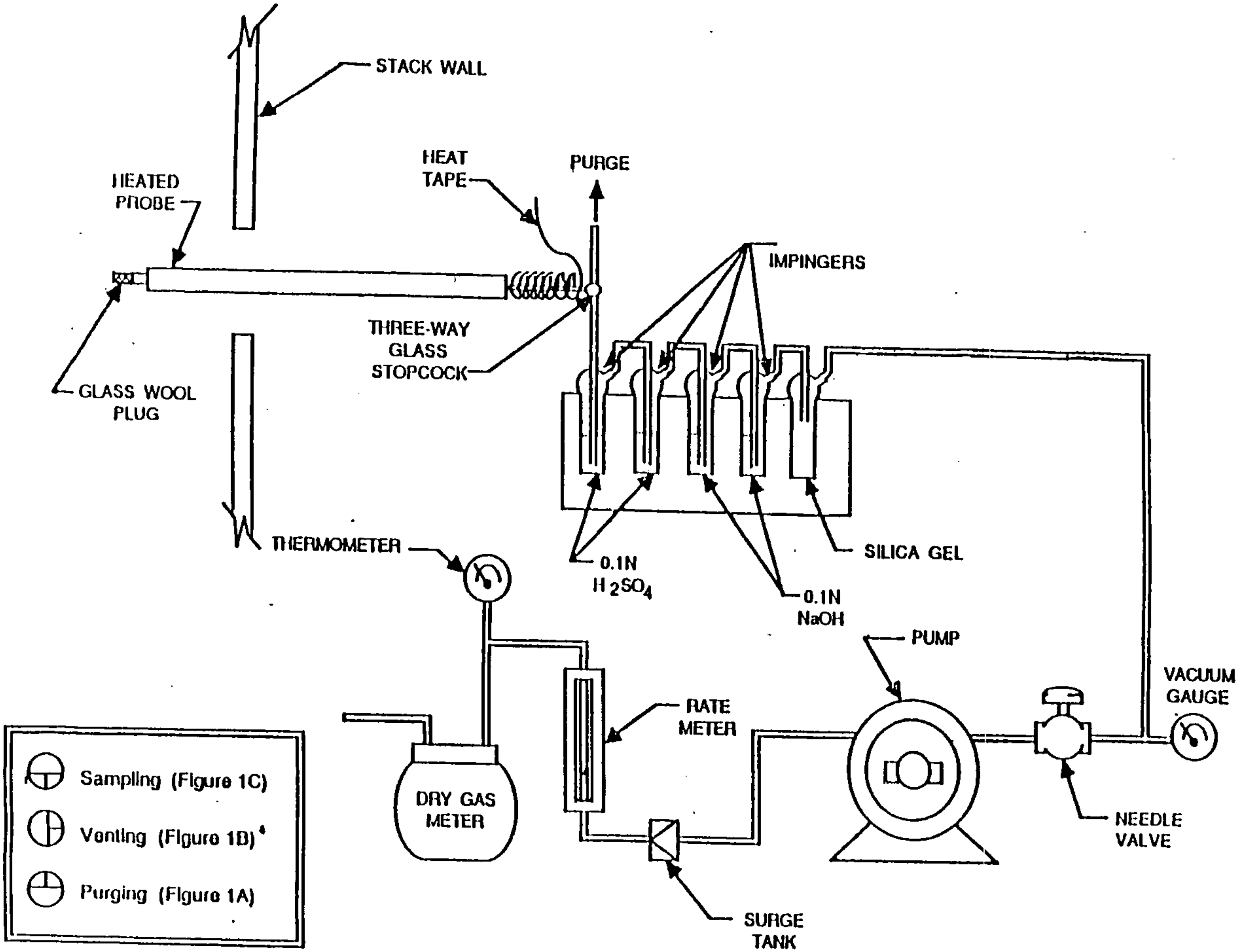


Figure A1-3. Schematic of the particulate/HCl train.

2. Rinse in hot water.

3. Rinse in distilled water.

4. Rinse in acetone.

5. Cap ends in aluminum foil (dull side in).

Sample bottles--All sample bottles required for recovery of HCl condensate were polyethylene or glass bottles. The sample bottles were rinsed with distilled water.

Sample collection--Sample collection, including leak-checking, was conducted in accordance with the procedures described in the EPA draft protocol, "Draft Method for the Determination of HCl Emissions from Municipal and Hazardous Waste Incinerators." Even though this draft method is directly applied to incineration systems, the proposed methods may be equally applied to other industrial combustion systems, such as the precalciner cement kiln.

Samples were collected at a single point in each duct (i.e., in the main precipitator and the bypass precipitator exhaust ducts). A sampling rate of approximately 10 L/min was maintained throughout a 2-h sample period.

Sample recovery--At the end of the test after the final leak check, the sample train was taken to the laboratory to recover the sample. The samples from the HCl train were recovered as follows:

- Container 1--Condensate, HCl, and rinsate. Combine contents of impingers 1 and 2. Rinse these impingers with water, and add the rinsate to the combined impinger volume.

  NOTE: The contents of impingers 3 and 4 can be discarded. To protect sampling equipment, these impingers were used to collect any Cl_2 present in the sample volume.

Blank train--A blank train was fully assembled in the field, heated, and then a train blank sample recovered using the same procedures as a normal sample recovery.

1.3 Volatile Organics Sampling Train

Volatile organics, including the volatile POHC (introduced during test Condition A), were collected from exhaust gases using a VOST. VOST samples were collected from a single source in each duct (i.e., the main and bypass precipitator exhaust ducts). The VOST was placed in a common port with the CEM/THC sampling probe to accommodate the number of available sample ports.

The VOST method involved collecting a 20-L exhaust gas sample at a flow rate of approximately 0.5 L/min. The gas sample was cooled to approximately 20°C by passage through a water-cooled condenser, and volatiles were collected on a pair of sorbent resin traps. Liquid condensate was collected in a catch flask placed between the two resin traps. The first resin trap (front trap) contained approximately 1.6 g of Tenax, and the second trap (back trap) contained approximately 1 g each of Tenax and petroleum-based charcoal, 2:1 by volume.

A diagram of the VOST component arrangement is presented in Figure A1-4. The sample was passed from the probe to a valve train, a water-cooled glass condenser, a sorbent cartridge containing Tenax (1.6 g), an empty catch flask for condensate removal, a second water-cooled glass condenser, a second sorbent cartridge containing Tenax and petroleum-based charcoal, a silica gel drying tube, a rotameter, a sampling pump, and a dry gas meter.

The gas pressure during sampling and for leak-checking was monitored by pressure gauges which were in line with and downstream of the silica gel drying tube.

The probe was constructed of borosilicate glass in a stainless steel outer sheath. The temperature of the probe was maintained at approximately 140°C, which was low enough to ensure a resin temperature of 20°C.

An isolation valve was used to isolate the VOST apparatus from the sample probe. The isolation valve consists of a greaseless stopcock and sliding Teflon plug. The charcoal tube valve was also used to direct a hydrocarbon-free gas (charcoal-filtered air) to the inlet of the sample train. This gas was used to prevent contamination during leak-check procedures.

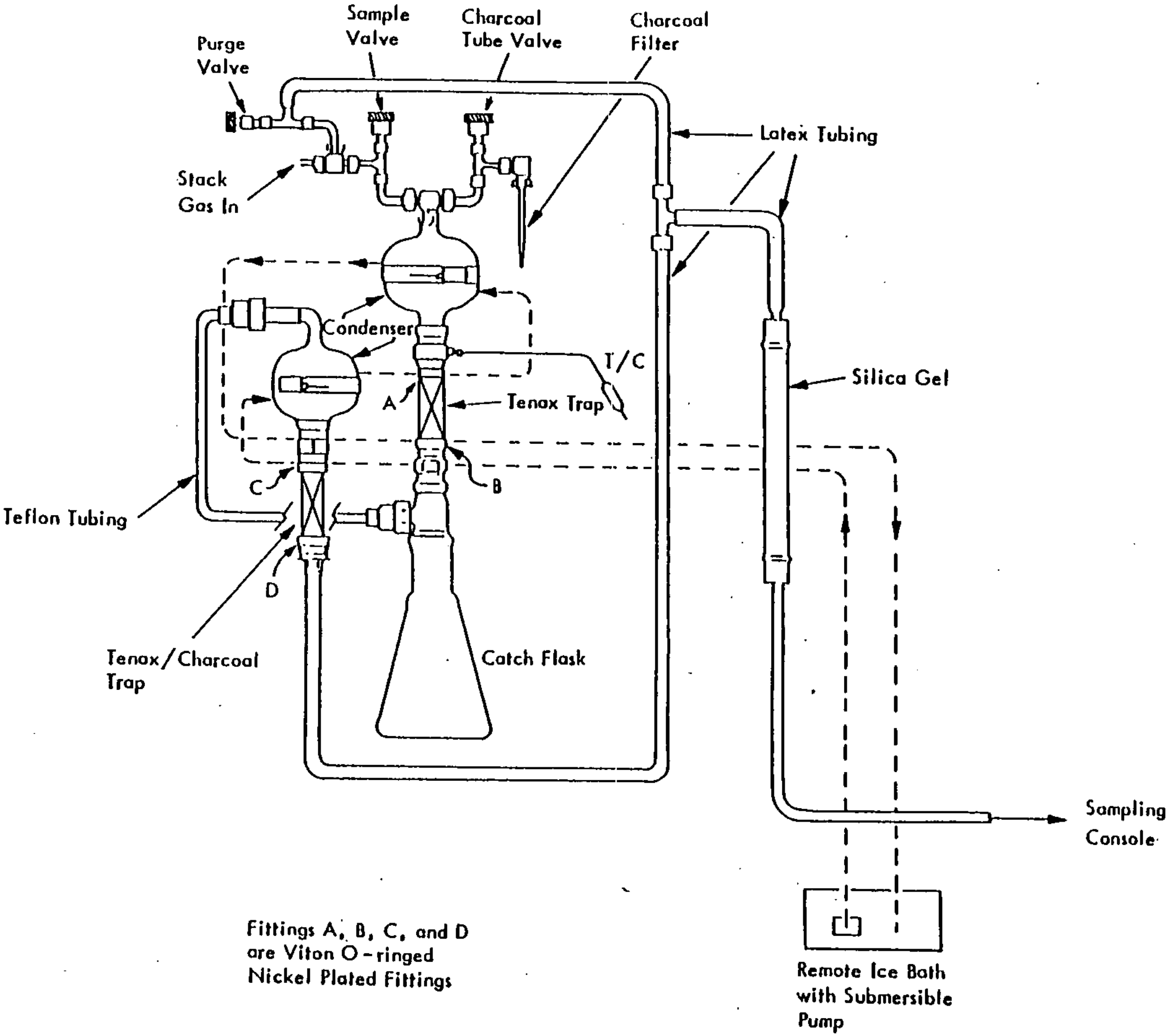
The condensers were of sufficient capacity to cool the gas stream to 20°C or less prior to passage through the first sorbent cartridge.

The sorbent cartridges for the VOST are of the inside-inside (I/I) configuration in which only a single glass tube is used for each of the two tubes. The second sorbent cartridge was placed in the sample train so that the sample gas stream passes through the Tenax layer first and then through the charcoal layer. The sorbent cartridges were glass tubes with approximate dimensions of 10 cm (long) by 1.6 cm i.d. The resin was held in place by Teflon-coated stainless steel screens and clips at each end of the resin layer. Threaded end caps were placed on the sorbent cartridges after packing to protect the sorbent from contamination during storage and transport.

The metering system for VOST consisted of vacuum gauges, a leak-free pump, a rotameter for monitoring the gas flow rate, a dry gas meter (low volume) with 2% accuracy at the required sampling rate and related valves and equipment. All sample transfer lines used with the VOST up to and including the second resin cartridge were Teflon or glass with connecting fittings that are capable of forming leak-free, vacuum-tight connections without the use of sealing grease.

Calibration--All VOST equipment was calibrated, checked for proper operation, and cleaned for use prior to arrival on-site. The gas meter and condenser thermocouple were calibrated before and after the test.

The gas meter was calibrated against a wet test meter. The thermocouple was calibrated against a mercury-in-glass thermometer.



Fittings A, B, C, and D are Viton O-ringed Nickel Plated Fittings

Figure A1-4. Volatile organic sampling train (VOST).

Glassware cleaning--All glass parts of the VOST train were cleaned as follows:

- Washed with Alconox and hot water.
- Rinsed with tap water.
- Rinsed with distilled water.
- Oven-dried at 150°C for 2 h.
- Capped with aluminum foil or Teflon caps until used.

Tenax preparation--The sorbent tube cartridges were packed with Tenax and conditioned by flowing, organic-free nitrogen (30 mL/min) through the resin while heating to 190°C for at least 3 h.

During the thermal conditioning, the Tenax cartridges are installed in a specially designed manifold which permits the nitrogen purge from the traps to be individually monitored by an FID. The conditioning is continued until the FID response indicates the traps are clean (less than 5 ppb total hydrocarbon as propane). If after 24 h of purging the trap is still contaminated, it is discarded.

Used Tenax cartridges are thermally conditioned by the method described above.

Charcoal (SKC petroleum base or equivalent)--Procedures for reconditioning charcoal are the same as those described for Tenax above.

Sample cartridges--"Primary" VOST cartridges were packed with 1.6 to 1.8 g of prepared Tenax, and "secondary" cartridges will be packed with approximately 1 g each of prepared Tenax and prepared petroleum-based charcoal (SKC Lot 104 or equivalent), 2:1 by volume. The packed cartridges were conditioned as described above.

After the tubes were conditioned, the tubes were capped and placed into a steel can which was then sealed for shipment. The can contained a small amount of charcoal for shipment. During each test, each tube was marked directly with a label.

VOST sample collection--Sample collection was conducted in accordance with procedures described in the USEPA document SW-846, Method 0030, except as noted below. Samples were collected from each exhaust duct at a single sample point for three 40-min sample periods during each test condition.

The following are exceptions and/or additions to the procedures in the above-referenced document.

1. After collection of the 20-L sample, the two sorbent cartridges were removed from the train, capped at the ends, and placed into the metal transport can which contains charcoal. The cans were stored and transported in

insulated containers packed with ice to maintain temperature of the tubes at 4°C at all times.

2. Field blanks, trip blanks, and other conditioned (clean) sorbent tubes are stored and transported as described above for the sample tubes.

The volatile organic sample train will be assembled as shown in Figure 1-4. A leak check of the train will be made at 250 mmHg with the three-way valve at the inlet from the probe to the condenser closed. After all leak checks, the vacuum will be released by admitting charcoal-filtered air through the three-way stopcock.

The probe will next be purged with stack gas by drawing stack gas through the probe via the three-way stopcock with a pump. After this purge of the probe, the sample is collected following these steps:

- Record the dry gas meter reading.
- Position the three-way stopcock to connect the condenser with the probe.
- Turn on the pump and open the coarse metering valve.
- Operate the train at the sampling rate of 0.5 L/min for the next 40 min.
- Collect readings as required by the VOST data sheet each 5 min throughout the run.
- Ensure the sampling rate remains constant throughout the run.
- Ensure the temperature of the gas entering the first sample tube remains below 20°C throughout the run.
- Ensure the probe remains above 140°C throughout the run.
- At the end of the sampling period, turn off the pump and the three-way valve.

After the sample is collected, the final meter volume is recorded and a final leak check done. The cartridges just used are removed and replaced with fresh cartridges. No cleaning of the condenser or other VOST equipment is required between subsamples. A new pair of traps is installed in the system, and sampling is continued as described above.

One set of field blanks was collected during each run. These samples were obtained by removing the end caps from a pair of traps and exposing them to the atmosphere while placing a pair of sample traps into the VOST train and again while removing the sample traps from the VOST train.

A set of trip blanks was retained at each duct (two sets per run) for analysis from the set of tubes used during the trial burn.

VOST sample recovery--The VOST traps removed from the sample train are immediately capped. A label is placed on the end cap to indicate the sample run number for ease in identification. However, each trap tube is permanently marked with a unique identification number. This identification number is recorded on the data form and sample traceability form to ensure proper sample identification. This trap number is used as the primary sample identification number.

The sealed trap is replaced in the trap storage/transport can, which is kept in a cooler with ice during the duration of the test and during storage on-site.

1.4 Field GC

The field GC will be utilized to identify C1 through C17 carbon fractions. This is necessary in obtaining an organic mass value.

GC samples were split directly off the hot THC pump exit, placing the GC sampling lines under positive pressure. The entire sampling system was leak-checked as a unit. Line and valve purging was sufficient to reduce/eliminate contamination from previous samples.

Prior to test run 1, it was discovered that an isothermal run program was inappropriate; oxygen present in the sample gas and higher temperatures acted on the GC columns to generate false high readings. A temperature-programmed run was developed and then utilized through the test. This program was defined as follows:

Dual columns: 30 m DB-1, 5.0 µM megabore; column flow and temperature were adjusted with the oven temperature at 100°C to 250°C at 20°C/min. Samples were held for 6 min at 250°C.

Analyzer: Shimadzu GC with dual FID

Carrier gas: He, 7 to 10 mL/min

Sample loops: Approximately 1 mL

Two propane standard concentrations were analyzed each day. A 4.98-ppm propane standard was analyzed prior to each test run to check instrument linearity. A 9.788-ppm propane standard was analyzed prior to and after each test run to generate an average response factor. The average response factors were then utilized to calculate the C1-C7 and C7-C17 carbon fractions.

Several aliquots of a C17 in a C7 solution were injected into the propane standard gas stream to determine appropriate retention times for carbon separation. The following ranges were determined:

C1-C7	Main Duct:	0-153s
	Bypass Duct:	0-141.5s

C7-C17 Main Duct: 154-583s
Bypass Duct: 142-572s

To shorten sampling time, some of the quality assurance (QA) samples (i.e., initial and final nitrogen blanks, propane standards, and ambient air samples) were not run through the entire temperature program. Early in the test, it was determined that there were no apparent high boiling point compounds present in the QA samples. Therefore, a second QA sample could be analyzed immediately following baseline recovery of the first, without qualitatively interfering with the analysis.

It should be noted that GC sampling times were reported by the operator prior to actually injecting the sample. Reported times may be off by up to 10 min. Also, a 10-ft length of sampling line was used to transfer sample gas to the field GC. A low flow rate was maintained through this line; therefore, GC sampling periods do not correspond directly (i.e., minute for minute) with hot THC sampling periods.

1.5 Orsat Analysis

An integrated, multipoint gas sample was taken from each exhaust duct during each test run using a modified EPA Reference Method 3 (40 CFR 60). The sampling procedures consisted of extracting a sample at a constant rate into a leak-free Mylar bag, which was subsequently analyzed for percent O_2 and CO_2 by volume on a dry basis using an Orsat gas analyzer.

Figure A1-5 is a schematic of the sampling system. The sample was taken from a connection at the exhaust end of the Method 0010 meter orifice. This sampling method provides a sample from which particulate and moisture have already been removed in the M5 train and automatically provides a multipoint and integrated sample. The integrated sample was taken over the entire 2-h Method 0010 sampling period.

The modified apparatus is the same as described in USEPA Method 3 for integrated sampling except that the probe and condenser are part of the Method 5 train (see Figure 1-5).

Large diameter flexible tubing of sufficient length (4 to 8 ft) is usually connected to the orifice meter outlet to exhaust sample gas so that it is vented away from the train operator. This tubing will not interfere with the orifice meter output and will ensure that no ambient air is drawn into the Method 3 apparatus.

The sampling system leak checks required in Method 3 was conducted prior to sampling. These included:

1. Leak checks of bags.
2. Sampling system leak check.

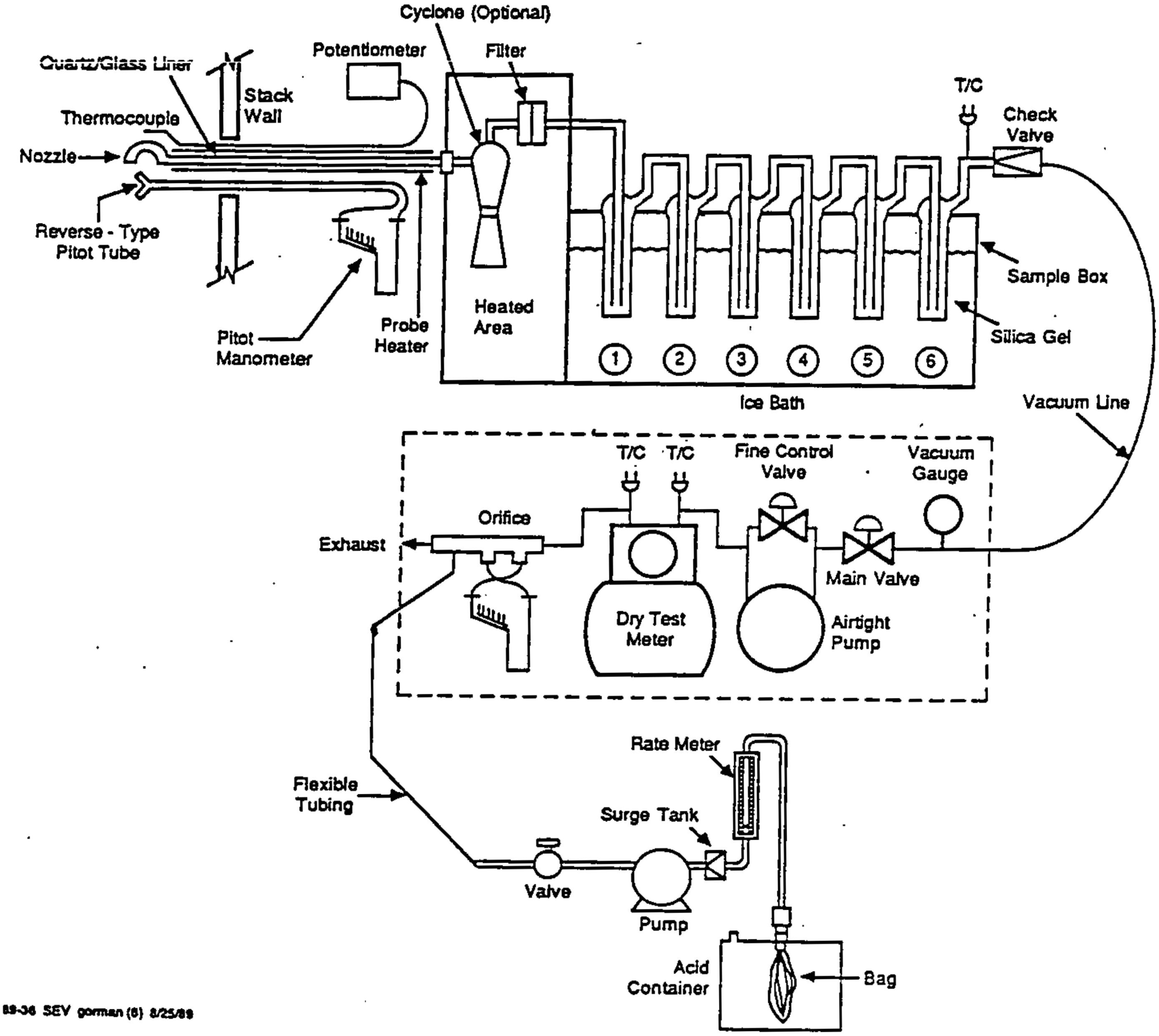


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Figure A1-5. MM3 sampling train (using a Method 5 train as primary sampling device).

All bags were leak-checked in the laboratory prior to being shipped to the field. The sampling train was leak-checked before and after each run as required in Method 3.

1.6 Continuous Emission Monitoring

Samples were collected at each exhaust duct to measure CO, CO_2, O_2, and hot and cold THC.

1.6.1 THC Measurement--

THC emissions were measured using EPA Modified Method 25A (MM25A) sampling systems, equipped with FIDs. This THC measurement was compared to an organic mass measurement (subsequently discussed).

Heated and unheated THC emission concentrations were measured using the MM25A systems. This method essentially measures hydrocarbons expressed in terms of propane.

To measure heated THC concentrations, the following changes were made to the Method 25A system:

- The entire sample system from probe to detector was heated to > 300°F (150°C).
- A Beckman 402 THC analyzer or equivalent was used.
- Propane was used as the calibration gas.
- EPA protocol 1 cylinder standards of 5, 20, and 100 ppm propane in nitrogen were used.

In measuring unheated THC concentrations, the following changes were made to the Method 25A system:

- An ice-cooled water knockout trap was used to remove condensables.
- An unheated Teflon sample line was used to conduct the sample through a stainless steel pump to the FID.
- Propane was used as the calibration gas.
- EPA protocol 1 cylinder standards of 5, 20, and 100 ppm propane in nitrogen were used.

Figure A1-6 illustrates the general configuration of the THC gas sampling system. At each sample point (i.e., exhaust duct), combustion gas was sampled using a probe with a sintered metal filter. Immediately after extraction, the gas sample was split into "heated" and "unheated" sample fractions. The heated sample fraction was transferred to a hot THC analyzer via a heated sample line. The sample line, along with in-line tees and valves, was maintained at over 300°F (150°C). Pumps were used to maintain constant purging of all sampling lines.

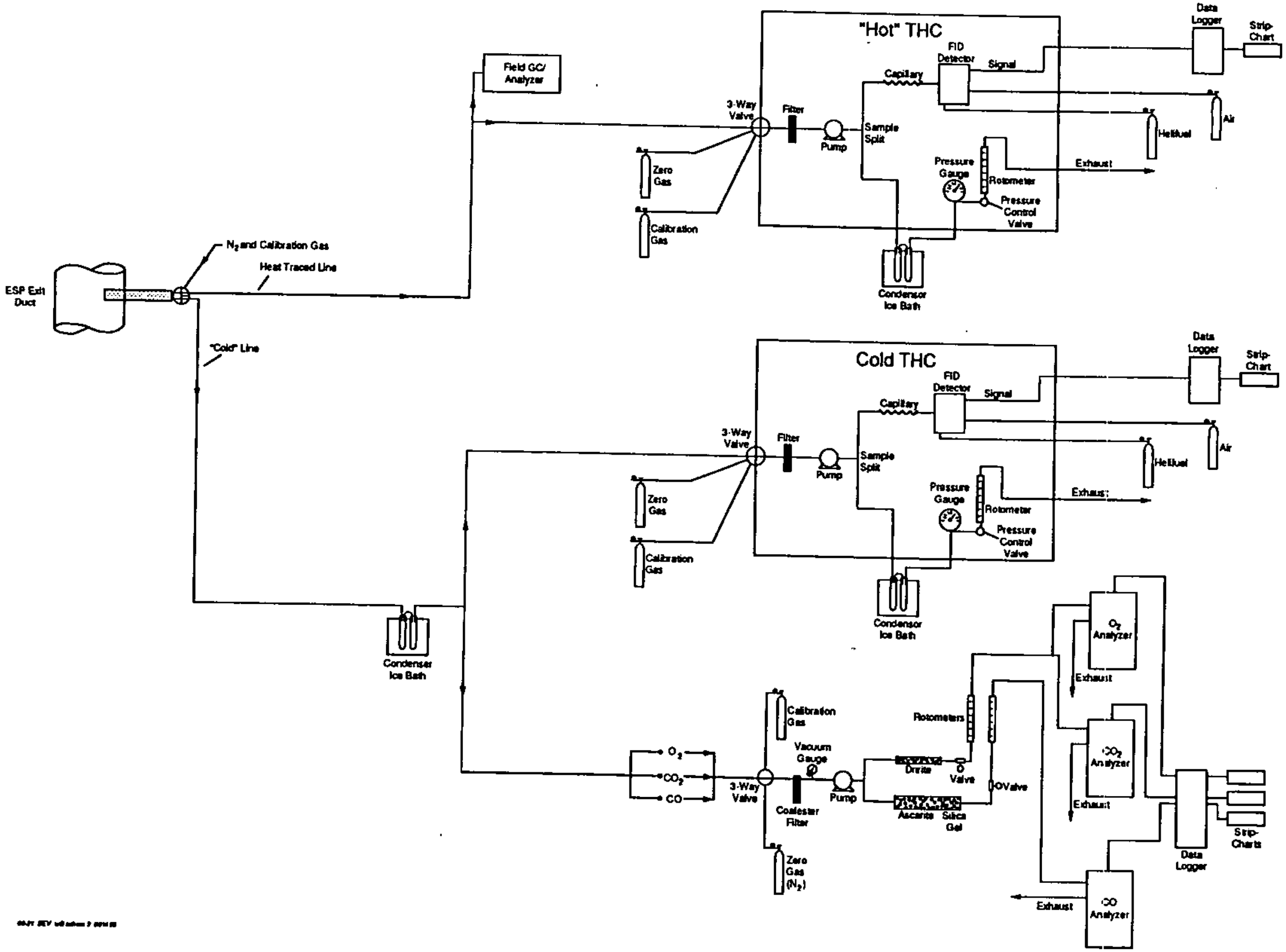


Figure A1-6. THC and CEM equipment layout associated with each exit duct.

The unheated sample fraction was passed through a condensate trap (i.e., a modified GBS impinger placed in an ice bath) which was located adjacent to the sample port. Using a Teflon sample line, the sample was then transferred to the cold FID, carbon monoxide, carbon dioxide, and oxygen analyzers.

During the test the condensate trap was operated at "contact" and "noncontact" conditions. Contact conditions were characterized by the sample gas bubbling through collected condensate. Noncontact conditions were achieved early in the day's test and were characterized by the sample gas passing through the condensate trap without contact with collected condensate.

The THC monitors included a Beckman 400 series model and a comparable MRI in-house designed model. A data logger was used to record all necessary information. The monitors were spanned and zeroed prior to and immediately following each run with 99.26 ppm propane, NBS-traceable EPA protocol 1 gas, and prepurified nitrogen. A linearity check was conducted in the field prior to initiating the first test run using 49.09 ppm propane and 20.35 ppm propane NBS-traceable EPA protocol 1 gases. Monitor response times also were checked (90% of full scale).

To determine the potential for organics to leach out of sample lines, a nitrogen blank sample was analyzed at the conclusion of each test run. Figure A1-6 illustrates the location of the nitrogen blank sampling line associated with each duct. As illustrated in the figure, nitrogen was introduced at the CEM/THC sample probe where it was immediately split into heated and unheated sample fragments. The split nitrogen blank was then transferred via the heated and unheated sample lines to the field GC, the hot and cold THC analyzer, and the CEM systems.

After each run, ambient air was collected and analyzed for hot and cold THC concentrations. These data offer information on potential THC bias because of ambient conditions.

1.6.2 Carbon Monoxide, Carbon Dioxide, and Oxygen Measurement--

Figure A1-6 (previously offered) ilustrates the schematic layout of the CEM system. As illustrated, CEM samples were split from the cold THC MM25A sample line. In the MM25A system, immediately after extraction, the gas sample was passed through a condensate trap. The sample was then transferred via TFE Teflon sample line and split for CO_2, O_2, CO, and cold THC analysis. CO_2 was independently monitored and used to volume-correct the CO reading to account for the CO_2 removed. A Horiba Model PIR-2000S nondispersive infrared (NDIR) analyzer was used to measure CO_2. O_2 was also independently monitored and used to correct the CO reading to 7% oxygen concentrations. A Horiba PMA-200 paramagnetic sensor and a Teledyne Model 320AX polarographic sensor were used to measure O_2. Each manifold maintained constant purge of the two cold TFE sample lines.

Total CO concentration was determined using Horiba Model PIR-2000L NDIRs. After a CO sample was split from the cold THC MM25A sample line, it was passed through an ascarite/silica gel cartridge containing approximately 200 g of ascarite and 20 g of silica gel. The ascarite trap removes carbon dioxide, which is an interference to the CO monitor, and the silica gel removes the last traces of moisture prior to the monitor. The sample fraction is then pumped to the NDIR analyzer.

Zero drift is determined by checking the zero calibration before and after each run and comparing the two. Calibration drift is determined by checking the span gas calibration before and after a given period of time (usually the same time as the zero drift is done). The response time is determined by adding a calibration gas while the instrument is at the zero calibration in the end of the probe and determining the length of time for the instrument to reach 90% of the corresponding span value. The calibration error (usually referred to as the linearity check) is done by zeroing and spanning the instrument and then adding a midlevel calibration gas and comparing the instrument value with the real gas value. Zero and calibration drift must be less than ±3% of the span value, while the calibration error must be less than ±5% of the calibration gas value.

The performance checks for the analyzers are summarized below:

Zero drift: 3% of span
Span drift: 3% of span
Linearity checks: 5% of cylinder gas value
Leak checks: < 4% of normal flow, before and after each run
Nominal gas concentrations:

	Linearity
THC--span 100 ppm propane	50, 20 ppm
CO--800 ppm	400, 200 ppm
CO_2--14%	7%
O_2--14%	7%

2.0 RAW MEAL SAMPLING

The raw feed (e.g., crushed limestone, clay, etc.) was sampled once every 30 min during each test run. These grab samples were composited into a single sample for each run for TOC analysis. A metal trier was used for the collection of the raw feed samples.

Sample containers for raw feed (e.g., crushed limestone, clay, ore, etc.) samples were prepared in the laboratory prior to the test. All bottles used for samples were made of polyethylene or glass. The sample bottles were cleaned as follows, prior to shipment to the field:

- Rinse copiously with tap water.
- Soak in hot, Alconox-soapy water.
- Rinse with hot water.
- Rinse with distilled water.
- Rinse with reagent-grade methanol.
- Rinse with methanol/methylene chloride.
- Rinse with toluene.

- Let dry, cap, and place in storage container.

3.0 ELECTROSTATIC PRECIPITATOR DUST SAMPLING

Dust discharged form the main and bypass electrostatic precipitators (ESPs) was sampled at the end of each run. These samples were archived for future analysis, if necessary.

APPENDIX A-2

SAMPLE HANDLING AND ANALYSIS

APPENDIX A-2

SAMPLE HANDLING AND ANALYSIS

The following sections briefly describe the procedures employed during the analysis of the samples collected during this project. These procedures cover the analysis of all emission (exhaust) samples and raw meal feed samples.

1.0 METHOD 0010 SAMPLES

The following sections summarize the procedures utilized in analyzing Method 0010 samples for estimates of semivolatile compounds, quantitation of dioxins and furans, and gravimetric analysis to combine with GC/FID data for total organic mass.

1.1 Sample Handling

All samples were sealed, labeled, and stored in insulated containers in the field and during transport. All samples that were to undergo organic analysis were stored on ice in the field and during transport. Upon receipt in the laboratory the samples were removed from the insulated containers and were placed in cold storage (< 4°C). Each of the samples included the following fractions:

1. Filter
2. Sorbent trap
3. Front-half organic rinse
4. Back-half organic rinse
5. Condensate (first and second impinger contents and rinse)

1.2 Sample Analysis

Figure A2-1 presents a schematic of the analytical scheme of the samples for semivolatiles, PCDDs/PCDFs, and gravimetric analyses. Prior to extraction, each component was spiked with method internal standards (surrogates). The PCDD/PCDF surrogates are listed in Table A2-1. The semivolatile surrogates included D4-2-chlorophenol and D10-pyrene.

Each train component was triple-extracted using methylene chloride, methyl *t*-butyl ether, and toluene. The solvent fractions generated through the extraction and concentration process were then ultimately combined, concentrated to a 10-mL final volume, and split into analytical aliquots.

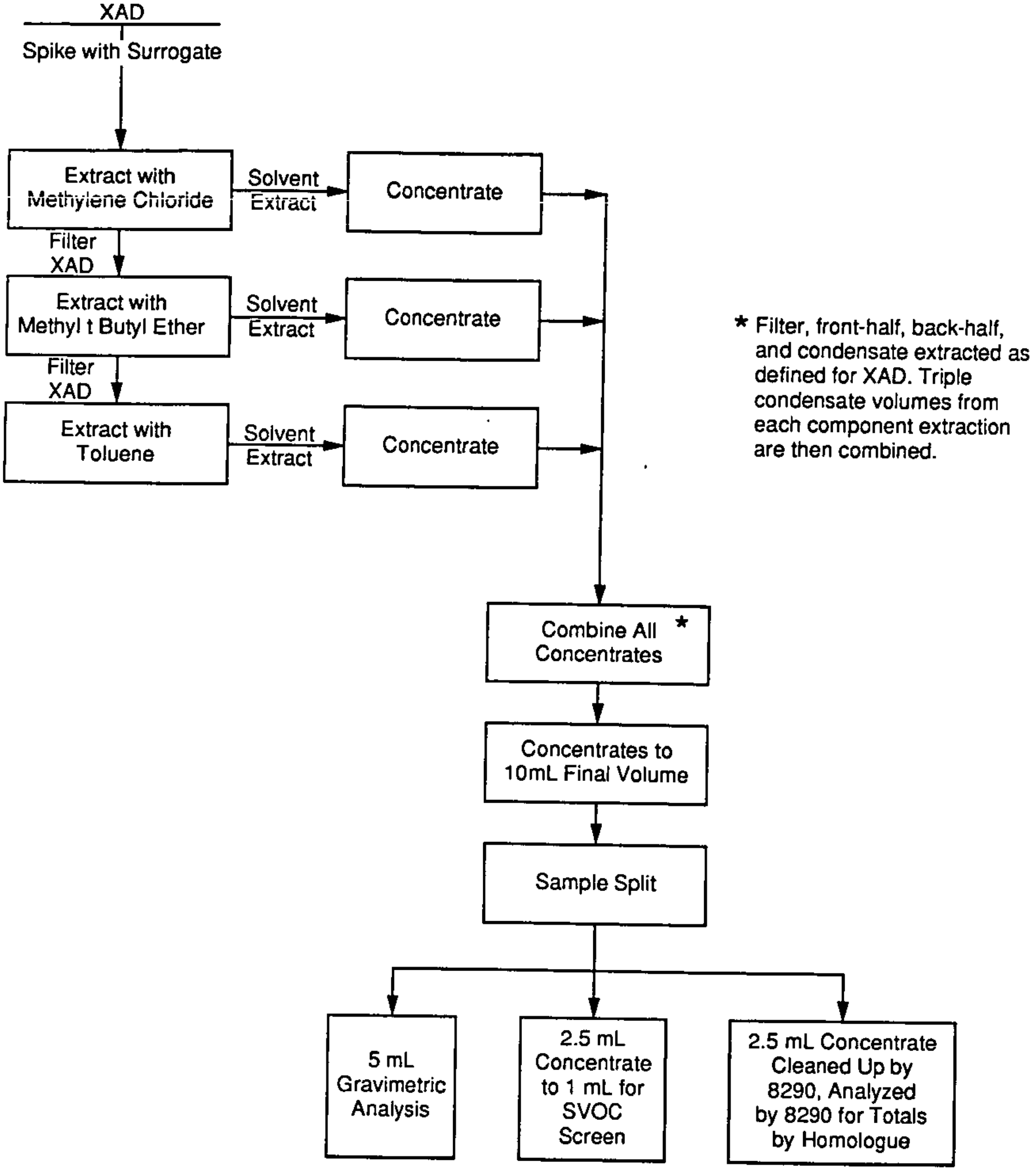


Figure A2-1. Sample analysis flow.

TABLE A2-1. LIST OF ANALYTES, STANDARDS, AND SURROGATES FOR DIOXIN/FURAN ANALYSES

Analyte	Compounds in calibration standard	Surrogate[a] (method internal standard)	GC/MS internal standards[b]
Tetra-CDD	2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD
Tetra-CDF	2,3,7,8-TCDF	$^{13}C_{12}$-2,3,7,8-TCDF	
Penta-CDD	1,2,3,7,8-PCDD		
Penta-CDF	1,2,3,7,8-PCDF	$^{13}C_{12}$-1,2,3,7,8-PCDD	
	2,3,4,7,8-PCDF	$^{13}C_{12}$-1,2,3,7,8-PCDF	
Hexa-CDD	1,2,3,4,8,9-HxCDD		
	1,2,3,4,7,8-HxCDD		
	1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
Hexa-CDF	1,2,3,7,8,9-HxCDF	$^{13}C_{12}$-1,2,3,5,7,8-HxCDF	
	2,3,4,6,7,8-HxCDF		
	1,2,3,6,7,8-HxCDF		
	1,2,3,4,7,8-HxCDF		
Hepta-CDD	1,2,3,4,6,7,8-HpCDD		
Hepta-CDF	1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	
	1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	
OCDD	Octa-CDD	$^{13}C_{12}$-OCDD	
OCDF	Octa-CDF		

[a] Added to sample prior to extraction and used for quantitation of dioxins/furans in sample.

[b] Added to extract at time of injection into GC/MS.

TABLE A2-2. COMPOUNDS MONITORED DURING GC/MS SCREEN FOR SEMI-VOLATILE ORGANICS ANALYSIS

1. *N*-Nitroso-dimethyl aniline
2 α-Picoline
3. Styrene
4. Bis(2-chlorophenol)ether
5. Phenol
6. 2-Chlorophenol
7. *N*-Decane
8. *N*-Nitroso-DI-*N*-propylamine
9. 1,3-Dichlorobenzene
10. 1,4-Dichlorobenzene
11. *P*-Cymene
12. 1,2-Dichlorobenzene
13. Bis(2-chloroisopropyl)ether
14. Hexachloroethane
15. Nitrobenzene
16. Isophrone
17. 2-Nitrophenol
18. 2,4-Dimethyl phenol
19. Bis(2-chloroethoxy)methane
20. 2,4-Dichlorophenol
21. 1,2,4-Trichlorobenzene
22. Naphthalene
23. α-Terpineol
24. *N*-Dodecane
25. 1,2,3-Trichlorobenzene
26. Hexachloro-1,3-butadiene
27. 4-Chloro-3-methyl phenol
28. Hexachlorocyclopentadiene
29. 2,4,6-Trichlorophenol
30. 2,4,5-Trichlorophenol
31. 2-Chloronaphthalene
32. Diphenyl
33. Diphenyl ether
34. 2,6-Dinitrotoluene
35. Dimethyl phthalate
36. Acenaphthylene
37. Acenaphthene
38. 2,4-Dinitrophenol
39. Dibenzofuran
40. 4-Nitrophenol
41. 2,4-Dinitrotoluene
42. 2-Naphthylamine
43. *N*-Hexadecane
44. Fluorene
45. 4-Chlorophenyl-phenyl ether
46. Diethyl phthalate
47. 4,6-Dinitro-2-methyl phenol
48. Diphenylamine
49. 1,2-Diphenylhydrazine
50. *N*-Nitroso-diphenylamine
51. 4-Bromophenyl-phenyl ether
52. Hexachlorobenzene
53. Dibenzothiophene
54. Pentachlorophenol
55. Phenanthrene
56. Anthracene
57. Carbazole
58. Di-*N*-butyl phthalate
59. *N*-Eicosane
60. Fluoranthene
61. Benzidine
62. Pyrene
63. Benzyl butyl phthalate
64. Tetracosane
65. Chrysene
66. 3,3'-Dichlorobenzidine
67. Benz[*a*]anthracene
68. Bis(2-ethylhexyl)phthalate
69. Di-*N*-octyl phthalate
70. Benzo[*b*]fluoranthene
71. Benzo[*k*]fluoranthene
72. Benzo[*a*]pyrene
73. Triacontane
74. Dibenz[*a,h*]anthracene
75. Benzo[*g,h,i*]perylene
76. Tetradecane
77. Octadecane
78. Docosane
79. Hexacosane
80. Octacosane
81. Indeno[1,2,3,-*c,d*]pyrene
82. 2,3,6-Trichlorophenol

The Method 0010 samples from test runs 1, 3, and 4 were split for semivolatile organics analysis, PCDD/PCDF determination, and gravimetric analysis. Samples from the blank train and test runs 2 and 5 were split for semivolatile organics analysis and gravimetric analysis.

A 2.5-mL to 5.0-mL aliquot was separated for the semivolatile organic screen. A 2.5-mL aliquot was separated for PCDD/PCDF determination, and a 5.0-mL aliquot was separated for gravimetric analysis. Detailed Standard Operating Procedures are included in Appendix A-4.

1.2.1 Sample Preparation and Analysis for Semivolatile Organics--

The semivolatile (SV) extraction procedures for rinses and condensates were adopted from SW-846, Methods 0010 and 3510 (separatory funnel extraction). The SV extraction procedures for the XAD and filter components were adopted from SW-846, Methods 0010 and 3540 (Soxhlet extraction). The extracts did not undergo column cleanup, because an organic screen was required.

SV analysis was conducted following SW-846, Method 8270, guidelines. This method is a capillary column full-scan GC/MS method applicable to a variety of semivolatile compounds. Table A2-1 lists the compounds screened in the SV analysis. Calibration checks were completed by daily standard verification (±30%). Quantification was accomplished by the internal standard method, using a relative response factor of 1.0.

1.2.2 Sample Preparation and Analysis for PCDD/PCDFs--

The final 2.5-mL aliquot for PCDD/PCDF analysis was solvent-exchanged to hexane and cleaned up according to SW-846 Method 8280 and analyzed for tetra through octa PCDD and PCDF congener groups. Samples were analyzed by high resolution gas chromatography mass spectrometry (HRGC/MS), using Draft ASME method 8290, "Analytical Procedures to Assay Stack Effluent Samples and Residual Combustion Products for Polychlorinated Dibenzo-*p*-dioxins (PCDD) and Polychlorinated Dibenzofurans (PCDF)." A 60-m x 0.25-mm DB-5 fused silica capillary column (FSCC) was utilized.

The levels of dioxins and furans were calculated by comparison of the response samples to calibration standards (listed in Table A2-1). Isomer-specific quantitation was not completed; total concentrations of each congener group were determined. Congeners were tabulated (by comparison to the appropriate response factor determined from the calibration curve. Table A2-1 lists the analytes, standard compounds, and surrogates used in PCDD/PCDF analysis.

1.2.3 Sample Preparation for Gravimetric Analysis--

Semivolatile and nonvolatile sample extraction were performed following the procedure given in "POHCs and PICs Screening Protocol" (Southern Research Institute), Section III.C. As mentioned in Section 5.1, all solvent rinses, filter, and XAD were combined and extracted with methylene chloride, again with methyl *t*-butyl ether, and a third time with toluene.

The methylene chloride, t-butyl methyl ether, and toluene extracts from the train components were combined and gravimetrically analyzed without deviation in accordance with the procedure in Section III.F. of "POHCs and PICs Screening Protocol." The precision and accuracy of duplicate analyses were based on two criteria:

- Duplicate sample weights were to be within ±20% of the average sample weight.
- The difference between replicate weights were to be < 0.1 mg (the required extent of accuracy).

A sample could fail the first test but still be within the limits of required accuracy; hence a sample was reanalyzed only if it did not pass the second test.

The respective method blank was subtracted from each sample. The remainder was then multiplied by a numerical factor to obtain the total µg per sample. Dividing by the dry standard sample volume allowed for µg/L calculation based on the air sampled. To obtain the ppm propane equivalent, it was assumed that half of the sample molecular weight had no FID response; thus ppm propane was calculated as follows:

(µg of sample/L of air sampled)•(0.5)•(24.1 µL per µmol of gas/44 µ propane per µmol propane)

2.0 METHOD 0030 SAMPLES

Volatile compounds present in stack gases were collected on Tenax and Tenax/charcoal sorbent cartridges using a volatile organic sampling train (VOST). Methods 5040 and 8240 in SW-846, third edition, describe in detail procedural steps required to desorb VOST cartridges and analyze the effluent gas stream for volatile organic compounds. An SOP is also provided in Appendix A-3 that basically follows Methods 5040 and 8240, but only addresses the quantitation of one each POHC, surrogate, and internal standard. The VOST samples were analyzed for the compounds listed in Table A2-3. Identification of target analytes in the VOST samples was performed using the Target Compound Analysis (TCA) procedure. The TCA program uses experimentally determined retention times and response factors to locate and quantitate any target analyte.

The contents of the sorbent cartridges were spiked with an internal standard and thermally desorbed for approximately 10 min at 180°C with organic-free nitrogen or helium gas (at a flow rate of 40 mL/min), bubbled through a tower to impinger water desorbed from the cartridges. Target analytes were trapped on an analytical adsorbent trap. After the 10-min desorption, the analytical adsorbent trap was rapidly heated to 180°C with the carrier gas flow reversed. Volatile organic compounds were desorbed from the analytical trap and vented directly to the gas chromatograph. The VOCs were separated by temperature-programmed gas chromatography and detected by low-resolution mass spectrometry. Concentrations of the POHC were calculated using the internal standard technique. PIC compounds were quantitated using a single-point calibration and by internal standard method using RRFs equal to 1.0.

TABLE A2-3. CEMENT KILN SEMIQUANTITATIVE SCREEN TARGET LIST FOR VOLATILE ORGANICS ANALYSIS

Acetone
Acrolein
Acrylonitrile
Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
2-Chloroethyl-vinyl ether
Chloroform
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
t-1,2-Dichloroethene
1,2-Dichloropropane
t-1,3-Dichloropropene
c-1,3-Dichlorpropene
Diethyl ether
Ethylbenzene
Methylene chloride
Methyl ethyl ketone
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane

3.0 HCl TRAIN SAMPLES

The contents of the condensate impingers from the HCl trains were analyzed for HCl using ion chromatography, ASTM Method D4327-84. Concentrations as low as 0.1 mg/L can be determined.

In the analysis, a filtered aliquot of the sample is injected into an ion chromatograph. The sample is pumped through three different ion exchange columns and into a conductivity detector. The first two columns, a precolumn and separator column, are packed with a low-capacity anion exchanger. Ions are separated based on their affinity for the exchange sites of the resin. The last column is a suppressor column that contains cation exchange resin in the hydrogen form. The suppressor column reduces the background conductivity of the eluent to a low or negligible level and converts the anions in the sample to their corresponding acids. The separated anions in their acid form are measured using an electrical-conductivity cell. Anions are identified based on their retention times compared to known standards. Quantitation is accomplished by measuring the peak height or area and comparing it to a calibration curve generated from known standards.

The HCl samples were also analyzed for potassium using inductively coupled plasma-atomic emissions spectrometry (ICP-AES). The samples were analyzed for ammonium using gas chromatograph/mass spectrometry-selective ion measurement (GC/MS-SIM).

4.0 RAW MATERIALS FEED SAMPLE HANDLING

Raw materials feed samples were analyzed for total organic carbon (TOC) by Galbraith Laboratories of Knoxville, Tennessee.

Samples were analyzed using Galbraith Procedure Nos. ME-7 and ME-6 for carbon, hydrogen, and nitrogen analysis. Galbraith Procedure No. E6-5 was utilized for the coulometric determination of inorganic carbon.

APPENDIX A-3

PROCEDURES FOR VOLATILE ORGANIC ANALYSIS

The analytical procedures used by MRI for volatile organic analysis are based on EPA SW-846 Method 5040, "Protocol for Analysis of Sorbent Cartridges from Volatile Organic Sampling Train" and Method 8240, "Gas Chromatography/Mass Spectrometry for Volatile Organics." Any deviations from these SW-846 methods normally used by MRI are noted in the procedures.

1.0 GLASSWARE PREPARATION

1.1 FIELD SAMPLING

1.1.1 All containers for field sampling are glass and have Teflon-lined caps or Teflon-lined septa. Samples for volatile organic analysis (VOA) are protected from light as much as possible to avoid degradation of halogenated compounds. Amber bottles are useful for this purpose. If amber bottles are not used, the sample bottle can be wrapped with foil or stored in a container to protect from light.

1.1.2 When possible, 40-mL screw cap septum vials (VOA vials) that have been manufacturer precleaned according to EPA protocol are used for the collection of water and waste samples. However, these vials are currently available in clear glass only. If contract specifications require amber VOA vials, these must be prepared according to the procedure in Section 1.2.

1.1.3 Other containers may be required for VOA sampling and these will be specified by the field programs crew chief prior to each burn. If other containers are required, they are also be prepared according to the procedure in Section 1.2.

1.1.4 Water field blanks are prepared for each field sampling trip by adding VOA water (see Section 2.1 for prep of VOA water) to clean VOA vials and sending them to the field with the other containers. These field blanks demonstrate that no contamination of samples has occurred due to ambient conditions at the site or during shipment.

1.2 GLASSWARE CLEANING

1.2.1 Preparation of glassware to be used in the collection or preparation of samples for volatile organic analysis (VOA) is performed in a laboratory free from organic solvents other than methanol.

1.2.2 All glassware (amber VOA vials, sampling bottles, compositing bottles, volumetric flasks, etc.) is prepared according to the following procedure:

1.2.2.1 Wash in hot soapy water using Micro (or equivalent) and a clean brush.

1.2.2.2 Rinse thoroughly in tap water (3 x), deionized water (3 x), and distilled-in-glass methanol (B&J or equivalent).

1.2.2.3 Any glassware that does not appear to be clean, i.e., does not "sheet" when rinsed with water or methanol, is cleaned by soaking in concentrated sulfuric acid, then rinsed as in Section 1.2.2.2.

1.2.2.4 Allow the glassware to air dry and then place in a clean glassware drying oven at ~ 110°C for at least 1 h.

1.2.2.5 After removing bottles from the oven, allow to cool to room temperature, then cap with Teflon lined lids. If glassware is not used immediately, cover the open ends with methanol rinsed aluminum foil and store.

1.2.3 Rinse Teflon liners and Teflon-lined septum thoroughly with distilled-in-glass methanol. Allow to either air dry or bake at ~ 110°C for no longer than 1 h.

1.2.4 New reactivials and 2-dram screw cap vials are rinsed with methanol and baked at ~110°C for at least 1 h. After removing from the oven, they are allowed to cool and then capped with Teflon lined lids.

1.2.5 Syringes should be thoroughly cleaned with methanol. This is done as soon as possible after use to avoid contamination of the syringe. Syringes are not routinely baked because high temperatures will weaken the adhesive used to affix the needle to the barrel.

2.0 REAGENTS

2.1 REAGENT WATER (VOA WATER)

2.1.1 Reagent water is defined as a water in which compounds that interfere with the analytes are not observed at the method detection limit.

2.1.2 Reagent water is prepared by pouring Milli-Q (or equivalent) through a carbon bed into a chromatography column. The column is maintained at a temperature of approximately 50°C with a gentle flow of prepurified nitrogen. Other methods of generating reagent water can be found in SW-846 method 8240 "GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS."

2.1.3 Reagent water is used to prepare matrix spikes, field blanks, and system blanks for the GC/MS system.

2.2 METHANOL

2.2.1 Only distilled-in-glass (pesticide quality, B&J or equivalent) methanol is used for glassware prep, preparation of standards, and preparation of samples.

2.2.2 Store methanol in an area not contaminated by solvent vapors.

2.2.3 Bulk methanol may be used for decontamination of bottles and vials prior to disposal and decontamination of glassware prior to cleaning for re-use.

2.3 TENAX AND TENAX/CHARCOAL TRAPS

2.3.1 VOST traps of tenax and tenax/charcoal are prepared by field sampling personnel. Details on preparation of traps are available in the appropriate field sampling standard operating procedures (SOP) documents.

2.4 SCREENING AND BLANKS

2.4.1 To ensure that no contaminants are present in the reagents, blanks of each matrix type are analyzed by the appropriate GC/MS method.

3.0 SAMPLE TRACEABILITY AND CHAIN-OF-CUSTODY

3.1 SAMPLE TRACEABILITY

3.1.1 Each sample taken in the field is given a unique number by field personnel. In the case of Volatile Organic Sampling Train (VOST) samples and gas bags, this number is carried throughout field sampling and analysis. Water and waste samples are also given a unique number by field personnel. However, these samples are composited in the laboratory prior to analysis. Afterwards, the sample composite is given a new number by laboratory personnel. A record of sample composition and their new numbers are recorded in the appropriate laboratory notebook.

3.1.2 A record of who was responsible for each sample and where the sample was during the sampling and analysis procedures is kept using the forms in Figures A2-1 and A2-2.

3.1.2.1 Figure A2-1 is the form used by the field sampling personnel. This form contains sampling information as well as the field sample numbers. This form accompanies the samples from the time they are taken in the field until their receipt by analytical personnel.

3.1.2.2 Figure A2-2 is the form used by analytical personnel. This form is used to transfer samples within the analytical sections or to instrument facilities.

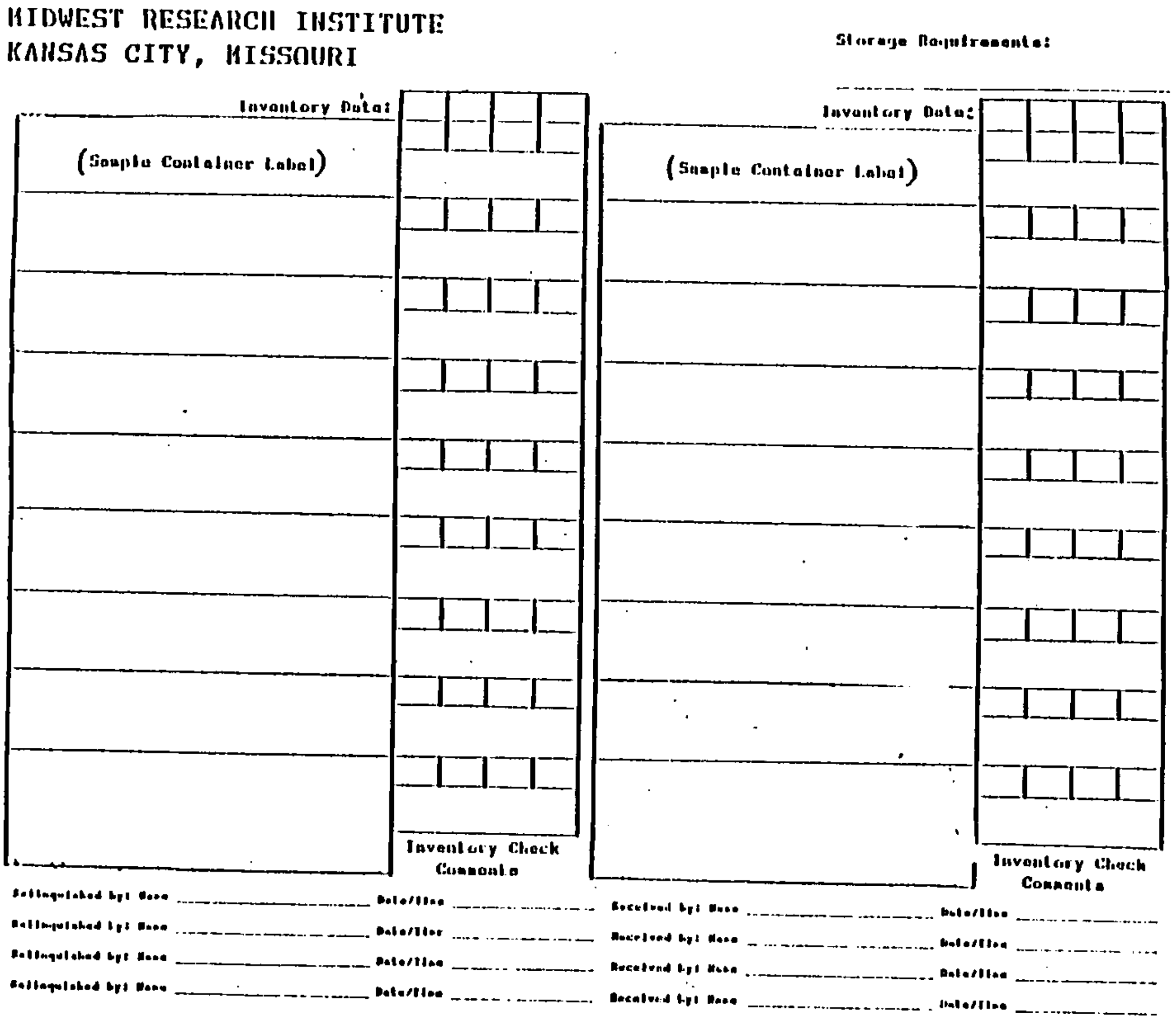
3.2 CHAIN-OF-CUSTODY

3.2.1 In the event a contract requires chain-of-custody, the samples are stored in a locked cold room which has restricted access. During the sample preparation or analysis, the samples must be within the sight of the person who has custody, in a locked container, or in a container sealed with evidence tape which has been appropriately signed and dated.

3.2.2 The forms in Figures A2-1 and A2-2 are appropriate for chain-of-custody so long as this is noted on the form.

4.0 SAMPLE RECEIPT

4.1 Volatile samples are usually shipped daily from the field site. These can be shipped by an overnight delivery service such as Federal Express or by airport counter-to-counter service. The samples are shipped with sufficient quantities of wet ice or "blue ice" to keep the samples cool. Dry ice is not recommended for water samples due to freezing of the samples which will, in turn, break the vials.


MIDWEST RESEARCH INSTITUTE
KANSAS CITY, MISSOURI

Storage Requirements: ____________

Inventory Date:

(Sample Container Label)

Inventory Check Comments

Inventory Date:

(Sample Container Label)

Inventory Check Comments

Relinquished by: Name ____________ Date/Time ____________

Relinquished by: Name ____________ Date/Time ____________

Relinquished by: Name ____________ Date/Time ____________

Relinquished by: Name ____________ Date/Time ____________

Received by: Name ____________ Date/Time ____________

Received by: Name ____________ Date/Time ____________

Received by: Name ____________ Date/Time ____________

Received by: Name ____________ Date/Time ____________

Figure A2-1. Sample traceability record.

LABORATORY CHAIN OF CUSTODY OR TRACEABILITY RECORD

① ☐ Chain of Custody Record
② ☐ Traceability Log
③ Project Number ____________
④ Date of Laboratory Check-In ________
⑤ Location ____________
⑥ Type of Samples ________
⑦ Container Type ____________
⑧ Custody Office Storage Location ____

⑨ Laboratory Sample No.	⑩ Field Sample No.	⑪ Sample Description	⑫ Amount of Sample Removed (give date)	⑬ Comments

Laboratory/Area	⑭ Relinquished by: (signature)	⑮ Date/Time	⑯ Received by: (signature)	⑰ Date/Time
Custody Office				
Sample Preparation				
Metals				
GC/MS				
Other (Identify)				

⑱ Notebook Reference Pages ☐
⑲ Notebook No. ☐
⑳ Analyst Comments ____________________

Figure A2-2

4.2 Once the samples arrive, they are inventoried and examined for breakage as soon as possible. In the event the samples cannot be inspected right away, they are stored in a cold room in the shipping container until such time as the inspection can be accomplished.

4.3 The inventory of the samples is performed in a volatile free laboratory and includes the following items:

4.3.1 The temperature of the shipping container is observed. The samples should still feel cool. If they are found to be above room temperature, this is noted either on the traceability sheet or in the appropriate laboratory notebook.

4.3.2 The samples are inventoried against the enclosed traceability sheets. If no traceability sheets accompany the samples, then the inventory is recorded in the appropriate laboratory notebook. During the inventory, the condition of the samples is noted as well as the labeling information. The label should be legible and contain the sample number as well as sample collection information.

4.3.3 After inventory, the samples are stored in a cold room to maintain sample integrity.

5.0 PREPARATION OF CALIBRATION STANDARDS, SPIKING SOLUTIONS, MATRIX SPIKES, AND MATRIX BLANKS

5.1 PRIMARY STANDARD SOLUTIONS

5.1.1 Standards may be prepared from the purest available standard materials or purchased as certified solutions.

5.1.2 The name, manufacturer, lot number, and purity of each compound used to prepare primary stock solutions is recorded in the appropriate laboratory notebook.

5.1.3 The following gravimetric method of standard preparation is used to prepare primary standard solutions:

5.1.3.1 With an analytical balance accurate to 0.0001 g, obtain initial and final weights.

5.1.3.2 Calibrate the balance using class "S" weights if available. This calibration should bracket the expected working range of the standards. Record the calibration in the appropriate laboratory notebook.

5.1.3.3 Place about 9.0 mL methanol in a clean 10.0 mL class "A" volumetric flask. Allow the flask to stand until all methanol wetted surfaces have dried. Stopper the flask and obtain an initial weight.

5.1.3.4 LIQUIDS: Determine the target concentration for the stock solution and use the density of the chemical to determine an approximate volume to add to the flask. Add the appropriate amount of the standard material to the flask using a syringe. The liquid must fall directly onto the surface of the methanol without touching the neck of the flask. Also, care should be taken to not touch the surface of the methanol with the end of the syringe as this would change the initial weight of the methanol and the flask. The flask is immediately restoppered.

5.1.3.5 GASES: To prepare standards for any compounds that boil below 30°C (e.g. bromomethane, chloroethane, chloromethane, and vinyl chloride), fill a 5.0 mL valved gas-tight syringe with the reference standard to the 5.0 mL mark. Lower the needle to 5 mm above the methanol meniscus. Slowly introduce the reference standard above the surface of the liquid. The heavy gas will rapidly dissolve in the methanol. Standards may also be prepared by using a lecture bottle equipped with a Hamilton Lecture Bottle Septum (#86600). Attach Teflon tubing to the side-arm relief valve and direct a gentle stream of gas into the methanol meniscus. Immediately restopper the flask.

5.1.3.6 Obtain a final weight on the flask. Dilute to volume, stopper, and mix by inverting the flask several times. Calculate the concentration in mg/mL from the net gain in weight. Unless the compound purity is stated to be 99+%, then the concentration must be corrected for compound purity.

5.1.4 The primary stock solution is transferred to a clean (see Section 1.2.4) 2-dram vial, capped with a Teflon lined lid, and sealed with Teflon tape. The vial is filled so that a minimum amount of headspace remains in the top of the vial. The vial is labeled with the name of the compound, concentration, solvent, date prepared, initials of person preparing, and the notebook reference for preparation. Store the vial at -10° to -20°C and protect from light.

5.1.5 Prepare fresh standards every two months for gases. Reactive compounds such as 2-chloroethyl vinyl ether may need to be prepared more frequently. All other standards must be replaced after six months, or sooner if comparison with check standards indicates a problem.

5.2 INTERMEDIATE DILUTION STANDARDS

5.2.1 Using primary stock solutions, prepare intermediate dilution standards in methanol either singly or as a combined mix.

5.2.2 Use volumetric glassware and syringes for all dilutions.

5.2.3 Allow the primary stock to reach room temperature before preparing the intermediate solution. Check the stock solution for signs of degradation or evaporation. The level of the liquid in the vial is marked after each use, if possible, therefore once the solution has reached room temperature the meniscus should match the mark on the vial. Gently mix the vial by inversion prior to removing an aliquot of the primary stock.

5.2.4 Add a small amount of methanol to the volumetric flask. Then add the appropriate amount of primary stock solution(s). Dilute to volume, stopper, and gently mix by inversion.

5.2.5 Transfer and store intermediate dilutions as described for primary standard solutions (see Section 5.1.4).

5.3 CALIBRATION STANDARDS

5.3.1 Calibration standards containing the POHCs, surrogates, and internal standards at a minimum of three concentration levels are prepared from intermediate or primary stock solutions (Sections 5.1 and 5.2). Prepare these solutions in methanol according to the procedure outlined in Section 5.2 for preparation of intermediate stock solution. Transfer an aliquot to a reactivial with minimum headspace, cap with a mininert valve and label. Transfer and store the remainder as in Section 5.1.4.

5.3.2 One of the concentration levels should be at a concentration near, but above, the method detection limit (usually 10 ng total). The remaining concentration levels should correspond to the expected range of concentrations found in real samples or should not exceed the working range of the GC/MS system. Each standard contains all analytes for detection by this method. In addition, the recovery internal standards (RIS) and surrogates are included in the calibration standard mixes.

5.3.3 The calibration standards are replaced when signs of degradation are evident (typical replacement time is 2 weeks). If the standards fail to pass the established curve or fail to pass the other calibration requirements (see Section 8.5), then the calibrations standards are reprepared.

5.4 SURROGATE AND RECOVERY INTERNAL STANDARD (RIS) SPIKING SOLUTIONS

5.4.1 Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate and should not vary from the expected values by more than ±35%. d8-Toluene, 4-bromofluorobenzene, and d4-1,2-dichloroethane are typically used as surrogate compounds, as recommended by SW-846 method 8240.

5.4.2 Recovery internal standards (RIS) are compounds added to all standards, blanks, and samples which are used to quantitate the analytes. The RIS chosen should be similar in analytical behavior to the compounds of interest. It must be demonstrated that the measurement of the internal standard is unaffected by method or matrix interferences. Bromochloromethane, 1,4-difluorobenzene, and d5-chlorobenzene are recommended by method 8240 as RIS compounds. (Bromochloromethane, however, is sometimes found as a "native" in samples, in which case its value as a surrogate is limited.) Method 5040, "PROTOCOL FOR ANALYSIS OF SORBENT CARTRIDGES FROM VOLATILE ORGANIC SAMPLING TRAIN" requires d6-benzene as a RIS for VOST analysis. Other compounds may be used depending on the analysis requirements. D6-benzene may be used as the RIS for all sample types.

5.4.3 A spiking solution containing each of the RIS and surrogate compounds is prepared in methanol according to the procedure in Section 5.2, INTERMEDIATE STOCK SOLUTIONS. Transfer an aliquot to a reactivial with a mininert valve and continue as in Section 5.1.4. The final concentrations of each surrogate and RIS are approximately 50 ng/µL). Two microliters (2 µL) are used to spike each VOST trap, gas bag sample, water sample, and system blank prior to analysis. This will yield 100 ng total per analysis for each surrogate and RIS. Alternate spiking volumes and concentrations may be used but will still yield approximately 100 ng total per analysis.

5.5 BROMOFLUOROBENZENE (BFB) FOR INSTRUMENT TUNING

5.5.1 A solution of 4-bromofluorobenzene in methanol with a concentration of 50 ng/µL is prepared according to the procedure in Section 5.2. This solution is used to tune the mass spectrometer according to SW-846 method 8240 specifications. (See Section 7.5.2.)

5.6 MATRIX SPIKING STANDARDS

5.6.1 Matrix spiking standards, if applicable, are prepared in methanol from compounds representative of those being investigated. This solution is used to prepare check samples and matrix spikes. No internal standards or surrogates are added to this mix as these are added to these samples during the routine prep of the samples. This solution is prepared according to the procedure outlined in Section 5.2.

5.7 QC CHECK SAMPLES

5.7.1 A QC check sample is analyzed during the initial GC/MS calibration (see Section 7.5.8) to verify the ratio of instrument response to analyte amount. Analysis of this sample also serves to verify the preparation of the calibration standards. This solution is prepared independently of the intermediate stocks used to prepare the calibration standards. The final concentrations of the analytes should fall within the calibration curve. This solution is prepared according to the procedure outlined in Section 5.2. It contains all analytes of specific quantitative interest.

6.0 PREPARATION OF SAMPLES, BLANKS, CHECK SAMPLES, MATRIX SPIKES, AND REPLICATES

6.1 HOLDING TIMES

6.1.1 Unless otherwise specified by the trial burn plan, QA plan, or the project leader, the holding time from date of sampling to date of analysis for VOST samples is 2-6 weeks (see SW-846 method 5040 Section 6.2), and for water samples, the holding time is 10 days.

6.2 VOST AND INTEGRATED GAS BAG SAMPLES (for analysis by purge and trap desorption GC/MS)

6.2.1 VOST traps are glass tubes filled with either Tenax (2,6-diphenylene oxide polymer) only or one half each Tenax and charcoal. The ends of these tube are tightly capped. One trap of each type constitutes a "pair." There are generally three or four sample "pairs" per run. Each trap is analyzed separately. In addition, the field sampling crew prepares a field blank pair for each run and a trip blank pair for each shipment container. The field blank pair is opened briefly in the field. These samples are used to demonstrate that there is no contamination from ambient conditions at the site. The trip blank pair is never opened and accompanies each respective sample batch of samples returning to the laboratory. These samples are to demonstrate that there is no contamination from the shipping process.

6.2.2 The VOST samples need no preparation prior to analysis. These samples are stored in the cold room until analysis and are spiked with a mixed RIS and surrogate solution by the GC/MS analyst immediately prior to analysis. A daily system blank is analyzed (see Section 8.5.3) by spiking a clean trap with the RIS/surrogate solution. This is to ensure the cleanliness of the GC/MS system and also serves as a blank sample for each day's analysis. Each VOST trap is only valid for one analysis, therefore replicate analyses and matrix spikes cannot be performed.

6.2.3 After analysis, the spent VOST traps and gas bags are returned to field programs where they will be recycled.

6.3 WATER AND VOST CONDENSATE SAMPLES (for analysis by purge and trap GC/MS)

6.3.1 Water samples are samples taken of various water streams as specified by the trial burn plan for each project. These are usually called scrubber waters and are usually of two types, inlets and outlets. Occasionally other types of water samples are taken, for example, VOST condensates, but they are prepared in the same manner.

6.3.2 The preparation of the water samples is performed in a volatile free laboratory (VOA lab).

6.3.3 Water samples are sampled at either 15- or 30-min intervals during each field test and are typically composited prior to analysis.

6.3.4 The samples are sorted according to run number and type. Then, all of the VOA vials of each run and type are composited by pouring the contents of the vial into a larger clean compositing bottle. The composite is gently mixed and the composited sample is returned to the original VOA vials filling them in such a manner as to have no headspace in the vials. This is done as quickly as possible to avoid loss of volatile compounds. The vials are labeled as having been composited. Each vial is typically used for only one analysis, with different VOA vial of the composited sample being used for each replicate analysis. The remainder of the vials are stored in the cold room (4°C).

6.3.5 Replicate analyses of samples should be performed at least once every 20 samples. The project QA plan should be consulted for specific requirements.

6.3.6 Laboratory blanks for the water samples are performed using VOA water with the addition of mixed surrogate and RIS spiking solution. This is done on a daily basis and also functions as the "system blank" for the GC/MS system. In addition, the water field blanks (Section 1.1.4) shipped with the samples are analyzed.

6.3.7 Five milliliters (5.0 mL) of each composited sample is analyzed by GC/MS purge and trap. The GC/MS analyst spikes each sample with the mixed RIS and surrogate spiking solution immediately prior to analysis.

7.0 GC/MS ANALYSIS OF WATER SAMPLES BY PURGE AND TRAP

7.1 SUMMARY OF METHOD

7.1.1 Five milliliters (5 mL) of the sample is poured into a glass syringe, spiked with surrogate and RIS, then added to a glass purge tower. An inert gas is bubbled through the solution at ambient temperature and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column. The volatile POHCs are separated by temperature programmed gas chromatography and detected by mass spectrometry. The concentrations of the POHCs are calculated using the internal standard technique.

7.1.2 Refer to SW-846 method 8240 "GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS" for complete details of this analytic method. Any deviations from SW-846 are listed in Section 11.0 of this document.

7.2 PURGE AND TRAP DEVICE

7.2.1 The purge and trap device consists of three separate pieces of equipment: the sample purger, the analytic trap, and the desorber. It is recommended that any surface to come in contact with the samples be constructed entirely of glass and Teflon.

7.2.2 The recommended purging chamber is designed to accept 5-mL samples with a water column at least 3 cm deep. The gaseous headspace between the water column and the trap must have a total volume of less than 15 mL. The purge gas must pass through the water column as finely divided bubbles with a diameter of less than 3 mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. The sample purger, illustrated in Figure A2-3 meets these design criteria. Alternate sample purge devices with 20-25 mL headspace may also be utilized. These have been demonstrated to yield equivalent sample recoveries and are useful for analysis of waste samples dispersed in PEG since line contamination is minimized.

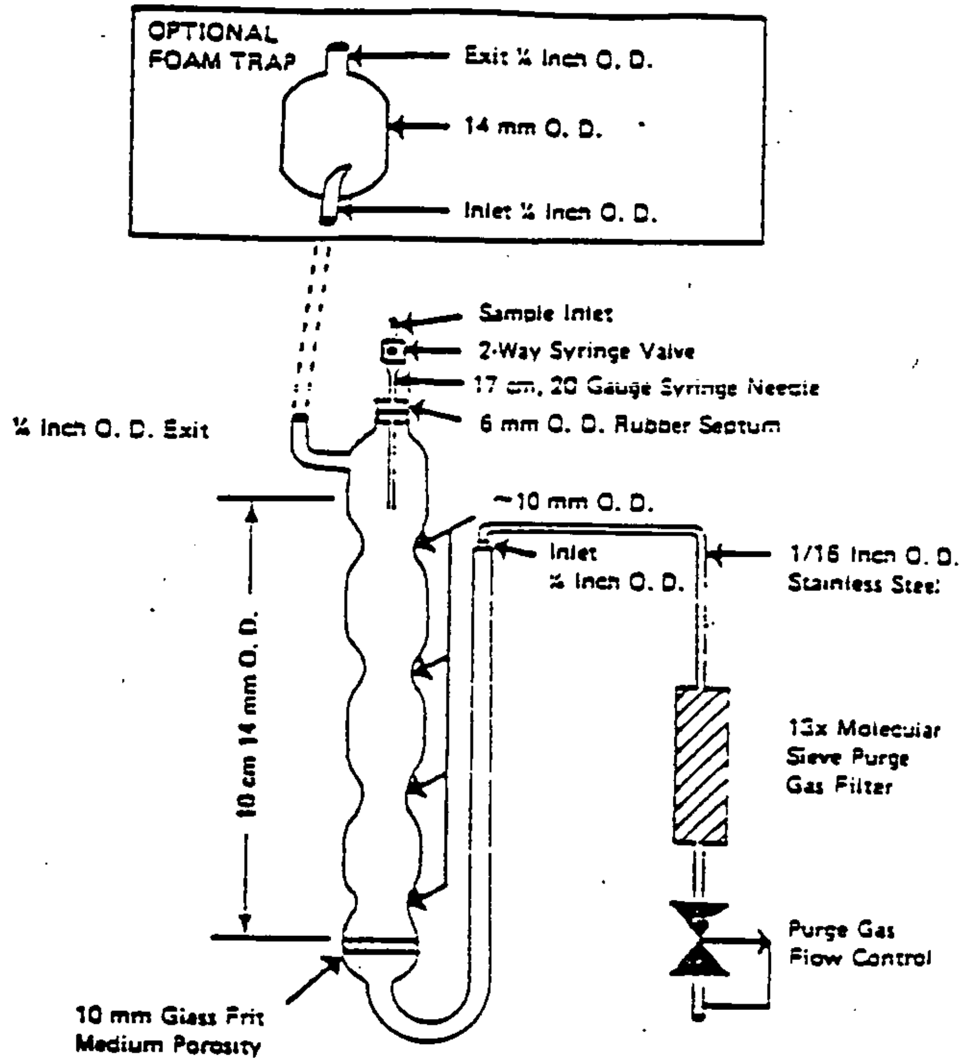


Figure A2-3. Purging chamber.

7.2.3 The trap must be at least 25 cm long and have an inside diameter of at least 0.105 in. Starting from the inlet, the trap is packed with the following: 1.0 cm of methyl silicone coated packing (3% SP2100 on 60/80 Chromosorb WAW or equivalent to prolong the life of the trap); 15 cm 2,6-diphenylene oxide polymer 60/80 mesh chromatographic grade (Tenax GC or equivalent); 8 cm silica gel 35/60 mesh (Davison, grade 15 or equivalent). If analysis for dichlorodifluoromethane or other fluorocarbons of similar volatility is required, then the trap should be packed with equal parts of coconut charcoal, Tenax, and silica gel with 1.0 cm of methyl silicone coated packing at the inlet. The coconut charcoal is prepared from Barnebey Cheney, CA-580-26 lot #M-2649 by crushing through 26 mesh screen. If only compounds boiling above 35°C are to be analyzed, then the trap should be packed with only the methyl silicone packing and Tenax. Before initial use, the trap should be conditioned overnight at 180°C by backflushing with an inert gas flow of at least 20 mL/min. Vent the trap effluent to the room, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 min at 180°C with backflushing. The trap may be vented to the analytical column during daily conditioning, however, the column must be run through the temperature program prior to analysis of samples.

7.2.4 The desorber should be capable of rapidly heating the trap to 180°C for desorption. The polymer section of the trap should not be heated higher than 180°C and the remaining sections should not exceed 220°C during bake-out mode. The desorber design in Figure A2-4 meets these criteria.

7.2.5 The purge-and-trap device may be assembled as a separate unit or may be coupled to a gas chromatograph as shown in Figures A2-5 and A2-6.

7.3 GAS CHROMATOGRAPHY/MASS SPECTROMETRY SYSTEM

7.3.1 GAS CHROMATOGRAPH: An analytical system complete with a temperature programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases.

7.3.2 COLUMN: 6 ft x 0.1 in i.d. glass, packed with 1% SP 1000 on Carbopak-B, 60/80 mesh, or equivalent. In some cases, an 8 ft column with similar packing provides better resolution of coeluting compound such as carbon tetrachloride and 1,1,1-trichloroethane. Alternatively, a 30-m DB-624 megabore capillary column can be used. This column has resolution and retention order comparable to the SP 1000, however, analysis time is shortened. (This column was not commercially available at the time SW-846 was published.)

7.3.3 MASS SPECTROMETER: Capable of scanning from 40-260 amu every 3 s or less, using 70 electron volts (nominal) electron energy in the electron impact mode and producing a mass spectrum that meets all the criteria in Table A3-1 when 100 ng of 4-bromofluorobenzene (BFB) are injected through the gas chromatographic inlet. Typically a MAT CH4, or Finnigan OWA, or Varian 312A is used.

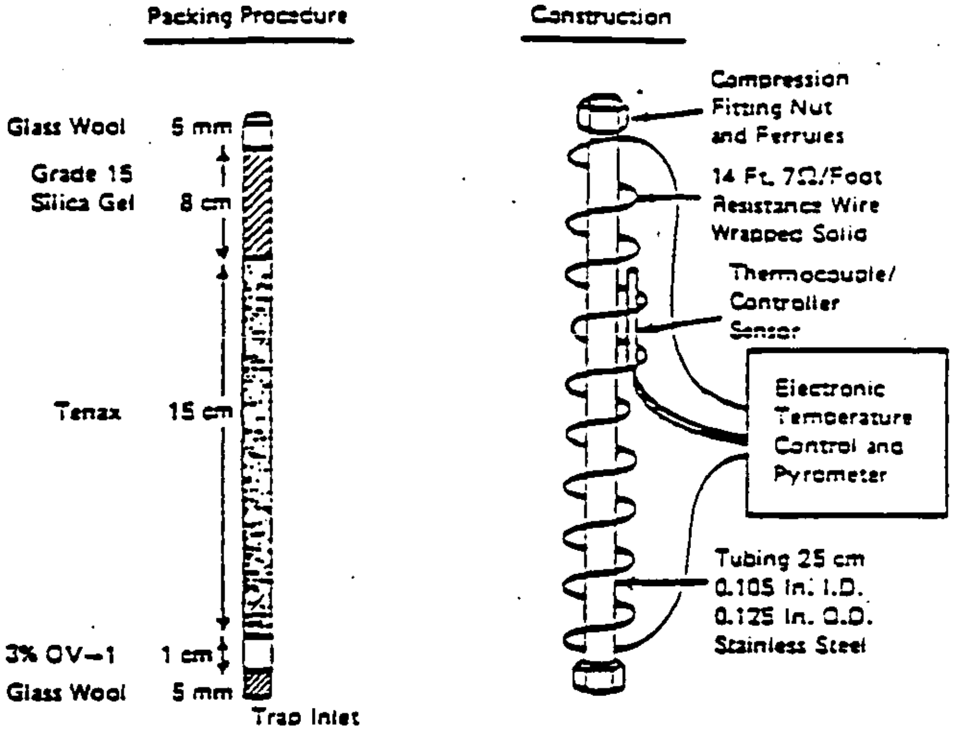


Figure A2-4. Trap packings and construction to include desorb capability.

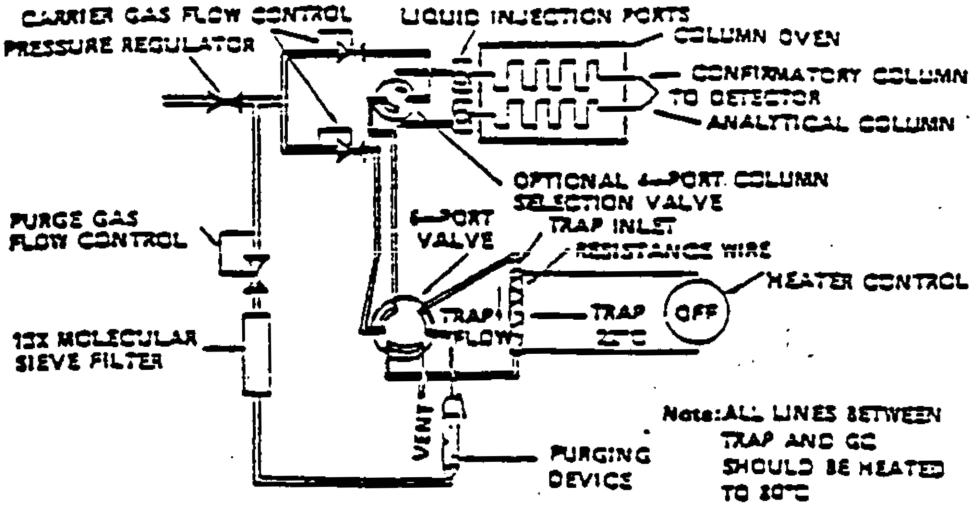


Figure A2-5. Schematic of purge-and-trap device--purge mode.

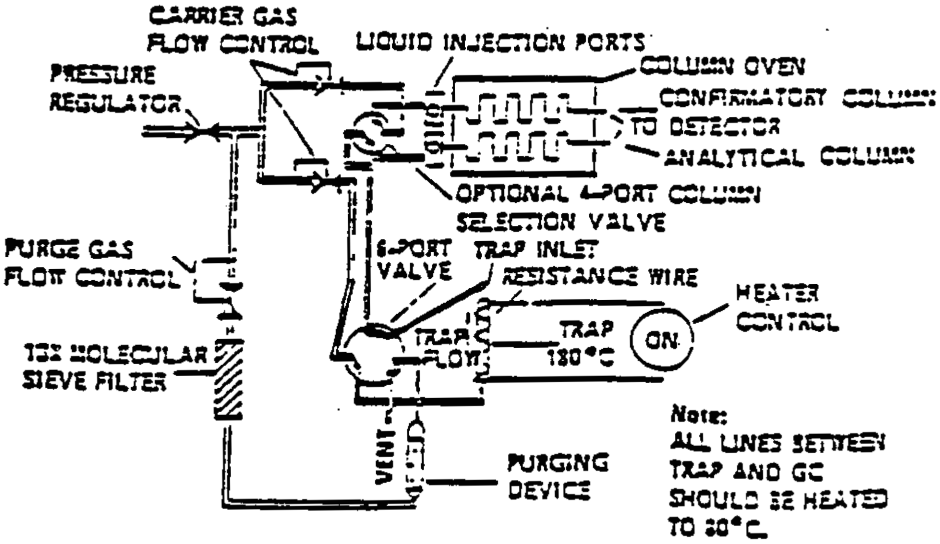


Figure A2-6. Schematic of purge-and-trap device--desorb mode.

7.3.4 GC/MS INTERFACE: Any GC-to-MS interface that gives acceptable performance criteria may be used. GC-to-MS interfaces constructed entirely of glass or of glass-lined materials are recommended. Glass can be deactivated by silanizing with dichlorodimethylsilane.

7.3.5 DATA SYSTEM: A computer system that allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program must be interfaced to the mass spectrometer. The computer must have software that allows searching any GC/MS data file for ions of a specified mass and plotting such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIH Mass Spectral Library should also be available.

7.4 GC/MS OPERATING CONDITIONS

Electron energy:	70 electron volts (nominal)
Mass range:	40-260 (40-280 amu for the MAT CH4 mass spectrometer)
Scan time:	To give 5 scans per peak but not to exceed 7 s/scan.
Initial column temperature:	45°C
Initial column holding time:	3 min
Column temperature program:	8°C/min
Final column temperature:	220°C
Final column holding time:	Analyte and matrix dependent
Injector temperature:	200-225°C
Source temperature:	According to manufacturer's specifications
Transfer line temperature:	250-300°C
Carrier gas:	Helium at 30 cm/sec
Purge flow:	Nitrogen at 40 mL/min

7.5 INITIAL CALIBRATION

7.5.1 Each mass spectrometer will be calibrated for mass scale using perfluorokerosene (PFK) or perfluorotributylamine (FC-43) according to manufacturer's specifications.

7.5.2 Each GC/MS system must be hardware tuned to meet the criteria in Table A2-1 for a 100 ng injection of BFB (see Section 5.5). Analysis must not begin until these criteria are met.

7.5.3 A system blank consisting of five milliliters (5.0 mL) reagent (VOA) water spiked with the surrogate/RIS solution will be analyzed (as outlined in Sections 7.5.4.1 through 7.5.4.5) to ensure that the GC/MS system is contaminant free. This shall be done immediately before and after the calibration curve injections. Should the system prove to be contaminated, then the following measures are taken.

TABLE A2-1. BFB ION ABUNDANCE CRITERIA

Mass	Ion abundance criteria
50	15% to 40% of mass 95
75	30% to 60% of mass 95
95	Base peak, 100% relative abundance
96	5% to 9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5% to 9% of mass 174
176	Greater than 95% but less than 101% of mass 174
177	5% to 9% of mass 176

7.5.3.1 Perform a "bake-out" of the analytic system by running through the temperature program and heating the analytic trap. Occasionally, an overnight bake-out of the system may be necessary to rid the system of gross contamination.

7.5.3.2 Ensure that the purge towers and syringes have been properly cleaned.

7.5.3.3 Obtain fresh VOA water to rule out contaminated water.

7.5.3.4 If necessary, the spiking solution will be reprepared to rule out contamination during the preparation.

7.5.3.5 If these measures prove to be unsuccessful in eliminating the contamination, then the GC/MS supervisor or project leader should be consulted for further action to be taken.

7.5.4 A five-point calibration curve will be established using the following procedure:

7.5.4.1 After allowing the standards to warm to room temperature, spike the calibration standards (see Section 5.3) into an all glass syringe containing 5 mL VOA water. Be sure the standard solution is expelled beneath the surface of the water and away from the delivering syringe needle.

7.5.4.2 This solution is then mixed by inversion and added to the purge tower. Purge the standard for 11.0 min at ambient temperature.

7.5.4.3 At the conclusion of the purge time, desorb the analytic trap, begin the GC temperature program, start the GC/MS data acquisition. Concurrently, introduce the trapped materials to the column by rapidly heating the trap to 180°C while backflushing the trap with inert gas between 20 and 60 mL/min for 4 min.

7.5.4.4 While the trap is being desorbed into the GC, empty the purge tower. Wash with a minimum of two 5 mL flushes of reagent water (or methanol followed by reagent water) to avoid carryover into subsequent analyses.

7.5.4.5 After desorbing the standard for 4 min, recondition the trap by returning the purge-and-trap device to the purge mode. Maintain flow through the trap. The trap temperature should be maintained at 180°C. Trap temperatures up to 220° may be employed, however, the higher temperatures will shorten the useful life of the trap. After approximately 7 min, turn off the trap heater and open the valve to stop the gas flow through the trap. When cool, the trap is ready for the next sample.

7.5.5 Tabulate the area response of the characteristic ions (see Table B2-1-2) against concentration for each organic compound of interest, surrogate, and each internal standard. This is calculated for each point in the curve. Calculate response factors (RF) for each compound relative to the internal standard.

TABLE A2-2. RETENTION TIMES AND CHARACTERISTIC IONS FOR VOLATILE COMPOUNDS

Compound	Retention time (min)	Primary ion	Secondary ion(s)
Acetone	--	43	58
Acrolein	--	56	55, 58
Acrylonitrile	--	53	52, 51
Benzene	17.0	78	52, 77
Bromodichloromethane	14.3	83	85, 129
Bromoform	19.8	173	171, 175, 252
Carbon tetrachloride	13.7	117	119, 121
Chlorodibromomethane	--	129	208, 206
2-Chloroethyl vinyl ether	18.6	63	65, 106
Chloroform	11.4	83	85, 47
1,1-Dichloroethane	--	63	65, 83
1,2-Dichloroethane	--	62	64, 98
1,1-Dichloroethene	9.0	96	61, 98
trans-1,2-Dichloroethene	10.0	96	61, 98
1,2-Dichloropropane	15.7	63	62, 41
cis-1,3-Dichloropropene	15.9	75	77, 39
trans-1,3-Dichloropropene	17.2	75	77, 39
Diethyl ether			
Ethylbenzene	26.4	106	91
Methylene chloride	6.4	84	49, 51, 86
Methyl ethyl ketone			
1,1,2,2-Tetrachloroethane	22.1	83	85, 131, 133
Tetrachloroethene	22.2	164	129, 131, 166
Toluene	23.5	92	91, 65
1,1,1-Trichloroethane	13.4	97	99, 117
1,1,2-Trichloroethane	17.2	97	83, 85, 99
Trichloroethene	16.5	130	95, 97, 132
Trichlorofluoromethane	8.3	101	103, 66

The RF is calculated as follows:

$$RF = (AxCis)/(AisCx)$$

where:

Ax = Area of the characteristic ion for the compound being measured.
Ais = Area of the characteristic ion for the specific internal standard.
Cis = Amount (ng) of the specific internal standard.
Cx = Amount (ng) of the compound being measured.

7.5.6 Tabulate the area response of the characteristic ions of each organic compound of interest and surrogate against the concentration of the internal standards as described in Section 7.5.5.

7.5.7 Calculate the average RF for each compound. If the RF value over the working range is a constant (±20% RSD), the RF can be assumed to be invariant, and the average RF can be used for calculations. This variability range may be expanded to ±30% RSD with the approval of the project leader. The ability to meet this criteria is dependent upon the concentration range of the calibration standards; i.e., a wider range will have a larger RSD. Alternatively, the results can be used to plot a calibration curve of response ratios As/Ais versus RF.

7.5.8 Analyze a QC check sample by the procedure described beginning in Section 7.5.4.1. The recoveries should fall within ±20% of the expected value.

7.6 DAILY CALIBRATION

7.6.1 Perform the calibration steps as described in Sections 7.5.1 and 7.5.2 on a daily basis. In addition, the BFB tuning requirement must be demonstrated every 12 h during extended work days.

7.6.2 Analyze an aliquot of reagent water. This will serve as both a system blank and a reagent blank.

7.6.3 Daily calibration checks are performed by analyzing the midrange standard at least once every 12 h.

7.6.3.1 The internal standard responses are examined for retention time shifts. If the retention times have shifted more than 30 s from the last calibration check, the chromatographic system must be inspected for malfunctions and corrections made.

7.6.3.2 If the EICP area for any of the internal standards changes by a factor of two from the last daily calibration check standard, the mass spectrometer must be inspected for malfunctions and corrections made as appropriate.

7.6.3.3 When corrections are made, reanalysis of samples analyzed while the system was malfunctioning are necessary.

7.7 ANALYSIS OF WATER SAMPLES

7.7.1 Once the initial and/or daily calibration requirements have been met, analysis of samples may begin.

7.7.2 An aliquot of the well mixed water sample prepared in Section 6.3 is poured into an all glass syringe. The volume of the water sample is adjusted to 5.0 mL. The sample is then spiked with the surrogate/RIS spiking solution and mixed by inversion.

7.7.3 Analysis then continues as described in Section 7.5.4 using 5.0 mL of sample and spiking with the RIS/surrogate solution.

7.7.4 If analysis of the sample shows any analyte to be outside the calibration range of the instrument, this sample must be diluted as described in 7.7.4.1 and 7.7.4.2. If the high level sample saturates any of the quantitation ion, a system blank must be analyzed to assure no carryover to the next analysis.

7.7.4.1 Dilutions are made from a different VOA vial of the composited sample than was used for the first analysis whenever possible.

7.7.4.2 Allow the water sample to be diluted and the VOA water to reach room temperature. Add an aliquot of the sample to a volumetric flask and dilute to volume with the VOA water. An aliquot of this dilution is analyzed as in Section 7.5.4 using 5.0 mL of the diluted sample and the RIS/surrogate solution.

7.7.5 Surrogate recoveries must be ±35% from the expected value. Reanalysis of the sample is necessary if recoveries fall out of this range.

7.7.6 A replicate analysis is performed for every 20 samples unless otherwise specified by the project specific trial burn plan or the QA plan.

8.0 GC/MS ANALYSIS OF VOST SAMPLES

8.1 SUMMARY OF METHOD

8.1.1 The traps are spiked with an internal standard solution using the flash evaporation technique. They are then thermally desorbed for 11 min at 180°C with organic-free nitrogen, bubbled through 5 mL of organic-free water, and trapped on the analytical trap. After the 11-min desorption, the analytical trap is rapidly heated to 180°C with the carrier gas reversed so that the effluent flow from the analytical trap is directed into the GC/MS. The volatile POHCs are separated by temperature-programmed gas chromatography and detected by low-resolution mass spectrometry. The concentrations of the volatile POHCs are calculated using the internal standard technique.

8.1.2 Refer to SW-846 method 5040 "PROTOCOL FOR ANALYSIS OF SORBENT CARTRIDGES FROM VOLATILE ORGANIC SAMPLING TRAIN" for complete details of this analytic method. Deviations are listed in Section 11.0 of this document.

8.2 APPARATUS

8.2.1 Trap spiking apparatus:

8.2.1.1 Internal standards are introduced into each VOST trap prior to analysis using a special accessory. This consists of a trap holder, a heated GC-type septum injector, and a supply of helium gas. The injector is maintained at a temperature of 220°C and the helium flow is about 50 mL/min.

8.2.2 Thermal desorption unit:

8.2.2.1 The thermal desorption unit is capable of heating the traps to 180°C with flow of organic-free nitrogen through the traps. For inside/inside VOST traps, use the Supelco "clamshell" heater; for inside/outside VOST traps, a user fabricated heater is required.

8.2.3 Purge and trap device:

8.2.3.1 The purge and trap unit is as described in Section 7.2.

8.3 GC/MS SYSTEM

8.3.1 The GC/MS system is as described in Section 7.3.

8.4 GC/MS OPERATING CONDITIONS

8.4.1 The GC/MS operating conditions are as described in Section 7.4.

8.5 INITIAL CALIBRATION

8.5.1 Each mass spectrometer will be calibrated for mass scale using perfluorokerosene (PFK) or perfluorotributylamine (FC-43) according to manufacturer's specifications.

8.5.2 Each GC/MS system must be hardware tuned to meet the criteria in Table B2-1-1 1 for a 100-ng injection of BFB (see Section 5.5). Analyses must not begin until these criteria are met.

8.5.3 A system blank is performed immediately before and after analysis of the calibration curve standards according to the following procedure:

8.5.3.1 Turn the helium flow on. Insert a clean trap into the spiking accessory and seal with the knurled nut.

8.5.3.2 Using an exact volume technique, slowly inject the internal standard solution into the vaporizing port of the spiking accessory. After 15 seconds, shut off the gas flow, and remove trap. The total flow of gas through the trap during addition of internal standards should be 25 mL or less.

8.5.3.3 Place the spiked trap into the thermal desorption unit and attach the "clamshell" heater. Check the flow to ensure a 40-mL/min nitrogen flow rate. Heat trap and desorb for 11 min.

8.5.3.4 The desorbed components pass into the bottom of the water column, are purged from the water, and are collected on the analytic trap. After the 11-min desorption period, the compounds are desorbed from the analytical trap into the GC/MS system by rapidly heating the analytic trap and backflushing with inert gas for 4 min.

8.5.3.5 If the system proves to be contaminated, then the corrective action outlined in Section 7.5.3 is initiated.

8.5.4 A minimum of calibration standards at three levels are used to prepare the calibration curve. Each standard is analyzed on three Tenax traps spiked with calibration standards to establish a calibration curve. These traps are spiked and analyzed as described beginning in Section 8.5.3.1.

8.5.5 Tabulate the area response of the characteristic ions of each analyte (surrogate and compound of interest) against the concentration of the internal standards as described in Section 7.5.5.

8.5.6 Calculate the average RF for each compound. If the RF value over the working range is a constant (±20% RSD), the RF can be assumed to be invariant, and the average RF can be used for calculations. This variability range may be expanded to ±30% RSD with the approval of the project leader. The ability to meet this criteria is dependent upon the concentration range of the calibration standards; i.e., a wider range will have a larger RSD. Alternatively, the results can be used to plot a calibration curve of response ratios As/Ais versus RF.

8.5.7 Analyze AQC check sample by the procedure described beginning in Section 8.5.3.2. The recoveries should fall within ±20% of the expected value.

8.6 DAILY CALIBRATION

8.6.1 Perform the calibration steps outlined in Sections 7.5.1 and 7.5.2. In addition, the BFB tuning requirement must be demonstrated every 12 h during extended work days.

8.6.2 A system blank is analyzed as outlined in Section 8.5.3.

8.6.3 A daily calibration check is performed by spiking a Tenax trap with the mid range calibration standard. The response factors calculated from this injection must not vary by more than ±20% for any analyte. This variability range may be expanded to ±30% with the approval of the project leader.

8.7 ANALYSIS OF VOST SAMPLES

8.7.1 Each sample trap, field blank trap, and trip blank trap is analyzed by the procedure described beginning in Section 8.5.3.

8.7.2 If analysis shows any analyte to be outside the calibration range of the instrument, then a higher level standard is prepared and analyzed to bracket that sample.

8.7.3 If samples are encountered that have concentrations of analytes above the highest point in the calibration curve, the cleanliness of the system must be proved by analyzing a system blank as in Section 8.5.3. If this system blank proves to be clean, this establishes a new lower limit for the analysis of system blanks. If, on subsequent analyses, a sample is encountered that is above this new limit, a system blank must be analyzed. Once again, if this proves the system to be clean, then this higher limit is established. This continues until an amount of analyte is found that does not clean up from the system during the usual operating procedure. When this occurs, a longer bake-out of the system is required.

9.0 DATA INTERPRETATION

9.1 QUALITATIVE ANALYSIS

9.1.1 An analyte is identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard references are obtained on the user's GC/MS within the same 12 h as the sample analysis. These standard reference spectra may be obtained through analysis of the calibration standards. Two criteria must be satisfied to verify identification: (1) elution of sample component at the same GC relative retention time (RRT) as those of the standard component; and (2) correspondence of the sample component and the standard component mass spectrum.

9.1.2 The sample component RRT must compare within ±0.06 RRT units of the RRT of the standard component. For reference, the standard must be run within the same 12 h as the sample. If coelution of interfering components prohibits accurate assignment of the sample component RRT from the total ion chromatogram, the RRT is assigned by using extracted ion current profiles for ions unique to the component of interest.

9.1.3 Every ion plot and mass spectrum will be visually inspected to ensure that (1) All ions present in the standard mass spectra at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100%) must be present in the sample spectrum. (2) The relative intensities of ions specified in (1) must agree within ±20% between the standard and sample spectra. (Example: for an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 30% and 70%.) These criteria may be relaxed slightly if, in the best professional judgment of the data analyst, a compound lacking all criteria is still deemed to be a "hit."

9.1.4 If the project specific trial burn plan indicates that compounds other than the analytes of interest (i.e., PICs or unknowns) are to be identified, this work is performed by personnel experienced in mass spectral interpretation. A computer search of the NBS mass spectral library is obtained for each unknown spectrum, followed by manual evaluation of the spectra and search results. Manual searches of mass spectral libraries are also used to facilitate identifications. In some cases it is not possible to identify a compound based on its electron impact mass spectrum alone. To the extent possible, these compounds will at least be characterized by class; for example, as "hydrocarbon", "amine", etc. Unknown and PIC compounds may also be semiquantitated by calculating ng amounts as outline in Section 7.5.9 using total ion areas for both unknown and internal standard and assuming a response factor of 1.000.

9.2 QUANTITATIVE ANALYSIS

9.2.1 Specific quantitation information based on response factors for compounds (Section 9.5.6) will be done for surrogates and POHCs only. Quantitation for PICs and unknowns will be calculated using RFs of 1.000 or historical response factors if available.

9.2.2 When a compound has been identified, the quantification of that compound will be based on the integrated abundance from the EICP of the primary characteristic ion. For VOST samples only, if the primary ion is saturated or has an interference, then a secondary ion is used for quantification. However, a new RF should be established for the secondary ion. Quantification will take place using the internal standard technique.

9.2.3 Calculate the total ng per analysis of each identified analyte in the sample as follows:

$$\text{total ng} = [Aa/Ais] \times [Cis/RFa]$$

where:

Aa = Area of the characteristic ion for the analyte to be measured.
Ais = Area of the characteristic ion for the specific internal standard.
Cis = Amount (ng) of the specific internal standard.
RFa = Calculated average response factor for the analyte.

9.2.4 The "TCA" quantitation report values may be used in place of manual calculations for the total ng per analysis.

9.2.5 VOST samples are reported as total ng per trap or total ng per pair.

9.2.6 Water samples are reported in ng/mL by the following:
μg/L = ng/mL = total ng found / purge volume (5.0 mL)

9.2.7 Waste feeds are reported in μg/g by the following:

μg/g = [μg found/injection volume (mL)] x [dilution (mL)/sample wt(g)]

9.2.8 Report results without correction for recovery data. When duplicates, matrix spikes, and check samples are analyzed, report all data with sample results.

10.0 QUALITY CONTROL

Specific QC requirements are included in the section where appropriate, however, a summary of the QC performed with sample preparation and analysis is summarized in this section.

10.1 BLANKS

10.1.1 Field blanks are analyzed to ensure that no contamination of the samples has occurred during the sampling and shipping processes. Trip blanks are a specific type of field blank and are utilized for VOST analysis to segregate the sampling process from the shipping process. See Section 6.2.1 for further explanation of VOST trip and field blanks. The preparation of water field blanks is outlined in Section 1.1.4.

10.1.2 System blanks for the GC/MS system are performed on each instrument on a daily basis. These analyses are to demonstrate that the GC/MS system is free from contaminants. These may also function as reagent blanks (Section 10.1.3).

10.1.3 Reagent blanks are performed by spiking the various reagents with RIS and surrogate and are analyzed according to the procedure for that type of sample. This is done for each batch or lot number of reagent.

10.2 SAMPLE QA REQUIREMENTS

10.2.1 For all water samples spiked with surrogates. Recoveries are calculated for all these samples and must fall within ±35%.

10.2.2 Replicate analyses water samples are performed at least once per 20 samples. However, the project specific QA plan is consulted for additional replicate analyses.

10.3 INITIAL INSTRUMENT CALIBRATION REQUIREMENTS

10.3.1 Each instrument is calibrated for mass scale using PFK or FC-43 according to manufacturer's specifications prior to the initial calibration curve.

10.3.2 Each instrument is tuned to meet the criteria in Table A2-1 for a 100-ng injection of BFB.

10.3.3 A calibration curve is established and acceptable performance demonstrated prior to the analysis of samples. Initial calibration procedures are dependent on sample type and are outlined in Sections 7.5, 8.4, and 8.5.

10.4 DAILY INSTRUMENT CALIBRATION REQUIREMENTS

10.4.1 Each instrument is calibrated for mass scale with PFK or FC-43 on a daily basis.

10.4.2 The BFB performance criteria in Table 1 must be demonstrated every 12 h.

10.4.3 Daily calibration requirements are dependent on sample type and are outlined in Sections 7.6 and 8.6.

11.0 MODIFICATIONS FROM SW-846 METHODS

11.1 METHOD 8240 "GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS"

METHOD 8240 SECTION NO.	MODIFICATION
4.12.3 5.5 7.2.2 7.3.1	100 ng of BFB is injected rather than 50 ng. This gives better instrument response on the lower intensity ions.
5.1.3	Purities < 100% (or 99+%) are corrected.
5.3 5.4 5.7	Concentrations of stock solutions will vary according to analysis needs. Usually, surrogate and RIS solutions are such that 100 ng per analysis is achieved. RIS and surrogates are prepared as a mix for VOST, water samples, and system blanks. A three point calibration curve is acceptable.
5.6	Calibration standards are prepared in methanol rather than reagent water and they are used until signs of degradation become evident.
5.8	standard solutions are stored in clear vials and placed in a closed container to protect from light.
6.1	New bottles and vials are cleaned according to Introductory Chapter, Section 4.1.2. Sample bottles and vials are not reused, they are decontaminated with methanol and disposed of. Reactivials and volumetric flasks are decontaminated after use, then cleaned as in Section 4.1.2.

7.2.5	Calibration standards are prepared as a mix which includes analytes, surrogates, and RIS. This standard is spiked directly into the glass syringe containing 5.0 mL VOA water, mixed, and added to the purge tower.
7.2.9	The GC/MS data system (INCOS) uses n rather than n-1 for %RSD calculations. If a %RSD falls within 3% of the cutoff value, then this %RSD is recalculated manually using n-1 to achieve a more accurate value.
7.4.1	Water samples are not prescreened as they generally contain a very low concentration of analytes.
7.4.1.5	Purge gas is nitrogen at 40 mL/min. Carrier gas is helium at 30 cm/s.
7.4.1.7.3	Only one aliquot for analysis is taken from any given VOA vial. If replicates are required, then these aliquots are taken from individual VOA vials. If dilutions are necessary, then an aliquot is taken from a fresh VOA vial.
7.5.2	Quantitation for PICs will be completed by using the RFs generated by standard injections. Unknowns will be quantified by using RRFs of 1.000.
8.5.1 8.5.2	Concentrations of analytes will vary depending on the analysis needs.

11.2 METHOD 5040 "PROTOCOL FOR ANALYSIS OF SORBENT CARTRIDGES FROM VOLATILE ORGANIC SAMPLING TRAIN"

METHOD 5040 SECTION NO.	MODIFICATION
5.3.2	Stock solutions are maintained for 2 months for reactive compounds and gases, 6 months for all others. They are replaced sooner if signs of degradation are evident. (per method 8240)
5.5	100 ng BFB used for better instrument response on 7.1 the lower intensity ions.
5.6	Concentrations of stock solutions will vary depending on analysis needs.
7.2.3	Internal standard amounts are typically 100 ng per analysis.
8.4.1	Acceptable range for internal standard areas is ±35% from run to run, or a factor of two (-50% to +100%) from the last daily standard per method 8240.

APPENDIX A-4

SEMIVOLATILE ORGANICS ANALYSIS AND PCDD/PCDF DETERMINATION

APPENDIX A-4

SEMIVOLATILE ORGANICS ANALYSIS AND PCDD/PCDF DETERMINATION

1.0 GLASSWARE PREPARATION

1.1 Standard Procedures

All glassware for field sampling and analysis of semivolatile organic compounds is prepared according to the following procedures.

1.1.1 Wash all glassware in hot, soapy water (use ISOCLEAN nonionic soap, Micro, Alconox, or equivalent synthetic detergents and a clean brush).

1.1.2 Rinse with tap water (5X), deionized water (3X), and bulk acetone (2X).

1.1.3 Air dry and cover open ends of glassware with solvent-rinsed aluminum foil and store in appropriate drawers.

1.1.4 Any glassware that gives an indication of still being dirty, i.e., the water and acetone rinses do not "sheet," should be recleaned by soaking in concentrated sulfuric acid overnight then rinsed as in Section 1.2.2.2.

1.1.5 Before actual use, clean glassware and Teflon liners from storage drawers should be rinsed with high purity acetone followed by a 2X rinse with the appropriate solvent to be used in the method. Glassware for field sampling should be rinsed a final time with methylene chloride (DCM).

1.1.6 Glassware used for extraction, concentration, and cleanup procedures are numbered as a set. Such glassware is to be used in a set.

1.1.7 A final rinse of the glassware sets with the appropriate solvent should be collected in a vial, labeled to note glassware type and set, and archived as a glassware rinse.

1.1.8 The dram vials, reacti-vials, and autosampler vials are rinsed 2X with the solvent to be used and allowed to air dry.

1.1.9 When required, dram vials may be precalibrated by dispensing a measured volume of the appropriate solvent into the vial and etching the glass at the bottom of the miniscus. Precalibrated vials are to be rerinsed with the appropriate solvent and allowed to dry.

1.1.10 Vial caps are to be lined with solvent-rinsed Teflon liners.

1.1.11 After use, glassware is to be rinsed once with extraction solvent and once with bulk acetone before detergent washing.

1.2 SW-846 Method Modifications, Deviations, and Enhancements

The following modifications, deviations, and enhancement from SW-846 and other standard methods will be employed during this study. None are expected to impact the quality of the results submitted. The glassware cleaning procedure deviates from SW-846, Chapter 4 recommended method, as follows.

1.2.1 SW-846 recommends using methanol rather than bulk acetone in Steps 1.1.2 and 1.1.11.

1.2.2 SW-846 suggests using a hot (≥ 50°C) soap water soak and a hot water rinse.

1.2.3 SW-846 recommends a soak with hot chromic acid solution to destroy traces of organic compounds.

2.0 SORBENT CLEANUP AND PREPARATION

2.1 XAD-2 Cleanup and Trap Preparation

2.1.1 Extraction and Fluidation--A batch of XAD-2 adsorbent (Alltech Assoc./Applied Science, 20/50 mesh, 90 Å pore size, precleaned) is placed into a Soxhlet extraction apparatus and extracted for 22 h with methylene chloride (DCM) as outlined in Section 2.3.2.

The XAD-2 is then placed into an evaporating dish lined with methylene chloride-rinsed aluminum foil, placed in a hood and dried for 12 h. The evaporating dish is lined with aluminum foil to prevent possible contamination of the XAD-2 resin from the dish. Prerinsed aluminum foil is placed over the XAD-2 to keep particulate matter from falling into the evaporating dish during drying.

Glass wool (preextracted with methylene chloride as outlined in Section 2.4.1) is placed in the bottom of a 1-L continuous extraction column. The XAD-2 adsorbent is next placed into the column (~ 1,000 g/ extraction column). A stream of high purity gaseous nitrogen is passed for 16 h through a bed of 50% activated carbon/50% molecular seive and then through the extraction column. The rate of N_2 flow should gently dry the resin. Excessive fluidation may cause the XAD-2 particles to break up. The activated charcoal/molecular sieve trap consists of a 8 x 1 1/2 in stainless steel case with stainless steel frits on the inlet and outlet. All lines connecting the N_2 tank to the column should be Teflon or precleaned copper tubing.

2.1.2 Storage of Extracted XAD-2--Precleaned XAD-2 resin not to be used immediately (within 2 weeks) should be stored under high purity methanol.

2.1.3 Packing the XAD Trap--

2.1.3.1 Dry method--Place a wad of glass wool (preextracted with methylene chloride) into the bottom of a precleaned XAD-2 cartridge. The XAD trap is packed just prior to use in the field (not to extend longer than 2 weeks prior to use). Use just enough glass wool to cover the glass frit. Add XAD-2 resin to fill the cartridge to the top of the curved section. Do not tap the cartridge. Packing the resin too tightly may plug the sample train during sampling. Add enough glass wool (preextracted) into the top of the cartridge to ensure the resin will not leak out. Cover both ends of the cartridge tightly with methanol-rinsed aluminum foil. Wrap the cartridge with bubble pack and tape to ensure safe delivery to the field site.

2.2 Cleanup and Preparation of Solid Materials Used in the Analytical Procedures

2.2.1 The following adsorbents are to be extracted in the giant Soxhlet extractor.

- Na_2SO_4 (anhydrous, granular, Fisher Scientific or equivalent)
- Florisil (pesticide grade, 60/100 mesh)

2.2.2 Soxhlet Extraction Procedure for the 12-L Giant Soxhlet--

2.2.2.1 Charge the Soxhlet by adding 6 L DCM in the 12-L round bottom flask.

2.2.2.2 Add boiling chips (silicon carbide) to the 12-L round bottom flask.

2.2.2.3 Place preextracted regular glass wool in bottom of Soxhlet extractor to prevent solids from entering into the Soxhlet arm. Add the solid material and wet with 1 L DCM.

2.2.2.4 Extract overnight, 16 to 22 h at a turnover rate of 2 cycles/h.

2.2.2.5 Remove the solid material from the extractor and air dry in methylene chloride-rinsed aluminum foil-lined evaporating dishes until solvent odor is no longer detected (~ 4 h).

2.2.3 Adsorbent and Drying Agent Activation Procedure--

2.2.3.1 Na_2SO_4--Ensure that the Na_2SO_4 is dry. Transfer the air-dried Na_2SO_4 to small evaporating dishes and heat in a muffle furnace at 400°C for 4 h.

Store the Na_2SO_4 in a clean glass jar covered with methylene chloride-rinsed foil in an oven at 130°C.

2.2.3.2 Florisil--Activate a batch of Florisil by heating at 130°C for 16 h. Store in a desiccator.

2.2.3.3 Carbopak C/Celite 545--Prepare by mixing 3.6 g of Carbopak C (80/100 mesh) and 16.4 g of Celite 545 in a 40-mL vial (different amounts may be mixed in the same proportions). Place sorbent mixture on rock tumbler and tumble for 3 h. Activate at 130°C for 6 h. Store in a desiccator.

2.3 Cleanup and Preparation of Glass Wool and Boiling Chips

2.3.1 Glass Wool (Soxhlet Extraction)--

2.3.1.1 Add approximately 6 L of methylene chloride to a 12-L round bottom flask. Add boiling chips (silicon carbide) to the 12-L round bottom flask.

2.3.1.2 Place regular or silanized glass wool in Soxhlet and wet with 1 L methylene chloride.

2.3.1.3 Extract overnight, 16 to 22 h at a rate of 2 cycles/h.

2.3.1.4 Air dry on methylene chloride-rinsed aluminum foil.

2.3.1.5 Store on bench in clean glass jar with Teflon-lined screw cap.

2.3.2 Boiling Chips--

2.3.2.1 Silicon carbide boiling chips (Soxhlet extraction)--

2.3.2.1.1 Add approximately 500 mL of methylene chloride to a 1-L round bottom flask. Add boiling chips (silicon carbide) to the round bottom flask.

2.3.2.1.2 Place preextracted regular glass wool in the bottom of a 71/60 Soxhlet extractor. Add the silicon carbide boiling chips to be extracted and wet with approximately 200 mL of methylene chloride.

2.3.2.1.3 Extract overnight, 16 to 22 h.

2.3.2.1.4 Air dry on methylene chloride-rinsed aluminum foil.

2.3.2.1.5 Store on bench in a clean glass jar with a Teflon-lined lid.

2.3.2.2 Berl saddle boiling chips--Simply crush the Berl saddles to small pieces and store in a methylene chloride-rinsed vial or jar with Teflon-lined lid.

2.4 SW-846 Method Modifications, Deviations, and Enhancements

The following modifications, deviations, and enhancement from SW-846 and other standard methods will be employed during this study. None are expected to impact the quality of the results submitted.

2.4.1 Appendix A of SW-846 Method 0010 suggests two XAD-2 cleanup methods.

2.4.1.1 Initial rinse of XAD-2 resin in Type II water (2X) in a beaker, followed by Soxhlet extraction with water (8 h), methanol (22 h), and two separate methylene chloride extractions, each for a duration of 22 h.

2.4.1.2 Using an XAD-2 cleanup extraction apparatus which includes a three-necked flask, air-jacketed Snyder distillation column, and an XAD-2 canister in which the resin is held light spring tension between a pair of coarse and fine screens. Solvent is refluxed through the Snyder column, and the distillate is continuously cycled upward through the XAD-containing canister for extraction and returned to the flask. The resin is first water-washed by pumping 20 L of distilled water upward through the canister. The resin is then solvent-rinsed with methanol and methylene chloride (2X) for 10 to 20 h using the described distillation apparatus.

2.4.1.3 MRI will extract the XAD-2 for 22 h using methylene chloride (Section 2.1.1). The resin purchased will have been precleaned by the manufacturer. A subsample of the cleaned resin will be solvent extracted and analyzed by GC/MS to ensure that the resin has been efficiently cleaned.

2.4.2 Appendix A of Method 0010 suggests two XAD-2 drying techniques. MRI will use a method similar to the second option recommended, modified as follows. The high purity nitrogen will be passed through a stainless steel case (approximately 200 cm^3 capacity) containing a mix of activated carbon and molecular sieve (in equal proportions).

2.4.3 Method 0010 recommends that cleaned XAD-2 be stored in an airtight, wide-mouth amber jar or in one of the glass sorbent modules sealed with Teflon film and elastic bands for no more than 4 weeks. MRI will modify this procedure by storing the precleaned resin in a jar under high purity methanol if it will not be used within 2 weeks after preparation.

2.4.4 Method 0010 recommends the use of Teflon boiling chips for all sample preparation procedures (Soxhlet extraction, Kuderna Danish volume reduction). MRI will use silicon carbide or Berl saddle boiling chips instead.

3.0 EXTRACTION OF FIELD SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS

3.1 Sample Train and Aqueous Sample Extraction

The components of the Modified Method 5 (MM5) sampling train that need to be extracted are as follows:

- Particulate filter/probe rinse
- XAD-2 resin/back half rinse
- Condensate water

These and several other additional aqueous samples (e.g., scrubber water, lean water) from the trial burns will be spiked with a method internal standard (i.e., surrogates) compounds and solvent extracted. The MM5 components will be solvent-extracted using procedures consistent with SW-846 Method 0010, while the additional aqueous and ash samples will be extracted using SW-846 3500-series methods.

The extracts from the MM5 sampling train components may be combined into a single extract, thus generating a new composite, as described below. Because they will be composited, only the particulate/XAD resin extracts will be spiked with method internal standards.

3.1.1 Extraction of Probe Rinse and Back Half Rinse--

The probe rinse and back half rinse are treated separately but in the same way. Each is composed of combined acetone and toluene rinses which may contain water.

3.1.1.1 If the rinse sample contains particulate matter, set up a glass fiber filter folded in quarters and held with a powder funnel such that it drains into a separatory funnel. Record the glassware identification numbers in the lab record book (LRB), collect all proper glassware rinses, and archive.

3.1.1.2 Filter the sample into the separatory funnel. The filter and filter catch will be extracted with the particulate filter and XAD-2 resins (Section 3.1.2). Rinse the powder funnel (used to hold the filter, if applicable) with toluene into the separatory funnel.

3.1.1.3 Rinse the sample container with toluene and pour the rinsates into the separatory funnel.

3.1.1.4 Back extract the rinses by adding enough reagent water to the separatory funnel so that its volume is 3X the volume of the field sample rinses. Drain the acetone/water layer from the bottom of the separatory funnel and save (see 3.1.1.5). Drain the toluene phase into a separate clean bottle.

3.1.1.5 Pour the acetone/water phase back into the separatory funnel and extract two more times with toluene. Combine these toluene extracts with the toluene extract from step 3.1.1.4.

3.1.1.6 Save this extract for combination with the particulates, XAD, and condensate extracts and proceed to Section 4.0.

3.1.1.7 At least one method blank (consisting of 1 L of reagent water spiked with the method internal standards) is to be extracted with each set of samples extracted by this method.

3.1.2 Extraction of Particulate Filters and XAD Resin--

3.1.2.1 Set up a $55/50 Soxhlet extraction apparatus with 200 mL toluene in a 500-mL boiling flask along with several boiling chips. Record the identification numbers of glassware and lot numbers of the solvent used in the lab record book (LRB). Collect all glassware rinses and archive.

3.1.2.2 Put preextracted regular glass wool in the bottom of the Soxhlet extractor to prevent particulates from entering the Soxhlet arm. Confirm that the probe rinses do not contain any particulate matter (refer to Section 3.1.2.1). If the probe rinses contain particulates, add the filter containing the particulates to the Soxhlet extractor.

3.1.2.3 Carefully fold the MM5 train filter in half. Do not allow any particulate material to be lost from the filter. Add the particulates sample to the Soxhlet extractor using tweezers, being careful not to lose any particulate material from the filter. Rinse the sample container with three 5-mL portions of toluene and add to the boiling flask.

3.1.2.4 Add the entire contents of the XAD-2 resin module (±75 g) from the sampling train to the Soxhlet extractor. Cover the XAD-2 resin with preextracted glass wool to ensure that the resin is held in the extractor. Soxhlet extractors should not be filled more than one half full with resin. Rinse the resin module thoroughly with toluene into the Soxhlet extractor.

3.1.2.5 Spike the sample with the method internal standards (surrogate) solution (see Tables 3 and 5).

3.1.2.6 Extract the sample for at least 16 h at a solvent cycling rate of 3 cycles/h.

3.1.2.7 Drain the solvent extract into the boiling flask. If there is an aqueous layer in the extract, transfer the extract into a separatory funnel and drain the water layer off.

3.1.2.8 Save the solvent extracts for combining with the condensate, the front half, and back half rinse extracts and proceed to Section 4.0.

3.1.3 MM5 Train Condensates--Each of the aqueous samples will be extracted according to SW-846 3500-series methods as described below. The MM5 train condensate samples will be extracted using toluene and will be combined with the filter, front half, and back half rinse extracts.

3.1.3.1 Separatory funnel extraction (SW-846-3510)--

This method is designed to quantitatively extract semivolatile organic compounds from aqueous samples using a separatory funnel. If emulsions present a significant problem during sample extraction, the sample will be drained into a continuous liquid-liquid extractor (Section 3.1.3.2) and the extraction continued.

3.1.3.1.1 The liquid samples will be extracted using a 2-L separatory funnel. Record the glassware identification numbers in the LRB and collect the appropriate glassware rinses for archiving.

3.1.3.1.2 Mark on the sample bottle the level of the meniscus for subsequent determination of total sample volume.

3.1.3.1.3 Shake the sample container for 30 s and pour a 1-L portion of the sample into a graduated cylinder. Add the 1-L portion to the separatory funnel. If the sample exhibits two separate phases, transfer the balance of the sample to the separatory funnel. Drain each phase into separate containers. The aqueous phase will be transferred back to the original sample container. The organic layer will be drained into a clean bottle and treated as described in Section 4.0.

3.1.3.1.4 Mark the level of the meniscus on the side of the sample container for determination of the aqueous phase volume. Measure a 1-L portion of the aqueous phase and pour it back into the separatory funnel.

3.1.3.1.5 Spike the sample with the method internal standards mix (see Tables 3 and 5) and gently swirl the solution. DO NOT SPIKE CONDENSATE SAMPLES FROM THE MM5 SAMPLING TRAIN WITH METHOD INTERNAL STANDARDS.

3.1.3.1.6 Check the pH of the aqueous sample using a glass stirring rod to apply several drops of the sample to a piece of multirange pH paper.

3.1.3.1.7 Adjust the pH of the sample to about 8 using either a 6N NaOH solution for acidic samples or a 6N H_2SO_4 solution for alkaline samples. Add the acid or base, swirl the contents of the separatory funnel, check the pH, and readjust as necessary until a neutral pH is attained.

3.1.3.1.8 Add 60 mL of the extraction solvent to the original sample container, cap, and shake 30 s to rinse it.

3.1.3.1.9 Transfer the solvent rinse to the separatory funnel and extract the sample by shaking vigorously for 2 min with periodic venting to release excess vapor pressure. Record solvent lot number in the LRB.

3.1.3.1.10 Allow the organic layer to separate from the aqueous phase. When using methylene chloride as a solvent, drain the organic phase into a clean bottle. If the solvent employed is toluene, drain the aqueous phase into the original sample bottle, and drain the organic phase into a clean bottle. Transfer the aqueous phase back to the separatory funnel.

3.1.3.1.11 Repeat steps 3.1.3.1.8 to 3.1.3.1.10 two more times, combining each of the three extracts in the same bottle and proceed to Section 4.0.

3.1.3.1.12 At least one method blank (consisting of 1 L of reagent water spiked with the method internal standards) is to be extracted with each set of samples extracted by this method.

3.1.3.1.13 Measure the volume of the aqueous phase and of the total sample described above by adding water to the sample bottle to the marks made. Pour the water into a graduated cylinder and record the volume of sample extracted.

3.1.3.2 Continuous liquid extraction (SW-846-3520)--

This method is designed to quantitatively extract semivolatile organic compounds from aqueous samples using a continuous liquid-liquid extractor. This method is to be used only for samples that form emulsions when extracted using a separatory funnel. The samples that form emulsions during step 3.1.3.1.9 should be transferred directly to the continuous liquid extractor and the extraction continued using the device.

3.1.3.2.1 The liquid samples will be extracted using a continuous liquid-liquid extractor. Record the glassware identification numbers in the LRB and collect the appropriate glassware rinses for archiving.

3.1.3.2.2 Assemble the device and add 200 mL of the appropriate solvent to the extractor. Add 300 mL of the appropriate solvent to the 500 mL boiling flask together with several boiling chips and install on the device.

3.1.3.2.3 Measure 1 L of sample into a 1-L graduated cylinder. If the sample to be extracted by this method is from the separatory funnel method described above, transfer the entire sample into the continuous liquid-liquid extractor, rinse the separatory funnel 3X with 25 mL of solvent and proceed to step 3.1.3.2.8.

3.1.3.2.4 Spike the sample with the method internal standards mix (see Tables 3 and 5) and gently swirl the solution. **DO NOT SPIKE CONDENSATE SAMPLES FROM THE MM5 SAMPLING TRAIN WITH METHOD INTERNAL STANDARDS.**

3.1.3.2.5 Check the pH of the aqueous sample using a glass stirring rod to apply several drops of the sample to a piece of multirange pH paper.

3.1.3.2.6 Adjust the pH of the sample to about 8 using either a 6N NaOH solution for acidic samples or a 6N H_2SO_4 solution for alkaline samples. Add the acid or base, swirl the contents of the separatory funnel, check the pH, and readjust as necessary until a neutral pH is attained.

3.1.3.2.7 Transfer the sample to the extractor. Rinse the graduated cylinder 3X with 30 mL of solvent and add to the extractor.

3.1.3.2.8 Turn on the cooling water to the condenser and the heating mantle and extract the sample for at least 18 h.

3.1.3.2.9 Treat the sample extract as described in Section 4.0.

3.1.3.2.10 At least one method blank (consisting of 1 L of reagent water spiked with the method internal standards) is to be extracted with each set of samples extracted by this method.

3.2 SW-846 Method Modifications, Deviations, and Enhancements

The following modifications, deviations, and enhancements from SW-846 and other standard methods will be employed during this study. None are expected to impact the quality of the results submitted.

3.2.1 SW-846 Method 3510 and 3520 require that samples extracted from an aqueous matrix be extracted first under basic conditions and subsequently under acidic conditions. Because of the nature of the target analytes, performing the extractions under nonneutral pH conditions may result in their degradation. Furthermore, the analysis is not directed toward base/neutral and acidic compounds, but rather to neutral compounds only.

3.2.2 SW-846 Method 0010 specifies that methylene chloride be used as the organic solvent for extraction of MM5 components. However, during the conduct of independent studies to test the effectiveness of various solvents in extracting PCDD/PCDFs from dynamically spiked MM5 train components, MRI scientists discovered that toluene is a more effective solvent. Therefore, toluene will be used as the preferred organic solvent for extracting MM5 components.

3.2.3 SW-846 Method 0010 specifies that each individual MM5 sampling train component be spiked with surrogates (i.e., method internal standards) prior to solvent extraction. Analysis of each MM5 component separately would increase analytical costs significantly. Furthermore, independent studies conducted by MRI scientists on dynamically spiked MM5 sampling trains indicated that the bulk of the organic analytes recovered from MM5 sampling trains is found in the particulate filter catch and XAD-2 trap. Therefore, the particulate filter catch will be coextracted with the XAD-2 resin components, and only this sample will be surrogate-spiked.

3.2.4 SW-846 Method 0010 specifies that the train solvent rinses are treated as a single sample during extraction. MRI will treat the probe and back half rinses separately.

3.2.5 SW-846 Method 0010 specifies that, during liquid-liquid extraction of MM5 train solvent rinses and condensate, the sample be initially extracted under acidic conditions and subsequently under basic conditions. Since the analytes of interest (PCDD/PCDFs, PCBs) are neutral, the samples will be extracted under neutral conditions.

4.0 EXTRACT CONCENTRATION AND COLUMN CLEANUP FOR SEMIVOLATILE ORGANIC COMPOUNDS

Each of the sample extracts from the various extraction procedures will be concentrated for GC/MS analysis. Depending on the type of compounds to be analyzed, concentration of the samples may be followed by a column cleanup procedure and then further concentrated. Column cleanup procedures for analysis of PCDD/PCDFs are based on those described in SW-846 Draft Method 8290. Method 0010 for the analysis of MM5 sampling train components has no provisions for extract cleanup. However, through long experience with the analysis of PCDD/PCDFs, MRI chemists have determined that the MM5 samples have sufficient interferences that make extract cleanup compulsory.

4.1 KD Concentration of Extracts

4.1.1 Place a small plug of preextracted silanized glass wool in a powder funnel and fill with approximately 20 g of preextracted anhydrous granular Na_2SO_4.

4.1.2 Transfer sample from the original extract container via the sodium sulfate packed funnel to a 500-mL KD flask fitted with a 25-mL graduated concentrator tube containing two clean boiling chips. Make sure the concentrator tube is firmly in place (with clamp or elastic bands) in order to avoid loosing sample or allowing steam to condense in the sample. Pour in enough sample extract to fill the KD flask no more than one-half full. Since the volume of the MM5 sampling train extracts will likely exceed the capacity of the KD flask, several transfers to the KD flask may be necessary.

4.1.3 Attach a 3-ball Snyder column to the KD flask and rinse with 1 mL of the appropriate solvent.

4.1.4 Place the KD apparatus on a steam bath outlet such that the entire lower rounded surface of the KD flask is bathed with steam. At the proper rate of distillation, the balls in the Snyder column will constantly chatter, but the chambers will not flood with condensed solvent.

4.1.5 When all of the contents of the original extract containers have been added to the KD flask, rinse the containers three times with 25 mL of the appropriate solvent and add the rinses to the KD flask through the sodium sulfate packed funnel.

4.1.6 Concentrate the extract to a final volume of 5 mL.

4.1.7 Add 50 mL of hexane to the KD flask, add a fresh boiling chip to the flask, reattach the Snyder column, and concentrate the sample extract to approximately 5 mL.

4.1.8 Rinse the flask and lower joint of the KD apparatus with two 5-mL portions of hexane and adjust the final extract volume to 20 mL.

4.1.8.1 If the sample is to be analyzed for both PCBs and PCDD/PCDFs (composited MM5 sampling train extracts), the sample extract will be split into two 10-mL portions. Dispense 10 mL of the extract into two separate vials.

4.1.8.2 If the sample is to be analyzed for PCBs only (ash, scrubber effluent, lean water samples), the volume is further reduced to 10 mL and stored in a vial.

4.2 Column Cleanup Procedures

The following column cleanup procedure is based on the methods described in SW-846 Draft Method 8290.

4.2.1 Transfer the 10-mL aliquot of the extract slated for analysis of PCDD/PCDFs into a 125-mL separatory funnel.

4.2.2 Add 40 mL of a 20% (w/v) aqueous KOH solution to the extract. Shake the contents for 2 min and rapidly drain and discard the aqueous (bottom) phase. Repeat the base washing until no color is visible in the aqueous layer to a maximum of four washings. Strong base is known to degrade certain PCDD/PCDFs, so contact time with the base must be minimized.

4.2.3 After the aqueous phase of the last base washing has been drained, add 40 mL of a 5% (w/v) aqueous NaCl solution. Shake for 2 min. Drain and discard the aqueous phase.

4.2.4 Add 40 mL concentrated H_2SO_4 to the sample extract. Shake for 2 min. Drain and discard the sulfuric acid (bottom) phase. Repeat the acid washing until no color is visible in the acid layer to a maximum of four washings.

4.2.5 After the acid phase of the last acidic washing has been drained, add 40 mL of a 5% (w/v) aqueous NaCl solution. Shake for 2 min. Remove and discard the aqueous (bottom) layer.

4.2.6 Transfer the extract to a 50-mL boiling flask by passing it through a powder funnel packed with anhydrous granular Na_2SO_4 as described above. Rinse the sodium sulfate with two 15-mL portions of hexane into the boiling flask, and concentrate the sample extract to near-dryness using a rotary evaporator (35°C water bath), making sure that all traces of toluene (when applicable) have been removed.

4.2.7 Dry pack a gravity column (glass, 300 mm x 10.5 mm) fitted with a PTFE stopcock in the following manner:

4.2.7.1 Insert a precleaned plug of silanized glass wool in the bottom of the column.

4.2.7.2 Add a 4-g layer of sodium sulfate to the column.

4.2.7.3 Add a 4-g layer of Woelm Super I neutral alumina and tap the top of the column gently. Woelm Super I neutral alumina does not need to be activated or cleaned prior to use, but it should be stored at all times in a sealed desiccator.

4.2.7.4 Add a 4-g layer of anhydrous granular sodium sulfate to cover the alumina.

4.2.7.5 Elute the column with 10 mL hexane and close the stopcock just before the level of the solvent reaches the top layer of sodium sulfate. Discard the eluate and check the column for channeling. If channeling is present, discard the packing and repack the column.

4.2.8 Adjust the volume of the acid and base washed extract to 2 mL with hexane and gently apply the extract to the top of the column. Open the stopcock to draw the sample into the column and close the stopcock. Rinse the sample container with three 1-mL portions of hexane and add to the column, always drawing the rinse into the column before applying the next rinse. Discard the eluate.

4.2.9 Elute the column with 10 mL of an 8% (v/v) methylene chloride in hexane solution. Collect this fraction and archive.

4.2.10 Elute the PCDD/PCDFs from the column using 15 mL of a 60% (v/v) methylene chloride in hexane solution. Collect this fraction in a 15-mL conical vial.

4.2.11 Pack a carbon column for further cleanup of the sample as follows:

4.2.11.1 Cut off both ends of a 10-mL disposable serological pipet such that a 4-in column remains.

4.2.11.2 Insert a preextracted silanized glass wool plug at one end of the column and pack the column with 0.64 g of the activated Carbopak C/Celite 545 mixture to form a 2-cm-long adsorbent bed. Cap the packing with another silanized glass wool plug.

4.2.12 Concentrate the alumina column eluate (step 4.2.1.10) using a nitrogen evaporator as follows:

4.2.12.1 Rinse the disposable pipettes to be used as needles in the N_2 evaporator with hexane.

4.2.12.2 Insert the sample vial in the rack and direct the flow of N_2 into the sample. Adjust the flow such that gentle waves are noticeable on the surface of the sample extract.

4.2.12.3 Concentrate the sample extract to < 1 mL, add 5 mL hexane, and concentrate to 2 mL.

4.2.13 Rinse the Carbopak C/Celite 545 column with the following solvents:

- 5 mL toluene
- 2 mL of a 75:20:5 (v/v) methylene chloride/methanol/ benzene mix
- 1 mL of a 1:1 (v/v) cyclohexane/methylene chloride mix
- 5 mL hexane

4.2.14 The flow rate should be less than 0.5 mL/min. Discard the rinsates.

4.2.15 While the column is still wet with hexane, add the sample concentrate to the top of the column. Rinse the sample extract container twice with 1-mL hexane portions and add the rinsates to the top of the column. Elute the column sequentially with:

- Two 2-mL portions of hexane
- One 2-mL portion of a 1:1 (v/v) cyclohexane/methylene chloride mix
- One 2-mL portion of a 75:20:5 (v/v) methylene chloride/ methanol/benzene mix

4.2.16 These eluates can be collected in the same container. Archive these the combined eluates for checks on column efficiency.

4.2.17 Invert the column and elute the PCDD/PCDF fraction with 20 mL toluene into a 50-mL boiling flask. Verify that there are no carbon fines in the eluate.

4.2.18 Concentrate the toluene fraction to about 1 mL on a rotary evaporator (water bath at 50°C). Carefully transfer the sample into a graduated 1-mL conical vial, and reduce the volume to about 100 µL using a nitrogen evaporator. Rinse the boiling flask three times with 300 µL of a 1% (v/v) toluene in methylene chloride solution and add to the cleaned-up extract. Reduce the volume to 100 µL once again.

4.2.19 Store the sample at room temperature in the dark.

5.0 PREPARATION AND USE OF CALIBRATION STANDARDS, METHOD INTERNAL STANDARDS (SURROGATES), AND RECOVERY INTERNAL STANDARDS

Recovery internal standards are compounds added to the native sample matrix just prior to GC/MS analysis to determine the recovery of method internal standards and relative response factors of the calibration standards. Method internal standards (surrogates) are compounds added to the native sample matrix prior to sample extraction to determine if any sample matrix effects and extraction problems prevent good recovery of the compounds from the sample.

5.1 General Procedures for Standard Preparation

5.1.1 Preparation and/or acquisition of accurate calibration standards, method internal standards, and recovery internal standards are extremely crucial in achieving accurate quantification of sample components and determination of analytical quality. It is also important that the standards be prepared in the correct solvent, since the standards are used both for direct analysis and for spiking.

5.1.2 As many as possible of the pure compounds and diluted calibration standards will be obtained from the EPA Quality Assurance Branch, EMSL/CI, and the Reference Standards Repository EPA/RTP.

5.1.3 The source, lot number, and purity of all standards will be recorded in the LRB. All standard solutions will contain the following information on its respective vial:

- Concentration of standard
- Date of preparation
- Solvent used
- Project number of sample ID
- Initials of person preparing solution
- Expiration date of solution

5.1.4 Primary stock solutions of the various target analytes will be prepared. All neat standards will be weighed on an analytical balance and diluted to the mark in a Class A volumetric flask with the appropriate solvent. Secondary standard mixes will be prepared by combining the appropriate volumes of the primary stock solutions in a Class A volumetric flask and diluting to the mark with the appropriate solvent.

5.1.4.1 Calibrate the analytical balance prior to weighing standards by using certified Class S weights which are in the range of the standard weighings.

5.1.4.2 Dilutions of the secondary standard mixed solutions will be prepared by serial dilution. Preparation of final working solutions will be recorded and dilution records maintained.

5.1.4.3 The various standard solutions will be stored at 4°C in a Teflon-lined screw-cap amber vial with the solution level marked on the vial.

5.2 Standards Used in the Analysis of PCDD/PCDF Organic Compounds

The semivolatile organic compounds consist of liquids and solids. The solid and liquid compounds will be weighed and diluted to volume in Class A volumetric flasks. Wash all glassware used in the standard preparation as outlined in Section 1.2.2 of Section 1.0. All standards are stored at ≤ 4°C in amber vials with Teflon-lined screw cap.

Recovery internal, method internal (surrogate), native calibration and GC performance check standard solutions for PCDD/PCDF analysis should be obtained from the MRI repository of dioxin/furan standards. See Table A4-1 for a complete list of dioxin/furan analytes, method internal standards, and recovery internal standards. Dioxin/furan native calibration standard, method internal standard (surrogate) and recovery internal standard solutions will be:

- Dissolved in anisole or toluene and diluted with tridecane for analysis by GC/MS. The method internal standards will be prepared in isooctane for spiking into samples.

- Prepared in quantities of at least 1 mL. Prepare enough method internal standard to last the entire project.

- Prepared in concentrations listed in Table A4-2. Each working standard solution will be prepared to contain the same concentration of each of the isotopically stable labeled method internal standards but a different concentration of native calibration standards. The ratio of native calibration standards to method internal standards will range from 0.05 to 4.

- Replaced after 6 months or sooner if comparison with quality control check samples indicates compound degradation or concentration change.

The GC performance check mixture will be per Table A4-3 with each isomer at a concentration equivalent to DF50 from Table A4-2.

TABLE A4-1. LIST OF ANALYTES, METHOD INTERNAL STANDARDS (SURROGATES), AND RECOVERY INTERNAL STANDARDS FOR DIOXIN/FURAN ANALYSIS

Analyte	Compounds in calibration standard	Method internal standard[a]	Recovery internal standard[b]
Tetra-CDD	2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD[c]
Tetra-CDF	2,3,7,8-TCDF	$^{13}C_{12}$-2,3,7,8-TCDF	
Penta-CDD	1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,7,8-PeCDD	
Penta-CDF	1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF	
Penta CDF	2,3,4,7,8-PeCDF		
Hexa-CDD	1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	
Hexa-CDD	1,2,3,6,7,8-HxCDD		
Hexa-CDD	1,2,3,7,8,9-HxCDD		$^{13}C_{12}$-1,2,3,7,8,9-HxCDD[d]
Hexa-CDF	1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	
Hexa-CDF	1,2,3,6,7,8-HxCDF		
Hexa-CDF	2,3,4,6,7,8-HxCDF		
Hexa-CDF	1,2,3,7,8,9-HxCDF		
Hepta-CDD	1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	
Hepta-CDF	1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	
Hepta-CDF	1,2,3,4,7,8,9-HpCDF		
Octa-CDD	OCDD	$^{13}C_{12}$-OCDD	
Octa-CDF	OCDF		

[a] Added to sample prior to extraction.

[b] Added to sample at time of injection into GC/MS.

[c] Used for recovery determinations of TCDD, TCDF, PeCDD, and PeCDF method internal standards.

[d] Used for recovery determinations of HxCDD, HxCDF, HpCDD, HpCDF, and OCDD method internal standards.

TABLE A4-2. SUGGESTED CONCENTRATIONS OF CONGENERS IN TCDD/TCDF-OCDD/OCDF CALIBRATION STANDARDS, METHOD INTERNAL STANDARDS (SURROGATES), AND RECOVERY INTERNAL STANDARDS FOR SIM ANALYSIS

Compound	Concentration (pg/μL)				
	DF2.5	DF5	DF10	DF50	DF200
Unlabeled Analytes					
2,3,7,8-TCDD	2.5	5	10	50	200
2,3,7,8-TCDF	2.5	5	10	50	200
1,2,3,7,8-PeCDD	2.5	5	10	50	200
1,2,3,7,8-PeCDF	2.5	5	10	50	200
2,3,4,7,8-PeCDF	2.5	5	10	50	200
1,2,3,4,7,8-HxCDD	6.25	12.5	25	125	500
1,2,3,6,7,8-HxCDD	6.25	12.5	25	125	500
1,2,3,7,8,9-HxCDD	6.25	12.5	25	125	500
1,2,3,4,7,8-HxCDF	6.25	12.5	25	125	500
1,2,3,6,7,8-HxCDF	6.25	12.5	25	125	500
1,2,3,7,8,9-HxCDF	6.25	12.5	25	125	500
2,3,4,6,7,8-HxCDF	6.25	12.5	25	125	500
1,2,3,4,6,7,8-HpCDD	6.25	12.5	25	125	500
1,2,3,4,6,7,8-HpCDF	6.25	12.5	25	125	500
1,2,3,4,7,8,9-HpCDF	6.25	12.5	25	125	500
OCDD	12.5	25	50	250	1,000
OCDF	12.5	25	50	250	1,000
Internal Standards					
$^{13}C_{12}$-2,3,7,8-TCDD	50	50	50	50	50
$^{13}C_{12}$-2,3,7,8-TCDF	50	50	50	50	50
$^{13}C_{12}$-1,2,3,7,8-PeCDD	50	50	50	50	50
$^{13}C_{12}$-1,2,3,7,8-PeCDF	50	50	50	50	50
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	125	125	125	125	125
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	125	125	125	125	125
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	125	125	125	125	125
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	125	125	125	125	125
$^{13}C_{12}$-OCDD	250	250	250	250	250
Recovery Standards					
$^{13}C_{12}$-1,2,3,4-TCDD[a]	50	50	50	50	50
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD[b]	125	125	125	125	125

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[a] Used for recovery determinations of TCDD, TCDF, PeCDD, and PeCDF internal standards.

[b] Used for recovery determinations of HxCDD, HxCDF, HpCDD, HpCDF, and OCDD internal standards.

TABLE A4-3. PCDD AND PCDF CONGENERS PRESENT IN THE GC PERFORMANCE EVALUATION SOLUTION AND USED FOR DEFINING THE HOMOLOGOUS GC RETENTION TIME WINDOWS ON A 60-m DB-5 COLUMN[a]

No. of chlorine atoms	PCDD-positional isomer		PCDF-positional isomer	
	Early eluter	Late eluter	Early eluter	Late eluter
4[b]	1,3,6,8	1,2,8,9	1,3,6,8	1,2,8,9
5	1,2,4,6,8/ 1,2,4,7,9	1,2,3,8,9	1,3,4,6,8	1,2,3,8,9
6	1,2,3,4,6,8	1,2,3,4,6,7	1,2,3,4,6,8	1,2,3,4,8,9
7	1,2,3,4,6,7,8	1,2,3,4,6,7,9	1,2,3,4,6,7,8	1,2,3,4,6,7,9
8		1,2,3,4,6,7,8,9		1,2,3,4,6,7,8,9

[a] Tetra- and penta-CDD and CDFs will be at 50 pg/µL, hexa- and hepta-CDD and CDFs will be at 125 pg/µL, and octa-CDD and CDFs will be at 250 pg/µL.

[b] In addition to these two PCDD isomers, the 1,2,3,4-, 1,2,3,7-, 1,2,3,8-, 2,3,7,8-, $^{13}C_{12}$-2,3,7,8-, and 1,2,3,9-TCDD isomers must also be present.

6.0 GC/MS ANALYSIS OF PCDD/PCDFs

Analysis for PCDD/PCDFs will be performed in accordance to SW-846 Draft Method 8290. This method employs high resolution gas chromatography/ high resolution mass spectrometry techniques to measure parts-per-trillion and lower levels of PCDD/PCDFs in soil, sediment, and aqueous samples. MRI has adapted the method for analysis of PCDD/PCDFs in MM5 sampling train components.

MRI will use in-house developed software to reduce and quantify the results for all samples. In addition, the data from a selected number of samples will be reduced manually to validate the results obtained from the MRI developed software.

6.1 Instrument Requirements and Operating Conditions

The following analytical instrument requirements and operating conditions will be used for the analysis of PCDD/PCDFs by GC/HRMS.

- Mass spectrometer--double focusing, capable of maintaining static resolving power at a minimum of 10,000 (10% valley). Should be operated in the electron impact mode at a nominal electron energy of 70 eV. The mass spectrometer must be operated in the selected ion monitoring (SIM) mode. System must be capable of acquiring data at a minimum of 10 ions per scan.
- Scan time--1 s or less (including voltage reset time).
- Scan range--202 to 472 amu, SIM mode monitoring the ions listed in Table A4-4.
- Resolution--10,000.
- Analytical column--DB-5, 60-m x 0.32-mm ID, 25-µm film thickness.
- Carrier gas--Helium, 20 to 40 cm/s.
- Injector--Grob type, splitless mode at 270°C, splitless valve time of 45 s.
- Injection volume--1 to 2 µL, same volume used for all standards and samples.
- Transfer line temperature--350°C.
- Temperature program--200°C (2-min hold), increase to 220°C at 5°C/min (16-min hold), increase to 235 at 5°C/min (7-min hold), increase to 330°C at 5°C/min (5-min hold).

TABLE A4-4. IONS MONITORED FOR HRGC/HRMS ANALYSIS OF PCDD/PCDFs (S = INTERNAL/RECOVERY STANDARD)

Descriptor	Accurate(a) Mass	Ion ID	Elemental Composition	Analyte
1	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF
	315.9419	M	${}^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF (S)
	317.9389	M+2	${}^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF (S)
	319.8965	M	$C_{12}H_4{}^{35}Cl_4O_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	331.9368	M	${}^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD (S)
	333.9339	M+2	${}^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD (S)
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_6O$	HxCDPE
	[354.9792]	LOCK	C_9F_{13}	PFK
2	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF
	351.9000	M+2	${}^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF (S)
	353.8970	M+4	${}^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF (S)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD
	367.8949	M+2	${}^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD (S)
	369.8919	M+4	${}^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD (S)
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_7O$	HpCDPE
	[354.9792]	LOCK	C_9F_{13}	PFK

(Continued)

TABLE A4-4 (continued)

Descriptor	Accurate Mass	Ion ID	Elemental Composition	Analyte
3	373.8208	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDF
	383.8642	M	$^{13}C_{12}H_2{}^{35}Cl_6O$	HxCDF (S)
	385.8610	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF (S)
	389.8156	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD
	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD (S)
	403.8529	M+4	$^{13}C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD (S)
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_6{}^{37}Cl_2O$	OCDPE
	[354.9792]	LOCK	C_9F_{13}	PFK
4	407.7818	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF
	409.7789	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O$	HpCDF
	417.8253	M	$^{13}C_{12}H^{35}Cl_7O$	HpCDF (S)
	419.8220	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF (S)
	423.7766	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD
	425.7737	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD
	435.8169	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD (S)
	437.8140	M+4	$^{13}C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD (S)
	479.7165	M+4	$C_{12}H^{35}Cl_7{}^{37}Cl_2O$	NCDPE
	[430.9728]	LOCK	C_9F_{17}	PFK

(Continued)

TABLE A4-4 (continued)

Descriptor	Accurate Mass	Ion ID	Elemental Composition	Analyte
5	441.7428	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO$	OCDF
	443.7399	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	$^{13}C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD (S)
	471.7750	M+4	$^{13}C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD (S)
	513.6775	M+4	$C_{12}{}^{35}Cl_8{}^{37}Cl_2O$	DCDPE
	[430.9728]	LOCK	C_9F_{17}	PFK

(a)The following nuclidic masses were used:

H = 1.007825	O = 15.994915
C = 12.000000	^{35}Cl = 34.968853
13C = 13.003355	^{37}Cl = 36.965903

6.2 Instrument Tuning and Calibration

The GC/MS must be tuned and calibrated every day during which samples are to be analyzed. The following tests must be performed at the beginning and end of each 12-h period (except as specified below) of sample analysis.

6.2.1 Mass Calibration--

The following tests are used to check the mass spectrometer's resolving power and mass accuracy. These tests are conducted because the mass of the ions monitored are exact (to four decimal places), and even slight instrumental drift may result in incorrect masses being monitored. These tests are to be performed at the beginning and end of each 12-h period of consecutive analysis.

6.2.1.1 Introduce a small amount of PFK (perfluorokerosene) into the system by molecular leak. The level of PFK introduced into the system should be adjusted so that the amplitude of the most intense lock-mass ion signal does not exceed 10% of the full-scale deflection.

6.2.1.2 The mass resolution check is accomplished by recording the peak profiles of *m/z* 304.9824 and 380.9760 of PFK on a calibrated mass scale (horizontal axis, amu or ppm per division) and measuring the width of the latter peak at the 5% abundance level over a 200-ppm range. The peak width must not exceed 100 ppm (or 0.038 amu).

6.2.1.3 Confirm that the exact mass of *m/z* 380.9760 is within 5 ppm of the required value.

6.2.2 GC Column Performance Check--

A GC column performance check mixture contains the known first and last chromatographic eluters for each group of PCDD/PCDF congeners, such that all of the congeners within a homologous series will elute between the first and last eluters. In addition, the GC performance check mixture contains 2,3,7,8-TCDD and several other TCDD congeners which elute close to 2,3,7,8-TCDD. This solution is analyzed to establish the retention times at which the ions monitored will be switched to a different set of ions, and also to determine the chromatographic resolution between 2,3,7,8-TCDD and the closest eluting TCDD congener. The GC column performance mix will be analyzed once at the beginning of each 12-h analysis, after performing the mass resolution and accuracy test described above.

6.2.2.1 Inject 2 µL of the GC performance check mixture (Table 3) and acquire SIM data as described in Table 4.

6.2.2.2 Determine the chromatographic resolution between 2,3,7,8-TCDD and the closest eluting TCDD peak. This is accomplished by the following equation:

$$\text{Resolution (\% valley)} = (x \div y) \times 100$$

where: x = total height of the valley (from baseline) separating 2,3,7,8-TCDD and the closest eluting TCDD

y = total peak height (from baseline) of 2,3,7,8-TCDD

6.2.2.3 The resolution must be ≤ 25%.

6.2.2.4 Determine the retention time (or scan number) of the first and last eluter for each homologous series. Print out an RIC (reconstructed ion chromatogram) for each of the five homologous series (Cl_4 to Cl_8) and label each peak together with an "F" for the first eluter and an "L" for the last eluter in the series. These retention times will be used to establish the switching times for the SIM descriptors.

6.2.2.5 Allowable tolerance on the daily verification of the GC performance check mixture will be ±10-s drift on the absolute retention times of all components.

6.2.3 Instrument Calibration--

Before any samples can be analyzed, an initial five-point calibration will be performed. This calibration will be verified at the beginning and end of each 12-h period of sample analysis.

6.2.3.1 Initial calibration--Initial calibration is required before any samples may be analyzed, but after all of the tests described above have been successfully completed. Initial calibration is also required if any continuous calibration check is not successful.

6.2.3.1.1 Analyze 2 µL of each of the five calibration solutions. Note that prior to analysis, each solution must be spiked with the appropriate amount of the recovery internal standards mix (50 pg/µL of ^{13}C-1,2,3,4-TCDD and 125 pg/µL of ^{13}C-1,2,3,7,8,9-HxCDD).

6.2.3.1.2 Confirm that the ratio of the areas for each of the two ions monitored for each homologous set of congeners and for the ^{13}C-labeled internal standards are within the control limits indicated in Table A4-5.

6.2.3.1.3 Confirm that the signal-to-noise (S/N) ratio for each target compound is ≥ 2.5.

6.2.3.1.4 Calculate the relative response factors (RRF) for each of the 17 unlabeled PCDD/PCDF target analytes relative to the appropriate method internal standards (surrogates) and for each of the 9 labeled PCDD/PCDF internal standards relative to the appropriate recovery internal standards.

6.2.3.1.5 Calculate the average RRF and the percent relative standard deviation (RSD) for each target compound. For the initial calibration to be acceptable, the % RSD of the average RRFs must be < 20%.

TABLE A4-5. THEORETICAL ION ABUNDANCE RATIOS AND THEIR CONTROL LIMITS FOR PCDDs AND PCDFs

Number of Chlorine Atoms	Ion Type	Theoretical Ratio	Control Limits lower	Control Limits upper
4	$\frac{M}{M+2}$	0.77	0.65	0.89
5	$\frac{M+2}{M+4}$	1.55	1.24	1.86
6	$\frac{M+2}{M+4}$	1.24	1.05	1.43
6(a)	$\frac{M}{M+2}$	0.51	0.43	0.59
7(b)	$\frac{M}{M+2}$	0.44	0.37	0.51
7	$\frac{M+2}{M+4}$	1.04	0.88	1.20
8	$\frac{M+2}{M+4}$	0.89	0.76	0.89

(a) Used only for ^{13}C-HxCDF (IS).
(b) Used only for ^{13}C-HpCDF (IS).

6.2.3.2 Continuing calibration--Continuing calibration must be conducted at the beginning of each 12-h period of analysis after successful mass accuracy and resolution GC resolution performance checks. Continuous calibration is also required at the end of a 12-h shift, before the final mass resolution and accuracy check. If the continuing calibration does not meet criteria, the initial calibration must be repeated and the samples reanalyzed except as noted below.

6.2.3.2.1 Analyze 2 µL of the midlevel calibration solutions. Note that prior to analysis, each solution must be spiked with the appropriate amount of the recovery internal standards mix (50 pg/µL of ^{13}C-1,2,3,4-TCDD and 125 pg/µL of ^{13}C-1,2,3,7,8,9-HxCDD).

6.2.3.2.2 Confirm that the ratio of the areas for each of the two ions monitored for each homologous set of congeners and for the ^{13}C-labeled internal standards must be within control limits.

6.2.3.2.3 Calculate the relative response factors (RRF) for each of the 17 unlabeled PCDD/PCDF target analytes relative to the appropriate method internal standards (surrogates) and for each of the 9 labeled PCDD/PCDF internal standards relative to the appropriate recovery internal standards.

6.2.3.2.3.1 For the continuing calibration to be acceptable, the RRFs must be within ±20% of the average RRF from the initial calibration.

6.2.3.2.3.2 If the end-of-the-day continuing calibration check standard has RRFs that are not within 20% but are within ±25% of the average RRF from the curve, samples analyzed during that 12-h period will be calculated using the average RRF from the beginning-of-day and the end-of-day standards.

6.2.3.2.3.3 If the end-of-day continuing calibration check standard has RRFs that are not within 25% of the average RRF from the curve, all positive samples analyzed during that 12-h period are invalidated and must be reanalyzed.

6.3 Sample Analysis

Samples may be analyzed only after the initial tuning and calibration requirements have been met. In addition, a solvent blank must be analyzed before any samples can be injected.

6.3.1 Adjust the volume of each sample to be analyzed to the final amount.

6.3.2 Add recovery internal standards to each sample or portion thereof such that there are 50 pg/µL of ^{13}C-1,2,3,4-TCDD and 125 pg/µL of ^{13}C-1,2,3,7,8,9-HxCDD.

6.3.3 Inject 2 µL of a hexane solvent blank. If the the blank contains any of the 2,3,7,8-substituted congeners at more than 10% of the detection limit, the results of all positive samples analyzed on that 12-h shift are invalidated and will require reanalysis.

6.3.4 Analyze 2 µL of each sample.

6.4 Data Reduction

Data reduction of each sample run consists of confirmation of target compounds identification and quantification of the compounds detected.

6.4.1 Documentation--

For each sample analyzed, the following documentation must accompany analytical results for the purpose of their validation.

6.4.1.1 Reconstructed ion chromatogram (RIC) with a header identifying the sample or standard by a unique laboratory designator.

6.4.1.2 Extracted current ion profiles (EICPs) for each compound detected within the appropriate retention time window. For each compound, there must be one EICP page which will include the name of the compound monitored in the page header, and the following information. All peaks must include scan numbers and areas found. The primary and secondary quantitation ions must be printed together with the appropriate PCDPE interferent ion.

6.4.2 Compound Identification Criteria--

For a GC peak to be positively identified as a PCDD/PCDF, it must meet all of the following criteria:

6.4.2.1 For 2,3,7,8-substituted congeners which have an equivalent ^{13}C-labeled method or recovery internal standard in the sample extract, the retention times of the unlabeled congeners must be within -1 and +3 s of the retention time of the equivalent ^{13}C-labeled congener.

6.4.2.2 For 2,3,7,8-substituted congeners that do not have an equivalent ^{13}C-labeled congener in the sample extract, the relative retention time (RRT) of the unlabeled congener must be within the established GC retention window for its homologous series.

6.4.2.3 For non-2,3,7,8-substituted congeners, the retention time must be within the established GC retention window for its homologous series.

6.4.2.4 The ion current responses for the primary and secondary ions used for confirmation and quantification purposes must reach their apex within ±2 s of each other.

6.4.2.5 The ion abundance ratios of both ions used for quantitative purposes must be within the tolerance limits for the homologous series to which the peak is assigned.

6.4.2.6 Signal-to-noise ratios must be ≥ 2.5 for compounds tentatively identified.

6.4.2.7 Because polychlorinated diphenyl ethers (PCDPE) are a common interferent for analysis of PCDFs, the extracted ion current plot of the corresponding PCDPE must have a S/N ratio < 2.5.

6.4.3 Quantification--

The amount of each 2,3,7,8-substituted congener included in the calibration standards will be calculated together with total tetra- to octa-PCDD/PCDFs using the formula:

$$C_x = \frac{(\text{area}_{\text{quantitation ion}} \times \text{amount}_{\text{internal standard }[\mu g]})}{(\text{area}_{\text{internal standard}} \times \text{RRF}_{\text{average}} \times \text{amount extracted }[\text{g or L}])}$$

where: C_x = concentration [µg/g or µg/L] or total amount [µg] found in the sample. If convenient, the units may be changed to reflect the magnitude of the value of C_x.

$\text{RRF}_{\text{average}}$ is the average RRF for each individual congener in the calibration mixtures or is representative of the RRF for that homologous group of congeners.

- For congeners that belong to a homologous series containing only one isomer (i.e., OCDD and OCDF) or only one 2,3,7,8-substituted congener (TCDDs, PeCDDs, HpCDDs and TCDFs), the average RRF to be used will be the same as that used for the individual compounds.
- For congeners that belong to a homologous series containing more than one 2,3,7,8-substituted congener (i.e., HxCDD, PeCDF, HxCDF, and HpCDF), the average RRF to be used will be the mean of the average RRFs calculated for the 2,3,7,8-substituted congeners representative of that homologous series analyzed during calibration.
- Please be sure to note Sections 6.2.3.2.3.1 to 6.2.3.2.3.3 for specific cases in which the average RRF from the curve will not be used.

6.5 SW-846 Method Modifications, Deviations, and Enhancements

The following modifications, deviations, and enhancements from SW-846 and other standard methods will be employed during this study. None are expected to impact the quality of the results submitted.

6.5.1 Method 8290 specifies that before any samples are analyzed, a method blank associated to the samples be analyzed. MRI will instead analyze a solvent blank to confirm that there is no carryover in the chromatographic system. If any method blank presents contamination problems, the specific causes of the problem will be investigated and reported.

APPENDIX A-5

TOC ANALYSIS PROCEDURES

TOTAL ORGANIC AND CARBONATE CARBON CONTENT OF SEDIMENTS

1.0 INTRODUCTION

Precise measurements of total organic and carbonate carbon are necessary for interpreting trace organic contamination. Carbon concentrations are determined on freeze-dried (or oven-dried at 40° to 50°C) sediment using a LECO Model 523-300 induction furnace (or equivalent) to burn samples in an oxygen atmosphere. The carbon dioxide that is produced is swept out of the furnace's combustion chamber by the oxygen flow. The gases then pass through a dust trap and two reaction tubes. The first of these is a two-stage chamber with the first stage consisting of manganese dioxide. The manganese dioxide absorbs the sulfur oxides that may have formed during combustion. The second stage is made of anhydrone which removes water vapor from the gas stream. The second tube, filled with platinized silica, is maintained at an elevated temperature by an external heating case. The contents of this tube act as a catalyst to convert any carbon monoxide present into carbon dioxide. Carbon dioxide is detected and quantified with a Horiba PIR-2000 infrared detector. The output signal from the Horiba is sent to a HP 3396A integrator which reports the quantity of carbon dioxide as a peak area.

Total organic carbon is determined after sample acidification. Carbonate carbon is determined as the difference between total carbon and total organic carbon.

2.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE

2.1 Sample Collection

Sediment should be collected in precleaned and/or precombusted (400°C) glass jars, or core liners and frozen (-20°C) in the field.

2.2 Sample Preservation and Storage

Sediment samples are shipped frozen to the laboratory and stored at -20°C until analysis. After subsampling excess sample is archived at -20°C in the dark.

3.0 APPARATUS AND MATERIALS

3.1 Labware and Apparatus

The following labware and equipment is needed to perform the total organic carbon and total carbon analyses:

Freeze Drier: Capable of freeze drying sediment at -40°C.

Mortar and Pestal: 500-ml mortar or other suitable container.

LECO Model 523-300 Induction Furnace

Horiba PIR-2000 Infrared Detector: Or other suitable detector.

HP 3396A Integrator: Or other suitable recorder/integrator.

Glass Measuring Scoop

Drying Oven: Capable of maintaining 40° to 50°C.

Analytical Balance: Capable of weighing to 1 mg.

Rotameter: Part No. 112-02, Cole-Parmer, Inc.

Flow Controller: Part No. 42300513, Veriflo Corp.

Note: Volumetric glassware for accelerator measurement and analytical balances must be calibrated.

3.2 Reagents

The following reagents are required:

10% HCl in Methanol (V:V)

LECO Iron Chip Accelerator: Part No. 501--077, Leco Corp.

LECO Copper Metal Accelerator: Part No. 501-263, Leco Corp.

LECO Combustion Crucibles

LECO Pin and Ring Carbon Standards: Range: 0.1 to 1.0% carbon.

4.0 PROCEDURE

4.1 Leco System Preparation

The first step in operating the LECO furnace is to turn it on by flipping all switches on the front panel to the "ON" (up) position. The "Grid Tap Switch" should be set to the "MED" position. The instrument then needs a warm-up period of at least 30 minutes. When the furnace has had time to warm-up, close the oven on the right side of the instrument (pedestal up) and open the valve on the oxygen tank; set the regulator pressure to 40 psi. Open the toggle valve and allow oxygen to flow through the system for 15 seconds and then check the flow rate using the rotameter. Set to the 150 mark on the rotameter tube with the knob on the flow controller to the right of the rotameter. After 30 seconds of correct flow, zero the panel meter on the front of the Horiba Infrared Analyzer. Set the Horiba Infrared Analyzer detector range to 3, and the span to 0.

4.2 Total Carbon Determination

4.2.1 Sample Preparation

Weigh 10 to 500 mg of freeze dried (or oven dried) sediment into a tared crucible. The amount of sample depends upon the expected carbon concentration. Ideally between 0.5 mg and 8.6 mg of carbon should be combusted to fall within the range of the standard curve.

Add one scoop each of the copper and iron chip accelerators to all the weighed crucibles containing samples. All crucibles should be kept covered with aluminum foil prior to analyses.

4.2.2 Sample Analyses

Place the crucible on the oven pedestal. Close the oven and start the oxygen flow. Allow the oxygen to flow for 15 seconds and then check the flow rate on the rotameter and adjust the flow, if needed. After 15 seconds of correct flow, push the pedestal lever in to start the induction furnace. At the same time push the "START" button on the HP integrator. About 20 seconds after the furnace is activated the metals should begin to burn. After about another 20 seconds the detector should begin to register carbon dioxide in the gas flow and the integrator should begin to show a peak. At this point carefully pull the lever out to turn the furnace OFF -- be sure that you don't open the combustion chamber. Once the integrator has returned to baseline, carefully open the oven and press STOP on the integrator. Use a pair of large tweezers or tongs to take the hot crucible off the oven pedestal and place it on a non-flammable heat-resistant surface to cool. Repeat this procedure for all crucibles to be run.

4.2.3 Standard Analyses

Stardard Leco pin and ring carbon standards are placed into an empty crucible with one scoop of the copper accelerator. Standards are analyzed per the identical procedure as outlined in Section 4.2.2.

4.3 Total Organic Carbon Determination

4.3.1 Sample Preparation

Weigh an appropriate amount of freeze dried (or oven dried) sample as per step 4.2.1 into a tared crucible. Add small amounts of 10% HCl in methanol solution slowly to the sample until all bubbling stops. Use a minimal amount of acid. Dry the treated samples overnight at $50^{O}C$ in the drying oven.

4.3.2 Sample Analyses

Combust and analyze as indicated in Section 4.2.2.

4.3.3 Standard Analyses

Standards are analyzed per the identical procedure as outlined in Section 4.2.3.

4.4 Total Carbonate Carbon Content

Carbonate content is determined by subtracting the total organic carbon concentration from the total carbon concentration. To express as percent calcium carbonate, instead of total carbonate carbon content, multiply this result by 8.33.

5.0 STANDARDIZATION AND CALCULATIONS

Prior to combusting samples, a set of standards is run to determine a standard curve. Standard curves vary slightly from day to day.

5.1 To determine the curve, combust a set of five standards at varying concentrations. Several standard rings and/or pins may need to be run initially to bring the system to correct operating conditions; the data collected will be discarded. The values of the standards in the set should be selected to cover the 0.1 to 1.0% carbon range (1 gram basis).

5.2 A graphics package on a Macintosh (such as Kaleidagraph) is used to make a graph of carbon percentage vs. integrator counts. This software is used to determine a best fit equation for the data. R should be no less than .99 or the data set should be discarded and another set of five calibration points should be run and plotted. This equation will be used to determine the carbon percentage of samples for that day.

5.3 The counts reported by the integrator for a sample are simply entered for X in the equation and Y becomes an intermediate value. The Y value is divided by the sample weight in grams to determine the percent carbon.

6.0 QUALITY CONTROL

Quality control samples are processed in an identical manner as the actual samples.

6.1 A method blank is run with every 20 samples, or with every sample set, whichever is more frequent. Blank levels should be no more than 3x method detection limit (MDL).

6.2 Duplicate samples are run every 20 samples, or with every sample set. Duplicates should be ± 20% for low level (<1.0% carbon) samples and ± 10% for normal/high level (>1.0% carbon) sample. Duplicates may be somewhat less precise for very inhomogeneous samples (i.e., peats, samples containing twigs, grasses, etc.).

6.3 Reference Materials: Leco pin and ring carbon standards are run as reference materials and standards.

7.0 REPORTNG AND PERFORMANCE CRITERIA

7.1 Reporting Units

Reporting units are percent organic carbon (on a dry weight basis) and percent carbonate carbon (on a dry weight basis).

7.2 Minimum Method Performance Criteria

The minimum method performance standard for the method is detection of 0.02 percent carbon in a sample.

7.3 Significant Figures

Results are reported to two (2) significant figures.

7.4 Duplicate Analyses

All duplicate analyses are reported. Duplicate analyses are run at least every 20 samples.

7.5 Reference Materials

Leco pin and ring carbon standards are analyzed as reference materials and standards.

ORGANIC CARBON, TOTAL

Method 415.1 (Combustion or Oxidation)

STORET NO. Total 00680
Dissolved 00681

1. Scope and Application
   1.1 This method includes the measurement of organic carbon in drinking, surface and saline waters, domestic and industrial wastes. Exclusions are noted under Definitions and Interferences.
   1.2 The method is most applicable to measurement of organic carbon above 1 mg/l.
2. Summary of Method
   2.1 Organic carbon in a sample is converted to carbon dioxide (CO_2) by catalytic combustion or wet chemical oxidation. The CO_2 formed can be measured directly by an infrared detector or converted to methane (CH_4) and measured by a flame ionization detector. The amount of CO_2 or CH_4 is directly proportional to the concentration of carbonaceous material in the sample.
3. Definitions
   3.1 The carbonaceous analyzer measures all of the carbon in a sample. Because of various properties of carbon-containing compounds in liquid samples, preliminary treatment of the sample prior to analysis dictates the definition of the carbon as it is measured. Forms of carbon that are measured by the method are:
      A) soluble, nonvolatile organic carbon; for instance, natural sugars.
      B) soluble, volatile organic carbon; for instance, mercaptans.
      C) insoluble, partially volatile carbon; for instance, oils.
      D) insoluble, particulate carbonaceous materials, for instance; cellulose fibers.
      E) soluble or insoluble carbonaceous materials adsorbed or entrapped on insoluble inorganic suspended matter; for instance, oily matter adsorbed on silt particles.
   3.2 The final usefulness of the carbon measurement is in assessing the potential oxygen-demanding load of organic material on a receiving stream. This statement applies whether the carbon measurement is made on a sewage plant effluent, industrial waste, or on water taken directly from the stream. In this light, carbonate and bicarbonate carbon are not a part of the oxygen demand in the stream and therefore should be discounted in the final calculation or removed prior to analysis. The manner of preliminary treatment of the sample and instrument settings defines the types of carbon which are measured. Instrument manufacturer's instructions should be followed.

Approved for NPDES
Issued 1971
Editorial revision 1974

4. Sample Handling and Preservation
   4.1 Sampling and storage of samples in glass bottles is preferable. Sampling and storage in plastic bottles such as conventional polyethylene and cubitainers is permissible if it is established that the containers do not contribute contaminating organics to the samples.
   NOTE 1: A brief study performed in the EPA Laboratory indicated that distilled water stored in new, one quart cubitainers did not show any increase in organic carbon after two weeks exposure.
   4.2 Because of the possibility of oxidation or bacterial decomposition of some components of aqueous samples, the lapse of time between collection of samples and start of analysis should be kept to a minimum. Also, samples should be kept cool (4°C) and protected from sunlight and atmospheric oxygen.
   4.3 In instances where analysis cannot be performed within two hours (2 hours) from time of sampling, the sample is acidified ($pH \leq 2$) with HCl or H_2SO_4.
5. Interferences
   5.1 Carbonate and bicarbonate carbon represent an interference under the terms of this test and must be removed or accounted for in the final calculation.
   5.2 This procedure is applicable only to homogeneous samples which can be injected into the apparatus reproducibly by means of a microliter type syringe or pipette. The openings of the syringe or pipette limit the maximum size of particles which may be included in the sample.
6. Apparatus
   6.1 Apparatus for blending or homogenizing samples: Generally, a Waring-type blender is satisfactory.
   6.2 Apparatus for total and dissolved organic carbon:
      6.2.1 A number of companies manufacture systems for measuring carbonaceous material in liquid samples. Considerations should be made as to the types of samples to be analyzed, the expected concentration range, and forms of carbon to be measured.
      6.2.2 No specific analyzer is recommended as superior.
7. Reagents
   7.1 Distilled water used in preparation of standards and for dilution of samples should be ultra pure to reduce the carbon concentration of the blank. Carbon dioxide-free, double distilled water is recommended. Ion exchanged waters are not recommended because of the possibilities of contamination with organic materials from the resins.
   7.2 Potassium hydrogen phthalate, stock solution, 1000 mg carbon/liter: Dissolve 0.2128 g of potassium hydrogen phthalate (Primary Standard Grade) in distilled water and dilute to 100.0 ml.
   NOTE 2: Sodium oxalate and acetic acid are not recommended as stock solutions.
   7.3 Potassium hydrogen phthalate, standard solutions: Prepare standard solutions from the stock solution by dilution with distilled water.
   7.4 Carbonate-bicarbonate, stock solution, 1000 mg carbon/liter: Weigh 0.3500 g of sodium bicarbonate and 0.4418 g of sodium carbonate and transfer both to the same 100 ml volumetric flask. Dissolve with distilled water.

7.5 Carbonate-bicarbonate, standard solution: Prepare a series of standards similar to step 7.3.

NOTE 3: This standard is not required by some instruments.

7.6 Blank solution: Use the same distilled water (or similar quality water) used for the preparation of the standard solutions.

8. Procedure

8.1 Follow instrument manufacturer's instructions for calibration, procedure, and calculations.

8.2 For calibration of the instrument, it is recommended that a series of standards encompassing the expected concentration range of the samples be used.

9. Precision and Accuracy

9.1 Twenty-eight analysts in twenty-one laboratories analyzed distilled water solutions containing exact increments of oxidizable organic compounds, with the following results:

Increment as TOC mg/liter	Precision as Standard Deviation TOC, mg/liter	Accuracy as	
		Bias, %	Bias, mg/liter
4.9	3.93	+15.27	+0.75
107	8.32	+ 1.01	+1.08

(FWPCA Method Study 3, Demand Analyses)

Bibliography

1. Annual Book of ASTM Standards, Part 31, "Water", Standard D 2574–79, p 469 (1976).
2. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 532, Method 505, (1975).

APPENDIX A-6

DATA REDUCTION/INTERPRETATION

APPENDIX A-6

DATA REDUCTION/INTERPRETATION

1.0 CEM DATA REDUCTION

Raw data were refined, as follows, to generate final data values (i.e., averages, etc.).

- The CEM raw data were first converted from percent of full-scale values to percent (O_2 and CO_2) or ppm (CO and THC) values using a data logging program. This conversion was based upon the average of initial and final zero and span calibration data.

- Hot THC data were corrected from a wet to a dry basis following applicable EPA Method 4 (40 CFR 60) protocols. The volume of moisture collected in the Method 0010 semivolatiles sampling train and the associated dry gas metered volume were used to determine a moisture content during each run.

- CO, hot THC, and cold THC data were corrected to 7% oxygen conditions using the following formula: (uncorrected value) x $(14/[21-O_2])$ = corrected value. Oxygen data collected during each run was used to make this correction.

- At various points during each test, the THC analyzers were taken off-line to zero and span the instrument. Available data points within the sample period were utilized to interpolate 1-min rolling averages, if necessary.

- Facility O_2, CO, NO_x, and THC data were recorded at varying time intervals during the pretest. Available data points within each sample period were utilized to interpolate 1-min averages.

2.0 TOTAL ORGANIC MASS DATA REDUCTIONS/INTERPRETATION

In field GC data analysis, areas integrated under each peak were summed to give a total peak area for each run. This value was then divided by the average daily reference factor for propane, resulting in a total organics concentration for ppm propane equivalent. The average daily reference factor was obtained from an average of peak areas for a standard propane sample of known concentration.

Carbon fractions (i.e., C1 - C7 and C7 - C17 fractions) were determined by comparing sample peak retention times to standard peak retention times.

Aliquots of a C17 in a C7 solution were injected into the propane standard and analyzed to establish standard peak retention times. The following standard retention time ranges were determined in the test:

C1-C7		C7-C17	
Main Duct:	0-153s	Main Duct:	154-583s
Bypass Duct:	0-141.5s	Bypass Duct:	142-572s

For gravimetric data reduction, method blank weight was subtracted from each sample analysis value to determine a net gravimetric value. This net value was then multiplied by a numerical factor to obtain the organic mass in µg per sample. The dry standard sample volume was then utilized to generate a µ/L emission concentration. The ppm propane equivalent was then calculated by assuming that half of the sample molecular weight has no FID response; calculated as follows:

$$\frac{\mu\text{g of sample}}{\text{L of air sampled}} \times 0.5 \times \frac{24.1\ \mu\text{L gas per }\mu\text{mol of gas}}{44\ \mu\text{L propane per }\mu\text{mol propane}} = \text{ppm propane equivalent}$$

3.0 DRE OF MONOCHLOROBENZENE

Monochlorobenzene concentrations in exhaust gas were determined and DRE for each run was calculated in several ways as explained in Section 4.2.2 of the Test Report. The following sample calculation shows the method of calculation for the "best estimate" DRE.

An examination of the process data and analytical results from the POHC levels in the bypass duct allows a calculation estimate of main duct POHC levels, however. This estimate is based upon the proportional split of the POHC with gas flow exiting the kiln.

Using stack flow rate measurements and organic levels in the bypass duct, measured oxygen levels, and known material input rates, a material balance is performed on the total kiln system. This allows calculation of the flow split as gases exit the kiln entering either the bypass duct or ghe main flow duct. The ratio of this split is then applied to the measured POHC level of the bypass duct, resulting in the "best estimate" of expected POHC levels in the main duct, and subsequent calculation of the DRE.

The calculation is divided up into 10 separate steps; Run 2 has been shown for the example.

3.1 Step 1

An oxygen balance and a flow balance are performed on the bypass duct, using a "known" oxygen level of 2.25% entering the duct. The "known" value is obtained from measured CO levels and Figure A6-1, CO, and NO vs. oxygen in kiln.

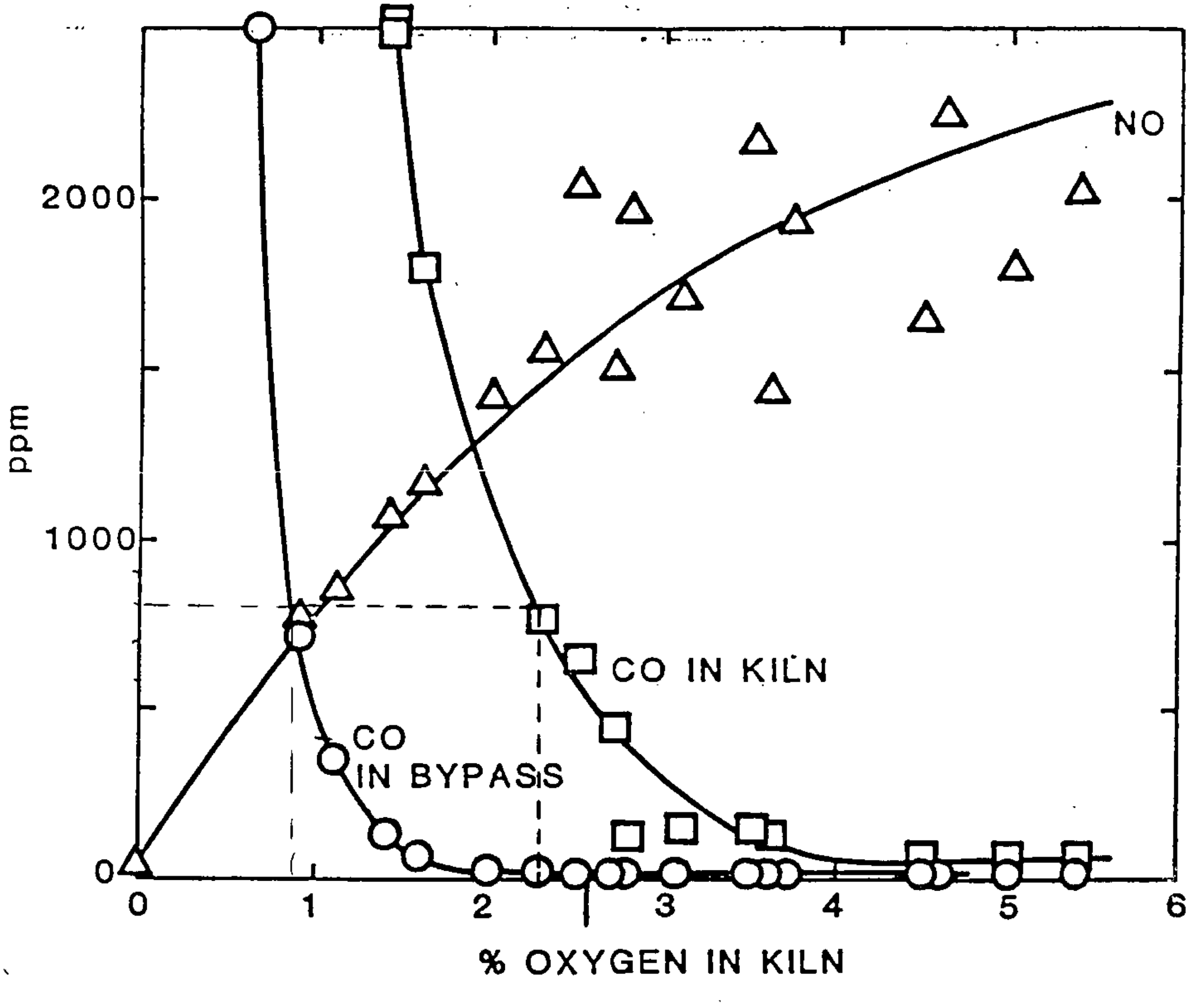

Figure A6-1. CO and NO vs. oxygen in kiln.

BF_1 = bypass flow into the duct at the end of the kiln (dscm/min), ~ 2.25% O_2

BF_2 = bypass flow at sampling location (dscm/min), at 17.5% O_2

BA = bypass air in (dscm/min), at 21% O_2

<u>Oxygen balance</u>: $BF_1\ O_2 + BA\ O_2 = BF_2\ O_2$

$BF_1\ (0.0225) + BA(0.21) = BF_2\ (0.175)$

<u>Flow balance</u>: $BF_1 + BA = BF_2$

BF_2 was measured by MM5 data to be 668 dscm/min. Solving for BF_1 in the flow balance equation, then:

$BF_1 = 668 - BA$

Substituting the numeric value of BF_2 and the algebraic value of BF_1 into the oxygen balance equation, BA and BF_1 are solved. Hence, the flow data values are:

BF_1 = 125 dscm/min
BA = 543 dscm/min
BF_2 = 668 dscm/min

<u>Step 2</u>: Steps 2 to 9 are performed to calculate the gas flow through the kiln itself. An overall mass balance is done along with combustion reaction stoichiometry.

<u>Feeds</u>:

Coal: 1.036 ton/h = 2,072 lb/h
Liquid waste (LIQ): 3.565 ton/h = 7,130 lb/h
Raw meal: 96.20 ton/h x .025 = 4,810 lb/h (2.5% of the total mass enters kiln as CO_2; rest is ignored for this calculation)
Chlorobenzene (Cl-B): 738 g/min = 98 lb/h (spiked into kiln)
Combustion air (CA) = unknown quantity, yet sufficient to give 2.25% O_2 at kiln exit

<u>Step 3</u>: Each feed stream is broken down into elemental quantities.

<u>COAL</u>:

Using ultimate analysis data as follows (O, 19.8; H, 5.5; C, 61.4; N, 1.5; Cl, 0.0; S, 0.6), sulfur content is dropped in the calculation...negligible presence.

For our mass input rate of 2,072 lb/h coal,

O	410 lb/h
H	114 lb/h
C	1,274 lb/h
N	31 lb/h

LIQ:

An ultimate analysis is assumed based on data from *Combustion Gas Velocity Measurement Manual*, Trenholm and Klamm, MRI, 1989 (C, 84; H, 10; Cl, 6).

For our mass input rate of 7,130 lb/h,

C	5,989 lb/h
H	713 lb/h
Cl	428 lb/h

Cl-B:

Chemical structure yields (C, 64; H, 4.4; Cl, 31.6).

For our mass input rate of 98 lb/h,

C	63 lb/h
H	4 lb/h
Cl	31 lb/h

Meal:

Introduces CO_2 into the kiln at 4,810 lb/h. CO_2 is (C, 27.2; O, 72.7).

C	1,308 lb/h
O	3,497 lb/h

CA:

By mass, air is (O, 23.3; N, 76.7). The total mass input rate, CA, is unknown.

O	.233 CA
N	.767 CA

Step 4: The overall reaction is written, and combined feed totals are converted to molar quantities.

$$C + H + O + N + Cl \rightarrow CO_2 + H_2O + HCl + N_2 + O_2$$

	C	H	O	N	Cl
COAL	1,272	114	410	31	--
LIQ	5,989	713	--	--	428
Meal	1,308	--	3,497	--	--
Cl-B	63	4	--	--	31
CA	--	--	.233 CA	.767 CA	--
Totals	8,632	831	3,907 + .233 CA	31 + .767 CA	459

Mass → moles conversion, divide by molecular weight of each species

$$\begin{array}{lll}
\text{C} & 8{,}632 \div 12 & = 719 \text{ moles/h} \\
\text{H} & 831 \div 1 & = 831 \text{ moles/h} \\
\text{O} & (3{,}907 + .233 \text{ CA}) \div 16 & = 244 + .0146 \text{ CA moles/h} \\
\text{N} & (31 + .767 \text{ CA}) \div 14 & = 2 + .0548 \text{ CA moles/h} \\
\text{Cl} & 459 \div 35.5 & = 13 \text{ moles/h}
\end{array}$$

Step 5: The reaction is completed in molar quantities, balanced by the reaction stoichiometry.

$$\begin{array}{ll}
C \rightarrow CO_2 & 719 \text{ moles/h } CO_2 \\
H \rightarrow H_2O \ (+ HCl) & \frac{831 - 13}{2} + 409 \text{ moles/h } H_2O \\
N \rightarrow N_2 & \frac{2 + .0548 \text{ CA}}{2} \text{ moles/h } N_2 \\
O \rightarrow O_2 \ (+ CO_2 + H_2O) & \frac{(244 + .0146 \text{ CA}) - 2(719) - 409}{2} = \\
 & \frac{-1603 + .0146 \text{ CA}}{2} \text{ moles/h } O_2
\end{array}$$

Step 6: We can now solve for CA the actual combustion air in, by using the products formed and known, 2.25% O_2 at the kiln exit.

$$(\text{dry}) \ \% \ O_2 = \frac{\text{moles } O_2}{\text{total dry moles}} \times 100$$

$$.0225 = \frac{\frac{-1603 + .0146 \text{ CA}}{2}}{\frac{-1603 + .0141 \text{ CA}}{2} + 719 + 13 + \frac{2 + .0548 \text{ CA}}{2}}$$

$$.0225 = \frac{-1603 + .0146 \text{ CA}}{-1603 + .0146 \text{ CA} + 1438 + 26 + 2 + .0548 \text{ CA}}$$

$$.0225 = \frac{-1603 + .0146 \text{ CA}}{-137 + .0694 \text{ CA}}$$

Cross-multiply: $-3.0825 + .0015615 \text{ CA} = -1603 + .0146 \text{ CA}$

$$1599.92 = .0130 \text{ CA}$$

Solve: CA = 122,707 lb/h (combustion air in) (CA originally defined as mass, not moles)

Step 7: The total moles of products are calculated based on the combustion air flow rate.

(Dry basis) CO_2 = 719 moles/h
HCl = 13 moles/h

$$N_2 = \frac{2 + .0548\ (122{,}707)}{2} = 3{,}363 \text{ moles/h}$$

$$O_2 = \frac{-\ 1603 + .0146\ (122{,}707)}{2} = 94 \text{ moles/h}$$

Step 8: Volumetric flow is calculated based on molar flow (dry basis) using the Ideal Gas Law.

$$PV = nRT$$

$$(14.7 \text{ psi})\ V = (4{,}298 \text{ moles/h})\quad 10.73\ \frac{\text{psi ft}^3}{\text{mole }^\circ\text{R}}\quad (528^\circ\text{R})$$

$$V = 1{,}656{,}467 \text{ dscf/h}$$

Convert units,

$$V = 782 \text{ dscm/min}$$

Step 9: Overall balance is performed at kiln exit/entry to bypass and main flow ducts.

$KF = BF_1 + MF$
$782 = 125 + MF$
$MF = 657$ dscm/min

Step 10: The flow split is determined and DRE calculated.

% MF = 657/782 = 84%
% BF_1 = 125/782 = 16%

DREs are then calculated using the flow split and emission in the bypass duct as a basis.

Feed = 738 g/min
Bypass emission = .01016 g/min

"Theoretical" main duct emission = $.01016 \times \frac{84}{16} = .05334$ g/min

"Total" emission = .01016 + .05334 = .0635 g/min

$$\text{"Best estimate" DRE} = \frac{\text{In} - \text{Out}}{\text{In}} \times 100$$

$$= \frac{738 - .0635}{738} \times 100$$

$$= \underline{99.9914\%}$$

APPENDIX B

SAMPLING AND ANALYSIS DATA

This appendix presents data collected during the test at the Ash Grove precalciner kiln. Data are presented as follows:

APPENDIX B-1

CEM DATA MEASURED BY ASH GROVE

OMAHA PLANT CEM DATA - BYPASS DUCT RUN 1

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY (%
1559.5	18.5	399	50	2	5.3
1604.5	18.7	416	16	2	3.8
1609.5	18.6	414	39	2	3.4
1614.5	18.5	400	69	6	3.4
1619.5	18.7	397	62	13	4.3
1624.5	18.6	412	44	7	3.4
1629.5	18.5	421	8	4	3.2
1634.5	18.5	415	23	3	4.1
1644.5	18.4	433	17	2	3.7
1649.5	18.2	396	58	3	3.1
1654.5	18.1	403	203	1	4.2
1659.5	18.5	404	-10	2	3.6
1724.5	18.5	385	33.4	2	3.9
1729.5	18.4	377	70	1	3.4
1734.5	18.1	351	421	4	4.2
1939.5	18.4	268	63	1	3.3
1744.5	17.9	273	91	1	4
1749.5	18.1	282	235	1	3.8
1754.5	18.3	313	-23	0	3.7
1759.5	17.9	246	133	-1	4.1
1804.5	17.8	297	1328	31	3.2
1809.5	18.3	304	92	3	3.7
1814.5	18.3	221	-9	1	3.4
1819.5	17.7	216	31	0	3.9
1824.5	17.8	254	53	1	3.7
1829.5	17.9	231	17	0	3.5
1834.5	17.8	224	21	0	3.5
1839.5	18	236	-2	0	3.6
1844.5	17.8	252	45	0	3.6
1849.5	17.8	248	28	0	3.6
1854.5	18	257	48	1	3.4
1859.5	18	258	73	14	3.6
1904.5	18	253	19	5	3.4
1909.5	17.8	267	79	5	3.4
1914.5	17.9	244	23	1	3.6
1919.5	17.8	282	96	0	3.8
1924.5	17.8	287	38	0	3.5
1934.5	17.7	281	73	2	3.5
1939.5	17.9	280	35	2	3.6
1944.5	17.9	289	39	1	3.7
1949.5	18.1	278	-6	2	3.5
1954.5	17.9	273	897	46	3.7
2004.5	18	289	25	2	4.1
Minimum=	18	216	-23	-1	3
Maximum=	19	433	1328	46	5
Average=	18	312	108	4	4

OMAHA PLANT CEM DATA - MAIN DUCT RUN 2

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY (%)
1159.2	4.7	532	445	8	3.6
1204.2	3.9	377	1295	14	3.8
1209.2	3.9	373	494	44	3.7
1214.2	4.0	389	1251	15	3.5
1219.2	4.4	470	635	10	3.9
1224.2	4.6	480	530	8	3.5
1229.2	4.3	430	685	9	3.6
1234.2	4.4	435	1157	28	3.5
1239.2	4.1	413	929	17	3.8
1244.2	4.2	428	812	9	3.7
1249.2	4.4	454	609	9	3.5
1254.2	3.9	338	1330	23	3.6
1259.2	4.6	503	536	8	3.6
1304.2	4.6	486	517	8	3.7
1309.2	4.5	477	549	8	3.3
1314.2	4.5	478	553	8	3.4
1319.2	4.7	514	398	8	3.6
1324.2	4.5	483	620	8	3.5
1329.2	4.1	418	875	11	3.7
1334.2	4.2	431	1037	17	4.1
1339.2	4.2	440	1024	10	3.5
1344.2	4.0	401	1010	11	3.6
1349.2	4.3	456	604	9	3.6
1354.2	4.2	419	1001	14	3.5
1359.2	4.2	419	694	10	3.8
1404.2	4.4	454	528	8	3.5
1409.2	4.4	470	523	8	3.7
1414.2	4.2	432	781	10	3.6
1419.2	4.5	466	523	8	4.1
1424.2	4.0	389	1069	14	3.1
1429.2	4.2	431	714	9	3.3
1434.2	4.1	412	1018	14	3.0
1439.2	4.4	457	690	8	3.4
1444.2	4.6	493	474	8	3.5
1449.2	4.2	443	781	11	3.4
Minimum=	3.9	338	398	8	3.0
Maximum=	4.7	532	1330	44	4.1
Average=	4.3	443	763	12	3.6

OMAHA PLANT CEM DATA - BYPASS DUCT RUN 2

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY (%)
1201.5	17.6	763	10	-1	3.7
1206.5	17.5	758	10	-2	2.9
1211.5	17.3	716	301	19	3.5
1216.5	17.7	789	47	0	3.7
1221.5	17.6	750	29	-1	3.7
1226.5	17.6	668	20	-1	3.4
1231.5	17.6	707	24	-1	3.5
1236.5	17.4	624	233	0	3.6
1241.5	17.4	646	115	0	3.4
1246.5	17.4	627	190	1	3.5
1251.5	17.7	663	19	-1	3.5
1256.5	17.5	679	46	0	3.5
1301.5	17.6	709	12	-1	3.4
1306.5	17.5	704	84	9	3.8
1311.5	17.3	708	72	4	3.5
1316.5	17.5	729	166	2	3.5
1321.5	17.4	768	21	-1	3.8
1326.5	17.5	736	17	0	3.6
1331.5	17.3	775	45	-1	3.6
1336.5	17.2	710	307	1	4.0
1341.5	17.5	756	88	0	3.5
1346.5	17.4	785	5	0	3.4
1351.5	17.4	742	135	-1	3.6
1356.5	17.3	715	355	16	3.5
1401.5	17.5	751	39	0	3.5
1406.5	17.5	719	36	-1	3.4
1411.5	17.5	721	7	-1	3.6
1416.5	17.4	690	89	-2	3.9
1421.5	17.4	738	38	-1	3.8
1426.5	17.5	771	95	-1	3.4
1431.5	17.4	754	42	-1	3.6
1436.5	17.4	726	113	-1	3.5
1441.5	17.7	726	21	-2	3.3
1446.5	17.5	758	116	10	3.9
Minimum=	17.2	624	5	-2	2.9
Maximum=	17.7	789	355	19	4.0
Average=	17.5	723	87	1	3.6

OMAHA PLANT CEM DATA - RUN 3 MAIN DUCT

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY
1139.2	4.5	466	470	7	3.3
1144.2	4.4	472	401	6	3.2
1149.2	4.2	469	375	6	2.7
1154.2	4.5	476	371	6	2.9
1159.2	4.6	488	331	6	3.3
1204.2	4.4	464	354	6	2.8
1209.2	4.5	482	349	6	3.0
1214.2	4.6	495	348	6	3.0
1219.2	4.6	493	327	6	3.3
1224.2	4.8	501	318	6	3.0
1229.2	4.7	492	314	6	3.2
1234.2	4.6	501	308	6	3.0
1239.2	4.6	521	297	6	3.6
1244.2	4.3	473	384	6	2.6
1249.2	4.7	536	303	6	3.0
1254.2	4.7	528	294	6	3.1
1259.2	4.7	525	279	6	3.2
1304.2	5.1	587	265	6	3.0
1309.2	4.2	486	311	6	3.6
1314.2	4.8	550	284	6	3.4
1326.5	5.0	564	279	6	3.0
1339.2	4.9	530	282	5	3.7
1346.5	4.9	545	284	5	3.0
1354.2	5.0	565	260	6	3.2
1401.5	5.0	546	295	6	3.4
1409.2	4.9	532	296	6	2.6
1416.5	4.9	529	323	5	3.8
1424.2	4.6	514	367	6	3.4
1431.5	4.5	509	324	5	2.9
Minimum=	4.2	464	260	5	2.6
Maximum=	5.1	587	470	7	3.8
Average=	4.7	512	324	6	3.1

OMAHA PLANT CEM DATA - RUN 3 BYPASS DUCT

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY (%)
1141.5	16.6	1119	37	0	3.1
1146.5	16.7	1173	25	0	2.8
1151.5	16.4	1072	116	0	3.5
1156.5	16.6	1181	14	0	3.4
1201.5	16.6	1085	82	0	3
1206.5	16.6	1105	6	0	3.1
1211.5	16.8	1147	18	0	3
1216.5	16.5	1101	70	0	2.9
1221.5	16.7	1137	9	1	2.9
1226.5	16.5	1047	22	0	3
1231.5	16.4	1162	9	1	3
1241.5	16.4	1139	80	1	3.1
1246.5	16.5	1237	17	1	3.1
1251.5	16.6	1277	-3	1	3.2
1256.5	16.4	1193	1	1	3
1301.5	16.5	1253	58	1	3.1
1306.5	16.4	1265	-10	0	2.5
1311.5	16.5	1200	6	0	3.5
1316.5	16.4	1223	43	1	2.8
1329.2	16.6	1203	-14	1	3.3
1341.5	16.3	1129	24	0	3.2
1349.2	16.3	1213	-4	0	3
1356.5	16.4	1189	20	0	3
1404.2	16.3	1156	-7	0	3.3
1411.5	16.3	1147	36	0	3.2
1419.2	16.5	1244	25	-1	2.7
1426.5	16.6	1297	-7	0	3
Minimum=	16.3	1047	-14	-1	2.5
Maximum=	16.8	1297	116	1	3.5
Average=	16.5	1174	25	0	3.1

OMAHA PLANT CEM DATA - RUN 4 MAIN DUCT

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY (%)
1138.2	4.4	373	879	-1	4.3
1146.5	4.7	383	815	-1	4.1
1151.5	4.3	383	1502	-1	4.1
1156.5	4.5	395	1326	-1	4.3
1201.5	4.6	389	754	-1	4.6
1206.5	4.5	408	1246	-1	4.2
1211.5	4.2	343	1747	-1	4.8
1216.5	4.2	280	1501	-1	3.7
1549.2	4.4	419	1077	-1	4.8
1554.2	4.4	406	992	-1	3.8
1559.2	4.6	436	1047	-1	4.3
1603.2	4.7	424	877	-1	4.8
1609.2	4.8	439	830	-1	4.5
1614.2	4.6	404	1037	-1	4.8
1619.2	4.6	417	960	-1	5.5
1629.2	4.5	411	1153	-1	4.3
1634.2	4.9	454	855	-1	4.8
1639.2	4.8	461	947	-1	4.6
1644.2	4.6	455	977	-1	5
1649.2	4.7	448	1012	-1	4.7
1654.2	4.6	423	963	-1	4.8
1659.2	4.5	405	1137	-1	4.2
1704.2	4.6	450	1040	-1	4.2
1709.2	4.5	414	881	-1	3.9
1714.2	4.4	415	1182	-1	4.5
1719.2	4.6	424	1011	-1	4.4
1724.2	4.7	434	963	-1	4.2
1729.2	4.7	434	963	-1	3.8
1734.2	4.7	434	963	-1	4.8
1739.2	4.9	450	835	-1	4.6
1744.2	4.8	429	693	-1	4.2
1749.2	4.8	417	801	-1	4.3
1754.2	4.5	375	668	-1	4
1759.2	4.5	391	1090	-1	4.2
1804.2	4.7	412	763	-1	4.3
1809.2	4.9	434	690	-1	4.2
1814.2	4.8	435	1120	-1	4.2
1819.2	4.8	425	546	-1	4.4
1824.2	4.7	421	968	-1	4.1
1829.4	4.7	410	742	-1	4.6
1834.2	4.7	414	912	-1	4.5
1839.2	4.6	430	1059	-1	4.4
1844.2	4.7	421	798	-1	4.3
1849.2	4.6	434	896	-1	4.4
Minimum=	4.2	280	546	-1	3.7
Maximum=	4.9	461	1747	-1	5.5
Average=	4.6	415	982	-1	4.4

OMAHA PLANT CEM DATA - RUN 4 BYPASS DUCT

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY (%)
1141.5	16.8	468	97	-3	4.2
1149.2	17.1	502	31	-3	3.6
1154.2	17	492	4	-3	4.2
1159.2	16.8	518	25	-3	3.8
1204.2	16.9	455	816	-3	4.2
1209.2	16.7	483	22	-3	4.3
1214.2	17	426	178	-3	4.5
1546.5	16.7	469	90	-36	5.1
1551.5	16.9	475	131	-3	4.6
1556.5	16.8	523	15	-3	4
1601.5	16.8	530	237	-3	4.5
1606.5	16.9	558	157	-3	5
1611.5	16.9	588	-3	-3	4.6
1616.5	16.8	530	174	-3	5.4
1621.5	16.6	516	537	-3	4.3
1626.5	16.8	393	3472	-3	4.8
1631.5	16.6	472	671	-3	4.2
1636.5	16.9	513	-4	-3	4.7
1641.5	16.9	438	200	-3	4.6
1646.5	16.7	425	61	-3	4.3
1651.5	16.9	370	246	-3	4.1
1656.5	16.7	426	309	-3	4.7
1707.5	16.7	429	208	-3	4.1
1706.5	16.7	399	510	-3	4.4
1711.5	16.7	426	165	-3	4.4
1716.5	16.7	427	381	-3	4.4
1721.5	16.8	463	20	-3	4.2
1726.5	16.9	456	-50	-3	4.4
1731.5	16.9	456	-50	-3	4.6
1736.5	16.9	456	-50	-3	4.5
1741.5	17.1	478	16	-3	4.3
1746.5	17	497	12	-3	4.5
1751.5	16.8	430	274	-3	4.7
1756.5	16.9	421	228	-3	4.3
1801.5	16.7	403	369	-3	4.3
1806.5	17.1	487	11	-3	4.3
1811.5	16.9	493	36	-3	4.4
1816.5	17	521	30	-3	4.3
1821.5	16.9	489	183	-3	4.2
1826.5	16.9	527	17	-3	4.2
1831.5	16.8	448	126	-3	4.7
1836.5	16.8	503	20	-3	4.2
1841.5	17.1	502	70	-3	4.3
1846.5	16.8	475	68	-3	4.5
Minimum=	16.6	370	-50	-36	3.6
Maximum=	17.1	588	3472	-3	5.4
Average=	16.8	472	229	-4	4.4

OMAHA PLANT CEM DATA - RUN 5 MAIN DUCT

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY
1124.2	4.2	564	543	6	3.4
1129.2	4.6	529	543	6	3.4
1134.2	4.5	515	644	6	4.2
1139.2	4.5	505	387	6	4.2
1144.2	4.3	482	870	6	3.8
1149.2	4.3	480	894	6	3.8
1154.2	4.3	527	659	6	3.7
1159.2	4.3	519	734	6	3.5
1204.2	4.1	480	879	6	3.6
1209.2	4.2	487	853	6	4.3
1214.2	4.4	511	493	6	3.5
1219.2	4.5	525	558	6	3.6
1224.2	4.6	526	674	6	3.8
1229.2	4.4	519	800	6	4.7
1234.2	4.3	514	686	6	4.1
1239.2	4.3	534	560	6	3.8
1244.2	4.3	523	684	6	3.6
1249.2	4.5	553	646	6	3.9
1259.2	4.5	513	556	6	3.8
1304.2	4.3	521	728	6	3.9
1309.2	4.3	516	736	6	3.7
1314.2	4.3	548	625	6	3.8
1319.2	4.5	553	550	6	3.6
1324.2	4.1	503	732	6	4.1
1329.2	4.4	508	673	6	3.7
1334.2	4.4	527	508	6	4.0
1339.2	4.4	524	770	6	3.9
1344.2	4.3	546	369	6	3.9
1349.2	4.1	501	644	6	3.8
1354.2	4.1	528	689	6	3.9
1359.2	4.2	567	536	6	3.9
1404.2	4.1	571	533	6	4.0
1409.2	4.4	592	492	6	4.1
1414.2	4.4	586	460	6	4.3
1419.2	4.3	580	696	6	4.4
1424.2	4.2	556	769	6	4.0
Minimum=	4.1	480	369	6	3.4
Maximum=	4.6	592	894	6	4.7
Average=	4.3	529	644	6	3.9

OMAHA PLANT CEM DATA - RUN 5 BYPASS DUCT

TIME	O2 (%)	NOx (ppm)	CO (ppm)	THC (ppm)	OPACITY
1119.2	17.3	806	15	0	3.7
1126.5	16.8	752	62	0	3.7
1131.5	16.6	719	98	1	3.6
1136.5	16.7	723	67	1	3.7
1141.5	16.8	712	308	1	3.8
1146.5	17.0	704	117	1	3.5
1151.5	16.6	711	482	2	3.5
1156.5	16.7	797	92	1	3.6
1201.5	16.9	728	580	2	3.4
1206.5	16.8	741	93	1	4.3
1211.5	17.0	702	701	2	4.2
1216.5	16.8	758	271	2	4.1
1221.5	17.0	844	51	2	3.9
1226.5	17.0	817	58	2	4.4
1231.5	16.8	769	123	2	4.3
1236.5	17.0	777	138	2	4.0
1241.5	16.8	794	326	2	4.1
1246.5	16.9	829	122	1	4.1
1251.5	16.9	732	323	1	3.7
1256.5	16.9	757	84	1	4.0
1301.5	16.9	667	502	2	3.9
1306.5	16.8	703	369	2	4.3
1316.5	16.9	819	144	2	4.1
1321.5	16.7	768	111	2	3.4
1326.5	16.8	688	425	2	3.6
1331.5	16.6	659	323	2	4.4
1336.5	17.0	760	17	2	4.0
1346.5	16.8	819	64	2	3.5
1351.5	16.9	721	404	2	4.0
1356.5	17.1	813	80	2	4.1
1401.5	17.3	893	-11	2	3.9
1406.5	17.0	854	-10	2	3.9
1411.5	16.9	878	21	2	3.7
1416.5	16.9	807	155	2	4.2
1421.5	16.7	767	410	2	4.4
Minimum=	16.6	659.0	-11.0	0.0	3.4
Maximum=	17.3	893.0	701.0	2.0	4.4
Average=	16.9	765.4	203.3	1.6	3.9

APPENDIX B-2

PROCESS DATA MEASURED BY ASH GROVE

SUMMARY OF PROCESS DATA MEASURED BY ASH GROVE

Parameter	Units	Run 1	Run 2	Run 3	Run 4	Run 5
Raw Meal Kiln Inlet Temp	F	1567	1606	1599	1594	1589
Entrance Kiln Gas Pressure	in Hg	-0.112	-0.124	-0.142	-0.161	-0.139
Kiln Coal Feed	T/hr	0.993	1.036	5.140	0.000	0.049
Kiln Speed	RPH	113.7	112.2	112.2	104.5	110.2
Kiln Current	Amps	178.2	228.1	244.2	226.2	258.9
Exit Kiln Gas Pressure	in Hg	-0.819	-0.613	-0.517	-0.583	-0.645
Kiln Inlet Temp.	F	1974	1883	1939	1565	1831
Raw Meal Feed	T/hr	98.11	96.20	95.00	95.38	96.71
Liquid Hazardous Waste Feed	STPH	2.874	3.565	0.000	5.789	5.756
Solid Hazardous Waste Feed	TPH	0.925	0.925	0.000	0.000	0.000
Pyroclone Coal Feed	T/hr	7.974	7.704	7.273	7.358	7.156
Pyroclone Temperature	F	1598	1616	1619	1601	1598
Pyroclone Exhaust/Main ESP Inlet:						
Temperature	F	742.5	755.2	716.7	739.8	741.4
Pressure	in H20	-28.03	-28.04	-26.81	-28.08	-27.65
Bypass ESP Inlet Temp	F	696.8	695.8	692.1	694.0	711.4
Bypass ESP Voltage	kV					
First Stage		36.1	36.6	35.9	36.3	34.8
Second Stage		32.6	30.3	34.3	29.6	29.8
Third Stage		27.2	27.8	27.5	28.1	28.2
Fourth Stage Cyclone Temp	F	1567	1593	1520	1573	1571
Bypass ESP Outlet						
Temperature	F	600.6	602.2	591.7	584.6	596.1
Pressure	in Hg	-3.074	-2.567	-2.639	-2.908	-2.508
Bypass Quench Water	gpm	6.0	8.0	8.0	8.0	8.0
Damper Setting Open	%	50.0	40.1	40.0	40.0	40.0

APPENDIX B-3

FUEL/WASTE CHARACTERIZATION

NOTE: Waste samples were collected and analyzed by Ash Grove. An independent contract laboratory also analyzed these samples. MRI had no control over the quality assurance/quality control procedures initiated and followed in the sampling and analysis of these samples.

FUEL CHARACTERIZATION AND TEST SUMMARY

	RUN #1	RUN #2	RUN #3	RUN#4	RUN #5
KILN					
Coal					
Feed Rate (T/hr)	0.99	1.04	5.14	0.00	0.05
Heating Value (Btu/lb)	12300.00	12300.00	12300.00	12300.00	12300.00
Chlorine (%)	0.00	0.00	0.00	0.00	0.00
Solid Waste					
Feed Rate (T/hr)	0.93	0.93	0.00	0.00	0.00
Heating Value (Btu/lb)	8620.00	8410.00	0.00	0.00	0.00
Chlorine (%)	3.30	3.70	0.00	0.00	0.00
Liquid Waste					
Feed Rate (T/hr)	2.87	3.57	0.00	5.79	5.76
Heating Value (Btu/lb)	10080.00	10010.00	0.00	11220.00	11170.00
Chlorine (%)	2.00	2.20	0.00	1.70	1.70
KILN HEAT INPUT RATE (106 Btu/h)	108.15	123.66	139.09	142.90	142.77
KILN Cl INPUT RATE (lb/h)	193.61	247.84	0.00	216.51	215.27
PYROCLONE					
Coal					
Feed Rate (T/hr)	7.97	7.70	7.27	7.36	7.16
Heating Value (Btu/lb)	12300.00	12300.00	12300.00	12300.00	12300.00
Chlorine (%)	0.00	0.00	0.00	0.00	0.00
PYROCLONE HEAT INPUT RATE (106 Btu/h)	215.78	208.47	196.81	199.11	193.64
PYROCLONE Cl INPUT RATE (lb/h)	0.00	0.00	0.00	0.00	0.00

THE PITTSBURG & MIDWAY COAL MINING CO.

EDNA MINE

TYPICAL ANALYSIS - AS RECEIVED

PROXIMATE ANALYSIS

	Average	Range
% Moisture	10.7	9.0-12.5
% Ash	11.2	9.0-14.0
% Volatile	34.9	32.7-36.6
% Fixed Carbon	43.2	40.7-45.4
BTU	10800	10600-11000
*% Sulfur	0.6	0.4-1.0

SULFUR FORMS

% Pyritic	0.1	0.0-0.2
% Sulfate	0.0	0.0-0.0
% Organic	0.5	0.4-0.8

ULTIMATE ANALYSIS

% Moisture	10.7	9.0-12.5
% Carbon	61.4	57.7-64.6
% Hydrogen	4.3	4.1-4.5
% Nitrogen	1.5	1.4-1.6
% Chlorine	0.0	0.0-0.0
% Sulfur	0.6	0.5-0.7
% Ash	11.2	9.0-14.0
% Oxygen	10.3	9.7-10.8

MINERAL ANALYSIS OF ASH

	Average	Range
Silica, SiO_2	51.0	45.0-57.0
Alumina, Al_2O_3	31.2	27.0-35.0
Titania, TiO_2	0.8	0.6-1.0
Ferric Oxide, Fe_2O_3	5.4	4.0-7.0
Lime, CaO	4.9	3.5-6.5
Magnesia, MgO	1.4	1.0-1.8
Potassium Oxide, K_2O	0.9	0.6-1.3
Sodium Oxide, Na_2O	0.5	0.3-0.8
Sulfur Trioxide, SO_3	2.5	1.0-3.5
Phos. Pentoxide, P_2O_5	1.3	1.0-1.7
Undetermined	0.1	---

ASH FUSION TEMPERATURE (°F)

	Reducing	Oxidizing
Initial Deformation	2500	2650
Softening (H=W)	2600	+2700
Softening (H=1/2W)	2640	+2700
Fluid	2685	+2700

Hardgrove Grindability	47
% Equilibrium Moisture	9.5
Alkalies as Na_2O (dry coal)	0.1
Free Swelling Index	Nil

*Sulfur Dioxide (SO_2) shall not exceed 1.2 pounds per million BTUs on a monthly average basis.

SUMMARY OF DATA FROM MRI TESTING
Oct./Nov. 1989

Samples tested

Sample ID		Description	
#1031	10/28/89	Test #1	Liquid Chemfuel
#1033	10/28/89	Test #1	Solid Chemfuel (Spiked)
#2031	10/29/89	Test #2	Liquid Chemfuel
#2033	10/29/89	Test #2	Solid Chemfuel (Spiked)
#4031	10/31/89	Test #4	Liquid Chemfuel
#5031	11/02/89	Test #5	Liquid Chemfuel
Coal		Coal sample typical during run	
Solid		Composite sample of solids before spiking	

Test Results

Lab:	Ash Grove Louisville		A&L Mid West Lab Omaha			Ash Grove Kansas City
					Monochlorobenzene	
ID	BTU	Cl	BTU	Cl	%	%
#1031	10080	2.0	9299	1.51		
#1033	8620	3.3	8605	0.99	8.43	7.8
#2031	10010	2.2	8839	1.69		
#2033	8410	3.7	8562	1.06	6.64	6.2
#4031	11220	1.7	9941	1.15		
#5031	11170	1.7	10350	0.89		
Coal	12030	0.0	12137	<0.01		
Solid	8640	1.7	8389	0.60	0.1	0.04

MCB = 9.19 lb/gal

AVG. WT SOLID = 2036 lb/hr

POHC SPIKE = 40 L/hr

$$\frac{40\ L/hr\ POHC}{2036\ lb/hr\ WASTE} = \frac{0.0196\ L\ POHC}{1\ lb\ WASTE} = \frac{0.048\ lb\ POHC}{1\ lb\ WASTE} = 4.8\%$$

RESEARCH LABORATORY

ASH GROVE CEMENT COMPANY

KANSAS CITY, KANSAS

JANUARY 19, 1990

REPORT ON LOUISVILLE STACK TEST SAMPLES:

COMPOSITION AND MONOCHLOROBENZENE DETERMINATION

Samples Received:

Sample No.	Identification	Date Received	Requested By
S-891206	#1033 10/28/89	12/15/89	R. Behrns
S-891207	#2033 10/29/89	"	"
S-891208	Solid Chemfuel	"	"
S-891209	Monochlorobenzene	"	"
S-891223	#1031 10/28/89	12/28/89	"
S-891224	#2031 10/29/89	"	"
S-891225	#4031 10/31/89	"	"
S-891226	#5031 11/2/89	"	"

The above samples were received with a request for determination by capillary gas chromatography of the amount of monochlorobenzene in all samples (except the monochlorobenzene, S-891209, which was included for a reference standard). The results of this determination are given in Table I attached.

An organic screen for the most abundant constituents in the sample marked "solid chemfuel" (S-891208) was also requested. The liquid chemfuel burned during the stack test (S-891223 - S-891226) was composited and analyzed for organic constituents also. These results are given in table II attached.

Finally Table III attached gives an analysis of "solid chemfuel" (S-891208) for water, volatile organic, non-volatile extractable organics, non-volatile non-extractable organics, and inorganic ash.

Tested and reported by,

Daniel J. Logan

Dan Logan
Chemist

DJL:lm
cc: G.D.J.
E.R.H.
D.R.Y.
W.E.W.
R. Behrns
R & E

TABLE I

DETERMINATION OF MONOCHLOROBENZENE (MClBz)
IN LOUISVILLE STATE TEST SAMPLES

S-Number	Louisville	Date	Sample Type	% MClBz by Wt.
S-891206	#1033	10/28/89	Spiked Solid Chemfuel	7.8% (S = ± 0.9, n = 3)
S-891207	#2033	10/29/89	" " "	6.2% (S = ± 0.9, n = 3)
S-891208			Solid Chemfuel	0.04% (Single Determination)
S-891223	#1031	10/28/89	Liquid Chemfuel	N.D. (<0.1%)
S-891224	#2031	10/29/89	" "	N.D. (<0.1%)
S-891225	#4031	10/31/89	" "	N.D. (<0.06%)
S-891226	#5031	11/2/89	" "	N.D. (<0.08%)

TABLE II

ANALYSIS OF ORGANICS IN CHEMFUEL AND SOLID CHEMFUEL FROM LOUISVILLE STACK TESTS

Compound Determined	Louisville Chemfuel Composite: S-891223, S-891224,1225, 1226	Louisville Solid Chemfuel S-891208
	%	%
Residue*	7.4	48.
Water	11.	16.
Stoddard Solvent	8.8	0.04
Xylenes	4.7	1.9
Toluene	3.5	2.0
Methyl Isobutyl Ketone	1.4	1.0
Isopropyl Alcohol	2.3	.08
VMP Naptha	4.6	.02
Methyl Ethyl Ketone	2.2	.23
1,1,1-Trichloroethane	0.76	.17
Trichloroethylene	0.87	.19
Methylene Chloride	1.6	.03
Ethyl Alcohol	0.86	.01
2-Nitropropane	0.96	.15
n-Hexane	0.61	.10
Tetrachloroethylene	0.24	.84
Heptane	3.1	.47
Chlorobenzene	N.D.(<0.1)	.04
Acetone	2.7	.03
Undetermined**	42.	29.

* Nonvolatile (100°C, 3 hours), non-extractable (into Methyl Isobutyl Ketone) residue.

** Includes oil, grease, and unidentified solvents.

TABLE III

CHARACTERIZATION OF SOLID CHEMFUEL S-891208

Water	16.1% by Weight
Volatiles* (including water)	37.4% by Weight
Extractable** Nonvolatile Organic Residue	14.8% by Weight
Non-Extractable Nonvolatile Organic Residue	21.9% by Weight
Inorganic ASH***	25.9% by Weight

* 100°C for 3 hours

** Methyl Isobutyl Ketone (M.I.B.K.) has been found to be the best solvent for extracting. Sample extracted 4 times with 20 ml M.I.B.K.

*** ASTM D 482 (775°C muffle furnace)

A&L MID WEST LABORATORIES, INC.

13611 "B" STREET • OMAHA, NE 68144 • (402) 334-7770

REPORT NUMBER: 0-010-1500
(Additional results 1-24-90)

1-10-90 M 1

Subject: Environmental Analysis

Ash Grove Cement Company #12465
Roger J. Behrns
P. O. Box 609
Louisville, NE 68037

Date Received: 12-15-89

Laboratory Number	Sample Identification	Analysis	Level Found	Detection Limit	Method
33701	Test #l, Liquid Chemfuel 10-28-89	BTU/lb Chloride	9299 BTU/lb 1.51%	0.01% as Chloride	ASTM D240 ASTM D1317-118
33702	Test #1, Solid Chemfuel (spiked) 10-28-89	BTU/lb Chloride Monochlorobenzene	8605 BTU/lb 0.99% 84300 µg/g	0.01% as Chloride 500 µg/g	ASTM D240 ASTM D1317-118
33703	Test #2, Liquid Chemfuel 10-29-89	BTU/lb Chloride	8839 BTU/lb 1.69%	0.01% as Chloride	ASTM D240 ASTM D1317-118
33704	Test #2, Solid Chemfuel (spiked) 10-29-89	BTU/lb Chloride Monochlorobenzene	8562 BTU/lb 1.06% 66400 µg/g	0.05% as Chloride 1000 µg/g	ASTM D240 ASTM D1317-118

Note: < = less than

Respectfully submitted,

Christine W Birt

Christine W. Birt
Client Services Representative

Dedicated Exclusively to Providing Quality Analytical Services

A&L MID WEST LABORATORIES, INC.
13611 "B" STREET • OMAHA, NE 68144 • (402) 334-7770

REPORT NUMBER: 0-010-1501
(Additional results 1-24-90)

1-10-90 M 1

Subject: Environmental Analysis

Ash Grove Cement Company #12465
Roger J. Behrns
P. O. Box 609
Louisville, NE 68037

Date Received: 12-15-89

Laboratory Number	Sample Identification	Analysis	Level Found	Detection Limit	Method
33705	Test #4, Liquid Chemfuel 10-31-89	BTU/lb Chloride	9941 BTU/lb 1.15%	0.01% as Chloride	ASTM D240 ASTM D1317-118
33706	Test #5, Liquid Chemfuel 11-2-89	BTU/lb Chloride	10350 BTU/lb 0.89%	0.01% as Chloride	ASTM D240 ASTM D1317-118
33707	Coal sample typical during run	BTU/lb Chloride	12137 BTU/lb < 0.01%	0.05% as Chloride	ASTM D240 ASTM D1317-118
33708	Composite sample of solids before spiking	BTU/lb Chloride Moonochlorobenzene	8389 BTU/lb 0.60% 1000 µg/g	0.01% as Chloride 1000 µg/g	ASTM D240 ASTM D1317-118

Comment: A relatively low level of monochlorobenzene was detected in this sample. Normally, the sample would have been rerun at a lower detection limit. In this case, however, there were too many other high-level compounds (toluene, ethylbenzene, xylenes, etc.) present to permit this.

Respectfully submitted,

Christine W. Birt

Christine W. Birt
Client Services Representative

Note: < = less than

Dedicated Exclusively to Providing Quality Analytical Services

APPENDIX B-4

TOC AND INORGANIC COMPOUND ANALYSIS RESULTS

HARRY W. GALBRAITH, PH.D
CHAIRMAN OF THE BOARD

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EXECUTIVE VICE-PRESIDENT

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SECRETARY/TREASURER

GALBRAITH
Laboratories, Inc.

QUANTITATIVE MICROANALYSES
ORGANIC – INORGANIC
615/546-1335

P.O. BOX 51610
KNOXVILLE, TN 37950-1610

2323 SYCAMORE DR.
KNOXVILLE, TN 37921-1750

Ms. Deann R. Williams
Midwest Reserach Institute
425 Volker Boulevard
Kansas City, Kansas 64110

February 1, 1990

Received: January 9th
PO#: 108796

Dear Ms. Williams:

Analysis of your compounds gave the following results:

Your #,	Our #,	Analyses,		
1022	J-5057	ppm Potassium	< 0.2	
	(I-7007)	mg/liter NH_3 as Nitrogen	57.6	
		mg/liter Chloride	14.9	
1023	J-5058	mg/liter Potassium	< 0.24	
	(I-7012)	mg/liter NH_3 as Nitrogen	0.77	
		mg/liter Chloride	< 1	
5022	J-5059	mg/liter NH_3 as Nitrogen	59.39	59.36
	(I-7011)			

There is no charge for these repeat analyses.

Sincerely yours,

GALBRAITH LABORATORIES, INC.

Gail R. Hutchens
Exec. Vice-President

GRH:sc

HARRY W. GALBRAITH, PH.D
CHAIRMAN OF THE BOARD

KENNETH S. WOODS
PRESIDENT

GAIL R. HUTCHENS
EXECUTIVE VICE-PRESIDENT

VELMA M. RUSSELL
SECRETARY/TREASURER

GALBRAITH
Laboratories, Inc.

QUANTITATIVE MICROANALYSES
ORGANIC – INORGANIC
615/546-1335

P.O. BOX 51610
KNOXVILLE, TN 37950-1610

2323 SYCAMORE DR.
KNOXVILLE, TN 37921-1750

Ms. Deann R. Williams
Midwest Research Institute
425 Volker Boulevard
Kansas City, Missouri 64110

December 7, 1989

Received: November 13th
PO#: 108796

Dear Ms. Williams:

Analysis of your compounds gave the following results:

Your #,	Our #,	% Total Carbon,	% Inorganic Carbon,	% Total Organic Carbo
1030	I-7002	9.57 9.90	10.15 10.90	less than 0. less than 0.5
2030	I-7003	9.66	9.96	less than 0.
3030	I-7004	9.56	9.81	less than 0.5
4030	I-7005	9.87	9.98	less than 0.
5030	I-7006	9.71	9.85	less than 0.

LETTER AND SHIPMENTS BY U.S. MAIL · P.O. BOX 51610, KNOXVILLE, TN 37950-1610. OTHER CARRIERS · 2323 SYCAMORE DR. KNOXVILLE, TN 37921-1750
ESTABLISHED 1950

Your #,	Our #,	ppm Potassium,	mg/liter NH_3 as Nitrogen,	mg/liter Chloride,
1022	I-7007	less than 1	44.2	12.51
2022	I-7008	less than 1	27.4	11.8
3022	I-7009	less than 1	29.0	6.96
4022	I-7010	less than 1	48.8	41.71
5022	I-7011	less than 1	0.42	42.8
1023	I-7012	less than 1	0.58	1.30
2023	I-7013	less than 1	0.22	2.27
3023	I-7014	less than 1	0.28	2.20
4023	I-7015	less than 1	0.066	1.59
5023	I-7016	less than 1	0.18	less than 20*
1024	I-7017	1.2	0.18	less than 0.4
1025	I-7018	less than 1	0.15	less than 0.4

* We regret that there was too much interference for a lower determination.

Your #,	Our #,	mg/liter Potassium,	mg/liter NH_3 as Nitrogen,	mg/liter Chloride,
21889	I-7019	4160	0.11	3545
21890	I-7020	43.9	0.092	35.4

See Raw Data package for information on TOC values.

Sincerely yours,

GALBRAITH LABORATORIES, INC.

Gail R. Hutchens
Exec. Vice-President

GRH:sc

GERG
Geochemical and Environmental Research Group
Ten South Graham Road
College Station, Texas 77840
TEXAS A&M UNIVERSITY
Telephone: (409) 690-0095
FAX: (409) 690-0059
TELEX: 910-380-8722

1 August 1990

Scott Klamm
Midwest Research Institute
425 Volker Blvd.
Kansas City, MO

Dear Scott:

Enclosed are TOC analysis results for the industrial cement kiln study (per GERG SOP-8907). These samples were particularly difficult to analyze and the following comments should be noted. A number of samples could not be dried even after several days of exposure in a recirculating oven at 50°C. This affected our ability to obtain an accurate sample weight and apparently the samples were moist with something other than water. The values on many samples approach the detection limit of the method (~0.05%). The samples were inhomogenous causing more than usual scatter in replicate analyses. Average TOC values are reported for each sample with replicates provided for the samples as requested. If you have any questions, please call.

Sincerely yours,

Mahlon C. Kennicutt

Mahlon C. Kennicutt II, Ph.D.
Associate Research Scientist

MCK/dep
enclosure

Table 1. Total organic carbon content of industrial cement kiln samples.

Sample I.D.	TOC (%)
1037	0.10
2037	0.10
3037	0.04
4037	0.07
5037	0.06

APPENDIX B-5

CEM DATA MEASURED BY MRI

NOTE: No significant problems were encountered with the CEM systems. All tests fell within the appropriate range for zero and calibration drift, and all final leak checks were passed.

The nitrogen bias sampling line was not correctly connected during test runs 2, 3, and 4, invalidating the nitrogen bias data collected. The ambient air sampling line was inappropriately connected during test run 5, invalidating data.

Times recorded in the field were in error during portions of the test. Because of a time change (i.e., daylight savings time change) and computer equipment changes during the test, analog times were recorded incorrectly. Reported times were corrected immediately following the test; sampling train data and field notes were utilized to determine appropriate time designations to be reported with CEM data. Appendix B notes the changes made to time analogs.

RUN 1 - O2, CO2, CO

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1548	15.80	4.5	32.6	3800	3218		18.7	1.2	-1	-7	
1549	15.82	4.6	32.4	3916	3347		18.7	1.3	-1	-3	
1550	15.83	4.7	32.3	4158	3571		18.6	1.4	0	2	
1551	15.85	4.8	32.0	6112	5269		18.5	1.4	-0	-2	
1552	15.87	4.8	31.9	6898	5942		18.4	1.5	5	27	
1553	15.88	4.9	31.7	7953	6907		18.4	1.5	4	23	
1554	15.90	4.9	31.7	5548	4834		18.5	1.4	4	20	
1555	15.92	4.9	31.6	3142	2727		18.5	1.3	1	8	
1556	15.93	4.7	31.7	1763	1516		18.7	1.3	0	1	
1557	15.95	4.3	32.4	1274	1068		18.7	1.3	1	8	
1558	15.97	4.0	33.1	1107	913		18.6	1.3	4	25	
1559	15.98	4.1	33.5	842	697		18.6	1.4	5	30	
1600	16.00	4.2	33.5	692	575		18.6	1.5	2	14	
1601	16.02	4.0	33.4	601	494		18.5	1.4	1	8	
1602	16.03	4.2	33.6	593	494		18.6	1.4	2	14	
1603	16.05	4.0	33.5	544	447		18.6	1.4	5	30	
1604	16.07	4.0	33.4	520	429		18.7	1.4	3	18	
1605	16.08	4.0	33.5	471	388		18.7	1.4	2	11	
1606	16.10	4.0	33.7	501	412		18.6	1.5	1	5	
1607	16.12	4.1	33.7	492	407		18.6	1.5	1	5	
1608	16.13	4.2	33.6	443	370		18.7	1.4	-1	-8	
1609	16.15	4.4	33.3	394	332		18.7	1.4	-0	-1	
1610	16.17	4.5	33.1	373	316		18.8	1.4	-2	-11	
1611	16.18	4.3	33.1	361	303		18.8	1.4	-3	-16	
1612	16.20	4.0	33.4	353	290		18.6	1.5	-0	-2	
1613	16.22	3.7	34.0	715	580		18.5	1.5	6	31	
1614	16.23	3.9	34.1	1409	1155		18.6	1.5	7	43	
1615	16.25	4.3	33.8	1005	841		18.7	1.4	5	30	
1616	16.27	4.4	33.2	551	465		18.7	1.4	-1	-7	
1617	16.28	4.3	33.1	383	322		18.7	1.4	-3	-17	
1618	16.30	4.2	33.3	357	297		18.7	1.4	-3	-17	
1619	16.32	4.1	33.5	386	320		18.6	1.4	-1	-4	
1620	16.33	4.1	33.4	397	328		18.6	1.4	0	1	
1621	16.35	4.1	33.6	407	337		18.7	1.4		2 *	
1622	16.37	4.1	33.6	441	365		18.6	1.5		4 *	
1623	16.38	4.1	33.6	451	374		18.6	1.5		5 *	
1624	16.40	4.4	33.5	417	352		18.7	1.4		6 *	
1625	16.42	4.7	32.8	362	311		18.8	1.3		8 *	
1626	16.43	4.9	32.4		308 •		18.9	1.2		9 *	
1627	16.45	4.9	32.0		304 •		18.9	1.3		11 •	
1628	16.47	4.7	32.1		301 •		18.8	1.3		12 •	
1629	16.48	4.4	32.6		298 •		18.8	1.4		14 •	
1630	16.50	4.3	32.8		295 *		18.8	1.4		15 •	
1631	16.52	4.3	33.0		292 •		18.8	1.4	3	17	
1632	16.53	4.2	33.3	346	289		18.8	1.5	2	10	
1633	16.55	4.1	33.4	334	277		18.8	1.5	2	14	
1634	16.57	4.2	33.5	416	347		18.8	1.5	1	8	
1635	16.58	4.3	33.3	451	378		18.8	1.5	-1	-3	
1636	16.60	4.3	33.3	404	340		18.8	1.5	1	3	
1637	16.62	4.5	33.2	384	326		18.8	1.6	1	9	
1638	16.63	4.4	33.0	361	305		18.8	1.6	1	3	
1639	16.65	4.4	33.1	338	286		18.8	1.6	0	2	
1640	16.67	4.3	33.2	330	277		18.8	1.6	1	9	
1641	16.68	4.1	33.5	322	267		18.7	1.6	1	8	
1642	16.70	4.1	33.5	369	306		18.8	1.4	2	10	
1643	16.72	4.3	33.8	400	334		18.8	1.4	-1	-7	
1644	16.73	4.5	33.4	504	427		18.8	1.6	-2	-10	
1645	16.75	4.1	33.2	393	326		18.7	1.5	-1	-5	
1646	16.77	4.0	33.8	338	278		18.6	1.5	-2	-11	
1647	16.78	4.2	33.8	426	354	970	18.6	1.5	-1	-3	7
1648	16.80	4.3	33.4	411	344	922	18.6	1.5	2	9	7
1649	16.82	4.2	33.4	374	312	872	18.7	1.4	-1	-8	7
1650	16.83	3.9	33.7	366	300	817	18.7	1.4	1	3	7
1651	16.85	3.8	33.9	395	321	735	18.6	1.5	-0	-1	7
1652	16.87	3.9	34.0	511	419	643	18.5	1.5	0	1	6
1653	16.88	3.9	33.9	605	496	536	18.5	1.5	-1	-3	6
1654	16.90	4.0	33.7	624	515	464	18.5	1.6	4	22	6
1655	16.92	4.1	33.8	676	560	428	18.5	1.6	2	10	6

		MAIN DUCT		CARBON MONOXIDE			BYPASS DUCT		CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1656	16.93	4.3	33.5	572	479	411	18.4	1.6	2	13	6
1657	16.95	4.3	33.1	476	400	400	18.5	1.6	1	8	6
1658	16.97	3.9	33.3	422	346	390	18.5	1.7	1	7	6
1659	16.98	3.8	33.9	485	394	385	18.4	1.8	2	10	6
1700	17.00	3.9	34.2	908	744	388	18.2	1.9	3	14	6
1701	17.02	4.1	34.1	887	735	392	18.2	1.9	8	40	6
1702	17.03	4.4	33.6	709	597	394	18.2	1.9	13	67	7
1703	17.05	4.6	33.2	510	435	393	18.3	1.8	14	73	8
1704	17.07	4.7	32.7	382	329	392	18.5	1.7	8	42	8
1705	17.08	4.6	32.7	341	291	390	18.6	1.6	3	16	8
1706	17.10	4.4	32.9	336	284	388	18.6	1.7	2	13	8
1707	17.12	4.3	33.3	348	292	386	18.5	1.7	1	4	8
1708	17.13	4.5	33.4	368	311	385	18.5	1.7	-1	-8	8
1709	17.15	4.6	33.2	374	319	385	18.4	1.8	-1	-7	8
1710	17.17	4.6	33.1	366	313	385	18.[illegible]	1.7	-0	-1	8
1711	17.18	4.6	33.0	333	283	385	18.5	1.8	-2	-11	9
1712	17.20	4.6	33.0	307	262	384	18.5	1.7	-1	-4	8
1713	17.22	4.3	33.3	303	254	379	18.[illegible]	1.7	-1	-5	8
1714	17.23	4.6	33.5	307	262	364	18.[illegible]	1.7	1	8	7
1715	17.25	4.7	32.8	317	273	354	18.[illegible]	1.8	3	14	7
1716	17.27	4.4	33.0	298	251	351	18.5	1.8	-1	-5	7
1717	17.28	4.3	33.4	302	252	350	18.[illegible]	1.8	28	150	10
1718	17.30	4.3	33.6	340	285	349	18.[illegible]	1.9	59	308	15
1719	17.32	4.3	33.7	367	307	349	18.[illegible]	1.9	54	277	20
1720	17.33	4.0	33.7	392	324	349	18.[illegible]	1.9	40	207	23
1721	17.35	3.9	34.1	355	290	348	18.4	1.9	30	159	26
1722	17.37	4.0	34.4	424	349	348	18.4	1.8	21	112	28
1723	17.38	4.1	34.2	514	425	349	18.4	1.8	13	69	29
1724	17.40	4.3	33.9	450	377	349	18.3	1.9	12	63	30
1725	17.42	4.4	33.5	413	349	350	18.4	1.9	11	58	31
1726	17.43	4.6	33.1	370	315	350	18.4	1.8	8	41	31
1727	17.45	4.3	33.0	337	282	350	18.5	1.7	4	20	31
1728	17.47	4.1	33.5	324	269	349	18.5	1.7	2	12	31
1729	17.48	4.3	33.6	431	360	350	18.5	1.7	8	43	32
1730	17.50	4.3	33.4	422	353	351	18.5	1.7	7	40	32
1731	17.52	3.9	33.7	3[illegible]9	319	352	18.5	1.7	4	24	32
1732	17.53	3.8	34.3	463	376	353	18.4	1.8	10	54	33
1733	17.55	3.9	34.5	764	627	359	18.2	2.0	17	84	34
1734	17.57	4.2	34.0	793	661	364	18.2	2.0	23	113	36
1735	17.58	4.1	33.7	538	445	365	18.2	2.0	19	94	38
1736	17.60	4.0	33.9	479	395	366	18.3	2.0	14	72	39
1737	17.62	4.0	34.0	513	422	368	18.3	2.0	13	66	40
1738	17.63	4.3	33.8	555	466	370	18.3	1.9	14	71	41
1739	17.65	4.1	33.2	494	410	373	18.4	1.8	10	55	42
1740	17.67	3.9	33.6	449	366	374	18.4	1.8	7	40	42
1741	17.68	3.7	34.3	734	593	379	18.3	1.9	15	79	43
1742	17.70	4.0	34.3	1215	1000	391	18.2	2.0	3[illegible]	182	46
1743	17.72	4.4	33.6	1515	1275	407	18.1	2.0	[illegible]	326	52
1744	17.73	4.5	33.1	682	578	409	18.2	2.0	[illegible]	256	56
1745	17.75	4.2	33.1	474	395	410	18.3	1.9	31	162	59
1746	17.77	3.8	33.7	432	351	412	18.4	1.9	18	96	61
1747	17.78	3.7	34.3	697	562	415	18.3	1.9	13	67	62
1748	17.80	3.9	34.5	1443	1184	429	18.2	2.0	14	72	63
1749	17.82	4.0	34.2	1268	1043	441	18.1	2.1	16	79	64
1750	17.83	3.9	34.2	702	576	446	18.0	2.2	1[illegible]	64	66
1751	17.85	4.2	34.3	623	517	449	18.0	2.2	12	58	66
1752	17.87	4.3	33.8	57[illegible]	484	450	18.0	2.2	[illegible]	42	67
1753	17.88	4.1	[illegible].7	457	378	448	18.1	2.2	[illegible]	30	68
1754	17.90	4.0	3[illegible].9	41[illegible]	339	445	18.2	2.1	[illegible]	10	68
1755	17.92	4.1	34.2	45[illegible]	377	442	18.2	2.1	[illegible]	44	68
1756	17.93	4.1	33.9	58[illegible]	486	442	18.2	2.1	2[illegible]	101	70
1757	17.95	4.5	33.7	514	436	443	18.2	2.1	2[illegible]	99	71
1758	17.97	4.7	32.9	47[illegible]	410	444	18.2	2.0	1[illegible]	78	72
1759	17.98	4.2	32.9	38[illegible]	316	443	18.3	2.0	8	43	73
1800	18.00	4.4	33.6	427	359	436	18.3	2.0	7	37	73
1801	18.02	4.6	33.3	460	392	431	18.3	1.9	5	26	73
1802	18.03	4.8	32.9	403	348	426	18.5	1.8	2	13	72
1803	18.05	4.5	32.6	366	311	424	18.5	1.8	1	6	71

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1804	18.07	3.9	33.4	348	285	424	18.2	2.0	8	43	71
1805	18.08	3.8	34.3	837	679	430	18.0	2.2	16	77	72
1806	18.10	3.8	34.4	1211	986	442	17.9	2.2	16	73	73
1807	18.12	3.9	34.4	993	812	450	17.8	2.3	18	79	74
1808	18.13	3.7	34.3	1216	982	462	17.8	2.4	56	244	79
1809	18.15	3.4	34.4	2461	1958	489	17.6	2.5	201	819	92
1810	18.17	3.5	34.6	8054	6458	591	17.5	2.4	322	1304	114
1811	18.18	3.6	34.5		5572 •	680	17.7	2.3	249	1064	132
1812	18.20	3.9	34.5	5736	4686	753	17.9	2.1	141	645	143
1813	18.22	4.0	34.3	2526	2075	784	18.0	2.1	83	382	149
1814	18.23	4.1	33.9	1926	1593	806	18.0	2.1	63	295	154
1815	18.25	4.2	33.9	1155	961	817	18.1	2.0	37	177	157
1816	18.27	4.2	33.9	660	550	822	18.2	1.9	20	97	158
1817	18.28	4.0	33.8	478	394	825	18.3	1.9	15	77	157
1818	18.30	4.0	34.1	489	402	827	18.3	1.9	9	48	153
1819	18.32	4.2	34.0	490	407	828	18.3	1.8	5	27	149
1820	18.33	4.4	33.6	467	394	829	18.5	1.7	3	15	146
1821	18.35	4.4	33.3	448	378	831	18.5	1.8	1	4	143
1822	18.37	4.3	33.4	404	338	831	18.4	1.9	1	4	141
1823	18.38	4.2	33.6	421	350	829	18.3	1.9	4	18	140
1824	18.40	4.2	33.7	428	356	829	18.3	2.0	5	24	140
1825	18.42	4.0	33.8	448	369	829	18.2	2.0	6	28	139
1826	18.43	3.8	34.0	454	370	830	18.1	2.0	7	36	139
1827	18.45	4.0	34.1	638	524	834	18.2	2.0	13	67	140
1828	18.47	4.2	34.0	742	619	840	18.3	1.9	13	65	141
1829	18.48	4.2	33.5	515	428	841	18.3	1.9	7	36	141
1830	18.50	3.7	33.8	501	406	842	18.3	1.9	7	33	140
1831	18.52	3.4	34.6	876	698	849	18.1	2.1	10	47	141
1832	18.53	3.5	34.8	2807	2246	880	18.0	2.1	15	69	141
1833	18.55	3.6	34.6	3739	3013	919	18.0	2.1	17	80	141
1834	18.57	3.7	34.6	1696	1373	931	18.0	2.1	16	77	140
1835	18.58	4.1	34.3	1090	903	939	18.2	1.9	7	33	139
1836	18.60	4.5	33.5	631	535	941	18.4	1.7	3	18	139
1837	18.62	4.7	32.9	436	375	940	18.5	1.7	-1	-4	137
1838	18.63	4.6	32.5	355	303	938	18.4	1.7	-3	-19	136
1839	18.65	4.4	32.7	341	288	936	18.4	1.8	-4	-18	135
1840	18.67	4.0	33.2	356	294	935	18.2	1.9	-2	-11	134
1841	18.68	3.9	33.7	389	319	930	18.1	2.0	3	13	133
1842	18.70	4.2	33.9	504	419	920	18.2	2.0	3	16	130
1843	18.72	4.3	33.9	468	393	906	18.3	2.0	2	11	125
1844	18.73	4.2	33.6	428	357	902	18.3	2.0	1	6	121
1845	18.75	4.5	33.5	415	352	901	18.4	1.9	2	9	118
1846	18.77	4.6	32.9	377	322	901	18.4	1.9	-1	-3	116
1847	18.78	4.3	32.9	346	290	896	18.3	2.0	-2	-11	115
1848	18.80	4.0	33.6	394	325	882	18.2	2.1	2	10	114
1849	18.82	4.0	34.0	503	415	871	18.2	2.1	11	52	114
1850	18.83	3.9	34.0	455	373	868	18.2	2.1	10	47	113
1851	18.85	4.3	34.1	529	444	867	18.3	2.0	4	19	113
1852	18.87	4.5	33.4	447	379	865	18.4	1.9	3	14	112
1853	18.88	4.5	33.2	344	292	864	18.5	1.8	-1	-4	112
1854	18.90	4.3	33.0	312	262	862	18.5	1.8	-1	-4	111
1855	18.92	4.1	33.4	329	272	861	18.3	2.0	0	2	111
1856	18.93	4.0	33.8	418	345	858	18.2	2.1	3	17	109
1857	18.95	3.9	34.0	465	381	857	18.1	2.2	0	0	107
1858	18.97	3.9	34.1	606	496	859	18.1	2.2	3	12	106
1859	18.98	3.9	34.2	655	536	862	18.1	2.1	17	82	107
1900	19.00	4.2	34.1	638	531	865	18.2	2.0	17	84	108
1901	19.02	4.3	33.5	484	405	865	18.3	1.9	26	133	110
1902	19.03	4.3	33.4	376	315	865	18.3	1.8	63	326	115
1903	19.05	4.3	33.4	356	298	865	18.3	1.9	47	241	119
1904	19.07	4.5	33.3	355	302	865	18.3	2.0	28	145	120
1905	19.08	4.6	33.0	369	315	859	18.3	2.0	15	76	120
1906	19.10	4.3	33.0	355	298	847	18.2	2.1	14	68	120
1907	19.12	4.2	33.5	355	295	839	18.2	2.1	15	75	120
1908	19.13	4.2	33.8	364	302	827	18.2	2.1	10	47	117
1909	19.15	4.1	33.9	378	314	800	18.2	2.1	10	49	104
1910	19.17	4.4	33.8	372	314	698	18.3	2.1	4	21	83
1911	19.18	4.4	33.5	340	286	610	18.4	2.0	1	5	65

				MAIN DUCT					BYPASS DUCT		
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1912	19.20	3.9	33.6	335	274	536	18.2	2.1	6	32	55
1913	19.22	3.6	34.3	1249	1002	518	18.0	2.2	20	90	50
1914	19.23	3.6	34.6	5437	4385	565	18.0	2.2	17	80	46
1915	19.25	3.7	34.7	3090	2507	590	18.1	2.2	11	54	44
1916	19.27	3.9	34.5	1896	1556	607	18.2	2.0	7	36	43
1917	19.28	4.4	33.9	1211	1018	618	18.4	1.9	1	6	42
1918	19.30	4.3	33.2	601	505	619	18.5	1.8	-0	-1	41
1919	19.32	4.1	33.2	440	365	619	18.4	1.8	-1	-8	41
1920	19.33	4.3	33.5	451	377	618	18.3	2.0	2	9	41
1921	19.35	4.0	33.7	426	349	618	18.2	2.1	7	33	41
1922	19.37	4.0	33.9	541	447	620	18.1	2.2	6	31	42
1923	19.38	4.1	33.8	597	493	622	18.2	2.2	7	33	42
1924	19.40	4.1	33.8	549	454	624	18.2	2.2	9	43	42
1925	19.42	3.8	33.9	533	434	625	18.1	2.2	15	71	43
1926	19.43	3.8	34.2	614	500	627	18.1	2.1	11	54	43
1927	19.45	4.1	34.1	776	641	629	18.3	2.1	5	25	43
1928	19.47	4.2	33.8	591	492	627	18.3	2.0	5	23	42
1929	19.48	4.1	33.8	434	359	626	18.1	2.1	4	18	42
1930	19.50	4.0	33.7	416	343	625	18.1	2.1	5	23	41
1931	19.52	4.2	33.9	439	365	619	18.2	2.1	4	20	41
1932	19.53	4.2	33.6	455	379	588	18.3	2.0	2	9	40
1933	19.55	4.0	33.6	407	336	543	18.2	2.0	0	2	39
1934	19.57	4.1	33.8	446	370	527	18.3	1.9	3	14	38
1935	19.58	4.0	33.8	420	346	517	18.3	2.0	5	24	37
1936	19.60	4.1	33.8	425	351	514	18.2	2.0	8	40	38
1937	19.62	4.3	33.7	442	370	514	18.2	2.0	6	30	38
1938	19.63	4.3	33.2	399	334	515	18.2	2.0	2	10	39
1939	19.65	4.2	33.3	354	295	515	18.1	2.1	2	10	39
1940	19.67	4.2	33.8	372	309	515	18.1	2.1	3	16	40
1941	19.68	4.2	33.5	437	364	516	18.2	2.1	5	23	40
1942	19.70	4.5	33.4	409	346	515	18.3	2.0	6	28	40
1943	19.72	4.4	33.2	368	310	513	18.2	2.2	14	72	41
1944	19.73	4.2	33.2	354	294	512	18.2	2.1	13	67	42
1945	19.75	4.2	33.6	398	331	512	18.2	2.1	7	37	43
1946	19.77	4.5	33.6	426	363	512	18.3	2.1	3	18	43
1947	19.78	4.3	33.4	345	289	512	18.3	2.1	2	11	43
1948	19.80	4.1	33.4	331	274	512	18.2	2.1	2	8	43
1949	19.82	4.0	33.9	516	425	512	18.2	2.1	10	49	43
1950	19.83	4.2	33.8	671	561	515	18.3	2.0	5	27	43
1951	19.85	4.2	33.5	447	372	514	18.3	2.0	4	20	43
1952	19.87	4.1	33.7	406	337	513	18.3	2.0	4	19	43
1953	19.88	4.1	33.7	495	409	515	18.2	2.0	4	19	43
1954	19.90	4.4	33.5	560	473	518	18.3	2.0	2	11	44
1955	19.92	4.7	32.9	440	377	520	18.4	2.0	-1	-6	44
1956	19.93	4.3	33.0	346	290	519	18.3	2.0	4	21	44
1957	19.95	4.2	33.5	364	302	518	18.2	2.1	3	13	44
1958	19.97	4.1	33.7	367	304	515	18.2	2.1	5	22	44
1959	19.98	3.9	34.1	379	310	511	18.1	2.1	66	316	48
2000	20.00	4.0	34.2	538	444	510	18.1	2.1	116	565	56
2001	20.02	4.1	33.9	458	378	509	18.2	2.0	64	318	59
2002	20.03	4.0	33.9	424	349	510	18.1	2.1	32	156	56
2003	20.05	4.0	33.9	448	370	511	18.1	2.1	17	81	54
2004	20.07	4.1	33.9	423	351	512	18.1	2.1	8	41	52
2005	20.08	4.2	33.6	381	317	512	18.2	2.0	5	23	51
2006	20.10	4.1	33.5	350	290	512	18.1	2.0	6	30	50
2007	20.12	4.3	33.9	334	279	511	18.1	2.1	20	96	51
2008	20.13	4.4	33.4	404	340	512	18.3	1.9	15	74	51
2009	20.15	4.2	33.2	339	283	511	18.3	1.9	6	30	51
2010	20.17	4.0	33.8	358	294	511	18.2	2.0	4	19	51
2011	20.18	3.8	34.3	465	378	513	18.0	2.2	10	46	51
2012	20.20	3.9	34.5	637	521	517	18.0	2.3	20	91	52
Minimum=		3.4	31.6	298	251		17.5	1.2	-4	-18.6	
Maximum=		4.9	34.8	8054	6907		18.9	2.5	322	1304.1	
Average=		4.2	33.6	788	667		18.3	1.8	13	59.3	

	MAIN DUCT					BYPASS DUCT				
			CARBON MONOXIDE					CARBON MONOXIDE		
TIME DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
Zero drift= (% of span)	0.35	4.38	3.50			0.49	0.05	1.71		
Span drift= (% of span)	0.86	10.06	3.89			1.73	3.82	0.56		
Error Est.=	0.08	3.90	58.17			0.38	0.08	13.52		

* Data points generated by extrapolation.

Comments:

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LINEARITY CHECK CO 392.8 PPM CYLINDER ALM-853 [10-28-1989 -- 09:45:00]
LINEAITY CHECK CO 148.2 PPM CYLINDER ALM-867 [10-28-1989 -- 09:56:17]
LINEARITY CHECK O2 6.044% CYLINDER ALM-2904 [10-28-1989 -- 10:07:31]
LINEARITY CHECKCO2 5.957% CYLINDER AAL-3453 [10-28-1989 -- 10:18:32]
ALL ANALYZERS PASSED LINEARITY CHECK [10-28-1989 -- 10:36:12]
 [10-28-1989 -- 10:48:17]
BYPASS IS AT 20 INCHES-LESS THAN 10 ROTOMETER. MAIN 22 INCHES-25 TO 30 ON PYREX INITIAL CHECK OK. [
Now on stack gas. [10-28-1989 -- 11:05:57]
   [10-28-1989 -- 16:28:35]
ASCARITE FILTER CHANGED [10-28-1989 -- 16:29:10]
LEAK CHECKED BYPASS LINE, ok. BACK TO SAMPLE. [10-28-1989 -- 16:45:58]
 [10-28-1989 -- 17:23:10]
 [10-28-1989 -- 20:22:18]
END RUN 1 [10-28-1989 -- 20:22:24]
BY PASS LESS THAN 5 AT 20 INCHES [10-28-1989 -- 20:28:12]
MAIN AT 22 INCHES 28 AND 18 ON PYREX BALLLLL--FINAL LEAK CHEC OK!!!!!! [10-28-1989 -- 20:29:17]
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RUN 1 - THC

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE
1548	15.72	0.6	3.1		36.7	30.6		38.5	40.1		0.3	1.7	
1549	15.73	0.6	3.1		59.2	49.3		80.9	84.2		0.3	1.7	
1550	15.75	0.6	3.1		67.3	56.1		57.6	59.9		0.3	1.7	
1551	15.77	0.7	3.6		85.3	71.1		127.5	132.6		0.4	2.2	
1552	15.78	0.7	3.6		101.9	84.9		60.3	62.7		0.4	2.2	
1553	15.88	0.7	3.6		29	24.2		22.3	23.2		0.4	2.2	
1554	15.90	0.7	3.6		27.5	22.9		29.5	30.7		0.5	2.8	
1555	15.92	0.7	3.6		14.1	11.8		13.5	14.0		0.5	2.8	
1556	15.93	0.7	3.6		14.8	12.3		18.1	18.8		0.6	3.4	
1557	15.95	0.7	3.6		11.4	9.5		12.4	13.1		0.6	3.4	
1558	15.97	0.6	3.1		9	7.5		11.4	11.9		0.6	3.4	
1559	15.98	0.6	3.1		8.4	7.0		10.8	11.2		0.7	3.9	
1600	16.00	0.6	3.1		9.4	7.8		12.[illegible]	13.2		0.7	3.9	
1601	16.02	0.6	3.1		8.7	7.3		10.[illegible]	10.9		0.7	3.9	
1602	16.03	0.7	3.6		8.1	6.8		10.[illegible]	11.2		0.7	3.9	
1603	16.05	0.6	3.1		8.3	6.9		10.[illegible]	11.0		0.7	3.9	
1604	16.07	0.6	3.[illegible]		7.9	6.6		10.[illegible]	10.8		0.7	3.9	
1605	16.08	0.6	3.[illegible]		7.8	6.5		10.3	10.7		0.6	3.4	
1606	16.10	0.6	3.[illegible]		7.8	6.5		10.1	10.5		0.6	3.4	
1607	16.12	0.6	3.[illegible]		7.6	6.3		9.9	10.3		0.5	2.8	
1608	16.13	0.6	3.1		7.3	6.1		9.7	10.1		0.5	2.8	
1609	16.15	0.6	3.1		7.1	5.9		9.5	9.9		0.5	2.8	
1610	16.17	0.6	3.1		7.1	5.9		9.7	10.1		0.5	2.8	
1611	16.18	0.6	3.1		7.4	6.2		10.2	10.6		0.5	2.8	
1612	16.20	0.6	3.1		24.3	20.3		3[illegible]	37.5		0.5	2.8	
1613	16.22	0.6	3.1		19.5	16.3		13.7	14.3		0.4	2.2	
1614	16.23	0.6	3.1		8.8	7.3		10.1	10.5		0.4	2.2	
1615	16.25	0.6	3.1		7.4	6.2		9.[illegible]	10.1		0.4	2.2	
1616	16.27	0.6	3.1		7.2	6.0		9.[illegible]	10.1		0.3	1.7	
1617	16.28	0.6	3.1		7.3	6.1		9.8	10.2		0.3	1.7	
1618	16.30	0.6	3.1		7.4	6.2		10	10.4		0.3	1.7	
1619	16.32	0.7	3.6		7.4	6.2		9.9	10.3		0.4	2.2	
1620	16.33	1.4	7.3		7.4	6.2		9.9	10.3		1.6	9.0	
1621	16.35	1.8	9.3		7.5	6.3		10.[illegible]	10.6		2	11.2	
1622	16.37	1.5	7.8		7.5	6.3		9.[illegible]	10.3		1.4	7.9	
1623	16.38	1.3	6.7		7.2	6.0		9.[illegible]	10.0		1.2	6.7	
1624	16.40	1.2	6.2		6.9	5.8		9.[illegible]	9.7		1.1	6.2	
1625	16.42		6.0 *			5.8 *			9.7 *			5.7 *	
1626			5.7 *			5.8 *			9.6 *			5.2 *	
1627			5.5 *			5.8 *			9.6 *			4.7 *	
1628			5.3 *			5.8 *			9.6 *			4.3 *	
1629			5.0 *			5.8 *			9.6 *			3.8 *	
1630			4.8 *			5.8 *			9.6 *			3.3 *	
1631			4.5 *			5.8 *			9.6 *			2.8 *	
1632			4.3 *			5.8 *			9.5 *			2.4 *	
1633			4.1 *			5.8 *			9.5 *			1.9 *	
1634			3.8 *			5.8 *			9.5 *			1.4 *	
1635			3.6 *			5.8 *			9.5 *			0.9 *	
1636	16.60		3.4 *			5.8 *			9.5 *			0.5 *	
1637	16.62	0.6	3.1		6.9	5.8		9.1	9.5		0	0.0	
1638	16.63	0	0.0		7	5.8		9.1	9.5		-0.6	-3.4	
1639	16.65	-0.2	-1.0		7	5.8		9	9.4		-0.7	-3.9	
1640	16.67	-0.2	-1.0		7.2	6.0		9.2	9.6		-0.7	-3.9	
1641	16.68	-0.3	-1.6		7.5	6.3		9.5	9.9		-0.8	-4.5	
1642	16.70	-0.3	-1.6		8.5	7.1		9.9	10.3		-0.8	-4.5	
1643	16.72	-0.2	-1.0		7.1	5.9		8.9	9.3		-0.7	-3.9	
1644	16.73	-0.2	-1.0		7.1	5.9		9.1	9.5		-0.7	-3.9	
1645	16.75	-0.2	-1.0		7.7	6.4		9.6	10.0		-0.7	-3.9	
1646	16.77	-0.2	-1.0		7.4	6.2		9.2	9.6		-0.6	-3.4	
1647	16.78	-0.2	-1.0	3.2	7.2	6.0	11.8	9.1	9.5	16.9	1.9	10.7	2.4
1648	16.80	-0.2	-1.0	3.1	7.2	6.0	11.4	9.1	9.5	16.4	1.6	9.0	2.5
1649	16.82	-0.2	-1.0	3.0	7.4	6.2	10.7	9.4	9.8	15.2	0.9	5.1	2.5
1650	16.83	-0.2	-1.0	3.0	7.8	6.5	9.8	9.7	10.1	14.4	0.8	4.5	2.6
1651	16.85	-0.2	-1.0	2.9	7.9	6.6	8.8	9.6	10.0	12.3	0.8	4.5	2.6
1652	16.87	-0.2	-1.0	2.8	8.1	6.8	7.4	10.3	10.7	11.5	0.8	4.5	2.7
1653	16.88	-0.2	-1.0	2.7	8.9	7.4	7.2	10.2	10.6	11.2	0.8	4.5	2.7

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE
1654	16.90	-0.2	-1.0	2.7	7.5	6.3	6.9	9.3	9.7	10.9	0.9	5.1	2.7
1655	16.92	-0.2	-1.0	2.6	7.3	6.1	6.8	9.1	9.5	10.8	0.8	4.5	2.8
1656	16.93	-0.3	-1.6	2.5	7.1	5.9	6.7	8.9	9.3	10.7	0.8	4.5	2.8
1657	16.95	-0.3	-1.6	2.4	7.8	6.5	6.6	9.9	10.3	10.6	0.8	4.5	2.8
1658	16.97	-0.3	-1.6	2.3	10.5	8.8	6.7	11.5	12.0	10.6	0.7	3.9	2.8
1659	16.98	-0.3	-1.6	2.2	8.5	7.1	6.7	9.9	10.3	10.6	0.7	3.9	2.8
1700	17.00	-0.3	-1.6	2.2	7.9	6.6	6.6	9.1	9.5	10.5	0.7	3.9	2.8
1701	17.02	-0.3	-1.6	2.1	7.2	6.0	6.6	8.7	9.1	10.5	0.6	3.4	2.8
1702	17.03	-0.3	-1.6	2.0	7.1	5.9	6.6	8.7	9.1	10.5	0.6	3.4	2.8
1703	17.05	-0.3	-1.6	1.9	6.9	5.8	6.6	8.6	8.9	10.4	0.5	2.8	2.8
1704	17.07	-0.3	-1.6	1.8	6.9	5.8	6.6	8.5	8.8	10.4	0.5	2.8	2.8
1705	17.08	-0.3	-1.6	1.8	7	5.8	6.6	8.7	9.1	10.4	0.4	2.2	2.7
1706	17.10	-0.3	-1.6	1.7	7.1	5.9	6.6	8.8	9.2	10.3	0.4	2.2	2.7
1707	17.12	-0.3	-1.6	1.6	7	5.8	6.5	8.7	9.1	10.3	0.4	2.2	2.7
1708	17.13	-0.3	-1.6	1.5	6.9	5.8	6.5	8.6	8.9	10.3	0.4	2.2	2.7
1709	17.15	-0.3	-1.6	1.5	6.8	5.7	6.5	8.5	8.8	10.3	0.4	2.2	2.7
1710	17.17	-0.3	-1.6	1.4	6.8	5.7	6.5	8.6	8.9	10.3	0.4	2.2	2.7
1711	17.18	-0.2	-1.0	1.3	6.8	5.7	6.5	8.7	9.1	10.2	0.4	2.2	2.7
1712	17.20	-0.2	-1.0	1.2	6.9	5.8	6.3	8.8	9.2	9.8	0.5	2.8	2.7
1713	17.22	-0.2	-1.0	1.2	6.9	5.8	6.1	8.8	9.2	9.7	0.5	2.8	2.7
1714	17.23	-0.2	-1.0	1.1	6.7	5.6	6.1	8.6	8.9	9.7	0.7	3.9	2.7
1715	17.25	-0.2	-1.0	1.0	6.8	5.7	6.1	8.8	9.2	9.6	3.3	18.5	3.0
1716	17.27	-0.2	-1.0	1.0	7	5.8	6.1	8.9	9.3	9.6	2.7	15.2	3.2
1717	17.28	-0.2	-1.0	0.9	7	5.8	6.1	8.8	9.2	9.6	2.1	11.8	3.4
1718	17.30	-0.2	-1.0	0.8	7	5.8	6.1	8.9	9.3	9.6	1.6	9.0	3.5
1719	17.32	-0.2	-1.0	0.8	7.1	5.9	6.1	8.9	9.3	9.6	1.3	7.3	3.6
1720	17.33	-0.2	-1.0	0.6	7.4	6.2	6.1	9.2	9.6	9.6	1.1	6.2	3.5
1721	17.35	-0.2	-1.0	0.4	7.5	6.3	6.1	9.2	9.6	9.6	1	5.6	3.4
1722	17.37	-0.3	-1.6	0.3	7.3	6.1	6.0	9.1	9.5	9.5	0.9	5.1	3.4
1723	17.38	-0.3	-1.6	0.1	7.2	6.0	6.0	8.8	9.2	9.5	0.8	4.5	3.4
1724	17.40	-0.3	-1.6	0.0	7.1	5.9	6.1	8.7	9.1	9.5	0.7	3.9	3.3
1725	17.42	-0.3	-1.6	-0.1	6.9	5.8	6.1	8.6	8.9	9.5	0.7	3.9	3.3
1726	17.43	-0.3	-1.6	-0.2	7	5.8	6.1	8.7	9.1	9.5	0.7	3.9	3.3
1727	17.45	-0.3	-1.6	-0.3	7.3	6.1	6.1	8.9	9.3	9.5	0.6	3.4	3.2
1728	17.47	-0.3	-1.6	-0.5	7.2	6.0	6.1	8.8	9.2	9.5	0.5	2.8	3.2
1729	17.48	-0.3	-1.6	-0.6	6.9	5.8	6.1	8.6	8.9	9.5	0.5	2.8	3.2
1730	17.50	-0.3	-1.6	-0.7	7.4	6.2	6.1	9.1	9.5	9.5	0.5	2.8	3.2
1731	17.52	-0.3	-1.6	-0.8	8	6.7	6.1	9.6	10.0	9.5	0.5	2.8	3.2
1732	17.53	-0.3	-1.6	-0.9	7.6	6.3	6.1	9.2	9.6	9.5	0.5	2.8	3.2
1733	17.55	-0.3	-1.6	-1.0	7.1	5.9	6.1	8.7	9.1	9.5	0.5	2.8	3.2
1734	17.57	-0.3	-1.6	-1.1	7	5.8	6.1	8.8	9.2	9.5	0.5	2.8	3.2
1735	17.58	-0.3	-1.6	-1.1	7.2	6.0	6.1	9	9.4	9.5	0.4	2.2	3.3
1736	17.60	-0.3	-1.6	-1.2	7.6	6.3	6.1	9.3	9.7	9.5	0.5	2.8	3.3
1737	17.62	-0.3	-1.6	-1.3	7.1	5.9	6.1	8.9	9.3	9.5	0.5	2.8	3.3
1738	17.63	-0.2	-1.0	-1.3	7	5.8	6.1	8.8	9.2	9.5	0.8	4.5	3.5
1739	17.65	-0.2	-1.0	-1.3	10.3	8.6	6.2	12.1	12.6	9.5	0.7	3.9	3.6
1740	17.67	-0.3	-1.6	-1.3	9.8	8.2	6.2	11.5	12.0	9.5	1.8	10.1	3.8
1741	17.68	-0.3	-1.6	-1.3	9.1	7.6	6.2	10.1	10.5	9.6	0.8	4.5	4.0
1742	17.70	-0.3	-1.6	-1.3	7.2	6.0	6.2	9	9.4	9.5	0.7	3.9	4.1
1743	17.72	-0.3	-1.6	-1.3	6.9	5.8	6.2	8.8	9.2	9.5	0.7	3.9	4.3
1744	17.73	-0.3	-1.6	-1.3	6.9	5.8	6.2	8.8	9.2	9.5	0.7	3.9	4.4
1745	17.75	-0.3	-1.6	-1.4	8.7	7.3	6.2	10.7	11.1	9.6	0.7	3.9	4.5
1746	17.77	-0.3	-1.6	-1.4	11.8	9.8	6.3	13.8	14.4	9.6	0.8	4.5	4.7
1747	17.78	-0.2	-1.0	-1.4	9.4	7.8	6.3	10	10.4	9.6	0.7	3.9	4.5
1748	17.80	-0.3	-1.6	-1.4	7.4	6.2	6.3	9.1	9.5	9.6	0.7	3.9	4.5
1749	17.82	-0.3	-1.6	-1.4	7.8	6.5	6.3	9.6	10.0	9.7	0.8	4.5	4.5
1750	17.83	-0.2	-1.0	-1.4	7.4	6.2	6.3	9.1	9.5	9.6	0.8	4.5	4.5
1751	17.85	-0.2	-1.0	-1.4	7.2	6.0	6.3	8.9	9.3	9.6	0.9	5.1	4.5
1752	17.87	-0.3	-1.6	-1.4	7.1	5.9	6.3	8.9	9.3	9.6	0.8	4.5	4.5
1753	17.88	-0.3	-1.6	-1.4	7.3	6.1	6.3	9.1	9.5	9.6	0.8	4.5	4.5
1754	17.90	-0.3	-1.6	-1.4	8.4	7.0	6.3	10.1	10.5	9.6	0.8	4.5	4.5
1755	17.92	-0.3	-1.6	-1.4	7.5	6.3	6.3	8.9	9.3	9.6	0.7	3.9	4.4
1756	17.93	-0.3	-1.6	-1.4	7.3	6.1	6.3	8.9	9.3	9.6	0.7	3.9	4.4
1757	17.95	-0.3	-1.6	-1.4	7	5.8	6.3	8.5	8.8	9.6	0.6	3.4	4.4
1758	17.97	-0.3	-1.6	-1.4	7.1	5.9	6.2	8.8	9.2	9.5	0.6	3.4	4.4
1759	17.98	23	119.3	0.6	7.3	6.1	6.2	8.9	9.3	9.5	0.5	2.8	4.4

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE
1800	18.00	0.7	3.6	0.7	7	5.8	6.2	8.6	8.9	9.5	0.4	2.2	4.4
1801	18.02	0.7	3.6	0.8	6.8	5.7	6.2	8.5	8.8	9.5	0.4	2.2	4.3
1802	18.03	0.7	3.6	0.9	6.8	5.7	6.2	8.6	8.9	9.5	0.4	2.2	4.3
1803	18.05	0.7	3.6	0.9	11.7	9.8	6.2	14.2	14.8	9.6	0.3	1.7	4.3
1804	18.07	0.6	3.1	1.0	10.6	8.8	6.3	10.7	11.1	9.6	0.3	1.7	4.3
1805	18.08	0.7	3.6	1.1	8.4	7.0	6.3	9.8	10.2	9.6	0.3	1.7	4.3
1806	18.10	0.8	4.1	1.2	10.4	8.7	6.4	12.2	12.7	9.7	0.3	1.7	4.3
1807	18.12	3.9	20.2	1.6	22.2	18.5	6.6	28.9	30.1	10.1	3.3	18.5	4.5
1808	18.13	8.6	44.6	2.3	131.7	109.8	8.3	149.2	155.2	12.5	7.9	44.3	5.2
1809	18.15	5	25.9	2.8	280.5	233.8	12.1	173.7	180.7	15.4	4.3	24.1	5.6
1810	18.17	2.7	14.0	3.1	37.4	31.2	12.5	26.6	27.7	15.7	2.2	12.3	5.8
1811	18.18	1.8	9.3	3.2	15.4	12.8	12.7	15.1	15.7	15.8	1.5	8.4	5.9
1812	18.20	1.4	7.3	3.4	18.2	15.2	12.8	20.1	20.9	16.0	1.3	7.3	5.9
1813	18.22	1	5.2	3.5	11.7	9.8	12.9	11.7	12.2	16.0	0.9	5.1	6.0
1814	18.23	0.9	4.7	3.6	9.3	7.8	12.9	10.7	11.1	16.1	0.8	4.5	6.0
1815	18.25	0.8	4.1	3.6	8.7	7.3	12.9	10.3	10.7	16.1	0.8	4.5	5.8
1816	18.27	0.8	4.1	3.7	8.2	6.8	13.0	9.7	10.1	16.1	0.8	4.5	5.6
1817	18.28	0.8	4.1	3.8	8.1	6.8	13.0	9.7	10.1	16.1	0.8	4.5	5.5
1818	18.30	0.7	3.6	3.9	8	6.7	13.0	9.6	10.0	16.1	0.8	4.5	5.4
1819	18.32	0.7	3.6	4.0	7.7	6.4	13.0	9.3	9.7	16.1	0.7	3.9	5.3
1820	18.33	0.6	3.1	4.0	7.8	6.5	13.0	9.3	9.7	16.1	0.6	3.4	5.3
1821	18.35	0.6	3.1	4.1	7.5	6.3	13.0	9.1	9.5	16.1	0.6	3.4	5.2
1822	18.37	0.6	3.1	4.2	7.5	6.3	13.0	9.2	9.6	16.1	0.5	2.8	5.2
1823	18.38	0.6	3.1	4.3	7.6	6.3	13.0	9.1	9.5	16.1	0.5	2.8	5.2
1824	18.40	0.6	3.1	4.3	7.6	6.3	13.0	9.2	9.6	16.2	0.4	2.2	5.2
1825	18.42	0.7	3.6	4.4	8	6.7	13.0	9.8	10.2	16.2	0.5	2.8	5.1
1826	18.43	0.7	3.6	4.5	9.3	7.8	13.1	10.4	10.8	16.2	0.4	2.2	5.1
1827	18.45	0.6	3.1	4.6	7.7	6.4	13.1	9.2	9.6	16.2	0.4	2.2	5.1
1828	18.47	0.6	3.1	4.7	7.3	6.1	13.1	8.9	9.3	16.2	0.4	2.2	5.1
1829	18.48	0.6	3.1	4.8	8.7	7.3	13.1	10.5	10.9	16.2	0.4	2.2	5.1
1830	18.50	0.6	3.1	4.8	17.6	14.7	13.2	21.6	22.5	16.5	0.4	2.2	5.1
1831	18.52	0.6	3.1	4.9	27.7	23.1	13.5	23.7	24.7	16.7	0.4	2.2	5.1
1832	18.53	0.6	3.1	5.0	11.6	9.7	13.6	11.8	12.3	16.8	0.4	2.2	5.0
1833	18.55	0.6	3.1	5.1	9.1	7.6	13.6	10.5	10.9	16.8	0.4	2.2	5.0
1834	18.57	0.6	3.1	5.1	8	6.7	13.6	9.5	9.9	16.8	0.4	2.2	5.0
1835	18.58	0.6	3.1	5.2	7.4	6.2	13.6	9.2	9.6	16.8	0.5	2.8	5.0
1836	18.60	0.6	3.1	5.3	7.1	5.9	13.6	8.8	9.2	16.8	0.5	2.8	5.0
1837	18.62	0.6	3.1	5.4	7	5.8	13.6	8.8	9.2	16.8	0.5	2.8	5.0
1838	18.63	0.6	3.1	5.4	7	5.8	13.6	8.8	9.2	16.8	0.5	2.8	5.0
1839	18.65	0.6	3.1	5.5	7.3	6.1	13.6	9.1	9.5	16.7	0.5	2.8	5.0
1840	18.67	0.6	3.1	5.6	7.7	6.4	13.5	9.5	9.9	16.7	0.6	3.4	4.9
1841	18.68	0.6	3.1	5.7	7.4	6.2	13.5	9.1	9.5	16.7	0.6	3.4	4.9
1842	18.70	0.6	3.1	5.7	7.3	6.1	13.5	9.1	9.5	16.7	0.6	3.4	4.8
1843	18.72	0.6	3.1	5.8	7.1	5.9	13.5	9	9.4	16.7	0.7	3.9	4.8
1844	18.73	0.6	3.1	5.9	7.2	6.0	13.5	9	9.4	16.7	0.7	3.9	4.8
1845	18.75	0.6	3.1	6.0	7	5.8	13.5	8.8	9.2	16.7	0.7	3.9	4.8
1846	18.77	0.6	3.1	6.1	7	5.8	13.4	8.9	9.3	16.6	0.7	3.9	4.8
1847	18.78	0.6	3.1	6.1	7.5	6.3	13.4	9.3	9.7	16.6	0.7	3.9	4.8
1848	18.80	0.6	3.1	6.2	7.5	6.3	13.4	9.2	9.6	16.6	0.6	3.4	4.8
1849	18.82	0.6	3.1	6.3	7.6	6.3	13.4	9.4	9.8	16.6	0.6	3.4	4.8
1850	18.83	0.6	3.1	6.4	7.5	6.3	13.4	9.1	9.5	16.6	0.6	3.4	4.8
1851	18.85	0.6	3.1	6.4	7	5.8	13.4	8.7	9.1	16.6	0.5	2.8	4.8
1852	18.87	0.6	3.1	6.5	7	5.8	13.4	8.8	9.2	16.6	0.6	3.4	4.7
1853	18.88	0.6	3.1	6.6	7	5.8	13.4	8.8	9.2	16.6	0.5	2.8	4.7
1854	18.90	0.6	3.1	6.7	7.2	6.0	13.4	9.1	9.5	16.5	0.4	2.2	4.7
1855	18.92	0.6	3.1	6.7	7.6	6.3	13.4	9.4	9.8	16.5	0.4	2.2	4.6
1856	18.93	0.6	3.1	6.8	7.9	6.6	13.4	10	10.4	16.6	0.4	2.2	4.6
1857	18.95	0.6	3.1	6.9	9.9	8.3	13.4	11.1	11.5	16.6	0.4	2.2	4.6
1858	18.97	0.6	3.1	7.0	7.8	6.5	13.4	9.5	9.9	16.6	0.4	2.2	4.6
1859	18.98	0.6	3.1	5.0	7.7	6.4	13.4	9.3	9.7	16.6	0.3	1.7	4.6
1900	19.00	1.9	9.9	5.1	7.2	6.0	13.4	9.1	9.5	16.6	1.6	9.0	4.7
1901	19.02	2.8	14.5	5.3	7	5.8	13.4	8.9	9.3	16.6	3	16.8	4.9
1902	19.03	2.4	12.4	5.5	7.1	5.9	13.4	9.1	9.5	16.6	2.1	11.8	5.1
1903	19.05	2	10.4	5.6	7	5.8	13.4	9	9.4	16.6	1.7	9.5	5.2
1904	19.07	1.6	8.3	5.7	6.7	5.6	13.3	8.7	9.1	16.5	1.5	8.4	5.3
1905	19.08	1.4	7.3	5.7	6.7	5.6	13.3	8.8	9.2	16.5	1.3	7.3	5.4
1906	19.10	1.4	7.3	5.8	7.2	6.0	13.3	9.2	9.6	16.5	1.4	7.9	5.5
1907	19.12	1.2	6.2	5.5	7.1	5.9	13.0	9	9.4	16.1	1.3	7.3	5.3

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE
1908	19.13	1.1	5.7	4.9	7.1	5.9	11.3	9	9.4	13.7	1.2	6.7	4.7
1909	19.15	1	5.2	4.5	7.1	5.9	7.5	9.1	9.5	10.8	1.1	6.2	4.4
1910	19.17	0.9	4.7	4.4	6.9	5.8	7.1	8.9	9.3	10.5	1.1	6.2	4.3
1911	19.18	1	5.2	4.3	10.5	8.8	7.0	15	15.6	10.5	1.2	6.7	4.3
1912	19.20	0.9	4.7	4.3	71.6	59.7	7.8	74.5	77.5	11.5	1.1	6.2	4.2
1913	19.22	0.9	4.7	4.3	34.8	29.0	8.1	27.6	28.7	11.7	1	5.6	4.3
1914	19.23	0.8	4.1	4.3	14.6	12.2	8.2	14.5	15.1	11.8	1	5.6	4.3
1915	19.25	0.7	3.6	4.3	18.5	15.4	8.3	19.9	20.7	12.0	0.8	4.5	4.3
1916	19.27	0.7	3.6	4.2	10.1	8.4	8.3	10.5	10.9	12.0	0.7	3.9	4.3
1917	19.28	0.6	3.1	4.2	7.5	6.3	8.3	9.3	9.7	12.0	0.6	3.4	4.2
1918	19.30	0.6	3.1	4.2	7.5	6.3	8.3	9.4	9.8	12.0	0.6	3.4	4.2
1919	19.32	0.6	3.1	4.2	7.5	6.3	8.3	9.3	9.7	12.0	0.5	2.8	4.2
1920	19.33	0.6	3.1	4.2	7.3	6.1	8.3	9.2	9.6	12.0	0.5	2.8	4.2
1921	19.35	0.6	3.1	4.2	7.8	6.5	8.3	9.6	10.0	12.0	0.4	2.2	4.2
1922	19.37	0.6	3.1	4.2	7.3	6.1	8.3	9.2	9.6	12.0	0.4	2.2	4.2
1923	19.38	0.6	3.1	4.2	7.4	6.2	8.3	9.2	9.6	12.0	0.5	2.8	4.2
1924	19.40	0.6	3.1	4.2	7.6	6.3	8.3	9.5	9.9	12.0	0.4	2.2	4.2
1925	19.42	0.6	3.1	4.2	8.3	6.9	8.3	10.6	11.0	12.0	0.4	2.2	4.2
1926	19.43	0.6	3.1	4.2	9.4	7.8	8.3	10.6	11.0	12.0	0.4	2.2	4.2
1927	19.45	0.6	3.1	4.2	7.3	6.1	8.3	9.1	9.5	12.0	0.4	2.2	4.2
1928	19.47	0.6	3.1	4.2	7.2	6.0	8.3	9.1	9.5	12.0	0.4	2.2	4.2
1929	19.48	0.6	3.1	4.2	7.3	6.1	8.3	9.2	9.6	12.0	0.4	2.2	4.2
1930	19.50	0.6	3.1	4.2	7.3	6.1	8.1	9.2	9.6	11.8	0.4	2.2	4.2
1931	19.52	0.6	3.1	4.2	7	5.8	7.9	8.9	9.3	11.5	0.3	1.7	4.2
1932	19.53	0.6	3.1	4.2	7.1	5.9	7.8	9.1	9.5	11.5	0.3	1.7	4.1
1933	19.55	0.6	3.1	4.2	7.2	6.0	7.8	9.2	9.6	11.4	0.4	2.2	4.1
1934	19.57	0.6	3.1	4.2	7.2	6.0	7.8	9.2	9.6	11.4	0.4	2.2	4.1
1935	19.58	0.6	3.1	4.2	7.2	6.0	7.7	9.2	9.6	11.4	0.5	2.8	4.1
1936	19.60	0.6	3.1	4.2	7.1	5.9	7.7	9.1	9.5	11.4	0.5	2.8	4.1
1937	19.62	0.6	3.1	4.2	7	5.8	7.7	9	9.4	11.4	0.5	2.8	4.1
1938	19.63	0.6	3.1	4.2	7.1	5.9	7.8	9.1	9.5	11.4	0.5	2.8	4.1
1939	19.65	0.6	3.1	4.2	7.1	5.9	7.7	9.1	9.5	11.4	0.5	2.8	4.1
1940	19.67	0.6	3.1	4.2	7.1	5.9	7.7	9.1	9.5	11.4	0.6	3.4	4.1
1941	19.68	0.6	3.1	4.2	7.1	5.9	7.7	9.1	9.5	11.4	0.6	3.4	4.1
1942	19.70	0.6	3.1	4.2	6.8	5.7	7.7	8.8	9.2	11.4	0.7	3.9	4.2
1943	19.72	0.6	3.1	4.2	6.9	5.8	7.7	9	9.4	11.4	0.7	3.9	4.2
1944	19.73	0.6	3.1	4.2	7.2	6.0	7.7	9.2	9.6	11.4	0.8	4.5	4.2
1945	19.75	0.6	3.1	4.2	7.2	6.0	7.7	9.1	9.5	11.4	0.7	3.9	4.2
1946	19.77	0.6	3.1	4.2	7	5.8	7.7	8.8	9.2	11.4	0.6	3.4	4.2
1947	19.78	0.6	3.1	4.2	7.3	6.1	7.7	9.2	9.6	11.4	0.6	3.4	4.1
1948	19.80	0.6	3.1	4.2	9.1	7.6	7.7	10.8	11.2	11.5	0.6	3.4	4.1
1949	19.82	0.6	3.1	4.2	7.5	6.3	7.7	9.1	9.5	11.5	0.5	2.8	4.1
1950	19.83	0.6	3.1	4.2	7.1	5.9	7.7	8.9	9.3	11.5	0.5	2.8	4.1
1951	19.85	0.6	3.1	4.2	7.4	6.2	7.7	9.2	9.6	11.5	0.4	2.2	4.1
1952	19.87	0.6	3.1	4.2	7.3	6.1	7.8	9.1	9.5	11.5	0.4	2.2	4.1
1953	19.88	0.6	3.1	4.2	7.3	6.1	7.8	9	9.4	11.5	0.3	1.7	4.1
1954	19.90	0.6	3.1	4.2	6.9	5.8	7.8	8.7	9.1	11.5	0.3	1.7	4.1
1955	19.92	0.6	3.1	4.2	6.8	5.7	7.7	8.7	9.1	11.5	0.3	1.7	4.1
1956	19.93	0.6	3.1	4.2	7	5.8	7.7	8.9	9.3	11.4	0.2	1.1	4.0
1957	19.95	0.6	3.1	4.2	7.1	5.9	7.7	9.1	9.5	11.4	0.2	1.1	4.0
1958	19.97	3.3	17.1	4.4	7.2	6.0	7.7	9.2	9.6	11.4	3.5	19.6	4.3
1959	19.98	3	15.6	4.6	7.3	6.1	7.7	9.4	9.8	11.4	3.1	17.4	4.6
2000	20.00	1.8	9.3	4.6	7	5.8	7.7	9.1	9.5	11.4	1.5	8.4	4.6
2001	20.02	1.3	6.7	4.5	7	5.8	7.7	9.1	9.5	11.4	1	5.6	4.4
2002	20.03	0.9	4.7	4.4	7.1	5.9	7.7	9.1	9.5	11.4	0.7	3.9	4.2
2003	20.05	0.8	4.1	4.3	7	5.8	7.7	9	9.4	11.4	0.6	3.4	4.1
2004	20.07	0.7	3.6	4.2	7	5.8	7.7	8.9	9.3	11.4	0.6	3.4	4.1
2005	20.08	0.7	3.6	4.1	7.1	5.9	7.7	9.2	9.6	11.4	0.6	3.4	4.0
2006	20.10	0.7	3.6	4.1	7.1	5.9	7.7	9	9.4	11.4	0.6	3.4	3.9
2007	20.12	0.6	3.1	4.0	6.8	5.7	7.7	8.7	9.1	11.4	0.6	3.4	3.9
2008	20.13	0.6	3.1	4.0	6.9	5.8	7.7	8.9	9.3	11.4	0.6	3.4	3.8
2009	20.15	0.6	3.1	3.9	7	5.8	7.7	9	9.4	11.4	0.6	3.4	3.8
2010	20.17	0.6	3.1	3.9	7.4	6.2	7.7	9.4	9.8	11.4	0.7	3.9	3.7
2011	20.18	0.6	3.1	3.9	7.3	6.1	7.6	9.1	9.5	11.3	0.7	3.9	3.7
2012	20.20	0.6	3.1	3.8	7.2	6.0	6.7	9.1	9.5	10.2	0.7	3.9	3.6

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE
2054	20.90												
2055	20.92	0			0.1			0.5			0.1		
2056	20.93	0			0.1			0.6			0.2		
2057	20.95	0			0.1			0.6			0.2		
2058	20.97	0			0.1			0.5			0.2		
2059	20.98	0			0.2			0.5			0.2		
2100	21.00	0			0.1			0.5			0.3		
2101	21.02	0			0.2			0.5			0.3		
2102	21.03	0			0.2			0.5			0.3		
2103	21.05	0			0.2			0.5			0.4		
2104	21.07	0			0.2			0.5			0.4		
2105	21.08	0			0.2			0.5			0.4		
2106	21.10	0			0.2			0.5			0.4		
2107	21.12	0			0.2			0.5			0.4		
2108	21.13	0			0.2			0.5			0.4		
2109	21.15	0			0.3			0.6			0.4		
2110	21.17	0			0.3			0.5			0.3		
2111	21.18	0			0.3			0.5			0.3		
2112	21.20	0			0.3			0.5			0.2		
2113	21.22	0			0.2			0.5			0.2		
2114	21.23	0			0.2			0.5			0.2		
2115	21.25	0			0.2			0.5			0.1		
2116	21.27	0			0.2			0.5			0.1		
2117	21.28	0			0.2			0.5			0.1		
2118	21.30	0			0.1			0.5			0.1		
2119	21.32	0			0.1			0.5			0		
2120	21.33	0			0.1			0.5			0		
2121	21.35	0			0.1			0.5			0		
2122	21.37	0			0			0.5			0		
2123	21.38	0			0			0.6			0.1		
2124	21.40	0			0			0.6			0.1		
2125	21.42	0			0			0.6			0.2		
2126	21.43	0			0			0.6			0.2		
2127	21.45	0			0			0.3			0.3		
2128	21.47	0			0.7			-0.2			0.2		
2129	21.48	0.2			2			1.2			0.1		
2130	21.50	0.9			2.7			5.2			0.8		
2131	21.52	0.9			1.8			2.6			1.1		
2132	21.53	0.8			1.6			2.1			1		
2133	21.55	0.8			1.6			1.9			0.9		
2134	21.57	0.8			1.5			1.9			0.8		
2135	21.58	0.8			1.5			1.8			0.9		
2136	21.60	0.8			1.5			1.7			0.8		
2137	21.62	0.8			1.4			1.7			0.8		
2138	21.63	0.8			1.4			1.6			0.7		
2139	21.65	0.8			1.3			1.7			0.7		
2140	21.67	0.8			1.2			1.7			0.7		
2141	21.68	0.8			1.3			1.7			0.7		
2142	21.70	0.8			1.3			1.6			0.7		
2143	21.72	0.8			1.3			1.6			0.6		
2144	21.73	0.8			1.3			1.6			0.6		
2145	21.75	0.8			1.3			1.6			0.6		
2146	21.77	0.8			1.3			1.6			0.6		
2147	21.78	0.8			1.3			1.6			0.6		
2148	21.80	0.8			1.2			1.6			0.5		
2149	21.82	0.8			1.2			1.6			0.5		
2150	21.83	0.8			1.1			1.6			0.6		
2151	21.85	0.8			1.1			1.7			0.6		
2152	21.87	0.8			1.1			1.6			0.6		
2153	21.88	0.8			1.1			1.7			0.6		
2154	21.90	0.8			1.1			1.7			0.7		
2155	21.92	0.8			1.1			1.7			0.7		
2156	21.93	0.8			1.1			1.6			0.7		
2157	21.95	0.8			1.2			1.6			0.8		
2158	21.97	0.8			1.1			1.6			0.8		
2159	21.98	0.8			1.1			1.6			0.9		
2200	22.00	0.8			1.2			1.6			0.9		
2201	22.02	0.8			1.2			1.6			0.9		
2202	22.03	0.8			1.2			1.6			0.9		
2203	22.05	0.8			1.2			1.6			1		
Run Average=		0.6			11.5			12.9			0.7		
N2 Bias Aver		0.0			0.1			0.5			0.2		
Ambient Air		0.8			1.3			1.7			0.7		

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 (ppm)	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE	(ppm)	AT 7% O2 DRY	RUNNING AVERAGE
For Time Period 1548-1624													
Zero Drift= (% of span)		0.04			0.11			0.18			0.00		
Span Drift= (% of span)		3.66			0.20			0.56			2.23		
Error Est.=		0.06			0.13			0.25			0.02		
For Time Period 1637-2012													
Zero Drift= (% of span)		0.00			0.09			0.05			0.60		
Span Drift= (% of span)		3.39			1.13			13.10			4.54		
Error Est.=		0.02			0.22			1.74			0.63		

- Data calculated by extrapolation.

Comments:

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LINEARITY CHECK 20,35 PPM PROPANE CYLINDER ALM-867 [10-28-1989 -- 11:49:51]
LINEARITY CHECK 49.09 PPM PROPANE CYLINDER ALM-854 [10-28-1989 -- 11:57:45]
ALL THC'S PASSED LINEARITY CHECK [10-28-1989 -- 11:58:42]
NOW ON STACK GAS [10-28-1989 -- 12:00:47]
SPAN THC'S [10-28-1989 -- 13:57:13]
ZERO THC'S [10-28-1989 -- 14:06:40]
BACK ON STACK GAS [10-28-1989 -- 14:12:31]
SPAN THC [10-28-1989 -- 16:25:57]
SPANNED THC'S FROM 16:23 TO 16:25 [10-28-1989 -- 16:26:41]
ZERO THC'S [10-28-1989 -- 16:27:05]
END RUN 1 [10-28-1989 -- 20:18:22]
NITROGEN BIAS CHECK [10-28-1989 -- 20:49:09]
STARTED AMBIENT AIR CHECK AT 2123. [10-28-1989 -- 21:29:37]
ALL TIMES MENTIONED IN THE COMMENTS ARE 5 MINUTES SLOW.
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RUN 2 - O2, CO2, CO

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	CO (ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	CO (ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1159	11.98	3.9	31.6	360	296		17.6	1.9	6	23	
1200	12.00	3.8	31.9	421	344		17.5	2.0	5	18	
1201	12.02	3.7	32.0	642	519		17.4	2.1	16	60	
1202	12.03	3.9	32.2	1869	1529		17.4	2.2	12	47	
1203	12.05	4.0	32.1	1204	990		17.4	2.1	12	45	
1204	12.07	4.0	31.9	767	632		17.4	2.0	5	21	
1205	12.08	4.0	31.6	515	424		17.4	2.1	5	20	
1206	12.10	3.8	32.2	519	421		17.2	2.3	18	66	
1207	12.12	3.8	32.5	1899	1544		17.1	2.4	61	222	
1208	12.13	3.7	32.4	3301	2666		17.1	2.4	91	328	
1209	12.15	3.7	32.8	3383	2737		17.2	2.4	76	277	
1210	12.17	3.8	32.2	1970	1602		17.2	2.3	37	134	
1211	12.18	3.7	32.4	1094	885		17.1	2.3	30	108	
1212	12.20	4.1	32.5	2234	1846		17.3	2.1	26	100	
1213	12.22	4.3	32.1	908	761		17.5	2.0	15	61	
1214	12.23	4.2	31.9	539	449		17.6	1.9	7	28	
1215	12.25	4.1	31.8	497	411		17.6	1.9	12	49	
1216	12.27	4.1	32.2	496	411		17.5	2.0	12	49	
1217	12.28	4.0	32.1	497	410		17.5	1.9	15	61	
1218	12.30	4.2	31.9	589	490		17.5	2.1	12	48	
1219	12.32	4.2	31.9	489	408		17.4	2.1	9	34	
1220	12.33	4.3	31.7	410	343		17.5	2.1	6	23	
1221	12.35	4.3	31.5	376	315		17.5	2.1	4	16	
1222	12.37	4.1	31.8	378	313		17.4	2.2	10	39	
1223	12.38	4.0	31.7	418	344		17.4	2.2	10	37	
1224	12.40	3.9	32.2	556	455		17.5	2.2	7	28	
1225	12.42	4.0	32.3	603	497		17.5	2.1	7	26	
1226	12.43	4.0	32.0	534	439		17.4	2.2	13	52	
1227	12.45	3.8	32.2	561	458		17.2	2.3	19	69	
1228	12.47	3.9	32.3	917	749		17.3	2.3	21	79	
1229	12.48	4.1	32.1	803	664		17.5	2.1	12	49	
1230	12.50	4.3	32.0	544	456		17.6	2.1	7	27	
1231	12.52	4.2	31.6	424	354		17.5	2.2	20	80	
1232	12.53	3.8	31.8	933	760		17.3	2.3	89	341	
1233	12.55	3.8	32.2	2261	1842		17.3	2.3	72	274	
1234	12.57	4.0	32.7	1310	1076		17.3	2.3	49	189	
1235	12.58	4.1	32.4	859	711		17.4	2.4	25	97	
1236	12.60	3.9	32.3	544	444		17.3	2.4	17	65	
1237	12.62	3.7	32.6	748	604		17.1	2.5	25	91	
1238	12.63	3.6	32.9	1695	1367		17.1	2.5	35	127	
1239	12.65	3.8	33.0	1670	1356		17.3	2.3	29	111	
1240	12.67	3.9	32.6	851	698		17.4	2.2	16	60	
1241	12.68	3.9	32.2	607	496		17.4	2.2	9	34	
1242	12.70	4.0	32.4	765	628		17.5	2.1	8	32	
1243	12.72	4.0	32.2	589	484		17.4	2.2	8	30	
1244	12.73	4.1	31.9	659	545		17.3	2.3	16	61	
1245	12.75	4.1	31.8	669	554		17.3	2.2	25	96	
1246	12.77	4.1	32.0	542	449		17.4	2.2	15	59	
1247	12.78	4.0	32.0	496	408		17.4	2.2	10	39	
1248	12.80	4.2	32.2	641	535		17.6	2.1	8	31	
1249	12.82	4.3	31.7	474	398		17.6	2.1	5	21	
1250	12.83	4.0	31.7	398	329		17.5	2.2	7	29	
1251	12.85	3.7	32.3	678	548		17.3	2.3	18	67	
1252	12.87	3.8	32.3	1972	1608		17.3	2.3	18	68	
1253	12.88	4.0	32.5	1282	1055		17.4	2.3	17	66	
1254	12.90	4.1	32.3	821	679		17.5	2.2	11	44	
1255	12.92	4.2	32.1	551	458		17.5	2.2	8	31	
1256	12.93	4.3	32.0	447	374		17.5	2.2	9	37	
1257	12.95	4.1	31.9	445	368		18.3		8	41	
1258	12.97	4.0	32.1	474	391	739	18.0		9	44	75
1259	12.98	4.0	32.1	509	420	741	18.0		6	28	75
1300	13.00	4.3	31.8	470	394	742	18.0		5	24	75
1301	13.02	4.2	31.7	407	340	739	17.9			34 *	75
1302	13.03	3.9	31.5	410	335	719	17.7			43 *	75
1303	13.05	3.9	32.3	624	511	711	17.7			53 *	75

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	CO (ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	CO (ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1304	13.07	4.2	32.4	586	487	708	17.7			62	76
1305	13.08	4.4	32.2	490	413	708	17.8		17	72	77
1306	13.10	4.7	32.3	470	403	708	17.7	2.1	19	81	77
1307	13.12	4.0	31.8	448	368	688	17.6	2.1	12	52	74
1308	13.13	3.9	32.3	541	444	651	17.6	2.2	16	64	70
1309	13.15	4.0	32.5	724	597	616	17.5	2.3	16	62	66
1310	13.17	4.1	32.2	518	429	596	17.5	2.3	14	57	65
1311	13.18	4.2	32.0	485	404	588	17.5	2.1	13	53	64
1312	13.20	4.1	31.9	454	376	564	17.5	2.2	10	39	63
1313	13.22	4.1	32.0	455	376	557	17.5	2.2	14	55	63
1314	13.23	4.1	32.2	524	433	557	17.5	2.1	21	82	64
1315	13.25	4.3	32.1	549	460	558	17.6	2.0	13	55	64
1316	13.27	4.4	31.7	429	361	557	17.7	2.0	5	22	63
1317	13.28	4.3	31.4	325	272	555	17.6	2.2	5	19	62
1318	13.30	4.0	31.9	396	327	552	17.4	2.3	7	26	62
1319	13.32	4.1	32.2	545	451	553	17.4	2.3	7	26	62
1320	13.33	4.3	32.2	530	444	554	17.5	2.1	6	22	62
1321	13.35	4.1	31.6	417	346	555	17.5	2.2	16	64	63
1322	13.37	4.1	32.1	568	469	557	17.5	2.3	18	74	63
1323	13.38	3.9	32.2	703	576	561	17.4	2.2	18	72	64
1324	13.40	4.1	32.1	900	747	566	17.5	2.2	11	43	64
1325	13.42	4.1	32.1	563	467	566	17.4	2.5	8	32	64
1326	13.43	3.8	32.2	629	512	567	17.2	2.4	9	32	64
1327	13.45	3.6	32.4	1065	857	573	17.2	2.4	21	75	64
1328	13.47	3.9	32.6	2712	2217	598	17.3	2.4	18	67	64
1329	13.48	4.0	32.2	1433	1177	606	17.4	2.3	12	46	64
1330	13.50	4.0	32.2	949	780	612	17.5	2.3	7	29	64
1331	13.52	4.0	32.0	738	609	616	17.5	2.3	8	34	63
1332	13.53	3.9	32.2	656	538	612	17.4	2.4	25	96	59
1333	13.55	3.8	32.2	1296	1051	599	17.4	2.4	33	128	57
1334	13.57	3.7	32.4	2532	2046	615	17.4	2.5	38	145	56
1335	13.58	3.7	32.5	2528	2042	638	17.3	2.4	33	126	56
1336	13.60	3.6	32.5	2154	1737	659	17.3	2.5	25	93	57
1337	13.62	3.8	32.5	2470	2011	683	17.3	2.4	37	141	58
1338	13.63	3.9	32.5	1745	1424	684	17.4	2.3	31	121	58
1339	13.65	4.0	32.5	1266	1041	678	17.6	2.2	22	91	57
1340	13.67	3.8	32.5	788	640	677	17.5	2.2	19	76	57
1341	13.68	3.8	32.6	1031	838	683	17.5	2.1	30	121	59
1342	13.70	3.9	32.4	1113	913	688	17.4	2.2	22	87	60
1343	13.72	4.0	32.1	616	508	688	17.4	2.1	14	55	60
1344	13.73	4.2	32.0	506	421	686	17.5	2.2	7	29	60
1345	13.75	4.0	32.0	510	421	684	17.5	2.1	7	26	59
1346	13.77	4.1	31.8	568	469	684	17.5	2.0	6	23	58
1347	13.78	3.9	31.8	465	381	684	17.5	2.1	3	14	57
1348	13.80	3.9	32.3	604	495	683	17.4	2.2	9	35	58
1349	13.82	4.0	32.3	771	636	687	17.5	2.1	12	47	58
1350	13.83	3.9	32.1	580	476	689	17.4	2.3	11	44	58
1351	13.85	3.8	32.4	788	640	691	17.2	2.4	77	283	62
1352	13.87	4.0	32.5	2162	1775	694	17.3	2.2	194	731	73
1353	13.88	3.9	32.2	1065	872	691	17.3	2.3	173	656	83
1354	13.90	4.1	32.3	821	679	691	17.4	2.3	91	353	88
1355	13.92	4.0	32.0	579	476	691	17.5	2.0	49	194	91
1356	13.93	3.9	31.9	464	379	691	17.5	2.0	23	90	91
1357	13.95	3.8	32.2	638	520	694	17.5	2.2	13	53	92
1358	13.97	3.8	32.6	899	734	699	17.5	2.1	14	57	92
1359	13.98	4.1	32.2	770	636	703	17.6	2.1	11	43	92
1400	14.00	4.2	32.0	514	428	704	17.6	2.1	9	36	92
1401	14.02	4.1	31.9	501	415	705	17.6	2.1	5	22	92
1402	14.03	4.2	31.7	419	350	705	17.7	2.0	7	29	92
1403	14.05	4.1	31.9	427	355	702	17.7	2.1	5	21	91
1404	14.07	4.2	31.9	479	398	701	17.6	2.1	6	25	91
1405	14.08	4.1	31.8	416	344	700	17.7	2.0	7	31	90
1406	14.10	4.1	31.8	350	289	698	17.7	2.2	5	21	89
1407	14.12	4.1	32.2	447	371	698	17.5	2.3	6	24	89
1408	14.13	4.1	32.0	475	394	697	17.6	2.1	8	34	88

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	CO (ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	CO (ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1409	14.15	3.9	31.9	419	343	693	17.5	2.2	7	28	88
1410	14.17	4.0	32.3	573	471	694	17.5	2.3	5	19	87
1411	14.18	3.9	32.4	641	524	696	17.5	2.2	11	44	87
1412	14.20	3.8	32.1	662	538	698	17.4	2.3	11	43	87
1413	14.22	3.8	32.5	785	637	703	17.3	2.4	16	61	87
1414	14.23	3.9	32.7	1213	992	712	17.5	2.2	17	66	87
1415	14.25	4.0	32.4	809	667	715	17.5	2.2	10	41	86
1416	14.27	4.0	32.1	602	497	718	17.5	2.2	6	24	86
1417	14.28	3.9	31.9	461	378	719	17.4	2.2	4	17	86
1418	14.30	4.0	32.3	789	650	725	17.4	2.3	6	24	86
1419	14.32	3.9	32.2	621	508	726	17.4	2.2	7	28	86
1420	14.33	3.8	32.3	806	655	729	17.5	2.0	9	37	87
1421	14.35	3.7	32.1	968	784	737	17.4	2.2	16	63	87
1422	14.37	3.8	32.4	1180	963	745	17.4	2.2	17	67	87
1423	14.38	4.0	32.5	924	760	748	17.5	2.2	17	69	87
1424	14.40	3.9	32.1	627	514	744	17.4	2.2	12	48	87
1425	14.42	3.9	32.2	728	597	746	17.4	2.2	15	59	87
1426	14.43	4.0	32.3	665	546	747	17.4	2.1	15	58	87
1427	14.45	4.0	32.1	515	424	740	17.4	2.2	10	40	87
1428	14.47	3.9	32.1	534	438	710	17.4	2.3	9	34	86
1429	14.48	3.9	32.3	644	528	699	17.5	2.3	9	36	86
1430	14.50	3.7	32.4	786	636	697	17.4	2.2	19	76	87
1431	14.52	3.8	32.3	2035	1660	714	17.5	2.3	21	83	88
1432	14.53	3.9	32.4	1088	891	720	17.5	2.4	14	55	87
1433	14.55	3.8	32.5	904	738	715	17.4	2.4	18	69	86
1434	14.57	3.8	32.3	1168	952	697	17.4	2.2	15	57	85
1435	14.58	3.9	32.2	758	621	673	17.4	2.3	8	32	83
1436	14.60	4.0	32.3	598	493	652	17.5	2.2	6	24	82
1437	14.62	4.1	31.9	532	440	626	17.5	2.1	5	21	80
1438	14.63	4.1	32.1	311	258	607	17.6	2.1	7	27	78
1439	14.65	4.1	32.1	352	292	594	17.6	2.1	2	6	77
1440	14.67	4.1	32.1	486	404	590	17.6	2.0	5	21	76
Minimum=		3.6	31.4	311	258		17.1	1.9	2	6	
Maximum=		4.7	33.0	3383	2737		18.3	2.5	194	731	
Average=		4.0	32.2	829	679		17.5	2.2	19	72	
Zero drift= (% of span)		0.92	2.34	4.88			0.58	0.34	0.39		
Span drift= (% of span)		1.41	3.73	3.83			0.58	0.32	1.14		
Error Est.=		0.17	1.48	50.91			0.17	0.05	1.75		

- Data generated by extrapolation.

Comments:

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LINEARITY CHECK CO 392.8 PPM [10-29-1989 -- 10:26:13]
LINEARITY CHECK CO 148.2 PPM [10-29-1989 -- 10:45:46]
LINEARITY CHECK O2 6.044% [10-29-1989 -- 10:50:33]
LINEARITY CHECK O2 6.044% [10-29-1989 -- 10:50:52]
LINEARITY CHECK CO2 5.957% [10-29-1989 -- 11:32:41]
LINEARITY CHECK O2 6.044% [10-29-1989 -- 11:39:25]
ALL ANALYZERS PASSED LINEARITY CHECK [10-29-1989 -- 11:51:28]
BYPASS LEAK CHECK OK, <5MM ON PYREX. [10-29-1989 -- 11:57:00]
BYPASS LINE NOW ON STACK GAS. [10-29-1989 -- 12:05:04]
MAIN LEAK CHECK IS OK, 20 EACH ON THE PYREX BALLS. [10-29-1989 -- 12:48:39]
NOW PULLING STACK GAS ON ALL SYSTEMS. [10-29-1989 -- 12:48:56]
CLOCK IS STILL ON DAYLIGHT TIME. [10-29-1989 -- 12:56:05]
BEGIN RUN 2 [10-29-1989 -- 12:57:51]
EXCHANGED DRIERITE FOR SILICA GEL ON BYPASS MANIFOLD. [10-29-1989 -- 13:56:33]
BYPASSED DRYER TRAPS COMPLETELY. [10-29-1989 -- 14:08:05]
CO2 RESPONSE SHOULD NOW BE MUCH FASTER WITH NO ABSORBENT. [10-29-1989 -- 14:08:33]
REPLACED  LIOH CARTRIDGE ON MAIN MANIFOLD. [10-29-1989 -- 15:38:05]
 [10-29-1989 -- 15:45:12]
END RUN 2 [10-29-1989 -- 15:45:52]

BYPASS LESS THAN 5 ON THE PYREX AT 20 INCHES [10-29-1989 -- 15:48:20]
MAIN AT 20 AND  5 ON PYREX AT 20 INCHES. ALL LEAK CHECKS OK!!!!!!!!!!!! [10-29-1989 -- 15:4
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RUN 2 - THC

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	(ppm)	AT 7% O2 DRY	ROLLING AVERAGE	(ppm)	AT 7% O2 DRY	ROLLING AVERAGE
1159	11.98	1.9	7.6		11.8	9.7		15.8	16.3		0.0	0.0	
1200	12.00	1.8	7.2		18.9	15.6		19.5	20.1		0.0	0.0	
1201	12.02	1.7	6.8		11.6	9.6		13.6	14.0		-0.1	-0.4	
1202	12.03	1.7	6.8		10.3	8.5		12.6	13.0		-0.1	-0.4	
1203	12.05	1.8	7.2		9.9	8.2		12.5	12.9		-0.2	-0.9	
1204	12.07	1.9	7.6		9.5	7.8		12.0	12.4		-0.2	-0.9	
1205	12.08	2.6	10.4		39.8	32.8		49.7	51.2		0.1	0.4	
1206	12.10	4.1	16.4		36.7	30.2		25.3	26.1		1.7	7.4	
1207	12.12	4.1	16.4		31.6	26.0		32.0	33.0		2.5	10.9	
1208	12.13	3.0	12.0		16.4	13.5		15.4	15.9		1.3	5.7	
1209	12.15	2.6	10.4		15.8	13.0		19.4	20.0		0.6	2.6	
1210	12.17	2.3	9.2		20.6	17.0		20.0	20.6		0.5	2.2	
1211	12.18	2.1	8.4		11.5	9.5		12.5	12.9		0.3	1.3	
1212	12.20	2.0	8.0		9.0	7.4		11.5	11.9		0.1	0.4	
1213	12.22	1.9	7.6		9.2	7.6		11.8	12.2		0.1	0.4	
1214	12.23	1.9	7.6		9.2	7.6		11.7	12.1		0.2	0.9	
1215	12.25	1.9	7.6		9.2	7.6		11.9	12.3		0.3	1.3	
1216	12.27	1.8	7.2		11.7	9.6		13.9	14.3		0.3	1.3	
1217	12.28	1.7	6.8		9.2	7.6		11.2	11.5		0.2	0.9	
1218	12.30	1.7	6.8		8.7	7.2		11.1	11.4		0.3	1.3	
1219	12.32	1.7	6.8		8.7	7.2		11.2	11.5		0.2	0.9	
1220	12.33	1.6	6.4		8.7	7.2		11.0	11.3		0.3	1.3	
1221	12.35	1.6	6.4		9.1	7.5		11.4	11.7		0.3	1.3	
1222	12.37	1.5	6.0		9.7	8.0		11.9	12.3		0.3	1.3	
1223	12.38	1.5	6.0		9.5	7.8		11.4	11.7		0.3	1.3	
1224	12.40	1.6	6.4		9.5	7.8		11.5	11.9		0.4	1.8	
1225	12.42	1.6	6.4		9.7	8.0		11.7	12.1		0.5	2.2	
1226	12.43	1.7	6.8		12.2	10.0		14.2	14.6		0.6	2.6	
1227	12.45	1.6	6.4		10.8	8.9		12.2	12.6		0.3	1.3	
1228	12.47	1.5	6.0		9.5	7.8		11.2	11.5		0.2	0.9	
1229	12.48	1.5	6.0		9.0	7.4		10.8	11.1		0.1	0.4	
1230	12.50	3.3	13.2		19.8	16.3		22.4	23.1		1.8	7.9	
1231	12.52	2.1	8.4		32.5	26.8		29.4	30.3		0.9	3.9	
1232	12.53	1.9	7.6		13.3	11.0		14.4	14.8		0.4	1.8	
1233	12.55	1.5	6.0		10.8	8.9		12.1	12.5		0.0	0.0	
1234	12.57	1.5	6.0		9.1	7.5		10.9	11.2		-0.1	-0.4	
1235	12.58	1.6	6.4		12.7	10.5		14.6	15.0		-0.1	-0.4	
1236	12.60	1.6	6.4		23.3	19.2		23.7	24.4		0.0	0.0	
1237	12.62	1.6	6.4		12.6	10.4		13.7	14.1		-0.1	-0.4	
1238	12.63	1.5	6.0		9.8	8.1		11.6	12.0		-0.1	-0.4	
1239	12.65	1.5	6.0		9.4	7.7		11.4	11.7		-0.1	-0.4	
1240	12.67	1.4	5.6		10.6	8.7		12.4	12.8		-0.1	-0.4	
1241	12.68	1.4	5.6		9.3	7.7		11.1	11.4		-0.1	-0.4	
1242	12.70	1.5	6.0		9.7	8.0		11.6	12.0		0.0	0.0	
1243	12.72	1.7	6.8		10.3	8.5		12.2	12.6		0.3	1.3	
1244	12.73	1.5	6.0		9.7	8.0		11.4	11.7		0.0	0.0	
1245	12.75	1.4	5.6		9.1	7.5		11.0	11.3		0.0	0.0	
1246	12.77	1.4	5.6		11.4	9.4		13.2	13.6		0.0	0.0	
1247	12.78	1.4	5.6		9.5	7.8		11.1	11.4		0.0	0.0	
1248	12.80	1.4	5.6		8.9	7.3		10.8	11.1		0.1	0.4	
1249	12.82	1.4	5.6		9.3	7.7		11.2	11.5		0.1	0.4	
1250	12.83	1.4	5.6		28.6	23.6		29.7	30.6		0.1	0.4	
1251	12.85	1.4	5.6		15.4	12.7		14.5	14.9		0.1	0.4	
1252	12.87	1.4	5.6		9.7	8.0		11.4	11.7		0.2	0.9	
1253	12.88	1.5	6.0		9.2	7.6		11.1	11.4		0.2	0.9	
1254	12.90	1.5	6.0		9.2	7.6		11.1	11.4		0.2	0.9	
1255	12.92	1.5	6.0		9.0	7.4		10.8	11.1		0.3	1.3	

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	(ppm)	AT 7% O2 DRY	ROLLING AVERAGE	(ppm)	AT 7% O2 DRY	ROLLING AVERAGE
1256	12.93	1.4	5.6		9.1	7.5		11.0	11.3		0.3	1.3	
1257	12.95	1.4	5.6		9.4	7.7		11.1	11.4		0.2	0.9	
1258	12.97	1.4	5.6	7.2	9.7	8.0	10.7	11.2	11.5	15.0	0.1	0.4	1.2
1259	12.98	1.9	7.6	7.2	9.2	7.6	10.6	10.7	11.0	14.9	0.2	0.9	1.2
1300	13.00	3.2	12.8	7.3	9.1	7.5	10.5	10.7	11.0	14.8	2.3	10.1	1.3
1301	13.02	2.7	10.8	7.3	10.5	8.6	10.5	12.1	12.5	14.7	1.3	5.7	1.5
1302	13.03	2.3	9.2	7.4	9.8	8.1	10.5	11.3	11.6	14.7	0.8	3.5	1.5
1303	13.05	2.1	8.4	7.4	9.2	7.6	10.5	10.8	11.1	14.7	0.5	2.2	1.6
1304	13.07	2.1	8.4	7.4	8.9	7.3	10.5	10.6	10.9	14.7	0.4	1.8	1.6
1305	13.08	2.0	8.0	7.4	9.1	7.5	10.0	10.7	11.0	14.0	0.2	0.9	1.6
1306	13.10	2.0	8.0	7.2	10.1	8.3	9.7	11.9	12.3	13.8	0.3	1.3	1.5
1307	13.12	1.9	7.6	7.1	10.3	8.5	9.4	11.7	12.1	13.4	0.2	0.9	1.3
1308	13.13	1.9	7.6	7.0	9.1	7.5	9.3	10.9	11.2	13.3	0.2	0.9	1.3
1309	13.15	1.9	7.6	6.9	9.1	7.5	9.2	10.9	11.2	13.2	0.2	0.9	1.2
1310	13.17	1.8	7.2	6.9	9.1	7.5	9.0	10.9	11.2	13.0	0.2	0.9	1.2
1311	13.18	1.7	6.8	6.9	9.2	7.6	9.0	11.0	11.3	13.0	0.1	0.4	1.2
1312	13.20	1.9	7.6	6.9	9.2	7.6	9.0	11.0	11.3	13.0	0.3	1.3	1.2
1313	13.22	1.7	6.8	6.9	9.9	8.2	9.0	11.5	11.9	13.0	0.3	1.3	1.2
1314	13.23	1.6	6.4	6.8	8.9	7.3	9.0	10.6	10.9	13.0	0.1	0.4	1.2
1315	13.25	1.5	6.0	6.8	9.0	7.4	9.0	10.7	11.0	13.0	0.1	0.4	1.2
1316	13.27	1.5	6.0	6.8	8.9	7.3	9.0	10.6	10.9	12.9	0.1	0.4	1.2
1317	13.28	1.5	6.0	6.8	9.2	7.6	9.0	10.9	11.2	12.9	0.1	0.4	1.2
1318	13.30	1.6	6.4	6.8	9.3	7.7	9.0	11.0	11.3	12.9	0.2	0.9	1.2
1319	13.32	1.6	6.4	6.8	9.1	7.5	9.0	10.8	11.1	12.9	0.1	0.4	1.2
1320	13.33	1.8	7.2	6.8	9.1	7.5	9.0	10.8	11.1	12.9	0.5	2.2	1.2
1321	13.35	1.6	6.4	6.8	9.2	7.6	9.0	10.7	11.0	12.9	0.3	1.3	1.2
1322	13.37	1.5	6.0	6.8	13.9	11.4	9.0	15.1	15.6	12.9	0.2	0.9	1.2
1323	13.38	1.5	6.0	6.8	10.6	8.7	9.1	11.9	12.3	12.9	0.2	0.9	1.2
1324	13.40	1.5	6.0	6.8	9.1	7.5	9.1	10.6	10.9	12.9	0.2	0.9	1.2
1325	13.42	1.5	6.0	6.8	12.0	9.9	9.1	13.5	13.9	13.0	0.2	0.9	1.1
1326	13.43	1.7	6.8	6.8	15.4	12.7	9.1	16.6	17.1	13.0	0.4	1.8	1.1
1327	13.45		6.7 •	6.8			9.1		16.9 •	13.1		2.0 *	1.1
1328			6.6 •	6.8			9.2		16.6 •	13.2		2.2 *	1.2
1329			6.5 •	6.8			9.2		16.4 •	13.2		2.4 *	1.2
1330			6.4 •	6.7			9.1		16.1 *	13.1		2.6 •	1.1
1331			6.3 •	6.6			8.7		15.9 *	12.9		2.8 *	1.1
1332			6.2 •	6.6			8.7		15.6 •	12.9		3.1 *	1.1
1333			6.1 •	6.6			8.7		15.4 •	12.9		3.3 *	1.2
1334			6.0 •	6.6			8.7		15.1 •	13.0		3.5 •	1.2
1335			5.9 *	6.6			8.7		14.9 •	13.0		3.7 •	1.3
1336			5.8 •	6.6			8.5		14.6 •	12.8		3.9 *	1.4
1337	13.62		5.7 •	6.6			8.4		14.4 •	12.8		4.2 •	1.4
1338	13.63	1.4	5.6	6.6	13.0	10.7	8.5	13.7	14.1	12.9	1.0	4.4	1.5
1339	13.65	1.7	6.8	6.6	12.3	10.1	8.5	13.6	14.0	12.9	0.9	3.9	1.6
1340	13.67	1.7	6.8	6.6	15.2	12.5	8.6	15.5	16.0	13.0	0.8	3.5	1.7
1341	13.68	1.6	6.4	6.6	11.1	9.1	8.6	12.4	12.8	13.0	0.6	2.6	1.7
1342	13.70	1.6	6.4	6.6	10.3	8.5	8.7	11.9	12.3	13.0	0.6	2.6	1.8
1343	13.72	1.6	6.4	6.6	9.4	7.7	8.6	11.1	11.4	13.0	0.6	2.6	1.8
1344	13.73	1.7	6.8	6.6	10.8	8.9	8.7	12.6	13.0	13.0	0.6	2.6	1.8
1345	13.75	1.7	6.8	6.7	10.7	8.8	8.7	12.2	12.6	13.0	0.6	2.6	1.9
1346	13.77	1.6	6.4	6.7	10.2	8.4	8.7	12.0	12.4	13.0	0.6	2.6	1.9
1347	13.78	1.6	6.4	6.7	10.0	8.2	8.7	11.8	12.2	13.0	0.7	3.1	2.0
1348	13.80	1.6	6.4	6.7	9.8	8.1	8.7	11.6	12.0	13.0	0.7	3.1	2.0
1349	13.82	1.7	6.8	6.7	9.6	7.9	8.7	11.5	11.9	13.0	0.7	3.1	2.0
1350	13.83	4.6	18.4	6.9	19.6	16.1	8.5	21.5	22.2	12.9	3.4	14.9	2.3
1351	13.85	7.4	29.6	7.3	18.9	15.6	8.6	18.1	18.7	13.0	7.5	32.8	2.8
1352	13.87	4.6	18.4	7.6	11.4	9.4	8.6	12.9	13.3	13.0	4.0	17.5	3.1

		COLD THC						HEATED THC					
		BYPASS			MAIN			MAIN			BYPASS		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	(ppm)	AT 7% O2 DRY	ROLLING AVERAGE	(ppm)	AT 7% O2 DRY	ROLLING AVERAGE
1353	13.88	3.0	12.0	7.7	9.5	7.8	8.6	11.2	11.5	13.0	2.2	9.6	3.2
1354	13.90	2.1	8.4	7.7	9.6	7.9	8.6	11.5	11.9	13.0	1.3	5.7	3.3
1355	13.92	1.8	7.2	7.7	10.3	8.5	8.7	12.1	12.5	13.0	1.1	4.8	3.4
1356	13.93	1.7	6.8	7.7	12.0	9.9	8.7	13.7	14.1	13.1	1.1	4.8	3.4
1357	13.95	1.7	6.8	7.8	9.9	8.2	8.7	11.6	12.0	13.1	1.0	4.4	3.5
1358	13.97	1.7	6.8	7.8	9.9	8.2	8.7	11.7	12.1	13.1	1.0	4.4	3.6
1359	13.98	1.7	6.8	7.8	9.2	7.6	8.7	11.1	11.4	13.1	1.0	4.4	3.6
1400	14.00	1.6	6.4	7.7	9.7	8.0	8.7	11.5	11.9	13.1	1.0	4.4	3.5
1401	14.02	1.5	6.0	7.6	9.5	7.8	8.7	11.3	11.6	13.1	1.0	4.4	3.5
1402	14.03	1.5	6.0	7.5	9.4	7.7	8.7	11.0	11.3	13.1	0.9	3.9	3.5
1403	14.05	1.5	6.0	7.5	9.5	7.8	8.7	11.0	11.3	13.1	0.9	3.9	3.5
1404	14.07	1.4	5.6	7.4	9.6	7.9	8.7	11.2	11.5	13.1	0.8	3.5	3.6
1405	14.08	1.4	5.6	7.4	9.7	8.0	8.7	11.3	11.6	13.1	0.7	3.1	3.6
1406	14.10	1.4	5.6	7.4	9.2	7.6	8.7	10.8	11.1	13.1	0.6	2.6	3.6
1407	14.12	1.4	5.6	7.3	9.4	7.7	8.7	11.1	11.4	13.1	0.5	2.2	3.7
1408	14.13	1.5	6.0	7.3	11.4	9.4	8.7	12.9	13.3	13.1	0.5	2.2	3.7
1409	14.15	1.5	6.0	7.3	9.8	8.1	8.8	11.3	11.6	13.1	0.4	1.8	3.7
1410	14.17	1.4	5.6	7.2	12.2	10.0	8.8	13.7	14.1	13.2	0.4	1.8	3.7
1411	14.18	1.4	5.6	7.2	10.8	8.9	8.8	12.3	12.7	13.2	0.3	1.3	3.7
1412	14.20	1.4	5.6	7.2	11.3	9.3	8.9	12.9	13.3	13.2	0.4	1.8	3.7
1413	14.22	1.4	5.6	7.2	11.0	9.1	8.9	12.6	13.0	13.2	0.4	1.8	3.7
1414	14.23	1.4	5.6	7.2	9.3	7.7	8.9	11.1	11.4	13.2	0.4	1.8	3.8
1415	14.25	1.4	5.6	7.1	9.3	7.7	8.9	11.2	11.5	13.3	0.4	1.8	3.8
1416	14.27	1.5	6.0	7.1	14.0	11.5	9.0	15.8	16.3	13.3	0.5	2.2	3.8
1417	14.28	1.5	6.0	7.1	10.9	9.0	9.0	12.0	12.4	13.4	0.6	2.6	3.8
1418	14.30	1.5	6.0	7.1	11.3	9.3	9.0	13.3	13.7	13.4	0.6	2.6	3.9
1419	14.32	1.5	6.0	7.1	14.1	11.6	9.1	15.5	16.0	13.5	0.6	2.6	3.9
1420	14.33	1.7	6.8	7.1	16.0	13.2	9.2	17.1	17.6	13.6	0.8	3.5	3.9
1421	14.35	1.6	6.4	7.1	14.4	11.9	9.3	15.2	15.7	13.7	0.8	3.5	4.0
1422	14.37	1.5	6.0	7.1	10.1	8.3	9.3	11.8	12.2	13.6	0.7	3.1	4.0
1423	14.38	1.6	6.4	7.1	10.0	8.2	9.3	11.8	12.2	13.6	0.8	3.5	4.0
1424	14.40	1.5	6.0	7.1	10.3	8.5	9.3	12.0	12.4	13.6	0.8	3.5	4.1
1425	14.42	1.5	6.0	7.1	10.9	9.0	9.3	12.5	12.9	13.6	0.8	3.5	4.1
1426	14.43	1.5	6.0	7.1	10.4	8.6	9.2	12.2	12.6	13.5	0.8	3.5	4.2
1427	14.45	1.5	6.0	7.1	10.4	8.6	9.2	11.9	12.3	13.5	0.8	3.5	4.2
1428	14.47	1.5	6.0	7.1	9.9	8.2	9.1	11.5	11.9	13.4	0.7	3.1	4.2
1429	14.48	1.7	6.8	7.1	26.6	21.9	9.4	27.8	28.7	13.6	1.0	4.4	4.2
1430	14.50	1.5	6.0	7.1	18.3	15.1	9.5	17.3	17.8	13.6	0.6	2.6	4.2
1431	14.52	1.4	5.6	7.1	13.6	11.2	9.5	14.4	14.8	13.6	0.6	2.6	4.2
1432	14.53	1.4	5.6	7.1	11.3	9.3	9.5	12.8	13.2	13.6	0.5	2.2	4.2
1433	14.55	1.4	5.6	7.1	16.5	13.6	9.6	17.2	17.7	13.6	0.4	1.8	4.2
1434	14.57	1.4	5.6	7.1	10.6	8.7	9.6	12.1	12.5	13.6	0.4	1.8	4.2
1435	14.58	1.4	5.6	7.1	9.7	8.0	9.6	11.3	11.6	13.5	0.4	1.8	4.1
1436	14.60	1.4	5.6	7.1	10.2	8.4	9.5	11.9	12.3	13.5	0.3	1.3	4.1
1437	14.62	1.4	5.6	7.1	10.9	9.0	9.5	12.6	13.0	13.4	0.4	1.8	4.0
1438	14.63	1.4	5.6	7.1	9.5	7.8	9.5	11.5	11.9	13.4	0.4	1.8	4.0
1439	14.65	1.4	5.6	7.0	9.7	8.0	9.4	11.6	12.0	13.4	0.5	2.2	4.0
1440	14.67	2.4	9.6	7.1	9.5	7.8	9.4	11.4	11.7	13.3	1.4	6.1	4.0
1441	14.68												
1627	16.45												
1628	16.47	0.8			0.7			1.7			0.5		
1629	16.48	0.8			0.7			1.8			0.5		
1630	16.50	0.8			0.7			1.7			0.5		
1631	16.52	0.8			0.7			1.7			0.6		
1632	16.53	0.8			0.7			1.8			0.5		
1633	16.55	0.8			0.8			1.8			0.6		
1634	16.57	0.8			0.8			1.8			0.6		

TIME	DECIMAL TIME	COLD THC BYPASS (ppm)	COLD THC BYPASS AT 7% O2 (ppm)	ROLLING AVERAGE	COLD THC MAIN (ppm)	COLD THC MAIN AT 7% O2 (ppm)	ROLLING AVERAGE	HEATED THC MAIN (ppm)	HEATED THC MAIN AT 7% O2 DRY	ROLLING AVERAGE	HEATED THC BYPASS (ppm)	HEATED THC BYPASS AT 7% O2 DRY	ROLLING AVERAGE
1635	16.58	0.8			0.8			1.8			0.6		
1636	16.60	0.8			0.9			1.8			0.5		
1637	16.62	0.8			0.9			1.7			0.5		
1638	16.63	0.8			0.9			1.7			0.4		
1639	16.65	0.7			0.9			1.7			0.3		
1640	16.67	0.7			0.9			1.6			0.2		
1641	16.68	0.7			0.8			1.6			0.1		
1642	16.70	0.7			0.8			1.6			0.1		
1643	16.72	0.8			0.7			1.6			0.1		
1644	16.73	0.8			0.7			1.6			0.0		
1645	16.75	0.8			0.6			1.7			0.1		
1646	16.77	0.8			0.6			1.7			0.1		
1647	16.78	0.8			0.6			1.7			0.1		
1648	16.80	0.8			0.6			1.7			0.1		
1649	16.82	0.8			0.6			1.7			0.2		
1650	16.83	0.8			0.6			1.7			0.2		
1651	16.85	0.8			0.6			1.7			0.2		
1652	16.87	0.8			0.6			1.7			0.3		
1653	16.88	0.6			0.6			1.7			0.3		
1654	16.90	0.0			0.6			1.6			-0.2		
1655	16.92	0.6			0.6			1.6			-0.1		
1656	16.93	0.9			0.6			0.9			0.3		
1657	16.95	0.0			0.0			-4.0			-1.3		
Run Average=		1.8	7.1		11.8	9.7		13.3	13.9		0.6	2.5	
Ambient Air		0.7			0.7			1.5			0.2		
For Time Peroid 1159-1326													
Zero Drift= (% of span)		0.15			0.60			0.42			1.48		
Span Drift= (% of span)		5.08			5.58			2.94			2.63		
Error Est.=		0.24			1.25			0.81			1.48		
For Time Peroid 1338-1440													
Zero Drift= (% of span)		0.04			0.18			0.08			0.10		
Span Drift= (% of span)		3.24			2.13			2.91			5.12		
Error Est.=		0.10			0.43			0.47			0.13		

- Data calculated by extrapolation.

Comments:

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LINEARITY CHECK PROPANE 49.09 PPM [10-29-1989 -- 09:49:59]
LINEARITY CHECK 49.09 PPM PROPANE [10-29-1989 -- 10:08:36]
LINEARITY CHECK PROPANE 20.35 PPM [10-29-1989 -- 10:11:02]
ALL BUT HOT THC MAIN PASSED LINEARITY CHECK-WILL REZERO AND RESPAN HOT MAIN [10-29-1989 -- 10:13:39]
LINEARITY CHECK 20.35 PPM PROPANE [10-29-1989 -- 12:06:51]
LINEARITY CHECK PROPANE 49.09 PPM [10-29-1989 -- 12:16:11]
ALL THC'S NOW PASS LINEARITY CHECK [10-29-1989 -- 12:20:08]
BYPASS THC'S NOW ON STACK GAS [10-29-1989 -- 12:21:27]
CLOCK IS 5 MINUTES SLOW. ALL CLOCKS THIS RUN ARE STILL ON DAYLIGHT TIME. [10-29-1989 -- 12:50:43]
BEGIN RUN 2 [10-29-1989 -- 12:54:59]
THC ZERO [10-29-1989 -- 14:21:48]
SPAN THC [10-29-1989 -- 14:27:05]
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RUN 3 - O2, CO2, CO

		MAIN DUCT		CARBON MONOXIDE			BYPASS DUCT		CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1139	11.65	4.1	31.2	332	275		16.3	4.2	9	25	
1140	11.67	4.2	31.1	299	249		16.2	4.1	14	41	
1141	11.68	4.1	31.1	310	257		16.4	3.9	16	48	
1142	11.70	4.0	31.2	318	261		16.5	3.8	12	37	
1143	11.72	4.0	31.3	306	252		16.4	3.9	8	26	
1144	11.73	4.0	31.3	330	272		16.4	3.9	5	14	
1145	11.75	4.0	31.2	344	284		16.3	4.0	4	12	
1146	11.77	4.0	31.3	311	256		16.3	3.9	4	12	
1147	11.78	4.0	31.3	298	245		16.3	4.0	4	13	
1148	11.80	4.0	31.2	296	244		16.2	4.1	9	25	
1149	11.82	4.1	31.1	351	291		16.2	4.1	17	50	
1150	11.83	4.2	31.2	410	341		16.3	4.0	9	27	
1151	11.85	4.2	31.2	317	264		16.5	3.9	6	19	
1152	11.87	4.2	31.2	296	247		16.5	3.8	4	12	
1153	11.88	4.3	30.9	275	230		16.5	3.9	2	7	
1154	11.90	4.3	30.8	266	223		16.4	4.0	5	15	
1155	11.92	4.3	30.8	248	208		16.4	4.0	11	34	
1156	11.93	4.4	30.8	251	211		16.4	4.1	9	28	
1157	11.95	4.3	30.7	256	214		16.3	4.2	4	11	
1158	11.97	4.2	31.2	246	205		16.4	4.2	7	20	
1159	11.98	4.2	31.2	256	213		16.4	4.1	15	45	
1200	12.00	4.2	31.1	248	207		16.5	4.1	13	38	
1201	12.02	4.2	31.2	257	214		16.5	4.0	8	25	
1202	12.03	4.3	31.2	272	227		16.4	4.1	6	18	
1203	12.05	4.3	30.9	262	220		16.4	4.1	3	8	
1204	12.07	4.2	30.9	258	215		16.4	4.1	4	12	
1205	12.08	4.2	30.9	256	213		16.4	4.0	21	65	
1206	12.10	4.2	31.0	273	228		16.6	4.0	26	82	
1207	12.12	4.1	31.0	271	225		16.5	4.0	13	39	
1208	12.13	4.1	31.1	282	234		16.6	3.8	8	27	
1209	12.15	4.2	31.1	289	240		16.7	3.8	3	9	
1210	12.17	4.2	31.1	310	258		16.6	3.9	5	16	
1211	12.18	4.3	31.0	319	267		16.5	4.0	10	29	
1212	12.20	4.3	30.8	277	232		16.4	4.0	20	62	
1213	12.22	4.3	30.7	269	225		16.3	4.2	16	47	
1214	12.23	4.3	30.9	253	212		16.4	4.0	13	40	
1215	12.25	4.3	30.8	266	224		16.5	4.0	8	24	
1216	12.27	4.3	30.7	247	207		16.4	4.1	9	27	
1217	12.28	4.3	30.6	248	208		16.5	4.0	8	25	
1218	12.30	4.4	30.8	247	208		16.5	4.1	5	14	
1219	12.32	4.6	30.6	233	198		16.4	4.2	3	9	
1220	12.33	4.5	30.3	225	191		16.5	4.1	5	15	
1221	12.35	4.4	30.4	229	194		16.4	4.3	7	22	
1222	12.37	4.4	30.6	234	197		16.3	4.3	4	13	
1223	12.38	4.3	30.7	238	199		16.3	4.3	5	15	
1224	12.40	4.2	31.0	236	197		16.5	4.2	5	14	
1225	12.42	4.3	31.0	236	198		16.4	4.3	11	32	
1226	12.43	4.3	30.9	226	190		16.5	4.3	29	88	
1227	12.45	4.2	31.0	234	195		16.5	4.3	20	60	
1228	12.47	4.2	31.2	251	209		16.4	4.3	7	22	
1229	12.48	4.1	31.1	257	213		16.3	4.3	6	17	
1230	12.50	4.2	31.1	335	279		16.3	4.2	6	17	
1231	12.52	4.2	31.0	333	278		16.4	4.1	4	12	
1232	12.53	4.3	30.8	258	216		16.5	3.9	1	4	
1233	12.55	4.2	30.6	239	199		16.5	4.0	1	4	
1234	12.57	4.3	30.8	234	196		16.5	3.9	0	1	
1235	12.58	4.3	30.6	241	202		16.6	4.0	1	3	
1236	12.60	4.3	30.7	228	191		16.4	4.1	1	2	
1237	12.62	4.3	30.8	225	188		16.4	4.2	3	8	
1238	12.63	4.3	30.8	218	183	227	16.4	4.1	4	13	25
1239	12.65	4.3	30.7	229	192	226	16.5	4.1	14	42	25
1240	12.67	4.2	30.7	261	217	225	16.4	4.2	21	64	26
1241	12.68	4.0	31.0	273	225	225	16.4	4.1	18	56	26
1242	12.70	4.1	31.3	291	241	224	16.5	4.0	13	42	26
1243	12.72	4.2	31.2	283	235	224	16.5	4.0	9	28	26
1244	12.73	4.3	30.9	251	210	223	16.5	4.0	1	4	26
1245	12.75	4.5	30.6	234	198	221	16.4	4.1	2	6	26
1246	12.77	4.3	30.6	209	175	220	16.4	4.1	1	2	25
1247	12.78	4.3	30.7	225	189	219	16.5	4.0	2	5	25
1248	12.80	4.4	30.7	238	201	218	16.5	4.0	5	16	25
1249	12.82	4.4	30.7	235	198	217	16.6	4.0	3	8	25
1250	12.83	4.4	30.7	224	189	214	16.6	4.0	2	6	24
1251	12.85	4.4	30.7	220	185	213	16.6	3.9	4	12	24
1252	12.87	4.4	30.8	224	189	212	16.6	4.1	8	24	24

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1253	12.88	4.5	30.8	226	191	211	16.5	4.2	9	26	25
1254	12.90	4.5	30.6	216	183	211	16.5	4.1	2	6	24
1255	12.92	4.5	30.5	216	182	210	16.4	4.1	6	18	24
1256	12.93	4.4	30.5	211	178	210	16.4	4.1	11	33	24
1257	12.95	4.6	30.5	215	183	209	16.5	4.2	19	58	25
1258	12.97	4.7	30.2	218	187	209	16.5	4.2	43	135	27
1259	12.98	4.7	30.1	219	189	209	16.6	4.1	22	70	27
1300	13.00	4.8	30.3	204	176	208	16.7	4.0	8	27	27
1301	13.02	4.8	30.2	197	170	207	16.6	4.1	3	9	27
1302	13.03	4.8	30.0	195	168	206	16.6	4.1	3	9	27
1303	13.05	4.6	30.0	199	170	206	16.5	4.2	2	6	27
1304	13.07	4.2	30.4	203	170	205	16.4	4.3	3	10	27
1305	13.08	4.0	31.0	219	181	204	16.3	4.3	1	2	26
1306	13.10	4.0	31.3	236	194	204	16.3	4.3	9	27	25
1307	13.12	4.0	31.5	239	197	203	16.4	4.2	14	41	25
1308	13.13	4.2	31.5	242	201	203	16.5	4.3	9	29	25
1309	13.15	4.3	31.3	232	194	202	16.5	4.2	7	23	25
1310	13.17	4.3	31.0	227	190	201	16.5	4.2	6	20	25
1311	13.18	4.3	30.8	225	189	199	16.5	4.2	2	6	25
1312	13.20	4.4	30.7	217	183	199	16.5	4.2	0	0	24
1313	13.22	4.4	30.6	213	180	198	16.4	4.3	4	13	23
1314	13.23	4.4	30.6	221	187	197	16.4	4.3	8	24	23
1315	13.25	4.5	30.5	221	187	197	16.4	4.3	7	21	23
1316	13.27	4.5	30.5	218	185	196	16.5	4.2	7	20	23
1317	13.28	4.7	30.4	217	186	196	16.6	4.2	5	16	23
1318	13.30	4.8	30.3	208	180	196	16.6	4.2	1	2	22
1319	13.32	4.9	30.0	207	180	195	16.6	4.2	2	7	22
1320	13.33	4.9	29.9	203	176	195	16.5	4.3	2	7	22
1321	13.35	4.8	30.0	202	174	195	16.4	4.3	2	7	22
1322	13.37	4.9	30.2	206	178	194	16.4	4.2	1	4	22
1323	13.38	4.7	30.2	203	174	194	16.4	4.3	2	6	22
1324	13.40	4.6	30.3	207	177	194	16.4	4.3	14	43	22
1325	13.42	4.7	30.4	223	191	194	16.5	4.2	9	29	22
1326	13.43	4.7	30.4	220	188	194	16.3	4.5	4	11	21
1327	13.45	4.7	30.5	210	180	193	16.2	4.6	3	7	20
1328	13.47	4.6	30.5	209	179	193	16.2	4.5	3	8	20
1329	13.48	4.7	30.5	205	176	192	16.2	4.3	0	1	19
1330	13.50	4.7	30.2	207	177	190	16.3	4.3	1	4	19
1331	13.52	4.7	30.3	203	174	189	16.3	4.3	4	11	19
1332	13.53	4.6	30.3	215	184	188	16.4	4.2	5	14	19
1333	13.55	4.6	30.2	214	182	188	16.3	4.3	6	18	20
1334	13.57	4.6	30.5	207	176	188	16.2	4.5	7	22	20
1335	13.58	4.6	30.6	215	184	187	16.1	4.5	6	16	20
1336	13.60	4.6	30.5	215	183	187	16.2	4.4	4	10	20
1337	13.62	4.6	30.4	206	176	187	16.1	4.4	10	29	21
1338	13.63	4.5	30.5	207	176	187	16.1	4.4	16	46	21
1339	13.65	4.5	30.6	220	186	187	16.2	4.3	13	39	21
1340	13.67	4.5	30.6	222	188	186	16.2	4.3	15	44	21
1341	13.68	4.6	30.6	216	184	186	16.3	4.2	19	56	21
1342	13.70	4.6	30.5	215	184	185	16.4	4.2	11	32	21
1343	13.72	4.6	30.5	212	181	184	16.3	4.3	7	22	20
1344	13.73	4.7	30.5	215	184	183	16.2	4.4	14	41	21
1345	13.75	4.7	30.3	207	178	183	16.2	4.5	13	38	22
1346	13.77	4.8	30.4	205	177	183	16.1	4.4	7	19	22
1347	13.78	4.8	30.3	202	174	183	16.2	4.4	16	46	23
1348	13.80	4.8	30.3	206	179	182	16.3	4.3	21	61	23
1349	13.82	4.8	30.3	206	178	182	16.3	4.3	8	23	24
1350	13.83	4.8	30.1	196	169	182	16.4	4.1	6	19	24
1351	13.85	4.7	30.2	193	166	181	16.3	4.3	5	16	24
1352	13.87	4.7	30.3	198	170	181	16.2	4.4	8	24	24
1353	13.88	4.6	30.5	204	174	181	16.2	4.4	9	26	24
1354	13.90	4.6	30.5	205	175	181	16.2	4.4	4	12	24
1355	13.92	4.5	30.5	206	175	181	16.1	4.5	3	8	24
1356	13.93	4.5	30.8	210	179	181	16.2	4.4	4	12	23
1357	13.95	4.6	30.5	219	187	181	16.3	4.2	4	11	23
1358	13.97	4.6	30.5	218	186	181	16.3	4.1	7	20	21
1359	13.98	4.5	30.4	220	186	181	16.3	4.2	7	21	20
1400	14.00	4.5	30.7	221	187	181	16.2	4.4	4	12	20
1401	14.02	4.5	30.6	216	184	181	16.1	4.5	4	10	20
1402	14.03	4.5	30.7	217	184	181	16.2	4.3	4	11	20
1403	14.05	4.6	30.5	222	189	182	16.2	4.3	5	15	20
1404	14.07	4.5	30.3	211	180	182	16.1	4.4	16	46	20
1405	14.08	4.6	30.6	224	191	182	16.3	4.2	13	40	21
1406	14.10	4.5	30.6	224	190	182	16.4	4.2	8	23	21

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1407	14.12	4.5	30.6	244	206	182	16.3	4.3	3	7	20
1408	14.13	4.4	30.8	276	233	182	16.3	4.4	5	14	20
1409	14.15	4.5	30.9	236	200	183	16.3	4.3	5	15	20
1410	14.17	4.4	30.7	226	190	183	16.2	4.3	5	16	20
1411	14.18	4.3	30.8	227	191	183	16.2	4.3	3	8	20
1412	14.20	4.4	31.0	231	194	183	16.2	4.3	1	4	20
1413	14.22	4.5	30.8	232	198	183	16.3	4.3	16	48	21
1414	14.23	4.3	30.7	240	201	183	16.2	4.2	36	106	22
1415	14.25	4.3	30.9	263	221	184	16.3	4.1	18	52	23
1416	14.27	4.4	30.9	311	262	185	16.3	4.3	13	38	23
1417	14.28	4.3	30.8	296	249	186	16.3	4.2	15	43	23
1418	14.30	4.4	30.8	261	220	187	16.3	4.3	6	17	24
1419	14.32	4.4	30.9	267	225	188	16.3	4.2	5	15	24
1420	14.33	4.3	30.8	265	222	188	16.3	4.2	4	13	24
1421	14.35	4.3	30.9	271	227	189	16.3	4.3	5	14	24
1422	14.37	4.3	30.9	269	225	190	16.3	4.2	6	19	24
1423	14.38	4.2	30.9	255	213	191	16.5	3.9	3	9	24
1424	14.40	4.1	31.1	275	228	192	16.6	4.0	2	7	24
1425	14.42	4.3	31.3	316	265	193	16.4	4.2	3	9	23
1426	14.43	4.3	30.9	285	239	194	16.3	4.2	2	7	23
1427	14.45	4.2	30.8	252	210	194	16.3	4.2	1	4	23
1428	14.47	4.2	31.0	248	207	195	16.3	4.2	3	9	23
1429	14.48	4.2	31.0	248	207	195	16.4	4.0	2	6	23
1430	14.50	4.2	30.9	258	215	196	16.5	4.1	6	19	24
Minimum=		4.0	29.9	193	166		16.1	3.8	0	0	
Maximum=		4.9	31.5	410	341		16.7	4.6	43	135	
Average=		4.4	30.7	243	204		16.4	4.2	8	23	
Zero drift= (% of span)		0.82	2.26	1.19			0.50	0.49	0.20		
Span drift= (% of span)		1.82	4.29	3.98			2.42	1.45	3.17		
Error Est.=		0.18	1.59	19.02			0.46	0.12	1.82		

Comments:

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LINEARITY  CHECK CO 392.8 PPM [10-30-1989 -- 09:34:01]
LINEARITY CHECK PROPANE 148.2 PPM [10-30-1989 -- 09:47:24]
LAST ENTRY MADE IN ERROR-LINEARITY CHECK IS 148.2 PPM CO [10-30-1989 -- 09:57:58]
LINEARITY CHECK O2 6.044% [10-30-1989 -- 10:04:01]
LINEARITY CHECK O2 6.044% [10-30-1989 -- 10:46:53]
LINEARITY CHECK CO2 5.957% [10-30-1989 -- 10:57:36]
ALL ANALYZERS PASSED LINEARITY CHECK [10-30-1989 -- 11:06:49]
BYPASS 20 INNCHES -LESS THAN 5 ON PYREX [10-30-1989 -- 11:11:26]
MAIN 22 INCHES 15 AND 25 ON PYREX [10-30-1989 -- 11:11:52]
ALL LEAK CHECKS OK!!!!!!!!!!! [10-30-1989 -- 11:12:09]
NOW ON STACK GAS [10-30-1989 -- 11:12:25]
BEGIN RUN 3 [10-30-1989 -- 11:18:15]
LAST ENTRY WAS IN ERROR-RUN 3 HAS NOT BEGUN [10-30-1989 -- 11:32:27]
 [10-30-1989 -- 11:41:36]
RUN 3 BEGAN AT 11:40 [10-30-1989 -- 11:47:31]
END RUN 3 [10-30-1989 -- 14:33:49]
BYPASS 20 INCHES LESS THAN 5 ON PYREX [10-30-1989 -- 14:38:00]
 [10-30-1989 -- 14:46:36]
MAIN 22 INCHES AND 20 ON PYREX BALLS-LINES PASS LEAK CHECK [10-30-1989 -- 14:47:46]
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RUN 3 - THC

		COLD THC				HEATED THC				
		BYPASS		MAIN		MAIN		BYPASS		
TIME	DECIMAL TIME	(ppm)	7% O2 (ppm)	(ppm)	7% O2 (ppm)	(ppm)	7% O2 DRY	(ppm)	7% O2 DRY	COMMENTS
1139	11.65	1.1	3.3	7.6	6.4	9.2	9.4	1.6	5.3	SAMPLING BEGUN
1140	11.67	1.1	3.3	7.6	6.4	8.5	8.7	1.6	5.3	
1141	11.68	1.1	3.3	7.1	6.0	8.4	8.6	1.6	5.3	
1142	11.70	1.1	3.3	7.7	6.5	9.4	9.6	1.5	4.9	
1143	11.72	1.1	3.3	8.5	7.2	9.1	9.3	1.5	4.9	
1144	11.73	1.1	3.3	7.4	6.2	8.5	8.7	1.5	4.9	
1145	11.75	1.1	3.3	7.1	6.0	8.2	8.4	1.5	4.9	
1146	11.77	1.1	3.3	7.2	6.1	8.2	8.4	1.5	4.9	
1147	11.78	1.1	3.3	7.2	6.1	8.7	8.9	1.4	4.6	
1148	11.80	1.1	3.3	8.4	7.1	8.6	8.8	1.4	4.6	
1149	11.82	1.1	3.3	7.1	6.0	7.9	8.1	1.4	4.6	
1150	11.83	1.1	3.3	7	5.9	8	8.2	1.3	4.3	
1151	11.85	1.1	3.3	6.9	5.8	7.9	8.1	1.3	4.3	
1152	11.87	1.1	3.3	7	5.9	8	8.2	1.4	4.6	
1153	11.88	1.1	3.3	7	5.9	7.9	8.1	1.4	4.6	
1154	11.90	1.1	3.3	6.7	5.7	7.7	7.9	1.4	4.6	
1155	11.92	1.1	3.3	6.8	5.7	7.8	8.0	1.5	4.9	
1156	11.93	1.1	3.3	6.8	5.7	7.8	8.0	1.4	4.6	
1157	11.95	1.1	3.3	6.8	5.7	7.8	8.0	1.4	4.6	
1158	11.97	1.1	3.3	6.8	5.7	7.8	8.0	1.4	4.6	
1159	11.98	1.1	3.3	6.8	5.7	7.8	8.0	1.4	4.6	
1200	12.00	1.1	3.3	6.9	5.8	7.9	8.1	1.4	4.6	
1201	12.02	1.1	3.3	7.1	6.0	8.1	8.3	1.4	4.6	
1202	12.03	1.1	3.3	7.2	6.1	8.1	8.3	1.4	4.6	
1203	12.05	1.1	3.3	7.1	6.0	8.1	8.3	1.3	4.3	
1204	12.07	1.1	3.3	7.1	6.0	8	8.2	1.3	4.3	
1205	12.08	1.1	3.3	7.1	6.0	7.8	8.0	1.3	4.3	
1206	12.10	1.1	3.3	7	5.9	7.8	8.0	1.3	4.3	
1207	12.12	1.1	3.3	6.9	5.8	7.7	7.9	1.2	4.0	
1208	12.13	1.1	3.3	7.2	6.1	8	8.2	1.2	4.0	
1209	12.15	1.1	3.3	7.3	6.2	7.9	8.1	1.2	4.0	
1210	12.17	1.1	3.3	7	5.9	7.8	8.0	1.2	4.0	
1211	12.18	1.1	3.3	7	5.9	7.7	7.9	1.2	4.0	
1212	12.20	1.1	3.3	7	5.9	7.8	8.0	1.3	4.3	
1213	12.22	1.1	3.3	7	5.9	7.9	8.1	1.3	4.3	
1214	12.23	1.1	3.3	7	5.9	7.9	8.1	1.3	4.3	
1215	12.25	1.1	3.3	7	5.9	7.9	8.1	1.3	4.3	
1216	12.27	1.1	3.3	7	5.9	7.9	8.1	1.3	4.3	
1217	12.28	1.1	3.3	6.9	5.8	7.9	8.1	1.3	4.3	
1218	12.30	1.1	3.3	6.9	5.8	7.7	7.9	1.4	4.6	
1219	12.32	1.1	3.3	6.[illegible]	5.7	7.7	7.9	1.4	4.6	
1220	12.33	1.1	3.3	6.[illegible]	5.7	7.7	7.9	1.3	4.3	
1221	12.35	1.1	3.3	6.6	5.7	7.7	7.9	1.2	4.0	
1222	12.37	1.1	3.3	6.9	5.8	7.8	8.0	1.2	4.0	
1223	12.38	1.1	3.3	6.9	5.8	7.8	8.0	1.2	4.0	
1224	12.40	1.1	3.3	6.9	5.8	7.8	8.0	1.1	3.6	
1225	12.42	1.1	3.3	6.9	5.8	7.7	7.9	1.1	3.6	
1226	12.43	1.1	3.3	6.8	5.7	7.7	7.9	1.2	4.0	
1227	12.45	1.1	3.3	7	5.9	7.8	8.0	1.1	3.6	
1228	12.47	1.1	3.3	9.1	7.7	11.2	11.4	1.1	3.6	
1229	12.48	1.1	3.3	9.2	8.3	8.3	8.5	1.1	3.6	
1230	12.50	1.1	3.3	7.3	6.1	7.7	7.9	1.1	3.6	
1231	12.52	1.1	3.3	[illegible]	5.9	7.7	7.9	1.1	4.0	
1232	12.53	1.1	3.3	[illegible]	5.9	7.7	7.9	1.[illegible]	4.0	
1233	12.55	1.1	3.3	[illegible]	5.9	7.7	7.9	1.[illegible]	4.0	
1234	12.57	1.1	3.3	[illegible]	5.9	7.6	7.8	1.[illegible]	4.0	
1235	12.58	1.1	3.3	6.[illegible]	5.8	7.7	7.9	1.[illegible]	4.0	
1236	12.60	1.2	3.7	7.[illegible]	6.0	7.8	8.0	1.2	4.0	
1237	12.62	1.1	3.3	7.2	6.1	7.9	8.1	1.2	4.0	
1238	12.63	1.1	3.3	7.4	6.2	7.9	8.1	1.2	4.0	
1239	12.65	1.1	3.3	7.3	6.2	7.9	8.1	1.2	4.0	
1240	12.67	1.1	3.3	7.3	6.2	7.8	8.0	1.1	3.6	
1241	12.68	1.1	3.3	7.2	6.1	7.7	7.9	1.1	3.6	
1242	12.70	1.1	3.3	7.2	6.1	7.8	8.0	1.1	3.6	
1243	12.72	1.2	3.7	7.2	6.1	7.8	8.0	1.1	3.6	

TIME	DECIMAL TIME	COLD THC				HEATED THC				COMMENTS
		BYPASS		MAIN		MAIN		BYPASS		
		(ppm)	7% O2 (ppm)	(ppm)	7% O2 (ppm)	(ppm)	7% O2 DRY	(ppm)	7% O2 DRY	
1244	12.73	1.2	3.7	7.1	6.0	7.8	8.0	1.1	3.6	
1245	12.75	1.2	3.7	7.1	6.0	7.7	7.9	1.1	3.6	
1246	12.77	1.2	3.7	7.2	6.1	7.8	8.0	1.1	3.6	
1247	12.78	1.2	3.7	7.1	6.0	7.7	7.9	1.1	3.6	
1248	12.80	1.2	3.7	7	5.9	7.7	7.9	1.1	3.6	
1249	12.82	1.2	3.7	7	5.9	7.6	7.8	1.1	3.6	
1250	12.83	1.1	3.3	7	5.9	7.6	7.8	1.1	3.6	
1251	12.85	1.1	3.3	7	5.9	7.6	7.8	1.1	3.6	
1252	12.87	1.1	3.3	7.1	6.0	7.6	7.8	1.1	3.6	
1253	12.88	1.1	3.3	7	5.9	7.6	7.8	1.1	3.6	
1254	12.90	1.1	3.3	7	5.9	7.6	7.8	1.1	3.6	
1255	12.92	1.1	3.3	7	5.9	7.6	7.8	1.1	3.6	
1256	12.93	1.1	3.3	7.4	6.2	8	8.2	1.1	3.6	
1257	12.95	1.1	3.3	7	5.9	7.5	7.6	1.1	3.6	
1258	12.97	1.1	3.3	6.6	5.6	7.4	7.5	1.1	3.6	
1259	12.98	1.2	3.7	6.6	5.6	7.6	7.8	1.2	4.0	
1300	13.00	1.2	3.7	6.5	5.5	7.4	7.5	1.1	3.6	
1301	13.02	1.2	3.7	6.5	5.5	7.5	7.6	1.1	3.6	
1302	13.03	1.2	3.7	6.5	5.5	7.4	7.5	1.1	3.6	
1303	13.05	1.1	3.3	6.6	5.6	7.5	7.6	1.1	3.6	
1304	13.07		3.3		5.6		7.7		3.7	ZERO AND
1305			3.3		5.6		7.8		3.8	SPAN CHECK
1306			3.3		5.7		7.8		3.9	
1307			3.3		5.7		7.9		4.0	
1308			3.3		5.7		7.9		4.1	
1309			3.2		5.8		8.0		4.2	
1310			3.2		5.8		8.1		4.3	
1311			3.2		5.8		8.1		4.4	
1312			3.2		5.9		8.2		4.5	
1313			3.2		5.9		8.2		4.6	
1314			3.2		5.9		8.3		4.7	
1315			3.1		6.0		8.4		4.8	
1316			3.1		6.0		8.4		4.9	
1317			3.1		6.1		8.5		5.0	
1318			3.1		6.1		8.5		5.1	
1319	13.32		3.1		6.1		8.6		5.2	
1320	13.33	1	3.0	7.3	6.2	8.5	8.7	1.6	5.3	
1321	13.35	1.1	3.3	6.4	5.4	8.6	8.8	0.9	3.0	
1322	13.37	1.1	3.3	6.4	5.4	8.6	8.8	0.8	2.6	
1323	13.38	1.1	3.3	6.4	5.4	8.6	8.8	0.8	2.6	
1324	13.40	1.1	3.3	6.4	5.4	8.6	8.8	0.7	2.3	
1325	13.42	1.1	3.3	6.3	5.3	8.6	8.8	0.7	2.3	
1326	13.43	1.1	3.3	6.3	5.3	8.3	8.5	0.7	2.3	
1327	13.45	1.1	3.3	6.3	5.3	8.2	8.4	0.7	2.3	
1328	13.47	1.1	3.3	6.3	5.3	8	8.2	0.6	2.0	
1329	13.48	1.1	3.3	6.3	5.3	8	8.2	0.6	2.0	
1330	13.50	1.1	3.3	6.3	5.3	8.1	8.3	0.6	2.0	
1331	13.52	1.1	3.3	6.2	5.2	8.1	8.3	0.5	1.6	
1332	13.53	1.1	3.3	6.2	5.2	8.2	8.4	0.5	1.6	
1333	13.55	1.1	3.3	6.2	5.2	8.2	8.4	0.5	1.6	
1334	13.57	1.1	3.3	6.2	5.2	8	8.2	0.5	1.6	
1335	13.58	1.1	3.3	6.1	5.1	8	8.2	0.5	1.6	
1336	13.60	1.2	3.7	6.3	5.3	8.1	8.3	0.6	2.0	
1337	13.62	1.2	3.7	6.2	5.2	8.1	8.3	0.7	2.3	
1338	13.63	1.1	3.3	6.3	5.3	8.1	8.3	0.6	2.0	
1339	13.65	1.1	3.3	6.3	5.3	8.1	8.3	0.5	1.6	
1340	13.67	1.1	3.3	6.2	5.2	8.1	8.3	0.5	1.6	
1341	13.68	1.1	3.3	6.2	5.2	8.1	8.3	0.6	2.0	
1342	13.70	1.1	3.3	6.2	5.2	8.1	8.3	0.5	1.6	
1343	13.72	1.1	3.3	6.1	5.1	8.1	8.3	0.6	2.0	
1344	13.73	1.1	3.3	6.1	5.1	8.1	8.3	0.6	2.0	
1345	13.75	1.1	3.3	6.3	5.3	8.2	8.4	0.6	2.0	
1346	13.77	1.1	3.3	6.1	5.1	8.1	8.3	0.7	2.3	
1347	13.78	1.1	3.3	6.1	5.1	8.2	8.4	0.7	2.3	
1348	13.80	1.1	3.3	6.1	5.1	8.3	8.5	0.7	2.3	

		COLD THC				HEATED THC				
		BYPASS		MAIN		MAIN		BYPASS		
TIME	DECIMAL TIME	(ppm)	7% O2 (ppm)	(ppm)	7% O2 (ppm)	(ppm)	7% O2 DRY	(ppm)	7% O2 DRY	COMMENTS
1349	13.82	1.1	3.3	6.2	5.2	8.3	8.5	0.7	2.3	
1350	13.83	1.1	3.3	6.2	5.2	8.6	8.8	0.7	2.3	
1351	13.85	1	3.0	6.2	5.2	8.8	9.0	0.7	2.3	
1352	13.87	1	3.0	6.1	5.1	9	9.2	0.6	2.0	
1353	13.88	1	3.0	6.1	5.1	8.9	9.1	0.6	2.0	
1354	13.90	1	3.0	6.2	5.2	8.7	8.9	0.6	2.0	
1355	13.92	1	3.0	6.2	5.2	8.6	8.8	0.6	2.0	
1356	13.93	1	3.0	6.2	5.2	8	8.2	0.6	2.0	
1357	13.95	1	3.0	6.2	5.2	7.3	7.4	0.6	2.0	
1358	13.97	1.1	3.3	6.2	5.2	6.9	7.0	0.6	2.0	
1359	13.98	1	3.0	6.1	5.1	6.8	6.9	0.7	2.3	
1400	14.00	1	3.0	6.1	5.1	6.6	6.7	0.6	2.0	
1401	14.02	1	3.0	6.1	5.1	6.5	6.6	0.6	2.0	
1402	14.03	1	3.0	6.1	5.1	6.3	6.4	0.7	2.3	
1403	14.05	1	3.0	6.2	5.2	6.5	6.6	0.7	2.3	
1404	14.07	1	3.0	6.1	5.1	6.8	6.9	0.7	2.3	
1405	14.08	1.1	3.3	6.1	5.1	7.1	7.2	0.7	2.3	
1406	14.10	1.1	3.3	8.7	7.3	9.3	9.5	0.8	2.6	
1407	14.12	1.1	3.3	6.6	5.6	7.6	7.8	0.7	2.3	
1408	14.13	1.1	3.3	6.2	5.2	7.5	7.6	0.8	2.6	
1409	14.15	1.1	3.3	6.2	5.2	7.6	7.8	0.7	2.3	
1410	14.17	1.1	3.3	6.3	5.3	7.7	7.9	0.7	2.3	
1411	14.18	1.1	3.3	6.3	5.3	7.7	7.9	0.7	2.3	
1412	14.20	1.1	3.3	6.2	5.2	7.8	8.0	0.8	2.6	
1413	14.22	1.1	3.3	6.1	5.1	7.8	8.0	0.7	2.3	
1414	14.23	1.1	3.3	7.1	6.0	9.2	9.4	0.7	2.3	
1415	14.25	1.1	3.3	7.5	6.3	8.8	9.0	0.7	2.3	
1416	14.27	1.1	3.3	6.4	5.4	7.9	8.1	0.7	2.3	
1417	14.28	1.1	3.3	6.3	5.3	8.2	8.4	0.8	2.6	
1418	14.30	1.1	3.3	6.3	5.3	8.1	8.3	0.8	2.6	
1419	14.32	1.1	3.3	6.3	5.3	8.1	8.3	0.7	2.3	
1420	14.33	1.1	3.3	6.3	5.3	8.1	8.3	0.8	2.6	
1421	14.35	1.1	3.3	6.2	5.2	8	8.2	0.8	2.6	
1422	14.37	1.1	3.3	6.1	5.1	7.8	8.0	0.8	2.6	
1423	14.38	1.1	3.3	6.6	5.6	8.3	8.5	0.8	2.6	
1424	14.40	1.1	3.3	6.9	5.8	8.6	8.8	0.8	2.6	
1425	14.42	1.1	3.3	6.4	5.4	8	8.2	0.9	3.0	
1426	14.43	1.1	3.3	6.3	5.3	8	8.2	0.9	3.0	
1427	14.45	1.1	3.3	6.4	5.4	8	8.2	0.8	2.6	
1428	14.47	1.1	3.3	6.4	5.4	8	8.2	0.8	2.6	
1429	14.48	1.1	3.3	6.3	5.3	8	8.2	0.8	2.6	
1430	14.50	1.1	3.3	6.3	5.3	8.3	8.5	0.8	2.6	
1431	14.52	1.1	3.3	6.3	5.3	8.9	9.1	0.8	2.6	SAMPLING ENDED
1432	14.53									
1558	15.97									
1559	15.98	0.9		1.0		1.2		0.5		AMBIENT AIR CHECK
1600	16.00	0.9		1.0		1.2		0.5		
1601	16.02	0.9		1.0		1.2		0.5		
1602	16.03	0.9		1.0		1.2		0.5		
1603	16.05	0.9		1.0		1.2		0.5		
1604	16.07	0.9		1.0		1.3		0.6		
1605	16.08	0.9		1.0		1.3		0.6		
1606	16.10	0.9		1.1		1.4		0.6		
1607	16.12	0.9		1.1		1.4		0.5		
1608	16.13	0.9		1.1		1.5		0.5		
1609	16.15	0.9		1.1		1.4		0.5		
1610	16.17	0.9		1.1		1.4		0.5		
1611	16.18	0.9		1.0		1.3		0.5		
1612	16.20	0.9		1.0		1.2		0.5		
1613	16.22	0.9		1.0		1.2		0.5		
1614	16.23	0.9		1.1		1.2		0.5		
1615	16.25	0.9		1.0		1.2		0.5		
1616	16.27	0.9		0.9		1.2		0.5		
1617	16.28	0.9		1.0		1.2		0.5		
1618	16.30	0.9		1.0		1.2		0.5		

		COLD THC				HEATED THC				
		BYPASS		MAIN		MAIN		BYPASS		
TIME	DECIMAL TIME	(ppm)	7% O2 (ppm)	(ppm)	7% O2 (ppm)	(ppm)	7% O2 DRY	(ppm)	7% O2 DRY	COMMENTS
1619	16.32	0.9		1.0		1.2		0.5		
1620	16.33	0.9		1.0		1.2		0.5		
1621	16.35	0.9		1.0		1.1		0.5		
1622	16.37	0.9		1.0		1.2		0.5		
1623	16.38	0.9		1.1		1.2		0.5		
1624	16.40	0.9		1.1		1.2		0.5		
1625	16.42	0.9		1.1		1.1		0.5		
1626	16.43	0.9		1.0		1.1		0.5		
1627	16.45	0.9		1.0		1.2		0.5		
1628	16.47	0.9		1.0		1.2		0.5		
1629	16.48	0.9		1.0		1.1		0.5		
1630	16.50	0.9		1.0		1.1		0.4		
1631	16.52	0.9		1.0		1.2		0.4		
1632	16.53	0.9		1.0		1.2		0.4		
1633	16.55	0.9		1.0		1.1		0.4		
1634	16.57	0.9		1.0		1.2		0.4		
1635	16.58	0.9		0.9		1.2		0.5		
1636	16.60	0.9		1.0		1.2		0.5		
1637	16.62	0.9		1.0		1.2		0.5		
1638	16.63	0.9		1.0		1.2		0.5		
1639	16.65	0.9		1.0		1.2		0.5		
1640	16.67	0.7		0.9		1.1		0.5		
Run Average=		1.1	3.3	6.8	5.7	8.0	8.1	1.0	3.4	
Ambient Air		0.9		1.0		1.2		0.5		
For Time Peroid 1139-1303										
Zero Drift= (% of span)		0.08		0.41		0.21		0.49		
Span Drift= (% of span)		0.89		3.63		9.23		0.46		
Error Est.=		0.09		0.65		0.94		0.49		
For Time Peroid 1320-1431										
Zero Drift= (% of span)		0.02		0.00		0.07		0.11		
Span Drift= (% of span)		1.04		2.38		2.88		5.27		
Error Est.=		0.03		0.16		0.30		0.16		

Cold THC corrected to 7%O2 = Raw value x ((14/(21-O2 conc.))
Hot THC corr. to 7%O2, dry = Raw value x ((14/(21-O2 conc.))/(1-moist. conc.)

Comments:
THC'S PASSED LINEARITY CHECK [10-30-1989 -- 11:51:05]
NOW ON STACK GAS [10-30-1989 -- 12:07:55]
BEGIN RUN 3 [10-30-1989 -- 12:13:38]
LAST ENTRY WAS MADE IN ERROR-RUN 3 HAS NOT BEGUN [10-30-1989 -- 12:28:56]
RUN 3 BGAN AT 11:40 [10-30-1989 -- 12:42:40]
SPAN THC'S [10-30-1989 -- 14:01:14]
ZERO THC'S [10-30-1989 -- 14:07:53]
BACK ON STACK GAS [10-30-1989 -- 14:14:01]
END RUN 3 [10-30-1989 -- 15:29:18]
NITROGEN BIAS CHECK [10-30-1989 -- 16:01:22]
ON AMBIENT AIR AT 1646. [10-30-1989 -- 16:53:50]
SECONDARY ZERO CHECK WITH THC PRESSURES AT ZERO. [10-30-1989 -- 17:35:51]
ALL TIMES MENTIONED IN THE COMMENTS ARE 55 MINUTES AHEAD.

RUN 4 - O2, CO2, CO

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O (ppm)	ROLLING AVERAGE
1100	11.00	4.3	30.3	834	700		17.5	3.0	-3	-12	
1101	11.02	4.3	30.7	630	527		17.5	3.1	-4	-14	
1102	11.03	4.5	31.0	1035	876		17.7	2.9	-2	-9	
1103	11.05	4.6	30.1	1093	930		17.8	2.9	-4	-18	
1104	11.07	4.5	30.3	676	574		17.7	3.1	-3	-14	
1105	11.08	4.5	30.3	774	656		17.6	3.0	-4	-15	
1106	11.10	4.4	30.5	599	505		17.6	3.1	-4	-15	
1107	11.12	4.3	30.5	720	604		17.6	3.1	-2	-9	
1108	11.13	4.2	31.0	556	463		17.5	3.3	-3	-14	
1109	11.15	4.3	31.3	829	695		17.6	3.1	-5	-19	
1110	11.17	4.3	30.5	819	686		17.6	3.2	-3	-13	
1111	11.18	4.2	31.0	683	570		17.6	3.1	-2	-10	
1112	11.20	4.3	30.7	1046	876		17.8	2.9	-3	-11	
1113	11.22	4.3	30.6	624	522		17.[illegible]	3.1	-6	-25	
1114	11.23	4.2	31.1	804	671		17.[illegible]	3.2	-2	-6	
1115	11.25	4.3	30.7	983	822		17.6	3.1	-1	-2	
1116	11.27	4.0	30.8	665	548		17.4	3.4	2	9	
1117	11.28	3.8	31.2	1304	1063		17.4	3.2	27	104	
1118	11.30	3.8	31.5	2285	1855		17.5	3.2	82	326	
1119	11.32	3.8	31.4	3571	2908		17.6	3.0	99	401	
1120	11.33	3.9	31.2	2210	1810		17.7	2.9	48	205	
1121	11.35	4.1	31.4	1744	1441		17.7	3.2	27	114	
1122	11.37	4.2	30.9	1903	1587		17.7	3.0	23	99	
1123	11.38	4.3	30.5	1131	947		17.8	3.1	8	34	
1124	11.40	4.3	30.6	1098	921		17.[illegible]	2.9	1	5	
1125	11.42	4.3	30.3	831	697		17.9	2.9	-2	-9	
1126	11.43	4.2	30.7	918	766		17.9	2.9	-3	-12	
1127	11.45	4.2	30.5	1304	1083		18.[illegible]	2.8	-2	-8	
1128	11.47	4.1	30.8	860	712		17.9	3.0	-2	-11	
1129	11.48	4.2	31.2	1201	1000		17.[illegible]	3.0	0	1	
1130	11.50	4.3	30.6	1111	932		17.9	2.9	-5	-21	
1131	11.52	4.2	30.8	701	585		17.8	3.2	-1	-4	
1132	11.53	4.2	31.0	1231	1027		17.8	3.0	1	3	
1133	11.55	4.2	30.6	1013	843		17.[illegible]	3.1	-1	-4	
1134	11.57	4.1	31.0	850	704		17.[illegible]	3.2	-1	-4	
1135	11.58	4.1	31.0	1333	1104		17.[illegible]	2.9	-3	-12	
1136	11.60	4.1	30.8	1052	870		17.[illegible]	2.9	-5	-22	
1137	11.62	4.1	31.1	1020	844		17.[illegible]	3.2	-2	-11	
1138	11.63	4.1	31.3	1722	1430		17.9	3.2	10	45	
1139	11.65	4.2	30.5	1491	1244		17.9	3.0	5	22	
1140	11.67	4.1	30.7	851	706		17.8	3.2	-1	-3	
1141	11.68	4.1	31.2	1276	1059		17.8	3.2	0	1	
1142	11.70	4.3	30.7	1713	1432		18.[illegible]	2.9	0	1	
1143	11.72	4.3	30.4	890	745		18.[illegible]	2.9	-4	-17	
1144	11.73	4.2	30.6	738	616		18.[illegible]	3.1	-4	-18	
1145	11.75	4.2	31.0	1538	1283		18.[illegible]	3.1	0	1	
1146	11.77	4.4	30.7	2004	1687		18.[illegible]	2.9	0	0	
1147	11.78	4.2	30.4	968	807		18.0	3.0	-2	-10	
1148	11.80										
1547	15.78										
1548	15.80	4.1	30.9	787	653		19.3	3.3	13	114	
1549	15.82	4.1	30.8	930	772		19.[illegible]	3.2	21	200	
1550	15.83	4.1	31.0	744	615		19.[illegible]	3.1	17	171	
1551	15.85	4.1	31.0	708	585		19.[illegible]	3.3	8	77	
1552	15.87	4.1	31.2	962	795		19.[illegible]	3.4	8	70	
1553	15.88	4.2	30.7	736	612		19.[illegible]	3.2	8	69	
1554	15.90	4.2	30.6	474	395		19.4	3.2	10	89	
1555	15.92	4.0	30.9	535	441		19.3	3.4	34	285	
1556	15.93	4.3	30.8	115	97		19.5	3.1	58	529	
1557	15.95	4.3	30.5	730	610		19.5	3.1	35	330	
1558	15.97	4.2	30.9	783	651		19.5	3.2	34	314	
1559	15.98	4.2	31.0	993	829		19.4	3.3	42	363	
1600	16.00	4.4	30.4	1240	1044		19.4	3.2	32	276	
1601	16.02	4.1	30.5	783	649		19.3	3.7	120	965	
1602	16.03	4.2	31.5	779	650		19.3	3.5	271	2244	

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O (ppm)	ROLLING AVERAGE
1603	16.05	4.3	30.6	908	759		19.5	3.1	166	1555	
1604	16.07	4.2	30.4	670	559		19.5	3.2	66	606	
1605	16.08	4.3	30.8	536	449		19.5	3.1	40	369	
1606	16.10	4.5	30.7	591	500		19.7	3.0	23	241	
1607	16.12	4.4	30.4	794	672		19.6	3.2	18	181	
1608	16.13	4.5	30.3	1141	965		19.6	3.0	15	152	
1609	16.15	4.4	29.9	923	778		19.6	3.2	9	87	
1610	16.17	4.2	30.6	595	497		19.4	3.6	22	192	
1611	16.18	4.3	31.4	674	566		19.4	3.5	49	417	
1612	16.20	4.4	30.9	1127	947		19.4	3.5	80	714	
1613	16.22	4.4	30.5	1428	1202		19.6	3.4	71	685	
1614	16.23	4.2	30.8	874	729		19.5	3.6	55	509	
1615	16.25	4.2	31.4	620	517		19.6	3.5	65	634	
1616	16.27	4.3	31.4	664	555		19.4	3.7	91	794	
1617	16.28	4.2	31.2	1032	860		19.4	3.7	236	2075	
1618	16.30	4.3	30.7	1484	1242		19.5	3.5	241	2173	
1619	16.32	4.1	30.8	858	711		19.3	3.8	164	1363	
1620	16.33	4.0	31.8	848	698		19.3	4.0	449	3611	
1621	16.35	4.0	32.1	1613	1331		19.5	3.6	751	6912	
1622	16.37	4.1	31.5	1402	1163		19.6	3.6	467	4505	
1623	16.38	4.0	31.7	1030	849		19.6	3.7	585	5889	
1624	16.40	4.1	31.7	1604	1330		19.7	3.4	549	5913	
1625	16.42	4.1	30.9	1025	850		19.6	3.4	280	2804	
1626	16.43	4.2	31.2	846	703		19.6	3.6	286	2782	
1627	16.45	4.2	31.3	1012	844		19.6	3.5	337	3419	
1628	16.47	4.3	31.0	1051	879		19.7	3.4	224	2379	
1629	16.48	4.3	30.9	863	722		19.7	3.5	151	1594	
1630	16.50	4.3	31.2	960	803		19.8	3.5	175	1961	
1631	16.52	4.4	31.1	1103	928		19.9	3.3	126	1664	
1632	16.53	4.4	30.9	958	807		20.0	3.4	69	959	
1633	16.55	4.4	30.9	960	811		20.1	3.5	52	771	
1634	16.57	4.5	31.0	937	792		20.0	3.6	32	456	
1635	16.58	4.4	31.0	882	745		20.0	3.6	21	299	
1636	16.60	4.4	31.0	762	644		20.0	3.8	13	173	
1637	16.62	4.4	31.1	777	657		20.0	3.7	14	192	
1638	16.63	4.5	31.1	805	681		20.0	3.7	12	174	
1639	16.65	4.4	31.1	744	628		20.1	3.7	25	369	
1640	16.67	4.3	31.3	856	718		20.1	3.7	27	428	
1641	16.68	4.3	31.6	841	704		20.0	3.7	73	1060	
1642	16.70	4.3	31.1	917	768		20.0	3.8	66	885	
1643	16.72	4.3	31.4	853	714		19.9	3.8	40	508	
1644	16.73	4.4	31.1	953	801		19.9	3.6	24	315	
1645	16.75	4.4	31.1	728	612		20.0	3.6	20	265	
1646	16.77	4.2	31.1	943	787		20.0	3.5	33	443	
1647	16.78	4.1	31.2	955	793	744	19.9	3.6	34	453	1167
1648	16.80	4.2	31.6	1079	899	749	20.0	3.5	41	563	1175
1649	16.82	4.2	31.4	1093	911	751	20.0	3.5	53	730	1183
1650	16.83	4.2	31.0	1054	878	755	19.8	3.5	54	638	1191
1651	16.85	4.1	31.2	912	757	758	19.7	3.7	57	613	1200
1652	16.87	4.1	31.3	998	828	759	19.6	3.8	65	643	1210
1653	16.88	4.2	31.3	1054	878	763	19.5	3.8	60	577	1218
1654	16.90	4.2	31.2	1066	888	771	19.6	3.6	57	563	1226
1655	16.92	4.2	31.1	1011	840	778	19.5	3.6	51	484	1229
1656	16.93	4.1	31.5	1099	911	791	19.5	3.5	55	508	1229
1657	16.95	4.2	31.2	1209	1005	798	19.5	3.6	34	325	1229
1658	16.97	4.1	31.2	988	820	801	19.3	3.7	41	334	1229
1659	16.98	4.2	31.1	1022	851	801	19.2	3.6	34	261	1228
1700	17.00	4.2	31.3	751	625	794	19.1	3.7	40	284	1228
1701	17.02	4.3	31.1	1070	896	798	19.0	3.6	35	244	1216
1702	17.03	4.2	30.9	947	788	801	18.9	3.7	50	337	1184
1703	17.05	4.2	31.4	960	798	801	18.9	3.6	98	655	1169
1704	17.07	4.1	31.3	1009	838	806	18.8	3.6	90	579	1168
1705	17.08	4.1	31.3	1069	886	813	18.8	3.5	112	717	1174
1706	17.10	4.2	30.8	1181	981	821	18.7	3.4	71	438	1178
1707	17.12	4.1	30.9	794	658	821	18.5	3.8	45	249	1179

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O (ppm)	ROLLING AVERAGE
1708	17.13	4.1	31.4	947	785	818	18.4	3.7	46	250	1180
1709	17.15	4.2	30.9	1102	916	820	18.4	3.7	35	186	1182
1710	17.17	4.1	31.1	746	617	822	18.3	3.9	79	402	1185
1711	17.18	4.2	31.2	1191	992	829	18.3	3.5	119	622	1189
1712	17.20	4.2	30.8	1141	949	830	18.3	3.7	72	367	1183
1713	17.22	4.1	31.3	1070	886	824	18.1	3.6	81	391	1178
1714	17.23	4.2	31.0	1289	1071	830	18.2	3.4	57	285	1174
1715	17.25	4.2	31.2	972	808	835	17.9	3.8	39	177	1167
1716	17.27	4.3	31.1	1307	1097	844	17.9	3.4	36	164	1156
1717	17.28	4.3	30.5	863	722	842	17.9	3.7	19	83	1123
1718	17.30	4.3	31.3	823	691	832	17.9	3.6	18	78	1088
1719	17.32	4.4	30.6	970	820	834	17.9	3.3	10	46	1066
1720	17.33	4.3	30.6	734	617	833	17.9	3.5	9	38	1007
1721	17.35	4.4	31.0	970	819	824	17.9	3.4	8	38	892
1722	17.37	4.5	30.7	893	756	817	17.9	3.2	7	33	818
1723	17.38	4.5	30.6	788	668	814	17.8	3.4	5	20	720
1724	17.40	4.4	30.8	761	643	803	17.6	3.6	6	23	622
1725	17.42	4.5	30.8	840	710	801	17.5	3.5	5	20	575
1726	17.43	4.4	30.7	664	559	798	17.4	3.7	10	40	530
1727	17.45	4.4	30.9	774	651	795	17.4	3.5	15	59	474
1728	17.47	4.3	30.8	646	541	789	17.3	3.6	7	27	434
1729	17.48	4.4	31.0	806	679	789	17.4	3.3	6	23	408
1730	17.50	4.4	30.5	721	607	785	17.4	3.4	8	31	376
1731	17.52	4.3	30.9	771	648	781	17.3	3.3	8	29	349
1732	17.53	4.3	30.7	795	667	778	17.2	3.5	5	19	333
1733	17.55	4.5	30.8	797	675	776	17.1	3.4	5	17	320
1734	17.57	4.5	30.2	614	519	772	17.0	3.4	2	6	313
1735	17.58	4.5	30.6	635	538	768	17.0	3.4	2	8	308
1736	17.60	4.6	30.3	879	749	770	17.1	3.2	0	1	305
1737	17.62	4.5	30.3	650	551	768	17.0	3.3	3	10	302
1738	17.63	4.5	30.5	783	665	768	17.1	3.1	5	19	300
1739	17.65	4.4	30.3	671	567	767	17.1	3.3	2	7	294
1740	17.67	4.4	30.6	807	682	766	17.0	3.2	4	14	287
1741	17.68	4.4	30.5	654	553	764	16.9	3.4	3	10	269
1742	17.70	4.5	30.8	734	624	761	16.9	3.4	16	55	255
1743	17.72	4.6	30.1	786	671	761	16.9	3.1	13	44	248
1744	17.73	4.5	30.0	500	423	754	16.8	3.5	5	18	243
1745	17.75	4.3	30.6	589	495	752	16.8	3.7	26	88	240
1746	17.77	4.4	30.5	910	767	752	16.8	3.5	30	100	234
1747	17.78	4.2	30.5	676	562	748	16.8	3.8	39	131	229
1748	17.80	4.1	31.3	904	749	746	16.8	3.8	58	197	223
1749	17.82	4.1	31.3	860	711	742	16.7	4.0	48	156	213
1750	17.83	4.1	31.3	1114	922	743	16.8	3.7	44	146	205
1751	17.85	4.2	31.0	797	663	742	16.8	3.5	25	83	196
1752	17.87	4.3	31.0	631	528	737	16.8	3.5	21	70	186
1753	17.88	4.3	30.6	940	790	735	17.0	3.3	38	130	179
1754	17.90	4.2	30.1	882	736	733	17.0	3.2	34	120	172
1755	17.92	4.1	30.9	773	641	729	16.9	3.6	51	177	166
1756	17.93	4.2	31.1	1257	1045	732	17.1	3.3	52	183	161
1757	17.95	4.1	30.8	1000	830	729	17.0	3.6	31	109	157
1758	17.97	4.1	31.2	1051	870	729	16.9	3.7	52	175	155
1759	17.98	4.2	31.2	1170	974	731	16.9	3.5	48	165	153
1800	18.00	4.3	30.7	934	784	734	17.1	3.2	25	90	150
1801	18.02	4.3	30.7	654	549	728	17.1	3.3	14	52	147
1802	18.03	4.4	30.7	883	746	728	17.3	3.1	16	61	142
1803	18.05	4.6	30.0	933	795	728	17.4	2.9	11	44	132
1804	18.07	4.5	30.0	624	528	722	17.4	3.1	7	26	123
1805	18.08	4.5	30.5	879	746	720	17.4	3.2	5	20	111
1806	18.10	4.5	30.3	783	665	715	17.3	3.1	2	8	104
1807	18.12	4.4	30.6	624	526	713	17.3	3.4	5	20	100
1808	18.13	4.4	30.7	918	774	712	17.3	3.4	9	34	97
1809	18.15	4.4	30.5	700	589	707	17.3	3.2	7	25	94
1810	18.17	4.4	30.6	654	551	706	17.3	3.4	6	22	87
1811	18.18	4.4	30.7	1058	891	704	17.4	3.2	8	33	78
1812	18.20	4.5	30.5	948	804	702	17.6	2.8	7	27	72

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                              MAIN DUCT                                     BYPASS DUCT
                                     CARBON MONOXIDE                                  CARBON MONOXIDE
TIME DECIMAL    O2       CO2              AT 7% O2   ROLLING      O2       CO2             AT 7% O  ROLLING
      TIME      (%)      (%)      (ppm)    (ppm)     AVERAGE      (%)      (%)    (ppm)   (ppm)   AVERAGE

1813  18.22     4.4      30.1      519      437        694        17.6     3.2       6      23        66
1814  18.23     4.2      30.8      677      565        686        17.3     3.7      11      41        62
1815  18.25     4.3      30.9     1163      976        689        17.3     3.2      15      56        60
1816  18.27     4.4      30.2      664      560        680        17.4     3.2       8      33        58
1817  18.28     4.2      30.6      592      494        676        17.3     3.6      16      60        57
1818  18.30     4.3      31.2     1090      912        680        17.4     3.5      34     133        58
1819  18.32     4.3      30.8      982      823        680        17.5     3.3      22      87        59
1820  18.33     4.3      30.9      826      693        681        17.5     3.5      11      44        59
1821  18.35     4.3      31.0      981      821        681        17.6     3.5      11      43        59
1822  18.37     4.4      31.2      905      764        681        17.6     3.5      11      46        59
1823  18.38     4.5      30.5      807      682        681        17.6     3.3       8      32        59
1824  18.40     4.3      30.7      604      507        679        17.5     3.8       8      33        60
1825  18.42     4.3      31.1      891      748        680        17.5     3.7      20      78        61

Minimum=        3.8      29.9      115       97                   16.7     2.8      -6     -25
Maximum=        4.6      32.1     3571     2908                   20.1     4.0     751    6912
Average=        4.3      30.9      946      791                   18.3     3.4      49     425

Zero drift=     0.88     2.74     4.91                            0.08     0.73   2.81
(% of span)
Span drift=     0.04     1.41     4.18                            5.67     0.57   4.24
(% of span)
Error Est.=     0.11     0.76    78.19                            1.05     0.11  24.19

Comments:
LINEARITY CHECK CO 392.8 PPM [10-31-1989 -- 09:31:39]
LINEARITY CHECK CO 148.2 PPM [10-31-1989 -- 09:40:10]
LINEARITY CHECK O2 6.044% [10-31-1989 -- 09:52:05]
LINEARITY CHECK CO2 5.957% [10-31-1989 -- 10:21:16]
ALL ANALYZERS PASSED LINEARITY CHECK [10-31-1989 -- 10:22:36]
BYPASS AT 20 INCHES LESS THAN 5 ON PYREX [10-31-1989 -- 10:29:35]
MAIN AT 22 INCHES 20 AND 25 ON PYREX-- SAMPLE LINES PASSED LEAK CHECK !!!!! [10-31-1989 --
ON STACK GAS [10-31-1989 -- 10:35:54]
BEGIN RUN4 [10-31-1989 -- 10:59:23]
TEST STOPPED [10-31-1989 -- 11:52:27]
RESTARTED SAMPLING. [10-31-1989 -- 15:53:19]
CHANGED LIOH ON MAIN MANIFOLD. [10-31-1989 -- 15:55:12]
END RUN4 [10-31-1989 -- 18:31:14]
MAIN AT 22 INCHES 5 AND 15 ON PYREX [10-31-1989 -- 18:41:23]
BYPASS AT 20 INCHES LESS THAN 5 ON PYREX--LEAK CHECK OK!!!!! [10-31-1989 -- 18:42:09]
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RUN 4 - THC

		COLD THC				HEATED THC				
		BYPASS		MAIN		BYPASS		MAIN		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 DRY	(ppm)	AT 7% O2 DRY	COMMENTS
1100	11.00	0.8	4.1	7.1	6.0	0	0.0	9.5	9.9	SAMPLING BEGUN
1101	11.02	0.8	4.1	6.9	5.8	0	0.0	9.1	9.5	
1102	11.03	0.8	4.1	6.9	5.8	0	0.0	9.2	9.6	
1103	11.05	0.8	4.1	6.8	5.7	0	0.0	8.8	9.2	
1104	11.07	0.8	4.1	6.9	5.8	-0.1	-0.6	8.9	9.3	
1105	11.08	0.8	4.1	6.9	5.8	0	0.0	8.8	9.2	
1106	11.10	0.8	4.1	7.2	6.0	-0.1	-0.6	9.2	9.6	
1107	11.12	0.8	4.1	7.2	6.0	0	0.0	9.1	9.5	
1108	11.13	0.8	4.1	7	5.9	0	0.0	8.7	9.1	
1109	11.15	0.8	4.1	7.1	6.0	-0.1	-0.6	9	9.4	
1110	11.17	0.8	4.1	7.2	6.0	0	0.0	8.9	9.3	
1111	11.18	0.8	4.1	7.1	6.0	-0.1	-0.6	8.9	9.3	
1112	11.20	0.8	4.1	7.2	6.0	-0.1	-0.6	8.9	9.3	
1113	11.22	0.8	4.1	6.9	5.8	-0.1	-0.6	8.4	8.7	
1114	11.23	0.8	4.1	7.1	6.0	-0.1	-0.6	8.8	9.2	
1115	11.25	0.8	4.1	7.1	6.0	-0.1	-0.6	8.7	9.1	
1116	11.27	0.7	3.6	8.8	7.4	-0.1	-0.6	10.8	11.2	
1117	11.28	0.7	3.6	9.3	7.8	-0.1	-0.6	10	10.4	
1118	11.30	0.7	3.6	10.4	8.7	-0.1	-0.6	11.9	12.4	
1119	11.32	0.7	3.6	9	7.5	-0.1	-0.6	9.4	9.8	
1120	11.33	0.7	3.6	7.7	6.5	0	0.0	9	9.4	
1121	11.35	0.7	3.6	7.3	6.1	0	0.0	8.6	9.0	
1122	11.37	0.7	3.6	7.2	6.0	0	0.0	8.5	8.9	
1123	11.38	0.7	3.6	7	5.9	0	0.0	8.4	8.7	
1124	11.40	0.7	3.6	7.3	6.1	0.2	1.1	8.8	9.2	
1125	11.42	0.7	3.6	7.6	6.4	0.6	3.4	8.7	9.1	
1126	11.43	0.7	3.6	7.4	6.2	0.6	3.4	8.8	9.2	
1127	11.45	0.7	3.6	7.3	6.1	0.6	3.4	8.6	9.0	
1128	11.47	0.8	4.1	7	5.9	0.6	3.4	8.3	8.6	
1129	11.48	0.7	3.6	7.2	6.0	0.6	3.4	8.7	9.1	
1130	11.50	0.7	3.6	7.2	6.0	0.6	3.4	8.5	8.9	
1131	11.52	0.7	3.6	7	5.9	0.6	3.4	8.3	8.6	
1132	11.53	0.7	3.6	7.3	6.1	0.6	3.4	8.7	9.1	
1133	11.55	0.8	4.1	7.1	6.0	0.6	3.4	8.4	8.7	
1134	11.57	0.8	4.1	7.3	6.1	0.6	3.4	8.8	9.2	
1135	11.58	0.8	4.1	7.6	6.4	0.6	3.4	9	9.4	
1136	11.60	0.8	4.1	7.3	6.1	0.6	3.4	8.7	9.1	
1137	11.62	0.8	4.1	7.1	6.0	0.7	3.9	8.5	8.9	
1138	11.63	0.7	3.6	8	6.7	0.7	3.9	8.7	9.1	
1139	11.65	0.7	3.6	7.4	6.2	0.7	3.9	8.4	8.7	
1140	11.67	0.8	4.1	7	5.9	0.7	3.9	8.1	8.4	
1141	11.68	0.7	3.6	7.1	6.0	0.7	3.9	8.3	8.6	
1142	11.70	0.7	3.6	7.3	6.1	0.7	3.9	8.6	9.0	
1143	11.72	0.7	3.6	7.4	6.2	0.7	3.9	8.5	8.9	
1144	11.73	0.7	3.6	7.1	6.0	0.8	4.5	8.3	8.6	
1145	11.75	0.8	4.1	7.6	6.4	0.7	3.9	9	9.4	
1146	11.77	0.8	4.1	7.4	6.2	0.7	3.9	8.7	9.1	
1147	11.78	0.8	4.1	7.3	6.1	0.7	3.9	8.5	8.9	SAMPLING STOPPED
1148	11.80									DUE TO MM5
1547	15.78									MECHANICAL FAILURE
1548	15.80	0.8	4.1	7	5.9	0.6	3.4	8.9	9.3	SAMPLING RESUMED
1549	15.82	0.8	4.1	7.2	6.0	0.6	3.4	9.3	9.7	
1550	15.83	0.8	4.1	7.4	6.2	0.7	3.9	9.4	9.8	
1551	15.85	0.8	4.1	7	5.9	0.6	3.4	8.8	9.2	
1552	15.87	0.8	4.1	7.2	6.0	0.6	3.4	9.2	9.6	
1553	15.88	0.8	4.1	7.6	6.4	0.7	3.9	9.6	10.0	
1554	15.90	0.8	4.1	7.3	6.1	0.6	3.4	9.2	9.6	
1555	15.92	0.8	4.1	7	5.9	0.7	3.9	9	9.4	
1556	15.93	0.8	4.1	7.2	6.0	0.7	3.9	9.3	9.7	
1557	15.95	0.8	4.1	7.3	6.1	0.7	3.9	9.4	9.8	
1558	15.97	0.8	4.1	7.1	6.0	0.7	3.9	9.2	9.6	
1559	15.98	0.8	4.1	7.1	6.0	0.6	3.4	9.2	9.6	
1600	16.00	0.8	4.1	7.2	6.0	0.6	3.4	9.3	9.7	
1601	16.02	0.8	4.1	7.3	6.1	0.6	3.4	9.4	9.8	
1602	16.03	0.8	4.1	7.1	6.0	0.6	3.4	9.2	9.6	

		COLD THC				HEATED THC				
		BYPASS		MAIN		BYPASS		MAIN		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 DRY	(ppm)	AT 7% O2 DRY	COMMENTS
1603	16.05	0.8	4.1	7.3	6.1	0.6	3.4	9.5	9.9	
1604	16.07	0.8	4.1	7.3	6.1	0.6	3.4	9.4	9.8	
1605	16.08	0.8	4.1	7.1	6.0	0.6	3.4	9.2	9.6	
1606	16.10	0.8	4.1	6.6	5.5	0.6	3.4	8.6	9.0	
1607	16.12	0.8	4.1	6.5	5.4	0.6	3.4	8.6	9.0	
1608	16.13	0.8	4.1	6.8	5.7	0.6	3.4	9	9.4	
1609	16.15	0.8	4.1	7.2	6.0	0.6	3.4	9.4	9.8	
1610	16.17	0.8	4.1	7	5.9	0.6	3.4	9.1	9.5	
1611	16.18	0.8	4.1	6.6	5.5	0.6	3.4	8.6	9.0	
1612	16.20	0.8	4.1	6.4	5.4	0.6	3.4	8.6	9.0	
1613	16.22	0.8	4.1	6.8	5.7	0.6	3.4	9.1	9.5	
1614	16.23	0.8	4.1	7.1	6.0	0.6	3.4	9.1	9.5	
1615	16.25	0.8	4.1	7.1	6.0	0.6	3.4	9	9.4	
1616	16.27	0.8	4.1	6.7	5.6	0.7	3.9	8.6	9.0	
1617	16.28	0.8	4.1	6.9	5.8	0.7	3.9	8.9	9.3	
1618	16.30	0.8	4.1	7	5.9	0.7	3.9	9.1	9.5	
1619	16.32	0.8	4.1	7	5.9	0.7	3.9	9	9.4	
1620	16.33	0.8	4.1	6.8	5.7	0.8	4.5	8.8	9.2	
1621	16.35	0.8	4.1	7	5.9	0.8	4.5	9	9.4	
1622	16.37	0.8	4.1	6.8	5.7	0.8	4.5	8.8	9.2	
1623	16.38	0.8	4.1	7.2	6.0	0.8	4.5	9.2	9.6	
1624	16.40		4.2 *		6.0 *		4.7 *		9.7	*ZERO AND
1625			4.2 *		6.0 *		5.0 *		9.8 *	
1626			4.2 *		6.0 *		5.2 *		9.9 *	
1627			4.3 *		6.0 *		5.5 *		10.0 *	
1628			4.3 *		6.0 *		5.7 *		10.1 *	
1629			4.3 *		5.9 *		6.0 *		10.2 *	
1630			4.4 *		5.9 *		6.2 *		10.3 *	
1631			4.4 *		5.9 *		6.5 *		10.4 *	
1632			4.4 *		5.9 *		6.7 *		10.5 *	
1633			4.5 *		5.9 *		7.0 *		10.6 *	
1634			4.5 *		5.9 *		7.2 *		10.7 *	
1635			4.5 *		5.9 *		7.5 *		10.8 *	
1636			4.5 *		5.8 *		7.7 *		10.9 *	
1637			4.6 *		5.8 *		8.0 *		11.0 *	
1638			4.6 *		5.8 *		8.2 *		11.1 *	
1639	16.65		4.6 *		5.8 *		8.5 *		11.2	*SPAN CHECK
1640	16.67	0.9	4.7	6.9	5.8		8.7 *	10.8	11.2	
1641	16.68	0.8	4.1	6.9	5.8	1.6	9.0	8.7	9.1	
1642	16.70	0.8	4.1	6.9	5.8	1.3	7.3	8.5	8.9	
1643	16.72	0.8	4.1	7.1	6.0	1.1	6.2	8.6	9.0	
1644	16.73	0.8	4.1	7.1	6.0	1	5.6	8.5	8.9	
1645	16.75	0.8	4.1	6.9	5.8	0.9	5.0	8.2	8.5	
1646	16.77	0.8	4.1	7	5.9	0.8	4.5	8.5	8.9	
1647	16.78	0.8	4.1	6.9	5.8	0.8	4.5	8.3	8.6	
1648	16.80	0.8	4.1	6.9	5.8	0.6	3.4	8.4	8.7	
1649	16.82	0.8	4.1	7	5.9	0.6	3.4	8.5	8.9	
1650	16.83	0.8	4.1	6.9	5.8	0.5	2.8	8.4	8.7	
1651	16.85	0.8	4.1	6.9	5.8	0.5	2.8	8.4	8.7	
1652	16.87	0.8	4.1	6.8	5.7	0.4	2.2	8.4	8.7	
1653	16.88	0.8	4.1	6.8	5.7	0.3	1.7	8.3	8.6	
1654	16.90	0.8	4.1	7	5.9	0.3	1.7	8.6	9.0	
1655	16.92	0.8	4.1	6.9	5.8	0.2	1.1	8.5	8.9	
1656	16.93	0.8	4.1	6.7	5.6	0.2	1.1	8.3	8.6	
1657	16.95	0.8	4.1	6.7	5.6	0.1	0.6	8.4	8.7	
1658	16.97	0.8	4.1	7.1	6.0	0.1	0.6	8.9	9.3	
1659	16.98	0.8	4.1	6.9	5.8	0.1	0.6	8.7	9.1	
1700	17.00	0.8	4.1	6.6	5.5	0.1	0.6	8.4	8.7	
1701	17.02	0.8	4.1	6.5	5.4	0	0.0	8.5	8.9	
1702	17.03	0.8	4.1	6.6	5.5	0	0.0	8.3	8.6	
1703	17.05	0.8	4.1	6.7	5.6	-0.1	-0.6	8.5	8.9	
1704	17.07	0.8	4.1	6.6	5.5	-0.1	-0.6	8.3	8.6	
1705	17.08	0.8	4.1	6.6	5.5	-0.1	-0.6	8.4	8.7	
1706	17.10	0.8	4.1	6.8	5.7	-0.1	-0.6	8.7	9.1	
1707	17.12	0.8	4.1	6.5	5.4	-0.1	-0.6	8.3	8.6	

		COLD THC				HEATED THC				
		BYPASS		MAIN		BYPASS		MAIN		
TIME	DECIMAL TIME	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 DRY	(ppm)	AT 7% O2 DRY	COMMENTS
1708	17.13	0.8	4.1	6.5	5.4	-0.1	-0.6	8.4	8.7	
1709	17.15	0.7	3.6	6.6	5.5	-0.1	-0.6	8.6	9.0	
1710	17.17	0.8	4.1	6.5	5.4	-0.2	-1.1	8.4	8.7	
1711	17.18	0.7	3.6	6.5	5.4	-0.2	-1.1	8.5	8.9	
1712	17.20	0.7	3.6	6.4	5.4	-0.2	-1.1	8.3	8.6	
1713	17.22	0.7	3.6	6.6	5.5	-0.2	-1.1	8.6	9.0	
1714	17.23	0.7	3.6	6.5	5.4	-0.2	-1.1	8.5	8.9	
1715	17.25	0.7	3.6	6.3	5.3	-0.3	-1.7	8.2	8.5	
1716	17.27	0.7	3.6	6.4	5.4	-0.3	-1.7	8.6	9.0	
1717	17.28	0.7	3.6	6.2	5.2	-0.3	-1.7	8.3	8.6	
1718	17.30	0.7	3.6	6.2	5.2	-0.3	-1.7	8.3	8.6	
1719	17.32	0.7	3.6	6.3	5.3	-0.4	-2.2	8.4	8.7	
1720	17.33	0.7	3.6	6.2	5.2	-0.4	-2.2	8.2	8.5	
1721	17.35	0.7	3.6	6.1	5.1	-0.4	-2.2	8.1	8.4	
1722	17.37	0.7	3.6	6.1	5.1	-0.4	-2.2	8.2	8.5	
1723	17.38	0.7	3.6	5.9	4.9	-0.4	-2.2	8	8.3	
1724	17.40	0.7	3.6	6	5.0	-0.4	-2.2	8.1	8.4	
1725	17.42	0.7	3.6	6.1	5.1	-0.4	-2.2	8.3	8.6	
1726	17.43	0.7	3.6	6	5.0	-0.4	-2.2	8.1	8.4	
1727	17.45	0.6	3.1	6.1	5.1	-0.4	-2.2	8.3	8.6	
1728	17.47	0.6	3.1	5.9	4.9	-0.4	-2.2	8	8.3	
1729	17.48	0.6	3.1	6.2	5.2	-0.4	-2.2	8.4	8.7	
1730	17.50	0.6	3.1	5.9	4.9	-0.5	-2.8	8	8.3	
1731	17.52	0.6	3.1	6	5.0	-0.5	-2.8	8.2	8.5	
1732	17.53	0.6	3.1	5.9	4.9	-0.5	-2.8	8.1	8.4	
1733	17.55	0.6	3.1	6	5.0	-0.5	-2.8	8.3	8.6	
1734	17.57	0.6	3.1	5.8	4.9	-0.5	-2.8	8.1	8.4	
1735	17.58	0.6	3.1	5.7	4.8	-0.4	-2.2	8	8.3	
1736	17.60	0.6	3.1	5.8	4.9	-0.4	-2.2	8.2	8.5	
1737	17.62	0.6	3.1	5.7	4.8	-0.4	-2.2	7.6	7.9	
1738	17.63	0.6	3.1	5.9	4.9	-0.4	-2.2	8	8.3	
1739	17.65	0.6	3.1	5.7	4.8	-0.4	-2.2	7.7	8.0	
1740	17.67	0.6	3.1	6	5.0	-0.4	-2.2	8	8.3	
1741	17.68	0.6	3.1	5.8	4.9	-0.4	-2.2	7.8	8.1	
1742	17.70	0.6	3.1	5.8	4.9	-0.4	-2.2	7.8	8.1	
1743	17.72	0.6	3.1	6.3	5.3	-0.3	-1.7	8.3	8.6	
1744	17.73	0.6	3.1	6.2	5.2	-0.3	-1.7	8.1	8.4	
1745	17.75	0.6	3.1	6.1	5.1	-0.3	-1.7	7.9	8.2	
1746	17.77	0.6	3.1	6.2	5.2	-0.3	-1.7	8.1	8.4	
1747	17.78	0.6	3.1	6.5	5.4	-0.3	-1.7	8.4	8.7	
1748	17.80	0.6	3.1	6.4	5.4	-0.3	-1.7	8.2	8.5	
1749	17.82	0.6	3.1	6.3	5.3	-0.3	-1.7	8	8.3	
1750	17.83	0.5	2.6	6.5	5.4	-0.3	-1.7	8.3	8.6	
1751	17.85	0.5	2.6	6.5	5.4	-0.3	-1.7	8.2	8.5	
1752	17.87	0.6	3.1	6.2	5.2	-0.3	-1.7	7.8	8.1	
1753	17.88	0.6	3.1	6.3	5.3	-0.3	-1.7	8	8.3	
1754	17.90	0.6	3.1	6.3	5.3	-0.3	-1.7	8	8.3	
1755	17.92	0.6	3.1	6.2	5.2	-0.3	-1.7	7.7	8.0	
1756	17.93	0.5	2.6	6.2	5.2	-0.3	-1.7	7.9	8.2	
1757	17.95	0.5	2.6	6	5.0	-0.3	-1.7	7.6	7.9	
1758	17.97	0.5	2.6	6.1	5.1	-0.3	-1.7	7.8	8.1	
1759	17.98	0.5	2.6	6.1	5.1	-0.3	-1.7	7.8	8.1	
1800	18.00	0.6	3.1	6.1	5.1	-0.3	-1.7	7.9	8.2	
1801	18.02	0.6	3.1	5.8	4.9	-0.3	-1.7	7.5	7.8	
1802	18.03	0.6	3.1	5.9	4.9	-0.2	-1.1	7.7	8.0	
1803	18.05	0.6	3.1	6	5.0	-0.2	-1.1	7.7	8.0	
1804	18.07	0.6	3.1	5.8	4.9	-0.2	-1.1	7.4	7.7	
1805	18.08	0.6	3.1	6	5.0	-0.2	-1.1	7.7	8.0	
1806	18.10	0.6	3.1	6	5.0	-0.2	-1.1	7.8	8.1	
1807	18.12	0.6	3.1	5.9	4.9	-0.2	-1.1	7.6	7.9	
1808	18.13	0.6	3.1	6.2	5.2	-0.2	-1.1	8	8.3	
1809	18.15	0.6	3.1	6.1	5.1	-0.2	-1.1	7.8	8.1	
1810	18.17	0.6	3.1	5.9	4.9	-0.2	-1.1	7.5	7.8	
1811	18.18	0.6	3.1	6	5.0	-0.2	-1.1	7.7	8.0	
1812	18.20	0.6	3.1	6.2	5.2	-0.2	-1.1	8	8.3	

TIME	DECIMAL TIME	COLD THC				HEATED THC				COMMENTS
		BYPASS		MAIN		BYPASS		MAIN		
		(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 (ppm)	(ppm)	AT 7% O2 DRY	(ppm)	AT 7% O2 DRY	
1813	18.22	0.6	3.1	6	5.0	-0.2	-1.1	7.7	8.0	
1814	18.23	0.6	3.1	6	5.0	-0.2	-1.1	7.6	7.9	
1815	18.25	0.6	3.1	6.2	5.2	-0.2	-1.1	7.9	8.2	
1816	18.27	0.6	3.1	6.2	5.2	-0.2	-1.1	7.8	8.1	
1817	18.28	0.6	3.1	5.9	4.9	-0.2	-1.1	7.5	7.8	
1818	18.30	0.6	3.1	6	5.0	-0.2	-1.1	7.7	8.0	
1819	18.32	0.6	3.1	6	5.0	-0.2	-1.1	7.6	7.9	
1820	18.33	0.6	3.1	5.8	4.9	-0.2	-1.1	7.4	7.7	
1821	18.35	0.6	3.1	5.9	4.9	-0.2	-1.1	7.4	7.7	
1822	18.37	0.6	3.1	5.9	4.9	-0.2	-1.1	7.5	7.8	
1823	18.38	0.6	3.1	6	5.0	-0.2	-1.1	7.6	7.9	
1824	18.40	0.6	3.1	5.8	4.9	-0.2	-1.1	7.4	7.7	
1825	18.42	0.6	3.1	6	5.0	-0.2	-1.1	7.6	7.9	SAMPLING ENDED
1826	18.43									
1939	19.65									
1940	19.67	0.9		0.7		0.4		1.4		AMBIENT AIR CHECK
1941	19.68	0.9		0.7		0.4		1.4		
1942	19.70	0.9		0.7		0.4		1.3		
1943	19.72	0.9		0.7		0.4		1.3		
1944	19.73	0.9		0.7		0.4		1.3		
1945	19.75	0.9		0.7		0.4		1.3		
1946	19.77	0.8		0.7		0.4		1.3		
1947	19.78	0.8		0.8		0.4		1.3		
1948	19.80	0.8		0.8		0.4		1.3		
1949	19.82	0.8		0.8		0.5		1.3		
1950	19.83	0.8		0.8		0.5		1.3		
1951	19.85	0.8		0.8		0.5		1.3		
1952	19.87	0.8		0.8		0.4		1.3		
1953	19.88	0.8		0.8		0.5		1.3		
1954	19.90	0.8		0.8		0.4		1.3		
1955	19.92	0.8		0.7		0.4		1.3		
1956	19.93	0.8		0.7		0.5		1.2		
1957	19.95	0.8		0.8		0.4		1.3		
1958	19.97	0.8		0.7		0.4		1.3		
1959	19.98	0.8		0.8		0.5		1.3		
2000	20.00	0.8		0.7		0.4		1.3		
2001	20.02	0.8		0.7		0.4		1.3		
2002	20.03	0.8		0.7		0.4		1.3		
2003	20.05	0.9		0.7		0.5		1.3		
2004	20.07	0.9		0.7		0.5		1.3		
2005	20.08	0.9		0.7		0.5		1.3		
2006	20.10	0.9		0.8		0.5		1.3		
2007	20.12	0.9		0.8		0.5		1.3		
2008	20.13	0.9		0.8		0.5		1.3		
2009	20.15	0.9		0.8		0.6		1.3		
2010	20.17	0.9		0.8		0.6		1.3		
2011	20.18	0.9		0.8		0		0.8		
2012	20.20	0.9		0.8		-0.4		0.1		
Run Average=		0.7	3.8	6.7	5.6	0.1	1.2	8.5	9.0	
Ambient Air		0.8		0.8		0.4		1.3		
For Time Peroid 1100-1147										
Zero Drift= (% of span)		0.08		0.65		0.07		0.06		
Span Drift= (% of span)		0.43		0.17		1.35		10.43		
Error Est.=		0.08		0.65		0.07		0.95		
For Time Peroid 1548-1623										
Zero Drift= (% of span)		0.18		0.31		0.65		0.49		
Span Drift= (% of span)		0.22		1.93		1.48		1.84		
Error Est.=		0.18		0.44		0.64		0.64		

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                          COLD THC                                      HEATED THC
               BYPASS                   MAIN                  BYPASS                   MAIN
TIME DECIMAL          AT 7% O2                 AT 7% O2                AT 7% O2                AT 7% O2          COMMENTS
       TIME    (ppm)    (ppm)       (ppm)    (ppm)        (ppm)      DRY          (ppm)      DRY


For Time Peroid 1640-1825
Zero Drift=     0.26                0.64                  1.42                    0.09
(% of span)
Span Drift=     3.07                3.27                  3.71                    1.46
(% of span)
Error Est.=     0.28                0.85                  1.41                    0.21

*    DATA CALCULATED BY EXTRAPOLATION.
Cold THC corrected to 7% O2 = Raw value x ((14/(21-O2 conc.))
Hot THC corr. to 7% O2, dry = Raw value x ((14/(21-O2 conc.))/(1-Moist. conc.)

Comments:
LINEARITY CHECK 20.35 PPM PROPANE [10-31-1989 -- 11:29:07]
LINEARITY CHECK PROPANE 49.09 PPM [10-31-1989 -- 11:35:17]
ALL THC'S PASSED LINEARITY CHECK [10-31-1989 -- 11:41:43]
ON STACK GAS [10-31-1989 -- 11:43:06]
BEGIN RUN4-THC [10-31-1989 -- 11:54:38]
TEST STOPPED [10-31-1989 -- 12:47:50]
ZERO THC'S [10-31-1989 -- 12:59:32]
SPAN THC'S [10-31-1989 -- 13:11:58]
BACK ON STACK GAS [10-31-1989 -- 13:15:22]
RESTARTED SAMPLING. [10-31-1989 -- 16:48:49]
ZERO THC'S [10-31-1989 -- 17:19:17]
SPAN THC'S [10-31-1989 -- 17:27:33]
END RUN4 [10-31-1989 -- 19:26:43]
NITROGEN LINE WAS NOT CONNECTED DURING PREVIOUS SECTION OF LINE BIAS CHECK. [10-31-1989 -- 20:28:34]
NITROGEN LINE WAS PROBABLY NOT CONNECTED DURING RUNS 2 THROUGH 4. [10-31-1989 -- 20:30:55]
NOW IN AMBIENT AIR CHECK. [10-31-1989 -- 20:31:42]
HAVE BEEN PULLING IN AMBIENT AIR FROM TRAILER DURING 2 THROUGH 4. [10-31-1989 -- 20:33:28]
ENTER KEY IS STIKING BADLY.  THIS SEGMENT MUST BE SPLICED INTO RUN4THC DUE TO MACHINE LOCKUP AT END OF TES
ALL TIMES MENTIONED IN THE COMMENTS ARE 55 MINUTES AHEAD.
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RUN 5 - O2, CO2, CO

				MAIN DUCT					BYPASS DUCT		
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1130	11.50	4.2	30.1	507	423		15.9	3.6	15	41	
1131	11.52	4.2	30.1	477	397		15.8	3.5	19	51	
1132	11.53	4.2	29.8	526	437		16.0	3.3	30	84	
1133	11.55	4.1	29.6	404	335		16.0	3.3	16	46	
1134	11.57	4.1	30.0	444	368		16.0	3.3	11	30	
1135	11.58	4.1	30.0	629	521		16.2	3.1	16	45	
1136	11.60	4.1	29.4	583	483		16.2	3.1	23	67	
1137	11.62	4.1	29.6	386	320		16.0	3.3	15	41	
1138	11.63	4.1	30.0	399	331		16.0	3.4	10	29	
1139	11.65	4.1	29.9	718	595		16.1	3.2	36	104	
1140	11.67	4.0	29.4	624	514		16.1	3.1	38	110	
1141	11.68	4.0	30.0	421	346		16.2	3.3	21	60	
1142	11.70	4.1	30.2	684	565		16.2	3.3	32	94	
1143	11.72	4.1	29.7	872	721		16.3	3.1	33	97	
1144	11.73	4.0	29.5	462	379		16.3	3.1	17	51	
1145	11.75	3.9	30.1	394	322		16.2	3.5	20	57	
1146	11.77	4.0	30.4	680	560		16.1	3.5	59	167	
1147	11.78	4.1	29.9	842	695		16.1	3.4	138	395	
1148	11.80	4.0	29.8	520	427		16.1	3.5	99	281	
1149	11.82	4.0	30.3	543	448		16.0	3.5	78	221	
1150	11.83	4.0	30.1	716	591		16.2	3.2	81	237	
1151	11.85	4.0	30.0	521	428		16.3	3.4	49	144	
1152	11.87	3.9	30.4	527	432		16.3	3.3	49	146	
1153	11.88	4.0	29.9	685	565		16.3	3.4	59	173	
1154	11.90	4.0	30.0	498	409		16.1	3.5	30	86	
1155	11.92	4.0	30.2	611	502		16.1	3.5	22	62	
1156	11.93	4.0	30.2	540	443		16.0	3.5	26	74	
1157	11.95	4.0	30.3	620	512		16.1	3.4	59	167	
1158	11.97	3.9	30.0	560	457		16.2	3.3	57	168	
1159	11.98	3.9	30.5	580	475		16.3	3.2	69	207	
1200	12.00	3.8	30.0	679	554		16.4	3.1	98	298	
1201	12.02	3.8	30.4	563	458		16.4	3.3	128	386	
1202	12.03	3.9	30.6	759	621		16.2	3.3	144	423	
1203	12.05	3.9	30.3	712	584		16.2	3.3	120	351	
1204	12.07	3.9	30.1	623	510		16.2	3.3	53	155	
1205	12.08	3.8	30.1	513	417		16.1	3.4	40	115	
1206	12.10	3.9	30.7	604	494		16.1	3.4	98	280	
1207	12.12	4.0	30.1	768	633		16.2	3.2	115	336	
1208	12.13	4.0	29.8	471	386		16.3	3.1	61	183	
1209	12.15	3.9	30.2	465	382		16.4	3.2	51	155	
1210	12.17	4.0	30.1	742	612		16.3	3.2	109	326	
1211	12.18	4.0	29.8	565	465		16.3	3.1	67	199	
1212	12.20	4.0	29.8	447	367		16.3	3.3	29	86	
1213	12.22	4.0	30.3	542	445		16.2	3.5	22	65	
1214	12.23	4.1	30.2	818	676		16.3	3.1	37	109	
1215	12.25	4.1	29.6	610	505		16.4	3.0	32	96	
1216	12.27	4.1	29.6	360	298		16.3	3.1	17	51	
1217	12.28	4.3	29.9	425	355		16.4	3.1	42	127	
1218	12.30	4.5	29.7	777	658		16.6	3.0	104	330	
1219	12.32	4.3	28.9	589	495		16.5	3.1	53	165	
1220	12.33	4.2	29.5	417	347		16.3	3.4	20	60	
1221	12.35	4.2	30.1	530	442		16.2	3.5	32	93	
1222	12.37	4.2	29.7	579	481		16.3	3.4	56	165	
1223	12.38	4.2	30.1	451	376		16.4	3.3	33	100	
1224	12.40	4.3	29.9	586	491		16.5	3.1	24	76	
1225	12.42	4.1	29.3	496	411		16.5	3.2	11	34	
1226	12.43	4.1	30.1	477	395		16.5	3.3	16	48	
1227	12.45	4.1	29.9	660	548		16.3	3.4	19	55	
1228	12.47	4.0	30.1	537	443		16.3	3.4	19	55	
1229	12.48	4.1	30.0	595	493	472	16.3	3.3	24	70	142
1230	12.50	4.0	29.8	425	350	471	16.2	3.4	19	56	142
1231	12.52	4.0	30.3	465	383	471	16.2	3.3	36	105	143
1232	12.53	4.0	30.0	562	463	471	16.4	3.2	58	174	145
1233	12.55	4.0	30.1	520	429	473	16.5	3.1	54	167	147
1234	12.57	3.9	29.9	500	409	474	16.5	3.2	28	86	148

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1235	12.58	3.9	30.4	496	405	472	16.3	3.4	36	108	149
1236	12.60	3.9	30.3	583	478	472	16.2	3.3	51	146	150
1237	12.62	3.9	30.2	511	419	473	16.2	3.5	41	117	151
1238	12.63	4.0	30.3	541	445	475	16.2	3.4	57	167	154
1239	12.65	4.0	29.9	624	512	474	16.3	3.3	83	246	156
1240	12.67	3.9	30.2	472	387	472	16.3	3.3	60	176	157
1241	12.68	4.0	30.3	658	542	475	16.4	3.1	66	201	159
1242	12.70	4.0	30.1	600	494	474	16.5	3.0	43	135	160
1243	12.72	4.1	29.9	584	484	470	16.6	3.0	58	183	162
1244	12.73	4.1	29.6	398	329	469	16.4	3.2	34	102	162
1245	12.75	4.1	30.1	376	311	469	16.3	3.4	33	99	163
1246	12.77	4.2	30.1	582	484	468	16.3	3.2	51	153	163
1247	12.78	4.2	29.7	547	455	464	16.4	3.0	45	137	159
1248	12.80	4.1	29.7	403	333	462	16.5	3.2	33	101	156
1249	12.82	4.0	30.1	504	416	461	16.4	3.2	37	113	154
1250	12.83	4.0	29.7	608	501	460	16.5	3.0	48	148	152
1251	12.85	4.0	29.8	407	336	458	16.6	3.0	29	91	151
1252	12.87	4.1	30.2	494	409	458	16.5	3.1	18	55	150
1253	12.88	4.1	29.6	576	477	457	16.5	3.0	47	146	149
1254	12.90	4.1	29.3	350	290	455	16.5	2.9	38	118	150
1255	12.92	4.1	29.5	296	245	450	16.5	3.1	18	55	150
1256	12.93	4.1	29.9	367	304	448	16.4	3.3	15	45	149
1257	12.95	4.1	29.8	544	450	447	16.4	3.2	25	75	148
1258	12.97	4.0	29.7	522	430	446	16.5	3.2	29	89	147
1259	12.98	3.9	29.8	453	371	445	16.5	3.2	28	87	144
1300	13.00	3.9	30.2	589	482	444	16.5	3.2	48	150	142
1301	13.02	3.9	30.1	678	555	445	16.6	3.2	54	172	138
1302	13.03	3.9	30.1	534	437	442	16.6	3.2	38	120	133
1303	13.05	3.9	30.3	569	466	440	16.5	3.2	24	75	129
1304	13.07	3.9	30.0	627	512	440	16.5	3.3	15	47	127
1305	13.08	3.8	30.2	551	449	441	16.5	3.3	28	86	127
1306	13.10	3.9	30.3	635	519	441	16.5	3.3	37	115	124
1307	13.12	4.1	30.2	618	511	439	16.5	3.1	30	95	120
1308	13.13	4.0	30.1	470	388	439	16.7	3.1	16	53	118
1309	13.15	3.9	29.9	576	472	441	16.6	3.2	11	33	116
1310	13.17	3.9	30.1	490	400	437	16.5	3.2	10	31	111
1311	13.18	4.0	30.4	621	510	438	16.5	3.2	15	45	108
1312	13.20	4.0	30.1	562	462	439	16.4	3.3	10	29	107
1313	13.22	4.0	30.3	523	431	439	16.5	3.2	10	32	107
1314	13.23	4.0	29.8	516	424	435	16.5	3.2	11	36	105
1315	13.25	4.1	30.3	482	399	433	16.5	3.2	26	80	105
1316	13.27	4.0	30.0	587	483	436	16.6	3.1	18	58	105
1317	13.28	4.0	30.2	482	397	437	16.5	3.3	11	34	104
1318	13.30	3.9	30.0	534	437	433	16.4	3.4	9	28	99
1319	13.32	3.9	30.3	487	399	432	16.3	3.5	14	42	97
1320	13.33	3.9	30.3	571	466	434	16.4	3.4	14	42	96
1321	13.35	3.8	30.3	462	376	433	16.3	3.5	20	58	96
1322	13.37	3.9	30.3	626	512	433	16.3	3.3	72	215	97
1323	13.38	3.9	30.0	500	409	434	16.4	3.3	45	139	97
1324	13.40	3.9	30.5	493	404	432	16.5	3.3	30	94	98
1325	13.42	4.0	30.2	670	552	435	16.5	3.2	74	233	101
1326	13.43	4.0	29.9	500	412	435	16.4	3.3	56	172	103
1327	13.45	4.0	29.9	577	475	434	16.4	3.2	58	177	105
1328	13.47	3.9	29.9	440	359	432	16.4	3.4	29	86	105
1329	13.48	3.9	30.4	576	471	432	16.4	3.3	53	161	107
1330	13.50	4.0	30.1	723	594	436	16.5	3.0	31	97	108
1331	13.52	3.9	29.8	451	368	436	16.6	3.0	14	45	107
1332	13.53	4.0	30.2	508	417	435	16.6	3.1	19	61	105
1333	13.55	4.1	29.7	681	563	437	16.7	2.9	28	91	104
1334	13.57	4.0	29.4	426	351	436	16.5	3.1	10	32	103
1335	13.58	4.0	29.8	344	283	434	16.4	3.4	12	36	101
1336	13.60	4.1	30.1	640	530	435	16.4	3.3	72	221	103
1337	13.62	4.0	29.5	591	486	436	16.5	3.1	36	112	103
1338	13.63	3.9	29.7	376	309	434	16.5	3.2	14	43	101
1339	13.65	3.9	30.2	519	425	432	16.5	3.3	84	260	101

		MAIN DUCT					BYPASS DUCT				
				CARBON MONOXIDE					CARBON MONOXIDE		
TIME	DECIMAL TIME	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE	O2 (%)	CO2 (%)	(ppm)	AT 7% O2 (ppm)	ROLLING AVERAGE
1340	13.67	3.9	30.0	747	612	436	16.6	3.1	92	290	103
1341	13.68	3.8	29.8	467	381	433	16.7	3.0	29	95	101
1342	13.70	3.9	30.3	389	319	431	16.6	3.3	22	71	100
1343	13.72	4.0	29.8	702	577	432	16.6	3.2	42	133	99
1344	13.73	3.9	30.0	504	411	433	16.4	3.5	18	54	98
1345	13.75	3.7	30.5	553	448	436	16.3	3.4	65	195	100
1346	13.77	3.7	30.3	862	699	439	16.4	3.4	64	196	101
1347	13.78	3.6	30.5	584	470	440	16.4	3.4	36	109	100
1348	13.80	3.7	30.7	751	609	444	16.5	3.2	83	259	103
1349	13.82	3.8	30.1	801	651	448	16.6	3.1	67	215	104
1350	13.83	3.7	30.5	567	458	447	16.7	3.1	63	206	105
1351	13.85	3.7	30.4	748	605	452	16.7	3.0	54	176	107
1352	13.87	3.6	30.4	601	485	453	16.7	3.0	19	61	107
1353	13.88	3.7	30.2	716	579	455	16.8	2.9	15	48	105
1354	13.90	3.6	30.1	526	424	457	16.8	3.0	12	40	104
1355	13.92	3.7	30.5	602	486	461	16.8	2.9	15	51	104
1356	13.93	3.8	30.1	795	645	467	17.0	2.7	19	66	104
1357	13.95	3.6	30.0	480	387	466	17.0	2.8	8	26	103
1358	13.97	3.6	30.5	662	534	467	17.1	2.7	6	20	102
1359	13.98	3.7	30.2	820	663	472	17.0	2.9	4	15	101
1400	14.00	3.7	30.5	654	528	473	16.8	2.8	3	9	99
1401	14.02	3.7	30.1	660	533	473	17.0	2.6	5	17	96
1402	14.03	3.7	29.8	442	358	471	17.0	2.7	3	11	94
1403	14.05	3.6	30.1	351	283	468	16.9	3.0	-0	-0	93
1404	14.07	3.8	30.5	702	572	469	16.9	2.9	5	17	93
1405	14.08	3.9	29.6	841	689	473	17.0	2.7	3	12	91
1406	14.10	3.8	29.6	440	359	471	16.9	2.9	3	11	90
1407	14.12	3.8	30.3	491	401	469	16.9	3.2	17	58	89
1408	14.13	3.9	30.0	697	570	472	16.8	3.1	22	72	89
1409	14.15	3.8	30.1	436	355	470	16.7	3.3	13	40	89
1410	14.17	3.9	30.6	503	411	470	16.6	3.4	28	88	90
1411	14.18	3.9	29.9	664	543	471	16.7	3.2	25	81	91
1412	14.20	3.7	30.0	392	318	468	16.7	3.3	12	38	91
1413	14.22	3.9	30.6	446	365	467	16.6	3.2	20	64	92
1414	14.23	4.0	29.9	658	540	469	16.8	3.0	29	97	93
1415	14.25	3.8	30.1	448	365	468	16.8	3.1	14	46	92
1416	14.27	3.9	30.4	578	474	468	16.8	3.1	9	31	92
1417	14.28	3.9	29.7	571	467	470	16.7	3.1	5	16	91
Minimum=		3.6	28.9	296	245		15.8	2.6	-0	-0	
Maximum=		4.5	30.7	872	721		17.1	3.6	144	423	
Average=		4.0	30.0	559	459		16.4	3.2	37	113	
Zero drift= (% of span)		0.47	2.30	0.98			0.21	0.94	0.47		
Span drift= (% of span)		1.24	2.92	0.09			3.24	2.13	2.01		
Error Est.=		0.10	1.15	8.21			0.56	0.18	4.45		

Comments:
LINEARITY CHECK CO2 5.957% [11-02-1989 -- 09:39:34]
LINEARITY CHECK O2 6.044% [11-02-1989 -- 09:50:30]
LINEARITY CHECK CO 392.8 PPM [11-02-1989 -- 10:09:10]
LINEARITY CHECK CO 148.2 PPM [11-02-1989 -- 10:18:22]
ALL ANALYZERS PASSED LINEARITY CHECK [11-02-1989 -- 10:34:35]
BYPASS 20 INCHES 10 ON PYREX [11-02-1989 -- 10:43:23]
MAIN AT 22 INCHES 18 AND 32 ON PYREX [11-02-1989 -- 10:43:58]
SAMPLE LINES PASSED LEAK CHECK!!!!!!!!!!! [11-02-1989 -- 10:44:32]
ON STACK GAS [11-02-1989 -- 10:49:44]
CHANGED CAUSTIC ON MAIN CO MONITOR. [11-02-1989 -- 11:04:42]
BEGIN RUN 5A [11-02-1989 -- 11:30:01]
PRINTER JAMMED. [11-02-1989 -- 13:55:59]
END OF RUN 5 [11-02-1989 -- 14:17:21]
FINAL LEAK CHECKS OK, BYPASS BOTH <5MM AT 20"HG, MAIN <10MM AT 22"HG. [11-02-1989 -- 14:25

RUN 5 - THC

		COLD THC				HOT THC				
		BYPASS DUCT		MAIN DUCT		BYPASS DUCT		MAIN DUCT		
TIME	DECIMAL TIME	(ppm)	7% O2 (ppm)	(ppm)	7% O2 (ppm)	(ppm)	7% O2,dry (ppm)	(ppm)	7% O2,dry (ppm)	COMMENTS
1130	11.50	0.7	2.1	6.2	5.1	7.6	7.7	0.5	1.6	TEST BEGUN
1131	11.52	0.8	2.4	6.1	5.0	7.7	7.8	0.5	1.6	
1132	11.53	0.8	2.4	6.4	5.3	8	8.1	0.5	1.6	
1133	11.55	0.7	2.1	6.2	5.1	7.6	7.7	0.5	1.6	
1134	11.57	0.8	2.4	6.2	5.1	7.6	7.7	0.5	1.6	
1135	11.58	0.8	2.4	6.3	5.2	7.9	8.0	0.5	1.6	
1136	11.60	0.7	2.1	6.5	5.4	8	8.1	0.5	1.6	
1137	11.62	0.8	2.4	6.4	5.3	7.8	7.9	0.5	1.6	
1138	11.63	0.8	2.4	6	4.9	7.5	7.6	0.5	1.6	
1139	11.65	0.8	2.4	6.2	5.1	8.1	8.2	0.5	1.6	
1140	11.67	0.8	2.4	6.3	5.2	8.1	8.2	0.5	1.6	
1141	11.68	0.8	2.4	6.1	5.0	7.6	7.7	0.6	2.0	
1142	11.70	0.8	2.4	6.2	5.1	7.4	7.5	0.7	2.3	
1143	11.72	0.7	2.1	6.7	5.5	7.7	7.8	0.5	1.6	
1144	11.73	0.7	2.1	6.8	5.6	7.7	7.8	0.5	1.6	
1145	11.75	0.7	2.1	6.4	5.3	7.4	7.5	0.5	1.6	
1146	11.77	0.7	2.1	6.4	5.3	7.6	7.7	0.5	1.6	
1147	11.78	0.8	2.4	6.6	5.4	7.9	8.0	0.6	2.0	
1148	11.80	0.8	2.4	6.3	5.2	7.6	7.7	0.6	2.0	
1149	11.82	0.8	2.4	6.2	5.1	7.7	7.8	0.6	2.0	
1150	11.83	0.8	2.4	6.5	5.4	8	8.1	0.6	2.0	
1151	11.85	0.8	2.4	6.4	5.3	7.8	7.9	0.6	2.0	
1152	11.87	0.8	2.4	6.5	5.4	7.9	8.0	0.6	2.0	
1153	11.88	0.8	2.4	6.6	5.4	8.1	8.2	0.6	2.0	
1154	11.90	0.8	2.4	6.4	5.3	7.9	8.0	0.6	2.0	
1155	11.92	0.7	2.1	6.6	5.4	8.1	8.2	0.6	2.0	
1156	11.93	0.7	2.1	6.5	5.4	7.8	7.9	0.6	2.0	
1157	11.95	0.7	2.1	6.6	5.4	8.1	8.2	0.6	2.0	
1158	11.97	0.7	2.1	6.6	5.4	7.9	8.0	0.6	2.0	
1159	11.98	0.7	2.1	6.6	5.4	8.1	8.2	0.6	2.0	
1200	12.00	0.7	2.1	6.7	5.5	7.9	8.0	0.6	2.0	
1201	12.02	0.7	2.1	6.6	5.4	7.5	7.6	0.6	2.0	
1202	12.03	0.7	2.1	6.5	5.4	7.6	7.7	0.6	2.0	
1203	12.05	0.7	2.1	6.5	5.4	7.7	7.8	0.6	2.0	
1204	12.07	0.7	2.1	6.6	5.4	8	8.1	0.6	2.0	
1205	12.08	0.7	2.1	6.5	5.4	7.7	7.8	0.6	2.0	
1206	12.10	0.7	2.1	6.4	5.3	7.8	7.9	0.6	2.0	
1207	12.12	0.8	2.4	6.6	5.4	8	8.1	0.6	2.0	
1208	12.13	0.8	2.4	6.4	5.3	7.6	7.7	0.6	2.0	
1209	12.15	0.8	2.4	6.2	5.1	7.4	7.5	0.6	2.0	
1210	12.17	0.7	2.1	6.4	5.3	7.7	7.8	0.5	1.6	
1211	12.18	0.8	2.4	6.5	5.4	7.8	7.9	0.6	2.0	
1212	12.20	0.8	2.4	6.3	5.2	7.5	7.6	0.6	2.0	
1213	12.22	0.8	2.4	6.3	5.2	7.6	7.7	0.6	2.0	
1214	12.23	0.8	2.4	6.6	5.4	8.1	8.2	0.6	2.0	
1215	12.25	0.8	2.4	6.7	5.5	8.1	8.2	0.5	1.6	
1216	12.27	0.8	2.4	6.	5.3	7.8	7.9	0.5	1.6	
1217	12.28	0.8	2.4	6.	5.0	7.5	7.6	0.6	2.0	
1218	12.30	0.8	2.4	6.2	5.1	7.6	7.7	0.6	2.0	
1219	12.32	0.8	2.4	6.3	5.2	7.5	7.6	0.5	1.6	
1220	12.33	0.8	2.4	6.2	5.1	7.3	7.4	0.5	1.6	
1221	12.35	0.8	2.4	6.3	5.2	7.5	7.6	0.5	1.6	
1222	12.37	0.8	2.4	6.4	5.3	7.6	7.7	0.5	1.6	
1223	12.38	0.8	2.4	6.2	5.1	7.4	7.5	0.6	2.0	
1224	12.40	0.8	2.4	6.5	5.4	7.9	8.0	0.5	1.6	
1225	12.42	0.8	2.4	6.	5.4	7.8	7.9	0.6	2.0	
1226	12.43	0.8	2.4	6.	5.4	7.7	7.8	0.5	1.6	
1227	12.45	0.8	2.4	6.	5.4	7.7	7.8	0.5	1.6	
1228	12.47	0.8	2.4	6.	5.4	7.7	7.8	0.6	2.0	
1229	12.48	0.8	2.4	6.7	5.5	8	8.1	0.5	1.6	
1230	12.50	0.8	2.4	6.	5.4	7.7	7.8	0.6	2.0	
1231	12.52	0.8	2.4	6.6	5.4	7.9	8.0	0.6	2.0	
1232	12.53	0.7	2.1	6.6	5.4	7.7	7.8	0.6	2.0	
1233	12.55	0.7	2.1	6.	5.5	7.9	8.0	0.6	2.0	
1234	12.57	0.7	2.1	6.7	5.5	7.7	7.8	0.6	2.0	
1235	12.58	0.7	2.1	6.6	5.4	7.7	7.8	0.5	1.6	
1236	12.60	0.7	2.1	6.6	5.4	7.7	7.8	0.6	2.0	
1237	12.62	0.7	2.1	6.5	5.4	7.5	7.6	0.5	1.6	
1238	12.63	0.8	2.4	6.5	5.4	7.7	7.8	0.5	1.6	
1239	12.65	0.8	2.4	6.5	5.4	7.5	7.6	0.5	1.6	
1240	12.67	0.7	2.1	6.3	5.2	7.3	7.4	0.5	1.6	
1241	12.68	0.7	2.1	6.3	5.2	7.4	7.5	0.7	2.3	
1242	12.70	0.8	2.4	6.2	5.1	7.4	7.5	0.5	1.6	
1243	12.72	0.8	2.4	6.5	5.4	7.8	7.9	0.5	1.6	

		COLD THC				HOT THC				
		BYPASS DUCT		MAIN DUCT		BYPASS DUCT		MAIN DUCT		
TIME	DECIMAL TIME	(ppm)	7% O2 (ppm)	(ppm)	7% O2 (ppm)	(ppm)	7% O2,dry (ppm)	(ppm)	7% O2,dry (ppm)	COMMENTS
1244	12.73	0.8	2.4	6.4	5.3	7.6	7.7	0.5	1.6	
1245	12.75	0.8	2.4	6.2	5.1	7.3	7.4	0.6	2.0	
1246	12.77	0.8	2.4	6.2	5.1	7.4	7.5	0.6	2.0	
1247	12.78	0.8	2.4	6.4	5.3	7.6	7.7	0.6	2.0	
1248	12.80	0.8	2.4	6.2	5.1	7.3	7.4	0.5	1.6	
1249	12.82	0.7	2.1	6.3	5.2	7.4	7.5	0.6	2.0	
1250	12.83	0.7	2.1	6.7	5.5	7.8	7.9	0.6	2.0	
1251	12.85	0.7	2.1	6.3	5.2	7.4	7.5	0.6	2.0	
1252	12.87	0.7	2.1	6.2	5.1	7.4	7.5	0.6	2.0	
1253	12.88	0.3	0.9		5.1		7.6	0.6	2.0	
1254	12.90		1.0		5.1		7.6		2.0	ZERO AND
1255			1.1		5.1		7.6		2.0	SPAN CHECK
1256			1.1		5.1		7.6		2.0	
1257			1.2		5.1		7.6		2.1	
1258			1.3		5.1		7.6		2.1	
1259			1.4		5.1		7.7		2.1	
1300			1.4		5.1		7.7		2.1	
1301			1.5		5.1		7.7		2.1	
1302			1.6		5.1		7.7		2.2	
1303			1.7		5.1		7.7		2.2	
1304			1.8		5.1		7.7		2.2	
1305			1.8		5.1		7.8		2.2	
1306			1.9		5.1		7.8		2.2	
1307			2.0		5.1		7.8		2.3	
1308	13.13	0.7	2.1	6.2	5.1	7.7	7.8	0.7	2.3	
1309	13.15	0.7	2.1	6.4	5.3	8.1	8.2	0.7	2.3	
1310	13.17	0.7	2.1	6.4	5.3	8	8.1	0.7	2.3	
1311	13.18	0.7	2.1	6.4	5.3	8.2	8.3	0.7	2.3	
1312	13.20	0.7	2.1	6.4	5.3	8	8.1	0.7	2.3	
1313	13.22	0.7	2.1	6.5	5.4	8.2	8.3	0.7	2.3	
1314	13.23	0.7	2.1	6.4	5.3	8	8.1	0.7	2.3	
1315	13.25	0.7	2.1	6.3	5.2	7.8	7.9	0.7	2.3	
1316	13.27	0.7	2.1	6.4	5.3	7.9	8.0	0.6	2.0	
1317	13.28	0.7	2.1	6.4	5.3	8	8.1	0.6	2.0	
1318	13.30	0.7	2.1	6.5	5.4	8	8.1	0.6	2.0	
1319	13.32	0.7	2.1	6.4	5.3	7.8	7.9	0.6	2.0	
1320	13.33	0.7	2.1	6.5	5.4	8	8.1	0.6	2.0	
1321	13.35	0.7	2.1	6.3	5.2	7.7	7.8	0.6	2.0	
1322	13.37	0.7	2.1	6.5	5.4	8.1	8.2	0.6	2.0	
1323	13.38	0.7	2.1	6.3	5.2	7.8	7.9	0.6	2.0	
1324	13.40	0.7	2.1	6.1	5.0	7.6	7.7	0.6	2.0	
1325	13.42	0.7	2.1	6.3	5.2	7.9	8.0	0.6	2.0	
1326	13.43	0.7	2.1	6.1	5.0	7.7	7.8	0.6	2.0	
1327	13.45	0.7	2.1	6.4	5.3	8.1	8.2	0.6	2.0	
1328	13.47	0.7	2.1	6.1	5.0	7.7	7.8	0.6	2.0	
1329	13.48	0.7	2.1	6	4.9	7.7	7.8	0.6	2.0	
1330	13.50	0.7	2.1	6.3	5.2	8.1	8.2	0.6	2.0	
1331	13.52	0.7	2.1	6.3	5.2	7.9	8.0	0.6	2.0	
1332	13.53	0.7	2.1	6.1	5.0	7.7	7.8	0.6	2.0	
1333	13.55	0.7	2.1	6.3	5.2	8.1	8.2	0.6	2.0	
1334	13.57	0.7	2.1	6.5	5.4	8.2	8.3	0.6	2.0	
1335	13.58	0.7	2.1	6.1	5.0	7.6	7.7	0.6	2.0	
1336	13.60	0.7	2.1	6.2	5.1	7.9	8.0	0.7	2.3	
1337	13.62	0.7	2.1	6.5	5.4	8.1	8.2	0.6	2.0	
1338	13.63	0.7	2.1	6.4	5.3	7.8	7.9	0.6	2.0	
1339	13.65	0.7	2.1	6.1	5.0	7.5	7.6	0.6	2.0	
1340	13.67	0.7	2.1	6.4	5.3	8	8.1	0.7	2.3	
1341	13.68	0.7	2.1	6.6	5.4	8.1	8.2	0.6	2.0	
1342	13.70	0.7	2.1	6.1	5.0	7.5	7.6	0.6	2.0	
1343	13.72	0.7	2.1	6.3	5.2	7.9	8.0	0.6	2.0	
1344	13.73	0.7	2.1	6.5	5.4	8	8.1	0.7	2.3	
1345	13.75	0.7	2.1	6.9	5.7	8.2	8.3	0.6	2.0	
1346	13.77	0.7	2.1	6.6	5.4	8.1	8.2	0.6	2.0	
1347	13.78	0.7	2.1	6.4	5.3	7.8	7.9	0.6	2.0	
1348	13.80	0.7	2.1	6.4	5.3	7.9	8.0	0.6	2.0	
1349	13.82	0.7	2.1	6.4	5.3	8	8.1	0.6	2.0	
1350	13.83	0.7	2.1	6.2	5.1	7.8	7.9	0.6	2.0	
1351	13.85	0.7	2.1	6.4	5.3	8.1	8.2	0.6	2.0	
1352	13.87	0.7	2.1	6.3	5.2	7.9	8.0	0.6	2.0	
1353	13.88	0.7	2.1	6.6	5.4	8.3	8.4	0.6	2.0	
1354	13.90	0.7	2.1	6.5	5.4	8	8.1	0.7	2.3	
1355	13.92	0.7	2.1	6.3	5.2	7.8	7.9	0.7	2.3	
1356	13.93	0.7	2.1	6.6	5.4	8.1	8.2	0.7	2.3	
1357	13.95	0.7	2.1	6.5	5.4	7.9	8.0	0.7	2.3	

TIME	DECIMAL TIME	COLD THC				HOT THC				COMMENTS
		BYPASS DUCT		MAIN DUCT		BYPASS DUCT		MAIN DUCT		
		(ppm)	7% 02 (ppm)	(ppm)	7% 02 (ppm)	(ppm)	7% 02,dry (ppm)	(ppm)	7% 02,dry (ppm)	
1358	13.97	0.7	2.1	6.4	5.3	7.8	7.9	0.7	2.3	
1359	13.98	0.8	2.4	6.4	5.3	7.8	7.9	0.7	2.3	
1400	14.00	0.8	2.4	6.3	5.2	7.8	7.9	0.6	2.0	
1401	14.02	0.7	2.1	6.8	5.6	8.3	8.4	0.6	2.0	
1402	14.03	0.7	2.1	6.8	5.6	8.4	8.6	0.7	2.3	
1403	14.05	0.7	2.1	6.4	5.3	7.9	8.0	0.6	2.0	
1404	14.07	0.8	2.4	6.2	5.1	7.7	7.8	0.7	2.3	
1405	14.08	0.7	2.1	6.6	5.4	8.2	8.3	0.7	2.3	
1406	14.10	0.8	2.4	6.4	5.3	7.9	8.0	0.6	2.0	
1407	14.12	0.7	2.1	6.3	5.2	7.7	7.8	0.6	2.0	
1408	14.13	0.8	2.4	6.5	5.4	8.1	8.2	0.6	2.0	
1409	14.15	0.8	2.4	6.4	5.3	7.9	8.0	0.7	2.3	
1410	14.17	0.8	2.4	6.2	5.1	7.7	7.8	0.6	2.0	
1411	14.18	0.8	2.4	6.5	5.4	8.2	8.3	0.6	2.0	
1412	14.20	0.7	2.1	6.6	5.4	8.1	8.2	0.7	2.3	
1413	14.22	0.7	2.1	6.2	5.1	7.6	7.7	0.6	2.0	
1414	14.23	0.7	2.1	6.5	5.4	8	8.1	0.7	2.3	
1415	14.25	0.7	2.1	6.4	5.3	7.4	7.5	0.7	2.3	
1416	14.27	0.7	2.1	6.5	5.4	7.6	7.7	0.7	2.3	
1417	14.28	0.7	2.1	6.8	5.6	8	8.1	0.7	2.3	SAMPLING ENDED
1418	14.30									
1445	14.75									
1446	14.77	0.0		0.9		1.1		0.0		N2 PURGE CHECK
1447	14.78	0.0		0.8		1.0		0.0		
1448	14.80	0.0		0.7		0.9		-0.1		
1449	14.82	0.0		0.6		0.8		0.0		
1450	14.83	0.0		0.5		0.8		-0.1		
1451	14.85	0.0		0.5		0.7		-0.1		
1452	14.87	0.0		0.5		0.6		-0.1		
1453	14.88	0.0		0.4		0.6		-0.1		
1454	14.90	0.0		0.4		0.6		-0.1		
1455	14.92	0.0		0.4		0.6		-0.1		
1456	14.93	0.0		0.4		0.6		-0.1		
1457	14.95	0.0		0.3		0.6		-0.1		
1458	14.97	0.0		0.3		0.6		-0.1		
1459	14.98	0.0		0.3		0.6		-0.1		
1500	15.00	0.0		0.3		0.6		-0.1		
1501	15.02	0.0		0.3		0.5		-0.1		
1502	15.03	0.0		0.2		0.6		-0.1		
1503	15.05	0.0		0.2		0.6		-0.1		
1504	15.07	0.0		0.2		0.6		-0.1		
1505	15.08	0.0		0.2		0.6		-0.1		
1506	15.10	0.0		0.2		0.5		-0.1		
1507	15.12	0.0		0.2		0.5		-0.1		
1508	15.13	0.0		0.2		0.5		-0.1		
1509	15.15	0.0		0.1		0.5		-0.1		
1510	15.17	0.0		0.2		0.5		-0.1		
1511	15.18	0.0		0.2		0.5		0.0		
1512	15.20	0.0		0.2		0.5		0.0		
1513	15.22	0.0		0.2		0.5		-0.1		
1514	15.23	0.0		0.2		0.5		-0.1		
1515	15.25	0.0		0.2		0.5		-0.1		
1516	15.27	0.0		0.2		0.5		0.0		
1517	15.28	0.0		0.2		0.5		-0.1		
1518	15.30	0.0		0.2		0.5		-0.1		
1519	15.32	0.0		0.1		0.5		0.0		
1520	15.33	0.0		0.2		0.5		0.0		
1521	15.35	0.0		0.2		0.5		0.0		
1522	15.37	0.0		0.1		0.5		0.0		
1523	15.38	0.0		0.2		0.5		-0.1		
1524	15.40	-0.2		0.0		-0.3		-0.1		
1525	15.42	-0.3		-0.3		-0.5		-0.4		
1526	15.43	-0.3		-0.4		-0.5		-0.8		
1527	15.45	-0.3		-0.5		-0.5		-0.9		
1528	15.47	-0.3		-0.5		-0.5		-0.9		
1529	15.48	-0.4		-0.5		-0.5		-0.9		
1530	15.50	-0.4		-0.5		-0.5		-0.9		
1531	15.52	-0.4		-0.5		-0.5		-0.9		
1532	15.53	0.0		0.2		6.3		1.0		
1533	15.55	0.6		1.2		2.1		1.1		
1534	15.57	0.8		1.2		1.6		0.6		
1535	15.58	0.9		1.3		1.7		0.6		
1536	15.60	0.8		1.1		1.5		0.6		
1537	15.62	0.8		1.1		1.5		0.5		

		COLD THC				HOT THC				
		BYPASS DUCT		MAIN DUCT		BYPASS DUCT		MAIN DUCT		
TIME	DECIMAL TIME	(ppm)	7% 02 (ppm)	(ppm)	7% 02 (ppm)	(ppm)	7% 02,dry (ppm)	(ppm)	7% 02,dry (ppm)	COMMENTS
1538	15.63	0.8		1.1		1.4		0.5		
1539	15.65	0.8		1.1		1.4		0.5		
1540	15.67	0.8		1.0		1.4		0.5		
1541	15.68	0.8		1.1		1.4		0.5		
1542	15.70	0.8		1.0		1.3		0.5		
1543	15.72	0.8		1.0		1.3		0.5		
1544	15.73	0.8		1.0		1.3		0.4		
1545	15.75	0.8		1.0		1.3		0.5		
1546	15.77	0.8		1.0		1.3		0.5		
1547	15.78	0.8		1.0		1.3		0.5		
1548	15.80	0.8		1.0		1.3		0.5		
1549	15.82	0.8		0.9		1.3		0.5		
1550	15.83	0.8		1.0		1.3		0.5		
1551	15.85	0.8		1.0		1.3		0.5		
1552	15.87	0.9		1.0		1.4		0.5		
1553	15.88	0.8		0.9		1.3		0.5		
1554	15.90	0.9		1.0		1.4		0.5		
1555	15.92	0.9		1.0		1.3		0.6		
1556	15.93	0.8		0.9		1.3		0.5		
1557	15.95	0.8		1.0		1.3		0.5		
1558	15.97	0.8		1.0		1.3		0.5		
1559	15.98	0.8		1.0		1.3		0.5		
1600	16.00	0.8		1.0		1.3		0.5		
1601	16.02	0.8		1.0		1.3		0.5		
1602	16.03	0.8		1.0		1.3		0.5		
1603	16.05	0.9		1.0		1.4		0.5		
1604	16.07	0.8		1.0		1.3		0.6		
1605	16.08	0.8		1.0		1.3		0.5		
Run Average=		0.7	2.2	6.4	5.3	7.8	7.9	0.6	2.0	
N2 Bias Aver		0.3		0.5		0.9		0.1		
For Time Peroid 1130-1253										
Zero Drift= (% of span)		0.04		0.32		0.31		0.03		
Span Drift= (% of span)		0.75		2.40		2.02		20.70		
Error Est.=		0.05		0.47		0.46		0.15		
For Time Peroid 1308-1417										
Zero Drift= (% of span)		0.15		0.05		0.02		0.43		
Span Drift= (% of span)		0.26		1.38		7.65		0.92		
Error Est.=		0.15		0.14		0.62		0.43		

* Data calculated by extrapolation.
Cold THC corrected to 7% 02 = Raw value x ((14/(21-02 conc.))
Hot THC corr. to 7% 02, dry = Raw value x ((14/(21-02 conc.))/(1-Moist. conc.)

Comments:
LINEARITY CHECK PROPANE 20.35 PPM [01-19-1980 -- 04:30:13]
LINEARITY CHECK PROPANE 49.09 PPM [01-19-1980 -- 04:35:09]
THC'S PASSED LINEARITY CHECK [01-19-1980 -- 04:38:08]
ON STACK GAS [01-19-1980 -- 04:45:33]
\BEGIN RUN 5A [01-19-1980 -- 05:25:48]
LOGGER TIME IS 6 HR, 5 MIN SLOW, TIME NOW IS 1237. [01-19-1980 -- 06:33:20]
ZERO THC'S [01-19-1980 -- 06:48:14]
SPAN THC' FROM 6:54 TO 6:55 [01-19-1980 -- 07:01:37]
BACK ON STACK GAS [01-19-1980 -- 07:01:53]
END OF RUN 5 [01-19-1980 -- 08:13:09]
FLAMEOUT ON COLD MAIN. [01-19-1980 -- 08:18:23]
ALL TIMES MENTIONED IN THE COMMENTS ARE 6 HOURS AND 5 MINUTES BEHIND.

APPENDIX B-6

ORGANIC MASS DATA

NOTE: QC sampling times were reported by the operator prior to actually injecting the sample. Reported times may be premature by up to 10 min. Also, a 10-ft length of sampling line was used to transfer sample gas from the hot THC sample line to the field GC. A low flow rate was maintained through this line; therefore, GC sampling times do not correlate directly (i.e., minute for minute) with THC sampling times.

<u>Method 0010</u>--No significant problems were encountered with the Method 0010 trains. All test runs at each duct fell within the acceptable range for isokinetic performance, and all leak checks were passed.

ORGANIC MASS DATA

RUN #	RUN TIME (24-hour)	SAMP. #	TIME	CARBON FRACTIONS (ppm Propane) C1-C7 (wet)	C1-C7 (dry)	C7-C17 (wet)	C7-C17 (dry)	>C17 (dry)	TOTAL MASS (ppm) (dry)
Main Duct 1	1548-2012	R1SS8	1557	55.7	69.54	1.6	2.00	0.39	71.93
		R1SS9	1616	8.2	10.24	0.3	0.37	0.39	11.00
		R1SS10	1645	7.8	9.74	0.4	0.50	0.39	10.63
		R1SS11	1720	5.00	6.24	0.00	0.00	0.39	6.63
		R1SS12	1739	5.80	7.24	0.30	0.37	0.39	8.01
		R1SS13	1757	6	7.49	0.4	0.50	0.39	8.38
		R1SS14	1815	53.10	66.29	3.00	3.75	0.39	70.43
		R1SS15	1834	6.40	7.99	0.20	0.25	0.39	8.63
		R1SS16	1852	6.30	7.87	0.50	0.62	0.39	8.88
		R1SS17	1910	6.00	7.49	0.50	0.62	0.39	8.50
		R1SS18	1930	7.40	9.24	0.60	0.75	0.39	10.38
		R1SS19	2002	6.10	7.62	0.60	0.75	0.39	8.75
		Run Average		14.48	18.08	0.70	0.87	0.39	19.35
2	1159-1440	R2SS2	1222	12.30	15.39	1.20	1.50	0.54	17.44
		R2SS3	1241	8	10.01	0.3	0.38	0.54	10.93
		R2SS4	1259	9.20	11.51	0.90	1.13	0.54	13.18
		R2SS5	1318	4.10	5.13	0.30	0.38	0.54	6.05
		R2SS6	1347	12.30	15.39	1.10	1.38	0.54	17.31
		R2SS7	1406	8.40	10.51	0.50	0.63	0.54	11.68
		R2SS8	1424	8.90	11.14	0.20	0.25	0.54	11.93
		Run Average		9.03	11.30	0.64	0.80	0.54	12.64
3	1139-1431	R3SS3	1154	7.10	8.59	0.80	0.97	0.90	10.45
		R3SS4	1213	7.90	9.55	0.50	0.60	0.90	11.06
		R3SS5	1247	6.50	7.86	0.40	0.48	0.90	9.24
		R3SS6	1251	6.20	7.50	0.40	0.48	0.90	8.88
		R3SS7	1321	7.30	8.83	0.30	0.36	0.90	10.09
		R3SS8	1342	7.00	8.46	0.60	0.73	0.90	10.09
		R3SS9	1401	7.20	8.71	0.40	0.48	0.90	10.09
		R3SS10	1419	5.00	6.05	0.50	0.60	0.90	7.55
		Run Average		6.78	8.19	0.49	0.59	0.90	9.68
4	1100-1147 1548-1825	R4SS2	1117	9.10	11.30	1.80	2.24	0.39	13.93
		R4SS3	1135	7.60	9.44	0.70	0.87	0.39	10.70
		R4SS4	1556	5.50	6.83	0.50	0.62	0.39	7.84
		R4SS5	1614	6.60	8.20	0.40	0.50	0.39	9.09
		R4SS7	1647	6.90	8.57	0.20	0.25	0.39	9.21
		R4SS8	1705	7.60	9.44	0.30	0.37	0.39	10.20
		R4SS9	1723	5.90	7.33	0.30	0.37	0.39	8.09
		R4SS10	1742	6.20	7.70	0.50	0.62	0.39	8.71
		R4SS11	1801	5.00	6.21	0.40	0.50	0.39	7.10
		R4SS12	1818	6.30	7.83	0.40	0.50	0.39	8.71
		Run Average		6.67	8.29	0.55	0.68	0.39	9.36

ORGANIC MASS DATA

RUN #	RUN TIME (24-hour)	SAMP. #	TIME	CARBON FRACTIONS (ppm Propane) C1-C7 (wet)	C1-C7 (dry)	C7-C17 (wet)	C7-C17 (dry)	>C17 (dry)	TOTAL MASS (ppm) (dry)
5	1130-1417	R5BSS2	1148	6.10	7.54	0.70	0.87	0.50	8.91
		R5BSS3	1207	6.70	8.28	0.50	0.62	0.50	9.40
		R5BSS4	1225	6.70	8.28	0.50	0.62	0.50	9.40
		R5BSS5	1243	5.90	7.29	0.20	0.25	0.50	8.04
		R5BSS6	1307	7.40	9.15	0.20	0.25	0.50	9.89
		R5BSS7	1330	6.00	7.42	0.60	0.74	0.50	8.66
		R5BSS8	1352	6.60	8.16	0.40	0.49	0.50	9.15
		R5BSS9	1409	6.80	8.41	0.50	0.62	0.50	9.52
		Run Average		6.53	8.07	0.45	0.56	0.50	9.12

ORGANIC MASS DATA

RUN #	RUN TIME (24-hour)	SAMP. #	TIME	CARBON FRACTIONS (ppm Propane)					TOTAL MASS (ppm) (dry)
				C1-C7 (wet)	C1-C7 (dry)	C7-C17 (wet)	C7-C17 (dry)	>C17 (dry)	
Bypass Duct									
1	1548-2012	R1SS8	1557	1.30	1.41	0.40	0.43	0.01	1.85
		R1SS9	1616	1.30	1.41	0.20	0.22	0.01	1.63
		R1SS10	1645	1.3	1.62	0.1	0.12	0.01	1.76
		R1SS11	1720	2.10	2.62	0.20	0.25	0.01	2.88
		R1SS12	1739	1.20	1.30	0.10	0.11	0.01	1.42
		R1SS13	1757	1.30	1.41	0.10	0.11	0.01	1.53
		R1SS14	1815	1.80	2.25	0.30	0.37	0.01	2.63
		R1SS15	1834	1.40	1.75	0.20	0.25	0.01	2.01
		R1SS16	1852	1.20	1.50	0.10	0.12	0.01	1.63
		R1SS17	1910	1.50	1.62	0.10	0.11	0.01	1.74
		R1SS18	1930	1.20	1.30	0.10	0.11	0.01	1.42
		R1SS19	2002	2.40	2.60	0.10	0.11	0.01	2.72
		Run Average		1.50	1.73	0.17	0.19	0.01	1.93
2	1159-1440	R2SS2	1222	1.70	1.86	0.00	0.00	0.44	2.30
		R2SS3	1241	1.4	1.75	0	0.00	0.44	2.19
		R2SS4	1259	1.50	1.64	0.00	0.00	0.44	2.08
		R2SS5	1318	1.10	1.20	0.60	0.66	0.44	2.30
		R2SS6	1347	1.60	1.75	0.00	0.00	0.44	2.19
		R2SS7	1406	1.50	1.64	0.00	0.00	0.44	2.08
		R2SS8	1424	1.40	1.53	0.00	0.00	0.44	1.97
		Run Average		1.46	1.63	0.09	0.09	0.44	2.16
3	1139-1431	R3SS3	1154	1.70	1.84	0.00	0.00	0.42	2.26
		R3SS4	1213	1.80	1.95	0.00	0.00	0.42	2.37
		R3SS5	1247	2.00	2.17	0.20	0.22	0.42	2.80
		R3SS6	1251	2.30	2.49	0.00	0.00	0.42	2.91
		R3SS7	1321	1.90	2.06	0.00	0.00	0.42	2.48
		R3SS8	1342	1.90	2.06	0.00	0.00	0.42	2.48
		R3SS9	1401	1.90	2.06	0.00	0.00	0.42	2.48
		R3SS10	1419	1.90	2.06	0.00	0.00	0.42	2.48
		Run Average		1.93	2.09	0.03	0.03	0.42	2.54
4	1100-1147 1548-1825	R4SS2	1117	1.50	1.62	0.00	0.00	N	1.62
		R4SS3	1135	1.70	1.84	0.20	0.22	N	2.05
		R4SS4	1556	1.30	1.40	0.00	0.00	N	1.40
		R4SS5	1614	1.30	1.40	0.10	0.11	N	1.51
		R4SS7	1647	1.40	1.51	0.00	0.00	N	1.51
		R4SS8	1705	1.40	1.51	0.00	0.00	N	1.51
		R4SS9	1723	1.40	1.51	0.00	0.00	N	1.51
		R4SS10	1742	1.40	1.51	0.00	0.00	N	1.51
		R4SS11	1801	1.40	1.51	0.00	0.00	N	1.51
		R4SS12	1818	1.30	1.40	0.00	0.00	N	1.40
		Run Average		1.40	1.51	0.00	0.00	N	1.51

ORGANIC MASS DATA

RUN #	RUN TIME (24-hour)	SAMP. #	TIME	CARBON FRACTIONS (ppm Propane) C1-C7 (wet)	C1-C7 (dry)	C7-C17 (wet)	C7-C17 (dry)	>C17 (dry)	TOTAL MASS (ppm) (dry)
5	1130-1417	R5BSS2	1148	2.00	2.16	0.10	0.11	0.26	2.53
		R5BSS3	1207	1.60	1.73	0.20	0.22	0.26	2.21
		R5BSS4	1225	1.70	1.84	0.00	0.00	0.26	2.10
		R5BSS5	1243	1.60	1.73	0.00	0.00	0.26	1.99
		R5BSS6	1307	1.70	1.84	0.00	0.00	0.26	2.10
		R5BSS7	1330	1.70	1.84	0.00	0.00	0.26	2.10
		R5BSS8	1352	1.80	1.95	0.00	0.00	0.26	2.21
		R5BSS9	1409	1.80	1.95	0.00	0.00	0.26	2.21
		Run Average		1.72	1.86	0.05	0.05	0.26	2.17

APPENDIX B-7

TOTAL HYDROCARBON AND TOTAL ORGANIC MASS DATA[a]

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[a] HC and organic mass data presented as dry, ppm propane equivalent.

RUN 1

				THC CONCENTRATION (dry)				
				BYPASS DUCT		MAIN DUCT		
TIME	DECIMAL TIME	ORGANIC MASS BYPASS	MAIN	Cold (ppm)	Hot (ppm)	Cold (ppm)	Hot (ppm)	COMMENTS
1548	15.72			0.6	0.3	36.7	38.5	SAMPLING BEGUN
1549	15.73			0.6	0.3	59.2	80.9	
1550	15.75			0.6	0.3	67.3	57.6	
1551	15.77			0.7	0.4	85.3	127.5	
1552	15.78			0.7	0.4	101.9	60.3	
1553	15.88			0.7	0.4	29.0	22.3	
1554	15.90			0.7	0.5	27.5	29.5	
1555	15.92			0.7	0.5	14.1	13.5	
1556	15.93			0.7	0.6	14.8	18.1	
1557	15.95	1.9	71.9	0.7	0.6	11.4	12.6	
1558	15.97			0.6	0.6	9.0	11.4	
1559	15.98			0.6	0.7	8.4	10.8	
1600	16.00			0.6	0.7	9.4	12.7	
1601	16.02			0.6	0.7	8.7	10.5	
1602	16.03			0.7	0.7	8.1	10.8	
1603	16.05			0.6	0.7	8.3	10.6	
1604	16.07			0.6	0.7	7.9	10.4	
1605	16.08			0.6	0.6	7.8	10.3	
1606	16.10			0.6	0.6	7.8	10.1	
1607	16.12			0.6	0.5	7.6	9.9	
1608	16.13			0.6	0.5	7.3	9.7	
1609	16.15			0.6	0.5	7.1	9.5	
1610	16.17			0.6	0.5	7.1	9.7	
1611	16.18			0.6	0.5	7.4	10.2	
1612	16.20			0.6	0.5	24.3	36.0	
1613	16.22			0.6	0.4	19.5	13.7	
1614	16.23			0.6	0.4	8.8	10.1	
1615	16.25			0.6	0.4	7.4	9.7	
1616	16.27	1.6	11.0	0.6	0.3	7.2	9.7	
1617	16.28			0.6	0.3	7.3	9.8	
1618	16.30			0.6	0.3	7.4	10.0	
1619	16.32			0.7	0.4	7.4	9.9	
1620	16.33			1.4	1.6	7.4	9.9	
1621	16.35			1.8	2.0	7.5	10.2	
1622	16.37			1.5	1.4	7.5	9.9	
1623	16.38			1.3	1.2	7.2	9.6	
1624	16.40			1.2	1.1	6.9	9.3	
1625	16.42							ZERO AND
1626								
1627								
1628								
1629								
1630								
1631								
1632								
1633								
1634								
1635								
1636	16.60							SPAN CHECK
1637	16.62			0.6	0.0	6.9	9.1	
1638	16.63			0.0	-0.6	7.0	9.1	
1639	16.65			-0.2	-0.7	7.0	9.0	
1640	16.67			-0.2	-0.7	7.2	9.2	
1641	16.68			-0.3	-0.8	7.5	9.5	
1642	16.70			-0.3	-0.8	8.5	9.9	
1643	16.72			-0.2	-0.7	7.1	8.9	
1644	16.73			-0.2	-0.7	7.1	9.1	
1645	16.75	1.8	10.6	-0.2	-0.7	7.7	9.6	
1646	16.77			-0.2	-0.6	7.4	9.2	
1647	16.78			-0.2	1.9	7.2	9.1	
1648	16.80			-0.2	1.6	7.2	9.1	
1649	16.82			-0.2	0.9	7.4	9.4	
1650	16.83			-0.2	0.8	7.8	9.7	
1651	16.85			-0.2	0.8	7.9	9.6	
1652	16.87			-0.2	0.8	8.1	10.3	

				THC CONCENTRATION (dry)				
				BYPASS DUCT		MAIN DUCT		
TIME	DECIMAL TIME	ORGANIC MASS BYPASS	MAIN	Cold (ppm)	Hot (ppm)	Cold (ppm)	Hot (ppm)	COMMENTS
1653	16.88			-0.2	0.8	8.9	10.2	
1654	16.90			-0.2	0.9	7.5	9.3	
1655	16.92			-0.2	0.8	7.3	9.1	
1656	16.93			-0.3	0.8	7.1	8.9	
1657	16.95			-0.3	0.8	7.8	9.9	
1658	16.97			-0.3	0.7	10.5	11.5	
1659	16.98			-0.3	0.7	8.5	9.9	
1700	17.00			-0.3	0.7	7.9	9.1	
1701	17.02			-0.3	0.6	7.2	8.7	
1702	17.03			-0.3	0.6	7.1	8.7	
1703	17.05			-0.3	0.5	6.9	8.6	
1704	17.07			-0.3	0.5	6.9	8.5	
1705	17.08			-0.3	0.4	7.0	8.7	
1706	17.10			-0.3	0.4	7.1	8.8	
1707	17.12			-0.3	0.4	7.0	8.7	
1708	17.13			-0.3	0.4	6.9	8.6	
1709	17.15			-0.3	0.4	6.8	8.5	
1710	17.17			-0.3	0.4	6.8	8.6	
1711	17.18			-0.2	0.4	6.8	8.7	
1712	17.20			-0.2	0.5	6.9	8.8	
1713	17.22			-0.2	0.5	6.9	8.8	
1714	17.23			-0.2	0.7	6.7	8.6	
1715	17.25			-0.2	3.3	6.8	8.8	
1716	17.27			-0.2	2.7	7.0	8.9	
1717	17.28			-0.2	2.1	7.0	8.8	
1718	17.30			-0.2	1.6	7.0	8.9	
1719	17.32			-0.2	1.3	7.1	8.9	
1720	17.33	2.9	6.6	-0.2	1.1	7.4	9.2	
1721	17.35			-0.2	1.0	7.5	9.2	
1722	17.37			-0.3	0.9	7.3	9.1	
1723	17.38			-0.3	0.8	7.2	8.8	
1724	17.40			-0.3	0.7	7.1	8.7	
1725	17.42			-0.3	0.7	6.9	8.6	
1726	17.43			-0.3	0.7	7.0	8.7	
1727	17.45			-0.3	0.6	7.3	8.9	
1728	17.47			-0.3	0.5	7.2	8.8	
1729	17.48			-0.3	0.5	6.9	8.6	
1730	17.50			-0.3	0.5	7.4	9.1	
1731	17.52			-0.3	0.5	8.0	9.6	
1732	17.53			-0.3	0.5	7.6	9.2	
1733	17.55			-0.3	0.5	7.1	8.7	
1734	17.57			-0.3	0.5	7.0	8.8	
1735	17.58			-0.3	0.4	7.2	9.0	
1736	17.60			-0.3	0.5	7.6	9.3	
1737	17.62			-0.3	0.5	7.1	8.9	
1738	17.63			-0.2	0.8	7.0	8.8	
1739	17.65	1.4	7.9	-0.2	0.7	10.3	12.1	
1740	17.67			-0.3	1.8	9.8	11.5	
1741	17.68			-0.3	0.8	9.1	10.1	
1742	17.70			-0.3	0.7	7.2	9.0	
1743	17.72			-0.3	0.7	6.9	8.8	
1744	17.73			-0.3	0.7	6.9	8.8	
1745	17.75			-0.3	0.7	8.7	10.7	
1746	17.77			-0.3	0.8	11.8	13.8	
1747	17.78			-0.2	0.7	9.4	10.0	
1748	17.80			-0.3	0.7	7.4	9.1	
1749	17.82			-0.3	0.8	7.8	9.6	
1750	17.83			-0.2	0.8	7.4	9.1	
1751	17.85			-0.2	0.9	7.2	8.9	
1752	17.87			-0.3	0.8	7.1	8.9	
1753	17.88			-0.3	0.8	7.3	9.1	
1754	17.90			-0.3	0.8	8.4	10.1	
1755	17.92			-0.3	0.7	7.5	8.9	
1756	17.93			-0.3	0.7	7.3	8.9	
1757	17.95	1.5	8.4	-0.3	0.6	7.0	8.5	

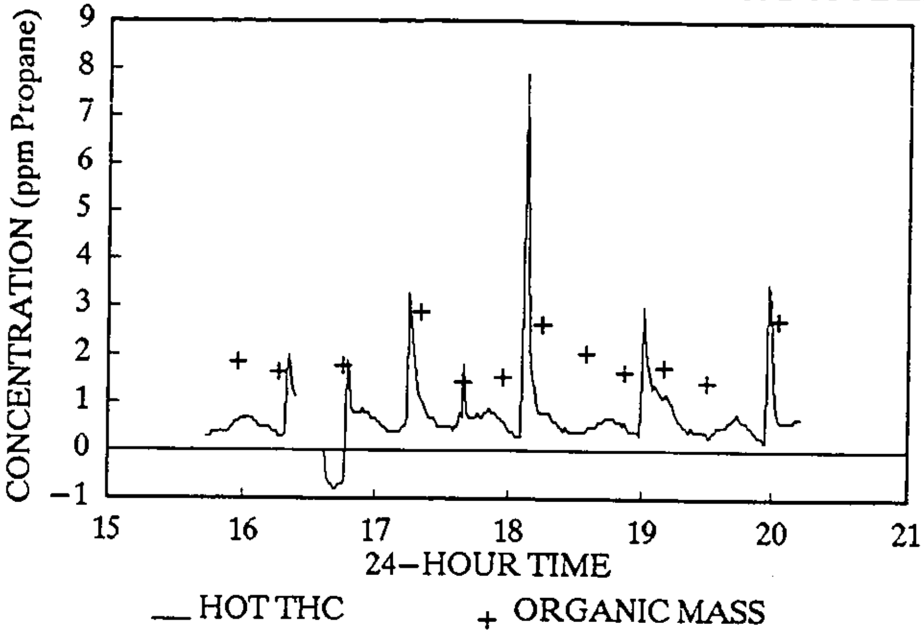
TIME	DECIMAL TIME	ORGANIC MASS BYPASS	ORGANIC MASS MAIN	THC CONCENTRATION (dry) BYPASS DUCT Cold (ppm)	THC CONCENTRATION (dry) BYPASS DUCT Hot (ppm)	THC CONCENTRATION (dry) MAIN DUCT Cold (ppm)	THC CONCENTRATION (dry) MAIN DUCT Hot (ppm)	COMMENTS
1758	17.97			-0.3	0.6	7.1	8.8	
1759	17.98			23.0	0.5	7.3	8.9	
1800	18.00			0.7	0.4	7.0	8.6	
1801	18.02			0.7	0.4	6.8	8.5	
1802	18.03			0.7	0.4	6.8	8.6	
1803	18.05			0.7	0.3	11.7	14.2	
1804	18.07			0.6	0.3	10.6	10.7	
1805	18.08			0.7	0.3	8.4	9.8	
1806	18.10			0.8	0.3	10.4	12.2	
1807	18.12			3.9	3.3	22.2	28.9	
1808	18.13			8.6	7.9	131.7	149.2	
1809	18.15			5.0	4.3	280.5	173.7	
1810	18.17			2.7	2.2	37.4	26.6	
1811	18.18			1.8	1.5	15.4	15.1	
1812	18.20			1.4	1.3	18.2	20.1	
1813	18.22			1.0	0.9	11.7	11.7	
1814	18.23			0.9	0.8	9.3	10.7	
1815	18.25	2.6	70.4	0.8	0.8	8.7	10.3	
1816	18.27			0.8	0.8	8.2	9.7	
1817	18.28			0.8	0.8	8.1	9.7	
1818	18.30			0.7	0.8	8.0	9.6	
1819	18.32			0.7	0.7	7.7	9.3	
1820	18.33			0.6	0.6	7.8	9.3	
1821	18.35			0.6	0.6	7.5	9.1	
1822	18.37			0.6	0.5	7.5	9.2	
1823	18.38			0.6	0.5	7.6	9.1	
1824	18.40			0.6	0.4	7.6	9.2	
1825	18.42			0.7	0.5	8.0	9.8	
1826	18.43			0.7	0.4	9.3	10.4	
1827	18.45			0.6	0.4	7.7	9.2	
1828	18.47			0.6	0.4	7.3	8.9	
1829	18.48			0.6	0.4	8.7	10.5	
1830	18.50			0.6	0.4	17.6	21.6	
1831	18.52			0.6	0.4	27.7	23.7	
1832	18.53			0.6	0.4	11.6	11.8	
1833	18.55			0.6	0.4	9.1	10.5	
1834	18.57	2.0	8.6	0.6	0.4	8.0	9.3	
1835	18.58			0.6	0.5	7.4	9.2	
1836	18.60			0.6	0.5	7.1	8.8	
1837	18.62			0.6	0.5	7.0	8.8	
1838	18.63			0.6	0.5	7.0	8.8	
1839	18.65			0.6	0.5	7.3	9.1	
1840	18.67			0.6	0.6	7.7	9.5	
1841	18.68			0.6	0.6	7.4	9.1	
1842	18.70			0.6	0.6	7.3	9.1	
1843	18.72			0.6	0.7	7.1	9.0	
1844	18.73			0.6	0.7	7.2	9.0	
1845	18.75			0.6	0.7	7.0	8.8	
1846	18.77			0.6	0.7	7.0	8.9	
1847	18.78			0.6	0.7	7.5	9.3	
1848	18.80			0.6	0.6	7.5	9.2	
1849	18.82			0.6	0.6	7.6	9.4	
1850	18.83			0.6	0.6	7.5	9.1	
1851	18.85			0.6	0.5	7.0	8.7	
1852	18.87	1.6	8.9	0.6	0.6	7.0	8.8	
1853	18.88			0.6	0.5	7.0	8.8	
1854	18.90			0.6	0.4	7.2	9.1	
1855	18.92			0.6	0.4	7.6	9.4	
1856	18.93			0.6	0.4	7.9	10.0	
1857	18.95			0.6	0.4	9.9	11.1	
1858	18.97			0.6	0.4	7.8	9.5	
1859	18.98			0.6	0.3	7.7	9.3	
1900	19.00			1.9	1.6	7.2	9.1	
1901	19.02			2.8	3.0	7.0	8.9	
1902	19.03			2.4	2.1	7.1	9.1	

				THC CONCENTRATION (dry)				
				BYPASS DUCT		MAIN DUCT		
TIME	DECIMAL TIME	ORGANIC MASS BYPASS	MAIN	Cold (ppm)	Hot (ppm)	Cold (ppm)	Hot (ppm)	COMMENTS
1903	19.05			2.0	1.7	7.0	9.0	
1904	19.07			1.6	1.5	6.7	8.7	
1905	19.08			1.4	1.3	6.7	8.8	
1906	19.10			1.4	1.4	7.2	9.2	
1907	19.12			1.2	1.3	7.1	9.0	
1908	19.13			1.1	1.2	7.1	9.0	
1909	19.15			1.0	1.1	7.1	9.1	
1910	19.17	1.7	8.5	0.9	1.1	6.9	8.9	
1911	19.18			1.0	1.2	10.5	15.0	
1912	19.20			0.9	1.1	71.6	74.5	
1913	19.22			0.9	1.0	34.8	27.6	
1914	19.23			0.8	1.0	14.6	14.5	
1915	19.25			0.7	0.8	18.5	19.9	
1916	19.27			0.7	0.7	10.1	10.5	
1917	19.28			0.6	0.6	7.5	9.3	
1918	19.30			0.6	0.6	7.5	9.4	
1919	19.32			0.6	0.5	7.5	9.3	
1920	19.33			0.6	0.5	7.3	9.2	
1921	19.35			0.6	0.4	7.8	9.6	
1922	19.37			0.6	0.4	7.3	9.2	
1923	19.38			0.6	0.5	7.4	9.2	
1924	19.40			0.6	0.4	7.6	9.5	
1925	19.42			0.6	0.4	8.3	10.6	
1926	19.43			0.6	0.4	9.4	10.6	
1927	19.45			0.6	0.4	7.3	9.1	
1928	19.47			0.6	0.4	7.2	9.1	
1929	19.48			0.6	0.4	7.3	9.2	
1930	19.50	1.4	10.4	0.6	0.4	7.3	9.2	
1931	19.52			0.6	0.3	7.0	8.9	
1932	19.53			0.6	0.3	7.1	9.1	
1933	19.55			0.6	0.4	7.2	9.2	
1934	19.57			0.6	0.4	7.2	9.2	
1935	19.58			0.6	0.5	7.2	9.2	
1936	19.60			0.6	0.5	7.1	9.1	
1937	19.62			0.6	0.5	7.0	9.0	
1938	19.63			0.6	0.5	7.1	9.1	
1939	19.65			0.6	0.5	7.1	9.1	
1940	19.67			0.6	0.6	7.1	9.1	
1941	19.68			0.6	0.6	7.1	9.1	
1942	19.70			0.6	0.7	6.8	8.8	
1943	19.72			0.6	0.7	6.9	9.0	
1944	19.73			0.6	0.8	7.2	9.2	
1945	19.75			0.6	0.7	7.2	9.1	
1946	19.77			0.6	0.6	7.0	8.8	
1947	19.78			0.6	0.6	7.3	9.2	
1948	19.80			0.6	0.6	9.1	10.8	
1949	19.82			0.6	0.5	7.5	9.1	
1950	19.83			0.6	0.5	7.1	8.9	
1951	19.85			0.6	0.4	7.4	9.2	
1952	19.87			0.6	0.4	7.3	9.1	
1953	19.88			0.6	0.3	7.3	9.0	
1954	19.90			0.6	0.3	6.9	8.7	
1955	19.92			0.6	0.3	6.8	8.7	
1956	19.93			0.6	0.2	7.0	8.9	
1957	19.95			0.6	0.2	7.1	9.1	
1958	19.97			3.3	3.5	7.2	9.2	
1959	19.98			3.0	3.1	7.3	9.4	
2000	20.00			1.8	1.5	7.0	9.1	
2001	20.02			1.3	1.0	7.0	9.1	
2002	20.03	2.7	8.8	0.9	0.7	7.1	9.1	
2003	20.05			0.8	0.6	7.0	9.0	
2004	20.07			0.7	0.6	7.0	8.9	
2005	20.08			0.7	0.6	7.1	9.2	
2006	20.10			0.7	0.6	7.1	9.0	
2007	20.12			0.6	0.6	6.8	8.7	

TIME	DECIMAL TIME	ORGANIC MASS BYPASS	ORGANIC MASS MAIN	THC CONCENTRATION (dry) BYPASS DUCT Cold (ppm)	BYPASS DUCT Hot (ppm)	MAIN DUCT Cold (ppm)	MAIN DUCT Hot (ppm)	COMMENTS
2008	20.13			0.6	0.6	6.9	8.9	
2009	20.15			0.6	0.6	7.0	9.0	
2010	20.17			0.6	0.7	7.4	9.4	
2011	20.18			0.6	0.7	7.3	9.1	
2012	20.20			0.6	0.7	7.2	9.1	SAMPLING ENDED

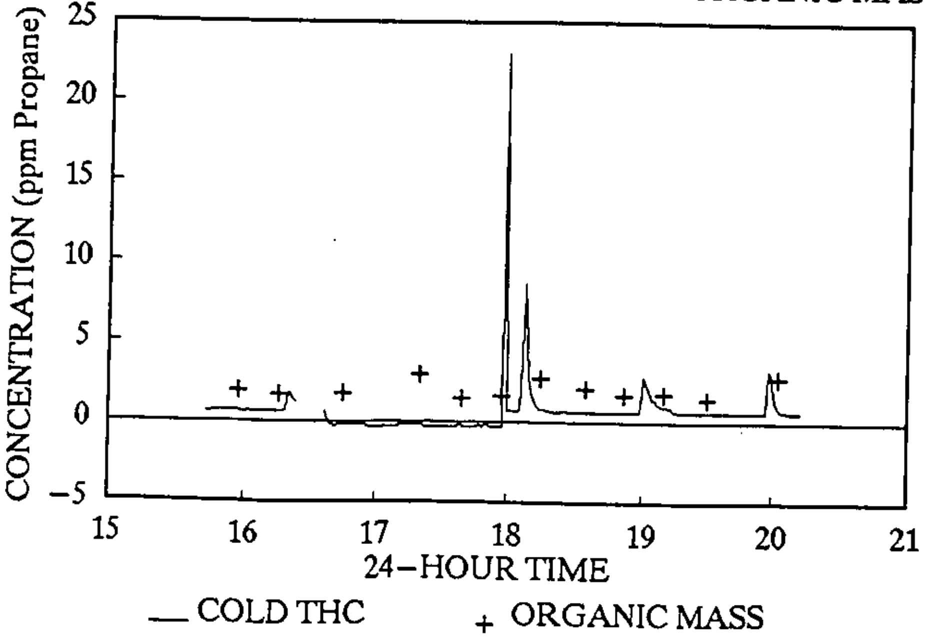
RUN 1, BYPASS DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



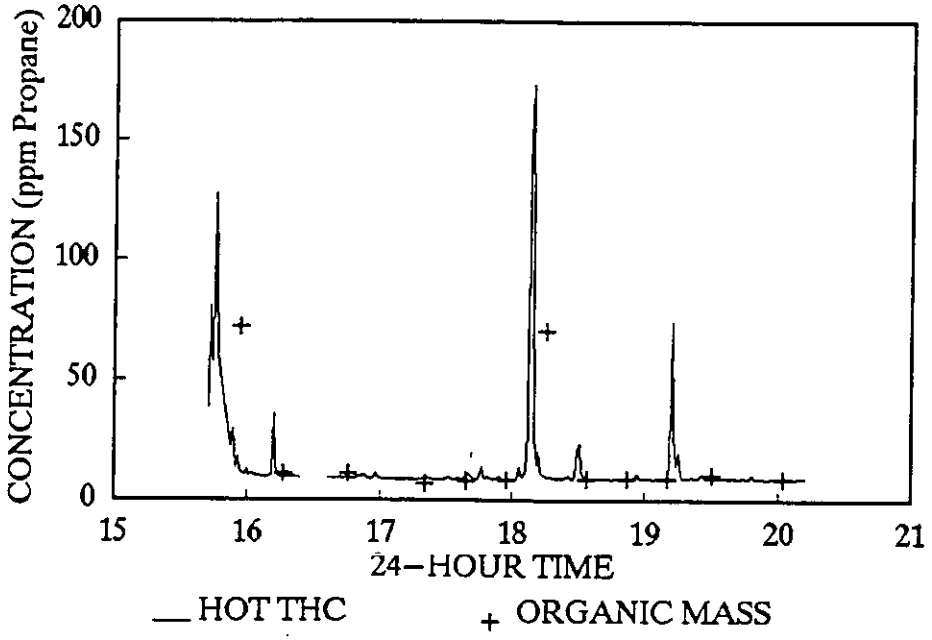
RUN 1, BYPASS DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



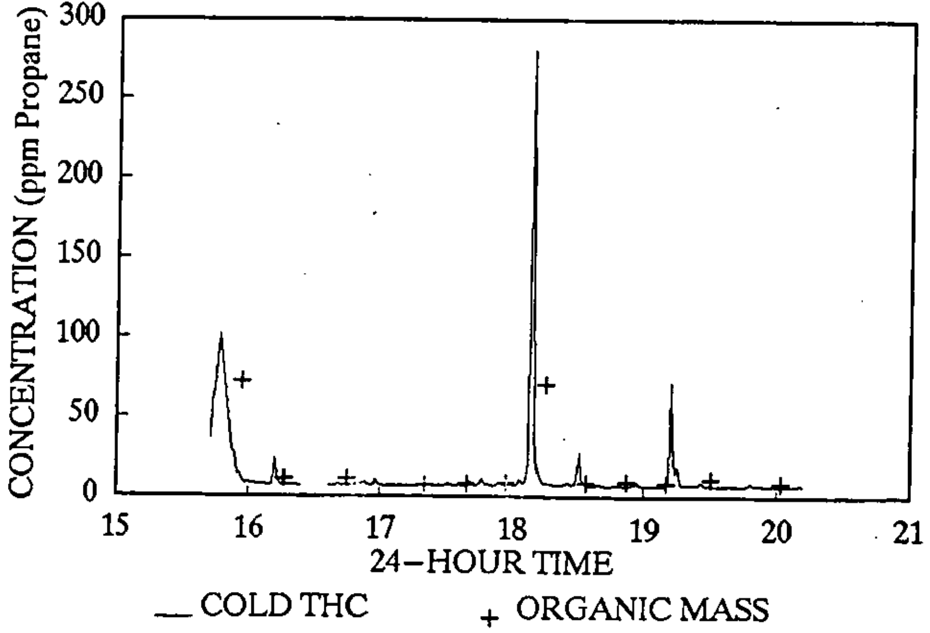
RUN 1, MAIN DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



RUN 1, MAIN DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS

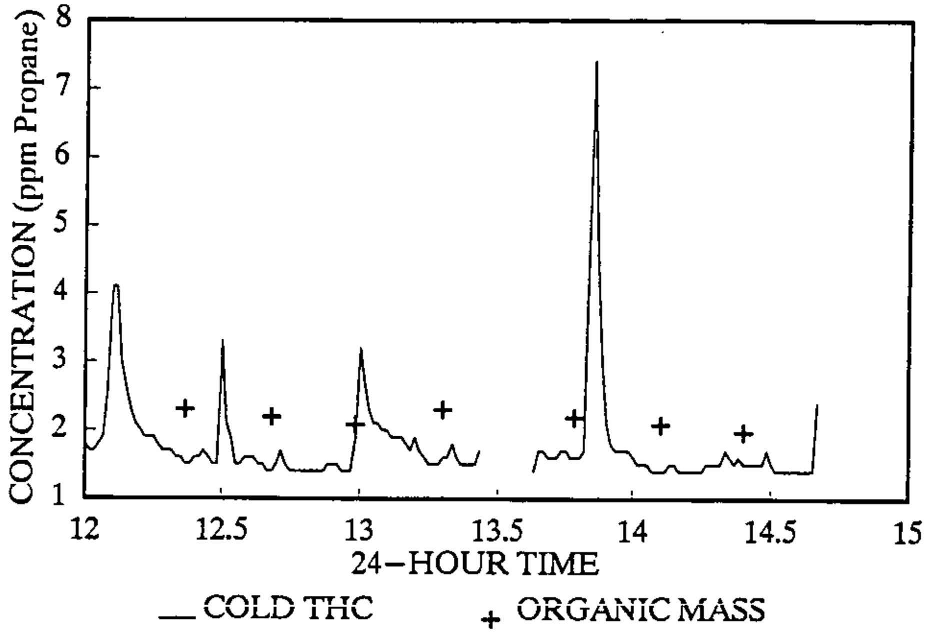


RUN 2

		ORGANIC MASS		THC CONCENTRATION (dry)				
				BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1159	11.98			1.9	0.0	11.8	15.8	SAMPLING BEGUN
1200	12.00			1.8	0.0	18.9	19.5	
1201	12.02			1.7	-0.1	11.6	13.6	
1202	12.03			1.7	-0.1	10.3	12.6	
1203	12.05			1.8	-0.2	9.9	12.5	
1204	12.07			1.9	-0.2	9.5	12.0	
1205	12.08			2.6	0.1	39.8	49.7	
1206	12.10			4.1	1.7	36.7	25.3	
1207	12.12			4.1	2.5	31.6	32.0	
1208	12.13			3.0	1.3	16.4	15.4	
1209	12.15			2.6	0.6	15.8	19.4	
1210	12.17			2.3	0.5	20.6	20.0	
1211	12.18			2.1	0.3	11.5	12.5	
1212	12.20			2.0	0.1	9.0	11.5	
1213	12.22			1.9	0.1	9.2	11.8	
1214	12.23			1.9	0.2	9.2	11.7	
1215	12.25			1.9	0.3	9.2	11.9	
1216	12.27			1.8	0.3	11.7	13.9	
1217	12.28			1.7	0.2	9.2	11.2	
1218	12.30			1.7	0.3	8.7	11.1	
1219	12.32			1.7	0.2	8.7	11.2	
1220	12.33			1.6	0.3	8.7	11.0	
1221	12.35			1.6	0.3	9.1	11.4	
1222	12.37	2.3	17.44	1.5	0.3	9.7	11.9	
1223	12.38			1.5	0.3	9.5	11.4	
1224	12.40			1.6	0.4	9.5	11.5	
1225	12.42			1.6	0.5	9.7	11.7	
1226	12.43			1.7	0.6	12.2	14.2	
1227	12.45			1.6	0.3	10.8	12.2	
1228	12.47			1.5	0.2	9.5	11.2	
1229	12.48			1.5	0.1	9.0	10.8	
1230	12.50			3.3	1.8	19.8	22.4	
1231	12.52			2.1	0.9	32.5	29.4	
1232	12.53			1.9	0.4	13.3	14.4	
1233	12.55			1.5	0.0	10.8	12.1	
1234	12.57			1.5	-0.1	9.1	10.9	
1235	12.58			1.6	-0.1	12.7	14.6	
1236	12.60			1.6	0.0	23.3	23.7	
1237	12.62			1.6	-0.1	12.6	13.7	
1238	12.63			1.5	-0.1	9.8	11.6	
1239	12.65			1.5	-0.1	9.4	11.4	
1240	12.67			1.4	-0.1	10.6	12.4	
1241	12.68	2.19	10.93	1.4	-0.1	9.3	11.1	
1242	12.70			1.5	0.0	9.7	11.6	
1243	12.72			1.7	0.3	10.3	12.2	
1244	12.73			1.5	0.0	9.7	11.4	
1245	12.75			1.4	0.0	9.1	11.0	
1246	12.77			1.4	0.0	11.4	13.2	
1247	12.78			1.4	0.0	9.5	11.1	
1248	12.80			1.4	0.1	8.9	10.8	
1249	12.82			1.4	0.1	9.3	11.2	
1250	12.83			1.4	0.1	28.6	29.7	
1251	12.85			1.4	0.1	15.4	14.5	
1252	12.87			1.4	0.2	9.7	11.4	
1253	12.88			1.5	0.2	9.2	11.1	
1254	12.90			1.5	0.2	9.2	11.1	
1255	12.92			1.5	0.3	9.0	10.8	
1256	12.93			1.4	0.3	9.1	11.0	
1257	12.95			1.4	0.2	9.4	11.1	
1258	12.97			1.4	0.1	9.7	11.2	
1259	12.98	2.08	13.18	1.9	0.2	9.2	10.7	
1300	13.00			3.2	2.3	9.1	10.7	
1301	13.02			2.7	1.3	10.5	12.1	

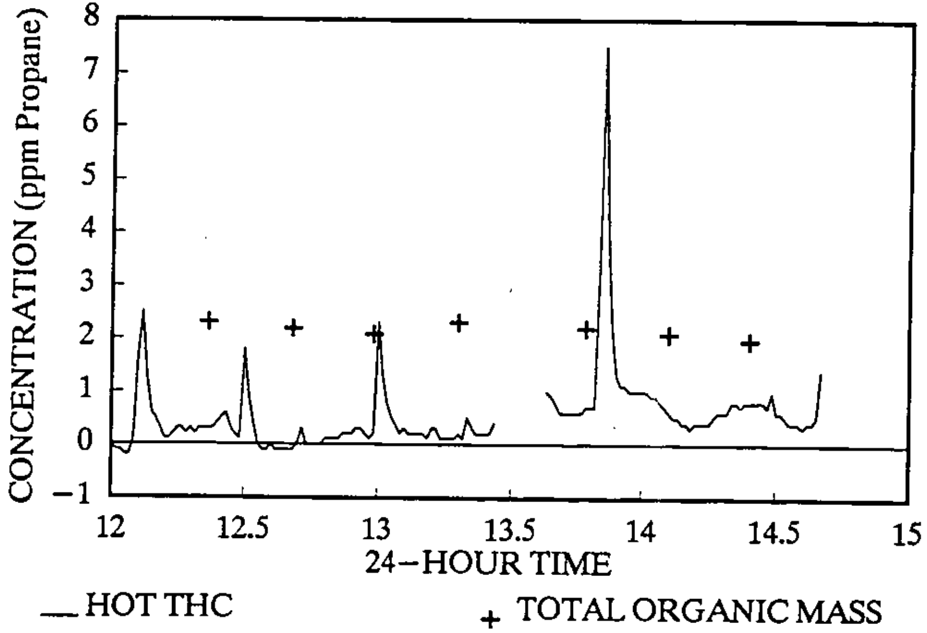
				THC CONCENTRATION (dry)				
		ORGANIC MASS		BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1302	13.03			2.3	0.8	9.8	11.3	
1303	13.05			2.1	0.5	9.2	10.8	
1304	13.07			2.1	0.4	8.9	10.6	
1305	13.08			2.0	0.2	9.1	10.7	
1306	13.10			2.0	0.3	10.1	11.9	
1307	13.12			1.9	0.2	10.3	11.7	
1308	13.13			1.9	0.2	9.1	10.9	
1309	13.15			1.9	0.2	9.1	10.9	
1310	13.17			1.8	0.2	9.1	10.9	
1311	13.18			1.7	0.1	9.2	11.0	
1312	13.20			1.9	0.3	9.2	11.0	
1313	13.22			1.7	0.3	9.9	11.5	
1314	13.23			1.6	0.1	8.9	10.6	
1315	13.25			1.5	0.1	9.0	10.7	
1316	13.27			1.5	0.1	8.9	10.6	
1317	13.28			1.5	0.1	9.2	10.9	
1318	13.30	2.3	6.05	1.6	0.2	9.3	11.0	
1319	13.32			1.6	0.1	9.1	10.8	
1320	13.33			1.8	0.5	9.1	10.8	
1321	13.35			1.6	0.3	9.2	10.7	
1322	13.37			1.5	0.2	13.9	15.1	
1323	13.38			1.5	0.2	10.6	11.9	
1324	13.40			1.5	0.2	9.1	10.6	
1325	13.42			1.5	0.2	12.0	13.5	
1326	13.43			1.7	0.4	15.4	16.6	
1327	13.45							ZERO AND
1328								
1329								
1330								
1331								
1332								
1333								
1334								
1335								
1336								
1337	13.62							SPAN CHECK
1338	13.63			1.4	1.0	13.0	13.7	
1339	13.65			1.7	0.9	12.3	13.6	
1340	13.67			1.7	0.8	15.2	15.5	
1341	13.68			1.6	0.6	11.1	12.4	
1342	13.70			1.6	0.6	10.3	11.9	
1343	13.72			1.6	0.6	9.4	11.1	
1344	13.73			1.7	0.6	10.8	12.6	
1345	13.75			1.7	0.6	10.7	12.2	
1346	13.77			1.6	0.6	10.2	12.0	
1347	13.78	2.19	17.31	1.6	0.7	10.0	11.8	
1348	13.80			1.6	0.7	9.8	11.6	
1349	13.82			1.7	0.7	9.6	11.5	
1350	13.83			4.6	3.4	19.6	21.5	
1351	13.85			7.4	7.5	18.9	18.1	
1352	13.87			4.6	4.0	11.4	12.9	
1353	13.88			3.0	2.2	9.5	11.2	
1354	13.90			2.1	1.3	9.6	11.5	
1355	13.92			1.8	1.1	10.3	12.1	
1356	13.93			1.7	1.1	12.0	13.7	
1357	13.95			1.7	1.0	9.9	11.6	
1358	13.97			1.7	1.0	9.9	11.7	
1359	13.98			1.7	1.0	9.2	11.1	
1400	14.00			1.6	1.0	9.7	11.5	
1401	14.02			1.5	1.0	9.5	11.3	
1402	14.03			1.5	0.9	9.4	11.0	
1403	14.05			1.5	0.9	9.5	11.0	
1404	14.07			1.4	0.8	9.6	11.2	

		ORGANIC MASS		THC CONCENTRATION (dry)				
				BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1405	14.08			1.4	0.7	9.7	11.3	
1406	14.10	2.08	11.68	1.4	0.6	9.2	10.8	
1407	14.12			1.4	0.5	9.4	11.1	
1408	14.13			1.5	0.5	11.4	12.9	
1409	14.15			1.5	0.4	9.8	11.3	
1410	14.17			1.4	0.4	12.2	13.7	
1411	14.18			1.4	0.3	10.8	12.3	
1412	14.20			1.4	0.4	11.3	12.9	
1413	14.22			1.4	0.4	11.0	12.6	
1414	14.23			1.4	0.4	9.3	11.1	
1415	14.25			1.4	0.4	9.3	11.2	
1416	14.27			1.5	0.5	14.0	15.8	
1417	14.28			1.5	0.6	10.9	12.0	
1418	14.30			1.5	0.6	11.3	13.3	
1419	14.32			1.5	0.6	14.1	15.5	
1420	14.33			1.7	0.8	16.0	17.1	
1421	14.35			1.6	0.8	14.4	15.2	
1422	14.37			1.5	0.7	10.1	11.8	
1423	14.38			1.6	0.8	10.0	11.8	
1424	14.40	1.97	11.93	1.5	0.8	10.3	12.0	
1425	14.42			1.5	0.8	10.9	12.5	
1426	14.43			1.5	0.8	10.4	12.2	
1427	14.45			1.5	0.8	10.4	11.9	
1428	14.47			1.5	0.7	9.9	11.5	
1429	14.48			1.7	1.0	26.6	27.8	
1430	14.50			1.5	0.6	18.3	17.3	
1431	14.52			1.4	0.6	13.6	14.4	
1432	14.53			1.4	0.5	11.3	12.8	
1433	14.55			1.4	0.4	16.5	17.2	
1434	14.57			1.4	0.4	10.6	12.1	
1435	14.58			1.4	0.4	9.7	11.3	
1436	14.60			1.4	0.3	10.2	11.9	
1437	14.62			1.4	0.4	10.9	12.6	
1438	14.63			1.4	0.4	9.5	11.5	
1439	14.65			1.4	0.5	9.7	11.6	
1440	14.67			2.4	1.4	9.5	11.4	SAMPLING ENDED



RUN 2, BYPASS DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS

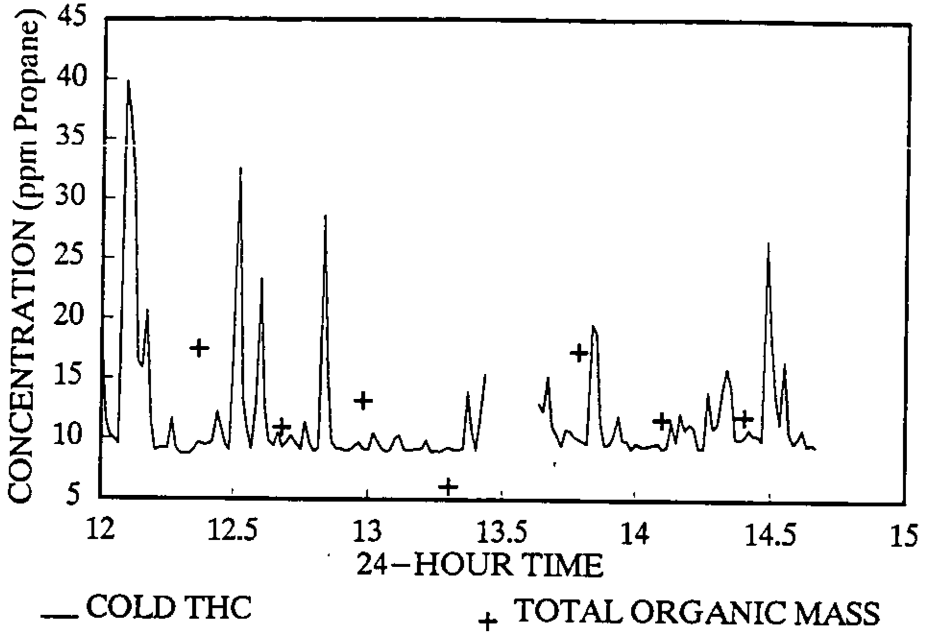


RUN 2, BYPASS DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS

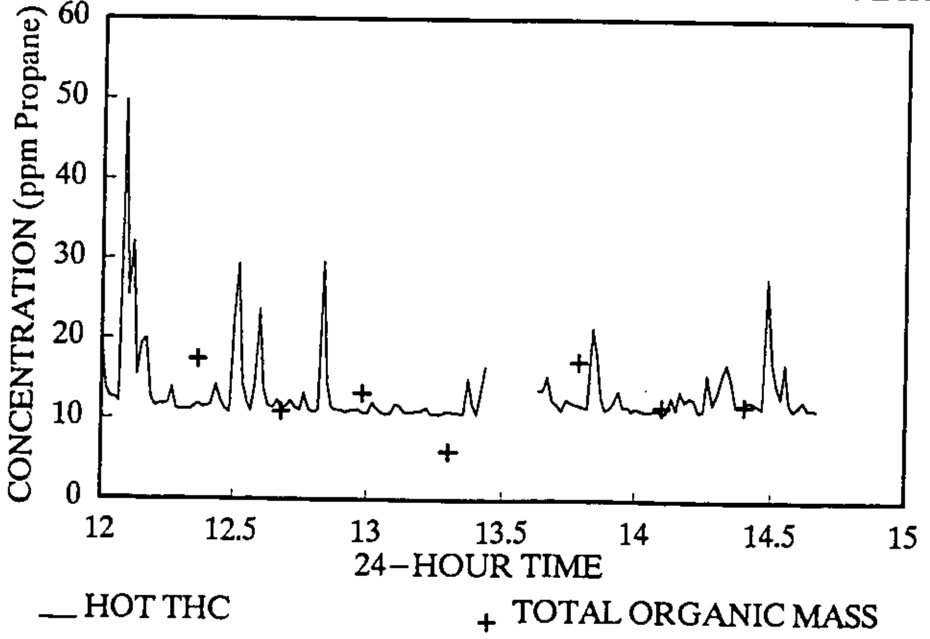
RUN 2, MAIN DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



RUN 2, MAIN DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



RUN 3

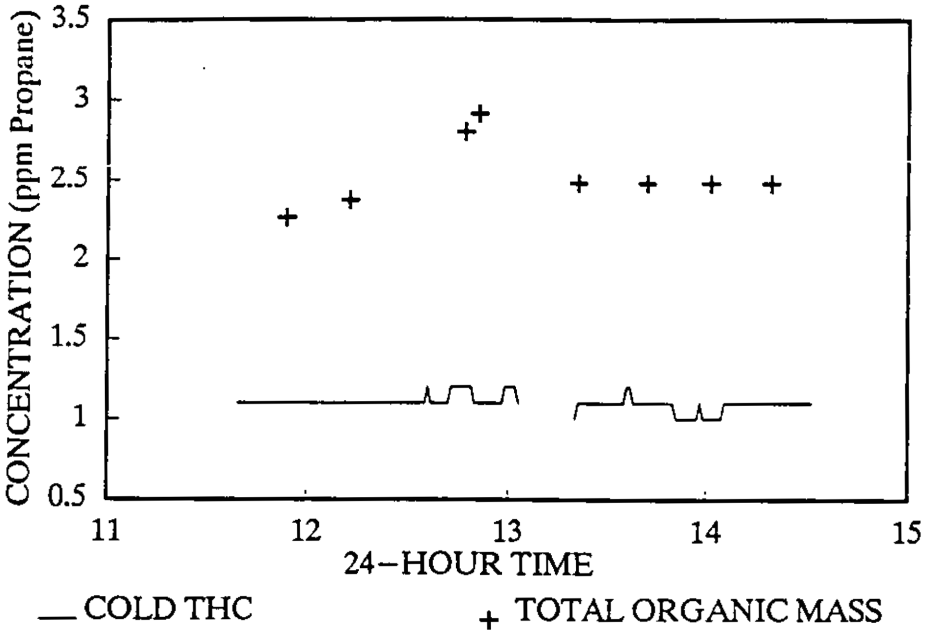
				THC CONCENTRATION (dry)				
		ORGANIC MASS		BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1139	11.65			1.1	1.6	7.6	9.2	SAMPLING BEGUN
1140	11.67			1.1	1.6	7.6	8.5	
1141	11.68			1.1	1.6	7.1	8.4	
1142	11.70			1.1	1.5	7.7	9.4	
1143	11.72			1.1	1.5	8.5	9.1	
1144	11.73			1.1	1.5	7.4	8.5	
1145	11.75			1.1	1.5	7.1	8.2	
1146	11.77			1.1	1.5	7.2	8.2	
1147	11.78			1.1	1.4	7.2	8.7	
1148	11.80			1.1	1.4	8.4	8.6	
1149	11.82			1.1	1.4	7.1	7.9	
1150	11.83			1.1	1.3	7	8	
1151	11.85			1.1	1.3	6.9	7.9	
1152	11.87			1.1	1.4	7	8	
1153	11.88			1.1	1.4	7	7.9	
1154	11.90	2.26	10.45	1.1	1.4	6.7	7.7	
1155	11.92			1.1	1.5	6.8	7.8	
1156	11.93			1.1	1.4	6.8	7.8	
1157	11.95			1.1	1.4	6.8	7.8	
1158	11.97			1.1	1.4	6.8	7.8	
1159	11.98			1.1	1.4	6.8	7.8	
1200	12.00			1.1	1.4	6.9	7.9	
1201	12.02			1.1	1.4	7.1	8.1	
1202	12.03			1.1	1.4	7.2	8.1	
1203	12.05			1.1	1.3	7.1	8.1	
1204	12.07			1.1	1.3	7.1	8	
1205	12.08			1.1	1.3	7.1	7.8	
1206	12.10			1.1	1.3	7	7.8	
1207	12.12			1.1	1.2	6.9	7.7	
1208	12.13			1.1	1.2	7.2	8	
1209	12.15			1.1	1.2	7.3	7.9	
1210	12.17			1.1	1.2	7	7.8	
1211	12.18			1.1	1.2	7	7.7	
1212	12.20			1.1	1.3	7	7.8	
1213	12.22	2.37	11.06	1.1	1.3	7	7.9	
1214	12.23			1.1	1.3	7	7.9	
1215	12.25			1.1	1.3	7	7.9	
1216	12.27			1.1	1.3	7	7.9	
1217	12.28			1.1	1.3	6.9	7.9	
1218	12.30			1.1	1.4	6.9	7.7	
1219	12.32			1.1	1.4	6.8	7.7	
1220	12.33			1.1	1.3	6.8	7.7	
1221	12.35			1.1	1.2	6.8	7.7	
1222	12.37			1.1	1.2	6.9	7.8	
1223	12.38			1.1	1.2	6.9	7.8	
1224	12.40			1.1	1.1	6.9	7.8	
1225	12.42			1.1	1.1	6.9	7.7	
1226	12.43			1.1	1.2	6.8	7.7	
1227	12.45			1.1	1.1	7	7.8	
1228	12.47			1.1	1.1	9.1	11.2	
1229	12.48			1.1	1.1	9.8	8.3	
1230	12.50			1.1	1.1	7.2	7.7	
1231	12.52			1.1	1.2	7	7.7	
1232	12.53			1.1	1.2	7	7.7	
1233	12.55			1.1	1.2	7	7.7	
1234	12.57			1.1	1.2	7	7.6	
1235	12.58			1.1	1.2	.9	7.7	
1236	12.60			1.2	1.2	.1	7.8	
1237	12.62			1.1	1.2	7.2	7.9	
1238	12.63			1.1	1.2	.4	7.9	
1239	12.65			1.1	1.1	7.3	7.9	
1240	12.67			1.1	1.1	7.3	7.8	
1241	12.68			1.1	1.1	7.2	7.7	
1242	12.70			1.1	1.1	7.2	7.8	

		ORGANIC MASS		THC CONCENTRATION (dry)				
				BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1243	12.72			1.2	1.1	7.2	7.8	
1244	12.73			1.2	1.1	7.1	7.8	
1245	12.75			1.2	1.1	7.1	7.7	
1246	12.77			1.2	1.1	7.2	7.8	
1247	12.78	2.8	9.24	1.2	1.1	7.1	7.7	
1248	12.80			1.2	1.1	7	7.7	
1249	12.82			1.2	1.1	7	7.6	
1250	12.83			1.1	1.1	7	7.6	
1251	12.85	2.91	8.88	1.1	1.1	7	7.6	
1252	12.87			1.1	1.1	7.1	7.6	
1253	12.88			1.1	1.1	7	7.6	
1254	12.90			1.1	1.1	7	7.6	
1255	12.92			1.1	1.1	7	7.6	
1256	12.93			1.1	1.1	7.4	8	
1257	12.95			1.1	1.1	7	7.5	
1258	12.97			1.1	1.1	6.6	7.4	
1259	12.98			1.2	1.2	6.6	7.6	
1300	13.00			1.2	1.1	6.5	7.4	
1301	13.02			1.2	1.1	6.5	7.5	
1302	13.03			1.2	1.1	6.5	7.4	
1303	13.05			1.1	1.1	6.6	7.5	
1304	13.07							ZERO AND SPAN CHECK
1305								
1306								
1307								
1308								
1309								
1310								
1311								
1312								
1313								
1314								
1315								
1316								
1317								
1318								
1319	13.32							
1320	13.33			1	1.6	7.3	8.5	
1321	13.35	2.48	10.09	1.1	0.9	6.4	8.6	
1322	13.37			1.1	0.8	6.4	8.6	
1323	13.38			1.1	0.8	6.4	8.6	
1324	13.40			1.1	0.7	6.4	8.6	
1325	13.42			1.1	0.7	6.3	8.6	
1326	13.43			1.1	0.7	6.3	8.3	
1327	13.45			1.1	0.7	6.3	8.2	
1328	13.47			1.1	0.6	6.3	8	
1329	13.48			1.1	0.6	6.3	8	
1330	13.50			1.1	0.6	6.3	8.1	
1331	13.52			1.1	0.5	6.2	8.1	
1332	13.53			1.1	0.5	6.2	8.2	
1333	13.55			1.1	0.5	6.2	8.2	
1334	13.57			1.1	0.5	6.2	8	
1335	13.58			1.1	0.5	6.1	8	
1336	13.60			1.2	0.6	6.3	8.1	
1337	13.62			1.2	0.7	6.2	8.1	
1338	13.63			1.1	0.6	6.3	8.1	
1339	13.65			1.1	0.5	6.3	8.1	
1340	13.67			1.1	0.5	6.2	8.1	
1341	13.68			1.1	0.6	6.2	8.1	
1342	13.70	2.48	10.09	1.1	0.5	6.2	8.1	
1343	13.72			1.1	0.6	6.1	8.1	
1344	13.73			1.1	0.6	6.1	8.1	
1345	13.75			1.1	0.6	6.3	8.2	
1346	13.77			1.1	0.7	6.1	8.1	

				THC CONCENTRATION (dry)				
		ORGANIC MASS		BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1347	13.78			1.1	0.7	6.1	8.2	
1348	13.80			1.1	0.7	6.1	8.3	
1349	13.82			1.1	0.7	6.2	8.3	
1350	13.83			1.1	0.7	6.2	8.6	
1351	13.85			1	0.7	6.2	8.8	
1352	13.87			1	0.6	6.1	9	
1353	13.88			1	0.6	6.1	8.9	
1354	13.90			1	0.6	6.2	8.7	
1355	13.92			1	0.6	6.2	8.6	
1356	13.93			1	0.6	6.2	8	
1357	13.95			1	0.6	6.2	7.3	
1358	13.97			1.1	0.6	6.2	6.9	
1359	13.98			1	0.7	6.1	6.8	
1400	14.00			1	0.6	6.1	6.6	
1401	14.02	2.48	10.09	1	0.6	6.1	6.5	
1402	14.03			1	0.7	6.1	6.3	
1403	14.05			1	0.7	6.2	6.5	
1404	14.07			1	0.7	6.1	6.8	
1405	14.08			1.1	0.7	6.1	7.1	
1406	14.10			1.1	0.8	8.7	9.3	
1407	14.12			1.1	0.7	6.6	7.6	
1408	14.13			1.1	0.8	6.2	7.5	
1409	14.15			1.1	0.7	6.2	7.6	
1410	14.17			1.1	0.7	6.3	7.7	
1411	14.18			1.1	0.7	6.3	7.7	
1412	14.20			1.1	0.8	6.2	7.8	
1413	14.22			1.1	0.7	6.1	7.8	
1414	14.23			1.1	0.7	7.1	9.2	
1415	14.25			1.1	0.7	7.5	8.8	
1416	14.27			1.1	0.7	6.4	7.9	
1417	14.28			1.1	0.8	6.3	8.2	
1418	14.30			1.1	0.8	6.3	8.1	
1419	14.32	2.48	7.55	1.1	0.7	6.3	8.1	
1420	14.33			1.1	0.8	6.3	8.1	
1421	14.35			1.1	0.8	6.2	8	
1422	14.37			1.1	0.8	6.1	7.8	
1423	14.38			1.1	0.8	6.6	8.3	
1424	14.40			1.1	0.8	6.9	8.6	
1425	14.42			1.1	0.9	6.4	8	
1426	14.43			1.1	0.9	6.3	8	
1427	14.45			1.1	0.8	6.4	8	
1428	14.47			1.1	0.8	6.4	8	
1429	14.48			1.1	0.8	6.3	8	
1430	14.50			1.1	0.8	6.3	8.3	
1431	14.52			1.1	0.8	6.3	8.9	SAMPLING ENDED

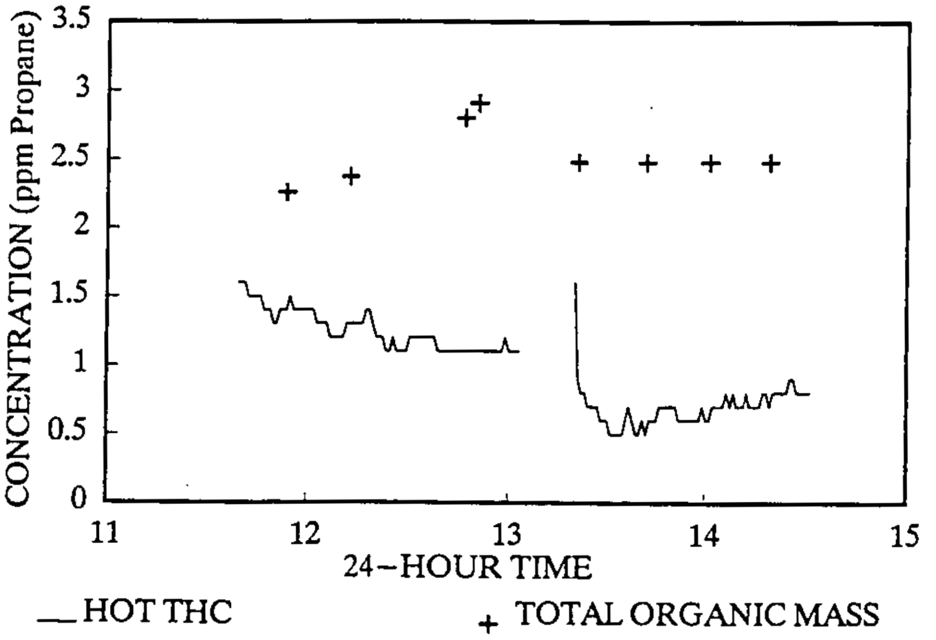
RUN 3, BYPASS DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



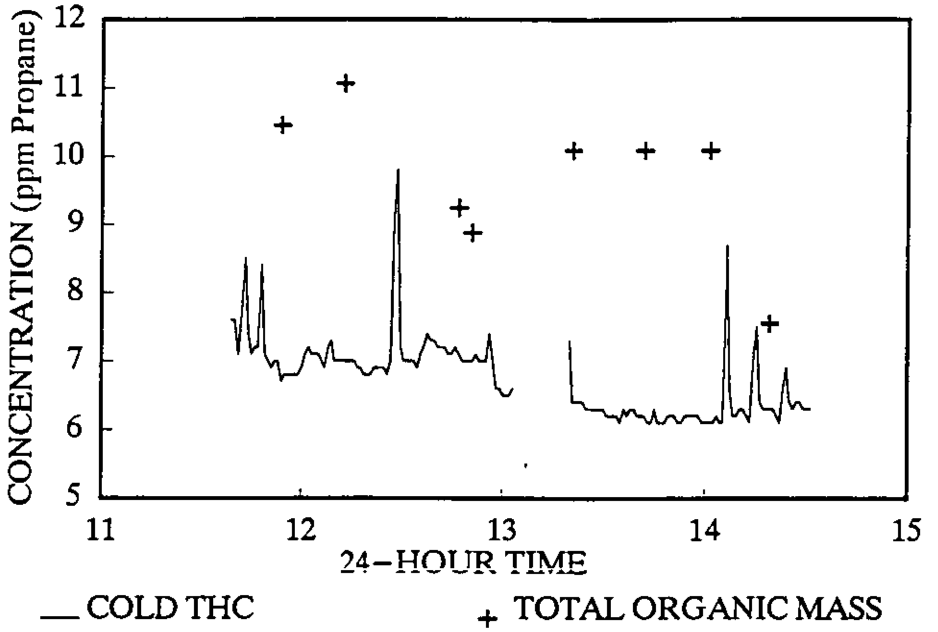
RUN 3, BYPASS DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



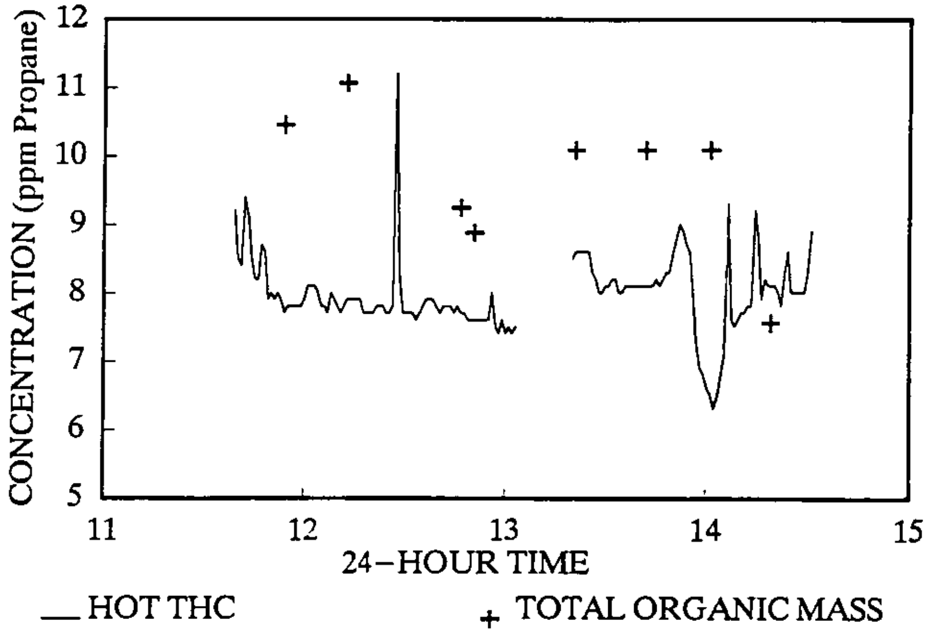
RUN 3, MAIN DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



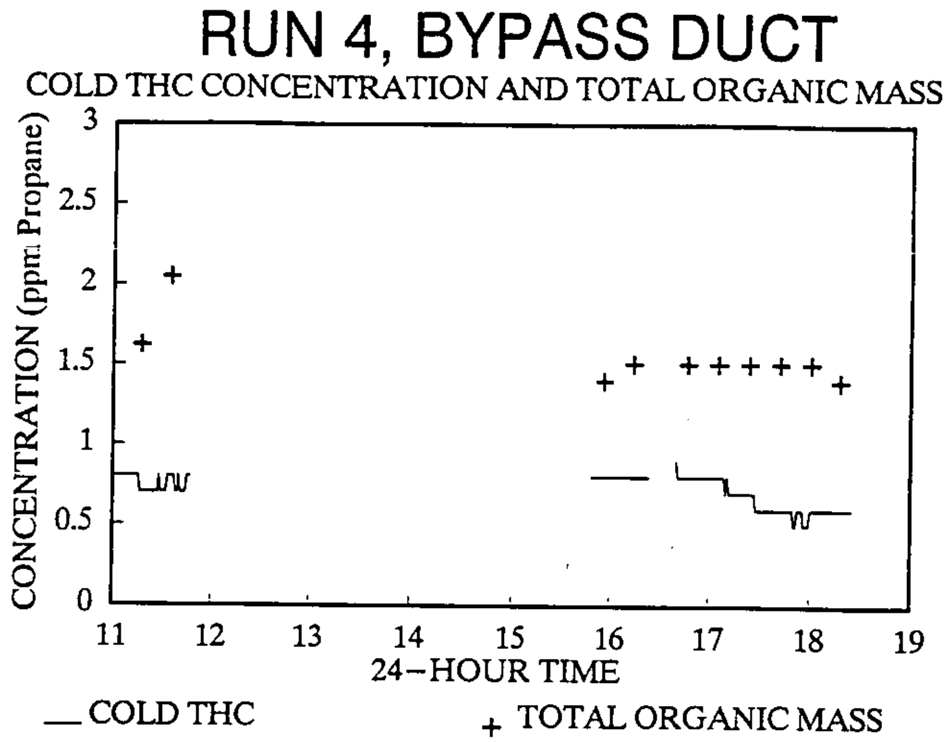
RUN 3, MAIN DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



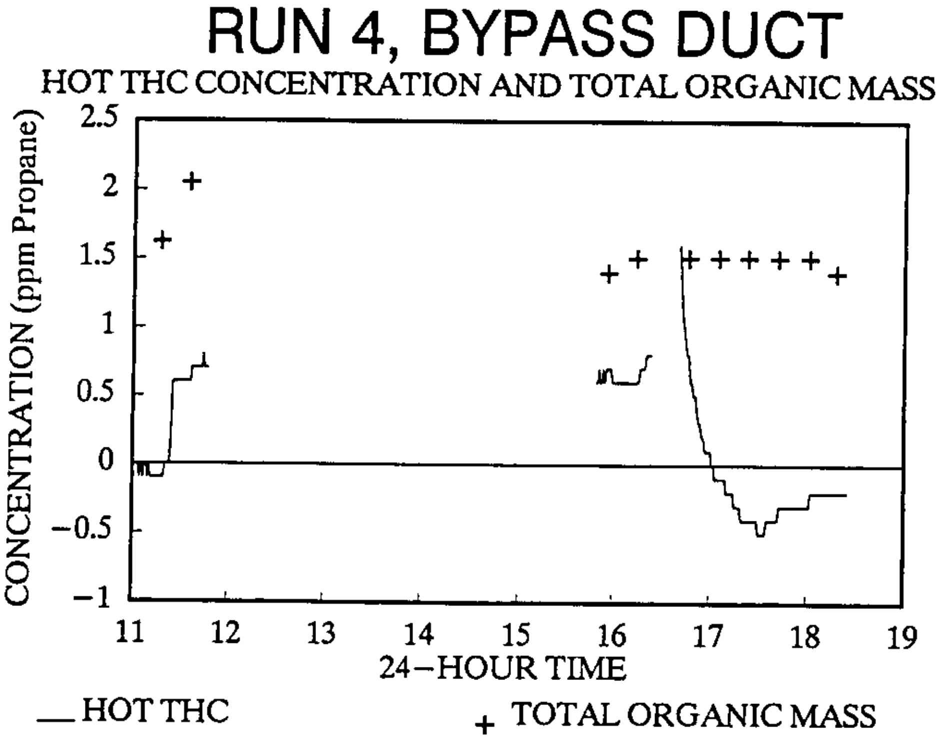
		ORGANIC MASS		THC CONCENTRATION (dry)				
				BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	(ppm)	COMMENTS
1706	17.10			0.8	-0.1	6.8	8.7	
1707	17.12			0.8	-0.1	6.5	8.3	
1708	17.13			0.8	-0.1	6.5	8.4	
1709	17.15			0.7	-0.1	6.6	8.6	
1710	17.17			0.8	-0.2	6.5	8.4	
1711	17.18			0.7	-0.2	6.5	8.5	
1712	17.20			0.7	-0.2	6.4	8.3	
1713	17.22			0.7	-0.2	6.6	8.6	
1714	17.23			0.7	-0.2	6.5	8.5	
1715	17.25			0.7	-0.3	6.3	8.2	
1716	17.27			0.7	-0.3	6.4	8.6	
1717	17.28			0.7	-0.3	6.2	8.3	
1718	17.30			0.7	-0.3	6.2	8.3	
1719	17.32			0.7	-0.4	6.3	8.4	
1720	17.33			0.7	-0.4	6.2	8.2	
1721	17.35			0.7	-0.4	6.1	8.1	
1722	17.37			0.7	-0.4	6.1	8.2	
1723	17.38	1.5	8.1	0.7	-0.4	5.9	8.0	
1724	17.40			0.7	-0.4	6.0	8.1	
1725	17.42			0.7	-0.4	6.1	8.3	
1726	17.43			0.7	-0.4	6.0	8.1	
1727	17.45			0.6	-0.4	6.1	8.3	
1728	17.47			0.6	-0.4	5.9	8.0	
1729	17.48			0.6	-0.4	6.2	8.4	
1730	17.50			0.6	-0.5	5.9	8.0	
1731	17.52			0.6	-0.5	6.0	8.2	
1732	17.53			0.6	-0.5	5.9	8.1	
1733	17.55			0.6	-0.5	6.0	8.3	
1734	17.57			0.6	-0.5	5.8	8.1	
1735	17.58			0.6	-0.4	5.7	8.0	
1736	17.60			0.6	-0.4	5.8	8.2	
1737	17.62			0.6	-0.4	5.7	7.6	
1738	17.63			0.6	-0.4	5.9	8.0	
1739	17.65			0.6	-0.4	5.7	7.7	
1740	17.67			0.6	-0.4	6.0	8.0	
1741	17.68			0.6	-0.4	5.8	7.8	
1742	17.70	1.5	8.7	0.6	-0.4	5.8	7.8	
1743	17.72			0.6	-0.3	6.3	8.3	
1744	17.73			0.6	-0.3	6.2	8.1	
1745	17.75			0.6	-0.3	6.1	7.9	
1746	17.77			0.6	-0.3	6.2	8.1	
1747	17.78			0.6	-0.3	6.5	8.4	
1748	17.80			0.6	-0.3	6.4	8.2	
1749	17.82			0.6	-0.3	6.3	8.0	
1750	17.83			0.5	-0.3	6.5	8.3	
1751	17.85			0.5	-0.3	6.5	8.2	
1752	17.87			0.6	-0.3	6.2	7.8	
1753	17.88			0.6	-0.3	6.3	8.0	
1754	17.90			0.6	-0.3	6.3	8.0	
1755	17.92			0.6	-0.3	6.2	7.7	
1756	17.93			0.5	-0.3	6.2	7.9	
1757	17.95			0.5	-0.3	6.0	7.6	
1758	17.97			0.5	-0.3	6.1	7.8	
1759	17.98			0.5	-0.3	6.1	7.8	
1800	18.00			0.6	-0.3	6.1	7.9	
1801	18.02	1.5	7.1	0.6	-0.3	5.8	7.5	
1802	18.03			0.6	-0.2	5.9	7.7	
1803	18.05			0.6	-0.2	6.0	7.7	
1804	18.07			0.6	-0.2	5.8	7.4	
1805	18.08			0.6	-0.2	6.0	7.7	
1806	18.10			0.6	-0.2	6.0	7.8	
1807	18.12			0.6	-0.2	5.9	7.6	
1808	18.13			0.6	-0.2	6.2	8.0	
1809	18.15			0.6	-0.2	6.1	7.8	

				THC CONCENTRATION (dry)				
		ORGANIC MASS		BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	(ppm)	COMMENTS
1810	18.17			0.6	-0.2	5.9	7.5	
1811	18.18			0.6	-0.2	6.0	7.7	
1812	18.20			0.6	-0.2	6.2	8.0	
1813	18.22			0.6	-0.2	6.0	7.7	
1814	18.23			0.6	-0.2	6.0	7.6	
1815	18.25			0.6	-0.2	6.2	7.9	
1816	18.27			0.6	-0.2	6.2	7.8	
1817	18.28			0.6	-0.2	5.9	7.5	
1818	18.30	1.4	8.7	0.6	-0.2	6.0	7.7	
1819	18.32			0.6	-0.2	6.0	7.6	
1820	18.33			0.6	-0.2	5.8	7.4	
1821	18.35			0.6	-0.2	5.9	7.4	
1822	18.37			0.6	-0.2	5.9	7.5	
1823	18.38			0.6	-0.2	6.0	7.6	
1824	18.40			0.6	-0.2	5.8	7.4	
1825	18.42			0.6	-0.2	6.0	7.6	SAMPLING ENDED



RUN 4, BYPASS DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS

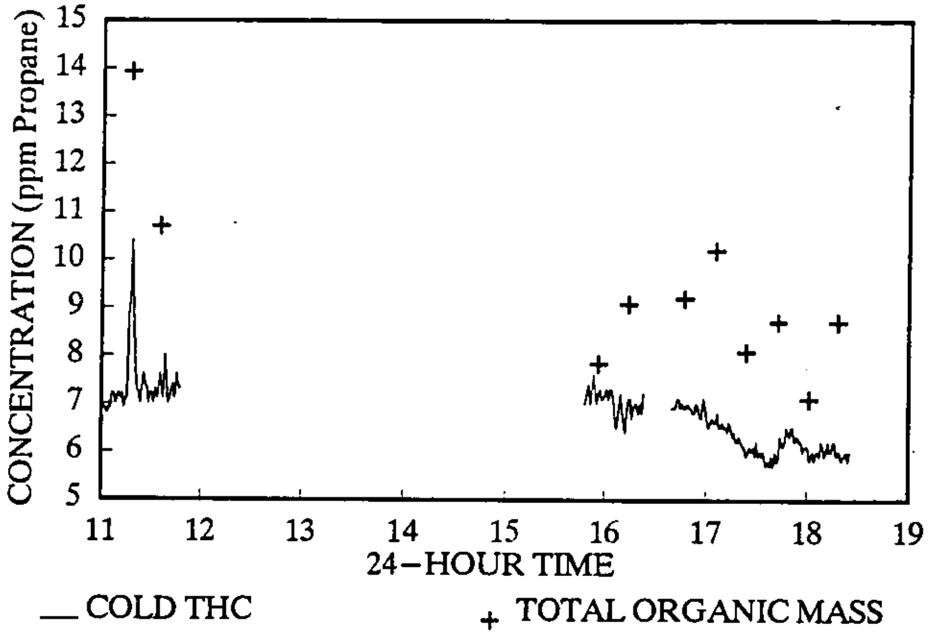


RUN 4, BYPASS DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS

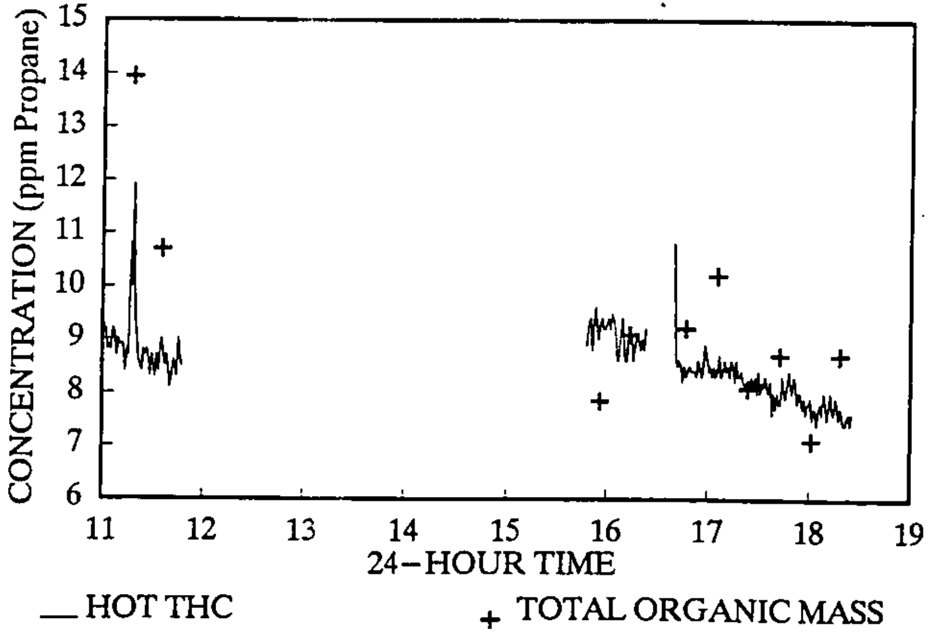
RUN 4, MAIN DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



RUN 4, MAIN DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



RUN 5

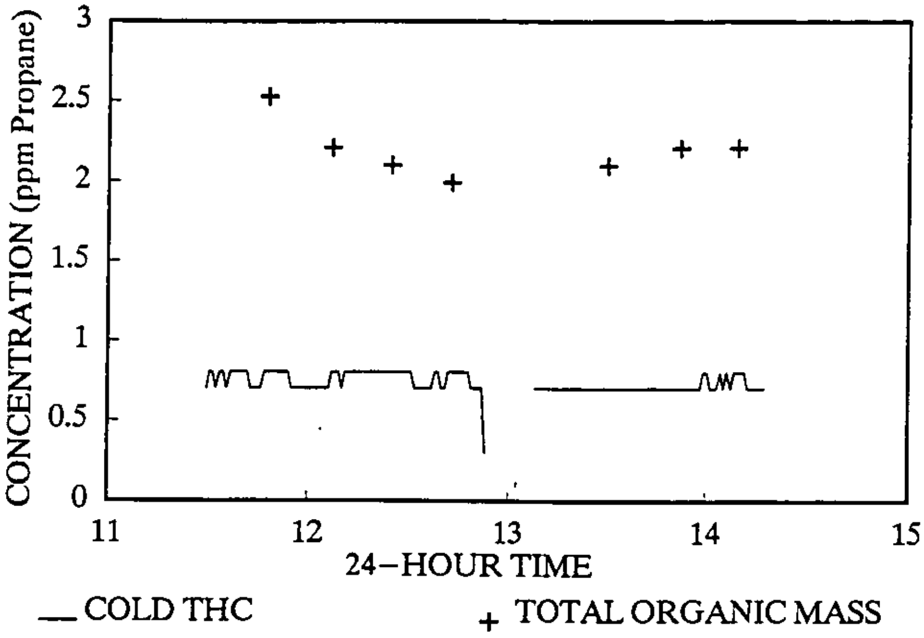
				THC CONCENTRATION (dry)				
		ORGANIC MASS		BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1130	11.50			0.7	0.5	6.2	7.6	TEST BEGUN
1131	11.52			0.8	0.5	6.1	7.7	
1132	11.53			0.8	0.5	6.4	8.0	
1133	11.55			0.7	0.5	6.2	7.6	
1134	11.57			0.8	0.5	6.2	7.6	
1135	11.58			0.8	0.5	6.3	7.9	
1136	11.60			0.7	0.5	6.5	8.0	
1137	11.62			0.8	0.5	6.4	7.8	
1138	11.63			0.8	0.5	6.0	7.5	
1139	11.65			0.8	0.5	6.2	8.1	
1140	11.67			0.8	0.5	6.3	8.1	
1141	11.68			0.8	0.6	6.1	7.6	
1142	11.70			0.8	0.7	6.2	7.4	
1143	11.72			0.7	0.5	6.7	7.7	
1144	11.73			0.7	0.5	6.8	7.7	
1145	11.75			0.7	0.5	6.4	7.4	
1146	11.77			0.7	0.5	6.4	7.6	
1147	11.78			0.8	0.6	6.6	7.9	
1148	11.80	2.5	8.9	0.8	0.6	6.3	7.6	
1149	11.82			0.8	0.6	6.2	7.7	
1150	11.83			0.8	0.6	6.5	8.0	
1151	11.85			0.8	0.6	6.4	7.8	
1152	11.87			0.8	0.6	6.5	7.9	
1153	11.88			0.8	0.6	6.6	8.1	
1154	11.90			0.8	0.6	6.4	7.9	
1155	11.92			0.7	0.6	6.6	8.1	
1156	11.93			0.7	0.6	6.5	7.8	
1157	11.95			0.7	0.6	6.6	8.1	
1158	11.97			0.7	0.6	6.6	7.9	
1159	11.98			0.7	0.6	6.6	8.1	
1200	12.00			0.7	0.6	6.7	7.9	
1201	12.02			0.7	0.6	6.6	7.5	
1202	12.03			0.7	0.6	6.5	7.6	
1203	12.05			0.7	0.6	6.5	7.7	
1204	12.07			0.7	0.6	6.6	8.0	
1205	12.08			0.7	0.6	6.5	7.7	
1206	12.10			0.7	0.6	6.4	7.8	
1207	12.12	2.2	9.4	0.8	0.6	6.6	8.0	
1208	12.13			0.8	0.6	6.4	7.6	
1209	12.15			0.8	0.6	6.2	7.4	
1210	12.17			0.7	0.5	6.4	7.7	
1211	12.18			0.8	0.6	6.5	7.8	
1212	12.20			0.8	0.6	6.3	7.5	
1213	12.22			0.8	0.6	6.3	7.6	
1214	12.23			0.8	0.6	6.6	8.1	
1215	12.25			0.8	0.5	6.7	8.1	
1216	12.27			0.8	0.5	6.4	7.8	
1217	12.28			0.8	0.6	6.1	7.5	
1218	12.30			0.8	0.6	6.2	7.6	
1219	12.32			0.8	0.5	6.3	7.5	
1220	12.33			0.8	0.5	6.2	7.3	
1221	12.35			0.8	0.5	6.3	7.5	
1222	12.37			0.8	0.5	6.4	7.6	
1223	12.38			0.8	0.6	6.2	7.5	
1224	12.40			0.8	0.5	6.5	7.9	
1225	12.42	2.1	9.4	0.8	0.6	6.5	7.8	
1226	12.43			0.8	0.5	6.5	7.7	
1227	12.45			0.8	0.5	6.5	7.7	
1228	12.47			0.8	0.6	6.5	7.7	
1229	12.48			0.8	0.5	6.7	8.0	
1230	12.50			0.8	0.6	6.6	7.7	
1231	12.52			0.8	0.6	6.6	7.9	
1232	12.53			0.7	0.6	6.6	7.7	
1233	12.55			0.7	0.6	6.7	7.9	

TIME	DECIMAL TIME	ORGANIC MASS		THC CONCENTRATION (dry)				COMMENTS
				BYPASS		MAIN		
		BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	
1234	12.57			0.7	0.6	6.7	7.7	
1235	12.58			0.7	0.5	6.6	7.7	
1236	12.60			0.7	0.6	6.6	7.7	
1237	12.62			0.7	0.5	6.5	7.5	
1238	12.63			0.8	0.5	6.5	7.7	
1239	12.65			0.8	0.5	6.5	7.5	
1240	12.67			0.7	0.5	6.3	7.3	
1241	12.68			0.7	0.7	6.3	7.4	
1242	12.70			0.8	0.5	6.2	7.4	
1243	12.72	2.0	8.0	0.8	0.5	6.5	7.8	
1244	12.73			0.8	0.5	6.4	7.6	
1245	12.75			0.8	0.6	6.2	7.3	
1246	12.77			0.8	0.6	6.2	7.4	
1247	12.78			0.8	0.6	6.4	7.6	
1248	12.80			0.8	0.5	6.2	7.3	
1249	12.82			0.7	0.6	6.3	7.4	
1250	12.83			0.7	0.6	6.7	7.8	
1251	12.85			0.7	0.6	6.3	7.4	
1252	12.87			0.7	0.6	6.2	7.4	
1253	12.88			0.3	0.6			
1254	12.90							ZERO AND SPAN CHECK
1255								
1256								
1257								
1258								
1259								
1300								
1301								
1302								
1303								
1304								
1305								
1306								
1307		2.1	9.9					
1308	13.13			0.7	0.7	6.2	7.7	
1309	13.15			0.7	0.7	6.4	8.1	
1310	13.17			0.7	0.7	6.4	8.0	
1311	13.18			0.7	0.7	6.4	8.2	
1312	13.20			0.7	0.7	6.4	8.0	
1313	13.22			0.7	0.7	6.5	8.2	
1314	13.23			0.7	0.7	6.4	8.0	
1315	13.25			0.7	0.7	6.3	7.8	
1316	13.27			0.7	0.6	6.4	7.9	
1317	13.28			0.7	0.6	6.4	8.0	
1318	13.30			0.7	0.6	6.5	8.0	
1319	13.32			0.7	0.6	6.4	7.8	
1320	13.33			0.7	0.6	6.5	8.0	
1321	13.35			0.7	0.6	6.3	7.7	
1322	13.37			0.7	0.6	6.5	8.1	
1323	13.38			0.7	0.6	6.3	7.8	
1324	13.40			0.7	0.6	6.1	7.6	
1325	13.42			0.7	0.6	6.3	7.9	
1326	13.43			0.7	0.6	6.1	7.7	
1327	13.45			0.7	0.6	6.4	8.1	
1328	13.47			0.7	0.6	6.1	7.7	
1329	13.48			0.7	0.6	6.0	7.7	
1330	13.50	2.1	8.7	0.7	0.6	6.3	8.1	
1331	13.52			0.7	0.6	6.3	7.9	
1332	13.53			0.7	0.6	6.1	7.7	
1333	13.55			0.7	0.6	6.3	8.1	
1334	13.57			0.7	0.6	6.5	8.2	
1335	13.58			0.7	0.6	6.1	7.6	
1336	13.60			0.7	0.7	6.2	7.9	
1337	13.62			0.7	0.6	6.5	8.1	

		ORGANIC MASS		THC CONCENTRATION (dry)				
				BYPASS		MAIN		
TIME	DECIMAL TIME	BYPASS (dry)	MAIN (dry)	COLD (ppm)	HOT (ppm)	COLD (ppm)	HOT (ppm)	COMMENTS
1338	13.63			0.7	0.6	6.4	7.8	
1339	13.65			0.7	0.6	6.1	7.5	
1340	13.67			0.7	0.7	6.4	8.0	
1341	13.68			0.7	0.6	6.6	8.1	
1342	13.70			0.7	0.6	6.1	7.5	
1343	13.72			0.7	0.6	6.3	7.9	
1344	13.73			0.7	0.7	6.5	8.0	
1345	13.75			0.7	0.6	6.9	8.2	
1346	13.77			0.7	0.6	6.6	8.1	
1347	13.78			0.7	0.6	6.4	7.8	
1348	13.80			0.7	0.6	6.4	7.9	
1349	13.82			0.7	0.6	6.4	8.0	
1350	13.83			0.7	0.6	6.2	7.8	
1351	13.85			0.7	0.6	6.4	8.1	
1352	13.87	2.2	9.2	0.7	0.6	6.3	7.9	
1353	13.88			0.7	0.6	6.6	8.3	
1354	13.90			0.7	0.7	6.5	8.0	
1355	13.92			0.7	0.7	6.3	7.8	
1356	13.93			0.7	0.7	6.6	8.1	
1357	13.95			0.7	0.7	6.5	7.9	
1358	13.97			0.7	0.7	6.4	7.8	
1359	13.98			0.8	0.7	6.4	7.8	
1400	14.00			0.8	0.6	6.3	7.8	
1401	14.02			0.7	0.6	6.8	8.3	
1402	14.03			0.7	0.7	6.8	8.4	
1403	14.05			0.7	0.6	6.4	7.9	
1404	14.07			0.8	0.7	6.2	7.7	
1405	14.08			0.7	0.7	6.6	8.2	
1406	14.10			0.8	0.6	6.4	7.9	
1407	14.12			0.7	0.6	6.3	7.7	
1408	14.13			0.8	0.6	6.5	8.1	
1409	14.15	2.2	9.5	0.8	0.7	6.4	7.9	
1410	14.17			0.8	0.6	6.2	7.7	
1411	14.18			0.8	0.6	6.5	8.2	
1412	14.20			0.7	0.7	6.6	8.1	
1413	14.22			0.7	0.6	6.2	7.6	
1414	14.23			0.7	0.7	6.5	8.0	
1415	14.25			0.7	0.7	6.4	7.4	
1416	14.27			0.7	0.7	6.5	7.6	
1417	14.28			0.7	0.7	6.8	8.0	SAMPLING ENDED

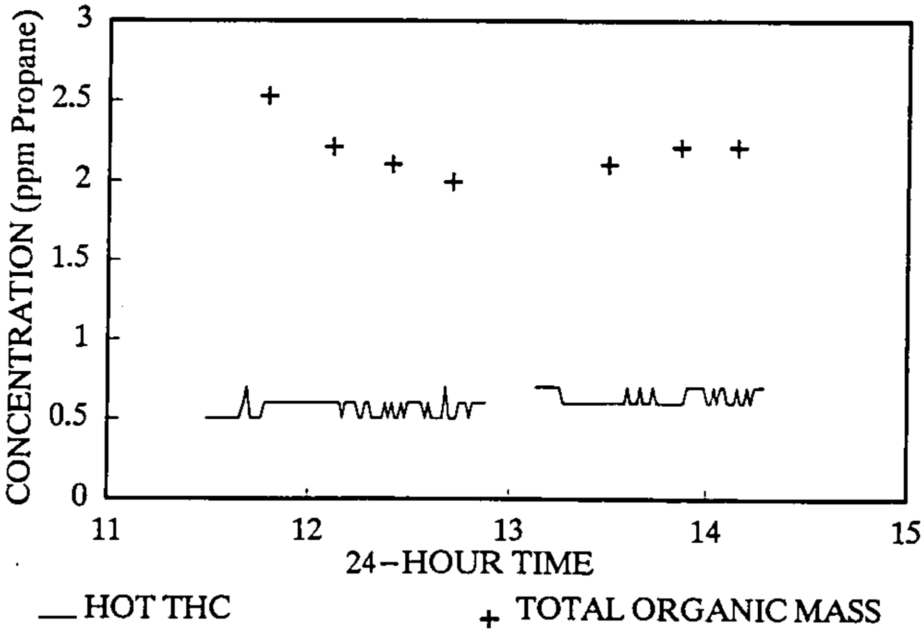
RUN 5, BYPASS DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



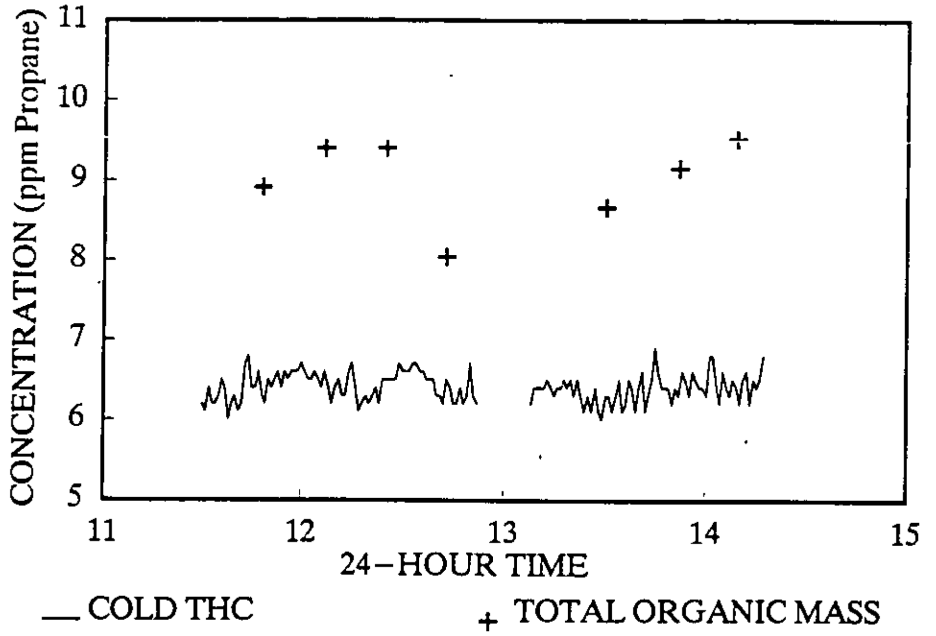
RUN 5, BYPASS DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



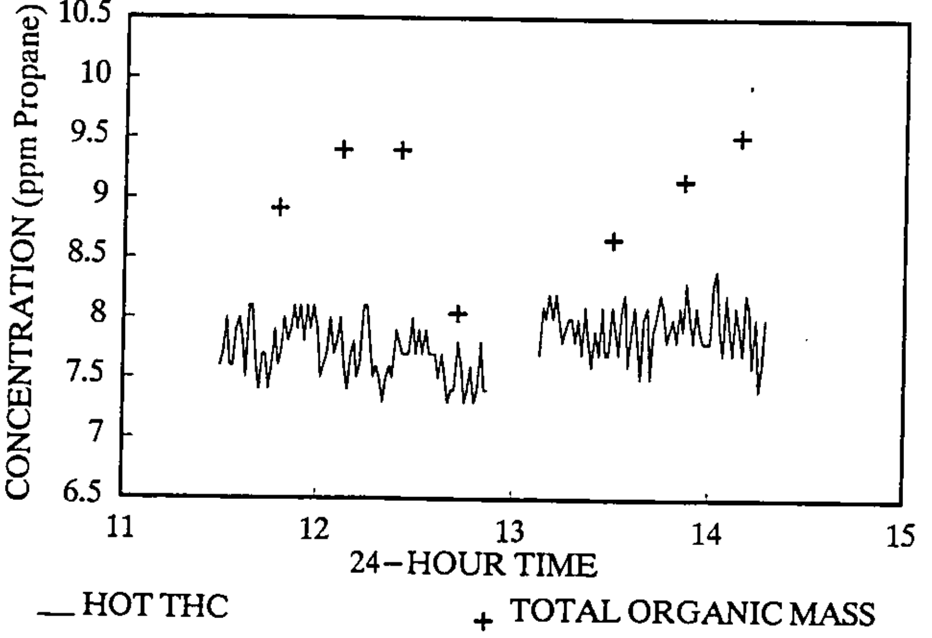
RUN 5, MAIN DUCT

COLD THC CONCENTRATION AND TOTAL ORGANIC MASS



RUN 5, MAIN DUCT

HOT THC CONCENTRATION AND TOTAL ORGANIC MASS



APPENDIX B-8

HCl DATA

NOTE: All leak checks of the HCl sample trains were passed with the exception of the final leak check for test Run 2 at the main duct. It is believed that the train's impinger connections were loosened as the train was removed from the duct at the conclusion of the test.

HCl TRAIN SAMPLING TIMES

	24-HOUR TIME				
SAMPLE PERIOD	RUN #1	RUN #2	RUN #3	RUN #4	RUN #5
MAIN DUCT					
1	1715 - 1745	1200 - 1730	1142 - 1212	1100 - 1130	1133 - 1203
2	1810 - 1840	1246 - 1316	1230 - 1300	1632 - 1702	1218 - 1248
3	1900 - 1930	1329 - 1359	1315 - 1345	1714 - 1744	1305 - 1335
4	1940 - 2010	1408 - 1438	1401 - 1431	1755 - 1825	1347 - 1417
BYPASS DUCT					
1	1549 - 1619	1159 - 1229	1139 - 1209	1100 - 1130	1130 - 1200
2	1730 - 1800	1249 - 1319	1218 - 1248	1626 - 1656	1205 - 1235
3	1900 - 1930	1323 - 1353	1257 - 1327	1704 - 1734	1241 - 1311
4	1941 - 2011	1410 - 1440	1340 - 1410	1740 - 1810	1320 - 1350

```
FILE NAME - R1MHCL                                              PROG.=VER 06/03/89
RUN # - RUN1HCL                                                 06-29-1990  06:22:20
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=               791.700
Final Meter Volume (Cubic Feet)=                 852.660
Meter Factor=                                      0.991
Final Leak Rate (cu ft/min)=                       0.000
Net Meter Volume (Cubic Feet)=                    60.411
Gas Volume (Dry Standard Cubic Feet)=             56.472

Barometric Pressure (in Hg)=                       29.11
Static Pressure (Inches H2O)=                      -0.41

Percent Oxygen=                                      5.9
Percent Carbon Dioxide=                             26.3
Moisture Collected (ml)=                             0.0
Percent Water=                                       0.0

Average Meter Temperature (F)=                        91
Average Delta H (in H2O)=                           0.88
Average Delta P (in H2O)=                          0.500
Average Stack Temperature (F)=                       300

Dry Molecular Weight=                              32.44
Wet Molecular Weight=                              32.44

Average Square Root of Delta P (in H2O)=          0.7071
% Isokinetic=                                       75.7

Pitot Coefficient=                                  0.83
Sampling Time (Minutes)=                           120.0
Nozzle Diameter (Inches)=                          0.250
Stack Axis #1 (Inches)=                             48.0
Stack Axis #2 (Inches)=                             96.0
Rectangular Stack
Stack Area (Square Feet)=                          32.00

Stack Velocity  (Actual, Feet/min)=                2,702
Flow Rate (Actual, Cubic ft/min)=                 66,451
Flow rate (Standard, Wet, Cubic ft/min)=          58,375
Flow Rate (Standard, Dry, Cubic ft/min)=          58,375

Particulate Loading - Front Half

Particulate Weight (g)=                           0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=           0.0000         0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=           0.0000
Emission Rate (lb/hr)=                              0.00

No Back Half Analysis
```

```
                         * * METRIC UNITS * *
FILE NAME - R1MHCL                                        PROG.=VER 06/09/89
RUN # - RUN1HCL                                           06-29-1990  06:22:25
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=             22.418
Final Meter Volume (Cubic Meters)=               24.144
Meter Factor=                                     0.991
Final Leak Rate (cu m/min)=                      0.0000
Net Meter Volume (Cubic Meters)=                  1.711
Gas Volume (Dry Standard Cubic Meters)=           1.599

Barometric Pressure (mm Hg)=                        739
Static Pressure (mm H2O)=                           -10

Percent Oxygen=                                     5.9
Percent Carbon Dioxide=                            26.3
Moisture Collected (ml)=                            0.0
Percent Water=                                      0.0

Average Meter Temperature (C)=                       33
Average Delta H (mm H2O)=                          22.4
Average Delta P (mm H2O)=                          12.7
Average Stack Temperature (C)=                      149

Dry Molecular Weight=                             32.44
Wet Molecular Weight=                             32.44

Average Square Root of Delta P (mm H2O)=         3.5637
% Isokinetic=                                      75.7

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              6.35
Stack Axis #1 (Meters)=                           1.219
Stack Axis #2 (Meters)=                           2.438
Rectangular Stack
Stack Area (Square Meters)=                       2.973

Stack Velocity  (Actual, m/min)=                    823
Flow rate (Actual, Cubic m/min)=                  2,448
Flow rate (Standard, Wet, Cubic m/min)=           1,653
Flow rate (Standard, Dry, Cubic m/min)=           1,653

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=            0.0           0.0          0.0
Particulate Loading, Actual (mg/cu m)=              0.0
Emission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

```
FILE NAME - R1MHCL                                           PROG.=VER 06/09/89
RUN # - RUN1HCL                                              06-29-1990   06:22:47
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Point #        Delta P    Delta H     Stack T       Meter T
              (in. H20) (in. H20)      (F)      In(F)   Out(F)
  1             0.500       0.88       300        81       80
  2             0.500       0.88       300        82       86
  3             0.500       0.88       300        84       93
  4             0.500       0.88       300        86       99
  5             0.500       0.88       300        87      100
  6             0.500       0.88       300        90      101
  7             0.500       0.88       300        86       85
  8             0.500       0.88       300        88       89
  9             0.500       0.88       300        89       98
 10             0.500       0.88       300        90      102
 11             0.500       0.88       300        92      104
 12             0.500       0.88       300        95      104
 13             0.500       0.88       300        88       88
 14             0.500       0.88       300        90       88
 15             0.500       0.88       300        89       90
 16             0.500       0.88       300        90       92
 17             0.500       0.88       300        90       93
 18             0.500       0.88       300        90       94
 19             0.500       0.88       300        88       88
 20             0.500       0.88       300        88       88
 21             0.500       0.88       300        88       90
 22             0.500       0.88       300        88       92
 23             0.500       0.88       300        89       92
 24             0.500       0.88       300        89       93


Fraction                    Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                               (g)        (g)        (g)       (g)
DRY CATCH                    0.0000     0.0000     0.0000    0.0000
FILTER                       0.0000     0.0000     0.0000    0.0000

Fraction                    Final Wt.  Tare Wt.    Vol.     Net Wt.
                               (g)        (g)      (ml)       (g)
PROBE RINSE                  0.0000     0.0000     0.0     0.0000
IMPINGERS                    0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=   0.0000
Impinger Blank (mg/ml)=   0.0000
```

```
FILE NAME - R1BHCL                                          PROG.=VER 06/09/89
RUN # - RUN1BHCL                                            06-29-1990  06:37:34
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=               488.374
Final Meter Volume (Cubic Feet)=                 547.180
Meter Factor=                                      1.030
Final Leak Rate (cu ft/min)=                       0.000
Net Meter Volume (Cubic Feet)=                    60.570
Gas Volume (Dry Standard Cubic Feet)=             57.914

Barometric Pressure (in Hg)=                       29.11
Static Pressure (Inches H2O)=                      -2.80

Percent Oxygen=                                     17.8
Percent Carbon Dioxide=                              2.6
Moisture Collected (ml)=                             0.0
Percent Water=                                       0.0

Average Meter Temperature (F)=                        78
Average Delta H (in H2O)=                           0.88
Average Delta P (in H2O)=                          0.500
Average Stack Temperature (F)=                       555

Dry Molecular Weight=                              29.13
Wet Molecular Weight=                              29.13

Average Square Root of Delta P (in H2O)=          0.7071
% Isokinetic=                                       85.2

Pitot Coefficient=                                  0.83
Sampling Time (Minutes)=                           120.0
Nozzle Diameter (Inches)=                          0.250
Stack Axis #1 (Inches)=                             24.0
Stack Axis #2 (Inches)=                             96.0
Rectangular Stack
Stack Area (Square Feet)=                          16.00

Stack Velocity  (Actual, Feet/min)=                3,305
Flow Rate (Actual, Cubic ft/min)=                 52,881
Flow rate (Standard, Wet, Cubic ft/min)=          26,574
Flow Rate (Standard, Dry, Cubic ft/min)=          26,574

Particulate Loading - Front Half

Particulate Weight (g)=                           0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=           0.0000        0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=           0.0000
Emission Rate (lb/hr)=                              0.00

No Back Half Analysis
```

```
                    * * METRIC UNITS * *
FILE NAME -> R1BHCL                                    PROG.=VER 06/09/89
RUN # - RUN1BHCL                                       06-29-1990  06:37:39
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=           13.829
Final Meter Volume (Cubic Meters)=             15.494
Meter Factor=                                   1.030
Final Leak Rate (cu m/min)=                    0.0000
Net Meter Volume (Cubic Meters)=                1.715
Gas Volume (Dry Standard Cubic Meters)=         1.640

Barometric Pressure (mm Hg)=                      739
Static Pressure (mm H2O)=                         -71

Percent Oxygen=                                  17.8
Percent Carbon Dioxide=                           2.6
Moisture Collected (ml)=                          0.0
Percent Water=                                    0.0

Average Meter Temperature (C)=                     26
Average Delta H (mm H2O)=                        22.4
Average Delta P (mm H2O)=                        12.7
Average Stack Temperature (C)=                    291

Dry Molecular Weight=                           29.13
Wet Molecular Weight=                           29.13

Average Square Root of Delta P (mm H2O)=       3.5637
% Isokinetic=                                    85.2

Pitot Coefficient=                               0.83
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (mm)=                            6.35
Stack Axis #1 (Meters)=                         0.610
Stack Axis #2 (Meters)=                         2.438
Rectangular Stack
Stack Area (Square Meters)=                     1.486

Stack Velocity  (Actual, m/min)=                1,007
Flow rate (Actual, Cubic m/min)=                1,497
Flow rate (Standard, Wet, Cubic m/min)=           753
Flow rate (Standard, Dry, Cubic m/min)=           753

Particulate Loading - Front Half

Particulate Weight (g)=                        0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=          0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=            0.0
Emission Rate (kg/hr)=                           0.00

No Back Half Analysis
```

```
FILE NAME - R1BHCL                                                PROG.=VER 06/09/89
RUN # - RUN1BHCL                                                  06-29-1990   06:38:01
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Point #        Delta P    Delta H    Stack T       Meter T
              (in. H2O)  (in. H2O)    (F)       In(F)   Out(F)
  1             0.500      0.88       555         72      71
  2             0.500      0.88       555         74      72
  3             0.500      0.88       555         77      73
  4             0.500      0.88       555         78      73
  5             0.500      0.88       555         82      75
  6             0.500      0.88       555         83      76
  7             0.500      0.88       555         75      76
  8             0.500      0.88       555         75      74
  9             0.500      0.88       555         77      74
  10            0.500      0.88       555         79      74
  11            0.500      0.88       555         81      76
  12            0.500      0.88       555         83      76
  13            0.500      0.88       555         83      76
  14            0.500      0.88       555         75      75
  15            0.500      0.88       555         77      77
  16            0.500      0.88       555         80      77
  17            0.500      0.88       555         83      78
  18            0.500      0.88       555         85      79
  19            0.500      0.88       555         86      80
  20            0.500      0.88       555         80      81
  21            0.500      0.88       555         82      81
  22            0.500      0.88       555         82      81
  23            0.500      0.88       555         83      81
  24            0.500      0.88       555         86      82


Fraction                Final Wt. Tare Wt. Blank Wt. Net Wt.
                          (g)       (g)       (g)       (g)
DRY CATCH               0.0000    0.0000    0.0000    0.0000
FILTER                  0.0000    0.0000    0.0000    0.0000

Fraction                Final Wt. Tare Wt.   Vol.     Net Wt.
                          (g)       (g)      (ml)       (g)
PROBE RINSE             0.0000    0.0000     0.0    0.0000
IMPINGERS               0.0000    0.0000     0.0    0.0000
Probe Rinse Blank (mg/ml)=   0.0000
Impinger Blank (mg/ml)=   0.0000
```

```
FILE NAME - R2MHCL                                                 PROG.=VER 06/09/89
RUN # - R2MHCL                                                     07-02-1990  06:25:56
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=                     852.900
Final Meter Volume (Cubic Feet)=                       914.720
Meter Factor=                                            0.991
Final Leak Rate (cu ft/min)=                             0.000
Net Meter Volume (Cubic Feet)=                          61.264
Gas Volume (Dry Standard Cubic Feet)=                   58.953

Barometric Pressure (in Hg)=                             29.14
Static Pressure (Inches H2O)=                            -0.41

Percent Oxygen=                                            4.4
Percent Carbon Dioxide=                                   28.5
Moisture Collected (ml)=                                   0.0
Percent Water=                                             0.0

Average Meter Temperature (F)=                              75
Average Delta H (in H2O)=                                 0.86
Average Delta P (in H2O)=                                0.500
Average Stack Temperature (F)=                             300

Dry Molecular Weight=                                    32.74
Wet Molecular Weight=                                    32.74

Average Square Root of Delta P (in H2O)=                0.7071
% Isokinetic=                                             79.3

Pitot Coefficient=                                        0.83
Sampling Time (Minutes)=                                 120.0
Nozzle Diameter (Inches)=                                0.250
Stack Axis #1 (Inches)=                                   48.0
Stack Axis #2 (Inches)=                                   96.0
Rectangular Stack
Stack Area (Square Feet)=                                32.00

Stack Velocity  (Actual, Feet/min)=                      2,688
Flow Rate (Actual, Cubic ft/min)=                       86,021
Flow rate (Standard, Wet, Cubic ft/min)=                58,144
Flow Rate (Standard, Dry, Cubic ft/min)=                58,144

Particulate Loading - Front Half

Particulate Weight (g)=                                 0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=                 0.0000         0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=                 0.0000
Emission Rate (lb/hr)=                                    0.00

No Back Half Analysis
```

```
                     * * METRIC UNITS * *
FILE NAME - R2MHCL                                         PROG.=VER 06/09/89
RUN # - R2MHCL                                             07-02-1990  06:26:00
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=           24.151
Final Meter Volume (Cubic Meters)=             25.901
Meter Factor=                                   0.991
Final Leak Rate (cu m/min)=                     0.0000
Net Meter Volume (Cubic Meters)=                1.735
Gas Volume (Dry Standard Cubic Meters)=         1.669

Barometric Pressure (mm Hg)=                      740
Static Pressure (mm H2O)=                         -10

Percent Oxygen=                                   4.4
Percent Carbon Dioxide=                          28.5
Moisture Collected (ml)=                          0.0
Percent Water=                                    0.0

Average Meter Temperature (C)=                     24
Average Delta H (mm H2O)=                        21.8
Average Delta P (mm H2O)=                        12.7
Average Stack Temperature (C)=                    149

Dry Molecular Weight=                           32.74
Wet Molecular Weight=                           32.74

Average Square Root of Delta P (mm H2O)=       3.5637
% Isokinetic=                                    79.3

Pitot Coefficient=                               0.83
Sampling Time (Minutes)=                        120.0
Nozzle Diameter (mm)=                            6.35
Stack Axis #1 (Meters)=                         1.219
Stack Axis #2 (Meters)=                         2.438
Rectangular Stack
Stack Area (Square Meters)=                     2.973

Stack Velocity  (Actual, m/min)=                  819
Flow rate (Actual, Cubic m/min)=                2,436
Flow rate (Standard, Wet, Cubic m/min)=         1,646
Flow rate (Standard, Dry, Cubic m/min)=         1,646

Particulate Loading - Front Half

Particulate Weight (g)=                        0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=          0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=            0.0
Emission Rate (kg/hr)=                           0.00

No Back Half Analysis
```

```
FILE NAME - R2MHCL                                        PROG.=VER 06/09/89
RUN # - R2MHCL                                            07-02-1990   06:26:22
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102

Point #        Delta P     Delta H     Stack T        Meter T
              (in. H2O)   (in. H2O)     (F)     In(F)    Out(F)
  1             0.500        0.86       300       63        62
  2             0.500        0.86       300       63        64
  3             0.500        0.86       300       64        68
  4             0.500        0.86       300       64        72
  5             0.500        0.86       300       66        75
  6             0.500        0.86       300       67        77
  7             0.500        0.86       300       68        71
  8             0.500        0.86       300       71        75
  9             0.500        0.86       300       72        82
  10            0.500        0.86       300       74        86
  11            0.500        0.86       300       75        88
  12            0.500        0.86       300       77        91
  13            0.500        0.86       300       74        78
  14            0.500        0.86       300       76        79
  15            0.500        0.86       300       76        81
  16            0.500        0.86       300       76        83
  17            0.500        0.86       300       77        84
  18            0.500        0.86       300       77        84
  19            0.500        0.86       300       74        77
  20            0.500        0.86       300       75        77
  21            0.500        0.86       300       75        80
  22            0.500        0.86       300       76        83
  23            0.500        0.86       300       76        83
  24            0.500        0.86       300       76        84


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000    0.0000     0.0000
FILTER                    0.0000     0.0000    0.0000     0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.      Net Wt.
                            (g)        (g)      (ml)        (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R2BHCL                                              PROG.=VER 06/09/89
RUN # - R2BHCL                                                  07-02-1990  06:35:32
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=                  550.608
Final Meter Volume (Cubic Feet)=                    611.763
Meter Factor=                                         1.030
Final Leak Rate (cu ft/min)=                          0.000
Net Meter Volume (Cubic Feet)=                       62.990
Gas Volume (Dry Standard Cubic Feet)=                61.200

Barometric Pressure (in Hg)=                          29.11
Static Pressure (Inches H2O)=                         -2.80

Percent Oxygen=                                        17.4
Percent Carbon Dioxide=                                 2.9
Moisture Collected (ml)=                                0.0
Percent Water=                                          0.0

Average Meter Temperature (F)=                           70
Average Delta H (in H2O)=                              0.88
Average Delta P (in H2O)=                             0.500
Average Stack Temperature (F)=                          580

Dry Molecular Weight=                                 29.16
Wet Molecular Weight=                                 29.16

Average Square Root of Delta P (in H2O)=             0.7071
% Isokinetic=                                          91.2

Pitot Coefficient=                                     0.83
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (Inches)=                             0.250
Stack Axis #1 (Inches)=                                24.0
Stack Axis #2 (Inches)=                                96.0
Rectangular Stack
Stack Area (Square Feet)=                             16.00

Stack Velocity  (Actual, Feet/min)=                   3,344
Flow Rate (Actual, Cubic ft/min)=                    53,499
Flow rate (Standard, Wet, Cubic ft/min)=             26,239
Flow Rate (Standard, Dry, Cubic ft/min)=             26,239

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=              0.0000        0.0000     0.0000
Particulate Loading, Actual (gr/cu ft)=              0.0000
Emission Rate (lb/hr)=                                 0.00

No Back Half Analysis
```

```
                    * * METRIC UNITS * *
FILE NAME - R2BHCL                                    PROG.=VER 06/09/89
RUN # - R2BHCL                                        07-02-1990  06:35:36
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=             15.591
Final Meter Volume (Cubic Meters)=               17.323
Meter Factor=                                     1.030
Final Leak Rate (cu m/min)=                       0.0000
Net Meter Volume (Cubic Meters)=                  1.784
Gas Volume (Dry Standard Cubic Meters)=           1.733

Barometric Pressure (mm Hg)=                        739
Static Pressure (mm H2O)=                           -71

Percent Oxygen=                                    17.4
Percent Carbon Dioxide=                             2.9
Moisture Collected (ml)=                            0.0
Percent Water=                                      0.0

Average Meter Temperature (C)=                       21
Average Delta H (mm H2O)=                          22.4
Average Delta P (mm H2O)=                          12.7
Average Stack Temperature (C)=                      304

Dry Molecular Weight=                             29.16
Wet Molecular Weight=                             29.16

Average Square Root of Delta P (mm H2O)=         3.5637
% Isokinetic=                                      91.2

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              6.35
Stack Axis #1 (Meters)=                           0.610
Stack Axis #2 (Meters)=                           2.438
Rectangular Stack
Stack Area (Square Meters)=                       1.486

Stack Velocity  (Actual, m/min)=                  1,019
Flow rate (Actual, Cubic m/min)=                  1,515
Flow rate (Standard, Wet, Cubic m/min)=             743
Flow rate (Standard, Dry, Cubic m/min)=             743

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=            0.0         0.0         0.0
Particulate Loading, Actual (mg/cu m)=              0.0
Emission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

```
FILE NAME - R2BHCL                                                PROG.=VER 06/09/89
RUN # - R2BHCL                                                    07-02-1990  06:35:59
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102

Point #      Delta P     Delta H     Stack T        Meter T
            (in. H2O)   (in. H2O)     (F)      In(F)   Out(F)
  1          0.500        0.88        580        63      65
  2          0.500        0.88        580        67      65
  3          0.500        0.88        580        71      65
  4          0.500        0.88        580        72      66
  5          0.500        0.88        580        72      67
  6          0.500        0.88        580        73      68
  7          0.500        0.88        580        66      66
  8          0.500        0.88        580        69      67
  9          0.500        0.88        580        71      67
  10         0.500        0.88        580        72      68
  11         0.500        0.88        580        73      68
  12         0.500        0.88        580        73      69
  13         0.500        0.88        580        71      69
  14         0.500        0.88        580        73      70
  15         0.500        0.88        580        74      70
  16         0.500        0.88        580        74      70
  17         0.500        0.88        580        75      70
  18         0.500        0.88        580        75      70
  19         0.500        0.88        580        67      68
  20         0.500        0.88        580        69      68
  21         0.500        0.88        580        72      69
  22         0.500        0.88        580        73      69
  23         0.500        0.88        580        74      69
  24         0.500        0.88        580        74      69


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000    0.0000     0.0000
FILTER                    0.0000     0.0000    0.0000     0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R3MHCL                                                    PROG.=VER 06/09/89
RUN # - R3MHCL                                                        07-02-1990  06:46:21
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=                    916.000
Final Meter Volume (Cubic Feet)=                      976.000
Meter Factor=                                           0.991
Final Leak Rate (cu ft/min)=                            0.000
Net Meter Volume (Cubic Feet)=                         59.460
Gas Volume (Dry Standard Cubic Feet)=                  60.403

Barometric Pressure (in Hg)=                            29.58
Static Pressure (Inches H2O)=                           -0.41

Percent Oxygen=                                           4.8
Percent Carbon Dioxide=                                  28.2
Moisture Collected (ml)=                                  0.0
Percent Water=                                            0.0

Average Meter Temperature (F)=                             55
Average Delta H (in H2O)=                                0.90
Average Delta P (in H2O)=                               0.580
Average Stack Temperature (F)=                            321

Dry Molecular Weight=                                   32.70
Wet Molecular Weight=                                   32.70

Average Square Root of Delta P (in H2O)=               0.7616
% Isokinetic=                                            75.9

Pitot Coefficient=                                       0.83
Sampling Time (Minutes)=                                120.0
Nozzle Diameter (Inches)=                               0.250
Stack Axis #1 (Inches)=                                  48.0
Stack Axis #2 (Inches)=                                  96.0
Rectangular Stack
Stack Area (Square Feet)=                               32.00

Stack Velocity  (Actual, Feet/min)=                     2,914
Flow Rate (Actual, Cubic ft/min)=                      93,262
Flow rate (Standard, Wet, Cubic ft/min)=               62,270
Flow Rate (Standard, Dry, Cubic ft/min)=               62,270

Particulate Loading - Front Half

Particulate Weight (g)=                                0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=                0.0000         0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=                0.0000
Emission Rate (lb/hr)=                                   0.00

No Back Half Analysis
```

```
                        * * METRIC UNITS * *
FILE NAME - R3MHCL                                          PROG.=VER 06/09/89
RUN # - R3MHCL                                              07-02-1990  06:46:25
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=          25.937
Final Meter Volume (Cubic Meters)=            27.636
Meter Factor=                                  0.991
Final Leak Rate (cu m/min)=                   0.0000
Net Meter Volume (Cubic Meters)=               1.684
Gas Volume (Dry Standard Cubic Meters)=        1.710

Barometric Pressure (mm Hg)=                     751
Static Pressure (mm H2O)=                        -10

Percent Oxygen=                                  4.8
Percent Carbon Dioxide=                         28.2
Moisture Collected (ml)=                         0.0
Percent Water=                                   0.0

Average Meter Temperature (C)=                    13
Average Delta H (mm H2O)=                       22.9
Average Delta P (mm H2O)=                       14.7
Average Stack Temperature (C)=                   161

Dry Molecular Weight=                          32.70
Wet Molecular Weight=                          32.70

Average Square Root of Delta P (mm H2O)=      3.8382
% Isokinetic=                                   75.9

Pitot Coefficient=                              0.83
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (mm)=                           6.35
Stack Axis #1 (Meters)=                        1.219
Stack Axis #2 (Meters)=                        2.438
Rectangular Stack
Stack Area (Square Meters)=                    2.973

Stack Velocity  (Actual, m/min)=                 888
Flow rate (Actual, Cubic m/min)=               2,641
Flow rate (Standard, Wet, Cubic m/min)=        1,763
Flow rate (Standard, Dry, Cubic m/min)=        1,763

Particulate Loading - Front Half

Particulate Weight (g)=                       0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=         0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=           0.0
Emission Rate (kg/hr)=                          0.00

No Back Half Analysis
```

```
FILE NAME - R3MHCL                                                    PROG.=VER 06/09/89
RUN # - R3MHCL                                                        07-02-1990  06:46:48
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102

Point #       Delta P    Delta H    Stack T       Meter T
             (in. H2O) (in. H2O)     (F)      In(F)   Out(F)
  1           0.580       0.90       321        41       41
  2           0.580       0.90       321        42       44
  3           0.580       0.90       321        43       48
  4           0.580       0.90       321        44       54
  5           0.580       0.90       321        47       58
  6           0.580       0.90       321        49       60
  7           0.580       0.90       321        50       53
  8           0.580       0.90       321        54       59
  9           0.580       0.90       321        55       66
 10           0.580       0.90       321        57       69
 11           0.580       0.90       321        58       72
 12           0.580       0.90       321        60       74
 13           0.580       0.90       321        54       55
 14           0.580       0.90       321        56       55
 15           0.580       0.90       321        55       57
 16           0.580       0.90       321        54       57
 17           0.580       0.90       321        54       57
 18           0.580       0.90       321        54       59
 19           0.580       0.90       321        50       51
 20           0.580       0.90       321        51       53
 21           0.580       0.90       321        52       57
 22           0.580       0.90       321        53       61
 23           0.580       0.90       321        54       63
 24           0.580       0.90       321        55       65


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)        (g)       (g)
DRY CATCH                0.0000     0.0000     0.0000     0.0000
FILTER                   0.0000     0.0000     0.0000     0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)       (g)
PROBE RINSE              0.0000     0.0000      0.0     0.0000
IMPINGERS                0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R3BHCL                                           PROG.=VER 06/09/89
RUN # - R3BHCL                                               07-02-1990  07:51:06
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=                612.704
Final Meter Volume (Cubic Feet)=                  669.882
Meter Factor=                                       1.030
Final Leak Rate (cu ft/min)=                        0.000
Net Meter Volume (Cubic Feet)=                     58.893
Gas Volume (Dry Standard Cubic Feet)=              60.166

Barometric Pressure (in Hg)=                        29.58
Static Pressure (Inches H2O)=                       -2.80

Percent Oxygen=                                      16.3
Percent Carbon Dioxide=                               4.7
Moisture Collected (ml)=                              0.0
Percent Water=                                        0.0

Average Meter Temperature (F)=                         52
Average Delta H (in H2O)=                            0.88
Average Delta P (in H2O)=                           0.500
Average Stack Temperature (F)=                        580

Dry Molecular Weight=                               29.40
Wet Molecular Weight=                               29.40

Average Square Root of Delta P (in H2O)=           0.7071
% Isokinetic=                                        89.3

Pitot Coefficient=                                   0.83
Sampling Time (Minutes)=                            120.0
Nozzle Diameter (Inches)=                           0.250
Stack Axis #1 (Inches)=                              24.0
Stack Axis #2 (Inches)=                              96.0
Rectangular Stack
Stack Area (Square Feet)=                           16.00

Stack Velocity  (Actual, Feet/min)=                 3,303
Flow Rate (Actual, Cubic ft/min)=                  52,848
Flow rate (Standard, Wet, Cubic ft/min)=           26,341
Flow Rate (Standard, Dry, Cubic ft/min)=           26,341

Particulate Loading - Front Half

Particulate Weight (g)=                            0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=            0.0000       0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=            0.0000
Emission Rate (lb/hr)=                               0.00

No Back Half Analysis
```

```
                         * * METRIC UNITS * *
FILE NAME - R3BHCL                                         PROG.=VER 06/09/89
RUN # - R3BHCL                                             07-02-1990  07:51:07
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=          17.349
Final Meter Volume (Cubic Meters)=            18.968
Meter Factor=                                  1.030
Final Leak Rate (cu m/min)=                   0.0000
Net Meter Volume (Cubic Meters)=               1.668
Gas Volume (Dry Standard Cubic Meters)=        1.704

Barometric Pressure (mm Hg)=                     751
Static Pressure (mm H20)=                        -71

Percent Oxygen=                                 16.3
Percent Carbon Dioxide=                          4.7
Moisture Collected (ml)=                         0.0
Percent Water=                                   0.0

Average Meter Temperature (C)=                    11
Average Delta H (mm H20)=                       22.4
Average Delta P (mm H20)=                       12.7
Average Stack Temperature (C)=                   304

Dry Molecular Weight=                          29.40
Wet Molecular Weight=                          29.40

Average Square Root of Delta P (mm H20)=      3.5637
% Isokinetic=                                   89.3

Pitot Coefficient=                              0.83
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (mm)=                           6.35
Stack Axis #1 (Meters)=                        0.610
Stack Axis #2 (Meters)=                        2.438
Rectangular Stack
Stack Area (Square Meters)=                    1.486

Stack Velocity  (Actual, m/min)=               1,007
Flow rate (Actual, Cubic m/min)=               1,496
Flow rate (Standard, Wet, Cubic m/min)=          746
Flow rate (Standard, Dry, Cubic m/min)=          746

Particulate Loading - Front Half

Particulate Weight (g)=                       0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=         0.0           0.0          0.0
Particulate Loading, Actual (mg/cu m)=           0.0
Emission Rate (kg/hr)=                          0.00

No Back Half Analysis
```

```
FILE NAME - R3BHCL                                        PROG.=VER 06/09/89
RUN # - R3BHCL                                            07-02-1990  07:51:09
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102

Point #      Delta P    Delta H    Stack T      Meter T
            (in. H20) (in. H20)    (F)      In(F)  Out(F)
 1           0.500      0.88       580       44      45
 2           0.500      0.88       580       47      45
 3           0.500      0.88       580       50      46
 4           0.500      0.88       580       52      46
 5           0.500      0.88       580       52      46
 6           0.500      0.88       580       52      46
 7           0.500      0.88       580       50      48
 8           0.500      0.88       580       53      49
 9           0.500      0.88       580       55      50
 10          0.500      0.88       580       57      51
 11          0.500      0.88       580       58      52
 12          0.500      0.88       580       59      52
 13          0.500      0.88       580       54      53
 14          0.500      0.88       580       56      53
 15          0.500      0.88       580       57      54
 16          0.500      0.88       580       57      54
 17          0.500      0.88       580       57      54
 18          0.500      0.88       580       49      49
 19          0.500      0.88       580       52      50
 20          0.500      0.88       580       54      50
 21          0.500      0.88       580       56      50
 22          0.500      0.88       580       57      51
 23          0.500      0.88       580       57      51
 24          0.500      0.88       580       58      52


Fraction                Final Wt. Tare Wt. Blank Wt. Net Wt.
                          (g)       (g)      (g)       (g)
DRY CATCH               0.0000    0.0000    0.0000    0.0000
FILTER                  0.0000    0.0000    0.0000    0.0000

Fraction                Final Wt. Tare Wt.   Vol.     Net Wt.
                          (g)       (g)      (ml)      (g)
PROBE RINSE             0.0000    0.0000     0.0    0.0000
IMPINGERS               0.0000    0.0000     0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R4MHCL                                             PROG.=VER 06/09/89
RUN # - RUN 4HCL - ASH GROVE CEMENT KILN                       11-01-1989  09:44:32
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=              976.200
Final Meter Volume (Cubic Feet)=               1037.780
Meter Factor=                                     0.991
Final Leak Rate (cu ft/min)=                      0.000
Net Meter Volume (Cubic Feet)=                   61.026
Gas Volume (Dry Standard Cubic Feet)=            60.064

Barometric Pressure (in Hg)=                      29.53
Static Pressure (Inches H2O)=                     -0.41

Percent Oxygen=                                     5.8
Percent Carbon Dioxide=                            24.1
Percent Water=                                      0.0

Average Meter Temperature (F)=                       70
Average Delta H (in H2O)=                          0.93
Average Delta P (in H2O)=                         0.550
Average Stack Temperature (F)=                      305

Dry Molecular Weight=                             32.09
Wet Molecular Weight=                             32.09

Average Square Root of Delta P (in H2O)=         0.7416
% Isokinetic=                                      52.7

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.300
Stack Axis #1 (Inches)=                            48.0
Stack Axis #2 (Inches)=                            96.0
Rectangular Stack
Stack Area (Square Feet)=                         32.00

Stack Velocity  (Actual, Feet/min)=               2,845
Flow Rate (Actual, Cubic ft/min)=                91,037
Flow rate (Standard, Wet, Cubic ft/min)=         61,951
Flow Rate (Standard, Dry, Cubic ft/min)=         61,951

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=          0.0000       0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=          0.0000
Emission Rate (lb/hr)=                             0.00

No Back Half Analysis
```

```
                         * * METRIC UNITS * *
FILE NAME - R4MHCL                                                 PROG.=VER 06/09/89
RUN # - RUN 4HCL - ASH GROVE CEMENT KILN                           11-01-1989  09:44:59
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=                27.642
Final Meter Volume (Cubic Meters)=                  29.386
Meter Factor=                                        0.991
Final Leak Rate (cu m/min)=                         0.0000
Net Meter Volume (Cubic Meters)=                     1.728
Gas Volume (Dry Standard Cubic Meters)=              1.701

Barometric Pressure (mm Hg)=                           750
Static Pressure (mm H2O)=                              -10

Percent Oxygen=                                        5.8
Percent Carbon Dioxide=                               24.1
Percent Water=                                         0.0

Average Meter Temperature (C)=                          21
Average Delta H (mm H2O)=                             23.6
Average Delta P (mm H2O)=                             14.0
Average Stack Temperature (C)=                         152

Dry Molecular Weight=                                32.09
Wet Molecular Weight=                                32.09

Average Square Root of Delta P (mm H2O)=            3.7376
% Isokinetic=                                         52.7

Pitot Coefficient=                                    0.83
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (mm)=                                 7.62
Stack Axis #1 (Meters)=                              1.219
Stack Axis #2 (Meters)=                              2.438
Rectangular Stack
Stack Area (Square Meters)=                          2.973

Stack Velocity  (Actual, m/min)=                       867
Flow rate (Actual, Cubic m/min)=                     2,578
Flow rate (Standard, Wet, Cubic m/min)=              1,754
Flow rate (Standard, Dry, Cubic m/min)=              1,754

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000     Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=               0.0            0.0          0.0
Particulate Loading, Actual (mg/cu m)=                 0.0
Emission Rate (kg/hr)=                                0.00

No Back Half Analysis
```

```
FILE NAME - R4MHCL                                              PROG.=VER 06/09/89
RUN # - RUN 4HCL - ASH GROVE CEMENT KILN                        11-01-1989  09:45:26
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Point #       Delta P     Delta H     Stack T       Meter T
            (in. H20)   (in. H20)      (F)      In(F)   Out(F)
  1           0.550        0.93        305        53       54
  2           0.550        0.93        305        54       58
  3           0.550        0.93        305        55       62
  4           0.550        0.93        305        57       66
  5           0.550        0.93        305        59       67
  6           0.550        0.93        305        61       69
  7           0.550        0.93        305        65       65
  8           0.550        0.93        305        65       67
  9           0.550        0.93        305        66       70
  10          0.550        0.93        305        67       73
  11          0.550        0.93        305        68       74
  12          0.550        0.93        305        69       76
  13          0.550        0.93        305        70       72
  14          0.550        0.93        305        72       73
  15          0.550        0.93        305        72       76
  16          0.550        0.93        305        73       78
  17          0.550        0.93        305        74       80
  18          0.550        0.93        305        75       81
  19          0.550        0.93        305        75       77
  20          0.550        0.93        305        76       79
  21          0.550        0.93        305        77       81
  22          0.550        0.93        305        77       82
  23          0.550        0.93        305        78       83
  24          0.550        0.93        305        78       84


Fraction                  Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000    0.0000     0.0000
FILTER                    0.0000     0.0000    0.0000     0.0000

Fraction                  Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)       (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R4BHCL                                                PROG.=VER 06/09/89
RUN # - RUN 4HCL - ASH GROVE CEMENT KILN                          11-01-1989  09:48:01
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-54-13

Initial Meter Volume (Cubic Feet)=                  672.138
Final Meter Volume (Cubic Feet)=                    733.201
Meter Factor=                                         0.887
Final Leak Rate (cu ft/min)=                          0.006
Net Meter Volume (Cubic Feet)=                       54.163
Gas Volume (Dry Standard Cubic Feet)=                53.663

Barometric Pressure (in Hg)=                          29.53
Static Pressure (Inches H2O)=                         -2.89

Percent Oxygen=                                        16.9
Percent Carbon Dioxide=                                 3.7
Percent Water=                                          0.0

Average Meter Temperature (F)=                           67
Average Delta H (in H2O)=                              0.87
Average Delta P (in H2O)=                             0.550
Average Stack Temperature (F)=                          570

Dry Molecular Weight=                                 29.27
Wet Molecular Weight=                                 29.27

Average Square Root of Delta P (in H2O)=             0.7416
% Isokinetic=                                          52.1

Pitot Coefficient=                                     0.84
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (Inches)=                             0.300
Stack Axis #1 (Inches)=                                24.0
Stack Axis #2 (Inches)=                                96.0
Rectangular Stack
Stack Area (Square Feet)=                             16.00

Stack Velocity  (Actual, Feet/min)=                   3,484
Flow Rate (Actual, Cubic ft/min)=                    55,742
Flow rate (Standard, Wet, Cubic ft/min)=             27,399
Flow Rate (Standard, Dry, Cubic ft/min)=             27,399

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=              0.0000         0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=              0.0000
Emission Rate (lb/hr)=                                 0.00

No Back Half Analysis
```

```
                          * * METRIC UNITS * *
FILE NAME - R4BHCL                                         PROG.=VER 06/09/89
RUN # - RUN 4HCL - ASH GROVE CEMENT KILN                   11-01-1989  09:48:28
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=             19.032
Final Meter Volume (Cubic Meters)=               20.761
Meter Factor=                                     0.887
Final Leak Rate (cu m/min)=                      0.0002
Net Meter Volume (Cubic Meters)=                  1.534
Gas Volume (Dry Standard Cubic Meters)=           1.520

Barometric Pressure (mm Hg)=                        750
Static Pressure (mm H2O)=                           -73

Percent Oxygen=                                    16.9
Percent Carbon Dioxide=                             3.7
Percent Water=                                      0.0

Average Meter Temperature (C)=                       19
Average Delta H (mm H2O)=                          22.1
Average Delta P (mm H2O)=                          14.0
Average Stack Temperature (C)=                      299

Dry Molecular Weight=                             29.27
Wet Molecular Weight=                             29.27

Average Square Root of Delta P (mm H2O)=         3.7376
% Isokinetic=                                      52.1

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              7.62
Stack Axis #1 (Meters)=                           0.610
Stack Axis #2 (Meters)=                           2.438
Rectangular Stack
Stack Area (Square Meters)=                       1.486

Stack Velocity  (Actual, m/min)=                  1,062
Flow rate (Actual, Cubic m/min)=                  1,578
Flow rate (Standard, Wet, Cubic m/min)=             793
Flow rate (Standard, Dry, Cubic m/min)=             793

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=            0.0         0.0         0.0
Particulate Loading, Actual (mg/cu m)=              0.0
Emission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

```
FILE NAME - R4BHCL                                          PROG.=VER 06/09/89
RUN # - RUN 4HCL - ASH GROVE CEMENT KILN                    11-01-1989  09:48:55
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Point #        Delta P    Delta H    Stack T       Meter T
              (in. H2O)  (in. H2O)    (F)     In(F)   Out(F)
  1            0.550       0.87       570       57      57
  2            0.550       0.87       570       64      59
  3            0.550       0.87       570       66      60
  4            0.550       0.87       570       67      61
  5            0.550       0.87       570       69      63
  6            0.550       0.87       570       69      64
  7            0.550       0.87       570       68      67
  8            0.550       0.87       570       63      62
  9            0.550       0.87       570       65      64
  10           0.550       0.87       570       67      64
  11           0.550       0.87       570       70      65
  12           0.550       0.87       570       70      66
  13           0.550       0.87       570       68      66
  14           0.550       0.87       570       70      66
  15           0.550       0.87       570       71      67
  16           0.550       0.87       570       73      67
  17           0.550       0.87       570       73      68
  18           0.550       0.87       570       74      68
  19           0.550       0.87       570       70      68
  20           0.550       0.87       570       71      68
  21           0.550       0.87       570       71      68
  22           0.550       0.87       570       71      68
  23           0.550       0.87       570       71      68
  24           0.550       0.87       570       71      68


Fraction                    Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                              (g)        (g)        (g)       (g)
DRY CATCH                   0.0000     0.0000     0.0000    0.0000
FILTER                      0.0000     0.0000     0.0000    0.0000

Fraction                    Final Wt.  Tare Wt.    Vol.     Net Wt.
                              (g)        (g)       (ml)       (g)
PROBE RINSE                 0.0000     0.0000      0.0     0.0000
IMPINGERS                   0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R5MHCL                                         PROG.=VER 06/09/89
RUN # - R5MHCL                                             07-02-1990  08:19:30
LOCATION - MAIN ESP OUTLET DUCT
DATE - 11/2/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=                  38.150
Final Meter Volume (Cubic Feet)=                    97.618
Meter Factor=                                        0.991
Final Leak Rate (cu ft/min)=                         0.000
Net Meter Volume (Cubic Feet)=                      58.933
Gas Volume (Dry Standard Cubic Feet)=               59.911

Barometric Pressure (in Hg)=                         29.72
Static Pressure (Inches H20)=                        -0.41

Percent Oxygen=                                        5.2
Percent Carbon Dioxide=                               27.4
Moisture Collected (ml)=                               0.0
Percent Water=                                         0.0

Average Meter Temperature (F)=                          57
Average Delta H (in H20)=                             0.89
Average Delta P (in H20)=                            0.590
Average Stack Temperature (F)=                         317

Dry Molecular Weight=                                32.59
Wet Molecular Weight=                                32.59

Average Square Root of Delta P (in H20)=            0.7681
% Isokinetic=                                         74.1

Pitot Coefficient=                                    0.83
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (Inches)=                            0.250
Stack Axis #1 (Inches)=                               48.0
Stack Axis #2 (Inches)=                               96.0
Rectangular Stack
Stack Area (Square Feet)=                            32.00

Stack Velocity  (Actual, Feet/min)=                  2,930
Flow Rate (Actual, Cubic ft/min)=                   93,761
Flow rate (Standard, Wet, Cubic ft/min)=            63,224
Flow Rate (Standard, Dry, Cubic ft/min)=            63,224

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=             0.0000        0.0000       0.0000
Particulate Loading, Actual (gr/cu ft)=             0.0000
Emission Rate (lb/hr)=                                0.00

No Back Half Analysis
```

```
                          * * METRIC UNITS * *
FILE NAME - R5MHCL                                          PROG.=VER 06/09/89
RUN # - R5MHCL                                              07-02-1990  08:19:32
LOCATION - MAIN ESP OUTLET DUCT
DATE - 11/2/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=           1.080
Final Meter Volume (Cubic Meters)=             2.764
Meter Factor=                                  0.991
Final Leak Rate (cu m/min)=                   0.0000
Net Meter Volume (Cubic Meters)=               1.669
Gas Volume (Dry Standard Cubic Meters)=        1.696

Barometric Pressure (mm Hg)=                     755
Static Pressure (mm H2O)=                        -10

Percent Oxygen=                                  5.2
Percent Carbon Dioxide=                         27.4
Moisture Collected (ml)=                         0.0
Percent Water=                                   0.0

Average Meter Temperature (C)=                    14
Average Delta H (mm H2O)=                       22.6
Average Delta P (mm H2O)=                       15.0
Average Stack Temperature (C)=                   158

Dry Molecular Weight=                          32.59
Wet Molecular Weight=                          32.59

Average Square Root of Delta P (mm H2O)=      3.8712
% Isokinetic=                                   74.1

Pitot Coefficient=                              0.83
Sampling Time (Minutes)=                       120.0
Nozzle Diameter (mm)=                           6.35
Stack Axis #1 (Meters)=                        1.219
Stack Axis #2 (Meters)=                        2.438
Rectangular Stack
Stack Area (Square Meters)=                    2.973

Stack Velocity  (Actual, m/min)=                 893
Flow rate (Actual, Cubic m/min)=               2,655
Flow rate (Standard, Wet, Cubic m/min)=        1,790
Flow rate (Standard, Dry, Cubic m/min)=        1,790

Particulate Loading - Front Half

Particulate Weight (g)=                       0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=         0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=           0.0
Emission Rate (kg/hr)=                          0.00

No Back Half Analysis
```

```
FILE NAME - R5MHCL                                          PROG.=VER 06/09/89
RUN # - R5MHCL                                              07-02-1990  08:19:34
LOCATION - MAIN ESP OUTLET DUCT
DATE - 11/2/89
PROJECT # - 9102

Point #      Delta P   Delta H    Stack T      Meter T
            (in. H2O) (in. H2O)    (F)     In(F)  Out(F)
  1          0.590      0.89       317      37      44
  2          0.590      0.89       317      40      42
  3          0.590      0.89       317      46      52
  4          0.590      0.89       317      47      54
  5          0.590      0.89       317      48      56
  6          0.590      0.89       317      50      57
  7          0.590      0.89       317      52      53
  8          0.590      0.89       317      53      57
  9          0.590      0.89       317      54      61
  10         0.590      0.89       317      56      63
  11         0.590      0.89       317      58      64
  12         0.590      0.89       317      59      65
  13         0.590      0.89       317      57      57
  14         0.590      0.89       317      57      60
  15         0.590      0.89       317      57      62
  16         0.590      0.89       317      58      62
  17         0.590      0.89       317      58      63
  18         0.590      0.89       317      59      65
  19         0.590      0.89       317      58      59
  20         0.590      0.89       317      60      63
  21         0.590      0.89       317      60      65
  22         0.590      0.89       317      60      65
  23         0.590      0.89       317      61      66
  24         0.590      0.89       317      62      66


Fraction                  Final Wt. Tare Wt. Blank Wt. Net Wt.
                             (g)       (g)      (g)      (g)
DRY CATCH                  0.0000    0.0000   0.0000   0.0000
FILTER                     0.0000    0.0000   0.0000   0.0000

Fraction                  Final Wt. Tare Wt.   Vol.    Net Wt.
                             (g)       (g)     (ml)      (g)
PROBE RINSE                0.0000    0.0000    0.0    0.0000
IMPINGERS                  0.0000    0.0000    0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R5BHCL                                          PROG.=VER 06/09/89
RUN # - R5BHCL                                              07-02-1990  08:41:05
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 11/02/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=              733.596
Final Meter Volume (Cubic Feet)=                784.313
Meter Factor=                                     1.030
Final Leak Rate (cu ft/min)=                      0.000
Net Meter Volume (Cubic Feet)=                   52.238
Gas Volume (Dry Standard Cubic Feet)=            52.925

Barometric Pressure (in Hg)=                      29.72
Static Pressure (Inches H20)=                     -2.80

Percent Oxygen=                                    16.8
Percent Carbon Dioxide=                             3.8
Moisture Collected (ml)=                            0.0
Percent Water=                                      0.0

Average Meter Temperature (F)=                       59
Average Delta H (in H20)=                          0.89
Average Delta P (in H20)=                         0.460
Average Stack Temperature (F)=                      570

Dry Molecular Weight=                             29.28
Wet Molecular Weight=                             29.28

Average Square Root of Delta P (in H20)=         0.6782
% Isokinetic=                                      97.4

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          100.0
Nozzle Diameter (Inches)=                         0.250
Stack Axis #1 (Inches)=                            24.0
Stack Axis #2 (Inches)=                            96.0
Rectangular Stack
Stack Area (Square Feet)=                         16.00

Stack Velocity  (Actual, Feet/min)=               3,152
Flow Rate (Actual, Cubic ft/min)=                50,433
Flow rate (Standard, Wet, Cubic ft/min)=         25,502
Flow Rate (Standard, Dry, Cubic ft/min)=         25,502

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% 02 & 12% C02
Particulate Loading, Dry Std. (gr/scf)=          0.0000        0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=          0.0000
Emission Rate (lb/hr)=                             0.00

No Back Half Analysis
```

```
                              * * METRIC UNITS * *
FILE NAME - R5BHCL                                        PROG.=VER 06/09/89
RUN # - R5BHCL                                            07-02-1990  08:41:07
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 11/02/89
PROJECT # - 9102

Initial Meter Volume (Cubic Meters)=             20.773
Final Meter Volume (Cubic Meters)=               22.209
Meter Factor=                                     1.030
Final Leak Rate (cu m/min)=                      0.0000
Net Meter Volume (Cubic Meters)=                  1.479
Gas Volume (Dry Standard Cubic Meters)=           1.499

Barometric Pressure (mm Hg)=                        755
Static Pressure (mm H20)=                           -71

Percent Oxygen=                                    16.8
Percent Carbon Dioxide=                             3.8
Moisture Collected (ml)=                            0.0
Percent Water=                                      0.0

Average Meter Temperature (C)=                       15
Average Delta H (mm H20)=                          22.6
Average Delta P (mm H20)=                          11.7
Average Stack Temperature (C)=                      299

Dry Molecular Weight=                             29.28
Wet Molecular Weight=                             29.28

Average Square Root of Delta P (mm H20)=         3.4182
% Isokinetic=                                      97.4

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          100.0
Nozzle Diameter (mm)=                              6.35
Stack Axis #1 (Meters)=                           0.610
Stack Axis #2 (Meters)=                           2.438
Rectangular Stack
Stack Area (Square Meters)=                       1.486

Stack Velocity  (Actual, m/min)=                    961
Flow rate (Actual, Cubic m/min)=                  1,428
Flow rate (Standard, Wet, Cubic m/min)=             722
Flow rate (Standard, Dry, Cubic m/min)=             722

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CC
Particulate Loading, Dry Std. (mg/cu m)=            0.0          0.0         0.0
Particulate Loading, Actual (mg/cu m)=              0.0
Emission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

```
FILE NAME - R5BHCL                                        PROG.=VER 06/09/89
RUN # - R5BHCL                                            07-02-1990  08:41:08
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 11/02/89
PROJECT # - 9102

Point #      Delta P    Delta H     Stack T       Meter T
            (in. H2O) (in. H2O)      (F)      In(F)  Out(F)
  1          0.460      0.89         570        49     48
  2          0.460      0.89         570        54     50
  3          0.460      0.89         570        57     51
  4          0.460      0.89         570        58     52
  5          0.460      0.89         570        60     54
  6          0.460      0.89         570        60     55
  7          0.460      0.89         570        58     57
  8          0.460      0.89         570        59     57
  9          0.460      0.89         570        61     58
  10         0.460      0.89         570        61     58
  11         0.460      0.89         570        61     59
  12         0.460      0.89         570        63     59
  13         0.460      0.89         570        61     61
  14         0.460      0.89         570        62     62
  15         0.460      0.89         570        63     61
  16         0.460      0.89         570        63     61
  17         0.460      0.89         570        64     61
  18         0.460      0.89         570        65     61
  19         0.460      0.89         570        58     61
  20         0.460      0.89         570        59     62


Fraction                   Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                             (g)        (g)        (g)       (g)
DRY CATCH                  0.0000     0.0000     0.0000    0.0000
FILTER                     0.0000     0.0000     0.0000    0.0000

Fraction                   Final Wt.  Tare Wt.    Vol.     Net Wt.
                             (g)        (g)       (ml)       (g)
PROBE RINSE                0.0000     0.0000      0.0    0.0000
IMPINGERS                  0.0000     0.0000      0.0    0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

APPENDIX B-9

VOLATILE ORGANICS DATA

NOTE: All leak checks of the VOST were passed with the exception of the final leak check for test Run 1 at the bypass duct. The Teflon seating located between the sample probe and the VOST valve assembly was replaced following Run 1, and no other problems were encountered through Runs 2 through 5.

VOST SAMPLING TIMES

	24-HOUR TIME				
VOST PAIR NUMBER	RUN #1	RUN #2	RUN #3	RUN #4	RUN #5
MAIN DUCT					
1	1548 - 1623	1201 - 1241	1144 - 1224	1100 - 1140	1133 - 1213
	1730 - 1735				
2	1750 - 1810	1252 - 1319	1233 - 1308	1632 - 1712	1220 - 1300
	1855 - 1915	1329 - 1342	1316 - 1321		
3	1924 - 1933	1350 - 1401	1330 - 1347	1720 - 1746	1308 - 1336
	1941 - 2007	1409 - 1438	1358 - 1421	1755 - 1809	1345 - 1357
BYPASS DUCT					
1	1552 - 1627	1202 - 1242	1141 - 1221	1100 - 1140	1130 - 1210
	1732 - 1737				
2	1744 - 1809	1250 - 1330	1228 - 1308	1633 - 1713	1218 - 1258
	1856 - 1911				
3	1918 - 1933	1341 - 1421	1316 - 1356	1722 - 1802	1306 - 1346
	1942 - 2007				

ADJUSTED TRAP PAIR VOLUMES - OMAHA KILN STUDY

RUN #	SAMPLE LOCATION	TRAP #	METER TEMP. (F)	PRESSURE (in Hg)	TRAP VOLUME (L)	METER CORRECTION FACTOR	ADJUSTED VOLUME (L)
1	MAIN	1	23	29.11	20.000	0.999	19.24
1	MAIN	2	24	29.11	19.970	0.999	19.15
1	MAIN	3	24	29.11	20.000	0.999	19.18
1	BYPASS	1	24	29.11	20.011	1.016	19.51
1	BYPASS	2	25	29.11	20.040	1.016	19.48
1	BYPASS	3	27	29.11	20.013	1.016	19.32
2	MAIN	1	19	29.13	20.000	0.999	19.52
2	MAIN	2	19	29.13	19.770	0.999	19.29
2	MAIN	3	19	29.13	20.000	0.999	19.52
2	BYPASS	1	22	29.13	20.011	1.016	19.66
2	BYPASS	2	23	29.13	20.029	1.016	19.61
2	BYPASS	3	24	29.13	20.017	1.016	19.53
3	MAIN	1	8	29.42	19.970	0.999	20.45
3	MAIN	2	9	29.42	19.950	0.999	20.36
3	MAIN	3	9	29.42	19.970	0.999	20.38
3	BYPASS	1	11	29.42	20.028	1.016	20.64
3	BYPASS	2	14	29.42	20.011	1.016	20.41
3	BYPASS	3	14	29.42	20.032	1.016	20.43
4	MAIN	1	14	29.48	19.930	0.999	20.03
4	MAIN	2	18	29.48	20.000	0.999	19.82
4	MAIN	3	18	29.48	19.800	0.999	19.62
4	BYPASS	1	20	29.48	20.023	1.016	20.04
4	BYPASS	2	23	29.48	20.012	1.016	19.83
4	BYPASS	3	26	29.48	20.008	1.016	19.63
5	MAIN	1	8	29.72	20.000	0.999	20.69
5	MAIN	2	9	29.72	20.000	0.999	20.62
5	MAIN	3	10	29.72	19.880	0.999	20.42
5	BYPASS	1	15	29.72	20.014	1.016	20.55
5	BYPASS	2	20	29.72	20.029	1.016	20.21
5	BYPASS	3	21	29.72	20.021	1.016	20.14

$$\text{STANDARD VOLUME} = \frac{\text{VOLUME MEASURED} * \text{PRESSURE MEASURED} * 293\ \text{K} * \text{METER FACTOR}}{29.92\ \text{in Hg} * (\text{METER TEMPERATURE} + 273\ \text{K})}$$

Appendix B-9
Volatile Organics Analysis
Data Summary

VOLATILE ORGANICS ANALYSIS DATA SUMMARY

This Data Summary describes the analysis of volatile samples collected from the Ash Grove Cement Kiln, Louisville, Nebraska. Two samples types were analyzed for volatile organic components: VOST traps and VOST condensate water samples. Analysis of samples began on November 8, 1989 and proceeded until November 15, 1989. All VOST trap samples were analyzed on a Finnigan/MAT 312 double-focusing magnetic sector GC/MS system, and all VOST condensate samples were analyzed on a Finnigan/MAT CH4 single-focusing magnetic sector GC/MS system.

Analysis consisted of three phases: POHC analysis, Tentatively Identified Compound analysis (TIC) and General Organic Screen analysis for the determination of products of incomplete combustion (PIC's). The POHC analysis consisted of a fully quantitative target compound analysis, including analysis of authentic POHC standards and quantitation using response factors based on a multipoint standard curve. The organic screen consisted of a semiquantitative target compound analysis in which PIC target compound amounts were quantitated using response factors derived from a single point calibration standard. The NBS mass spectral database was used as the reference library for the forward search. POHC analysis was performed on both VOST and VOST condensate samples, while PIC and TIC analysis was performed on the VOST samples only. Additional details regarding each of these three analysis types are described below. For a more complete description of the objectives and guidelines for these analyses, please refer to the Draft Test and QA Plan, Work Assignment No. 64 (October 11, 1989).

1.0 POHC ANALYSIS

Analytical and quality assurance procedures which were used for POHC analysis were the same as those typically used for trial burn tests and are essentially identical to EPA SW-846 (Rev. 3) Methods 8240 and 5040. Modifications from these methods which were followed by MRI for this test were noted in the Test/QA Plan.

One POHC compound, monochlorobenzene, was selected fro this study. In addition, one internal standard (d_6-benzene) and two surrogate compounds (d_4-1,2-dichloroethane and d_8-toluene) were also used.

Two separate procedures were used to analyze the two sample types: purge-and-trap GC/MS for the analysis of VOST condensate water samples, and VOST desorption GC/MS for the analysis of the VOST cartridges. Separate calibration curves and QA data were generated for each of these two procedures.

2.0 ORGANIC SCREEN ANALYSIS

The organic screen was conducted on the VOST samples using the same GC/MS datafiles that were generated for the POHC analysis. The major difference between this analysis and the POHC analysis was that only a single calibration standard was analyzed to determine response factors for the PIC target compounds and no daily PIC verification standards were run. Quantitation of PIC compounds was performed via the internal standard method using response factors determined from the single-point calibration standard.

3.0 TENTATIVELY IDENTIFIED COMPOUND ANALYSIS

TIC analysis was performed on the VOST samples using the same GC/MS datafiles that were generated for the POHC analysis. In this analysis, the five largest GC/MS peaks in each of the VOST samples were selected. The corresponding mass spectra for each of these peaks were then searched against the NBS/EPA mass spectral database using the Finnigan/INCOS mass spectral searching program, LIBR. The LIBR program output consisted of a list of the best ten matches to the unknown mass spectrum. The results of each library search were then manually reviewed and the most appropriate match chosen from the list of candidate compounds. The reduced list of TIC compounds found in each sample was then checked by a second staff member experienced in mass spectral interpretation.

4.0 DATA ORGANIZATION

Results of this analysis are available in two forms: summary reports and "raw" GC/MS data. The summary reports are attached to this memo and the raw data has been appropriately stored for possible future reference. The contents of each of these two data formats are summarized below:

A. Summary Reports
  1. Calibration Standard Preparation Summary
  2. Calibration Curve Analysis Summary
  3. Daily Standard and Blank Analysis Summary
  4. SPCC Control Chart
  5. VOST Analysis Summary
  6. VOST Condensate Analysis Summary
  7. VOST Organic Screen Analysis Summary
  8. VOST Tentatively Identified Compound Summary

B. Raw Data
  1. Daily PRK spectrum and mass listing
  2. Daily BFB spectrum, mass listing and mass calibration summary
  3. Daily POHC spectrum and mass listing from the first daily verification standard
  4. PARA printouts for each GC/MS datafiles
  5. QUAN quantitation report printouts for each GC/MS datafile
  6. RIC and ion plots for each GC/MS datafile
  7. Copies of all relevant laboratory/MS instrument logbook pages
  8. Calibration curve products, including RESP cali curve plots, EDRL listings and average relative response factors.

5.0 ADDITIONAL NOTES REGARDING THIS ANALYSIS

5.1 All samples were analyzed within the 14 day holding time specified in the Test/QA Plan.

5.2 Two calibration curves were generated during the course of the VOST analysis and one curve was generated for the VOST condensate analysis. Relative standard deviations for the surrogates and POHC were well within the specifications of the the Test/QA Plan. All daily system blanks and daily standards were also within the Test/QA Plan specifications.

5.3 A BFB standard was analyzed at the beginning of each 12 hour shift. All BFB runs passed the Test/QA specifications.

5.4 An independently prepared QA performance check sample was analyzed on each of the two GC/MS systems used in this study. Only one compound, monochlorobenzene was added to the QA check sample. Both of the GC/MS systems passed the 60-120% POHC recovery accuracy requirement specified in the Test/QA Plan.

5.5 Limit of Quantitation (LOQ) values were determined for the POHC and for PIC's by finding the peak height of a give compound's quantitation ion at a known concentration, extrapolating to find the concentration of the compound at the instrument hardware threshold, and multiplying the extrapolated concentration by a multiplication factor.

$$\mathrm{LOQ} = \frac{C_{(std)} \times H_{(thresh)} \times \mathrm{Factor}}{H_{(std)}}$$

where:

$C_{(std)}$ = concentration of standard compound
$H_{(std)}$ = peak height of standard compound
$H_{(threshold)}$ = instrument hardware threshold (units of peak ht)
Factor = multiplication factor

The multiplication factor used for this study was 10, i.e., a signal had to rise 10 times above the instrument hardware threshold in order for it to be considered a quantifiable peak. The use of a multiplication factor of 10 is somewhat arbitrary; its purpose is to eliminate the reporting of false positives from spurious signals and to raise the minimum quantifiable value to a level that is hopefully within the linear range for that compound. As an example, the following equation shows the LOQ that was determined for the POHC in VOST samples:

$$\mathrm{LOQ} = \frac{5\ \mathrm{ng} \times 100\ \mathrm{counts}}{825\ \mathrm{counts}} \times 10 = 6\ \mathrm{ng}$$

It should be noted that this LOQ value is very close to the concentration of the standard used in the equation. This is because the data used to calculate this LOQ came from the lowest level standard in the VOST calibration curve, and the mass spectrometer sensitivity was intentionally adjusted so that this standard would fall near the limit of quantitation, thereby maximizing the linear range of the calibration curve.

5.6 In addition to observing all of the normal QA requirements specified in Methods 9240 and 5050, an additional QA standard containing three System Performance Calibration Check (SPCC) compounds was analyzed on a daily basis. A multipoint SPCC calibration curve was not generated. The daily SPCC compound response factors were plotted versus time as a check of the instruments' continuing system performance.

5.7 Two VOST samples (3040 and 3044) were received cracked. However, there was no loss of absorbent material so the contents of these traps were transferred to clean unbroken tubes prior to analysis. Immediately before the transfer of absorbent material was performed, the sample was spiked with the internal standard surrogates so that any losses incurred during the transfer might be estimated. There was no loss of Tenax from sample 3040 but a small amount of Tenax was lost from sample 3044 during the transfer. The difference in I.S. and surrogate signal between these two samples and the other samples and standards analyzed on the same day was estimated to be ca. 20% to 25%. However, this figure may not necessarily be relevant to the amount of POHC or other compounds that were lost since the time the sample was collected. It should also be noted that the I.S. and surrogates were spiked on the cracked tube using a flow of inert gas to transport them onto the absorbent material. Thus, some loss of I.S. and surrogates may have occurred if any portion of the carrier gas flowed through the crack rather than through the tube. Since so many factors related to the quantitation of these samples could not be fully quantified, no correction was made to the amounts of any compounds found in these samples.

5.8 One sample, 5043, was received broken. However, a significant amount of absorbent material had spilled from the tube during shipment so it was not possible to salvage it using the procedure described above.

5.9 One sample, 3051, broke while its contents were being purged onto the GC/MS. The internal standard responses for this sample was only ca. 15% to 20%, compared to other samples and standards that were analyzed on the same day. No correction was made to any compound amounts found in this sample since the I.S. was spiked onto the tube while it was still intact. Thus, it may be assumed that the loss of I.S. was representative of the loss of any other compounds which may have been on the trap.

5.10 The field blank pairs for Runs 4 and 5 (4046, 4047, 5056, and 5057) were not analyzed. It should be noted that no POHC was observed in the field blank pairs for Runs 1, 2, or 3.

5.11 Very high levels of native benzene and toluene were observed in many of the VOST samples. Unfortunately, the Test/QA Plan called for d_6-benzene to serve as the internal standard for this analysis. Based strictly on a comparison of mass spectral overlap, the presence of native benzene should not have caused any interference to the d_6-benzene signal. However, the presence of large amounts of benzene did in fact severely alter the MS response of the d_6-benzene in this study. Since the two compounds are chemically and physically identical (or nearly so), they exhibit nearly the same GC elution characteristics and thus enter the mass spectrometer at the same time. It is unclear whether the observed change in the d_6-benzene response was due to chromatographic or mass spectrometric effects, although the latter is the most likely possibility. A similar change in d_8-toluene response was also observed when native toluene was present in large quantities, although the change was much less severe than that for benzene. As a result, the internal standard used to quantitate POHC concentrations in VOST samples was changed from d_6-benzene to d_8-toluene (it should be noted that the internal standard and surrogates were added to the samples at the same time, thus allowing their roles to be switched). The switch from d_6-benzene to d_8-toluene resulted in a more consistent internal standard response throughout the sample set, although the d_6-benzene, in its new role as surrogate, exhibited very poor and erratic recovery values as a result. No significant amounts of benzene or toluene were observed in the VOST condensates and so d_6-benzene continued to be used as the internal standard for these samples.

5.12 Many of the compounds reported as TICs were not actually identified by a specific compound name but rather in terms of a compound class. This is due to the fact that many compounds have similar mass spectra. In such cases, the library search program was unable to locate a unique match but was successful in providing at least some structural or class information related to the unknown compound. In these cases, the most general compound description encompassing the range of library candidate compounds was given. For example, a search of a peak in sample 1042 resulted in a number of library candidate compounds of the general formula $C_{10}H_{22}$, yet no single candidate compound was significantly better than the others in its match to the unknown spectrum. As a result, the peak was identified simply as "decene," with the understanding that no further information regarding the location of the double bond could be discerned from the available information.

5.13 For the quantitation of TICs in the samples, a different approach to the internal standard problem had to be used. Quantitation of TICs usually consists of comparing the absolute response between the TIC and the internal standard peak. Response is determined using the total ion count over the entire mass scanning range. A response factor of unity is assumed, since historical Rfs are not usually available for TICs. Unfortunately, the total ion peaks of the labeled compounds in many of these samples were completely obscured by the very much larger TIC and PIC peaks, most notably benzene and toluene. Thus, it was necessary to use an "external" I.S. total ion count, taken from each sample's corresponding daily system blank. Since the system blanks did not contain any native compounds, a "clean" I.S. signal could be measured, against which the TICs in the samples were then quantitated.

Calibration Standard Preparation Summary / Ash Grove Cement Kiln 9102R-6415

Compound / Nominal POHC Concentration	Concentration (ng/ul)					
	0	2.5	10	25	100	250
d6-Benzene	51.2	51.2	51.2	51.2	51.2	51.2
d4-1,2-Dichloroethane (d4-DCE)	52.4	10.5	21	52.4	105	210
d8-Toluene (d8-Tol)	50.4	10.1	20.2	50.4	100.8	202
Monochlorobenzene (MCB)	0	2.4	9.9	24.8	99.3	250

Calibration Curve Summary / Ash Grove Cement Kiln 9102L-6415

	Amount[a] (total ng)	Response Factor (Rf)				
		d6-Benzene	d4-DCE	d8-Toluene	MCB (112)[b]	MCB (114)[c]
VOST	5	1.000	.179	.695	.543	.118
11/8/89	20	1.000	.198	.824	.661	.194
Rf's vs d6-Benzene	50	1.000	.215	.873	.704	.215
	200	1.000	.220	.893	.746	.240
	500	1.000	.212	.884	.728	.240
	Average Rf:		.205	.834	.676	.201
	RSD (%):		8.1	9.8	12.0	25.0

	Amount[a] (total ng)	Response Factor (Rf)				
		d6-Benzene	d4-DCE	d8-Toluene	MCB (112)[b]	MCB (114)[c]
VOST	5	1.437	.258	1.000	.781	.170
11/8/89	20	1.212	.240	1.000	.802	.235
Rf's vs d8-Toluene	50	1.145	.246	1.000	.806	.246
	200	1.119	.246	1.000	.835	.269
	500	1.130	.240	1.000	.822	.271
	Average Rf:	1.209	.246		.809	.238
	RSD (%):	11.0	3.0		2.5	17.2

	Amount[a] (total ng)	Response Factor (Rf)				
		d6-Benzene	d4-DCE	d8-Toluene	MCB (112)[b]	MCB (114)[c]
VOST 11/10/89 High-Level Std.	2000	1.137	.239	1.000	.481	.237

	Amount[a] (total ng)	Response Factor (Rf)				
		d6-Benzene	d4-DCE	d8-Toluene	MCB (112)[b]	MCB (114)[c]
VOST Condensate	5	1.000	.188	.891	.687	
(Purge-and-Trap)	20	1.000	.181	.945	.832	.229
11/13/89	50	1.000	.174	1.010	.926	.276
Rf's vs d6-Benzene	200	1.000	.153	.955	.853	.265
	500	1.000	.190	.904	.817	.266
	Average Rf:	1.000	.177	.941	.823	.259
	RSD (%):		8.4	5.0	10.5	8.0

Notes:

a. Standard amounts are shown as nominal values. Exact concentrations of target analytes are shown in the Calibration Standard Preparation Summary.

b. Quantitated using primary quantitation ion (m/z 112).

c. Quantitated using secondary quantitation ion (m/z 114).

Standard and Blank Analysis Summary \ Ash Grove Cement Kiln 9102L-6415

VOST

Date	POHC Amt. (ng)	Description	Amount (total ng)[a] d6-Benz	d4-DCE	MCB [b]	MCB [c]	% Variance d6-Benz	d4-DCE	MCB [b]	MCB [c]
11/9/89	0	Daily Blank	100	102	2	0	0	2		
	50	Daily Verification Std.	101	102	50	52	1	2	1	5
	0	Cleanup Blank	98	97	3	3	-2	-3		
	50	Shift Verification Std.	96	96	58	62	-4	-4	17	24
	0	Cleanup Blank	98	98	0	0	-2	-2		
	2000	Daily Final Std.[d]	94	97	1190	1992	-6	-3	-41[e]	0
11/10/89	0	Daily Blank	101	100	0	0	1	0		
	50	Daily Verification Std.	95	96	51	52	-5	-4	1	5
	0	Cleanup Blank	97	95	3	2	-3	-5		
	50	Shift Verification Std.	98	94	49	51	-2	-6	-2	2
	50	Daily Final Std.	99	99	52	55	-1	-1	5	9
11/13/89	0	Daily Blank	98	93	0	0	-2	-7		
	50	Daily Verification Std.	100	95	47	50	0	-5	-6	-1
	50	Shift Verification Std.	193	186	46	48	-3	-7	-8	-4
	50	Daily Final Std.	97	94	55	58	-3	-6	9	16
11/14/89	0	Daily Blank	101	96	0	0	1	-4		
	50	Daily Verification Std.	97	92	46	49	-3	-8	-7	-2
	50	Shift Verification Std.	96	92	49	53	-4	-8	-2	6
	0	Cleanup Blank	96	89	1	0	-4	-11		
	0	Cleanup Blank	97	90	0	0	-3	-10		
	0	Cleanup Blank	97	93	0	0	-3	-7		
	50	Daily Final Std.	97	98	49	51	-3	-2	-2	1
11/15/89	0	Daily Blank	103	100	0	0	3	0		
	50	Daily Verification Std.	92	90	47	49	-8	-10	-6	-2
	50	Shift Verification Std.	91	90	44	46	-9	-10	-11	-8
	0	Cleanup Blank	101	99	4	3	1	-1		
	50	Daily Final Std.	97	93	48	50	-3	-7	-3	0

VOST Condensate (Purge-and-Trap)

Date	POHC Amt. (ng)	Description	Amount (total ng) d4-DCE	d8-Tol	MCB [b]	MCB [c]	% Variance d4-DCE	d8-Tol	MCB [b]	MCB [c]
11/14/89	0	Daily blank	117	99	0	0	11	-2		
	50	Daily verification std.	114	100	49	45	9	0	-1	-10
	50	Daily final std.	108	105	47	43	3	4	-5	-14
11/15/89	0	Daily blank	86	107	0	0	-18	6		
	50	Daily verification std.	103	103	48	45	-1	2	-3	-8
	50	Daily final std.	110	87	47	48	5	-14	-6	-3

Notes:

a. Compounds quantitated vs d8-toluene internal standard.

b. Amounts calculated using primary quantitation ion (m/z 112).

c. Amounts calculated using secondary quantitation ion (m/z 114).

d. This standard also served as an extended point for the 11/8/89 calibration curve.

e. Primary quantitation ion was saturated at this level.

VOST Analysis Summary / Ash Grove Cement Kiln 9201L-6415

			MCB	% Recovery [b]	
No.	Sample No	Description	Amount (ng)[b]	d6-Benzene	d4-DCE
1	1040	PR1 TNX	1011 [a]	47	144
2	1041	PR1 TC	- [c]	100	100
3	1042	PR2 TNX	1060 [a]	23	104
4	1043	PR2 TC	-	95	96
5	1044	PR3 TNX	681 [a]	62	149
6	1045	PR3 TC	-	99	98
7	1047	PR1 TC	-	100	98
8	1048	TB TNX	-	99	96
9	1049	TB TC	-	100	97
10	1050	PR1 TNX	140	93	98
11	1051	PR1 TC	18	100	99
12	1054	PR3 TNX	220	97	99
13	1055	PR3 TC	-	100	98
14	1056	FB TNX	-	100	97
15	1057	FB TC	-	101	99
16	1058	TB TNX	-	101	99
17	1059	TB TC	-	101	98
18	2040	PR1 TNX	1278 [a]	42	148
19	2041	PR1 TC	-	98	99
21	2042	PR2 TNX	1331 [a]	52	160
20	2043	PR2 TC	-	101	101
22	2044	PR3 TNX	1540 [a]	53	158
23	2045	PR3 TC	-	98	99
24	2046	FB TNX	-	96	96
25	2047	FB TC	-	95	94
26	2048	TB TNX	-	98	96
27	2049	TB TC	-	100	98
28	2050	PR1 TNX	33	94	106
29	2051	PR1 TC	6	98	96
30	2054	PR3 TNX	556 [a]	98	111
31	2055	PR3 TC	-	99	98
32	2058	TB TNX	-	105	102
33	2059	TB TC	-	100	99
34	3040	PR1 TNX [d]	108	70	139
35	3041	PR1 TC	-	96	91
36	3042	PR2 TNX	114	74	145
37	3043	PR2 TC	-	98	96
38	3044	PR3 TNX [d]	104	70	125
39	3045	PR3 TC	-	97	93
40	3048	TB TNX	-	99	94
41	3049	TB TC	-	102	97
42	3050	PR1 TNX	9	96	92
43	3051	PR1 TC [e]	-	196	190

VOST Analysis Summary / Ash Grove Cement Kiln 9201L-6415

No.	Sample No	Description	MCB Amount (ng)	% Recovery d6-Benzene	% Recovery d4-DCE
44	3052	PR2 TNX	9	98	94
45	3053	PR2 TC	-	101	97
46	3054	PR3 TNX	6	97	92
47	3055	PR3 TC	-	99	103
48	3056	FB TNX	-	138	130
49	3057	FB TC	-	135	129
50	3058	TB TNX	-	97	93
51	3059	TB TC	-	169	170
52	4040	PR1 TNX	1394[a]	61	126
53	4041	PR1 TC	-	96	94
54	4044	PR3 TNX	1226[a]	64	127
55	4045	PR3 TC	-	96	94
56	4048	TB TNX	-	95	93
57	4049	TRB TC	-	97	93
58	4050	PR1 TNX	11	93	90
59	4051	PR1 TC	-	98	98
60	4054	PR3 TNX	-	96	94
61	4055	PR3 TC	-	98	98
62	4058	TB TX	-	96	94
63	4059	TB TC	-	107	103
64	5040	PR1 TNX	1329[a]	64	132
65	5041	PR1 TC	-	97	95
66	5044	PR3 TNX	1197[a]	64	133
67	5045	PR3 TNX	-	96	95
68	5048	TB TNX	-	96	94
69	5049	TC TC	-	104	102
70	5050	PR1 TNX	23	103	110
71	5051	PR1 TC	-	164	176
72	5054	PR3 TNX	6	94	92
73	5055	PR3 TC	-	129	131
74	5058	TB TNX	-	93	90
75	5059	TB TC	-	160	159

Notes:

a. MCB amounts in excess of 500 ng were determined using a secondary ion (m/z 114).

b. All MCB amounts and surrogate recovery values were determined using d8-toluene as the internal standard.

c. Not detected above the measured limit of quantitation. LOQ = 6 total ng of POHC.

d. VOST cartridge was received broken. The cartridge contents were transferred to a new tube prior to analysis.

e. VOST cartridge cracked during heated purge. Internal standard (d8-toluene) response was very low, resulting in artificially high surrogate recovery values.

VOST Condensate Analysis Summary / Ash Grove Cement Kiln 9102L-6415

No.	Description	MCB Amount (mg/l)	Surrogate Recovery (%) [a/] d4-DCE	Surrogate Recovery (%) [a/] d8-Toluene
1	1026	- [b/]	97	95
2	2026	-	100	95
3	2027	-	88	78
4	3026	-	80	98
5	3027	-	90	76
6	4026	-	92	93
7	4027	-	95	80
8	5026	-	94	95
9	5027	-	89	82

Notes:

a. Surrogate recovery determined relative to d6-Benzene internal standard.

b. Not detected above the measured limit of quantitation. LOQ = 2.2 mg/l condensate.

VOST Screen Analysis Summary / 9102-6415

No.	Compound	LOQ[a]	1040[b]	1041	1042	1043	1044	1045	1047	1048	1049	1050	1051	1054
			Amount (Total ng)											
1	TRICHLOROETHENE	14	37	-	29	-	-	-	-	-	-	23	38	-
2	1,1-DICHLOROETHENE	23	-	-	-	-	-	-	-	-	-	-	-	-
3	METHYLENE CHLORIDE	20	796	359	837	353	821	547	-	-	-	25	-	-
4	TRICHLOROFLUOROMETHANE	50	-	-	-	-	-	-	-	-	-	-	68	-
5	TRANS-1,2-DICHLOROETHENE	18	-	-	-	-	-	-	-	-	-	-	-	-
6	1,1-DICHLOROETHANE	11	-	-	64	-	-	-	-	-	-	-	-	-
7	CHLOROFORM	12	-	-	1283	-	-	-	-	-	-	-	-	-
8	1,1,1-TRICHLOROETHANE	26	-	-	-	-	-	-	-	-	-	-	-	-
9	CARBON TETRACHLORIDE	28	-	-	-	-	-	-	-	-	-	-	-	-
10	BENZENE [c]	4	12418*	46	19837*	33	10428*	100	11	11	19	508	33	536
11	1,2-DICHLOROETHANE	22	-	-	2346	-	-	-	-	-	-	-	-	-
12	1,2-DICHLOROPROPANE	10	-	-	-	-	-	-	-	-	-	-	-	-
13	BROMODICHLOROMETHANE	13	-	-	392	-	-	-	-	-	-	-	-	-
14	2-CHLOROETHYLVINYL ETHER	22	-	-	7745	-	-	-	-	-	-	-	-	-
15	CIS-1,3-DICHLOROPROPENE	7	-	-	19	-	-	-	-	-	-	-	-	-
16	TOLUENE [d]	5	12066*	11	17485*	21	10092*	6	-	26	7	509	29	312
17	TRANS-1,3-DICHLOROPROPENE	51	-	-	-	-	-	-	-	-	-	-	-	-
18	1,1,2-TRICHLOROETHANE	13	-	-	1562	-	-	-	-	-	-	-	-	-
19	TETRACHLOROETHENE	14	201	-	103	-	46	-	-	-	-	44	-	21
20	1,1,2,2-TETRACHLOROETHANE	8	-	-	25	-	-	-	-	-	-	-	-	-
21	ETHYLBENZENE	10	2159	-	2354	-	1769	-	-	-	-	43	-	46
22	BROMOFORM	14	-	-	-	-	-	-	-	-	-	-	-	-
23	DIBROMOCHLOROMETHANE	12	-	-	88	-	-	-	-	-	-	-	-	-
24	ACETONE	65	-	-	-	-	-	-	-	106	-	-	-	-
25	ACROLEIN	49	-	-	3333	-	-	-	-	-	-	-	-	-
26	ACRYLONITRILE	10	-	-	28	-	-	-	-	-	-	-	-	-
27	DIETHYL ETHER	8	-	-	-	-	-	-	-	-	-	-	-	-
28	METHYL ETHYL KETONE	37	-	-	-	-	-	-	-	-	-	124	-	399

Notes:

a. Limit of quantitation expressed in units of total ng/trap
b. Sample No.
c. * = quantitated using secondary ion (m/z 51)
d. * = quantitated using secondary ion (m/z 65)

VOST Screen Analysis Summary / 9102-6415

		Amount (Total ng)											
No.	Compound	1055 a/	1056	1057	1058	1059	2040	2041	2042	2043	2044	2045	2046
1	TRICHLOROETHENE	-	-	-	-	-	-	-	20	-	-	-	-
2	1,1-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
3	METHYLENE CHLORIDE	-	-	-	-	-	1100	434	1175	535	1294	648	-
4	TRICHLOROFLUOROMETHANE	-	-	-	153	-	-	-	-	-	-	-	-
5	TRANS-1,2-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
6	1,1-DICHLOROETHANE	-	-	-	-	-	-	-	39	-	-	-	-
7	CHLOROFORM	-	-	-	-	-	-	-	-	84	-	-	-
8	1,1,1-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	-	-	-
9	CARBON TETRACHLORIDE	-	-	-	-	-	-	-	-	-	-	-	-
10	BENZENE b/	26	27	14	27	21	13938*	121	12342*	84	13018*	111	32
11	1,2-DICHLOROETHANE	-	-	-	-	-	-	-	1062	-	-	-	-
12	1,2-DICHLOROPROPANE	-	-	-	-	-	-	-	-	-	-	-	-
13	BROMODICHLOROMETHANE	-	-	-	-	-	-	-	439	-	-	-	-
14	2-CHLOROETHYLVINYL ETHER	-	-	-	-	-	-	-	4651	-	-	-	-
15	CIS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	7	-	-	-	-
16	TOLUENE c/	-	6	6	31	-	12521*	28	12062*	12	12726*	9	12
17	TRANS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-	-	-
18	1,1,2-TRICHLOROETHANE	-	-	-	-	-	-	-	1214	-	-	-	-
19	TETRACHLOROETHENE	-	-	-	-	-	51	-	31	-	23	-	-
20	1,1,2,2-TETRACHLOROETHANE	-	-	-	-	-	-	58	-	-	-	-	-
21	ETHYLBENZENE	-	-	-	-	-	2377	-	2263	-	2605	-	-
22	BROMOFORM	-	-	-	-	-	-	22	-	-	-	-	-
23	DIBROMOCHLOROMETHANE	-	-	-	-	-	-	-	25	-	-	-	-
24	ACETONE	-	-	-	-	-	-	-	-	-	-	-	141
25	ACROLEIN	-	-	-	-	-	-	-	8230	-	-	-	-
26	ACRYLONITRILE	-	-	-	-	-	-	-	69	-	-	-	-
27	DIETHYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
28	METHYL ETHYL KETONE	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

a/ Sample No.
b/ * = quantitated using secondary ion (m/z 51)
c/ * = quantitated using secondary ion (m/z 65)

VOST Screen Analysis Summary / 9102-6415

No.	Compound	Amount (Total ng)											
		2047[a]	2048	2049	2050	2051	2054	2055	2058	2059	3040	3041	3042
1	TRICHLOROETHENE	-	-	-	20	16	15	-	-	-	44	-	-
2	1,1-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
3	METHYLENE CHLORIDE	-	44	-	37	-	26	-	-	-	8949	223	886
4	TRICHLOROFLUOROMETHANE	-	63	-	-	-	-	61	-	-	1303	56	70
5	TRANS-1,2-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
6	1,1-DICHLOROETHANE	-	-	-	-	-	-	-	-	-	43	-	50
7	CHLOROFORM	-	-	-	-	-	-	-	-	-	-	-	1346
8	1,1,1-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	31	-	-
9	CARBON TETRACHLORIDE	-	-	-	-	-	-	-	-	-	36	-	-
10	BENZENE [b]	-	11	22	1081*	53	1285*	46	26	13	10155*	199	9770*
11	1,2-DICHLOROETHANE	-	-	-	-	-	-	-	-	-	660	-	537
12	1,2-DICHLOROPROPANE	-	-	-	-	-	-	-	-	-	-	-	-
13	BROMODICHLOROMETHANE	-	-	-	-	-	-	-	-	-	1174	-	375
14	2-CHLOROETHYLVINYL ETHER	-	-	-	-	-	-	-	-	-	-	-	3865
15	CIS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-	-	-
16	TOLUENE [c]	-	63	8	390	47	374	6	-	7	9748*	16	10570*
17	TRANS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-	-	-
18	1,1,2-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	746	-	948
19	TETRACHLOROETHENE	-	-	-	33	-	24	-	-	-	57	-	-
20	1,1,2,2-TETRACHLOROETHANE	-	-	-	-	-	-	-	-	-	13	33	-
21	ETHYLBENZENE	-	-	-	48	-	71	-	-	-	1411	-	1747
22	BROMOFORM	-	-	-	-	-	-	-	-	-	-	-	-
23	DIBROMOCHLOROMETHANE	-	-	-	-	-	-	-	-	-	48	-	-
24	ACETONE	-	167	-	-	-	-	-	-	-	-	-	-
25	ACROLEIN	-	-	-	-	-	-	-	-	-	2505	344	3809
26	ACRYLONITRILE	-	-	-	-	-	-	-	-	-	461	22	28
27	DIETHYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
28	METHYL ETHYL KETONE	-	-	-	324	-	-	-	-	-	46	-	-

Notes:

[a] Sample No.

[b] * = quantitated using secondary ion (m/z 51)

[c] * = quantitated using secondary ion (m/z 65)

VOST Screen Analysis Summary / 9102-6415

No.	Compound	3043 a/	3044	3045	3048	3049	3050	3051	3052	3053	3054	3055	3056
		Amount (Total ng)											
1	TRICHLOROETHENE	-	92	-	-	-	-	-	16	-	-	-	-
2	1,1-DICHLOROETHENE	-	-	-	-	-	29	-	30	-	39	-	-
3	METHYLENE CHLORIDE	245	1397	148	51	115	399	-	1668	42	187	97	38
4	TRICHLOROFLUOROMETHANE	108	81	-	-	-	68	-	159	87	55	64	-
5	TRANS-1,2-DICHLOROETHENE	-	-	-	-	-	23	-	24	-	31	-	-
6	1,1-DICHLOROETHANE	-	55	-	-	-	-	-	-	-	-	-	-
7	CHLOROFORM	20	1101	-	-	-	-	-	-	-	-	-	-
8	1,1,1-TRICHLOROETHANE	-	-	-	-	-	-	-	36	-	41	-	-
9	CARBON TETRACHLORIDE	-	-	-	-	-	-	-	-	-	-	-	-
10	BENZENE b/	310	9039*	487	25	50	121	396	176	61	75	18	7
11	1,2-DICHLOROETHANE	-	496	-	-	-	-	-	-	-	-	-	-
12	1,2-DICHLOROPROPANE	-	-	-	-	-	-	-	-	-	-	-	-
13	BROMODICHLOROMETHANE	-	1347	-	-	-	-	-	-	-	-	-	-
14	2-CHLOROETHYLVINYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
15	CIS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-	-	-
16	TOLUENE c/	11	9317*	11	7	16	135	-	201	-	96	9	-
17	TRANS-1,3-DICHLOROPROPENE	-	347	-	-	-	-	-	-	-	-	-	-
18	1,1,2-TRICHLOROETHANE	-	805	-	-	-	-	-	-	-	-	-	-
19	TETRACHLOROETHENE	-	37	-	-	-	21	-	16	-	-	-	-
20	1,1,2,2-TETRACHLOROETHANE	56	25	-	-	-	-	-	-	-	-	-	-
21	ETHYLBENZENE	-	1610	-	-	-	30	-	-	-	20	-	-
22	BROMOFORM	18	-	-	-	-	-	-	-	-	-	-	-
23	DIBROMOCHLOROMETHANE	-	-	-	-	-	-	-	-	-	-	-	-
24	ACETONE	-	-	-	-	-	258	-	-	-	-	241	138
25	ACROLEIN	-	3564	-	-	-	50	-	-	-	-	-	-
26	ACRYLONITRILE	15	-	-	-	-	-	-	-	-	-	-	-
27	DIETHYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
28	METHYL ETHYL KETONE	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

a/ Sample No.
b/ * = quantitated using secondary ion (m/z 51)
c/ * = quantitated using secondary ion (m/z 65)

VOST Screen Analysis Summary / 9102-6415

No.	Compound	Amount (Total ng) 3057 a/	3058	3059	4040	4041	4044	4045	4048	4049	4050	4051	4054
1	TRICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
2	1,1-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
3	METHYLENE CHLORIDE	-	190	143	822	245	676	384	179	57	76	89	-
4	TRICHLOROFLUOROMETHANE	-	-	-	-	-	-	-	-	-	-	-	-
5	TRANS-1,2-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
6	1,1-DICHLOROETHANE	-	-	-	25	-	21	-	-	-	-	-	-
7	CHLOROFORM	-	-	-	-	39	-	76	-	-	-	-	-
8	1,1,1-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	-	-	-
9	CARBON TETRACHLORIDE	-	-	-	-	-	-	-	-	-	-	-	-
10	BENZENE b/	-	37	24	10272*	87	9382*	107	33	10	98	80	47
11	1,2-DICHLOROETHANE	-	-	-	748	-	599	-	-	-	-	-	-
12	1,2-DICHLOROPROPANE	-	-	-	-	-	-	-	-	-	-	-	-
13	BROMODICHLOROMETHANE	-	-	-	945	-	996	-	-	-	-	-	-
14	2-CHLOROETHYLVINYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
15	CIS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-	-	-
16	TOLUENE c/	-	34	-	9691*	-	9027*	12	15	11	135	13	63
17	TRANS-1,3-DICHLOROPROPENE	-	-	-	-	-	278	-	-	-	-	-	-
18	1,1,2-TRICHLOROETHANE	-	-	-	918	-	853	-	-	-	-	-	-
19	TETRACHLOROETHENE	-	-	-	-	-	-	-	-	-	26	-	-
20	1,1,2,2-TETRACHLOROETHANE	-	-	-	-	-	12	-	-	-	-	-	-
21	ETHYLBENZENE	-	-	-	1766	-	1607	-	-	-	-	-	-
22	BROMOFORM	-	-	-	-	-	-	-	-	-	-	-	-
23	DIBROMOCHLOROMETHANE	-	-	-	-	-	-	-	-	-	-	-	-
24	ACETONE	-	-	-	-	-	-	-	-	-	-	-	-
25	ACROLEIN	-	-	-	5579	462	-	1531	-	-	-	-	-
26	ACRYLONITRILE	-	-	-	18	10	14	32	-	-	-	-	-
27	DIETHYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
28	METHYL ETHYL KETONE	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

a/ Sample No.

b/ * = quantitated using secondary ion (m/z 51)

c/ * = quantitated using secondary ion (m/z 65)

VOST Screen Analysis Summary / 9102-6415

No.	Compound	Amount (Total ng)											
		4055 a/	4058	4059	5040	5041	5044	5045	5048	5049	5050	5051	5054
1	TRICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
2	1,1-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
3	METHYLENE CHLORIDE	-	74	86	846	596	853	332	519	-	121	114	43
4	TRICHLOROFLUOROMETHANE	-	-	-	-	-	-	-	71	-	-	-	-
5	TRANS-1,2-DICHLOROETHENE	-	-	-	-	-	-	-	-	-	-	-	-
6	1,1-DICHLOROETHANE	-	-	-	34	-	30	-	-	-	-	-	-
7	CHLOROFORM	-	-	-	-	46	-	35	-	-	-	-	-
8	1,1,1-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	-	-	-
9	CARBON TETRACHLORIDE	-	-	-	-	-	-	-	-	-	-	-	-
10	BENZENE b/	39	25	35	9178*	115	9018*	110	35	16	204	-	114
11	1,2-DICHLOROETHANE	-	-	-	624	-	601	-	-	-	-	-	-
12	1,2-DICHLOROPROPANE	-	-	-	-	-	-	-	-	-	-	-	-
13	BROMODICHLOROMETHANE	-	-	-	1264	-	932	-	-	-	-	-	-
14	2-CHLOROETHYLVINYL ETHER	-	-	-	-	-	-	-	-	-	95	-	46
15	CIS-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	25	-	18
16	TOLUENE c/	-	7	10	9137*	42	8786*	7	28	-	207	-	110
17	TRANS-1,3-DICHLOROPROPENE	-	-	-	-	-	254	-	-	-	-	-	-
18	1,1,2-TRICHLOROETHANE	-	-	-	915	-	858	-	-	-	-	-	-
19	TETRACHLOROETHENE	-	-	-	-	-	-	-	-	-	26	-	-
20	1,1,2,2-TETRACHLOROETHANE	-	-	-	16	20	26	-	-	-	19	-	-
21	ETHYLBENZENE	-	-	-	1630	-	1527	-	-	-	38	-	12
22	BROMOFORM	-	-	-	-	-	-	-	-	-	-	-	-
23	DIBROMOCHLOROMETHANE	-	-	-	-	-	-	-	-	-	-	-	-
24	ACETONE	-	-	-	-	-	-	-	-	-	-	-	-
25	ACROLEIN	-	-	-	5019	702	-	316	-	-	-	-	-
26	ACRYLONITRILE	-	-	-	42	27	38	-	-	-	32	-	12
27	DIETHYL ETHER	-	-	-	-	-	-	-	-	-	-	-	-
28	METHYL ETHYL KETONE	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

a/ Sample No.

b/ * = quantitated using secondary ion (m/z 51)

c/ * = quantitated using secondary ion (m/z 65)

VOST Screen Analysis Summary / 9102-6415

No.	Compound	Amount (Total ng)		
		5055[a]	5058	5059
1	TRICHLOROETHENE	-	-	-
2	1,1-DICHLOROETHENE	-	-	-
3	METHYLENE CHLORIDE	21	58	-
4	TRICHLOROFLUOROMETHANE	52	-	-
5	TRANS-1,2-DICHLOROETHENE	-	-	-
6	1,1-DICHLOROETHANE	-	-	-
7	CHLOROFORM	-	-	-
8	1,1,1-TRICHLOROETHANE	-	-	-
9	CARBON TETRACHLORIDE	-	-	-
10	BENZENE [b]	26	37	-
11	1,2-DICHLOROETHANE	-	-	-
12	1,2-DICHLOROPROPANE	-	-	-
13	BROMODICHLOROMETHANE	-	-	-
14	2-CHLOROETHYLVINYL ETHER	-	-	-
15	CIS-1,3-DICHLOROPROPENE	-	-	-
16	TOLUENE [c]	-	-	-
17	TRANS-1,3-DICHLOROPROPENE	-	-	-
18	1,1,2-TRICHLOROETHANE	-	-	-
19	TETRACHLOROETHENE	-	-	-
20	1,1,2,2-TETRACHLOROETHANE	-	-	-
21	ETHYLBENZENE	-	-	-
22	BROMOFORM	-	-	-
23	DIBROMOCHLOROMETHANE	-	-	-
24	ACETONE	-	-	-
25	ACROLEIN	-	-	-
26	ACRYLONITRILE	-	-	-
27	DIETHYL ETHER	-	-	-
28	METHYL ETHYL KETONE	-	-	-

Notes:

[a] Sample No.

[b] * = quantitated using secondary ion (m/z 51)

[c] * = quantitated using secondary ion (m/z 65)

Cement Kiln Semi-Quantitative Screen Target List

acetone
acrolein
acrylonitrile
benzene
bromodichloromethane
bromoform
carbon tetrachloride
2-chloroethyl-vinyl ether
chloroform
dibromochloromethane
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethene
t-1,2-dichloroethene
1,2-dichloropropane
t-1,3-dichloropropene
c-1,3-dichloropropene
diethyl ether
ethylbenzene
methylene chloride
methyl ethyl ketone
1,1,2,2-tetrachloroethane
tetrachloroethene
toluene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethene
trichlorofluoromethane

Method 1624 Target Analytes Not Selected for Kiln Screen

chloromethane
bromomethane
chloroethane
vinyl chloride
p-dioxane
chlorobenzene (POHC)

VOLATILE PICs

MAIN DUCT	RUN #1		RUN #2		RUN #3		RUN #4		RUN #5	
COMPOUND	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)
Acetone										
Acrolein										
Acrylonitrile										
Benzene	598.64	874.01	696.94	1019.63	487.18	727.37	501.08	757.64	448.00	677.37
Bromodichloromethane										
Bromoform			0.55	0.81						
Carbon Tetrachloride										
2-Chloroethylvinyl Ether										
Chloroform										
Dibromochloromethane										
1,1-Dichloroethane										
1,2-Dichloroethane										
1,1-Dichloroethene										
Trans-1,2-Dichloroethene										
1,2-Dichloropropane										
Trans-1,3-Dichloropropene										
CIS-1,3-Dichloropropene										
Diethyl Ether										
Ethylbenzene	102.28	149.33	127.74	186.89	74.04	110.54	85.18	128.79	76.78	116.09
Methylene Chloride	65.72	95.95	89.17	130.45	262.64	392.13	53.70	81.19	63.89	96.60
Methyl Ethyl Ketone										
1,1,2,2-Tetrachloroethane			1.48	2.17						
Tetrachloroethene	6.43	9.39	1.90	2.78	2.31	3.45				
Toluene	577.75	843.52	648.62	948.94	468.16	698.97	473.21	715.49	437.39	661.34
1,1,1-Trichloroethane										
1,1,2-Trichloroethane										
Trichloroethene	0.97	1.42			3.34	4.98				
Trichlorofluoromethane					35.25	52.63				

VOLATILE PICs

BYPASS DUCT	RUN #1		RUN #2		RUN #3		RUN #4		RUN #5	
COMPOUND	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONQEN-TRATION (ng/L)	EMISSION RATE (mg/min)	CONCEN-TRATION (ng/L)	EMISSION RATE (mg/min)
Acetone					60.75	42.16				
Acrolein										
Acrylonitrile										
Benzene	28.43	20.24	62.87	42.00	16.64	11.55	6.66	4.57	8.67	5.96
Bromodichloromethane										
Bromoform										
Carbon Tetrachloride										
2-Chloroethylvinyl Ether										
Chloroform										
Dibromochloromethane										
1,1-Dichloroethane										
1,2-Dichloroethane										
1,1-Dichloroethene					1.66	1.15				
Trans-1,2-Dichloroethene										
1,2-Dichloropropane										
Trans-1,3-Dichloropropene										
CIS-1,3-Dichloropropene										
Diethyl Ether										
Ethylbenzene	2.28	1.63	3.04	2.03	1.21	0.84			1.27	0.87
Methylene Chloride	0.65	0.46	1.60	1.07	16.64	11.55	4.15	2.85	7.54	5.18
Methyl Ethyl Ketone	67.68	48.19							0.73	0.50
1,1,2,2-Tetrachloroethane										
Tetrachloroethene	1.67	1.19	1.44	0.96	0.50	0.35	0.66	0.45	0.65	0.44
Toluene	21.87	15.57	20.82	13.91	5.85	4.06	5.33	3.66	7.97	5.47
1,1,1-Trichloroethane					1.01	0.70				
1,1,2-Trichloroethane										
Trichloroethene	1.57	1.12	1.29	0.86						
Trichlorofluoromethane	1.75	1.24	1.55	1.04	4.53	3.14			1.32	0.91

Shaded values may be impacted by blank data values.

	RUN #1
MAIN DUCT	
Pair 1 Sample Vol	19.2 L
Pair 3 Sample Vol	19.1 L
Total Sample Vol	38.4 L
Stack flow rate	1460 dscm/min

Compound	Amount Detected (ng) Trip Blk T	Trip Blk T/C	Pair 1 T	Pair 1 T/C	Pair 3 T	Pair 3 T/C	Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
Trichloroethene			37				37	0.97	1.42
1,1-Dichloroethene									
Methylene Chloride			796	359	821	547	2524	65.72	95.95
Trichlorofluoromethane									
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	11	19	12415	46	10426	100	22988	598.64	874.01
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene	26	7	12072	11	10097	6	22186	577.75	843.52
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane									
Tetrachloroethene			201		46		247	6.43	9.39
1,1,2,2-Tetrachloroethane									
Ethylbenzene			2159		1769		3928	102.28	149.33
Bromoform									
Dibromochloromethane									
Acetone	529								
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone									

* SUM OF TWO PAIRS

RUN #2

MAIN DUCT

Pair 1 Sample Vol	19.5 L
Pair 3 Sample Vol	19.5 L
Total Sample Vol	39 L
Stack flow rate	1463 dscm/min

Compound	Amount Detected (ng)								Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Field Blk		Trip Blk		Pair 1		Pair 3				
	T	T/C	T	T/C	T	T/C	T	T/C			
Trichloroethene											
1,1-Dichloroethene											
Methylene Chloride			44		1101	434	1294	648	3478	89.17	130.45
Trichlorofluoromethane			63						0	0.00	0.00
Trans-1,2-Dichloroethene											
1,1-Dichloroethane											
Chloroform											
1,1,1-Trichloroethane										0.00	0.00
Carbon Tetrachloride											
Benzene	32		11	22	13935	121	13015	110	27181	696.94	1019.63
1,2-Dichloroethane											
1,2-Dichloropropane											
Bromodichloromethane											
2-Chloroethylvinyl Ether											
CIS-1,3-Dichloropropene											
Toluene	12	5	63	8	12527	28	12732	9	25296	648.62	948.94
Trans-1,3-Dichloropropene											
1,1,2-Trichloroethane											
Tetrachloroethene					51		23		74	1.90	2.78
1,1,2,2-Tetrachloroethane						58			58	1.48	2.17
Ethylbenzene					2377		2605		4982	127.74	186.89
Bromoform						22			22	0.55	0.81
Dibromochloromethane											
Acetone	707		835								
Acrolein											
Acrylonitrile											
Diethyl Ether											
Methyl Ethyl Ketone											

* SUM OF TWO PAIRS

	RUN #3
MAIN DUCT	
Pair 1 Sample Vol	20.4 L
Pair 3 Sample Vol	20.3 L
Total Sample Vol	40.8 L
Stack flow rate	1493 dscm/min

Compound	Amount Detected (ng)						Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Trip Blk		Pair 1		Pair 3				
	T	T/C	T	T/C	T	T/C			
Trichloroethene				44	92		136	3.34	4.98
1,1-Dichloroethene									
Methylene Chloride	51	115	8949	223	1397	148	10716	262.64	392.13
Trichlorofluoromethane			1303	55	81		1438	35.25	52.63
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	25	50	10153	199	9038	487	19877	487.18	727.37
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene	7	16	9753	16	9322	11	19101	468.16	698.97
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane									
Tetrachloroethene			57		37		94	2.31	3.45
1,1,2,2-Tetrachloroethane									
Ethylbenzene			1411		1610		3021	74.04	110.54
Bromoform									
Dibromochloromethane									
Acetone									
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone									

* SUM OF TWO PAIRS

	RUN #4
MAIN DUCT	
Pair 1 Sample Vol	20.0 L
Pair 3 Sample Vol	19.6 L
Total Sample Vol	39.6 L
Stack flow rate	1512 dscm/min

Compound	Amount Detected (ng)						Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Trip Blk		Pair 1		Pair 3				
	T	T/C	T	T/C	T	T/C			
Trichloroethene									
1,1-Dichloroethene									
Methylene Chloride	179	57	822	245	676	384	2126	53.70	81.19
Trichlorofluoromethane							0	0.00	0.00
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	33	10	10270	87	9379	107	19843	501.08	757.64
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene	15	11	9696		9032	11	18739	473.21	715.49
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane									
Tetrachloroethene									
1,1,2,2-Tetrachloroethane									
Ethylbenzene			1766		1607		3373	85.18	128.79
Bromoform									
Dibromochloromethane									
Acetone									
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone									

* SUM OF TWO PAIRS

	RUN #5
MAIN DUCT	
Pair 1 Sample Vol	20.7 L
Pair 3 Sample Vol	20.4 L
Total Sample Vol	41.1 L
Stack flow rate	1512 dscm/min

	Amount Detected (ng)						Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Trip Blk		Pair 1		Pair 3				
Compound	T	T/C	T	T/C	T	T/C			
Trichloroethene									
1,1-Dichloroethene									
Methylene Chloride	519		846	596	853	332	2626	63.89	96.60
Trichlorofluoromethane	71								
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	35	16	9176	115	9016	110	18417	448.00	677.37
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene	28	2	9142	41	8791	7	17981	437.39	661.34
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane									
Tetrachloroethene									
1,1,2,2-Tetrachloroethane									
Ethylbenzene			1630		1527		3156	76.78	116.09
Bromoform									
Dibromochloromethane									
Acetone									
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone									

* SUM OF TWO PAIRS

RUN #1

BYPASS DUCT

Pair 1 Sample Vol 19.5 L

Pair 3 Sample Vol 19.3 L

Total Sample Vol 38.8 L

Stack flow rate 712 dscm/min

Compound	Amount Detected (ng) Field Blk T	Field Blk T/C	Trip Blk T	Trip Blk T/C	Pair 1 T	Pair 1 T/C	Pair 3 T	Pair 3 T/C	Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
Trichloroethene					23	38			61	1.57	1.12
1,1-Dichloroethene											
Methylene Chloride					25				25	0.65	0.46
Trichlorofluoromethane			153			68			68	1.75	1.24
Trans-1,2-Dichloroethene											
1,1-Dichloroethane											
Chloroform											
1,1,1-Trichloroethane											
Carbon Tetrachloride											
Benzene	26	14	27	21	508	33	536	26	1104	28.43	20.24
1,2-Dichloroethane											
1,2-Dichloropropane											
Bromodichloromethane											
2-Chloroethylvinyl Ether											
CIS-1,3-Dichloropropene											
Toluene	6	6	31		509	29	312		849	21.87	15.57
Trans-1,3-Dichloropropene											
1,1,2-Trichloroethane											
Tetrachloroethene					44		21		65	1.67	1.19
1,1,2,2-Tetrachloroethane											
Ethylbenzene					43		46		89	2.28	1.63
Bromoform											
Dibromochloromethane											
Acetone											
Acrolein											
Acrylonitrile											
Diethyl Ether											
Methyl Ethyl Ketone					623		2005		2628	67.68	48.19

*Sum of Pair 1 & 2.

RUN #2

BYPASS DUCT	
Pair 1 Sample Vol	19.7 L
Pair 3 Sample Vol	19.5 L
Total Sample Vol	39.2 L
Stack flow rate	668 dscm/min

	Amount Detected (ng)						Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Trip Blk		Pair 1		Pair 3				
Compound	T	T/C	T	T/C	T	T/C			
Trichloroethene			20	16	15		51	1.29	0.86
1,1-Dichloroethene									
Methylene Chloride			37		26		63	1.60	1.07
Trichlorofluoromethane						61	61	1.55	1.04
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	26	13	1081	53	1284	46	2464	62.87	42.00
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene		7	390	47	373	6	816	20.82	13.91
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane								0.00	0.00
Tetrachloroethene			32		24		56	1.44	0.96
1,1,2,2-Tetrachloroethane									
Ethylbenzene			48		71		119	3.04	2.03
Bromoform									
Dibromochloromethane									
Acetone									
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone			1628				1628		

* SUM OF TWO PAIRS

RUN #3

BYPASS DUCT

Pair 1 Sample Vol	20.6 L
Pair 3 Sample Vol	20.4 L
Total Sample Vol	41.1 L
Stack flow rate	694 dscm/min

Compound	Amount Detected (ng)								Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Field Blk		Trip Blk		Pair 1		Pair 3				
	T	T/C	T	T/C	T	T/C	T	T/C			
Trichloroethene											
1,1-Dichloroethene					29		39		68	1.66	1.15
Methylene Chloride	38		95	143	399		187	97	684	16.64	11.55
Trichlorofluoromethane					68		55	64	186	4.53	3.14
Trans-1,2-Dichloroethene											
1,1-Dichloroethane											
Chloroform											
1,1,1-Trichloroethane							41		41	1.01	0.70
Carbon Tetrachloride											
Benzene	7		19	24	121	396	75	18	609	14.83	10.29
1,2-Dichloroethane											
1,2-Dichloropropane											
Bromodichloromethane											
2-Chloroethylvinyl Ether											
CIS-1,3-Dichloropropene											
Toluene			17		135		96	9	240	5.85	4.06
Trans-1,3-Dichloropropene											
1,1,2-Trichloroethane											
Tetrachloroethene					21				21	0.50	0.35
1,1,2,2-Tetrachloroethane											
Ethylbenzene					30		20		50	1.21	0.84
Bromoform											
Dibromochloromethane											
Acetone	688				1292			1203	2495	60.75	42.16
Acrolein											
Acrylonitrile											
Diethyl Ether											
Methyl Ethyl Ketone											

* SUM OF TWO PAIRS

RUN #4

BYPASS DUCT

Pair 1 Sample Vol	20.0 L
Pair 3 Sample Vol	19.6 L
Total Sample Vol	39.7 L
Stack flow rate	687 dscm/min

Compound	Amount Detected (ng)						Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Trip Blk		Pair 1		Pair 3				
	T	T/C	T	T/C	T	T/C			
Trichloroethene									
1,1-Dichloroethene									
Methylene Chloride	74	86	76	89			165	4.15	2.85
Trichlorofluoromethane									
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	25	35	98	80	47	39	264	6.66	4.57
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene	7	10	135	13	63		212	5.33	3.66
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane									
Tetrachloroethene			26				26	0.66	0.45
1,1,2,2-Tetrachloroethane									
Ethylbenzene									
Bromoform									
Dibromochloromethane									
Acetone									
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone									

* SUM OF TWO PAIRS

RUN #5

BYPASS DUCT
Pair 1 Sample Vol 20.0 L
Pair 3 Sample Vol 19.6 L
Total Sample Vol 39.7 L
Stack flow rate 687 dscm/min

Compound	Amount Detected (ng)						Total Amount (ng)*	Average conc (ng/L or ug/dscm)	Analyte Emission rate (mg/min)
	Trip Blk		Pair 1		Pair 3				
	T	T/C	T	T/C	T	T/C			
Trichloroethene									
1,1-Dichloroethene									
Methylene Chloride	58		121	114	43	21	299	7.54	5.18
Trichlorofluoromethane						52	52	1.32	0.91
Trans-1,2-Dichloroethene									
1,1-Dichloroethane									
Chloroform									
1,1,1-Trichloroethane									
Carbon Tetrachloride									
Benzene	37		204		114	26	344	8.67	5.96
1,2-Dichloroethane									
1,2-Dichloropropane									
Bromodichloromethane									
2-Chloroethylvinyl Ether									
CIS-1,3-Dichloropropene									
Toluene			207		110		316	7.97	5.47
Trans-1,3-Dichloropropene									
1,1,2-Trichloroethane									
Tetrachloroethene			26				26	0.65	0.44
1,1,2,2-Tetrachloroethane									
Ethylbenzene			38		12		51	1.27	0.87
Bromoform									
Dibromochloromethane									
Acetone									
Acrolein									
Acrylonitrile									
Diethyl Ether									
Methyl Ethyl Ketone						29	29	0.73	0.50

* SUM OF TWO PAIRS

NON-LISTED V-PICs

BLANK TRAP DATA RANGES

Compound	RANGE (ng) (LOW)	(HIGH)
* ACENAPHTHYLENE	140	
ALKENE		
ALKYLATED HYDROCARBON		
BENZALDEHYDE	16	821
BENZONITRILE	16	1540
* 2-BUTANONE	10	24
BUTENE/2-METHYL-1-PROPENE		
CARBON DIOXIDE	24	89
CARBON DISULFIDE	74	
DECANSE		
• DIBENZOFURAN	86	
1,1-DIMETHYLCYCLOPROPANE		
DIMETHYL HEPTENE		
ETHYLCYCLOPROPANE		
ETHYLENIMINE		
* 2-FURANCARBOXALDEHYDE	16	
* HEPTANE	29	
1-HEPTANOL		
1-HEPTENE		
HEXANE	10	85
1-HEXENE		
ISOCYANOMETHANE	90	280
KETONE	209	
3-METHYLENE-PENTANE		
3-METHYLHEXANE	13	71
2-METHYL-1-PROPENE		
NAPHTHALENE	33	
* OXYBISMEHANE	18	
2-PENTENE		
1-PHENYLETHANONE	48	411
2-PROPENENITRIL		
2-PROPYL-1-HEPTANOL		
TETRAHYDROFURAN	100	
TRIDECANE		
2,3,4-TRIMETHYLHEXANE		
• 1,3,6-TRIOXOCANE	47	
4-UNDECENE		
XYLENE		
o-XYLENE		

* Detected only in blank traps.

Blank ranges determined using total (T + T/C) data values. Field blank data and trip blank data were used as separate data points.

NON-LISTED V-PICs

Compound	MAIN DUCT RUN #1 PAIR #1 T 1040	 T/C 1041	 PAIR #3 T 1044	 T/C 1045	 TrpBlk T 1048	 T/C 1049	TOTAL (ng)	AVERAG CONC. (ng/L)	EMISSION RATE (mg/min)
* ACENAPHTHYLENE						140			
ALKENE									
ALKYLATED HYDROCARBON									
BENZALDEHYDE				274	47	87	274.00	7.14	10.42
BENZONITRILE				207	190	340	207.00	5.39	7.87
* 2-BUTANONE									
BUTENE/2-METHYL-1-PROPENE									
CARBON DIOXIDE		390		460			850.00	22.14	32.32
CARBON DISULFIDE		690		900			1590.00	41.41	60.45
DECANSE	3300						3300.00	85.94	125.47
* DIBENZOFURAN					86				
1,1-DIMETHYLCYCLOPROPANE				1200			1200.00	31.25	45.63
DIMETHYL HEPTENE									
ETHYLCYCLOPROPANE		500		1400			1900.00	49.48	72.24
ETHYLENIMINE		800					800.00	20.83	30.42
* 2-FURANCARBOXALDEHYDE									
* HEPTANE									
1-HEPTANOL									
1-HEPTENE			4200				4200.00	109.38	159.69
HEXANE									
1-HEXENE			3000				3000.00	78.13	114.06
ISOCYANOMETHANE					36	54			
KETONE									
3-METHYLENE-PENTANE									
3-METHYLHEXANE									
2-METHYL-1-PROPENE		1000		2200			3200.00	83.33	121.67
NAPHTHALENE	1422				33		1422.00	37.03	54.07
* OXYBISMEHANE									
2-PENTENE									
1-PHENYLETHANONE					35	56			
2-PROPENENITRIL									
2-PROPYL-1-HEPTANOL									
TETRAHYDROFURAN									
TRIDECANE									
2,3,4-TRIMETHYLHEXANE									
* 1,3,6-TRIOXOCANE									
4-UNDECENE	2400	359					2758.90	71.85	104.90
XYLENE	6100		5600				11700.00	304.69	444.84
o-XYLENE	4796	46					4842.30	126.10	184.11

* Detected only in blank traps

Shaded ▨ : data may be impacted by blank data values.

NON-LISTED V-PICs

	MAIN DUCT RUN #2										
	PAIR #1		PAIR #3		FldBlk		TrpBlk			AVE.	EMISS.
	T	T/C	T	T/C	T	T/C	T	T/C	TOTAL	CONC.	RATE
Compound	2040	2041	2044	2045	2046	2047	2048	2049	(ng)	(ng/L)	(mg/min)
* ACENAPHTHYLENE											
ALKENE			2580						2580.0	66.2	96.8
ALKYLATED HYDROCARBON											
BENZALDEHYDE											
BENZONITRILE											
* 2-BUTANONE											
BUTENE/2-METHYL-1-PROPENE											
CARBON DIOXIDE		280		520	23	40	23	40	800.0	20.5	30.0
CARBON DISULFIDE		780		580					1360.0	34.9	51.0
DECANSE											
* DIBENZOFURAN											
1,1-DIMETHYLCYCLOPROPANE											
DIMETHYL HEPTENE	4458								4458.0	114.3	167.2
ETHYLCYCLOPROPANE		880		1500					2380.0	61.0	89.3
ETHYLENIMINE											
* 2-FURANCARBOXALDEHYDE											
* HEPTANE											
1-HEPTANOL			5500						5500.0	141.0	206.3
1-HEPTENE											
HEXANE							26				
1-HEXENE	3800		3500						7300.0	187.2	273.8
ISOCYANOMETHANE											
KETONE											
3-METHYLENE-PENTANE	3100								3100.0	79.5	116.3
3-METHYLHEXANE											
2-METHYL-1-PROPENE		1600		2800					4400.0	112.8	165.1
NAPHTHALENE											
* OXYBISMEHANE											
2-PENTENE		460		950					1410.0	36.2	52.9
1-PHENYLETHANONE											
2-PROPENENITRIL											
2-PROPYL-1-HEPTANOL											
TETRAHYDROFURAN											
TRIDECANE											
2,3,4-TRIMETHYLHEXANE											
* 1,3,6-TRIOXOCANE											
4-UNDECENE											
XYLENE	5600		4700						10300.0	264.1	386.4
o-XYLENE											

* Detected only in blank traps

NON-LISTED V-PICs

	MAIN DUCT RUN #3								
	PAIR #1		PAIR #3		TrpBlk			AVE.	EMISS.
	T	T/C	T	T/C	T	T/C	TOTAL	CONC.	RATE
Compound	3040	3041	3044	3045	3048	3049	(ng)	(ng/L)	(mg/min)
* ACENAPHTHYLENE									
ALKENE									
ALKYLATED HYDROCARBON									
BENZALDEHYDE				450	120	210	450.00	11.03	16.47
BENZONITRILE				350	44	84	350.00	8.58	12.81
* 2-BUTANONE									
BUTENE/2-METHYL-1-PROPENE									
CARBON DIOXIDE		460		530	24		990.00	24.26	36.23
CARBON DISULFIDE		240					240.00	5.88	8.78
DECANSE									
* DIBENZOFURAN									
1,1-DIMETHYLCYCLOPROPANE									
DIMETHYL HEPTENE									
ETHYLCYCLOPROPANE		3300					3300.00	80.88	120.76
ETHYLENIMINE									
* 2-FURANCARBOXALDEHYDE									
* HEPTANE									
1-HEPTANOL									
1-HEPTENE	3100						3100.00	75.98	113.44
HEXANE						25			
1-HEXENE	4500		3000				7500.00	183.82	274.45
ISOCYANOMETHANE									
KETONE									
3-METHYLENE-PENTANE			2800				2800.00	68.63	102.46
3-METHYLHEXANE									
2-METHYL-1-PROPENE		1800		2000			3800.00	93.14	139.05
NAPHTHALENE									
* OXYBISMEHANE									
2-PENTENE		160					160.00	3.92	5.85
1-PHENYLETHANONE				240	78	96	240.00	5.88	8.78
2-PROPENENITRIL									
2-PROPYL-1-HEPTANOL									
TETRAHYDROFURAN									
TRIDECANE									
2,3,4-TRIMETHYLHEXANE									
* 1,3,6-TRIOXOCANE									
4-UNDECENE									
XYLENE	3600		3600				7200.00	176.47	263.47
o-XYLENE									

* Detected only in blank traps

Shaded ▨ : data may be impacted by blank data values.

NON-LISTED V-PICs

MAIN DUCT RUN #4

Compound	PAIR #1 T 4040	 T/C 4041	PAIR #3 T 4044	 T/C 4045	TrpBlk T 4048	 T/C 4049	TOTAL (ng)	AVE. CONC. (ng/L)	EMISS. RATE (mg/min)
* ACENAPHTHYLENE									
ALKENE									
ALKYLATED HYDROCARBON									
BENZALDEHYDE					250	510			
BENZONITRILE					440	1100			
* 2-BUTANONE									
BUTENE/2-METHYL-1-PROPENE									
CARBON DIOXIDE		520		340			860.00	21.72	32.84
CARBON DISULFIDE		670		730			1400.00	35.35	53.45
DECANSE									
* DIBENZOFURAN									
1,1-DIMETHYLCYCLOPROPANE									
DIMETHYL HEPTENE									
ETHYLCYCLOPROPANE		430		1300			1730.00	43.69	66.05
ETHYLENIMINE									
* 2-FURANCARBOXALDEHYDE									
* HEPTANE									
1-HEPTANOL									
1-HEPTENE			3600				3600.00	90.91	137.45
HEXANE									
1-HEXENE	3000		2900				5900.00	148.99	225.27
ISOCYANOMETHANE						280			
KETONE					59	150			
3-METHYLENE-PENTANE									
3-METHYLHEXANE									
2-METHYL-1-PROPENE		1500		2400			3900.00	98.48	148.91
NAPHTHALENE									
* OXYBISMEHANE									
2-PENTENE	3300	270		1500			5070.00	128.03	193.58
1-PHENYLETHANONE					57				
2-PROPENENITRIL									
2-PROPYL-1-HEPTANOL									
TETRAHYDROFURAN									
TRIDECANE									
2,3,4-TRIMETHYLHEXANE									
* 1,3,6-TRIOXOCANE									
4-UNDECENE									
XYLENE	3700		3600				7300.00	184.34	278.73
o-XYLENE									

* Detected only in blank traps

NON-LISTED V-PICs

MAIN DUCT RUN #5

	PAIR #1		PAIR #3		TrpBlk			AVE.	EMISS.
	T	T/C	T	T/C	T	T/C	TOTAL	CONC.	RATE
Compound	5040	5041	5044	5045	5048	5049	(ng)	(ng/L)	(mg/min)
* ACENAPHTHYLENE									
ALKENE									
ALKYLATED HYDROCARBON				470			470.00	11.44	17.29
BENZALDEHYDE					31	790			
BENZONITRILE						320			
* 2-BUTANONE									
BUTENE/2-METHYL-1-PROPENE									
CARBON DIOXIDE		690		540			1230.00	29.93	45.25
CARBON DISULFIDE		870		480			1350.00	32.85	49.66
DECANSE									
* DIBENZOFURAN									
1,1-DIMETHYLCYCLOPROPANE									
DIMETHYL HEPTENE									
ETHYLCYCLOPROPANE		1000		480			1480.00	36.01	54.45
ETHYLENIMINE									
* 2-FURANCARBOXALDEHYDE									
* HEPTANE									
1-HEPTANOL									
1-HEPTENE	4100		4200				8300.00	201.95	305.34
HEXANE					85				
1-HEXENE									
ISOCYANOMETHANE									
KETONE									
3-METHYLENE-PENTANE									
3-METHYLHEXANE					71				
2-METHYL-1-PROPENE		2500		1600			4100.00	99.76	150.83
NAPHTHALENE									
* OXYBISMEHANE									
2-PENTENE	3600	470					4070.00	99.03	149.73
1-PHENYLETHANONE					51	360			
2-PROPENENITRIL			3200				3200.00	77.86	117.72
2-PROPYL-1-HEPTANOL									
TETRAHYDROFURAN									
TRIDECANE									
2,3,4-TRIMETHYLHEXANE									
* 1,3,6-TRIOXOCANE						47			
4-UNDECENE									
XYLENE	4200		3800				8000.00	194.65	294.31
o-XYLENE									

* Detected only in blank traps

NON-LISTED V-PICs

Compound	BYPASS DUCT RUN #1 PAIR #1 T 1050	 T/C 1051	 PAIR #3 T 1054	 T/C 1055	 FldBlk T 1056	 T/C 1057	 TrpBlk T 1058	 T/C 1059	TOTAL (ng)	AVE. CONC. (ng/L)	EMISS. RATE (mg/min)
* ACENAPHTHYLENE											
ALKENE	170								170.00	4.38	3.12
ALKYLATED HYDROCARBON											
BENZALDEHYDE		11	210	35		16			256.00	6.60	4.70
BENZONITRILE					47	60	18	36			
* 2-BUTANONE											
BUTENE/2-METHYL-1-PROPENE		260		220					480.00	12.37	8.81
CARBON DIOXIDE		110		160	22	48	22	43	270.00	6.96	4.95
CARBON DISULFIDE											
DECANSE											
* DIBENZOFURAN											
1,1-DIMETHYLCYCLOPROPANE											
DIMETHYL HEPTENE											
ETHYLCYCLOPROPANE	220	17							237.00	6.11	4.35
ETHYLENIMINE											
* 2-FURANCARBOXALDEHYDE								16			
* HEPTANE											
1-HEPTANOL											
1-HEPTENE											
HEXANE											
1-HEXENE	420		230						650.00	16.75	11.93
ISOCYANOMETHANE		33		37					70.00	1.80	1.28
KETONE											
3-METHYLENE-PENTANE											
3-METHYLHEXANE											
2-METHYL-1-PROPENE											
NAPHTHALENE											
* OXYBISMEHANE											
2-PENTENE											
1-PHENYLETHANONE				25					25.00	0.64	0.46
2-PROPENENITRIL											
2-PROPYL-1-HEPTANOL											
TETRAHYDROFURAN											
TRIDECANE											
2,3,4-TRIMETHYLHEXANE											
* 1,3,6-TRIOXOCANE											
4-UNDECENE											
XYLENE											
o-XYLENE											

* Detected only in blank traps

Shaded : data may be impacted by blank data values.

NON-LISTED V-PICs

BYPASS DUCT RUN #2

Compound	PAIR #1 T 2050	PAIR #1 T/C 2051	TrpBlk T 2058	TrpBlk T/C 2059	TOTAL (ng)	AVERAG CONC. (ng/L)	EMISSIO RATE (mg/min)
* ACENAPHTHYLENE							
ALKENE							
ALKYLATED HYDROCARBON							
BENZALDEHYDE		370			370	9.44	6.31
BENZONITRILE		160			160	4.08	2.73
* 2-BUTANONE				24			
BUTENE/2-METHYL-1-PROPENE							
CARBON DIOXIDE			30	45			
CARBON DISULFIDE							
DECANSE							
* DIBENZOFURAN							
1,1-DIMETHYLCYCLOPROPANE							
DIMETHYL HEPTENE							
ETHYLCYCLOPROPANE							
ETHYLENIMINE							
* 2-FURANCARBOXALDEHYDE							
* HEPTANE							
1-HEPTANOL							
1-HEPTENE							
HEXANE							
1-HEXENE	560				560	14.29	9.54
ISOCYANOMETHANE		740			740	18.88	12.61
KETONE							
3-METHYLENE-PENTANE							
3-METHYLHEXANE							
2-METHYL-1-PROPENE		230			230	5.87	3.92
NAPHTHALENE							
* OXYBISMEHANE				18			
2-PENTENE							
1-PHENYLETHANONE							
2-PROPENENITRIL							
2-PROPYL-1-HEPTANOL	370				370	9.44	6.31
TETRAHYDROFURAN				100			
TRIDECANE	430						
2,3,4-TRIMETHYLHEXANE							
* 1,3,6-TRIOXOCANE							
4-UNDECENE							
XYLENE							
o-XYLENE							

* Detected only in blank traps

Shaded : data may be impacted by blank data values

NON-LISTED V-PICs

	BYPASS DUCT RUN #3										
	PAIR #1		PAIR #3		FldBlk		TrpBlk			AVE.	EMISS.
	T	T/C	T	T/C	T	T/C	T	T/C	TOTAL	CONC.	RATE
Compound	3050	3051	3054	3055	3056	3057	3058	3059	(ng)	(ng/L)	(mg/min)
* ACENAPHTHYLENE											
ALKENE											
ALKYLATED HYDROCARBON	32		18						50.00	1.22	0.84
BENZALDEHYDE			71	100		45			▨ 171.00	▨ 4.16	2.89
BENZONITRILE				38		16			▨ 38.00	▨ 0.92	0.64
* 2-BUTANONE											
BUTENE/2-METHYL-1-PROPENE											
CARBON DIOXIDE				610	18	33		42	610.00	14.84	10.30
CARBON DISULFIDE											
DECANSE											
* DIBENZOFURAN											
1,1-DIMETHYLCYCLOPROPANE											
DIMETHYL HEPTENE											
ETHYLCYCLOPROPANE											
ETHYLENIMINE											
* 2-FURANCARBOXALDEHYDE											
* HEPTANE											
1-HEPTANOL											
1-HEPTENE											
HEXANE	63								▨ 63.00	▨ 1.53	1.06
1-HEXENE								13			
ISOCYANOMETHANE				140					▨ 140.00	▨ 3.41	2.36
KETONE											
3-METHYLENE-PENTANE											
3-METHYLHEXANE	50								50.00	1.22	0.84
2-METHYL-1-PROPENE											
NAPHTHALENE											
* OXYBISMEHANE											
2-PENTENE											
1-PHENYLETHANONE						48		12			
2-PROPENENITRIL											
2-PROPYL-1-HEPTANOL											
TETRAHYDROFURAN											
TRIDECANE											
2,3,4-TRIMETHYLHEXANE	24		11						35.00	0.85	0.59
* 1,3,6-TRIOXOCANE											
4-UNDECENE											
XYLENE											
o-XYLENE											

* Detected only in blank traps

Shaded ▨: data may be impacted by blank data values.

NON-LISTED V-PICs

Compound	BYPASS DUCT RUN #4 PAIR #1 T 4050	 T/C 4051	 PAIR #3 T 4054	 T/C 4055	 TrpBlk T 4058	 T/C 4059	TOTAL (ng)	AVE. CONC. (ng/L)	EMISS. RATE (mg/min)
* ACENAPHTHYLENE									
ALKENE									
ALKYLATED HYDROCARBON									
BENZALDEHYDE	250	140	190	230			810.00	20.40	14.02
BENZONITRILE	340	85	180	120			725.00	18.26	12.55
* 2-BUTANONE									
BUTENE/2-METHYL-1-PROPENE									
CARBON DIOXIDE		150		690	30		840.00	21.16	14.54
CARBON DISULFIDE						74			
DECANSE									
* DIBENZOFURAN									
1,1-DIMETHYLCYCLOPROPANE									
DIMETHYL HEPTENE									
ETHYLCYCLOPROPANE									
ETHYLENIMINE									
* 2-FURANCARBOXALDEHYDE									
* HEPTANE						29			
1-HEPTANOL									
1-HEPTENE									
HEXANE					14	33			
1-HEXENE									
ISOCYANOMETHANE	100	410	57	530			1097.00	27.63	18.98
KETONE	78						78.00	1.96	1.35
3-METHYLENE-PENTANE									
3-METHYLHEXANE					13				
2-METHYL-1-PROPENE									
NAPHTHALENE									
* OXYBISMEHANE									
2-PENTENE									
1-PHENYLETHANONE			38				38.00	0.96	0.66
2-PROPENENITRIL									
2-PROPYL-1-HEPTANOL									
TETRAHYDROFURAN									
TRIDECANE									
2,3,4-TRIMETHYLHEXANE									
* 1,3,6-TRIOXOCANE									
4-UNDECENE									
XYLENE									
o-XYLENE									

* Detected only in blank traps

▨ Shaded ▨: data may be impacted by blank data values.

NON-LISTED V-PICs

BYPASS DUCT RUN #5

Compound	PAIR #1 T 5050	 T/C 5051	PAIR #3 T 5054	 T/C 5055	TrpBlk T 5058	 T/C 5059	TOTAL (ng)	AVE. CONC. (ng/L)	EMISS. RATE (mg/min)
* ACENAPHTHYLENE									
ALKENE									
ALKYLATED HYDROCARBON									
BENZALDEHYDE	430	15	350				795.00	20.03	13.76
BENZONITRILE	1200		990				2190.00	55.16	37.90
* 2-BUTANONE						10			
BUTENE/2-METHYL-1-PROPENE									
CARBON DIOXIDE		520		410	31	58	930.00	23.43	16.09
CARBON DISULFIDE									
DECANSE									
* DIBENZOFURAN									
1,1-DIMETHYLCYCLOPROPANE									
DIMETHYL HEPTENE									
ETHYLCYCLOPROPANE									
ETHYLENIMINE									
* 2-FURANCARBOXALDEHYDE									
* HEPTANE									
1-HEPTANOL									
1-HEPTENE									
HEXANE		12			10		12.00	0.30	0.21
1-HEXENE									
ISOCYANOMETHANE			530				530.00	13.35	9.17
KETONE			190				190.00	4.79	3.29
3-METHYLENE-PENTANE									
3-METHYLHEXANE									
2-METHYL-1-PROPENE									
NAPHTHALENE	250						250.00	6.30	4.33
* OXYBISMEHANE									
2-PENTENE									
1-PHENYLETHANONE		37		22			59.00	1.49	1.02
2-PROPENENITRIL	550						550.00	13.85	9.52
2-PROPYL-1-HEPTANOL									
TETRAHYDROFURAN									
TRIDECANE									
2,3,4-TRIMETHYLHEXANE									
* 1,3,6-TRIOXOCANE									
4-UNDECENE									
XYLENE									
o-XYLENE									

* Detected only in blank traps

Shaded ▨ : data may be impacted by blank data values.

APPENDIX B-10

SEMIVOLATILE ORGANICS DATA

Appendix B-9
Volatile Organics Analysis
Data Summary

NOTE: No significant problems were encountered with the Method 0010 trains. All test runs at each duct fell within the acceptable range for isokinetic performance, and all leak checks were passed.

```
FILE NAME - R1MSV                                           PROG.=VER 06/27/89
RUN # - RUN 1SV -ASH GROVE CEMENT KILN                      01-16-1980   10:25:08
LOCATION - MAIN ESP OUTLET DUCT
DATE -  10/28/89
PROJECT # - 9999

Initial Meter Volume (Cubic Feet)=              653.300
Final Meter Volume (Cubic Feet)=                763.750
Meter Factor=                                     1.000
Multiple leak checks, see end of printout               Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                  110.450
Gas Volume (Dry Standard Cubic Feet)=           104.176

Barometric Pressure (in Hg)=                      29.11
Static Pressure (Inches H2O)=                     -0.41

Percent Oxygen=                                     5.9
Percent Carbon Dioxide=                            26.3
Moisture Collected (ml)=                          548.0
Percent Water=                                     19.9

Average Meter Temperature (F)=                       89
Average Delta H (in H2O)=                          3.20
Average Delta P (in H2O)=                         0.558
Average Stack Temperature (F)=                      307

Dry Molecular Weight=                             32.44
Wet Molecular Weight=                             29.58

Average Square Root of Delta P (in H2O)=         0.7458
% Isokinetic=                                     109.8

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.300
Stack Axis #1 (Inches)=                            48.0
Stack Axis #2 (Inches)=                            96.0
Rectangular Stack
Stack Area (Square Feet)=                         32.00

Stack Velocity  (Actual, Feet/min)=               3,006
Flow Rate (Actual, Cubic ft/min)=                96,182
Flow rate (Standard, Wet, Cubic ft/min)=         64,344
Flow Rate (Standard, Dry, Cubic ft/min)=         51,567

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=          0.0000         0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=          0.0000
Emission Rate (lb/hr)=                             0.00

No Back Half Analysis
```

```
                        * * METRIC UNITS * *
FILE NAME - R1MSV                                                 PROG.=VER 06/27/89
RUN # - RUN 15V -ASH GROVE CEMENT KILN                            01-16-1980   10:25:36
LOCATION - MAIN ESP OUTLET DUCT
DATE -  10/28/89
PROJECT # - 9999

Initial Meter Volume (Cubic Meters)=                 18.499
Final Meter Volume (Cubic Meters)=                   21.626
Meter Factor=                                         1.000
Multiple leak checks, see end of printout                        Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                      3.128
Gas Volume (Dry Standard Cubic Meters)=               2.950

Barometric Pressure (mm Hg)=                            739
Static Pressure (mm H2O)=                               -10

Percent Oxygen=                                         5.9
Percent Carbon Dioxide=                                26.3
Moisture Collected (ml)=                              548.0
Percent Water=                                         19.9

Average Meter Temperature (C)=                           32
Average Delta H (mm H2O)=                              81.3
Average Delta P (mm H2O)=                              14.2
Average Stack Temperature (C)=                          153

Dry Molecular Weight=                                 32.44
Wet Molecular Weight=                                 29.58

Average Square Root of Delta P (mm H2O)=             3.7589
% Isokinetic=                                         109.8

Pitot Coefficient=                                     0.83
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (mm)=                                  7.62
Stack Axis #1 (Meters)=                               1.219
Stack Axis #2 (Meters)=                               2.438
Rectangular Stack
Stack Area (Square Meters)=                           2.973

Stack Velocity  (Actual, m/min)=                        916
Flow rate (Actual, Cubic m/min)=                      2,724
Flow rate (Standard, Wet, Cubic m/min)=               1,822
Flow rate (Standard, Dry, Cubic m/min)=               1,460

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=                0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=                  0.0
Emission Rate (kg/hr)=                                 0.00

No Back Half Analysis
```

```
FILE NAME - R1MSV                                          PROG.=VER 06/27/89
RUN # - RUN 1SV -ASH GROVE CEMENT KILN                     01-16-1980  10:26:04
LOCATION - MAIN ESP OUTLET DUCT
DATE -  10/28/89
PROJECT # - 9999

Point #        Delta P    Delta H    Stack T      Meter T
              (in. H2O) (in. H2O)    (F)     In(F)   Out(F)
 1             0.600      3.30       307       71      71
 2             0.570      3.20       307       81      73
 3             0.580      3.30       307       89      75
 4             0.550      3.15       306       94      78
 5             0.440      2.55       300       98      82
 6             0.600      3.35       307       77      76
 7             0.570      3.20       309       86      80
 8             0.570      3.25       309       95      82
 9             0.610      3.50       309      100      85
 10            0.500      2.90       308      103      87
 11            0.680      3.80       308       85      85
 12            0.650      3.70       308       92      86
 13            0.610      3.50       308       97      97
 14            0.600      3.50       308      101      88
 15            0.560      3.50       308      103      90
 16            0.490      2.80       305       88      86
 17 .          0.520      3.00       307       97      90
 18            0.510      3.00       307      102      91
 19            0.500      2.89       307      103      92
 20            0.450      2.60       307      105      92


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)        (g)       (g)
DRY CATCH                0.0000     0.0000     0.0000    0.0000
FILTER                   0.0000     0.0000     0.0000    0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)       (g)
PROBE RINSE              0.0000     0.0000      0.0     0.0000
IMPINGERS                0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0020    30.0000
    0.0010    30.0000
    0.0020    30.0000
    0.0010    30.0000
```

```
FILE NAME - R1BSV                                               PROG.=VER 06/09/89
RUN # - R1BSV                                                   06-29-1990  06:12:04
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Initial Meter Volume (Cubic Feet)=                 964.679
Final Meter Volume (Cubic Feet)=                  1061.885
Meter Factor=                                        1.027
Final Leak Rate (cu ft/min)=                         0.004
Net Meter Volume (Cubic Feet)=                      99.831
Gas Volume (Dry Standard Cubic Feet)=               94.736

Barometric Pressure (in Hg)=                         29.11
Static Pressure (Inches H2O)=                        -2.89

Percent Oxygen=                                       17.8
Percent Carbon Dioxide=                                2.6
Moisture Collected (ml)=                             166.5
Percent Water=                                         7.6

Average Meter Temperature (F)=                          84
Average Delta H (in H2O)=                             2.33
Average Delta P (in H2O)=                            0.508
Average Stack Temperature (F)=                         568

Dry Molecular Weight=                                29.13
Wet Molecular Weight=                                28.28

Average Square Root of Delta P (in H2O)=            0.7095
% Isokinetic=                                        102.4

Pitot Coefficient=                                    0.84
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (Inches)=                            0.300
Stack Axis #1 (Inches)=                               24.0
Stack Axis #2 (Inches)=                               96.0
Rectangular Stack
Stack Area (Square Feet)=                            16.00

Stack Velocity  (Actual, Feet/min)=                  3,428
Flow Rate (Actual, Cubic ft/min)=                   54,850
Flow rate (Standard, Wet, Cubic ft/min)=            27,210
Flow Rate (Standard, Dry, Cubic ft/min)=            25,130

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=             0.0000        0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=             0.0000
Emission Rate (lb/hr)=                                0.00

No Back Half Analysis
```

```
                      * * METRIC UNITS * *
ILE NAME - R1BSV                                      PROG.=VER 06/09/89
UN # - R1BSV                                          06-29-1990  06:12:08
OCATION - BYPASS ESP OUTLET DUCT
ATE - 10/28/89
ROJECT # - 9102

nitial Meter Volume (Cubic Meters)=          27.316
inal Meter Volume (Cubic Meters)=            30.068
eter Factor=                                  1.027
inal Leak Rate (cu m/min)=                   0.0001
et Meter Volume (Cubic Meters)=               2.827
as Volume (Dry Standard Cubic Meters)=        2.683

arometric Pressure (mm Hg)=                     739
tatic Pressure (mm H2O)=                        -73

ercent Oxygen=                                 17.8
ercent Carbon Dioxide=                          2.6
oisture Collected (ml)=                       166.5
ercent Water=                                   7.6

verage Meter Temperature (C)=                    29
verage Delta H (mm H2O)=                       59.2
verage Delta P (mm H2O)=                       12.9
verage Stack Temperature (C)=                   298

ry Molecular Weight=                          29.13
et Molecular Weight=                          28.28

verage Square Root of Delta P (mm H2O)=      3.5755
 Isokinetic=                                  102.4

itot Coefficient=                              0.84
ampling Time (Minutes)=                       120.0
ozzle Diameter (mm)=                           7.62
tack Axis #1 (Meters)=                        0.610
tack Axis #2 (Meters)=                        2.438
ectangular Stack
tack Area (Square Meters)=                    1.486

tack Velocity  (Actual, m/min)=               1,045
low rate (Actual, Cubic m/min)=               1,553
low rate (Standard, Wet, Cubic m/min)=          771
low rate (Standard, Dry, Cubic m/min)=          712

articulate Loading - Front Half

articulate Weight (g)=                       0.0000    Corr. to 7% O2 & 12% CO2
articulate Loading, Dry Std. (mg/cu m)=         0.0          0.0          0.0
articulate Loading, Actual (mg/cu m)=           0.0
mission Rate (kg/hr)=                          0.00

 Back Half Analysis
```

```
FILE NAME - R1BSV                                             PROG.=VER 06/09/89
RUN # - R1BSV                                                 06-29-1990  06:12:30
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/28/89
PROJECT # - 9102

Point #       Delta P    Delta H     Stack T      Meter T
             (in. H2O) (in. H2O)      (F)      In(F)  Out(F)
 1            0.290       1.20       511        74      74
 2            0.520       2.00       577        76      74
 3            0.620       2.80       561        81      75
 4            0.610       2.80       550        88      76
 5            0.550       2.60       564        92      79
 6            0.360       1.40       556        75      76
 7            0.510       2.30       572        79      76
 8            0.550       2.60       580        86      77
 9            0.550       2.60       580        91      79
 10           0.540       2.60       582        95      82
 11           0.330       1.50       553        79      79
 12           0.470       2.00       572        84      80
 13           0.500       2.20       578        90      81
 14           0.510       2.50       578        95      84
 15           0.540       2.70       582        97      86
 16           0.410       2.00       577        87      85
 17           0.500       2.40       591        91      86
 18           0.620       2.90       565        96      87
 19           0.600       2.90       542       100      88
 20           0.580       2.60       588       102      90


Fraction                Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                          (g)        (g)       (g)        (g)
DRY CATCH               0.0000     0.0000    0.0000     0.0000
FILTER                  0.0000     0.0000    0.0000     0.0000

Fraction                Final Wt.  Tare Wt.    Vol.     Net Wt.
                          (g)        (g)       (ml)       (g)
PROBE RINSE             0.0000     0.0000      0.0     0.0000
IMPINGERS               0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000
```

```
FILE NAME - R2MSV                                                 PROG.=VER 06/27/89
RUN # - RUN 2SV - ASH GROVE CEMENT KILN                           01-15-1980  11:31:41
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=                  765.100
Final Meter Volume (Cubic Feet)=                    863.350
Meter Factor=                                         1.000
Multiple leak checks, see end of printout                      Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                       98.250
Gas Volume (Dry Standard Cubic Feet)=                94.971

Barometric Pressure (in Hg)=                          29.11
Static Pressure (Inches H2O)=                         -0.41

Percent Oxygen=                                         4.4
Percent Carbon Dioxide=                                28.5
Moisture Collected (ml)=                              506.7
Percent Water=                                         20.1

Average Meter Temperature (F)=                           75
Average Delta H (in H2O)=                              2.62
Average Delta P (in H2O)=                             0.577
Average Stack Temperature (F)=                          321

Dry Molecular Weight=                                 32.74
Wet Molecular Weight=                                 29.78

Average Square Root of Delta P (in H2O)=             0.7585
% Isokinetic=                                          99.9

Pitot Coefficient=                                     0.83
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (Inches)=                             0.300
Stack Axis #1 (Inches)=                                48.0
Stack Axis #2 (Inches)=                                36.0
Rectangular Stack
Stack Area (Square Feet)=                             32.00

Stack Velocity  (Actual, Feet/min)=                   3,074
Flow Rate (Actual, Cubic ft/min)=                    98,369
Flow rate (Standard, Wet, Cubic ft/min)=             64,636
Flow Rate (Standard, Dry, Cubic ft/min)=             51,655

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=              0.0000        0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=              0.0000
Emission Rate (lb/hr)=                                 0.00

No Back Half Analysis
```

```
                          * * METRIC UNITS * *
FILE NAME - R2MSV                                          PROG.=VER 06/27/89
RUN # - RUN 25V - ASH GROVE CEMENT KILN                    01-15-1980  11:32:08
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=         21.665
Final Meter Volume (Cubic Meters)=           24.447
Meter Factor=                                 1.000
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=              2.782
Gas Volume (Dry Standard Cubic Meters)=       2.689

Barometric Pressure (mm Hg)=                    739
Static Pressure (mm H20)=                       -10

Percent Oxygen=                                 4.4
Percent Carbon Dioxide=                        28.5
Moisture Collected (ml)=                      506.7
Percent Water=                                 20.1

Average Meter Temperature (C)=                   24
Average Delta H (mm H20)=                      66.6
Average Delta P (mm H20)=                      14.7
Average Stack Temperature (C)=                  161

Dry Molecular Weight=                         32.74
Wet Molecular Weight=                         29.78

Average Square Root of Delta P (mm H20)=     3.8229
% Isokinetic=                                  99.9

Pitot Coefficient=                             0.83
Sampling Time (Minutes)=                      120.0
Nozzle Diameter (mm)=                          7.62
Stack Axis #1 (Meters)=                       1.219
Stack Axis #2 (Meters)=                       2.438
Rectangular Stack
Stack Area (Square Meters)=                   2.973

Stack Velocity  (Actual, m/min)=                937
Flow rate (Actual, Cubic m/min)=              2,785
Flow rate (Standard, Wet, Cubic m/min)=       1,830
Flow rate (Standard, Dry, Cubic m/min)=       1,463

Particulate Loading - Front Half

Particulate Weight (g)=                      0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=        0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=          0.0
Emission Rate (kg/hr)=                         0.00

No Back Half Analysis
```

```
FILE NAME - R2MSV                                              PROG.=VER 06/27/89
RUN # - RUN 2SV - ASH GROVE CEMENT KILN                        01-15-1980  11:32:36
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102-64-13

Point #        Delta P    Delta H     Stack T      Meter T
             (in. H2O)  (in. H2O)      (F)     In(F)    Out(F)
  1            0.600      2.65        322       60       59
  2            0.580      2.60        323       67       61
  3            0.590      2.60        323       76       63
  4            0.590      2.70        322       80       65
  5            0.460      2.00        319       82       68
  6            0.650      2.90        322       68       67
  7            0.630      2.80        323       76       69
  8            0.590      2.70        322       82       70
  9            0.640      2.90        322       85       72
 10            0.550      2.55        320       88       74
 11            0.670      3.05        320       71       68
 12            0.650      3.00        321       79       73
 13            0.640      2.95        321       84       74
 14            0.610      2.80        321       88       75
 15            0.540      2.50        319       89       76
 16            0.500      2.30        317       75       71
 17            0.520      2.40        320       80       74
 18            0.530      2.45        320       83       74
 19            0.530      2.45        322       86       75
 20            0.470      2.15        321       87       76


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000    0.0000     0.0000
FILTER                    0.0000     0.0000    0.0000     0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=   0.0000
Impinger Blank (mg/ml)=   0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0130    30.0000
    0.0100    30.0000
    0.0150    30.0000
    0.0100    30.0000
```

```
FILE NAME - R2BSV                                                  PROG.=VER 06/27/89
RUN # - RUN 2SV - ASH GROVE CEMENT KILN                            01-15-1980  11:26:55
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=                   63.339
Final Meter Volume (Cubic Feet)=                    151.421
Meter Factor=                                         1.027
Final Leak Rate (cu ft/min)=                          0.004
Net Meter Volume (Cubic Feet)=                       90.460
Gas Volume (Dry Standard Cubic Feet)=                86.485

Barometric Pressure (in Hg)=                          29.11
Static Pressure (Inches H2O)=                         -2.89

Percent Oxygen=                                        17.4
Percent Carbon Dioxide=                                 2.9
Moisture Collected (ml)=                              172.4
Percent Water=                                          8.6

Average Meter Temperature (F)=                           80
Average Delta H (in H2O)=                              1.97
Average Delta P (in H2O)=                             0.463
Average Stack Temperature (F)=                          577

Dry Molecular Weight=                                 29.16
Wet Molecular Weight=                                 28.20

Average Square Root of Delta P (in H2O)=             0.6780
% Isokinetic=                                          99.6

Pitot Coefficient=                                     0.84
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (Inches)=                             0.300
Stack Axis #1 (Inches)=                                24.0
Stack Axis #2 (Inches)=                                96.0
Rectangular Stack
Stack Area (Square Feet)=                             16.00

Stack Velocity  (Actual, Feet/min)=                   3,279
Flow Rate (Actual, Cubic ft/min)=                    52,464
Flow rate (Standard, Wet, Cubic ft/min)=             25,806
Flow Rate (Standard, Dry, Cubic ft/min)=             23,591

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000     Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=              0.0000          0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=              0.0000
Emission Rate (lb/hr)=                                 0.00

No Back Half Analysis
```

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                       • * METRIC UNITS * *
FILE NAME - R2BSV                                          PROG.=VER 06/27/89
RUN # - RUN 2SV - ASH GROVE CEMENT KILN                    01-15-1980  11:27:22
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=               1.794
Final Meter Volume (Cubic Meters)=                 4.288
Meter Factor=                                      1.027
Final Leak Rate (cu m/min)=                       0.0001
Net Meter Volume (Cubic Meters)=                   2.561
Gas Volume (Dry Standard Cubic Meters)=            2.449

Barometric Pressure (mm Hg)=                         739
Static Pressure (mm H2O)=                            -73

Percent Oxygen=                                     17.4
Percent Carbon Dioxide=                              2.9
Moisture Collected (ml)=                           172.4
Percent Water=                                       8.6

Average Meter Temperature (C)=                        27
Average Delta H (mm H2O)=                           50.0
Average Delta P (mm H2O)=                           11.8
Average Stack Temperature (C)=                       303

Dry Molecular Weight=                              29.16
Wet Molecular Weight=                              28.20

Average Square Root of Delta P (mm H2O)=          3.4172
% Isokinetic=                                       99.6

Pitot Coefficient=                                  0.84
Sampling Time (Minutes)=                           120.0
Nozzle Diameter (mm)=                               7.62
Stack Axis #1 (Meters)=                            0.610
Stack Axis #2 (Meters)=                            2.438
Rectangular Stack
Stack Area (Square Meters)=                        1.486

Stack Velocity  (Actual, m/min)=                     999
Flow rate (Actual, Cubic m/min)=                   1,486
Flow rate (Standard, Wet, Cubic m/min)=              731
Flow rate (Standard, Dry, Cubic m/min)=              668

Particulate Loading - Front Half

Particulate Weight (g)=                           0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=             0.0            0.0        0.0
Particulate Loading, Actual (mg/cu m)=               0.0
Emission Rate (kg/hr)=                              0.00

No Back Half Analysis
```

```
FILE NAME - R2BSV                                            PROG.=VER 06/27/89
RUN # - RUN 2SV - ASH GROVE CEMENT KILN                      01-15-1980  11:27:49
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/29/89
PROJECT # - 9102-64-13

Point #       Delta P    Delta H     Stack T      Meter T
             (in. H2O)  (in. H2O)     (F)      In(F)   Out(F)
  1            0.360       1.50        580        70      69
  2            0.430       2.00        592        73      69
  3            0.510       2.40        568        80      70
  4            0.520       2.30        510        84      73
  5            0.510       2.30        598        86      74
  6            0.350       1.60        570        74      73
  7            0.440       1.80        584        80      74
  8            0.480       1.90        584        85      75
  9            0.500       1.90        584        87      76
 10            0.500       1.90        585        90      78
 11            0.250       1.10        534        86      79
 12            0.460       2.00        578        86      80
 13            0.510       2.20        591        88      80
 14            0.510       2.20        588        88      80
 15            0.470       2.10        587        89      81
 16            0.400       1.60        585        78      76
 17            0.470       2.00        596        82      78
 18            0.550       2.20        570        87      78
 19            0.540       2.20        567        88      79
 20            0.500       2.20        584        88      80



Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)       (g)        (g)
DRY CATCH                 0.0000     0.0000    0.0000     0.0000
FILTER                    0.0000     0.0000    0.0000     0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)      (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=   0.0000
Impinger Blank (mg/ml)=   0.0000
```

```
FILE NAME - R3MSV                                              PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                        01-16-1980  10:15:29
LOCATION - MAIN ESP OUTLET
FILE NAME - R3MSV                                              PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                        01-16-1980  10:19:07
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=                  865.100
Final Meter Volume (Cubic Feet)=                    957.590
Meter Factor=                                         1.000
Multiple leak checks, see end of printout                     Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                       92.490
Gas Volume (Dry Standard Cubic Feet)=                94.436

Barometric Pressure (in Hg)=                          29.58
Static Pressure (Inches H2O)=                         -0.41

Percent Oxygen=                                         4.8
Percent Carbon Dioxide=                                28.2
Moisture Collected (ml)=                              418.6
Percent Water=                                         17.3

Average Meter Temperature (F)=                           54
Average Delta H (in H2O)=                              2.41
Average Delta P (in H2O)=                             0.548
Average Stack Temperature (F)=                          305

Dry Molecular Weight=                                 32.70
Wet Molecular Weight=                                 30.16

Average Square Root of Delta P (in H2O)=             0.7392
% Isokinetic=                                          97.3

itot Coefficient=                                      0.83
ampling Time (Minutes)=                               120.0
ozzle Diameter (Inches)=                              0.300
tack Axis #1 (Inches)=                                 48.0
tack Axis #2 (Inches)=                                 96.0
ectangular Stack
tack Area (Square Feet)=                              32.00

tack Velocity  (Actual, Feet/min)=                    2,922
low Rate (Actual, Cubic ft/min)=                     93,506
low rate (Standard, Wet, Cubic ft/min)=              63,747
low Rate (Standard, Dry, Cubic ft/min)=              52,737

articulate Loading - Front Half

articulate Weight (g)=                               0.0000   Corr. to 7% O2 & 12% CO2
articulate Loading, Dry Std. (gr/scf)=               0.0000        0.0000     0.0000
articulate Loading, Actual (gr/cu ft)=               0.0000
mission Rate (lb/hr)=                                  0.00

o Back Half Analysis
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                        * • METRIC UNITS * *
FILE NAME - R3MSV                                                 PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                           01-16-1980  10:19:35
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=                  24.496
Final Meter Volume (Cubic Meters)=                    27.115
Meter Factor=                                          1.000
Multiple leak checks, see end of printout                     Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                       2.619
Gas Volume (Dry Standard Cubic Meters)=                2.674

Barometric Pressure (mm Hg)=                             751
Static Pressure (mm H2O)=                                -10

Percent Oxygen=                                          4.8
Percent Carbon Dioxide=                                 28.2
Moisture Collected (ml)=                               418.6
Percent Water=                                          17.3

Average Meter Temperature (C)=                            12
Average Delta H (mm H2O)=                               61.2
Average Delta P (mm H2O)=                               13.9
Average Stack Temperature (C)=                           152

Dry Molecular Weight=                                  32.70
Wet Molecular Weight=                                  30.16

Average Square Root of Delta P (mm H2O)=              3.7255
% Isokinetic=                                           97.3

Pitot Coefficient=                                      0.83
Sampling Time (Minutes)=                               120.0
Nozzle Diameter (mm)=                                   7.62
Stack Axis #1 (Meters)=                                1.219
Stack Axis #2 (Meters)=                                2.438
Rectangular Stack
Stack Area (Square Meters)=                            2.973

Stack Velocity  (Actual, m/min)=                         891
Flow rate (Actual, Cubic m/min)=                       2,648
Flow rate (Standard, Wet, Cubic m/min)=                1,805
Flow rate (Standard, Dry, Cubic m/min)=                1,493

Particulate Loading - Front Half

Particulate Weight (g)=                               0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=                 0.0           0.0          0.0
Particulate Loading, Actual (mg/cu m)=                   0.0
Emission Rate (kg/hr)=                                  0.00

No Back Half Analysis
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```
FILE NAME - R3MSV                                               PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                         01-16-1980  10:20:03
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102-64-13

Point #        Delta P    Delta H    Stack T      Meter T
              (in. H2O) (in. H2O)     (F)     In(F)   Out(F)
 1             0.630      2.40       307       43       43
 2             0.600      2.60       308       48       49
 3             0.590      2.55       307       55       44
 4             0.600      2.60       307       58       45
 5             0.450      2.00       299       61       47
 6             0.460      2.40       309       49       48
 7             0.540      2.35       308       56       49
 8             0.540      2.40       308       64       51
 9             0.600      2.65       306       69       53
 10            0.540      2.45       304       71       54
 11            0.610      2.65       307       51       51
 12            0.620      2.75       305       57       52
 13            0.590      2.60       305       60       51
 14            0.580      2.55       303       61       51
 15            0.540      2.40       302       62       51
 16            0.500      2.20       301       50       49
 17            0.520      2.25       302       57       51
 18            0.520      2.25       304       62       51
 19            0.500      2.20       304       66       53
 20            0.430      1.95       302       67       54


raction                Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                          (g)        (g)        (g)       (g)
RY CATCH               0.0000     0.0000     0.0000    0.0000
ILTER                  0.0000     0.0000     0.0000    0.0000

raction                Final Wt.  Tare Wt.    Vol.     Net Wt.
                          (g)        (g)       (ml)      (g)
ROBE RINSE             0.0000     0.0000      0.0     0.0000
MPINGERS               0.0000     0.0000      0.0     0.0000
robe Rinse Blank (mg/ml)=  0.0000
mpinger Blank (mg/ml)=  0.0000

ultiple leak checks used.  Final readings for each segment are listed below

k Rate (cfm) Time (min)
    0.0130    30.0000
    0.0040    30.0000
    0.0050    30.0000
    0.0050    30.0000
```

```
FILE NAME - R3BSV                                                  PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                            01-16-1980  10:10:06
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=                  154.126
Final Meter Volume (Cubic Feet)=                    242.077
Meter Factor=                                         1.027
Multiple leak checks, see end of printout                       Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                       90.326
Gas Volume (Dry Standard Cubic Feet)=                89.712

Barometric Pressure (in Hg)=                          29.58
Static Pressure (Inches H20)=                         -2.90

Percent Oxygen=                                        16.3
Percent Carbon Dioxide=                                 4.7
Moisture Collected (ml)=                              158.1
Percent Water=                                          7.7

Average Meter Temperature (F)=                           68
Average Delta H (in H20)=                              1.97
Average Delta P (in H20)=                             0.478
Average Stack Temperature (F)=                          556

Dry Molecular Weight=                                 29.40
Wet Molecular Weight=                                 28.53

Average Square Root of Delta P (in H20)=             0.6884
% Isokinetic=                                          99.5

Pitot Coefficient=                                     0.84
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (Inches)=                             0.300
Stack Axis #1 (Inches)=                                24.0
Stack Axis #2 (Inches)=                                96.0
Rectangular Stack
Stack Area (Square Feet)=                             16.00

Stack Velocity  (Actual, Feet/min)=                   3,250
Flow Rate (Actual, Cubic ft/min)=                    52,004
Flow rate (Standard, Wet, Cubic ft/min)=             26,530
Flow Rate (Standard, Dry, Cubic ft/min)=             24,497

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000     Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=              0.0000          0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=              0.0000
Emission Rate (lb/hr)=                                 0.00

No Back Half Analysis
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                        * * METRIC UNITS * *
FILE NAME - R3BSV                                       PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                 01-16-1980  10:10:34
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 3102-64-13

Initial Meter Volume (Cubic Meters)=              4.364
Final Meter Volume (Cubic Meters)=                6.855
Meter Factor=                                     1.027
Multiple leak checks, see end of printout               Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                  2.558
Gas Volume (Dry Standard Cubic Meters)=           2.540

Barometric Pressure (mm Hg)=                        751
Static Pressure (mm H2O)=                           -74

Percent Oxygen=                                    16.3
Percent Carbon Dioxide=                             4.7
Moisture Collected (ml)=                          158.1
Percent Water=                                      7.7

Average Meter Temperature (C)=                       20
Average Delta H (mm H2O)=                          49.9
Average Delta P (mm H2O)=                          12.1
Average Stack Temperature (C)=                      291

Dry Molecular Weight=                             29.40
Wet Molecular Weight=                             28.53

Average Square Root of Delta P (mm H2O)=         3.4696
% Isokinetic=                                      99.5

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              7.62
Stack Axis #1 (Meters)=                           0.610
Stack Axis #2 (Meters)=                           2.438
Rectangular Stack
Stack Area (Square Meters)=                       1.486

Stack Velocity  (Actual, m/min)=                    991
Flow rate (Actual, Cubic m/min)=                  1,473
Flow rate (Standard, Wet, Cubic m/min)=             751
Flow rate (Standard, Dry, Cubic m/min)=             694

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CO2
articulate Loading, Dry Std. (mg/cu m)=             0.0          0.0          0.0
articulate Loading, Actual (mg/cu m)=               0.0
mission Rate (kg/hr)=                              0.00

o Back Half Analysis
```

```
FILE NAME - R3BSV                                          PROG.=VER 06/27/89
RUN # - RUN 3SV - ASH GROVE CEMENT KILN                    01-16-1980  10:11:01
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/30/89
PROJECT # - 9102-64-13

Point #       Delta P    Delta H    Stack T      Meter T
             (in. H2O)  (in. H2O)    (F)     In(F)   Out(F)
 1            0.370      1.70        422       51      51
 2            0.520      2.10        584       67      55
 3            0.580      2.30        561       78      58
 4            0.570      2.30        554       86      62
 5            0.540      2.20        581       88      64
 6            0.350      1.40        556       70      63
 7            0.470      2.00        566       74      65
 8            0.520      2.20        572       79      66
 9            0.510      2.20        570       85      68
 10           0.480      2.10        570       88      69
 11           0.300      1.20        543       72      67
 12           0.440      1.80        565       76      67
 13           0.480      1.90        568       73      66
 14           0.510      2.10        568       75      64
 15           0.510      2.10        568       75      63
 16           0.330      1.40        537       56      55
 17           0.460      1.70        582       63      57
 18           0.540      2.20        536       69      57
 19           0.540      2.20        530       74      59
 20           0.530      2.20        584       81      61


Fraction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)        (g)       (g)
DRY CATCH                0.0000     0.0000     0.0000    0.0000
FILTER                   0.0000     0.0000     0.0000    0.0000

Fraction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)       (g)
PROBE RINSE              0.0000     0.0000      0.0     0.0000
IMPINGERS                0.0000     0.0000      0.0     0.0000
Probe Rinse Blank (mg/ml)=   0.0000
Impinger Blank (mg/ml)=   0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0030    30.0000
    0.0000    30.0000
    0.0020    30.0000
    0.0020    30.0000
```

```
FILE NAME - R4MSV                                              PROG.=VER 06/09/89
RUN # - RUN 4SV - ASH GROVE CEMENT KILN                        11-01-1989  09:34:34
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=              987.750
Final Meter Volume (Cubic Feet)=               1090.420
Meter Factor=                                     1.000
Multiple leak checks, see end of printout                Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                  102.670
Gas Volume (Dry Standard Cubic Feet)=            99.843

Barometric Pressure (in Hg)=                      29.53
Static Pressure (Inches H2O)=                     -0.41

Percent Oxygen=                                     5.8
Percent Carbon Dioxide=                            24.1
Moisture Collected (ml)=                          512.4
Percent Water=                                     19.5

Average Meter Temperature (F)=                       79
Average Delta H (in H2O)=                          2.86
Average Delta P (in H2O)=                         0.587
Average Stack Temperature (F)=                      317

Dry Molecular Weight=                             32.09
Wet Molecular Weight=                             29.35

Average Square Root of Delta P (in H2O)=        0.7647
% Isokinetic=                                     101.6

Pitot Coefficient=                                 0.83
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.300
Stack Axis #1 (Inches)=                            48.0
Stack Axis #2 (Inches)=                            96.0
Rectangular Stack
Stack Area (Square Feet)=                         32.00

Stack Velocity  (Actual, Feet/min)=               3,092
Flow Rate (Actual, Cubic ft/min)=                98,934
Flow rate (Standard, Wet, Cubic ft/min)=         66,281
Flow Rate (Standard, Dry, Cubic ft/min)=         53,378

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=          0.0000        0.0000     0.0000
Particulate Loading, Actual (gr/cu ft)=          0.0000
Emission Rate (lb/hr)=                             0.00

No Back Half Analysis
```

```
                            * * METRIC UNITS * *
FILE NAME - R4MSV                                                   PROG.=VER 06/09/89
RUN # - RUN 4SV - ASH GROVE CEMENT KILN                             11-01-1989  09:35:02
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=                 27.969
Final Meter Volume (Cubic Meters)=                   30.876
Meter Factor=                                         1.000
Multiple leak checks, see end of printout                     Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                      2.907
Gas Volume (Dry Standard Cubic Meters)=               2.827

Barometric Pressure (mm Hg)=                            750
Static Pressure (mm H2O)=                               -10

Percent Oxygen=                                         5.8
Percent Carbon Dioxide=                                24.1
Moisture Collected (ml)=                              512.4
Percent Water=                                         19.5

Average Meter Temperature (C)=                           26
Average Delta H (mm H2O)=                              72.7
Average Delta P (mm H2O)=                              14.9
Average Stack Temperature (C)=                          158

Dry Molecular Weight=                                 32.09
Wet Molecular Weight=                                 29.35

Average Square Root of Delta P (mm H2O)=             3.8542
% Isokinetic=                                         101.6

Pitot Coefficient=                                     0.83
Sampling Time (Minutes)=                              120.0
Nozzle Diameter (mm)=                                  7.62
Stack Axis #1 (Meters)=                               1.219
Stack Axis #2 (Meters)=                               2.438
Rectangular Stack
Stack Area (Square Meters)=                           2.973

Stack Velocity  (Actual, m/min)=                        942
Flow rate (Actual, Cubic m/min)=                      2,802
Flow rate (Standard, Wet, Cubic m/min)=               1,877
Flow rate (Standard, Dry, Cubic m/min)=               1,512

Particulate Loading - Front Half

Particulate Weight (g)=                              0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=                0.0          0.0          0.0
Particulate Loading, Actual (mg/cu m)=                  0.0
Emission Rate (kg/hr)=                                 0.00

No Back Half Analysis
```

```
FILE NAME - R4MSV                                               PROG.=VER 06/09/89
RUN # - RUN 4SV - ASH GROVE CEMENT KILN                         11-01-1989  09:35:30
LOCATION - MAIN ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Point #      Delta P   Delta H   Stack T      Meter T
           (in. H20) (in. H20)    (F)     In(F)  Out(F)
 1           0.630      3.00      316       63      64
 2           0.590      2.80      317       73      65
 3           0.590      2.80      318       77      66
 4           0.580      2.80      317       83      66
 5           0.440      2.15      312       87      70
 6           0.730      3.45      319       74      71
 7           0.690      3.35      320       83      74
 8           0.620      3.00      319       89      75
 9           0.660      3.25      319       90      76
 10          0.530      2.65      316       91      76
 11          0.650      3.10      316       75      73
 12 .        0.650      3.10      318       83      75
 13          0.610      3.05      317       88      75
 14          0.630      3.10      318       91      76
 15          0.530      2.60      316       93      77
 16          0.510      2.50      315       79      76
 17          0.530      2.65      316       88      79
 18          0.540      2.75      317       94      81
 19          0.540      2.70      318       97      81
 20          0.490      2.45      317      100      83


raction                 Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                           (g)        (g)        (g)       (g)
RY CATCH                 0.0000     0.0000     0.0000    0.0000
ILTER                    0.0000     0.0000     0.0000    0.0000

raction                 Final Wt.  Tare Wt.    Vol.     Net Wt.
                           (g)        (g)       (ml)      (g)
ROBE RINSE               0.0000     0.0000      0.0    0.0000
MPINGERS                 0.0000     0.0000      0.0    0.0000
robe Rinse Blank (mg/ml)=  0.0000
mpinger Blank (mg/ml)=  0.0000

ultiple leak checks used.  Final readings for each segment are listed below

k Rate (cfm) Time (min)
    0.0030   30.0000
    0.0020   30.0000
    0.0020   30.0000
    0.0020   30.0000
```

```
FILE NAME - R4BSV                                             PROG.=VER 06/09/89
RUN # - RUN 4SV - ASH GROVE CEMENT KILN                       11-01-1989  09:39:07
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=              244.957
Final Meter Volume (Cubic Feet)=                332.385
Meter Factor=                                     1.027
Multiple leak checks, see end of printout                 Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                   89.789
Gas Volume (Dry Standard Cubic Feet)=            88.306

Barometric Pressure (in Hg)=                      29.53
Static Pressure (Inches H2O)=                     -2.90

Percent Oxygen=                                    16.9
Percent Carbon Dioxide=                             3.7
Moisture Collected (ml)=                          149.8
Percent Water=                                      7.4

Average Meter Temperature (F)=                       72
Average Delta H (in H2O)=                          1.95
Average Delta P (in H2O)=                         0.459
Average Stack Temperature (F)=                      543

Dry Molecular Weight=                             29.27
Wet Molecular Weight=                             28.43

Average Square Root of Delta P (in H2O)=         0.6754
% Isokinetic=                                      98.8

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.300
Stack Axis #1 (Inches)=                            24.0
Stack Axis #2 (Inches)=                            96.0
Rectangular Stack
Stack Area (Square Feet)=                         16.00

Stack Velocity  (Actual, Feet/min)=               3,177
Flow Rate (Actual, Cubic ft/min)=                50,831
Flow rate (Standard, Wet, Cubic ft/min)=         26,211
Flow Rate (Standard, Dry, Cubic ft/min)=         24,272

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=          0.0000        0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=          0.0000
Emission Rate (lb/hr)=                             0.00

No Back Half Analysis
```

```
                        * * METRIC UNITS * *
FILE NAME - R4BSV                                        PROG.=VER 06/09/89
RUN # - RUN 4SV - ASH GROVE CEMENT KILN                  11-01-1989  09:39:35
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=             6.936
Final Meter Volume (Cubic Meters)=               9.412
Meter Factor=                                    1.027
Multiple leak checks, see end of printout              Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                 2.542
Gas Volume (Dry Standard Cubic Meters)=          2.500

Barometric Pressure (mm Hg)=                       750
Static Pressure (mm H2O)=                          -74

Percent Oxygen=                                   16.9
Percent Carbon Dioxide=                            3.7
Moisture Collected (ml)=                         149.8
Percent Water=                                     7.4

Average Meter Temperature (C)=                      22
Average Delta H (mm H2O)=                         49.5
Average Delta P (mm H2O)=                         11.7
Average Stack Temperature (C)=                     284

Dry Molecular Weight=                            29.27
Wet Molecular Weight=                            28.43

Average Square Root of Delta P (mm H2O)=        3.4038
% Isokinetic=                                     98.8

Pitot Coefficient=                                0.84
Sampling Time (Minutes)=                         120.0
Nozzle Diameter (mm)=                             7.62
Stack Axis #1 (Meters)=                          0.610
Stack Axis #2 (Meters)=                          2.438
Rectangular Stack
Stack Area (Square Meters)=                      1.486

Stack Velocity  (Actual, m/min)=                   968
Flow rate (Actual, Cubic m/min)=                 1,439
Flow rate (Standard, Wet, Cubic m/min)=            742
Flow rate (Standard, Dry, Cubic m/min)=            687

Particulate Loading - Front Half

Particulate Weight (g)=                         0.0000   Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=           0.0            0.0         0.0
Particulate Loading, Actual (mg/cu m)=             0.0
mission Rate (kg/hr)=                             0.00

No Back Half Analysis
```

```
FILE NAME - R4BSV                                             PROG.=VER 06/09/89
RUN # - RUN 4SV - ASH GROVE CEMENT KILN                       11-01-1989  09:40:03
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 10/31/89
PROJECT # - 9102-64-13

Point #        Delta P    Delta H    Stack T      Meter T
              (in. H2O) (in. H2O)    (F)     In(F)   Out(F)
 1             0.310       1.30      570       58       59
 2             0.440       1.80      584       63       59
 3             0.530       2.10      542       72       61
 4             0.500       2.10      513       77       63
 5             0.510       2.10      571       80       66
 6             0.370       2.10      206       70       68
 7             0.430       1.90      571       64       64
 8             0.470       2.10      569       67       64
 9             0.500       2.10      569       73       64
 10            0.500       2.10      572       77       66
 11            0.310       1.50      552       71       68
 12            0.460       2.00      570       76       69
 13            0.500       2.10      575       82       71
 14            0.490       2.00      571       84       72
 15            0.490       2.00      571       86       74
 16            0.350       1.50      555       77       74
 17            0.460       1.90      578       83       76
 18            0.550       2.10      530       88       77
 19            0.530       2.10      526       86       76
 20            0.480       2.10      571       87       77


Fraction                  Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)        (g)       (g)
DRY CATCH                 0.0000     0.0000     0.0000    0.0000
FILTER                    0.0000     0.0000     0.0000    0.0000

Fraction                  Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)       (ml)       (g)
PROBE RINSE               0.0000     0.0000      0.0    0.0000
IMPINGERS                 0.0000     0.0000      0.0    0.0000
Probe Rinse Blank (mg/ml)=   0.0000
Impinger Blank (mg/ml)=   0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
     0.0150    30.0000
     0.0040    30.0000
     0.0100    30.0000
     0.0100    30.0000
```

```
FILE NAME - R5MSV                                                   PROG.=VER 06/09/89
RUN # - R5MSV                                                       11-02-1989  17:04:09
LOCATION - MAIN ESP OUTLET DUCT
DATE - 11-2-89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=                 91.500
Final Meter Volume (Cubic Feet)=                  185.510
Meter Factor=                                       1.000
Multiple leak checks, see end of printout                    Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                     94.010
Gas Volume (Dry Standard Cubic Feet)=              95.592

Barometric Pressure (in Hg)=                        29.72
Static Pressure (Inches H2O)=                       -0.41

Percent Oxygen=                                       5.2
Percent Carbon Dioxide=                              27.4
Moisture Collected (ml)=                            479.9
Percent Water=                                       19.1

Average Meter Temperature (F)=                         59
Average Delta H (in H2O)=                            2.46
Average Delta P (in H2O)=                           0.551
Average Stack Temperature (F)=                        320

Dry Molecular Weight=                               32.59
Wet Molecular Weight=                               29.80

Average Square Root of Delta P (in H2O)=           0.7413
% Isokinetic=                                       100.6

Pitot Coefficient=                                   0.83
Sampling Time (Minutes)=                            120.0
Nozzle Diameter (Inches)=                           0.300
Stack Axis #1 (Inches)=                              48.0
Stack Axis #2 (Inches)=                              96.0
Rectangular Stack
Stack Area (Square Feet)=                           32.00

Stack Velocity  (Actual, Feet/min)=                 2,971
Flow Rate (Actual, Cubic ft/min)=                  95,065
Flow rate (Standard, Wet, Cubic ft/min)=           63,820
Flow Rate (Standard, Dry, Cubic ft/min)=           51,615

Particulate Loading - Front Half

Particulate Weight (g)=                            0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=            0.0000         0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=            0.0000
Emission Rate (lb/hr)=                               0.00

No Back Half Analysis
```

```
                    * * METRIC UNITS * *
FILE NAME - R5MSV                                             PROG.=VER 06/09/89
RUN # - R5MSV                                                 11-02-1989  17:04:36
LOCATION - MAIN ESP OUTLET DUCT
DATE - 11-2-89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Meters)=                 2.591
Final Meter Volume (Cubic Meters)=                   5.253
Meter Factor=                                        1.000
Multiple leak checks, see end of printout                  Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                     2.662
Gas Volume (Dry Standard Cubic Meters)=              2.707

Barometric Pressure (mm Hg)=                           755
Static Pressure (mm H2O)=                              -10

Percent Oxygen=                                        5.2
Percent Carbon Dioxide=                               27.4
Moisture Collected (ml)=                             473.9
Percent Water=                                        19.1

Average Meter Temperature (C)=                          15
Average Delta H (mm H2O)=                             62.5
Average Delta P (mm H2O)=                             14.0
Average Stack Temperature (C)=                         160

Dry Molecular Weight=                                32.59
Wet Molecular Weight=                                29.80

Average Square Root of Delta P (mm H2O)=            3.7359
% Isokinetic=                                        100.6

Pitot Coefficient=                                    0.83
Sampling Time (Minutes)=                             120.0
Nozzle Diameter (mm)=                                 7.62
Stack Axis #1 (Meters)=                              1.219
Stack Axis #2 (Meters)=                              2.438
Rectangular Stack
Stack Area (Square Meters)=                          2.973

Stack Velocity  (Actual, m/min)=                       905
Flow rate (Actual, Cubic m/min)=                     2,692
Flow rate (Standard, Wet, Cubic m/min)=              1,807
Flow rate (Standard, Dry, Cubic m/min)=              1,462

Particulate Loading - Front Half

Particulate Weight (g)=                             0.0000     Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (mg/cu m)=               0.0           0.0         0.0
Particulate Loading, Actual (mg/cu m)=                 0.0
Emission Rate (kg/hr)=                                0.00

No Back Half Analysis
```

```
FILE NAME - R5MSV                                                PROG.=VER 06/09/89
RUN # - R5MSV                                                    11-02-1989  17:05:05
LOCATION - MAIN ESP OUTLET DUCT
DATE - 11-2-89
PROJECT # - 9102-64-13

Point #      Delta P   Delta H   Stack T      Meter T
            (in. H2O) (in. H2O)   (F)     In(F)  Out(F)
 1            0.600      2.58     320       43      42
 2            0.580      2.44     320       52      44
 3            0.540      2.30     320       60      46
 4            0.550      2.40     321       63      48
 5            0.470      2.15     318       64      50
 6            0.640      2.77     322       52      49
 7            0.600      2.72     322       61      52
 8            0.590      2.66     322       69      54
 9            0.590      2.70     322       73      56
 10           0.530      2.45     321       75      58
 11           0.640      2.85     320       56      54
 12           0.620      2.82     321       62      56
 13           0.600      2.75     321       69      57
 14           0.550      2.48     321       70      57
 15           0.490      2.22     322       72      58
 16           0.480      2.15     318       59      56
 17           0.490      2.18     318       64      58
 18           0.500      2.27     320       70      58
 19           0.510      2.31     320       71      59
 20           0.450      2.04     320       72      60


Fraction                  Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                            (g)        (g)        (g)       (g)
DRY CATCH                 0.0000     0.0000     0.0000    0.0000
FILTER                    0.0000     0.0000     0.0000    0.0000

Fraction                  Final Wt.  Tare Wt.    Vol.     Net Wt.
                            (g)        (g)       (ml)       (g)
PROBE RINSE               0.0000     0.0000     0.0     0.0000
IMPINGERS                 0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
     0.0000    30.0000
     0.0000    30.0000
     0.0010    30.0000
     0.0000    30.0000
```

```
FILE NAME - R5BSV                                           PROG.=VER 06/09/89
RUN # - R5BSV                                               11-02-1989  17:00:14
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 11/2/89
PROJECT # - 9102-64-13

Initial Meter Volume (Cubic Feet)=              333.969
Final Meter Volume (Cubic Feet)=                420.868
Meter Factor=                                     1.027
Multiple leak checks, see end of printout               Leak Correction=  0.0000
Net Meter Volume (Cubic Feet)=                   89.245
Gas Volume (Dry Standard Cubic Feet)=            87.960

Barometric Pressure (in Hg)=                      29.72
Static Pressure (Inches H2O)=                     -2.90

Percent Oxygen=                                    16.8
Percent Carbon Dioxide=                             3.8
Moisture Collected (ml)=                          153.1
Percent Water=                                      7.6

Average Meter Temperature (F)=                       74
Average Delta H (in H2O)=                          1.79
Average Delta P (in H2O)=                         0.430
Average Stack Temperature (F)=                      579

Dry Molecular Weight=                             29.28
Wet Molecular Weight=                             28.43

Average Square Root of Delta P (in H2O)=         0.6537
% Isokinetic=                                     103.3

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (Inches)=                         0.300
Stack Axis #1 (Inches)=                            24.0
Stack Axis #2 (Inches)=                            96.0
Rectangular Stack
Stack Area (Square Feet)=                         16.00

Stack Velocity  (Actual, Feet/min)=               3,119
Flow Rate (Actual, Cubic ft/min)=                49,901
Flow rate (Standard, Wet, Cubic ft/min)=         25,019
Flow Rate (Standard, Dry, Cubic ft/min)=         23,124

Particulate Loading - Front Half

Particulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CO2
Particulate Loading, Dry Std. (gr/scf)=          0.0000        0.0000      0.0000
Particulate Loading, Actual (gr/cu ft)=          0.0000
Emission Rate (lb/hr)=                             0.00

No Back Half Analysis
```

```
                    * * METRIC UNITS * *
FILE NAME - R5BSV                                        PROG.=VER 06/09/89
RUN # - R5BSV                                            11-02-1989  17:00:43
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 11/2/89
PROJECT # - 9102-54-13

Initial Meter Volume (Cubic Meters)=              9.457
Final Meter Volume (Cubic Meters)=               11.917
Meter Factor=                                     1.027
Multiple leak checks, see end of printout                  Leak Correction=  0.0000
Net Meter Volume (Cubic Meters)=                  2.527
Gas Volume (Dry Standard Cubic Meters)=           2.491

Barometric Pressure (mm Hg)=                        755
Static Pressure (mm H2O)=                           -74

Percent Oxygen=                                    16.8
Percent Carbon Dioxide=                             3.8
Moisture Collected (ml)=                          153.1
Percent Water=                                      7.6

Average Meter Temperature (C)=                       23
Average Delta H (mm H2O)=                          45.5
Average Delta P (mm H2O)=                          10.9
Average Stack Temperature (C)=                      304

Dry Molecular Weight=                             29.28
Wet Molecular Weight=                             28.43

Average Square Root of Delta P (mm H2O)=         3.2945
% Isokinetic=                                     103.3

Pitot Coefficient=                                 0.84
Sampling Time (Minutes)=                          120.0
Nozzle Diameter (mm)=                              7.62
Stack Axis #1 (Meters)=                           0.610
Stack Axis #2 (Meters)=                           2.438
Rectangular Stack
Stack Area (Square Meters)=                       1.486

Stack Velocity  (Actual, m/min)=                    951
Flow rate (Actual, Cubic m/min)=                  1,413
Flow rate (Standard, Wet, Cubic m/min)=             708
Flow rate (Standard, Dry, Cubic m/min)=             655

 articulate Loading - Front Half

 articulate Weight (g)=                          0.0000    Corr. to 7% O2 & 12% CO2
 articulate Loading, Dry Std. (mg/cu m)=            0.0              0.0        0.0
 articulate Loading, Actual (mg/cu m)=              0.0
 mission Rate (kg/hr)=                             0.00

 o Back Half Analysis
```

```
FILE NAME - R5BSV                                                PROG.=VER 06/09/89
RUN # - R5BSV                                                    11-02-1989  17:01:10
LOCATION - BYPASS ESP OUTLET DUCT
DATE - 11/2/89
PROJECT # - 9102-64-13

Point #        Delta P   Delta H   Stack T       Meter T
              (in. H20) (in. H20)    (F)     In(F)  Out(F)
  1             0.300      1.10      566       51      51
  2             0.440      1.70      582       58      54
  3             0.500      2.00      562       68      56
  4             0.490      2.00      564       74      59
  5             0.480      2.00      582       79      62
  6             0.330      1.40      565       70      64
  7             0.460      1.90      585       76      68
  8             0.480      2.00      585       77      68
  9             0.480      2.00      580       79      69
 10             0.470      1.90      580       79      70
 11             0.290      1.10      572       72      69
 12             0.410      1.50      588       76      73
 13             0.430      1.70      590       86      77
 14             0.450      1.80      586       89      79
 15             0.450      1.80      586       87      80
 16             0.320      1.40      588       79      79
 17             0.410      1.80      600       82      81
 18             0.480      2.10      580       89      83
 19             0.470      2.30      528       93      84
 20             0.460      2.30      602       96      85


Fraction                   Final Wt.  Tare Wt.  Blank Wt.  Net Wt.
                              (g)        (g)       (g)       (g)
DRY CATCH                   0.0000     0.0000    0.0000    0.0000
FILTER                      0.0000     0.0000    0.0000    0.0000

Fraction                   Final Wt.  Tare Wt.    Vol.     Net Wt.
                              (g)        (g)      (ml)       (g)
PROBE RINSE                 0.0000     0.0000     0.0     0.0000
IMPINGERS                   0.0000     0.0000     0.0     0.0000
Probe Rinse Blank (mg/ml)=  0.0000
Impinger Blank (mg/ml)=  0.0000

Multiple leak checks used.  Final readings for each segment are listed below

Lk Rate (cfm) Time (min)
    0.0000    30.0000
    0.0010    30.0000
    0.0010    30.0000
    0.0040    30.0000
```

Appendix B-9
Volatile Organics Analysis
Data Summary

METHODS

The MM5 samples for semivolatiles, PCDD/PCDFs, and gravimetric analyses were extracted according to EPA SW-846 methods with some modifications. The five components of the MM5 sampling train (front-half rinse, filter, back-half rinse, XAD, and condensate) were each extracted separately. All samples were treated similarly. The surrogates for the PCDD/PCDFs and semivolatiles were added alternating between the five components. The surrogates employed for this study were D_4-2-chlorophenol and D_{10}-pyrene to monitor accuracy for the semivolatile organic screen and the ^{13}C-labeled PCDD/PCDFs specified in SW-846 Method 8290 to monitor accuracy for PCDD/PCDF analysis.

Prior to extracting the filter, the front-half rinse was filtered to remove any particulates. This filter and solids catch were added to the Soxhlet setup used to extract the MM5 filter. The filter and XAD samples were extracted initially with methylene chloride for 16 to 22 h. The solvent was removed, and toluene was added to the apparatus for a second extraction. A third solvent, methyl-*t*-butyl ether, was added to the components and extracted for 16 to 22 h. All three solvent extractions were combined and saved to be combined with the aqueous extracts. These samples were extracted using a Soxhlet extraction device according to SW-846 Method 3540.

The three solvent extraction scheme was also used for front-half, back-half, and condensate components of the MM5 train. The pH of the fractions was initially adjusted to neutral, pH 7-8, using 1 N NaOH or 1:1 H_2SO_4:H_2O. Methylene chloride was the first solvent, and each sample was extracted three times in a separatory funnel. The pH was adjusted to 11 using 1 N NaOH and the sample extracted three more times with methylene chloride. The pH of the fraction was adjusted back to neutral for extraction with toluene and methyl-*t*-butyl ether, respectively. All the solvent extracts were combined and saved to be concentrated with the filter and XAD fractions. SW-846 Method 3510 was used for these extractions.

The five component extracts from each train were combined and concentrated by rotoevaporation to approximately 5 mL. The samples were then transferred to a vial calibrated to a volume of 10 mL together with several rinses. The combined extracts were concentrated to 10 mL using a nitrogen evaporator and split as follows: 2.5 mL for PCDD/PCDF analysis, 2.5 mL for semivolatile organic screen, and 5 mL for gravimetric analysis. The semivolatile portion was nitrogen-evaporated to 1 mL and held for analysis. The PCDD/PCDF portion was cleaned up according to SW-846 Method 8280. The cleaned-up extracts were concentrated to a final volume of 25 µL.

The sample aliquots designated for the semivolatile organic screens were spiked with 100 µg of 2,2'-difluorobiphenyl and analyzed according to EPA Method 1625. This analytical method is roughly equivalent to SW-846 Method 8270 in terms of chromatographic conditions and analytical parameters. The target compound list from Method 1625 (Table B-10-1) was used to create a target compound library. In addition, the five most abundant nontarget compounds were identified for each sample. With the exception of the surrogates, relative response factors equal to 1 were used to calculate target and nontarget compound concentrations. All sample concentration calculations accounted for the splits described above.

The cleaned-up sample aliquots designated for PCDD/PCDF analysis were spiked with the Method 8290-required internal standards (98 pg of ^{13}C-1,2,3,4-TCDD and 196 pg of ^{13}C-1,2,3,7,8,9-HxCDD). They were analyzed by SW-846 Method 8290. All sample concentration calculations accounted for the splits described above.

Several quality control samples were prepared to monitor the quality (precision and accuracy) of the analytical results. These samples were a filter blank, blank filter matrix spike, blank filter matrix spike duplicate, XAD blank, blank XAD matrix spike, blank XAD matrix spike duplicate, water blank, blank water matrix spike, and blank water matrix spike duplicate. These nine samples were prepared and analyzed as described above for PCDD/PCDF. The blanks were also analyzed for semivolatiles.

RESULTS

Table B-10-2 summarizes the analytical results for PCDDs and PCDFs in the Ash Grove samples. Positive identification of the 2,3,7,8-substituted congeners was based on retention time and theoretical ratios of areas measured for each of the two ions monitored (±30%). All calibration criteria specified on SW-846 Method 8290 for the initial and continuing calibration checks of PCDDs and PCDFs were met during the analysis of these samples.

Surrogate recoveries for PCDDs and PCDFs are summarized in Table B-10-3. Only two of the 63 surrogate recovery determinations did not meet the accuracy quality control limit (QCL) of 40% to 120%. Precision QCLs (35% RSD) were met for the combined total of surrogate recoveries and also for the surrogates spiked into the XAD-2 resin component of the MM5 sampling trains. One of nine surrogate determinations spiked into the filter component of the sampling trains did not meet precision QCLs.

Tables B-10-4 and B-10-6 present the recoveries of PCDD/PCDFs spiked into XAD, filter, and water blanks, respectively. For the XAD spiked blanks (Table B-4), only three out of 34 recovery determinations did not meet the accuracy QCLs. Both of the duplicate spiked blanks met the precision quality control limits. The filter (Table B-10-5) and water (Table B-10-6) spikes met accuracy QCLs for 32 out of 34 determinations, and the duplicate spiked blanks met precision QCLs.

Tables B-10-7 to B-10-16 summarize the results of the semivolatile organic screen using GC/MS. For each table, the compounds specified in Table B-10-1 that were found in these samples are reported together with approximate concentrations for compounds found above or near the estimated detection limit, also specified in the tables. In addition, for each sample, the five most abundant nontarget compounds identified are reported, with approximated sample concentrations.

Table B-10-17 summarizes surrogate recoveries for samples screened for semivolatile organic compounds by GC/MS. Only D_{10}-pyrene recoveries are reported. D_4-2-Chlorophenol recoveries were not reported because this compound eluted within the toluene solvent front. The use of toluene as an extraction solvent was required for effective solvent extraction of PCDDs and PCDFs. It was not foreseen that this compound would elute within the toluene solvent front, and thus no corrective action could be taken to resolve this. Out of 14 surrogate recovery determinations, 13 met accuracy quality control limits. Precision QCLs for overall surrogate recoveries were met but were slightly above the QCL of 35% for surrogates spiked into the filter and XAD-2 components of the sampling trains.

Tables B-10-18 to B-10-20 present the results for the blanks (XAD, filter, and water) corresponding to samples screened for semivolatile organic compounds using GC/MS.

TABLE B-10-1. COMPOUNDS MONITORED DURING GC/MS SCREEN

1. *N*-Nitrosodimethylaniline
2. α-Picoline
3. Styrene
4. Bis(2-chlorophenol) ether
5. Phenol
6. 2-Chlorophenol
7. *n*-Decane
8. *N*-Nitroso-di-*n*-propylamine
9. 1,3-Dichlorobenzene
10. 1,4-Dichlorobenzene
11. *p*-Cymene
12. 1,2-Dichlorobenzene
13. Bis(2-chloroisopropyl) ether
14. Hexachloroethane
15. Nitrobenzene
16. Isophrone
17. 2-Nitrophenol
18. 2,4-Dimethylphenol
19. Bis(2-chloroethoxy)methane
20. 2,4-Dichlorophenol
21. 1,2,4-Trichlorobenzene
22. Naphthalene
23. α-Terpineol
24. *n*-Dodecane
25. 1,2,3-Trichlorobenzene
26. Hexachloro-1,3-butadiene
27. 4-Chloro-3-methylphenol
28. Hexachlorocyclopentadiene
29. 2,4,6-Trichlorophenol
30. 2,4,5-Trichlorophenol
31. 2-Chloronaphthalene
32. Diphenyl
33. Diphenyl ether
34. 2,6-Dinitrotoluene
35. Dimethyl phthalate
36. Acenaphthylene
37. Acenaphthene
38. 2,4-Dinitrophenol
39. Dibenzofuran
40. 4-Nitrophenol
41. 2,4-Dinitrotoluene
42. 2-Naphthylamine
43. *N*-Hexadecane
44. Fluorene
45. 4-Chlorophenyl-phenyl ether
46. Diethyl phthalate
47. 4,6-Dinitro-2-methylphenol
48. Diphenylamine
49. 1,2-Diphenylhydrazine
50. *N*-Nitrosodiphenylamine
51. 4-Bromophenyl-phenyl ether
52. Hexachlorobenzene
53. Dibenzothiophene
54. Pentachlorophenol
55. Phenanthrene
56. Anthracene
57. Carbazole
58. Di-*n*-butyl phthalate
59. *n*-Eicosane
60. Fluoranthene
61. Benzidine
62. Pyrene
63. Benzyl butyl phthalate
64. Tetracosane
65. Chrysene
66. 3,3'-Dichlorobenzidine
67. Benz[*a*]anthracene
68. Bis(2-ethylhexyl) phthalate
69. Di-*n*-octyl phthalate
70. Benzo[*b*]fluoranthene
71. Benzo[*k*]fluoranthene
72. Benzo[*a*]pyrene
73. Triacontane
74. Dibenz[*a,h*]anthracene
75. Benzo[*g,h,i*]perylene
76. Tetradecane
77. Octadecane
78. Docosane
79. Hexacosane
80. Octacosane
81. Indeno[1,2,3-*c,d*]pyrene
82. 2,3,6-Trichlorophenol

TABLE B-10-2. AMOUNT OF PCDD/PCDF FOUND (pg)

Analyte	Run 1001-1005	Run 1006-1010	Run 3001-3005	Run 3006-3010	Run 4001-4005	Run 4006-4010
2,3,7,8-TCDF	ND	240	59.6	63.1	700	170
2,3,7,8-TCDD	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDF	57.7	ND	50.1	ND	279	128
2,3,4,7,8-PeCDF	37.3	101	33	ND	330	ND
1,2,3,7,8-PeCDD	21.8	ND	ND	ND	92	ND
1,2,3,4,7,8-HxCDF	69.6	126	96.8	62.9	796	147
1,2,3,6,7,8-HxCDF	ND	61.5	36.1	ND	267	40.8
2,3,4,6,7,8-HxCDF	36.3	80.8	ND	25.9	380	33.1
1,2,3,7,8,9-HxCDF	ND	ND	ND	ND	ND	34.1
1,2,3,4,7,8-HxCDD	ND	ND	ND	ND	141	ND
1,2,3,6,7,8-HxCDD	ND	ND	ND	ND	140	ND
1,2,3,7,8,9-HxCDD	44.1	37.3	31.4	38.2	212	39.3
1,2,3,4,6,7,8-HpCDF	ND	ND	157	ND	1300	ND
1,2,3,4,7,8,9-HpCDF	ND	ND	ND	55.2	241	92
1,2,3,4,6,7,8-HpCDD	177	122	134	119	799	123
OCDF	211	312	616	405	1210	328
OCDD	761	468	550	629	1350	677
TCDF	136	1290	177	108	3220	625
TCDD	ND	ND	ND	ND	463	ND
PeCDF	240	552	225	59.7	3130	259
PeCDD	21.8	44.5	ND	ND	595	ND
HxCDF	97.8	413	184	116	2540	297
HxCDD	122	118	98.2	108	1310	49.2
HpCDF	ND	110	273	101	2020	172
HpCDD	302	219	349	193	1470	212

TABLE B-10-3. PERCENT SURROGATE RECOVERIES (PCDD/PCDF)

	Run 1001-1005	Run 1006-1010	Run 3001-3005	Run 3006-3010	Run 4001-4005	Run 4006-4010	Total average recovery	% RSD	Filter average recovery	% RSD	XAD average recovery	% RSD
^{13}C-TCDF	82.6	81.2	82.1	82.6	88.2	72	81.5	5.8	84.3	3.28	78.6	5.98
^{13}C-TCDD	59.5	79.6	66.3	59.3	83	59.8	67.9	14	69.6	14.2	66.2	14.3
^{13}C-PeCDF	87.3	78.1	91.4	79.9	85.7	82.5	80.8	10	81.5	13.8	80.2	2.25
^{13}C-PeCDD	87.8	81.8	78.5	79.7	76.9	72.8	76.3	6.1	74.4	6.27	78.1	4.92
^{13}C-HxCDF	57.7	56.3	48.1	55.9	51.8	37[a]	51.1	14	52.5	7.53	49.7	18.1
^{13}C-HxCDD	65.1	65.5	54.5	69.5	63.1	43.4	59.7	14	80.8	7.55	58.5	18.2
^{13}C-HpCDF	53.7	48.5	33.6[a]	52	92.9	44.8	54.3	34	60.1	41.0	48.4	6.07
^{13}C-HpCDD	64.2	69.4	44.5	80.1	75.8	56	65.0	18	61.5	21.0	68.5	14.4
^{13}C-OCDD	51.8	61.5	50	68.4	64.8	46.6	57.2	14	55.5	11.9	58.8	15.5
Average Train Recovery	65.5	69.1	61.0	69.4	73.6	57.2						
% RSD	18	16	30	16	17	26						
Spiked on	Filter	XAD	Filter	XAD	Filter	XAD						

[a] Outside data quality objective limits.

TABLE B-10-4. ACCURACY AND PRECISION OF XAD SPIKED BLANKS

QA type (dup., MS, MS dup.):	Blank		MS			MS dup			
Reporting units: Analytes	pg	Avg.	pg	Matrix spike level	Matrix spike % recovery^{a}	pg	Matrix spike level	Matrix spike % recovery^{a}	Matrix spike duplicates RPD^{b}
2,3,7,8-TCDF	194	194	6630	5998	107.3	6480	5998	104.8	2.3
2,3,7,8-TCDD	211	212	6340	5978	102.5	5750	5978	92.6	9.8
1,2,3,7,8-PeCDF	325	324	9300	6028	148.9^{c}	8900	6028	142.3^{c}	4.4
2,3,4,7,8-PeCDF	218	217	6350	5978	102.6	6190	5978	99.9	2.6
1,2,3,7,8-PeCDD	150	150	5100	6098	81.2	4880	6098	77.6	4.4
1,2,3,4,7,8-HxCDF	533	533	17700	14868	115.5	16900	14868	110.1	4.6
1,2,3,6,7,8-HxCDF	469	469	15300	14856	99.8	15500	14856	101.2	1.3
2,3,4,6,7,8-HxCDF	505	505	17800	15130	114.3	17000	15130	109.0	4.6
1,2,3,7,8,9-HxCDF	469	469	16800	14814	110.2	16100	14814	105.5	4.3
1,2,3,4,7.8-HxCDD	453	453	15300	14680	101.1	13900	14680	91.6	9.6
1,2,3,6,7,8-HxCDD	400	400	13500	15266	85.8	12800	15286	81.2	5.3
1,2,3,7,8,9-HxCDD	343	343	16300	15266	104.5	15000	15266	96.0	8.3
1,2,3,4,6,7,8-HpCDF	533	534	15500	15002	99.8	15800	15002	101.8	1.9
1,2,3,4,7,8,9-HpCDF	580	580	17100	15050	109.8	19700	15050	127.0^{c}	14.1
1,2,3,4,6,7,8-HpCDD	550	550	14600	14988	93.7	13600	14988	87.1	7.1
OCDF	1300	1300	34200	30318	108.5	32500	30318	102.9	5.1
OCDD	1530	1530	31000	20412	103.3	30600	29412	98.8	4.2

[a] % recovery = (Amount found in spike - Native level average/Amount spiked) • 100.

[b] RPD (relative percent difference) =(Rep 1 - Rep 2)(Average of Rep 1 and Rep 2) • 100.

[c] Outside data quality objective limits.

NA = not analyzed or not applicable; ND = not detected.

TABLE B-10-5. ACCURACY AND PRECISION OF FILTER SPIKED BLANKS

QA type (dup., MS, MS dup.):	Blank		MS			MS dup			
Reporting units: Analytes	pg	Avg.	pg	Matrix spike level	Matrix spike % recovery[a]	pg	Matrix spike level	Matrix spike % recovery[a]	Matrix spike duplicates RPD[b]
2,3,7,8-TCDF	ND	NA	6680	5998	111.4	8160	5998	102.7	8.1
2,3,7,8-TCDD	ND	NA	6670	5978	111.6	8550	5978	109.6	1.8
1,2,3,7,8-PeCDF	ND	NA	8710	6028	144.5[c]	9020	8028	149.6[c]	3.5
2,3,4,7,8-PeCDF	ND	NA	6650	5978	111.2	6360	5978	106.4	4.5
1,2,3,7,8-PeCDD	ND	NA	4840	6098	79.4	4410	6098	72.3	9.3
1,2,3,4,7,8-HxCDF	20.6	20.6	16700	14868	112.2	18400	14868	110.2	1.8
1,2,3,6,7,8-HxCDF	ND	NA	14700	14856	98.9	14500	14856	97.6	1.4
2,3,4,6,7,8-HxCDF	ND	NA	16400	15130	108.4	16800	15130	111.0	2.4
1,2,3,7,8,9-HxCDF	14.6	14.6	15600	14814	105.2	15800	14814	106.6	1.3
1,2,3,4,7.8-HxCDD	ND	NA	13900	14680	94.7	12700	14680	86.5	9.0
1,2,3,6,7,8-HxCDD	ND	NA	13200	15266	86.5	11380	15266	74.5	14.8
1,2,3,7,8,9-HxCDD	16.5	16.5	15200	15266	99.5	13900	15266	90.9	8.9
1,2,3,4,6,7,8-HpCDF	ND	NA	14400	15002	96.0	14000	15002	93.3	2.8
1,2,3,4,7,8,9-HpCDF	30.9	30.9	16600	15050	110.1	17500	15050	116.1	5.3
1,2,3,4,6,7,8-HpCDD	55.9	55.9	13300	14988	88.4	14000	14988	93.0	5.1
OCDF	167	167	34800	30318	114.2	34500	30318	113.2	0.9
OCDD	295	295	30600	29412	103.0	30900	29412	104.1	1.0

[a] % recovery = (Amount found in spike - Native level average/Amount spiked) • 100.

[b] RPD (relative percent difference) =(Rep 1 - Rep 2)(Average of Rep 1 and Rep 2) • 100.

[c] Outside data quality objective limits.

NA = not analyzed or not applicable; ND = not detected.

TABLE B-10-6. ACCURACY AND PRECISION OF WATER SPIKED BLANKS

QA type (dup., MS, MS dup.):	Blank		MS			MS dup			
Reporting units:									
Analytes	pg	Avg.	pg	Matrix spike level	Matrix spike % recovery[a]	pg	Matrix spike level	Matrix spike % recovery[a]	Matrix spike duplicates RPD[b]
2,3,7,8-TCDF	ND	NA	5920	5998	98.7	6630	5998	110.5	11.3
2,3,7,8-TCDD	ND	NA	5810	5978	97.2	6610	5978	110.6	12.9
1,2,3,7,8-PeCDF	24.9	24.9	8710	6028	144.1[c]	9280	6028	153.5[c]	6.3
2,3,4,7,8-PeCDF	ND	NA	7190	5978	120.3	8580	5978	110.1	8.9
1,2,3,7,8-PeCDD	ND	NA	4260	6098	69.9	4520	6098	74.1	5.9
1,2,3,4,7,8-HxCDF	29.7	29.7	15200	14868	102.0	16200	14868	108.8	6.4
1,2,3,6,7,8-HxCDF	14.3	14.3	13500	14856	90.8	14700	14856	98.9	8.5
2,3,4,6,7,8-HxCDF	16.8	16.8	15600	15130	103.0	15300	15130	101.0	1.9
1,2,3,7,8,9-HxCDF	ND	NA	14400	14814	97.2	14600	14814	98.6	1.4
1,2,3,4,7.8-HxCDD	ND	NA	12800	14680	87.2	12900	14680	87.9	0.8
1,2,3,6,7,8-HxCDD	ND	NA	11540	15266	75.8	12100	15266	79.3	4.7
1,2,3,7,8,9-HxCDD	20.4	20.4	12900	15266	84.4	14700	15266	96.2	13.0
1,2,3,4,6,7,8-HpCDF	61.6	61.6	15200	15002	100.9	14700	15002	97.6	3.3
1,2,3,4,7,8,9-HpCDF	40.6	40.6	16600	15050	110.0	17300	15050	114.7	4.1
1,2,3,4,6,7,8-HpCDD	111	111	12900	14988	85.3	14300	14988	94.7	10.3
OCDF	244	244	32300	30318	105.7	32700	30318	107.1	1.2
OCDD	614	614	2800	29412	93.1	30200	29412	100.6	7.6

[a] % recovery = (Amount found in spike - Native level average/Amount spiked) • 100.

[b] RPD (relative percent difference) =(Rep 1 - Rep 2)(Average of Rep 1 and Rep 2) • 100.

[c] Outside data quality objective limits.

NA = not analyzed or not applicable; ND = not detected.

TABLE B-10-7. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 1001-1005

Total extract volume (mL): 10
Split volume (mL): 2.5
Final split volume (mL): 1

Amount surrogate spike (μg)
D_{10}-Pyrene: 394
D_4-2-Chlorophenol: 400

IS area: 329.526
Detection limit: 40 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	420337	295.8	75.1%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
35	Diphenyl	25849	31.4	NA
42	Dibenzofuran	60925	74.0	NA
59	Anthracene	23360	28.4	NA
71	Bis(2-ethylhexyl) phthalate	37718	45.8	NA

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
764	Methylphenol	320	1280	NA
775	Methylphenol	31	124	NA
1036	Alkane	1600	6400	NA
795	Methylphenol	52	208	NA
882	Methylbutylbenzene	11	44	NA

---

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c]
$$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \cdot 100 \cdot \text{Final split vol.} \cdot \text{Total extract vol.})}{(\text{IS area} \cdot \text{RRF} \cdot \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-8. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 1006-1010

Total extract volume (mL): 10	Amount surrogate spike (µg)
Split volume (mL): 2.5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 256.563
Detection limit: 40 total µg[a]

No.	Compound	Total area	Sample amount[c] (µg)	Surrogate recovery
2	D_{10}-Pyrene	350293	316.6	80.4%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
71	Bis(2-ethylhexyl) phthalate	13223	20.6	NA

Nontarget majors

Scan	Compound	Conc. (µg/mL)	Sample amount[c] (µg)	Surrogate recovery
718	Trimethylbenzene	21	84	NA
758	Methylphenol	120	480	NA
884	Substituted benzene	340	1360	NA
1035	Alkane	2100	8400	NA
1250	Substituted benzene	28	112	NA

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \cdot 100 \cdot \text{Final split vol.} \cdot \text{Total extract vol.})}{(\text{IS area} \cdot \text{RRF} \cdot \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-9. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 1011-1015

Total extract volume (mL): 10	Amount surrogate spike (μg)
Split volume (mL): 5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 454.457
Detection limit: 20 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	1037216	264.6	67.2%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
61	Di-*n*-butyl phthalate	20426	9.0	NA
71	Bis(2-ethylhexyl) phthalate	73761	32.5	NA

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
748	Methylphenol	110	220	NA
1229	Substituted benzene	46	92	NA
778	Phenyl ethanone	6	12	NA
979	Ethyl phenyl ethanone	7.4	14.8	NA
1240	Bis-ethanediyl benzene	35	70	NA

---

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount (μg)} = \frac{(\text{Total area} \cdot 100 \cdot \text{Final split vol.} \cdot \text{Total extract vol.})}{(\text{IS area} \cdot \text{RRF} \cdot \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-10. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 2001-2005

Total extract volume (mL): 10	<u>Amount surrogate spike (µg)</u>
Split volume (mL): 5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 336.527
Detection limit: 20 total µg[a]

No.	Compound	Total area	Sample amount[c] (µg)	Surrogate recovery
2	D_{10}-Pyrene	871752	300.3	76.2%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
35	Diphenyl	47586	28.3	NA
42	Dibenzofuran	126490	75.2	NA
61	Di-*n*-butyl phthalate	27166	16.1	NA
71	Bis(2-ethylhexyl) phthalate	68199	40.5	NA

Nontarget majors

Scan	Compound	Conc. (µg/mL)	Sample amount[c] (µg)	Surrogate recovery
757	Methylphenol	320	640	NA
767	Methylphenol	58	116	NA
789	Methylphenol	150	300	NA
1247	Methyl phenylmethyl benzene	160	320	NA
1258	Methyl phenylmethyl benzene	57	114	NA

---

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-11. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 2006-2010

Total extract volume (mL): 10
Split volume (mL): 5
Final split volume (mL): 1

Amount surrogate spike (μg)
D_{10}-Pyrene: 394
D_4-2-Chlorophenol: 400

IS area: 301.311
Detection limit: 20 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	745166	286.7	72.8%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
762	Methylphenol	240	480	NA
890	Substituted benzene	560	1120	NA
717	Trimethylbenzene	30	60	NA
1022	Alkane	27	54	NA
1249	Bis-ethanediyl benzene	39	78	NA

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-12. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 3001-3005

Total extract volume (mL): 10	Amount surrogate spike (µg)
Split volume (mL): 2.5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 254.282
Detection limit: 40 total µg[a]

No.	Compound	Total area	Sample amount[c] (µg)	Surrogate recovery
2	D_{10}-Pyrene	43747	39.9	10.1%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
71	Bis(2-ethylhexyl) phthalate	105234	165.5	NA

Nontarget majors

Scan	Compound	Conc. (µg/mL)	Sample amount[c] (µg)	Surrogate recovery
756	Methylphenol	230	920	NA
1025	Alkane	970	3880	NA
1029	Alkane	210	840	NA
1859	Alkanoic acid ester	67	268	NA
1255	Methyl phenylmethyl benzene	51	204	NA

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-13. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 3006-3010

Total extract volume (mL): 10	Amount surrogate spike (μg)
Split volume (mL): 2.5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 278.781
Detection limit: 40 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	351046	292.0	74.1%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
71	Bis(2-ethylhexyl) phthalate	222088	318.7	NA

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
894	Benzaldehyde	57	228	NA
905	Dimethyl ethoxy toluene	120	480	NA
1032	Alkane	1600	6400	NA
1863	Substituted benzene	220	880	NA
1256	Methyl phenylmethyl benzene	100	400	NA

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-14. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 4001-4005

Total extract volume (mL): 10
Split volume (mL): 2.5
Final split volume (mL): 1

Amount surrogate spike (µg)
D_{10}-Pyrene: 394
D_4-2-Chlorophenol: 400

IS area: 370.980
Detection limit: 40 total µg[a]

No.	Compound	Total area	Sample amount[c] (µg)	Surrogate recovery
2	D_{10}-Pyrene	344368	215.3	54.6%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
71	Bis(2-ethylhexyl) phthalate	117158	126.3	NA

Nontarget majors

Scan	Compound	Conc. (µg/mL)	Sample amount[c] (µg)	Surrogate recovery
756	Methylphenol	380	1520	NA
726	Substituted benzene	30	120	NA
785	Methylphenol	55	220	NA
1024	Alkane	1300	5200	NA
765	Methylphenol	27	108	NA

---

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount (µg)} = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-15. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 5001-5005

Total extract volume (mL): 10
Split volume (mL): 5
Final split volume (mL): 1

<u>Amount surrogate spike (µg)</u>
D_{10}-Pyrene: 394
D_4-2-Chlorophenol: 400

IS area: 340.186
Detection limit: 20 total µg[a]

No.	Compound	Total area	Sample amount[c] (µg)	Surrogate recovery
2	D_{10}-Pyrene	720208	245.5	62.3%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
71	Bis(2-ethylhexyl) phthalate	146269	86.0	NA

Nontarget majors

Scan	Compound	Conc. (µg/mL)	Sample amount[c] (µg)	Surrogate recovery
757	Methylphenol	98	196	NA
888	Substituted benzene	23	46	NA
715	Trimethylbenzene	35	70	NA
923	Benzothiophene + unknown	43	86	NA
919	Methyl benzaldehyde	28	56	NA

---

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \cdot 100 \cdot \text{Final split vol.} \cdot \text{Total extract vol.})}{(\text{IS area} \cdot \text{RRF} \cdot \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-16. GC/MS SCREEN DATA SUMMARY FOR SAMPLE 5006-5010

Total extract volume (mL): 10	Amount surrogate spike (μg)
Split volume (mL): 5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 322.369
Detection limit: 20 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	870250	313.0	79.4%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
760	Methylphenol	94	188	NA
881	Substituted benzene	68	136	NA
714	Unknown compound	35	70	NA
897	Benzaldehyde	43	86	NA
2114	Unknown	23	46	NA

---

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount (μg)} = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-17. PERCENT SURROGATE RECOVERIES (SVO)

Sample	D_{10}-Pyrene	D_4-2-Chlorophenol	Spiked on
Filter blank	91.8	ND	
Water blank	86.6	ND	
XAD blank	85.8	ND	
1001-1005	75.1	ND	Filter
1006-1010	80.4	ND	XAD
1011-1015	67.2	ND	Condensate
2001-2005	76.2	ND	FH/BH
2006-2010	72.8	ND	FH/BH
3001-3005	10.1[a]	ND	Filter
3006-1010	74.1	ND	XAD
4001-4005	54.6	ND	XAD
4006-4010	50.6	ND	Filter
5001-5005	62.3	ND	Condensate
5006-5010	79.4	ND	Condensate
Average recovery			
Total	69.1	NA	
% RSD	28.8	NA	
Filter	62.9	NA	
Range %	39.0[a]	NA	
XAD	69.7	NA	
Range %	37.0[a]	NA	
FH/BH	74.5	NA	
Range %	4.56	NA	
Condensate	69.6	NA	
Range %	24.6	NA	

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[a] Did not meet DQOs.

TABLE B-10-18. GC/MS SCREEN DATA SUMMARY FOR XAD BLANK

Total extract volume (mL): 10	Amount surrogate spike (μg)
Split volume (mL): 2.5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 248.178
Detection limit: 40 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	361752	338.0	85.8%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%
71	Bis(2-ethylhexyl) phthalate	24137	38.9	NA

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
752	Methylphenol	37	148	NA
1036	Alkane	2700	10800	NA
715	Trimethylbenzene	13	52	NA
815	Butylbenzene	5.1	20.4	NA
908	Benzoic acid	27	108	NA

[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-19. GC/MS SCREEN DATA SUMMARY FOR FILTER BLANK

Total extract volume (mL): 10	Amount surrogate spike (µg)
Split volume (mL): 2.5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 234.672
Detection limit: 40 total µg[a]

No.	Compound	Total area	Sample amount[c] (µg)	Surrogate recovery
2	D_{10}-Pyrene	366190	361.8	91.8%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%

Nontarget majors

Scan	Compound	Conc. (µg/mL)	Sample amount[c] (µg)	Surrogate recovery
711	Trimethylbenzene	27	108	NA
749	Methylphenol	12	84	NA
873	Substituted benzene	15	60	NA
919	Alkane	3100	12400	NA
1037	Alkane	13	52	NA

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[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \cdot 100 \cdot \text{Final split vol.} \cdot \text{Total extract vol.})}{(\text{IS area} \cdot \text{RRF} \cdot \text{Split volume})}$$

where RRF = 1 except for surrogates.

TABLE B-10-20. GC/MS SCREEN DATA SUMMARY FOR WATER BLANK

Total extract volume (mL): 10	Amount surrogate spike (μg)
Split volume (mL): 2.5	D_{10}-Pyrene: 394
Final split volume (mL): 1	D_4-2-Chlorophenol: 400

IS area: 275.288
Detection limit: 40 total μg[a]

No.	Compound	Total area	Sample amount[c] (μg)	Surrogate recovery
2	D_{10}-Pyrene	405163	341.3	86.6%
3	D_4-2-Chlorophenol[b]	0	0.0	0.0%

Nontarget majors

Scan	Compound	Conc. (μg/mL)	Sample amount[c] (μg)	Surrogate recovery
753	Methylphenol	35	140	NA
878	Substituted benzene	44	176	NA
1040	Alkane	27	108	NA
714	Substituted benzene	24	96	NA
1249	Substituted benzene	16	64	NS

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[a] All compounds with areas less than 10% of the internal standard are considered to be below the stated detection limit. All of the target analytes monitored are listed separately.

[b] The filament on the mass spectrometer was turned on too late to detect this compound. This was due to the use of toluene in the sample extracts, which burned out the filament several times.

[c] $$\text{Sample amount } (\mu g) = \frac{(\text{Total area} \bullet 100 \bullet \text{Final split vol.} \bullet \text{Total extract vol.})}{(\text{IS area} \bullet \text{RRF} \bullet \text{Split volume})}$$

where RRF = 1 except for surrogates.

APPENDIX C

QUALITY ASSURANCE/QUALITY CONTROL

SUMMARY OF QUALITY ASSURANCE AUDITS

This appendix describes the audits conducted during this work assignment. All audits were conducted by T. Dux, the Quality Assurance Coordinator (QAC) for this work assignment. All audits were reported to the program Quality Assurance Manager, C. Green, the Program Manager, T. Ferguson, the Work Assignment Manager, A. Trenholm, and appropriate line management and work assignment task leaders.

Audits of Field Activities

There were three audits of field activities. First, a technical systems audit was conducted of all field operations done on 10/29/89, Run 2. Second, an audit of the data quality associated with the field sampling operations was done by reviewing the field sampling records and resulting calculations. Third, an audit of the data quality of the field GC results was done by reviewing the supporting records and final calculations.

Technical Systems Audit of Field Operations--

Scope of the audit--The audit was conducted on 10/29/89, Run 2; the QAC was present from initial setup to final disposition of samples. During the audit, the QAC compared actual field operations to the specifications in the applicable methods and the draft test/QA plan, plus the comments from the EPA reviewers. Specific audit forms with applicable questions/observations were generated for this audit and filled out on-site. After the audit, the qualifications of all sampling personnel were verified by checking corporate records.

The following specific operations were observed:

- Sampling of raw meal
- Sampling of waste feed
- Delivery of waste feed, both solid and liquid
- VOST sampling by Method 0030
- SVOST sampling by Method 0010
- M3 sampling
- M5 sampling
- MM5 sampling for hydrogen chloride
- Calibration of field GC
- Calibration of THC
- Disassembly and storage of the MM5 train components
- Disassembly and storage of VOST condensate and cartridges
- Collection of plant operating data

Audit results--In general, all field operations were conducted in accordance with the methodology and the draft test/QA plan. Personnel appeared to be well trained and competent. There was sufficient information recorded in most cases to completely support the data generated during this demonstration test. Most calibration, leak checks, and associated QA procedures and information were well within criteria.

Audit of Data Quality of Field Sampling and Associated Calibrations and Calculations--

Scope of the audit--The raw data and calculations associated with field sampling were examined by the QAC and compared to the test plan for compliance to planned methodology and achievement of project objectives. All information and data for Run 3 sampling of the main duct emissions (semivolatile, hydrogen chloride, volatile, and Orsat), raw meal, liquid waste, solid waste, and ESP dust were reviewed and traced through the project records. This was done to verify the reported results of Run 3 sampling and to establish that analytical results are traceable to valid field samples. Project records were reviewed to determine if the overall conduct of the test met project requirements.

Audit results--The samples of raw meal and ESP dust were traceable and generated in accordance with project requirements. The Orsat samples and analytical results were traceable and were in accordance with method requirements. The hydrogen chloride, semivolatile samples (MM5 train), and volatile samples (VOST) were generated in accordance with project and method requirements. Some difficulties were noted during the audit concerning HCl calculations and field equipment calibration records. These topics were reported to project and line management and corrected before the test report was finalized.

Audit of Data Quality of Field GC Sampling and Analysis--

Scope of the audit--This audit concerned field analyses for organics which are chromatographable and can be detected with a flame ionization detector. Samples were taken from the main and bypass ducts and introduced directly into the GC for analysis. Quantitation was done using a reference standard of propane, and a standard containing C7 and C17 hydrocarbons was used to separate data into a C1-7 fraction and a C7-17 fraction.

The raw data and summary results were examined and compared to the test plan for compliance to planned methodology and achievement of project objectives. All information and data for Run 3 sampling were reviewed and traced through the project records to verify the reported results. Calculations were manually checked.

Results of the audit--The audit indicated that standards, blanks, and linearity standards were analyzed and met objectives, and that final sample data were traceable and correctly calculated. In general, project objectives were met, and any analysis difficulties are discussed in the technical portion of this report.

Audit of Data Quality for Semivolatile, Dioxin/Furan, and Gravimetric Determinations of Stack Gas Samples

Scope of the Audit--

The objective of these determinations was to characterize the semivolatile organic fraction of a stack gas sample by determining the amount of polychlorinated dibenzodioxins and dibenzofurans (PCDD/F) by GC/MS, identifying the major semivolatile (SVO) components by GC/MS, and determining organic residue by gravimetric analysis. Sampling train components were extracted with three solvents, and the three extracts were combined into a single sample which was split into three fractions, one each for PCDD/F, SVO, and gravimetric analysis. The reported data consist of total organic residue results, PCDD/F data for specific isomers and total homologs, plus qualitative results for the SVO analysis for compounds listed in EPA Method 1625 and the five major components of the SVO fraction. The analytical methodology was based on EPA procedures.

The analysis summary, project records, and raw data were examined by the QAC and compared to the test plan and 12/13/89 memo (Trenholm to Hlustick) for compliance to planned methodology and achievement of project objectives. All information and data for initial and continuing calibration, surrogate recoveries, field blanks, system blanks, GC/MS logbook entries, sample preparation, and standard preparation were reviewed in detail. One train, Run 3 bypass duct (samples 3006-3010), was traced through the project records, and sample results were verified by hand calculation.

Audit Results--

For PCDD/F and gravimetric analyses, the results and supporting documentation for the PCDD/F meet project requirements and objectives. Holding times were met; calibration criteria were met; all sample results for PCDD/F surrogates, matrix spike, and spike duplicates met precision and accuracy criteria. A calculation error was noted with the gravimetric analyses and corrected before sample data were finalized.

The results for SVO analysis did not meet some of the project requirements. Following are the main QA topics of the audit:

- Some sample preparation and analysis holding times were exceeded by a short time; however, the results were not compromised.

- SVO calibration procedures were different from those specified in the test plan, but the calibration procedure was satisfactory.

- There were two surrogates for SVO analysis, one base-neutral and one acidic surrogate. Results were not obtained for the acidic surrogate because of solvent interferences which are explained in technical report, Appendix B.

All difficulties noted during the audit were reported to project and line management for consideration and resolution. All pertinent topics concerning analysis difficulties are discussed in the technical portion of this report, Appendix B.

Audit of Data Quality for Volatile Organic Determinations in Stack Gas Samples

Scope of the Audit--

This audit covered the volatile organic analysis (VOST) for the principal organic hazardous constituent (POHC), chlorobenzene, and the major volatile components in the stack gas. For VOST, there was a quantitative chlorobenzene analysis, a semiquantitative volatile compound report (identification and semiquantitation of all compounds on the EPA Method 1624 target analyte list), and a qualitative tentatively identified compound analysis (reporting of five largest peaks). The analytical methodology was based upon SW-846 procedures.

The project records and raw data were examined by the QAC and compared to the test plan and the 12/13/89 memo (Trenholm to Hlustick) for compliance with planned methodology and achievement of project objectives. All data for initial and continuing calibration, surrogate recoveries, field blanks, system blanks, performance samples, and GC/MS logbook entries were reviewed in detail. One sample, 4040, was traced through the project records to verify sample results.

Audit Results--

In general, the data were generated according to project specifications and meet project objectives. The records were organized, traceable, and relatively complete. The majority of calibration criteria were met, as were applicable surrogate accuracy and precision objectives. Samples were analyzed within holding times. Blanks demonstrated that operations were generally free from contamination. Due to a sample handling problem, a few VOST field blanks were not analyzed; however, other field blanks showed that there were no contamination problems. A few analysis problems and one calculation error were reported to project and line management for consideration. The calculation error was corrected, and analysis difficulties are discussed in Appendix B-9.

Performance Audit Samples

Two performance audit samples were prepared. An EPA certified standard of the POHC, chlorobenzene, was diluted in methanol (50 µg/mL level) and analyzed following instrument calibration. A potassium chloride reference solution was diluted to two levels (7 and 0.7 g/L). Results for chlorobenzene, potassium, and chloride are reported in the technical portions of this report. Accuracy results were within the objectives specified in the test plan: 60% to 120% of the reference value for chlorobenzene and 90% to 110% for chloride.