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Source Sampling Fine Particulate Matter

Institutional Oil-Fired Boiler

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Section 1
Introduction

In July 1997, the U.S. Environmental Protection Agency (EPA) promulgated new National Ambient Air Quality Standards (NAAQS) for ambient particulate matter of aerodynamic diameter 2.5 μm or less (PM-2.5). Implementation of the new standards has been delayed to allow EPA time to better understand the factors underlying the observed correlation between ambient fine PM and adverse human health effects and to better evaluate risk management options.

States are required under the federal consolidated emission reporting rule (CERR) to report emissions information to U.S. EPA for inventory and planning purposes, including $PM_{2.5}$ and ammonia. The purpose of the CERR is to simplify reporting, offer options for data collection and exchange, and unify reporting dates for various categories of criteria pollutant emission inventories. This rule consolidates the emission inventory reporting requirements found in various parts of the Clean Air Act (CAA). Consolidation of reporting requirements enables state and local agencies to better explain to program managers and the public the necessity for a consistent inventory program, increases the efficiency of the emission inventory program, and provide more consistent and uniform data. One concern with this reporting requirement is there are no reliable emission factors to use for estimating $PM_{2.5}$ or NH_3. Sources should be able to provide more accurate emission estimates than are currently available in emission inventories or AP-42. This is especially concerning to Title V sources that are required to certify the emissions estimate.

Fine particles can be directly emitted from sources or, like ozone, can be formed in the atmosphere from precursor gases. The most common source of directly emitted $PM_{2.5}$ is incomplete combustion of fuels containing carbon (fossil or biomass), which produces carbonaceous particles consisting of a variety of organic substances and black carbon (soot), as well as gaseous carbon monoxide, VOCs and NO_x. Certain high energy industrial processes also emit primary $PM_{2.5}$. Examples of direct $PM_{2.5}$ sources include diesel and gasoline vehicles, open

burning, residential wood burning, forest fires, power generation, and industrial metals production and processing. The major gaseous precursors of secondary $PM_{2.5}$ include SO_2, NO_x, certain VOCs and NH_3. Secondary formation of $PM_{2.5}$ involves complex chemical and physical processes. The major sources of secondary $PM_{2.5}$ forming gases (SO_2, NO_x, certain VOCs, NH_3) include nearly every source category of air pollutants. Major SO_2 sources in the U.S. include coal-fired power plants and industrial boilers and smelters. EPA required states upwind of $PM_{2.5}$ nonattainment areas to control and reduce emissions of sulfur dioxide (SO_2) or nitrogen oxides (NO_x). Measurement of the primary $PM_{2.5}$ content and the chemicals that participate in secondary fine particulate formation is important in PM control and attainment of NAAQS. Consequently, EPA has concluded that small contributions of pollution transport to downwind nonattainment areas should be considered significant from an air quality standpoint because these contributions could prevent or delay downwind areas from achieving the health-based standards.

In 1999, a national network of ambient monitoring stations was started under the overall guidance of the EPA's Office of Air Quality Planning and Standards (OAQPS) to assist the States in determining regulatory nonattainment areas and to develop State Implementation Plans (SIPs) to bring those areas into compliance with the law for PM-2.5 regulations. One component of the monitoring network was seven supersites: i.e., urban airsheds in which intensive coordinated PM-related research was carried out to better understand the atmospheric formation, composition, and sources of fine PM.

To further support development of better emission factors and an understanding of the formation of fine particulate after emissions leave stationary sources, the Emissions Characterization and Prevention Branch (ECPB) of the Air Pollution Prevention and Control Division (APPCD) implemented research to characterize PM-2.5 emissions from specific source categories. This research focuses on updating and improving source emission rates and profiles for PM-2.5 with the aim of improving the quality of data used for dispersion and receptor modeling and of providing quality emissions data for risk management strategies.

This program has concentrated its PM source sampling efforts on the sources and types of PM-2.5 where data are most needed, with a primary focus on the collection of fine particles emitted by combustion sources, both stationary and mobile. To ensure that the collected PM is representative of the PM collected by ambient monitors downstream of the source, PM samples were collected using a dilution sampling method to simulate the processes of cooling and condensation that occur when material leaves a stack as hot exhaust gas and to provide a means to comply with the requirements of the Consolidated Emissions Reporting Rule.

The mission of the ECPB of the APPCD is to characterize source emissions and develop and evaluate ways to prevent those emissions. Source characterizations as defined here include the measurement of PM mass emission rates, source PM profiles (PM chemical composition and associated chemical mass emission rates), and emission rates of ambient aerosol precursors such as SO_x, NO_x, and NH_3.

PM mass emission rates are used in emission inventories and as inputs to atmospheric dispersion models that yield estimates of ambient PM concentrations from considerations of atmospheric transport and transformation of emitted particles. Source characterization data are used in receptor models which enable apportionment of ambient concentrations of PM to the various sources that emitted the particles and in atmospheric dispersion models that compute the formation of secondary organic aerosols. Source types for testing in this program were selected on the basis of the quantity of fine PM emitted by the source as determined from existing emission inventories and on the basis of the quality of existing PM-2.5 source profiles for each source type. This report presents the results of testing one source type so selected, an institutional scale oil-fired boiler (SCC 1-02-005-01)[1].

Description of Testing and Testing Objectives

This test report describes the measurement and characterization of fine particulate matter (fine PM) emissions and volatile organic compound (VOC) emissions from an institutional scale #2 distillate oil-fired boiler with a rated capacity of 60,000 lbs/h (18.7 MW, 67.3 GJ/h)[1]. This

category of boilers was responsible for an estimated 1245.4 kJ (ca. 45.6%) of distillate oil consumption in the U.S. in 1990[2]. The boiler tested in this study was one of three boilers in a university power plant that provided space and water heating to a number of buildings on the university campus. Sampling was conducted in the exhaust duct of one boiler prior to the point at which all three boiler exhausts were combined into a single exhaust stream to the power plant stack. The boiler employed low-NO_x burners for control of NO_x emissions, but no devices for control of particulate matter were utilized.

The report presents results of the test efforts in two ways:

- As mass emission factors (i.e., mass of emitted species per unit mass of fuel consumed), and
- Mass fraction composition of the particle and gas phase emissions.

Mass emission factors are useful for emission inventories and for atmospheric dispersion models that yield estimates of ambient pollutant concentrations via considerations of atmospheric transport and transformation of emitted species. Compositional data are used in source-receptor models to enable the apportionment of ambient air pollutants to the responsible pollutant sources.

Source-receptor models such as the Chemical Mass Balance (CMB) model require as input both the chemical composition of the ambient air samples and the composition of the emissions of all major sources contributing to the ambient pollutants. The oil-fired boiler emission tests described here are among a number of such tests of significant emission sources aimed at updating and improving the quality of source emission profiles in EPA's source profile database (SPECIATE), which is available for use by state and local environmental agencies and others for source-receptor modeling.

Sampling the hot stack gas emissions in the present study involved withdrawing a known amount of sample from the exhaust duct of the boiler and cooling and diluting the sample stream

with cleaned ambient air to near ambient conditions prior to collecting the particle- and gas-phase emissions. A custom-fabricated dilution sampler following the design by Hildemann et al.[3] was used. This sampler was constructed entirely of electropolished stainless steel and contained no rubbers, greases, or oils to ensure no introduction of organic contaminants in the samples. Ambient air used to dilute the stack gas was pre-cleaned by means of a HEPA filter, a large bed of activated carbon (carbonaceous material contained in a 30-gallon drum), and a Teflon membrane filter prior to mixing with the stack gas. By sampling in this way, the particle emissions are deemed to be more representative of the material as it exists in the ambient air downwind of the source.

The boiler was tested in two separate campaigns. An initial test series (i.e., campaign #1) was conducted in January 2001. The primary objective of the first campaign effort was to chemically characterize the fine PM emissions (i.e., PM-2.5, particles equal to or less than 2.5 μm aerodynamic diameter) and to develop emission factors for EPA's SPECIATE data base. Many past efforts have focused on the coarse fraction of emitted PM (PM-10) or only the filterable portion of emitted PM. Condensible PM, which can form when a hot exhaust stream is diluted and cooled with ambient air, has not often been characterized in previous work. Also, earlier chemical characterization studies of PM were often limited to the elemental composition of the material with the nature of the organic content of carbonaceous PM unidentified.

This initial test series included a trial run to determine an appropriate test duration and to ensure all systems were operating properly. The trial run was followed by three replicate sampling runs, one run on each of three successive days. Samples of gas phase organic compound emissions were collected concurrently with the fine PM samples in test campaign #1, and results of these gaseous emissions determinations are also reported here for completeness.

A second test series (i.e., campaign #2) was conducted in July 2002 in collaboration with the EPA's OAQPS, Emissions Monitoring and Analysis Division (EMAD). The second campaign had a dual purpose:

- To provide referee comparative data to EMAD to help in the development of a more compact and portable dilution sampler suitable for routine regulatory compliance stack gas sampling and for source emissions profiling; and

- To compare the PM2.5 results of the two test campaigns conducted at winter and summer boiler operating conditions, respectively.

A prototype of the EMAD sampler design was operated concurrently with the Hildemann-designed sampler so that results of the two devices could be compared under the same boiler operating conditions.

Some of the experimental design matrix was changed for the second campaign to focus effort on measurements that provided comparison between the Hildemann designed sampler and the EMAD prototype sampler. Measurements focused on contributions to PM2.5 and its formation. Semivolatile organic compound sampling and analysis was added to assess a fuller range of condensible organic compounds. Organic and elemental carbon as well as inorganic components contributing to particulate formation were included in both campaigns enabling consistent PM2.5 comparisons between campaigns and between the sampling trains.

This report presents only the results derived from the Hildemann-designed dilution sampler for the two test campaigns. The EMAD sampling system and procedure can be found at http://www.epa.gov/ttn/emc/ctm.html in conditional test method CTM-039.

Organization of Report

This report is organized into five additional sections plus references and appendices. Section 2 provides the conclusions derived from the study results, and Section 3 describes the process operation and the test site. Section 4 outlines the experimental procedures used in the research, and Section 5 presents and discusses the study results. Section 6 presents the quality control/quality assurance procedures used in the research to ensure generation of high quality data. Section 7 presents the references cited in this report.

Section 2
Conclusions

Salient results from both the winter 2001 and summer 2002 test campaigns (campaign #1 and campaign #2, respectively) at the institutional-scale oil-fired boiler are summarized in Table 2-1. Complete tabulated results with associated uncertainties are provided in Section 5 of this report, along with the combustion parameters data (i.e., O_2, CO, H_2O, fuel consumption).

Table 2-1. Results Summary for Industrial Scale Oil-Fired Boiler

	Campaign #1		Campaign #2			
Test Date	**1/16/01**	**1/17/01**	**1/18/01**	**7/9/02**	**7/10/02**	**7/11/02**
Emission Factors (mg/kg fuel):						
PM-2.5 mass[a]	26.9	32.1	39.8	40.4	42.7	178.0
Particle mass semivolatile organic species	NS	NS	NS	1.0	0.66	7.9
Gas-phase semivolatile organic species	NS	NS	NS	89.5	75.4	123.1
Nonmethane volatile organic compounds						
Speciated	3.0	18.7	32.7	NS	NS	NS
Total	2.4	18.0	35.3	NS	NS	NS
Gas-phase carbonyls						
Speciated	0.25	0.30	0.50	NS	NS	NS
Total	.27	0.30	0.55	NS	NS	NS
PM Composition (wt.%):						
Elemental carbon (EC)	1.8	10.5	34.0	5.8	3.1	1.6
Organic carbon (OC)	NQ	0.5	NQ	43.3	45.7	63.1
Sulfate	58.0	56.9	45.5	6.8	10.7	3.5
Ammonium	NQ	NQ	NQ	2.0	2.6	0.46
Sulfur	5.2	3.4	8.3	2.7	3.7	1.3
Silicon	NQ	NQ	NQ	0.89	0.75	0.24

NQ = below quantitation limit; NS = not sampled
[a] Filterable only.

The filterable PM-2.5 mass emission factor was fairly consistent throughout both test campaigns with the exception of one day during campaign #2 (7/11/02) for which the emission factor was nearly five times higher than the average of the other five test days. Excluding the single day of markedly higher emissions, the average PM-2.5 mass emission factor was 36.4 mg per kg of fuel (0.81 μg/kJ) with a range of 26.9 to 42.7 mg/kg (0.60 - 0.96 μg/kJ). The single day of substantially higher PM-2.5 emissions gave an emission factor of 178.0 mg per kg of fuel (3.99 μg/kJ). No unusual event on that day was identified to explain the higher PM-2.5 emissions for that test. However, during both campaign #1 and campaign #2 the boiler was operated at very low load where combustion conditions are difficult to maintain. Under such conditions, erratic behavior in boiler operation and emissions may occur.

A PM-2.5 emission factor for industrial-scale distillate oil-fired boilers with no PM emission controls has been estimated by the EPA as 283 - 313 mg/kg of fuel with fuel sulfur contents ranging from 0.05 - 0.09 wt %, respectively.[4] It should be noted that these EPA estimates do not consider the condensible portion of fine PM. From this study, the average PM-2.5 emission factor for campaign #1 when the fuel contained 0.09% sulfur was 32.9 mg/kg, nearly an order of magnitude less than the estimated EPA value. The average PM-2.5 emission factor for campaign #2 when the fuel contained 0.05% sulfur was 41.6 mg/kg (excluding the single high emission day) or 87.0 mg/kg with all three test results averaged. These values are 6.8 and 3.3 times less than the current EPA estimated emission factor, respectively.

The PM-2.5 mass emission factor was fairly consistent for both test campaigns, whereas the composition of the PM-2.5 was very different for the two campaigns. Sulfate comprised 45.5 to 58.0% by mass of the PM-2.5 emitted during campaign #1 but accounted for only 3.5 to 10.8% of the PM-2.5 mass during campaign #2. Conversely, there was much more carbon in the PM-2.5 emitted during campaign #2, most of which was organic carbon (43.3 to 63.1% of the PM-2.5 mass). The organic carbon (OC) content of the fine PM was highest for Test Day #3 of campaign #2 (7/11/02), for which the PM-2.5 emission factor was also the highest of all tests.

Most of the speciated and quantified OC associated with the fine PM was made up of the C_{16} through C_{31} *n*-alkanes (63.8 wt % of the speciated PM organics). *n*-Tetracosane (C_{24}) was the single most prominent *n*-alkane with the other C_{16} - C_{31} species in a near-Gaussian distribution by carbon number around C_{24}. Benzene di- and tri-carboxylic acids comprised the second largest category of organic constituents found in the fine PM (21.4 wt % of the quantified species). Polynuclear aromatic hydrocarbons (PAHs) and *n*-alkanoic acids made up most of the remaining 14.8% of the quantified and speciated particle-phase organic compounds. The benzene di- and tri-carboxylic acids and chrysene were the only semivolatile organic species confined to the particle phase. All of the other semivolatile species were found in both the gas and particle phases with the predominant amounts in the gas phase. The only two elements in the PM found at levels above method quantitation limits were silicon and sulfur.

Two factors may have contributed to this marked difference in PM composition. The sulfur content of the fuel oil was 1.8 times higher during the campaign #1 tests than during the campaign #2 tests (0.09 vs 0.05 wt %, respectively). This factor could have contributed to a higher sulfate content during the campaign #1 tests. During the campaign #2 tests, the fuel feed rate averaged 37.6% lower than for the campaign #1 tests, and the excess oxygen levels were much higher (campaign #2 = 15.7 to 20.5%; campaign #1 = 7.6 to 9.2% excess oxygen). During campaign #1, the boiler was fired at 37 - 42% of its rated capacity; during campaign #2, the boiler was fired at only 25% capacity. A lower combustion efficiency associated with the low combustion load during the summertime is likely responsible for the PM emissions being enriched in OC.

A quantitative analysis of individual organic compounds associated with the organic carbon content of the fine PM was not possible for the campaign #1 owing to breakthrough of the organic species in the PM sampling arrays during the tests. For the campaign #1 tests, XAD-coated annular denuders were used in front of pre-fired quartz filters in an attempt to minimize adsorption of gas-phase organic species on the quartz filters and a consequent positive artifact in the PM mass and PM organic carbon content. Polyurethane foam (PUF) plugs were employed behind the quartz filters to collect any particle-phase semivolatiles that were air stripped from

the filters during sampling. Sampling durations were long (i.e., 10 hours per test) in an attempt to gather sufficient fine PM for analysis of particle-phase organics. However, the lengthy sampling periods resulted in exceeding the capacity of the denuders and PUF plugs. Therefore, an unknown quantity of organic compounds passed through the arrays and could not be accounted for.

During the campaign #2 test, the denuders were omitted from the sample collection arrays, and an attempt was made to correct for the positive Organic Carbon (OC) artifact in the PM collected on the quartz filters by subtracting from each of these filters the amount of OC collected on a quartz filter placed behind a Teflon membrane filter. This correction was based on the presumption that the Teflon filter collected particle-phase organic compounds and the backup quartz filter behind the Teflon filter collected adsorbed gas-phase organics equivalent to those adsorbed on the undenuded primary quartz filter. Even with this substantial correction, the PM collected during the summer campaign contained much more OC than the PM collected during the winter campaign.

Gas-phase organic nonmethane volatile organic compounds (NMOC) and carbonyl compound emissions were measured only during the campaign #1 tests, when the boiler was operating at more typical load conditions. For the campaign #1 tests, total NMOC (speciated + unspeciated) and PM-2.5 mass emission factors increased with increasing fuel consumption rates (2.42, 17.96, and 35.30 mg/kg for successive test days), but total gas-phase carbonyl compound emission factors exhibited the opposite trend.

A Scanning Mobility Particle Sizer (SMPS) operated on all three test days during the campaign #1 tests and collected data on particle size distribution in the range below 2.5 μm (the range monitored was 10 nm to 392 nm), with one complete scan over the entire range every three minutes. Both the particle size distribution and particle number count observed on Day 1 (January 16, 2001) differed with respect to the other two test days. The number of counts observed in each channel was approximately four orders of magnitude lower on Day 1 than on the other two test days. The SMPS instrumental operating parameters appeared to be normal,

and there was no obvious indication of instrumental malfunction. On the second and third test days, the number counts and distribution profiles were similar to the distributions centered at 46 nm and 50 nm, respectively.

During campaign #2, particle size data were collected using an Electrical Low Pressure Impactor (ELPI). The particle size distribution suggests bimodal behavior. Note that the SMPS gives an electrical mobility diameter and the ELPI gives an aerodynamic diameter, so the two values should not necessarily agree.

Results of this study indicate that the fine PM composition emitted from an institutional-scale oil-fired boiler can be markedly different depending on the combustion load and the characteristics of the fuel. Therefore, to the extent possible, source-receptor modeling should consider these conditions when selecting profiles and fitting species for source apportionment modeling. In this study, the boiler tested produced a wide variation in particle size and composition dependent on the fuel combustion and fuel composition. Industrial-scale boilers used to generate process steam and utility boilers used to generate power may be less susceptible to changing demand and therefore emit a fine PM with a more consistent composition.

Section 3
Methods and Materials

Description of the Testing Program

Two field tests (campaign #1, January 16-18, 2001; and campaign #2, July 7-9, 2002) were conducted at an institutional-scale boiler fired with #2 distillate oil and located on the campus of North Carolina A&T University in Greensboro, NC. Quality control procedures were implemented to obtain source emissions measurements of high and known quality. To simulate the behavior of fine particles as they enter the ambient atmosphere from an emissions source, dilution sampling was performed to cool, dilute, and collect gaseous and fine particulate emissions from the institutional-scale oil-fired boiler. Gaseous and fine particulate material collected during the sampling was also characterized. ERG coordinated all field test activities; laboratory testing activities were divided between EPA and ERG according to the scheme shown in Table 3-1.

The objectives of the testing activities were to evaluate the sampling equipment and to characterize the fine particulate emissions from an institutional oil-fired boiler. ERG performed source sampling to collect artifact-free, size-resolved particulate matter in a quantity and form sufficient to identify and quantify trace elements and organic compounds and to distinguish gas-phase and particle-phase organic compounds. Total particulate matter mass in the diluted and cooled emissions gas was size resolved at the PM-10 and PM-2.5 cut points with the PM-2.5 fraction further continuously resolved down to 30 nm diameter using a particle size analyzer. Fine particle emission profiles can be used in molecular marker-based source apportionment models, which have been shown to be powerful tools to study the source contributions to atmospheric fine particulate matter.

Table 3-1. Sampling Medium Used for Collection of Samples, Analysis Performed, Analytical Method, and Responsible Laboratory

Sampling Medium	Analysis	Method	Laboratory
Teflon Filter	PM-2.5 mass	Gravimetric (GRAV)	EPA
Teflon Filter	Elemental Analysis	X-ray fluorescence (XRF)	EPA
Teflon Filter	Inorganic Ions	Ion Chromatography (IC)	EPA
Quartz Filter	Elemental Carbon/ Organic Carbon	Thermal-Optical Evolution (TOE)	EPA
Quartz filter XAD-4 denuder PUF	Organic species	Gas Chromatography/ Mass Spectrometry (GC/MS)	EPA
DNPH-impregnated silica gel tubes[a]	Carbonyl compounds	High Performance Liquid Chromatography (HPLC) Method TO-11A	ERG
SUMMA canisters[a]	Air Toxics Speciated Nonmethane Organic Compounds	GC/MS Method TO-15 ERG Concurrent Analysis	ERG
Particle Size Analyzer	Particle Sizes	Scanning Mobility Particle Sizer (SMPS) Electrical Low Pressure Impactor (ELPI)	ERG

[a]DNPH tubes and SUMMA canisters were used for campaign #1 only.

To assist in the characterization of the stationary source and to obtain chemical composition data representative of particle emissions after cooling and mixing with the atmosphere, ERG performed the following activities at the test site:

- Performed preliminary measurements using EPA Methods 1-4 to evaluate source operating conditions and parameters;
- Installed the pre-cleaned dilution sampling system, sample collection trains, and ancillary equipment at the field site without introduction of contaminants;
- Calibrated flow meters before and after sampling, monitoring and adjusting gas flows (as necessary) throughout the tests;

- Acquired process data for the test periods, including temperatures, pressures, flows, fuel consumption, etc.;
- Determined the type of combustion fuel and rate of consumption during the source testing;
- Collected six sets of stationary source samples (three per test campaign) as prescribed in the Site-Specific Test Plans, including field blanks (one per test campaign); and
- Recovered the dilution sampling unit and sample collection trains for analysis for specific parameters and return of the dilution sampling unit to EPA.

For Test campaign #1, ERG transported the dilution sampling system to the test site to collect integrated samples, performed whole air analysis of SUMMA -polished stainless steel canisters and gas-phase carbonyl compounds collected on silica gel cartridges impregnated with 2,4-dinitrophenylhydrazine (DNPH), and evaluated particle size distribution data. EPA was responsible for pre-test cleaning of the dilution system, for analysis of semivolatile organic compounds from XAD-4 denuders and polyurethane foam (PUF) modules resulting from the test efforts and for characterization of the particulate-phase emissions and mass loading on quartz and Teflon filters. For Test campaign #2, ERG transported the dilution sampling system to the test site to collect integrated samples and evaluated particle size distribution data. EPA was responsible for pre-test cleaning of the dilution system, for analysis of semivolatile organic compounds from polyurethane foam (PUF) modules resulting from the test efforts and for characterization of the particulate-phase emissions and mass loading on quartz and Teflon filters.

Description of Test Equipment

Dilution Sampling System

The dilution sampling system used in the source test was based on the original design by Dr. L. M. Hildemann[3], modified to incorporate more secure closure fittings and electronic controls. Automatic flow control and data acquisition capabilities were added to the dilution

sampler to improve the ease of operation of the unit. A touchscreen interface connected to the main controller was used to monitor current conditions and allow setpoints to be entered into the system readily. A laptop computer was used for continuous monitoring of operating parameters and logging of the sampler operation.

The dilution sampling system dilutes hot exhaust emissions with clean air to simulate atmospheric mixing and particle formation. Control of residence time, temperature, and pressure allows condensible organic compounds to adsorb to fine particles as they might in ambient air. The sampler is also designed and fabricated to minimize any contamination of samples, especially organic compound contamination, and to minimize particle losses to the sampler walls.

Figure 3-1 shows a schematic diagram of the dilution sampling system and dilution air cleaning and conditioning system. As shown, the dilution air cleaning system provides high efficiency particulate arresting (HEPA) and activated carbon-filtered air for dilution of source emissions. Acid gases (if present) will not be completely removed by the dilution air cleaning system, but the presence of acid gases can be monitored in the dilution tunnel immediately downstream of the dilution air inlet. The dilution air cleaning system can be modified to add a heater, cooler, and dehumidifier as needed. Cleaned dilution air enters the main body of the sampler downstream of the dilution air orifice meter. The key zones of the dilution sampling system and their function are discussed below.

Sample Inlet Zone—

Stack Emissions Inlet: designed to allow source exhaust gas to be sampled through an inlet cyclone separator to remove particles with nominal aerodynamic diameters > 10 μm. The PM-10 cyclone prevents large particles from entering the sampler to plug or damage the equipment. Three ports are dedicated to sampling of the dilution air before it mixes with the source gas.

Heated Inlet Line: 3/4" heated stainless steel sampling probe draws source gas through a venturi meter into the main body of the sampler. Sample flow rate can be adjusted from 15-50 Lpm (typically 30 Lpm).

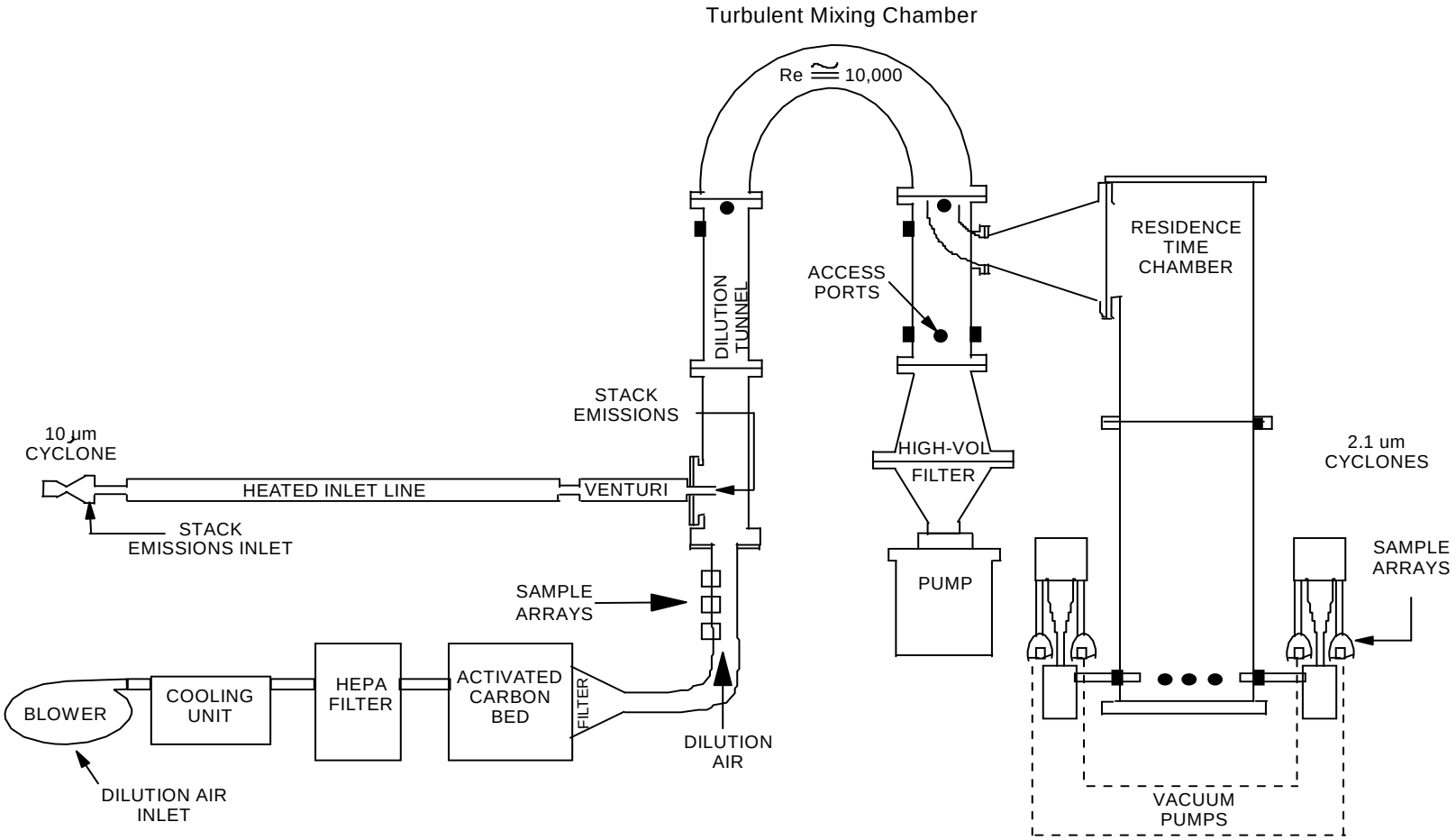

Figure 3-1. Diagram of the dilution sampler and dilution air conditioning system.

Venturi Meter—

Constructed of low carbon, very highly corrosion-resistant stainless steel; equipped for temperature and pressure measurement. Wrapped with heating coils and insulated to maintain the same isothermal temperature as the inlet cyclone and inlet line.

Turbulent Mixing Chamber—

Consists of an entrance zone, U-bend, and exit zone.
Inside diameter: 6 in., yielding a Reynolds number of ~10,000 at a flow rate of 1000 Lpm.
Dilution air enters the mixing chamber in the direction parallel to the flow.
Hot source emission gas enters the chamber perpendicular to the dilution airflow, 4.5 in. downstream of the dilution air inlet.
The combined flow travels 38 in. before entering the U-bend.
After the residence chamber transfer line, the mixing chamber continues for 18 in., then expands to an in-line high-volume sampler filter holder. Collected particulate has not experienced time to equilibrate with the gas phase at the diluted condition.
Sample and instrumentation ports are installed on the turbulent mixing chamber at various locations.

Residence Time Chamber—

The inlet line to the residence time chamber expands from a 2 in. line (sized to provide a quasi-isokinetic transfer of sample gas from the turbulent mixing chamber to the residence time chamber at a flow rate of ~100 Lpm) within the mixing chamber to a 7 in. line at the wall of the residence chamber.
The flow rate is controlled by the total sample withdrawal from the bottom of the residence time chamber and provides a 60-sec residence time in the chamber.
Twelve ports are installed at the base of the residence time chamber:

- Nine ports for sample withdrawal;
- Three ports for instrumentation.

Sample Collection Zone—

Samples collected from the sample ports at the base of the residence time chamber have experienced adequate residence time for the semivolatile organic compounds to re-partition between the gas phase and the particle phase.

Since it is very difficult to maintain both isokinetic sampling and a fixed cyclone size cut during most stack sampling operations, the inlet cyclone may be operated to provide a rough PM-10 cut while maintaining near-isokinetic sampling. The rough inlet size cut has minimal impact on sampling operations since the dilution sampling system is mainly used to collect fine particulate matter from combustion sources and the critical fine particle size cut is made at the end of the residence time chamber. Typically, the calculated total time the sample spends in the dilution sampling system ranges from 58-75 sec: 2-3 sec for the turbulent mixing chamber and 56-72 sec for the residence chamber.

Dilution Sampling System Control Instrumentation

Instrumentation for control and analysis of the dilution sampling system is shown in Figure 3-2. Differential pressure measurements made across the venturi and orifice meters are used to determine the dilution airflow rate, the sample gas flow rate, and the exhaust gas flow rate. Since flow equations used for determination of the flow across venturi and orifice meters correct for flowing temperature and pressure, the flowing temperature and pressure of the venturi and orifice meters must be recorded during sampling operations. Thermocouples for monitoring temperature are placed at each flow meter as well as at the inlet PM-10 cyclone, at various points on the sample inlet line, at the inlet to the mixing chamber U-bend, and at the outlet of the residence time chamber. An electronic relative humidity probe is used to determine the relative humidity of the sample gas. The dilution sampling system is equipped with automated data logging capabilities to better monitor source testing operations and to minimize manpower requirements during sampling operations. Dilution sampler flows and temperatures are monitored and controlled automatically at set points established by the operator using a QSI Corporation QTERM-K65 electronic touch-screen interface. The dilution sampling system was operated by three testing staff members during the test at the institutional oil-fired boiler facility.

In operation, the source sample flow, the dilution airflow, and the total airflow (not including the sample collection arrays) were each measured by separate flow meters and pressure

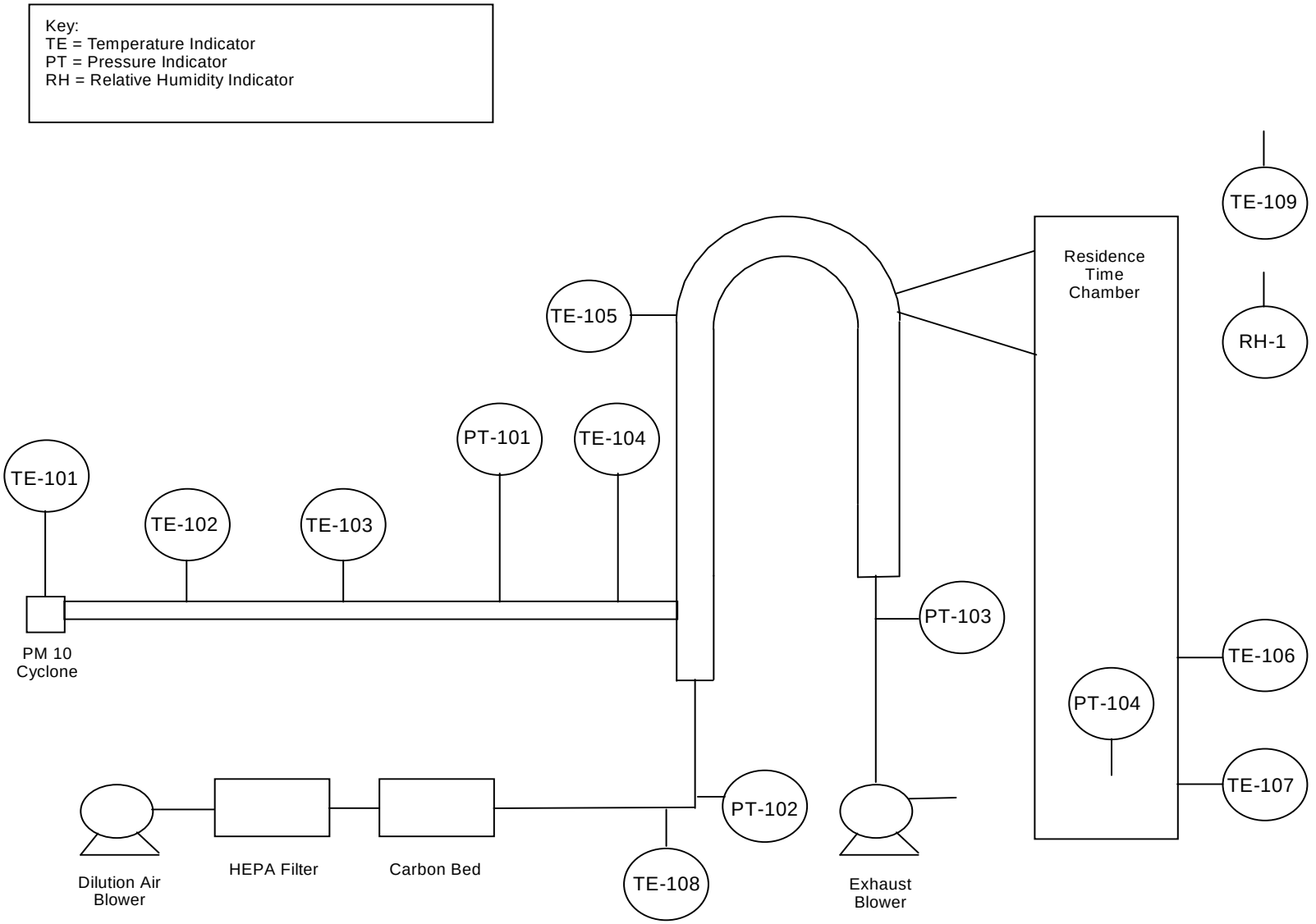

Figure 3-2. Instrumentation for control and analysis of the dilution sampler.

transducers. A venturi measured the source sample flow and orifices were used for the dilution and total flows. A ring compressor was used to push the dilution air through a HEPA filter, a carbon adsorber, and a final filter into the turbulent mixing chamber. The compressor motor was modulated by a variable frequency drive to match the desired dilution flow based on a set point entry. A separate blower (connected to a speed controller adjusted to achieve the desired sample flow based on a set point entry) at the end of the sampler pulled the source sample flow through the venturi. Flow through this blower consisted of the dilution airflow plus the source sample flow not including the flow exiting through the sample collection arrays.

The main controller modulated the power used to heat the sample probe (32 in. long, one heated zone). The controller switched solid-state relays on and off as needed to maintain the probe temperature entered by the operator.

Sample Collection Arrays

Virtually any ambient sampling equipment (including filters, denuders, PUF cartridges, DNPH-impregnated sampling cartridges, SUMMA -polished canisters, cyclones, particle size distribution measurement instrumentation) can be employed with the dilution sampling system. The exact number and type of sample collection arrays is uniquely configured for each testing episode.

Process Description/Site Operation[i]

With the concurrence of the EPA work assignment manager, an institutional oil-fired boiler located at North Carolina A&T University in Greensboro, NC, that was used to heat multiple dormitories was selected as the test site. The boiler, constructed by the Nebraska Boiler Company, was permitted for operation with either #2 distillate oil or #6 residual oil. For the duration of both tests (January 16-18, 2001, and July 7-9, 2002), the fuel used during testing was #2 distillate oil.

The watertube boiler tested was one of four boilers used to supply space and water heating for several university buildings. The test boiler flue gas was connected through a common duct with the other three boilers to a common exhaust fan and stack as shown in Figure 3-3. The test boiler had a rated capacity of 67.3 GJ/h, was capable of utilizing either #2 distillate oil, #6 residual oil, or natural gas as fuel, and was equipped with a burner designed to reduce NO_x emissions by reducing the peak flame temperature at the flame base. Low NO_x operation of the burner was accomplished by staging the combustion process with specially designed fuel nozzle injectors and an air recirculator. There were no control devices for control of particulate matter emissions from the boiler. Emissions sampling was conducted at a sampling port located in the exhaust gas duct from the boiler prior to the junction of that duct with exhaust ducts from the other two boilers. Exhaust gases from all boilers were fed together to a single stack from the university power plant.

The analysis of the #2 distillate oil used as fuel for the North Carolina A&T boiler is shown in Table 3-2 for both test campaigns; slight differences in the analyzed values were observed.

Table 3-2. Analysis of the #2 Distillate Oil Used to Fuel the Institutional Boiler

Component	Campaign #1 January 16-18, 2001	Campaign #2 July 7-9, 2002
sulfur	0.09%	0.05%
heat value	19,374 BTU per pound	19,193 BTU per pound
ash	< 0.01%	< 0.01%
carbon	85.93%	86.53%
hydrogen	13.66%	12.75%
nitrogen	0.03%	0.02%
oxygen	0.26%	0.65%
chlorine	Not Determined	303.8 ppm

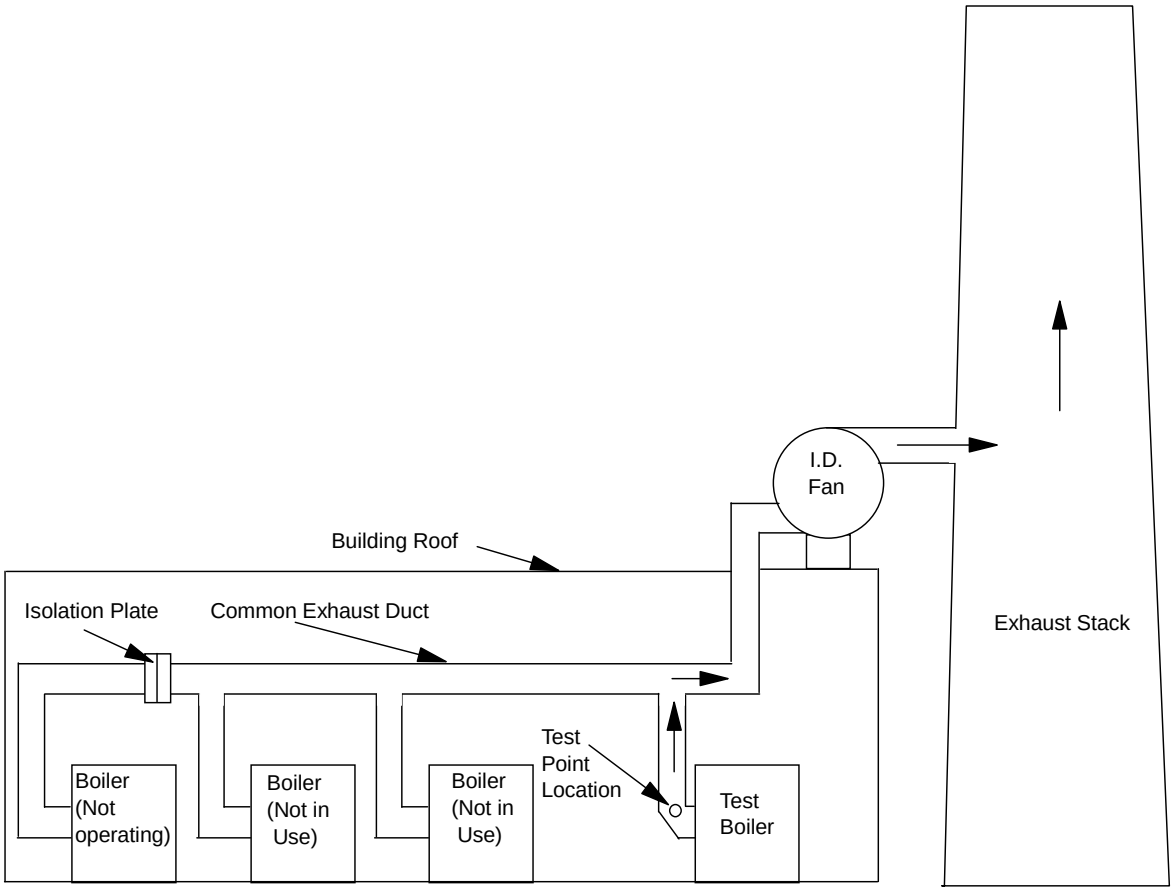

Figure 3-3. Schematic Diagram of Test Boiler Exhaust to Stack Connection

The fuel use for both test campaigns by test days is summarized in Table 3-3.

Table 3-3. Fuel Use Data for Testing Days: #2 Distillate Oil

Campaign #	Test #	Test Date	Test Duration (min)	Fuel Use (gal/min)	Total Fuel (gal)
1	1	1/16/01	600.33	3.428	2058
	2	1/17/01	600.50	3.615	2171
	3	1/18/01	600.17	4.134	2481
2	1	7/09/02	600.60	2.314	1390
	2	7/10/02	600.67	2.331	1400
	3	7/11/02	600.00	2.333	1400

Both test campaigns were scheduled to minimize disruption to the normal operation of the test facility and to enable as much simultaneous data collection important to all parties as possible. ERG scheduled the sampling test at the chosen facility and obtained permission and cooperation of the site/institution/management.

Description of the Oil-Fired Boiler Tested at North Carolina A&T (Greensboro, NC)

The burner tested at North Carolina A&T (Greensboro, NC) was manufactured by Forney Corporation and assembled on a 60,000 lbs/hr Nebraska D-type water tube boiler. The NOXMISER Low NO_x burner is designed to reduce NO_x emissions by reducing the peak flame temperature at the flame base. The formation of NO_x during the combustion process was:

- Exponentially proportional to peak flame temperature;
- Proportional to time duration at peak flame temperature; and
- Proportional to the square root of the number of oxygen molecules available at the primary zone where the peak temperature occurs.

Low NO_x operation is accomplished by staging the combustion process with specially designed fuel nozzle injectors and an air recirculator. This mode of operation results in lower peak flame

temperature yet stable flame with minimum flue gas recirculation and low carbon monoxide emissions.

The combustion air forced draft fan, a direct-drive high performance airfoil fan designed for a speed of 3500 rpm, is sized to provide all the required combustion air and flue gas for recirculation. The combustion air forced draft fan is equipped with a 100% width inlet cone. The airflow control damper is located between the windbox and forced draft fan; the damper assembly is linked to the burner jack shaft.

The burner wind box, designed to provide equal air distribution into the air register, contains the zone divider and the primary and secondary air slide damper assembly. The air slide damper assembly provides a manual adjustment to the distribution of the total air between the primary and secondary air zones.

A flame safeguard system, designed to provide proper burner sequencing for safe burner operation, sequences the burner from purge, low fire ignition of the pilot, and main flame automatically. The flame safeguard system monitors main flame, limit switches, and boiler operating interlocks applicable to boiler operation, and interfaces with fuel shutoff valves and oil pumps.

The burner consists of the subassemblies listed below:

- Basic Burner
  - The basic burner is completely assembled with fuel and air control devices with necessary control linkages and levers. Electrical components are pre-wired, using Sealtite conduit, to a junction box. Oil and atomizing air piping trains are a part of the basic burner.
- A burner refractory throat tile seal-welded to the boiler furnace plate, with plastic refractory packed between the burner refractory throat and the furnace wall;
- Burner positioned to the boiler front plate with support to center the burner with the refractory throat inside diameter;

- Flame safeguard system, in its own enclosure, with a conduit and wiring to the forced draft fan motor and separate conduits and wiring to junction box #1 (located at the burner) and junction box #2 (located at the gas train assembly), as well as the boiler limit switches. House power was connected to the flame safeguard enclosure fuse block;

- Gas train assembly with gas vent lines installed per applicable codes, piped to the designated safe and nonhazardous location;

- Piping connecting the fuel gas train outlets to the burner flow control valve inlet, with fuel oil and atomizing medium supplied to the burner on a combination fuel-firing boiler; and

- A stack gas fuel inlet nozzle located approximately five stack diameters downstream of the boiler smoke box outlet, with a fuel gas recirculation line running from the stack inlet nozzle to the flue gas recirculation fan inlet.

Proper burner setup is essential for safe operation and optimum burner performance; the burner was started up by an authorized service engineer.

Pre-Test Surveys

A thorough survey of the test site was performed prior to each test campaign. The purpose of the surveys was to determine that the test equipment would fit in the test location, to identify and gain access to the utilities needed to operate the dilution system and its ancillary equipment, to arrange for installation of a sample collection port (installation for campaign #1 - the same port was used for campaign #2), to arrange for installation of power for operation of the dilution sampling system (installation for campaign #1 only) and to evaluate the means for positioning the sampler at the desired location. The same sampling location and port were utilized in both campaigns. A schematic diagram of the sampling port is shown in Figure 3-3; a photograph of the port, as installed, with cap plate, is shown in Figure 3-4. The relationship of the sampling port relative to the boiler and the exhaust ductwork is discussed in Section 4.

A new power panel and feeder to provide power to two quad outlets and a 50-amp, 2-pole circuit, including a breaker in the existing main panel, was also installed prior to campaign #1. ERG conducted pre-test site surveillance and site preparation to ensure readiness of the site for

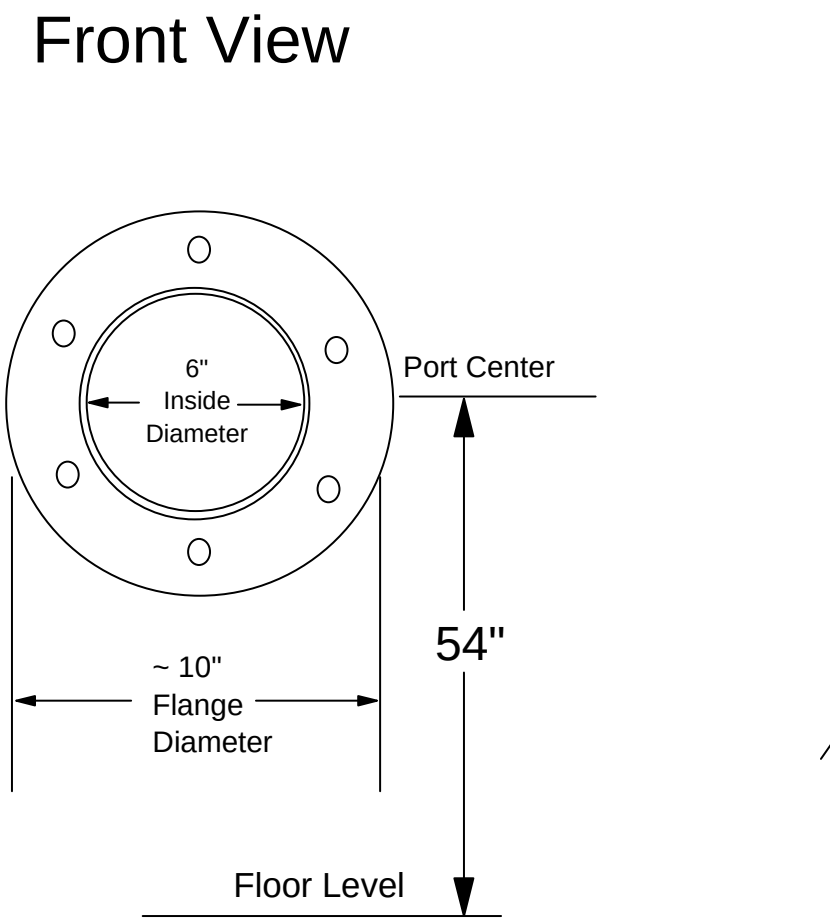

Figure 3-4. Diagram of the sampling port.

the start of the scheduled sampling activities. The pre-test survey considered access to utilities and personnel, as well as legal and safety requirements. ERG obtained source data such as exhaust gas flow rate and velocity, exhaust gas temperature and water vapor content, and approximate particulate matter concentration, parameters useful for estimating appropriate dilution ratios and duration of sample collection.

The sampling port was positioned to allow the dilution sampling unit to sit on a sturdy hydraulic lift cart, which could be rolled into place and raised to allow the probe access to the sampling port. The cart sat on the floor of the boiler room, with its wheels firmly anchored. Access to the test facility was attained by a ground-level door that was sufficiently wide to accommodate the dilution sampling unit. The two modules (dilution air supply/control module and sampler module) were positioned at the sampling location, (Figure 3-5), by rolling the units through the ground-level door at the test facility (Figure 3-6); testing occurred at ground level inside the facility (Figure 3-7), with the dilution system elevated to allow access to the sampling port.

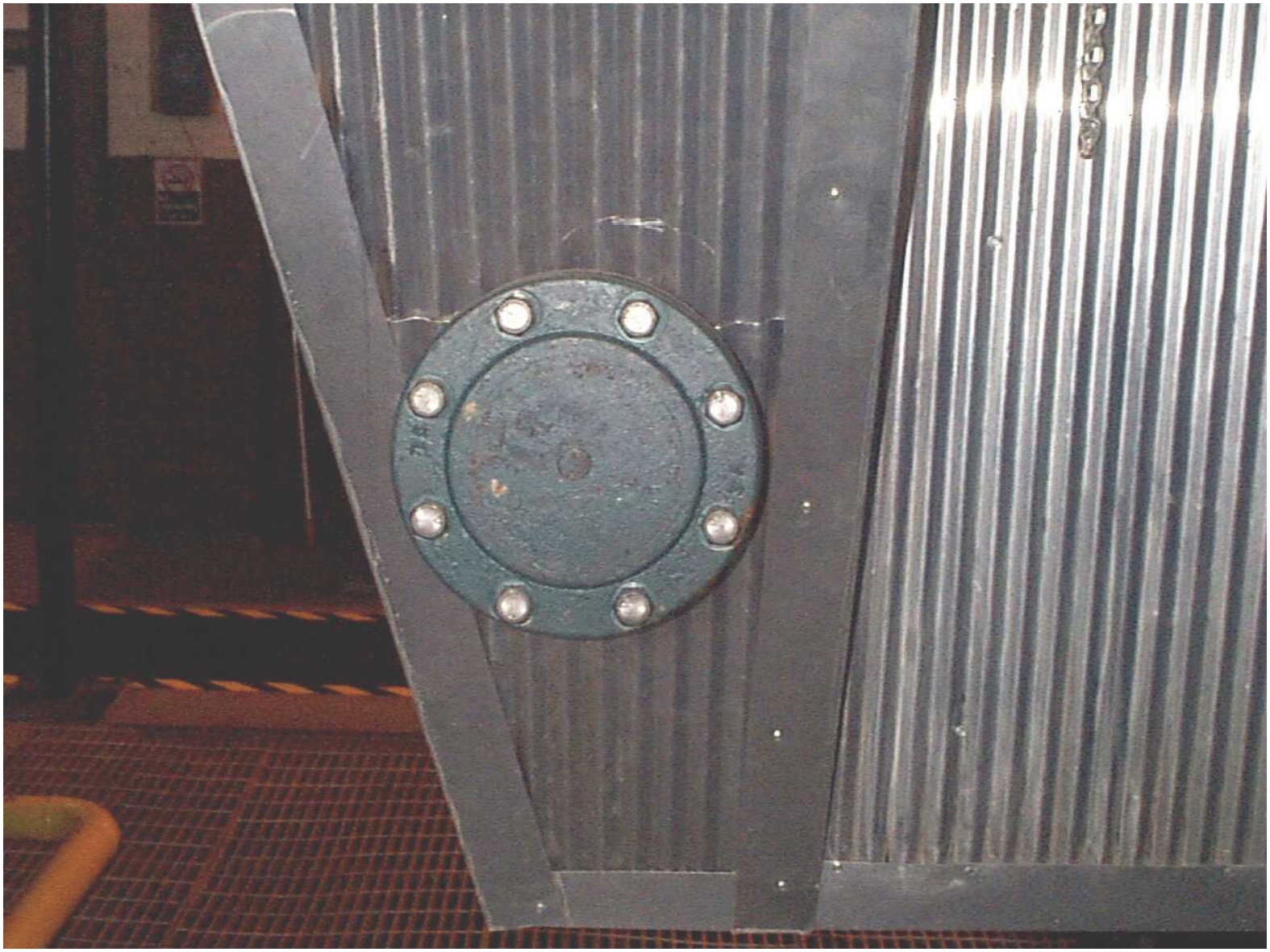

Figure 3-5. Sampling port with cap plate.

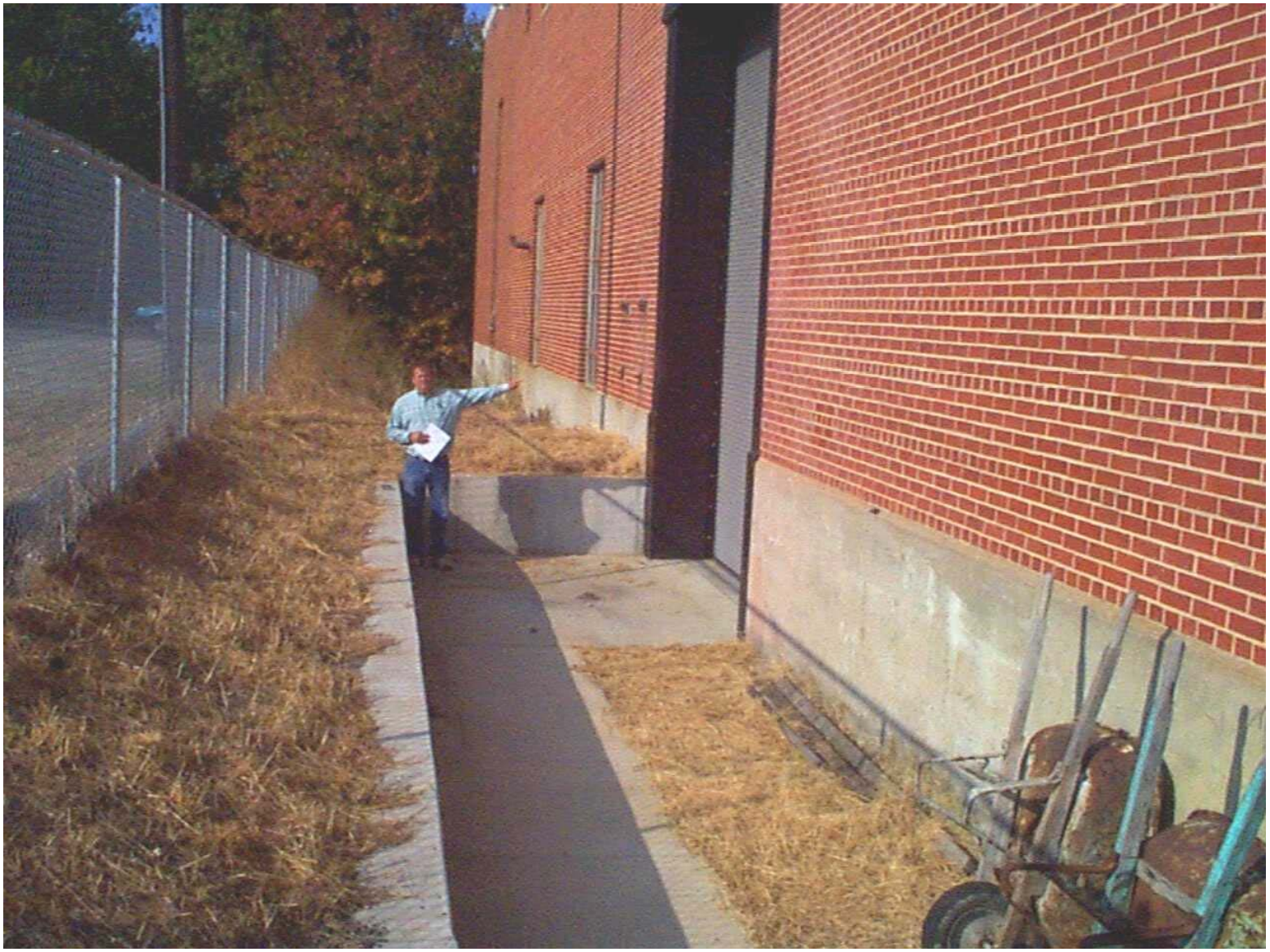

Figure 3-6. Ground level access to the test facility.

Figure 3-7. Testing area, ground level.

Section 4
Experimental Procedures

To sample undiluted hot exhaust gas streams, the EPA/ECPB dilution sampling system (schematic diagram in Figure 3-1), sample collection arrays, sample substrates, and a dilution air cleaning system were used by ERG. To minimize introduction of contaminants, EPA pre-cleaned and pre-assembled the dilution sampler and sample collection arrays in a clean environment prior to transport to the test site. The sampler and dilution air cleaning system were assembled on separate portable aluminum frames equipped with wheels and tie-down lugs for transport to and from the site. ERG maintained the sampler and sample collection arrays in a contaminant-free condition prior to collection of institutional oil-fired boiler samples and field blanks.

A sampler blank test was run prior to transporting the sampler to the test site for each campaign to ensure that the system had been cleaned properly and was leak free. The blank test was run in the laboratory by completely assembling the sampling system, including the sample collection arrays connected to the residence chamber and all instrumentation. The blank test was conducted for a time period consistent with the expected duration of the source tests (10 hours). Following the blank test, the sampler was shut down in reverse order from startup, and all substrates were unloaded, preserved as appropriate, and analyzed to verify the absence of contamination in the dilution sampling system.

Preparation for Test Setup

Prior to deployment of the dilution sampling system at the test site and initiation of sampling with the dilution sampling system and associated sample collection arrays, EPA Methods 1-4[5-8] were used to establish key experimental parameters for the test conditions.

Application of EPA Methods 1-4

Traverse Point Determination Using EPA Method 1

EPA Method 1[5], "Sample and Velocity Traverses for Stationary Sources," was used to establish the number and location of sampling traverse points necessary for isokinetic and flow sampling. These parameters are based upon how much duct distance separates the sampling ports from the closest downstream and upstream flow disturbances.

The selected sample collection location did not meet the minimum requirements of EPA Method 1 for length of straight run or for orientation of the port with respect to the plane of bends in the ductwork. However, this location was the only position on the duct work with sufficient space for physical location of the sampling system. The duct work was rectangular. The inside stack dimensions were length, 48 in.; width, 22 in. The port was located 3 ft. downstream from the exit of the boiler breech area and 20 ft. upstream of the common exhaust duct. Traverse point locations are shown in Table 4-1. A table of metric unit conversions is shown in Appendix A. Sampling at the test site was performed at the point determined by Method 1 to represent the average velocity in the oil-fired boiler exhaust stack (Figure 3-4).

The absolute pressure of the flue gas (in inches of mercury) was calculated according to the following equation:

$$PS = P_{bar} + \frac{P_g}{13.6} \qquad (4\text{-}1)$$

Where:

PS	=	absolute gas pressure, inches of mercury
P_{bar}	=	barometric pressure, inches of mercury
P_g	=	gauge pressure, inches of water (static pressure)

Table 4-1. EPA Method 1—Traverse Point Location for Institutional Boiler Exhaust (A Rectangular Duct)

Traverse Point Number	Fraction of Inside Stack Dimension Length (%)	Distance from Inside Stack Wall (in.)	Traverse Point Location from Outside Sampling Port[a] (in.)
1	2.6	1.250	8.250
2	8.2	3.875	10.875
3	14.6	7.000	14.000
4	27.6	13.250	20.125
5	34.2	16.375	23.375
6	65.8	31.500	38.500
7	77.4	37.250	44.125
8	85.4	41.000	48.000
9	91.8	44.125	51.125
10	97.4	46.750	53.750

[a] The thickness of the stack wall plus the port flange was 7.0 in.

The value 13.6 represents the specific gravity of mercury (1 inch of mercury = 13.6 inches of water). For the stack tested, the absolute gas pressure under these conditions was 29.68 inches of mercury.

Volumetric Flow Rate Determination Using EPA Method 2

Volumetric flow rate was measured according to EPA Method 2[6], "Velocity — S-Type Pitot". A Type K thermocouple and S-type pitot tube were used to measure flue gas temperature and velocity, respectively. All of the isokinetically sampled methods that were used incorporated EPA Method 2.

Pitot Tube Calibration

The EPA has specified guidelines concerning the construction and geometry of an acceptable Type-S pitot tube. If the specified design and construction guidelines are met, a pitot tube coefficient of 0.84 is used. Information pertaining to the design and construction of the

Type-S pitot tube is presented in detail in Section 3.1.1 of *Quality Assurance Handbook for Air Pollution Measurement Systems*. Volume III. Stationary Source Specific Methods.[9] Only Type-S pitot tubes meeting the required EPA specifications were used. Pitot tubes were inspected and documented as meeting EPA specifications prior to field sampling.

Calculation of Average Flue Gas Velocity

The average flue gas velocity for each traverse point is calculated using the following equation:

$$V_s = K_p * C_p * \sqrt{\frac{\Delta P_{avg} * (460 + T_s)}{P_s * M_s}} \qquad (4\text{-}2)$$

Where:

V_s	=	average flue gas velocity, ft/sec
K_p	=	Pitot constant (85.49)
C_p	=	Pitot coefficient (dimensionless), typically 0.84 for Type S
ΔP_{avg}	=	average flue gas velocity head, inches of water
460	=	zero degrees Fahrenheit expressed as degrees Rankine
T_s	=	flue gas temperature, degrees Fahrenheit
P_s	=	absolute stack pressure (barometric pressure at measurement site plus stack static pressure), in. Hg
M_s	=	wet molecular weight, pounds per pound-mole

The flue gas velocity calculated for each traverse point and the average velocity are shown in Table 4-2.

Table 4-2. Campaign-Specific Flue Gas Velocity for Each Traverse Point

Traverse Point (As Calculated in Table 4-1)	Campaign #1 Velocity, ft/min	Campaign #2 Velocity, ft/min
1	0.0	293.9
2	0.0	339.1
3	0.0	321.0
4	0.0	340.0
5	423.3	366.7
6	598.0	390.3
7	792.4	423.4
8	732.3	298.4
9	0.0	230.7
10	0.0	230.7
Average Velocity	**(4-point $\bar{x}$) 636.51**	**(10-point $\bar{x}$) 323.42**

For campaign #1, the point of average velocity has the closest relationship to traverse point #6. For campaign #2, the point of average velocity has the closest relationship to traverse point #3.

Determination of Volumetric Flow Rate for Stack Gas

Because stack gas flow rate velocity could be measured at only four of ten traverse points for the testing performed for campaign #1 (whereas stack flow could be measured at all ten traverse points for campaign #2), stack volumetric flow rates could not be determined on the same basis in both test campaigns. Stack gas flow rates were therefore calculated for both campaigns on the basis of carbon content of fuel feed, as shown in Table 4-3. The values shown in Table 4-3 for flue gas flow rate were used in subsequent calculations for emission factors.

Table 4-3. Carbon-Based Calculation of Flue Gas Flow Rates

Volume occupied by 1 mole of gas at 273.16 K and 1 atm (29.92 " Hg) [Standard Temperature and Pressure]
PV = nRT V = nRT/P
V = [(1 mol) * (0.082056 L atm K^{-1} mol^{-1}) * (273.16 K)]/1 atm
Molar volume at 273 K, 1 atm
V = 22.4144 L/g-mol
1 ft^3 = 28.317 L
Therefore, 22.4144 L/mol = 791.55 ft^3/kg-mol, and corrected to the test conditions 849.66 ft^3/kg-mol.

Parameter	Sampling Campaign #1			Sampling Campaign #2		
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
Fuel volumetric flow rate (gal/min)	3.43	3.62	4.14	2.32	2.33	2.33
Fuel density (kg/gal)	3.19	3.19	3.19	3.19	3.19	3.19
Fuel mass feed rate (kg/min)	10.9417	11.5478	13.2066	7.4008	7.4327	7.4327
Carbon in fuel (wt %)	85.93	85.93	85.93	86.53	86.53	86.53
Carbon feed rate (kg/min)	9.4022	9.9230	11.3484	6.404	6.4315	6.4315
Carbon feed rate (kmol/min)	0.7829	0.8623	0.9449	0.5337	0.5360	0.5360
CO_2 in flue gas (vol %, wet)	16.20	15.67	15.47	10.70	10.40	9.90
CO in flue gas (vol %, wet)	0.03	0.03	0.03	0.03	0.03	0.03
Ideal gas conversion (0 °C, 1 atm) (scf/kmol)	849.66	849.66	849.66	849.66	849.66	849.66
Gaseous carbon in flue gas (kmol/scf)	0.000191	0.000184	0.000182	0.000126	0.000123	0.000123
Organic carbon on quartz filter (µg/cm^2)	0.31	2.39	2.37	20.337	20.267	66.04
Elemental carbon on quartz filter (µg/cm^2)	0.59	2.51	10.31	1.47	0.66	1.47
Total carbon on filter[a] (µg)	12.105	65.905	170.546	293.304	281.468	908.010

Table 4-3. (Continued)

Parameter	Sampling Campaign #1			Sampling Campaign #2		
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
Sample flow (sLpm)	8.255	8.242	8.489	8.239	8.195	8.251
Test run time (min)	600.33	600.50	600.17	600.60	600.67	600.00
PM concentration at filter (kmol/scf)	5.785×10^{-11}	3.139×10^{-10}	7.891×10^{-11}	1.397×10^{-9}	1.348×10^{-9}	4.323×10^{-10}
Dilution ratio	46.81	48.67	45.91	44.31	44.37	44.95
PM carbon in flue gas (kmol/scf)	2.695×10^{-9}	1.528×10^{-8}	3.623×10^{-9}	6.191×10^{-8}	5.980×10^{-8}	1.943×10^{-8}
Total carbon in flue gas (kmol/scf)	0.000191	0.000184	0.000182	0.000126	0.000123	0.000117
Flue gas flow rate by carbon content (scfm)	4065	4159	4827	3935	4066	4270
Flue gas flow rate by pitot (scfm)	4666			2371		
Difference in flow measurements	-1.3%			39.7%		

[a]Filter area on which particulate matter was collected was 13.45 cm^2.

No structural changes to the ductwork were made between the two test campaigns. The percent load at which the boiler was operated was different for the two campaigns. During the campaign #2 tests, the fuel feed rate averaged 37.6% lower than the campaign #1 tests, and the excess oxygen levels were much higher (campaign #2 = 15.7 to 20.5%; campaign #1 = 7.6 to 9.2% excess oxygen). During campaign #1, the boiler was fired at 37 - 42% of its rated capacity; during campaign #2, the boiler was fired at only 25% capacity. The differences in load resulted in different stack velocities for the two campaigns (see Section 4, Table 4-2). As the point at which the sampling port used for these tests had to be installed (due to physical constraints) was very close to the breech area exit of the boiler, the upstream and downstream distances specified in EPA Method 1 could not be attained (see Section 3). Consequently, the stack gas at the different velocities behaved differently in the duct work resulting in a different flow profile. As the point of average velocity was determined using EPA Methods 1 - 4 for both tests, representativeness and comparability are considered to be appropriate.

Nozzle Size Determination

It is desirable to sample at or near isokinetic velocities at the probe inlet nozzle. The nozzle size is based on the required sample flow rate. Prior to using an Excel macro to perform nozzle size calculations according to the procedures of EPA Method 5[8] (U.S. EPA, 1989d) the velocity in the stack (feet per minute) must be determined from the pitot traverses prior to the start of the test run. The additional input required by the macro is sampling rate in liters/minute. At the average velocity calculated using the four-point average for campaign #1, the recommended nozzle size was 0.552 in. At the average velocity calculated using the 10-point average for campaign #2, the recommended nozzle size was 0.505 in.

Measurement of O_2 and CO_2 Concentrations

The O_2 and CO_2 concentrations were determined by use of a Fyrite bulb during the traverse.

Stationary Gas Distribution (as Percent Volume)

The following values were measured for the stationary gases:

	Campaign #1	Campaign #2
Measured O_2 vol % (wet)	6.0	8.1
Measured CO_2 vol % (wet)	15.0	11.0
(Provided) CO vol % (wet)	0.03	0.03

The percentage of nitrogen (N_2) was calculated according to the following equation:

$$\begin{aligned} N_2 \text{ vol \%} &= 100 - (O_2 \text{ vol \%} + CO_2 \text{ vol \%} + CO \text{ vol \%}) \\ &= 100 - (6.0 + 15.0 + 0.03) \\ &= 78.97 \text{ (campaign \#1)} \\ &= 100 - (8.1 + 11.0 + 0.03) \\ &= 80.87 \text{ (campaign \#2)} \end{aligned} \qquad (4\text{-}3)$$

Dry Molecular Weight of Flue Gas

The dry molecular weight of the flue gas (M_d) was calculated according to the following equation:

$$\begin{aligned} M_d &= (CO_2 \text{ vol \%} * 0.44) + (O_2 \text{ vol \%} * 0.32) + [(CO \text{ vol \%} + N_2 \text{ vol \%}) * 0.28] \\ &= (15.0 * 0.44) + (6.0 * 0.32) + [(0.03 + 78.97) * 0.28] \\ &= 6.60 + 1.92 + 22.12 \\ &= 30.64 \text{ lb/lb-mole (campaign \#1)} \\ &= 30.08 \text{ lb/lb-mole (campaign \#2)} \end{aligned} \qquad (4\text{-}4)$$

Where:

M_d = molecular weight of flue gas, dry basis (lb/lb-mole)
CO_2 vol % = percent CO_2 by volume, dry basis

O_2 vol %	=	percent O_2 by volume, dry basis
CO vol %	=	percent CO by volume, dry basis
N_2 vol %	=	percent N_2 by volume, dry basis
0.44	=	molecular weight of CO_2, divided by 100
0.32	=	molecular weight of O_2, divided by 100
0.28	=	molecular weight of N_2 or CO, divided by 100.

Wet Molecular Weight of Flue Gas

The wet molecular weight of the flue gas (M_s) was calculated according to the following equation:

$$M_s = (M_d * M_{fd}) + (0.18 * H_2O \text{ vol } \%)$$
$$= 29.25 \text{ wet lb/lb-mole (campaign \#1)} \quad (4\text{-}5)$$
$$= 28.65 \text{ wet lb/lb-mole (campaign \#2)}$$

Where:

M_s	=	wet molecular weight of flue gas, wet lb/lb-mole
M_d	=	molecular weight of flue gas, dry basis (lb/lb-mole)
M_{fd}	=	dry mole fraction of effluent gas, calculated as [1 - H_2O vol % / 100]
0.18	=	molecular weight of H_2O, divided by 100
$\%H_2O$	=	percent H_2O, by volume.

Determination of Average Moisture Using EPA Method 4

EPA Method 4[7], "Moisture Content", was used to determine the average moisture content of the stack gas. A gas sample was extracted from the source, moisture was removed from the sample stream, and the moisture content was determined gravimetrically. Before sampling, the initial weight of the impingers was recorded. When sampling was completed, the final weights of the impingers were recorded and the weight gain was calculated. The weight gain and the volume of gas sampled were used to calculate the average moisture content (percent) of the stack gas. The calculations were performed by computer. Method 4 was incorporated into the techniques that were used for all of the manual sampling methods used during the test.

The measurements shown in Table 4-4 were made on January 15, 2001, for campaign #1 and on July 7, 2002, for campaign #2, using Method 4 to determine moisture recovery.

Table 4-4. Moisture Recovery for Method 4

Measured on January 15, 2001, for Campaign #1

Impinger Number	Impinger Solution	Weight of Impinger Contents (g)	Impinger Tip Configuration	Impinger Weight		
				Final (g)	Initial (g)	Weight Gain (g)
1	Water	100	S&G	702.3	625.1	77.2
2	Water	100	S&G	672.0	642.1	29.9
3	Empty	0	S&G	597.2	590.0	7.2
4	Silica Gel	300	S&G	749.1	748.3	3.8
				Total Weight Gain (g)		**118.1**

Measured on July 7, 2002, for Campaign #2

Impinger Number	Impinger Solution	Weight of Impinger Contents (g)	Impinger Tip Configuration	Impinger Weight		
				Final (g)	Initial (g)	Weight Gain (g)
1	Water	100	S&G	674.5	607.6	66.9
2	Water	100	S&G	609.0	575.9	33.1
3	Empty	0	S&G	492.7	484.8	7.9
4	Silica Gel	300	S&G	732.3	720.3	12.0
				Total Weight Gain (g)		**119.9**

Volume of Dry Gas Sampled at Standard Conditions (dscf)

The volume of dry gas sampled under standard conditions was calculated using the following equation:

$$V_{m(std)} = 17.64 * Y * V_m * P_{bar} + \frac{\frac{\Delta H}{13.6}}{460 + T_m} \qquad (4\text{-}6)$$

Where:

$V_{m(std)}$	=	volume of dry gas sampled at standard conditions, dry standard cubic feet (dscf)
Y	=	dry gas meter calibration factor (0.98)
V_m	=	volume of gas metered, cubic feet, dry
P_{bar}	=	barometric pressure at measurement site, inches of mercury
ΔH	=	Sampling rate, measured as differential pressure at the meter orifice, inches of water
T_m	=	dry gas meter temperature, degrees Fahrenheit

The constant 17.64 was used for conversion to standard conditions (68°F + 460°R)/29.92 in. Hg; 460 is zero degrees Fahrenheit in degrees Rankine. Using measured values from the field data sheet, the volume of dry gas sampled at standard conditions ($V_{m(std)}$) was calculated to be 43.011 dscf for campaign #1, 42.034 dscf for campaign #2.

Volume of Water Vapor at Standard Conditions (dscf)

The volume of water vapor under standard conditions was calculated using the following equation:

$$V_{w(std)} = 0.04707 * V_{lc} \quad (4\text{-}7)$$

Where:

$V_{w(std)}$	=	volume of water vapor at standard conditions, dry standard cubic feet (dscf)
V_{lc}	=	volume of liquid catch, grams

The constant 0.04707 is the standard cubic feet per gram (or milliliter) of water at standard conditions. Using the total weight gain for water determined using Method 4 (Table 4-4 above), the volume of water vapor at standard conditions is calculated to be 5.559 scf for campaign #1, 5.644 scf for campaign #2.

Calculation of Moisture/Water Content (as % Volume)

The moisture content of the gaseous stack emissions is calculated using the following equation:

$$H_2O \text{ vol } \% = 100 * \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}} \qquad (4\text{-}8)$$

Using values measured using EPA Method 4 and values calculated previously, the moisture content was calculated to be 10.993 percent volume for campaign #1 and 11.838 percent volume for campaign #2.

Calculation of Dry Mole Fraction of Flue Gas

The dry mole fraction of flue gas is calculated using the following equation:

$$M_{fd} = 1 - \frac{H_2O \text{ vol } \%}{100} \qquad (4\text{-}9)$$

Where:

M_{fd} = dry mole fraction of effluent gas.

Using the percent moisture determined above, the dry mole fraction of effluent gas is calculated as 0.8901 for campaign #1 and 0.8816 for campaign #2.

Setup of the Dilution Sampling System

The site location was a boiler room at the NC A&T facility, with the 6-inch flanged sampling port installed in the exhaust duct work to allow the dilution sampling unit to sit on a sturdy hydraulic lift cart, which could be rolled into place and raised to allow the probe of the dilution sampling system (Figure 3-2) access to the sampling port. The dilution system control module, the sampling module, and all ancillary equipment were delivered to the test site by truck. The two modules (dilution air supply/control module and sampling module) were positioned at the sampling location by rolling the units through a ground-level door, then elevating the sampling module to the appropriate height for access to the sampling port using the sturdy hydraulic lift to raise and lower the sampling assembly. A power panel and feeder to provide power to two quad outlets and a 50-amp, 2-pole circuit, including a breaker in the existing main panel, had also been installed by the facility prior to campaign #1.

The location provided convenient access to the stack and sampling port, as shown in Figure 3-4, and sufficient space for the equipment and personnel for both testing campaigns. The dilution air system module positioned at the sampling location in the boiler room is shown during testing operations in Figure 4-1. Figure 4-2 shows the sampling probe installed in the 6-in. I.D. flanged port used for sampling. The dilution air supply/control module (Figure 4-3) was located in the boiler room, approximately 12 feet from the sampling module and around the corner of the boiler. A TSI SMPS (Figure 4-4), with associated laptop computer, was also connected to the sampling module (visible behind the TSI display in Figure 4-4), together with the sample collection arrays for campaign #1. An Electrical Low Pressure Impactor (ELPI) (Figure 4-5), with an associated laptop computer, was connected to the sampling module together with the sample collection arrays for campaign #2. The dilution system sampling module, together with other sample collection arrays and instruments attached, is shown in Figure 4-6 for campaign #1. The dilution system sampling module, together with other sample collection arrays and instruments attached, is shown in Figure 4-7 for campaign #2.

Figure 4-1. Dilution sampling system elevated on mobile lift for access to the sampling port.

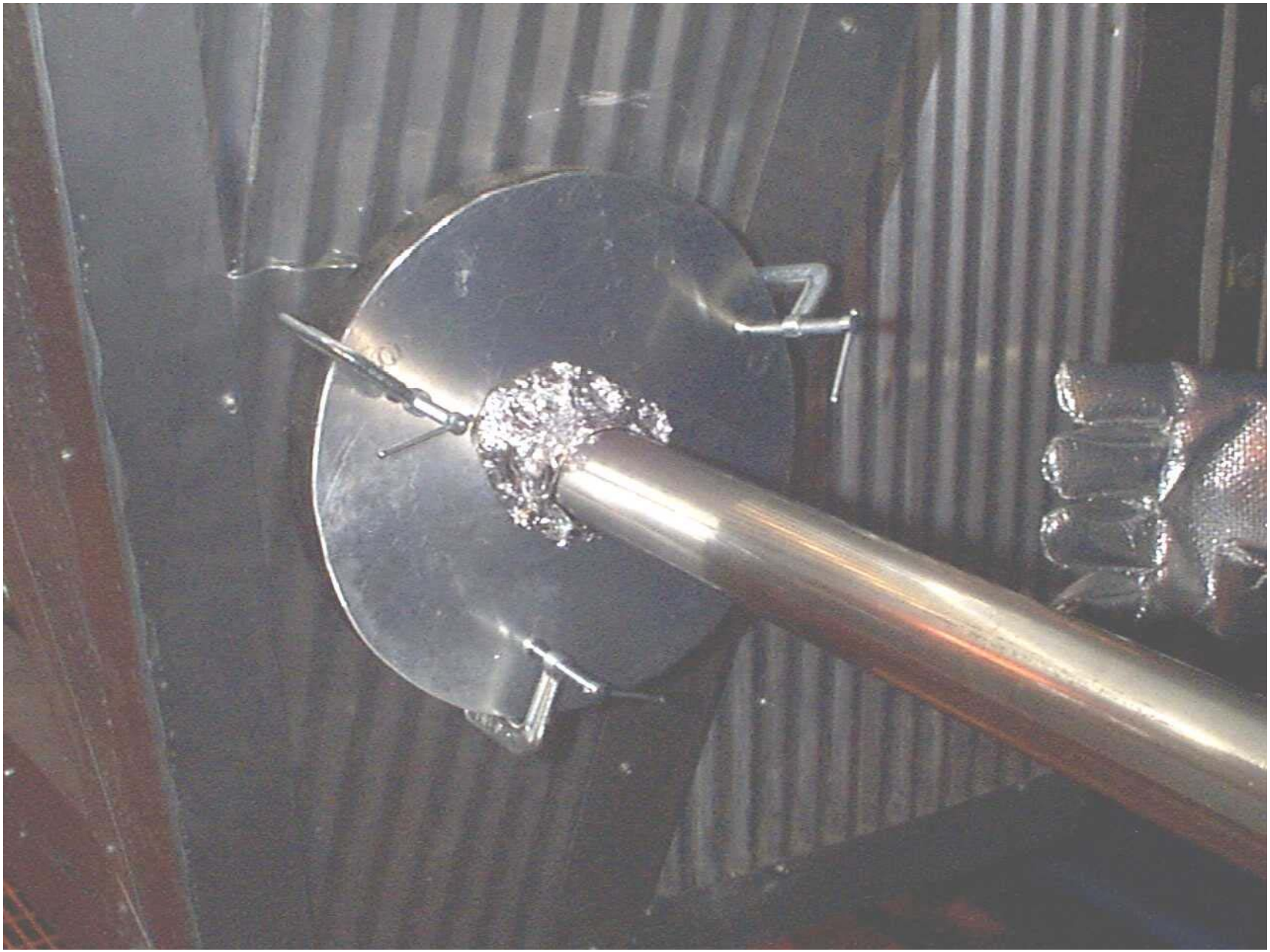

Figure 4-2. Dilution system sampling probe installed in 6 in. I.D. flanged port.

Figure 4-3. Dilution system control module positioned at the sampling location.

Figure 4-4. TSI particle sizer positioned at the sampling location (January 16, 2001) for Campaign #1.

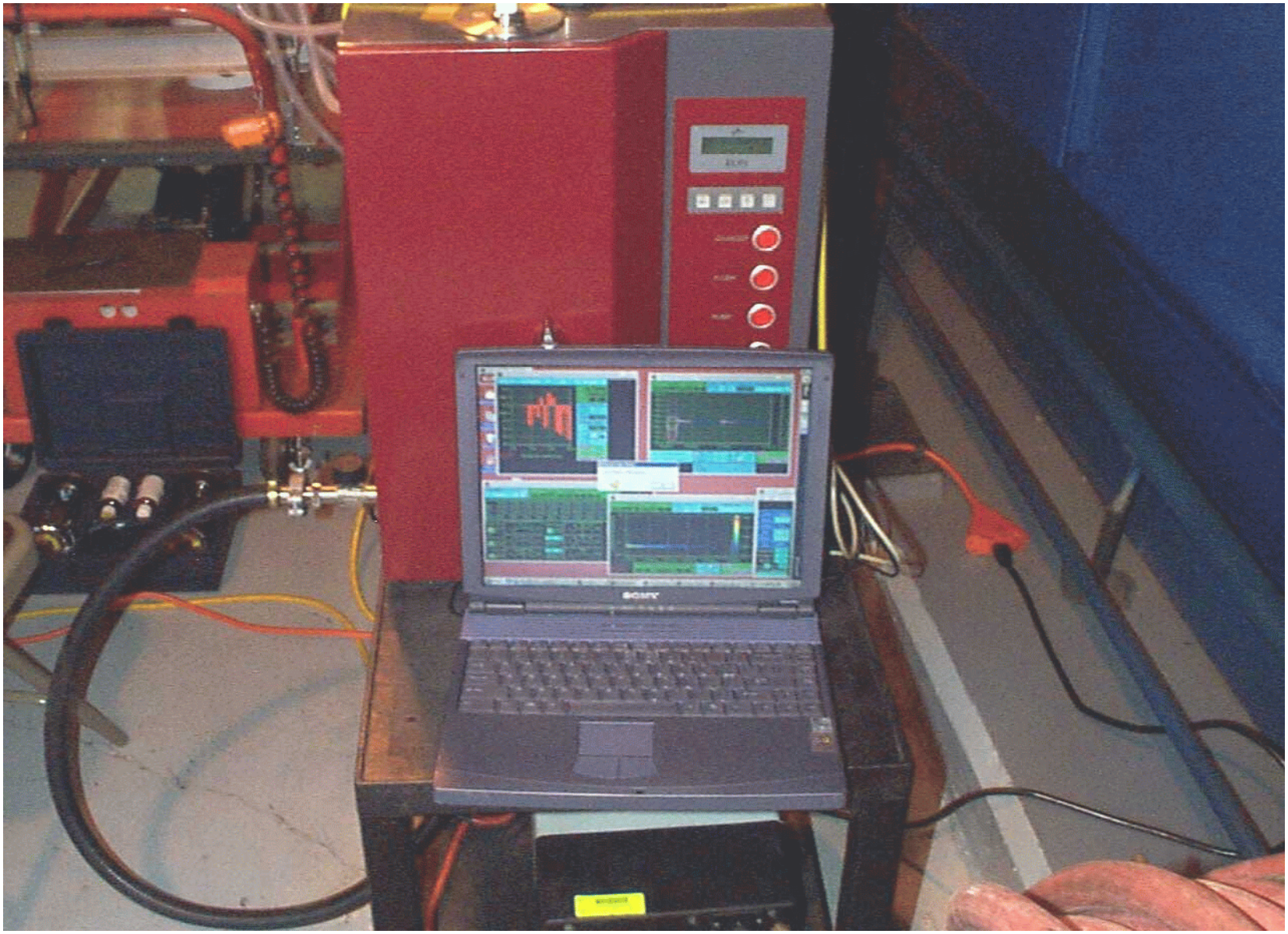

Figure 4-5. ELPI particle sizer positioned at the sampling location (July 7, 2002) for Campaign #2.

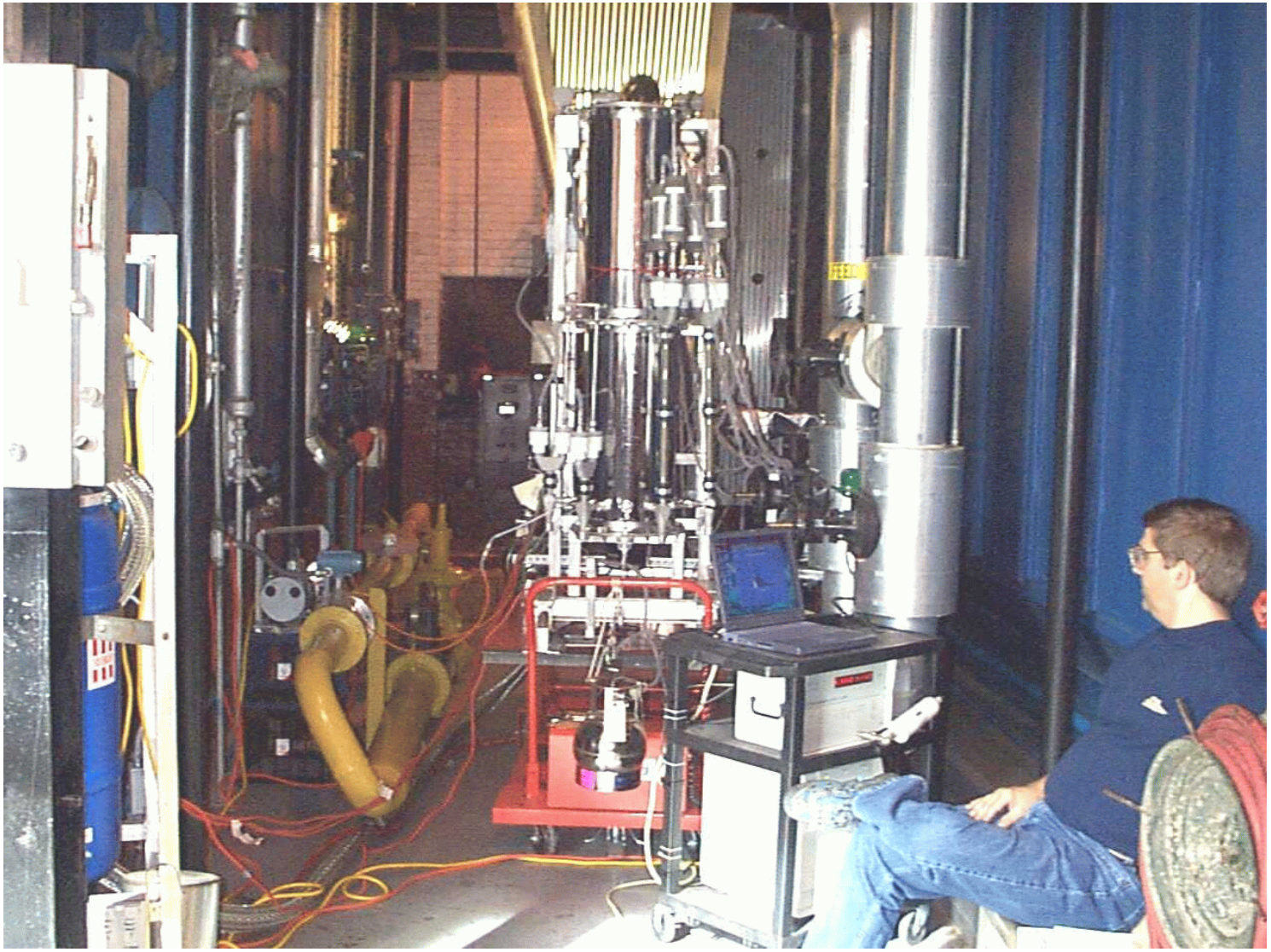

Figure 4-6. Dilution system with all sample collection arrays and instruments attached for Campaign #1.

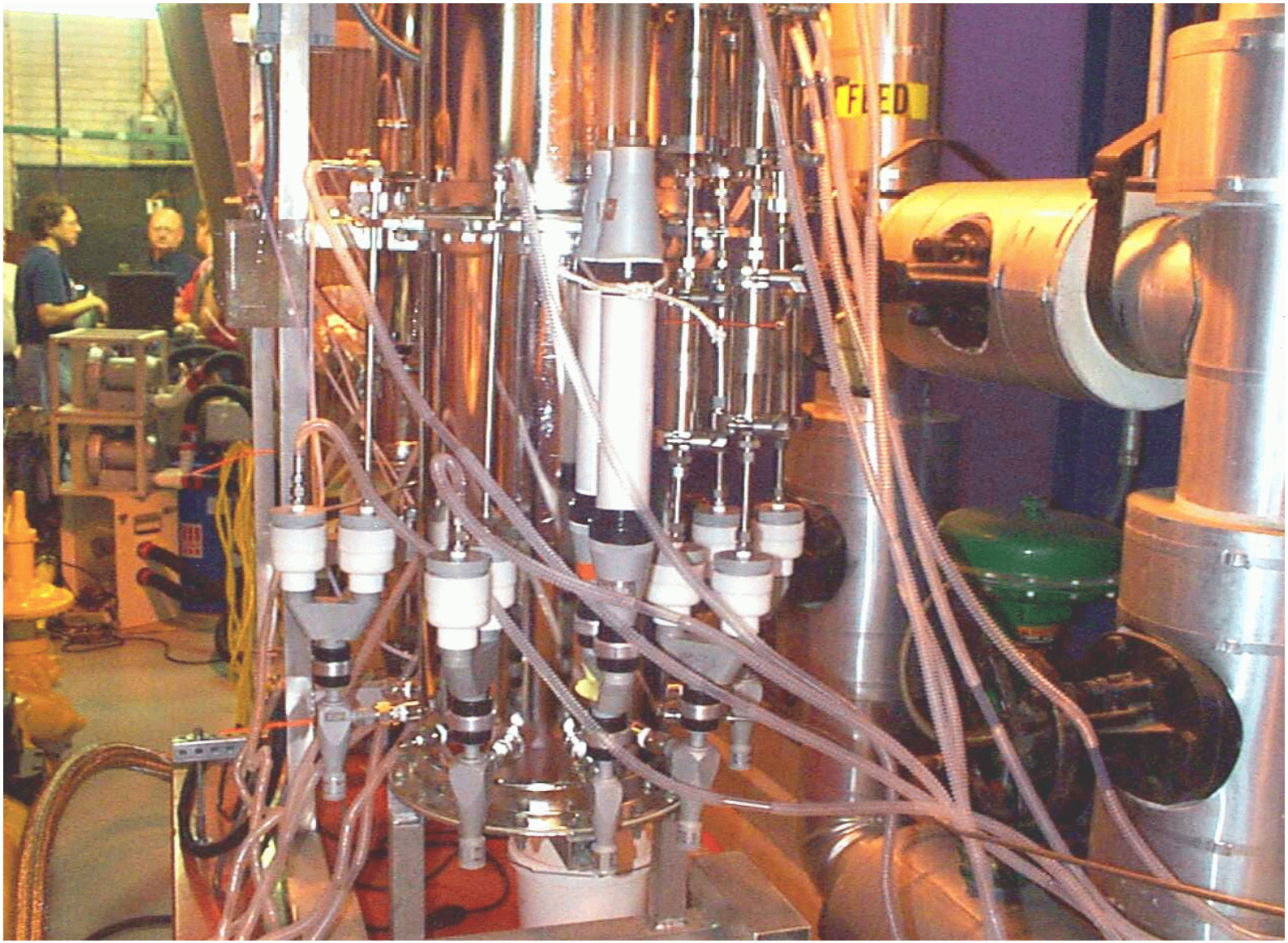

Figure 4-7. Dilution system sampling module, together with sample collection arrays, for Campaign #2.

Figures 4-8 and 4-9 present the recovery area used during both testing campaigns. Figure 4-9 shows the analyst recovering a PUF sampling module. Figure 4-10 shows the removal of a filter from a sample collection array prior to packaging for transport to the laboratory.

Pre-Test Leak Check

To perform a pre-test leak check on the assembled dilution system in the field, the inlet end of the probe was plugged with a Swagelok fitting. Solvent-cleaned solid plates were inserted in place of the orifice plates at the orifice meter run flanges and sealed off using gaskets on each side. A new preweighed quartz 8-in. x 10-in. filter was inserted into the filter holder and carefully sealed in place using screw fittings. A vacuum pump was attached to the residence chamber and a Magnehelic gauge was attached to an available port. The valve between the pump and the chamber was opened and the vacuum was monitored as the system was evacuated. As the reading passed 27 in., the valve between the pump and the chamber was closed. The leak rate was timed between 25 to 20 in. H_2O and again from 20 to 15 in. H_2O, and the two times were averaged. Using the recorded data, the leakage rate in cubic feet/minute was calculated according to Equation 4-10.

$$\text{leakage rate} = \frac{\Delta P}{\Delta T} \times V \times CF \qquad (4\text{-}10)$$

Where:

leakage rate	=	rate of leakage (ft^3/min)
ΔP	=	change in pressure (in. H_2O)
ΔT	=	time increment (sec)
V	=	volume of the evacuated dilution sampler (15.3 ft^3)
CF	=	unit conversion factors
		– 60 sec/min
		– 1 atm/406.8 in. H_2O

Figure 4-8. Sample recovery area.

Figure 4-9. Sample recovery area.

Figure 4-10. Teflon filter being removed from the holder in preparation for packaging for transport to the laboratory.

The criteria for an acceptable leak are ≤0.1 cfm, or ≥1 min 53 sec, equivalent to a pressure increase of 5 in. H_2O. For campaign #1, an average time of 1 min 58 sec was required for a 5-in. pressure change to occur (resulting leak rate: 0.100 cfm). For campaign #2, an average time of 1 min 59 sec was required for a 5-in. pressure change to occur (resulting leak rate: 0.095 cfm). These leak rates both met the acceptance criteria.

Orifice Flow Check

Critical orifice flows on the sampling pumps were checked without sample collection arrays in place using a rotameter to verify that the channels on sample collection array pumps were at the specified flow rate of 16.7 L/min. Rotameters were calibrated with an NIST-traceable electronic bubble flow meter.

Determination of Test Duration

To maximize the collection of particulate material, the decision was made to extend the run time for the longest duration (~10 hours) allowed by the facility.

Canister/Veriflow Blanks

Canisters and Veriflows were utilized only for campaign #1. Prior to deployment in the field, SUMMA-polished canisters and Veriflow canister filling units were cleaned, and blank analysis was performed in the laboratory. All units met the cleanliness criterion of < 10 parts per billion carbon (ppbC, Table 4-5).

Table 4-5. Blank Values for Veriflows and Canisters (Campaign #1)

Unit	Blank Value, ppbC
Veriflows	
Unit #418 (Source)	0.0
Unit #315 (Dilution Air)	0.0
ERG-3 (Ambient)	0.7
Canisters	
3950	1.1
3953	4.4
4031	1.4
4040	1.03
3965	1.0
1404	1.0
4028	0.0
4039	0.0
4024	1.5
5000	3.7

Determination of Flow Rates

A Visual Basic macro was written to process raw data files of flow rate information and convert this information to actual flow based on temperature, pressure, and calibration data. For venturi flows, the macro converted the differential pressure into a reported flow rate. The square root of the differential pressure was then multiplied by a previously determined calibration factor based on the flowing temperature, and the resulting value was converted to standard liters per minute (sLpm) using ideal gas law relationships (1 atm, 70°F).

Calibration data for the venturi were generated by placing a dry gas meter at the inlet to the sample probe. The flows reported by the data acquisition system were corrected to actual conditions (aLpm) and compared to those produced by the dry gas meter corrected to the venturi conditions. An Excel macro automatically selected a correct calibration value to be applied based on the flowing temperature.

Since the actual venturi flow was dependent upon the operating conditions, the setpoint value displayed and entered on the viewing screens needed to be adjusted to achieve the desired flow. Information to be entered included desired flow, flowing temperature, flowing pressure, and barometric pressure; the Excel macro automatically selected the correct value to be applied based on the flowing temperature.

Sample Collection Arrays: Campaign #1

Prior to actual testing (Test Run #1, January 16, 2001; Test Run #2, January 17, 2001; Test Run #3, January 18, 2001), sample collection arrays were attached to various ports on the dilution sampling system, as shown in Figure 4-11. Up to ten sampling ports were available, attached to either the dilution chamber (designated Ports #D1, #D2, and #D3) or the residence chamber (designated Ports #R2, #R3, #R4, #R5, #R6, #R8, and #R10); the available sampling ports are shown in Figure 3-1. The following sample collection arrays were used on all three test days for campaign #1; the sample collection arrays with two denuders in series were used only on the first test day (Figure 4-11A):

- **Dilution Chamber Sample Collection for Campaign #1**
  - *Dilution Chamber Collection Array D1*
    Collection array D1 collects gas phase semivolatile organic compounds, particle-bound organic materials, and metals. The array consists of a cyclone separator to remove particulate matter with aerodynamic diameter greater than 2.5 μm. The gas stream is split into two legs. Leg 1 contains a quartz filter followed by two PUF units in series. The other leg of array D1 consists of a Teflon filter.
  - *Dilution Chamber Array D2*
    Collection array D2 collects gas-phase carbonyl compounds using a pair of carbonyl collection cartridges in series in a pump.
  - *Dilution Chamber Array D3*
    Collection array D3 collects fine particulate matter and gas-phase organic compounds. This array consists of a single filter unit followed by a SUMMA canister.

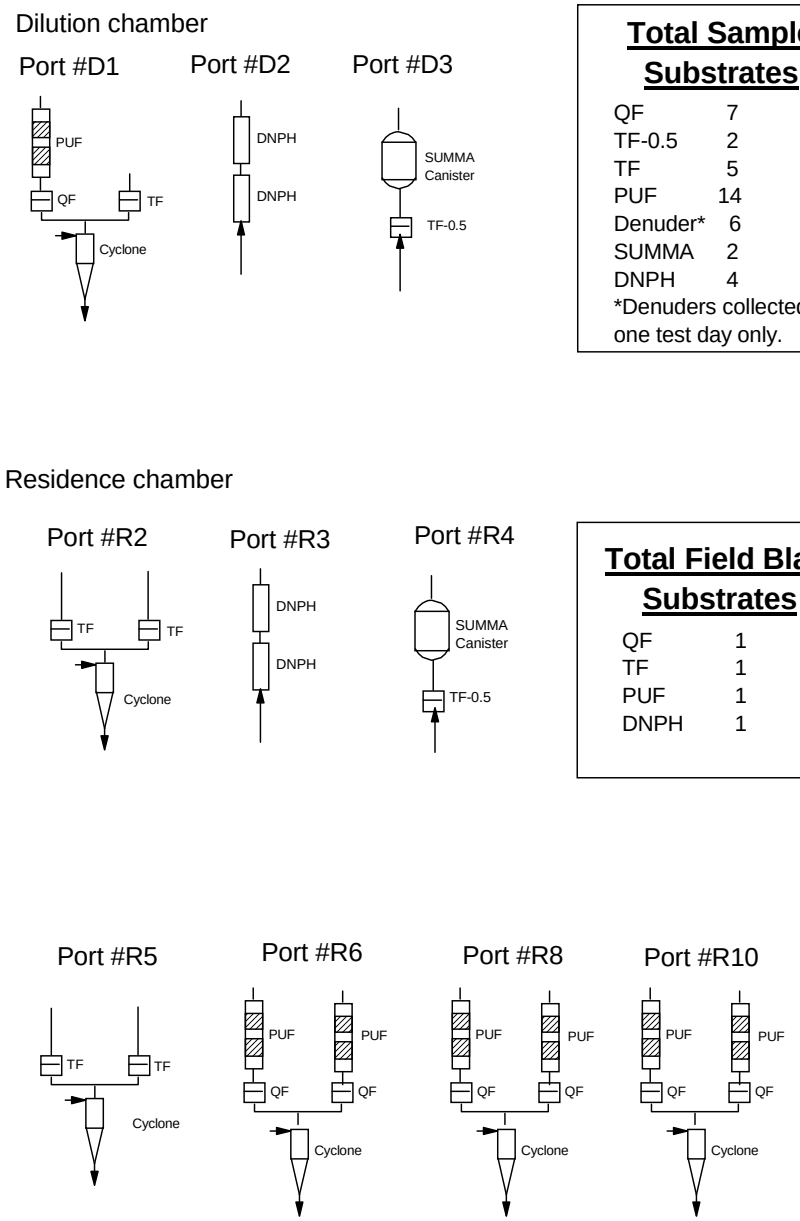

Figure 4-11. Schematic diagram of sample collection arrays used in field test (January 16-18, 2001) for Campaign #1.

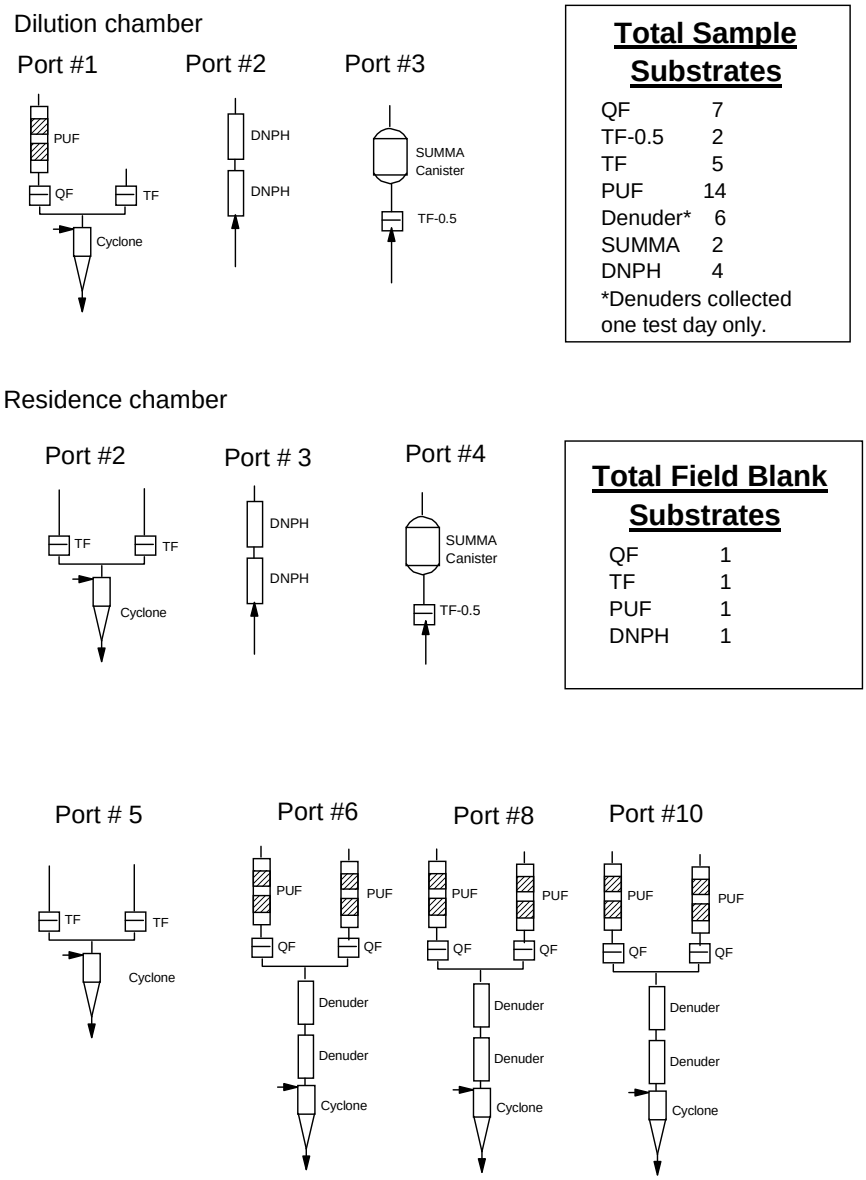

Figure 4-11A. Schematic diagram of sample collection arrays used in field test (January 16-18, 2001) for Campaign #1, showing denuders used on only one test day.

- **Residence Chamber Collection Arrays for Campaign #1**

  - *Residence Chamber Collection Array R2*
    Collection array R2 collects fine particulate matter. The array consists of a 2.5-μm cyclone followed by two identical legs containing Teflon filters.

  - *Residence Chamber Collection Array R3*
    Collection array R3 collects fine particulate matter and gas-phase carbonyl compounds. This array consists of a pair of carbonyl collection cartridges in series and a pump.

  - *Residence Chamber Collection Array R4*
    Collection array R4 collects fine particulate matter and gas-phase organic compounds. This array consists of a single filter unit followed by a SUMMA canister.

  - *Residence Chamber Collection Array R5*
    Collection array R5 collects fine particulates. The array consists of a 2.5-μm cyclone followed by two identical legs containing Teflon filters.

  - *Residence Chamber Collection Arrays R6, R8, and R10*
    Collection arrays R6, R8, and R10 collect fine particulate matter on quartz filters for total carbon and elemental carbon analysis. These sampling arrays consist of a 2.5-μm cyclone followed by two identical legs each containing a quartz filer followed by two PUF plugs in series. On one test day, two XAD-4-coated denuders in series will be used with each array to collect semivolatile organic compounds.

In addition to the sample collection arrays, a TSI continuous particle size analyzer was used on the residence chamber. The scanning mobility particle sizer (SMPS) includes a TSI Model 3081 Electrostatic Classifier in tandem with a TSI Model 3025A Ultrafine Condensation Particle Counter. This device scanned the range of 9-421 nanometers (nm) in a scan cycle of approximately 3 minutes, with data collected continuously onto a laptop computer with real-time data display and saving. The SMPS was connected to the residence chamber at port #R7 to continuously monitor particle size distribution.

Sample Collection Arrays: Campaign #2

Prior to actual testing (Test Run #1, July 9, 2002; Test Run #2, July 10, 2002; and Test Run #3, July 11, 2002), sample collection arrays were attached to various ports on the dilution sampling system, as shown in Figure 4-12. Up to ten sampling ports were available, attached to either the dilution chamber (designated port #D1) or the residence chamber (designated ports #R2, 3, 4, 5, 6, 8, and 10); the available sampling ports are shown in Figure 4-12, the schematic diagram of the dilution sampling system. The following sample collection arrays were used on all three test days for campaign #2:

- **Dilution Chamber Sample Collection for Campaign #2**

  - *Dilution Chamber Collection Array D1*
    Collection array D1 collects gas phase semivolatile organic compounds, particle-bound organic materials (both organic and inorganic). The array consists of a cyclone separator to remove particulate matter with aerodynamic diameter greater than 2.5 μm. The gas stream is split into two legs. Leg one contains a quartz filter followed by two PUF units in series. The other leg of array D1 consists of a Teflon filter.

- **Residence Chamber Collection Arrays for Campaign #2**

  - *Residence Chamber Collection Arrays R6, R8 and R10*
    Collection arrays R6, R8 and R10 collects fine particulate matter and semivolatile organic compounds for analysis of elemental carbon/organic carbon (EC/OC) and speciated organic compounds. The array consists of a 2.5-μm cyclone followed by two identical legs containing quartz filters and four PUF plugs in series (two PUF modules containing two PUF plugs each on each leg).

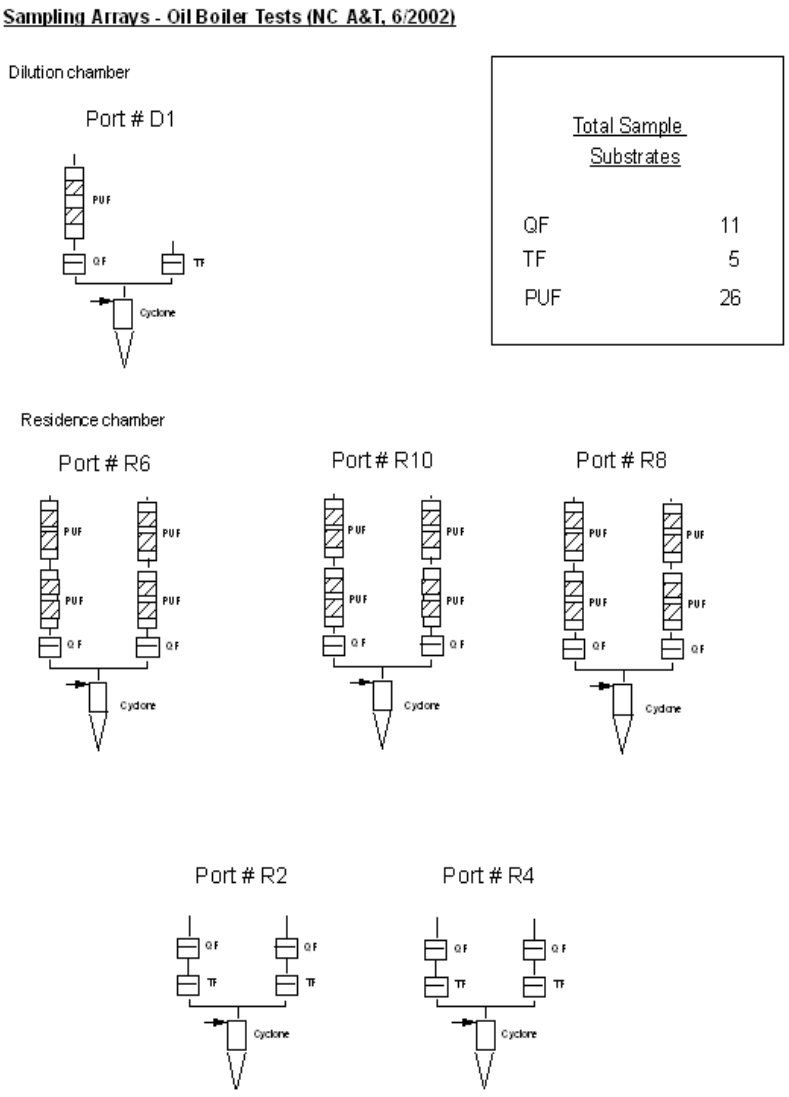

Figure 4-12. Schematic diagram of sample collection arrays used in field test (July 9-11, 2002) for Campaign #2.

- *Residence Chamber Collection Arrays R2 andR4*
  Collection arrays R2 and R4 collected PM-2.5 on Teflon filters for determination of mass, elements and inorganic ions. The Teflon filters are followed by quartz filters to determine any semivolatile organic compounds stripped from the Teflon filters during sampling.

In addition to the sample collection arrays, an ELPI was connected to the residence chamber at port R3 to continuously monitor particle size distribution.

Measurement of O_2 and CO_2 Process Concentrations

For campaign #1, measurements of O_2 were made using the certified facility O_2 analyzer every 15 min for the duration of each test day to determine average O_2 concentrations during test conditions. For campaign #2, measurement of O_2 and CO_2 were made using Fyrite bulbs every 30 min across the duration of the tests to determine average O_2 and CO_2 concentrations during testing.

Operation of the Dilution Sampling System and Sample Collection Arrays

To prepare the dilution sampling system for a full test run, sampling probe temperature setpoints were set equal to or slightly above the measured stack temperature. The system was equilibrated at temperature. Sample collection arrays were loaded with appropriate media, and flow/leak checks were performed with each sample collection array to ensure that the entire system would be leak-free in operation. Sampler flows were set just before initiation of the test to prevent heat loss from the heated probe. The blower and the ring compressor were started to achieve a slightly positive pressure, then the blower flow was adjusted to cause the stack gas to flow into the dilution sampling system after the probe was inserted in the stack. Sample collection array pumps were started, and for campaign #1 valves for the SUMMA canisters were opened to initiate canister air sample collection. The sampling process was carefully monitored by the sampling team based on pressure change in the canister to ensure that filters were not overloaded in the course of sampling. Start time and other pertinent data were recorded. At the end of the predetermined sampling interval, the sampling process was stopped by stopping the

pumps for the sample collection arrays and closing the valves on the SUMMA canisters. The probe was withdrawn from the stack, the blower and ring compressor were turned off, and heaters were turned off and allowed to cool. Each sampling array was leak-checked at the end of the sampling period, and ending flow rates were documented. Experimental parameters for tests #1, #2, and #3 of campaign #1 are shown in Tables 4-6 through 4-8; blower flow, dilution flow, and venturi flow for tests #1, #2, and #3 of campaign #1 are shown graphically in Figures 4-13 through 4-21. Experimental parameters for tests #1, #2, and #3 of campaign #2 are shown in Tables 4-9 through 4-11; blower flow, dilution flow, and venturi flow for tests #1, #2, and #3 of campaign #2 are shown graphically in Figures 4-22 through 4-30.

At the end of the sampling period, the pumps on the dilution system were turned off, and recovery of the dilution sampling system consisted of removing the sample collection arrays and turning off the particle size analyzer. Sample collection arrays were then carried to the recovery area and disassembled, the parts were carefully labeled, and the components were carefully packaged for transport to the laboratories.

The sample collection arrays were removed sequentially at the cyclone connection. Each individual collection array was removed and the ends of the assembly were covered with aluminum foil. As each sample collection array was removed from the sampling system, the sampling aperture was covered to avoid introduction of any contaminants into the dilution sampler. The ends of the sample collection array were capped and the array placed in a secure container for transport to the sample recovery area.

Table 4-6. Run Time Summary Information, Test Run #1, Campaign #1

Test Run #1 (January 16, 2001)	
Start Time	9:25:09 a.m.
End Time	7:25:29 p.m.
Run Time	600.33 min
Barometric Pressure	29.68 in. Hg
Nozzle Size	0.390

Parameter	**Average**
Venturi Flow	30.47 aLpm
	18.53 sLpm
PT-101	-0.92 in. WC
TE-104	205.53 °C
Dilution Flow	876.58 aLpm
	847.89 sLpm
PT-102	-1.37 in. WC
TE-108	25.23 °C
Blower Flow	918.41 aLpm
	839.02 sLpm
PT-103	-17.59 in. WC
TE-105	28.20 °C
Dilution Ratio	46.81
TE-101	189.98 °C
TE-102	198.11 °C
TE-103	198.14 °C

Sample Flow Rates

Actual Flow aLpm	**Corrected Flow sLpm**	**Notes**	**Average Flow sLpm**
17.22	16.96	PM 2.5 sample on dilution air: start	16.88
17.07	16.81	PM 2.5 sample on dilution air: end	
16.92	16.66	PM 2.5 sample on residence chamber port 10: start	16.51
16.62	16.36	PM 2.5 sample on residence chamber port 10: end	
17.22	16.96	PM 2.5 sample on residence chamber port 8: start	16.96

Table 4-6. (Continued)

Sample Flow Rates

Actual Flow aLpm	Corrected Flow sLpm	Notes	Average Flow sLpm
17.22	16.96	PM 2.5sample on residence chamber port 8: end	
16.92	16.66	PM 2.5 sample on residence chamber port 6: start	16.51
16.62	16.36	PM 2.5 sample on residence chamber port 6: end	
17.22	16.96	PM 2.5 sample on residence chamber port 4: start	16.96
17.22	16.96	PM 2.5 sample on residence chamber port 4:end	
17.22	16.96	PM 2.5 sample on residence chamber port 2: start	16.96
17.22	16.96	PM 2.5 sample on residence chamber port 2:end	
0.90	0.89	DNPH sample on residence chamber port 3: start	0.96
1.05	1.03	DNPH sample on residence chamber port 3: end	
1.47	1.45	DNPH sample on dilution air port 3: start	1.45
1.47	1.45	DNPH sample on dilution air port 3: end	

Canisters	Start Pressure	End Pressure
#4024, Dilution	29.0 in. Hg	5.0 in. Hg
#4039, Source	29.0 in. Hg	8.0 in. Hg
#5000, Ambient[a]	29.0 in. Hg	0.0 in. Hg
#1404, Blank	29.0 in. Hg	29.0 in. Hg

[a] The ambient sample was collected on the first test day of campaign #1 at the inlet of the charcoal scrubber subsystem of the EPA Dilution Sampling System. The data from the analysis of the ambient canister sample were reported but no correction of the monitoring data for ambient levels was performed. The ambient information was supplied to provide an indicator of the performance of the dilution sampling system scrubber efficiency in removing the ambient background from the air used for sample dilution at the test site.

PT = pressure transducer
TE = thermocouple
aLpm = actual liters per minute
sLpm = standard liters per minute
WC = water column

Table 4-7. Run Time Summary Information, Test Run #2, Campaign #1

Test Run #2 (January 17, 2001)

Start Time	7:50:00 a.m.
End Time	5:50:30 p.m.
Run Time	600.50 min
Barometric Pressure	29.83 in. Hg
Nozzle Size	0.390 in.

Parameter	Average
Venturi Flow	29.37 aLpm
	17.88 sLpm
PT-101	-0.96 in. WC
TE-104	207.51 °C
Dilution Flow	870.64 aLpm
	848.35 sLpm
PT-102	-1.34 in. WC
TE-108	24.57 °C
Blower Flow	877.00 aLpm
	833.41 sLpm
PT-103	-13.30 in. WC
TE-105	27.67 °C
Dilution Ratio	48.67
TE-101	194.54 °C
TE-102	207.63 °C
TE-103	209.57 °C

Sample Flow Rates

Actual Flow aLpm	Corrected Flow sLpm	Notes	Average Flow sLpm
17.40	17.39	PM 2.5 sample on dilution air: start	17.31
17.25	17.24	PM 2.5 sample on dilution air: end	
16.49	16.48	PM 2.5 sample on residence chamber port 10: start	16.48
16.49	16.48	PM 2.5 sample on residence chamber port 10: end	
17.10	17.08	PM 2.5 sample on residence chamber port 8: start	17.08

Table 4-7. (Continued)

Sample Flow Rates

Actual Flow aLpm	Corrected Flow sLpm	Notes	Average Flow sLpm
17.10	17.08	PM 2.5 sample on residence chamber port 8:end	
16.49	16.48	PM 2.5 sample on residence chamber port 6: start	16.48
16.49	16.48	PM 2.5 sample on residence chamber port 6: end	
17.10	17.08	PM 2.5 sample on residence chamber port 4: start	17.08
17.10	17.08	PM 2.5 sample on residence chamber port 4: end	
17.25	17.24	PM 2.5 sample on residence chamber port 2: start	17.16
17.10	17.08	PM 2.5 sample on residence chamber port 2: end	
0.99	0.99	DNPH sample on residence chamber port 3: start	0.96
0.93	0.93	DNPH sample on residence chamber port 3: end	
0.93	0.93	DNPH sample on dilution air port 3: start	0.93
0.93	0.93	DNPH sample on dilution air port 3: end	
Canisters	**Start Pressure**	**End Pressure**	
#4031, Dilution	29.0 in. Hg	5.0 in. Hg	
#4040, Source	29.0 in. Hg	4.0 in. Hg	

PT = pressure transducer
TE = thermocouple
aLpm = actual liters per minute
sLpm = standard liters per minute
WC = water column

Table 4-8. Run Time Summary Information, Test Run #3, Campaign #1

Test Run #3 (January 18, 2001)

Start Time	7:35:06 a.m.
End Time	5:35:16 p.m.
Run Time	600.17 min
Barometric Pressure	29.74 in. Hg
Nozzle Size	0.390 in.

Parameter	Average
Venturi Flow	31.26 aLpm
	19.02 sLpm
PT-101	-0.99 in. WC
TE-104	206.60 °C
Dilution Flow	875.34 aLpm
	850.66 sLpm
PT-102	-1.39 in. WC
TE-108	24.44 °C
Blower Flow	885.81 aLpm
	836.70 sLpm
PT-103	-14.68 in. WC
TE-105	27.44 °C
Dilution Ratio	45.91
TE-101	196.98 °C
TE-102	203.77 °C
TE-103	206.10 °C

Sample Flow Rates

Actual Flow aLpm	Corrected Flow sLpm	Notes	Average Flow sLpm
17.36	17.13	PM 2.5 sample on dilution air: start	17.13
17.36	17.13	PM 2.5 sample on dilution air: end	
16.60	16.38	PM 2.5 sample on residence chamber port 10: start	16.38
16.60	16.38	PM 2.5 sample on residence chamber port 10: end	
17.20	16.98	PM 2.5 sample on residence chamber port 8: start	16.98
17.20	16.98	PM 2.5 sample on residence chamber port 6:start	16.98

Table 4-8. (Continued)

Actual Flow aLpm	Corrected Flow sLpm	Notes	Average Flow sLpm
17.20	16.98	PM 2.5 sample on residence chamber port 6: end	
17.20	16.98	PM 2.5 sample on residence chamber port 4: start	16.98
17.20	16.98	PM 2.5 sample on residence chamber port 4: end	
17.20	16.98	PM 2.5 sample on residence chamber port 2: start	16.98
17.20	16.98	PM 2.5 sample on residence chamber port 2: end	
1.14	1.12	DNPH sample on residence chamber port 3:start	1.12
1.14	1.12	DNPH sample on residence chamber port 3: end	
1.18	1.17	DNPH sample on dilution air port 3: start	1.17
1.18	1.17	DNPH sample on dilution air port 3: end	
Canisters	**Start Pressure**	**End Pressure**	
#3953, Dilution	29.0 in. Hg	5.0 in. Hg	
#3950, Source	29.0 in. Hg	3.0 in. Hg	

PT = pressure transducer
TE = thermocouple
aLpm = actual liters per minute
sLpm = standard liters per minute
WC = water column

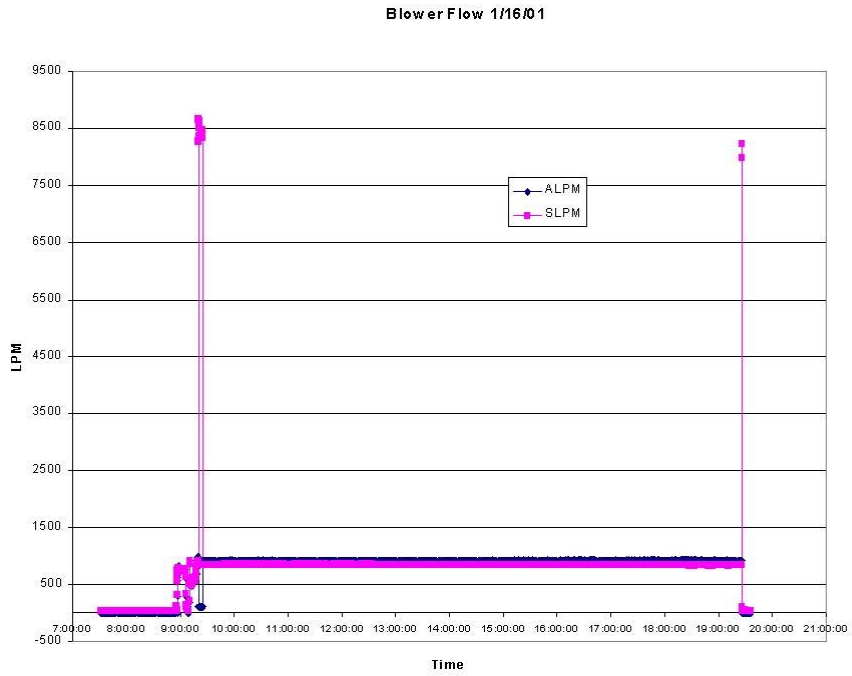

Figure 4-13. Blower flow, Test 1—Day 1, January 16, 2001, Campaign #1.

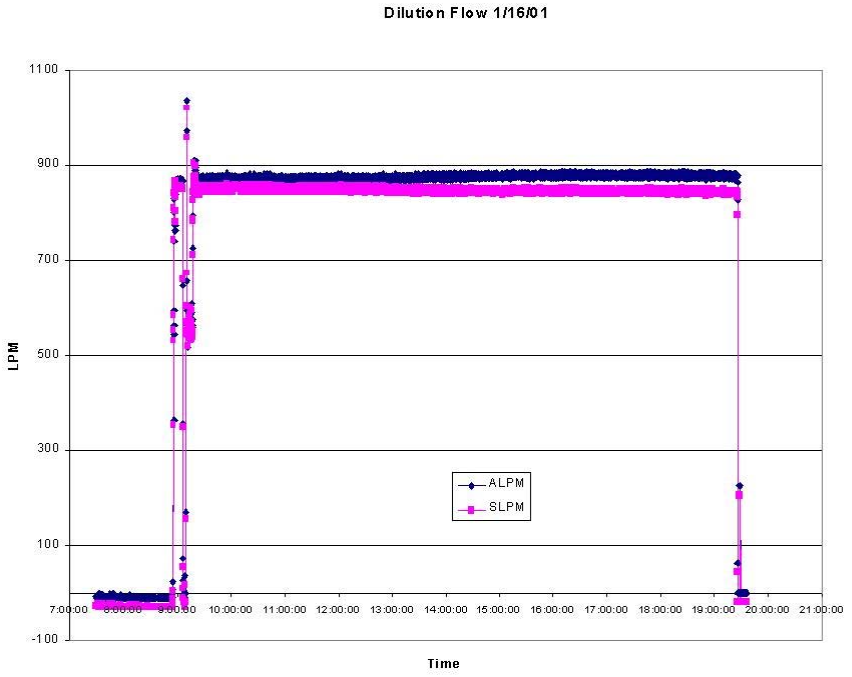

Figure 4-14. Dilution flow, Test 1—Day 1, January 16, 2001, Campaign #1.

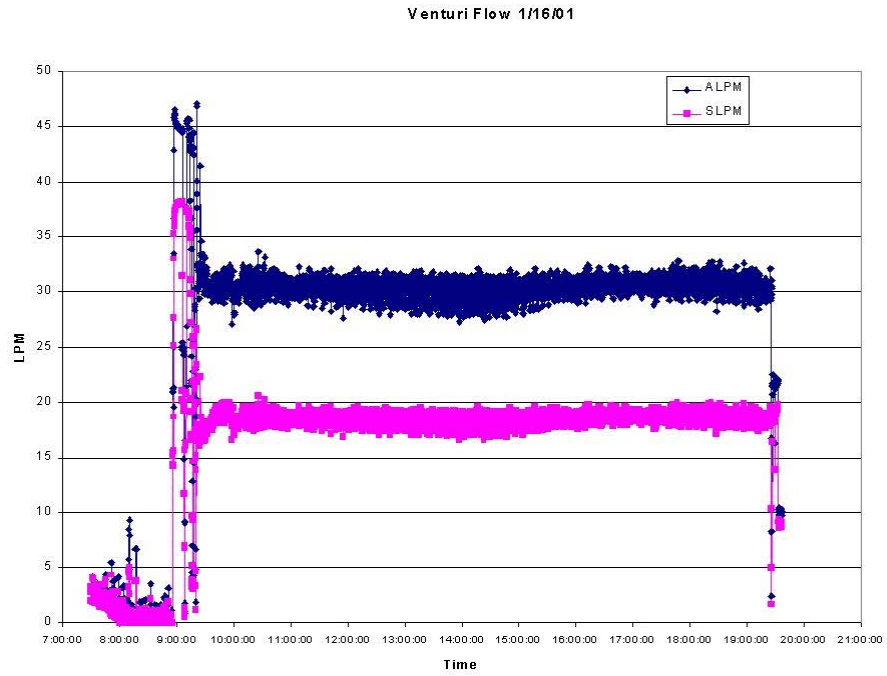

Figure 4-15. Venturi flow, Test 1—Day 1, January 16, 2001, Campaign #1.

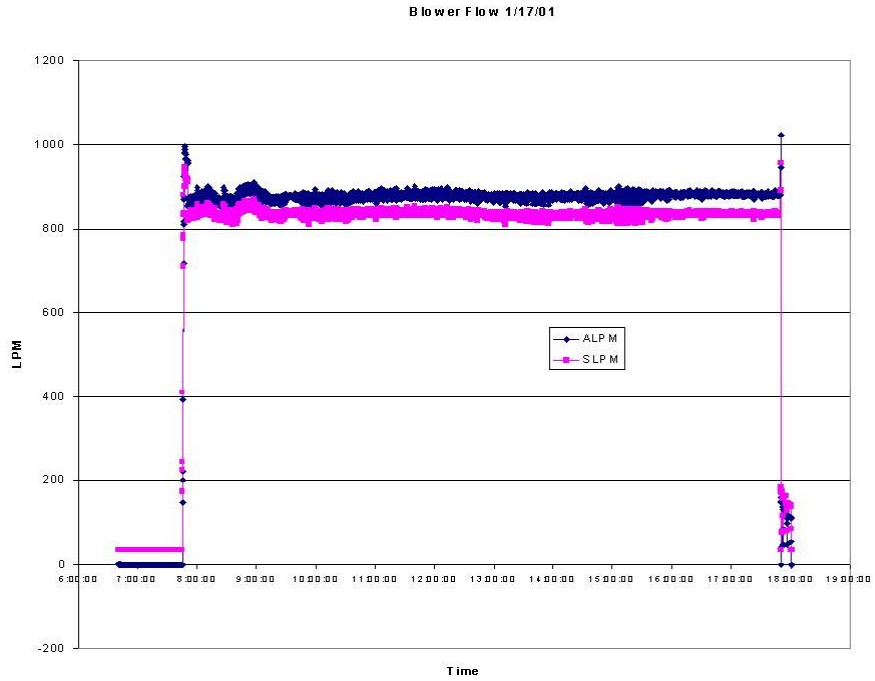

Figure 4-16. Blower flow, Test 2—Day 2, January 17, 2001, Campaign #1.

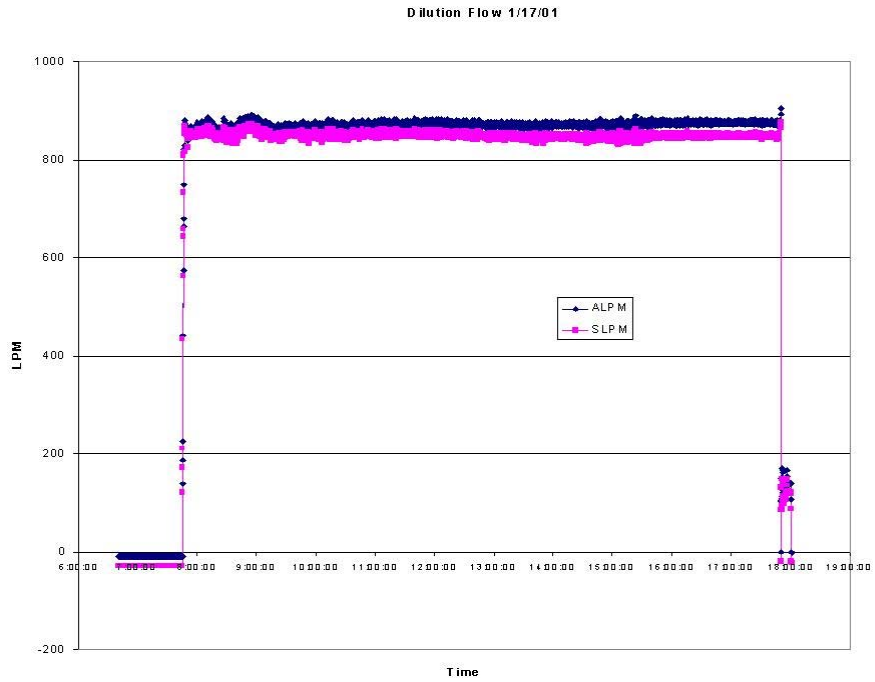

Figure 4-17. Dilution flow, Test 2—Day 2, January 17, 2001 Campaign #1.

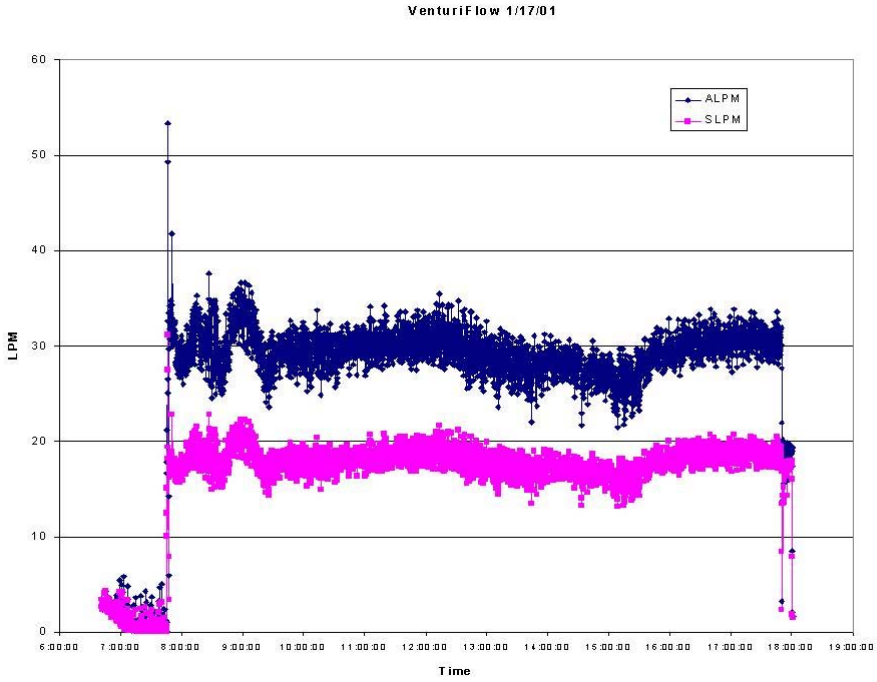

Figure 4-18. Venturi flow, Test 2—Day 2, January 17, 2001, Campaign #1.

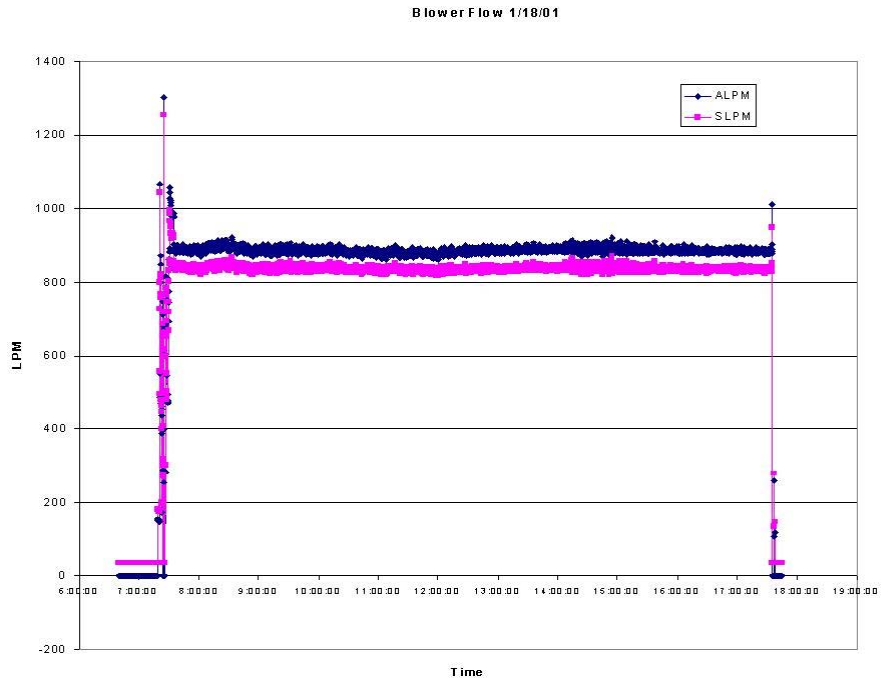

Figure 4-19. Blower flow, Test 3—Day 3, January 18, 2001, Campaign #1.

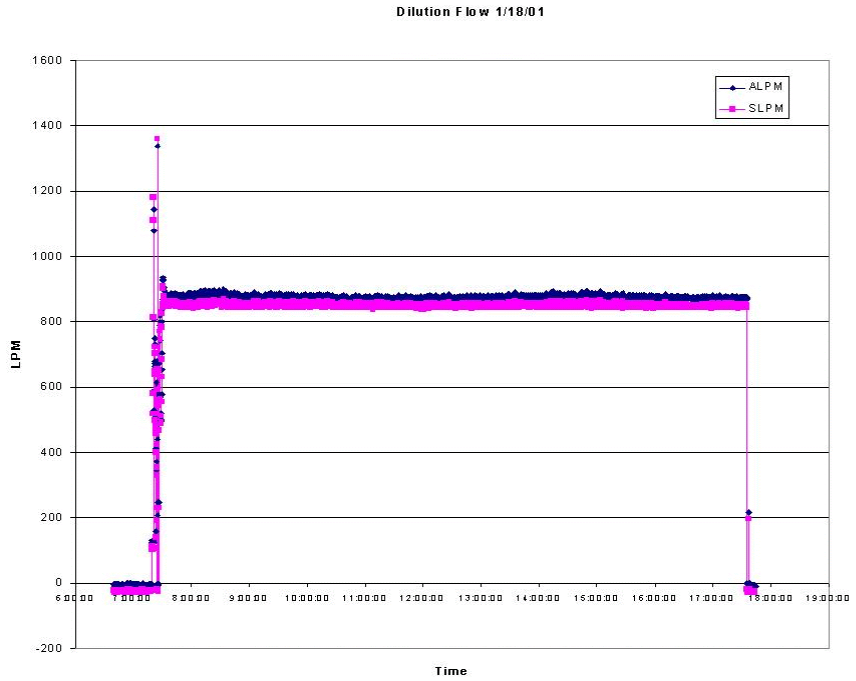

Figure 4-20. Dilution flow, Test 3—Day 3, January 18, 2001, Campaign #1.

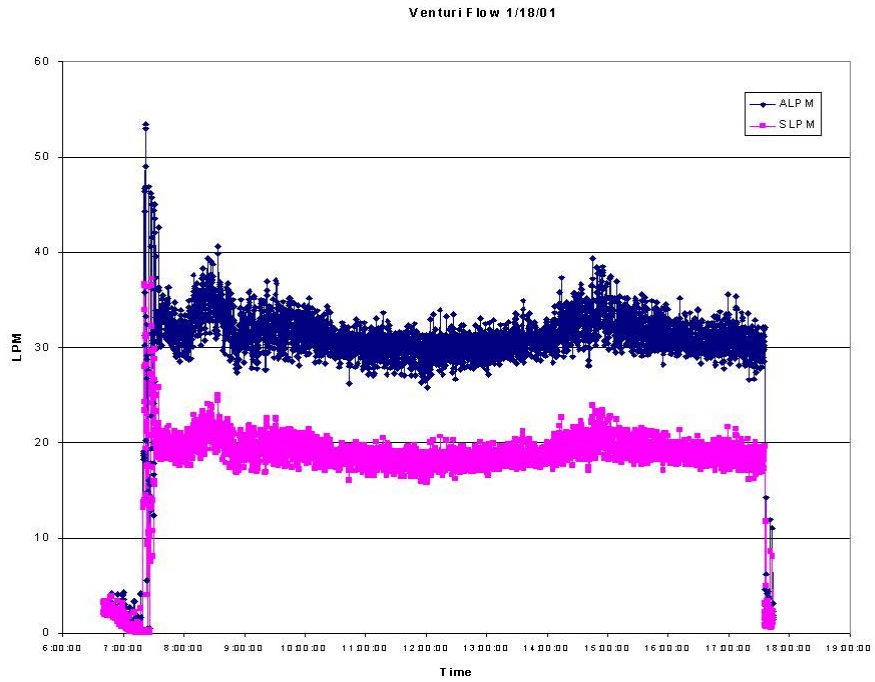

Figure 4-21. Venturi flow, Test 3—Day 3, January 18, 2001, Campaign #1.

Table 4-9. Run Time Summary Information, Test Run #1, Campaign #2

Test Run #1 (July 9, 2002)	
Start Time	8:01:08 a.m.
End Time	6:01:44 p.m.
Run Time	600.60 min
Barometric Pressure	28.79 inches Hg
Nozzle Size	0.505 inches

Parameter	**Average**
Venturi Flow	30.03 aLpm
	18.85 sLpm
PT-101	-0.77 inches WC
TE-104	176.89 °C
Dilution Flow	908.65 aLpm
	816.28 sLpm
PT-102	-1.42 inches WC
TE-108	38.82 °C
Blower Flow	789.12 aLpm
	680.59 sLpm
PT-103	-16.54 inches WC
TE-105	41.37 °C
Dilution Ratio	44.33
TE-101	171.45 °C
TE-102	176.73 °C
TE-103	176.48 °C

Actual Flow sLpm	**Corrected Flow aLpm**	**Notes**	**Average Flow sLpm**
16.43	17.78	PM 2.5 sample on dilution air–start	16.43
16.43	17.78	PM 2.5 sample on dilution air–end	
16.43	17.78	PM 2.5 sample on residence chamber port 10–start	16.43
16.43	17.78	PM 2.5 sample on residence chamber port 10–end	
16.58	17.93	PM 2.5 sample on residence chamber port 8–start	16.58
16.58	17.93	PM 2.5 sample on residence chamber port 8–end	
16.43	17.78	PM 2.5 sample on residence chamber port 6–start	16.43
16.43	17.78	PM 2.5 sample on residence chamber port 6–end	

Table 4-9. (Continued)

Actual Flow sLpm	Corrected Flow aLpm	Notes	Average Flow sLpm
8.91	9.64	PM 2.5 sample on residence chamber port 5–start	9.04
9.16	9.91	PM 2.5 sample on residence chamber port 5–end	
16.29	17.62	PM 2.5 sample on residence chamber port 4–start	16.22
16.14	17.46	PM 2.5 sample on residence chamber port 4–end	
16.58	17.93	PM 2.5 sample on residence chamber port 2–start	16.51
16.43	17.78	PM 2.5 sample on residence chamber port 2–end	

PT = pressure transducer
TE = thermocouple
aLpm = actual liters per minute
sLpm = standard liters per minute
WC = water column

Table 4-10. Run Time Summary Information, Test Run #2, Campaign #2

Test Run #2 (July 10, 2002)	
Start Time	7:06:05 a.m.
End Time	5:06:45 p.m.
Run Time	600.67 min
Barometric Pressure	28.67 inches Hg
Nozzle Size	0.505 inches

Parameter	**Average**
Venturi Flow	30.00 aLpm
	18.79 sLpm
PT-101	-0.80 inches WC
TE-104	176.03 °C
Dilution Flow	911.02 aLpm
	814.43 sLpm
PT-102	-1.42 inches WC
TE-108	39.00 °C
Blower Flow	783.42 aLpm
	673.14 sLpm
PT-103	-16.32 inches WC
TE-105	41.45 °C
Dilution Ratio	44.37
TE-101	171.71 °C
TE-102	177.13 °C
TE-103	176.68 °C

Sample Flow Rates

Actual Flow sLpm	**Corrected Flow aLpm**	**Notes**	**Average Flow sLpm**
16.51	18.00	PM 2.5 sample on dilution air–start	16.44
16.37	17.85	PM 2.5 sample on dilution air–end	
16.37	17.85	PM 2.5 sample on residence chamber port 10–start	16.37
16.37	17.85	PM 2.5 sample on residence chamber port 10–end	
16.37	17.85	PM 2.5 sample on residence chamber port 8–start	16.37
16.37	17.85	PM 2.5 sample on residence chamber port 8–end	

Table 4-10. (Continued)

Sample Flow Rates

Actual Flow sLpm	Corrected Flow aLpm	Notes	Average Flow sLpm
16.37	17.85	PM 2.5 sample on residence chamber port 6–end	
9.12	9.95	PM 2.5 sample on residence chamber port 5–start	9.19
9.25	10.08	PM 2.5 sample on residence chamber port 5–end	
16.22	17.69	PM 2.5 sample on residence chamber port 4–start	16.15
16.08	17.53	PM 2.5 sample on residence chamber port 4–end	
16.37	17.85	PM 2.5 sample on residence chamber port 2–start	16.37
16.37	17.85	PM 2.5 sample on residence chamber port 2–end	

PT = pressure transducer
TE = thermocouple
aLpm = actual liters per minute
sLpm = standard liters per minute
WC = water column

Table 4-11. Run Time Summary Information, Test Run #3, Campaign #2

Test Run #3 (July 11, 2002)	
Start Time	7:17:03 a.m.
End Time	5:17:03 p.m.
Run Time	600.00 min
Barometric Pressure	28.64 inches Hg
Nozzle Size	0.505 inches
Parameter	**Average**
Venturi Flow	30.02 aLpm
	18.78 sLpm
PT-101	-0.98 inches WC
TE-104	176.12 °C
Dilution Flow	900.09 aLpm
	824.70 sLpm
PT-102	-1.45 inches WC
TE-108	31.22 °C
Blower Flow	774.50 aLpm
	681.74 sLpm
PT-103	-16.20 inches WC
TE-105	33.61 °C
Dilution Ratio	44.95
TE-101	169.72 °C
TE-102	177.18 °C
TE-103	176.86 °C

Table 4-11. (Continued)

Sample Flow Rates

Actual Flow sLpm	Corrected Flow aLpm	Notes	Average Flow sLpm
16.41	17.80	PM 2.5 sample on dilution air–start	16.41
16.41	17.80	PM 2.5 sample on dilution air–end	
16.55	17.96	PM 2.5 sample on residence chamber port 10–start	16.48
16.41	17.80	PM 2.5 sample on residence chamber port 10–End	
16.55	17.96	PM 2.5 sample on residence chamber port 8–start	16.48
16.41	17.80	PM 2.5 sample on residence chamber port 8–end	
16.70	18.11	PM 2.5 sample on residence chamber port 6–start	16.56
16.41	17.80	PM 2.5 sample on residence chamber port 6–end	
9.27	10.06	PM 2.5 sample on residence chamber port 5–start	9.15
9.02	9.79	PM 2.5 sample on residence chamber port 5–end	
16.12	17.49	PM 2.5 sample on residence chamber port 4–start	16.12
16.12	17.49	PM 2.5 sample on residence chamber port 4–end	
16.55	17.96	PM 2.5 sample on residence chamber port 2–start	16.55
16.55	17.96	PM 2.5 sample on residence chamber port 2–end	

PT = pressure transducer
TE = thermocouple
aLpm = actual liters per minute
sLpm = standard liters per minute
WC = water column

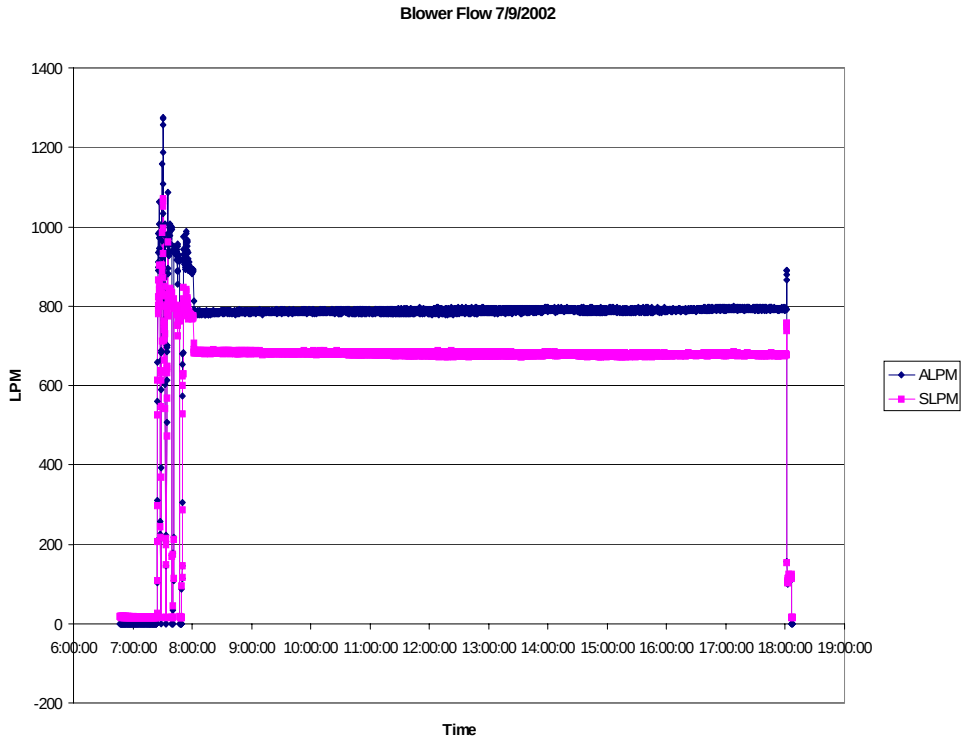

Figure 4-22. Blower flow, Test 1–Day 1, July 9, 2002, Campaign #2.

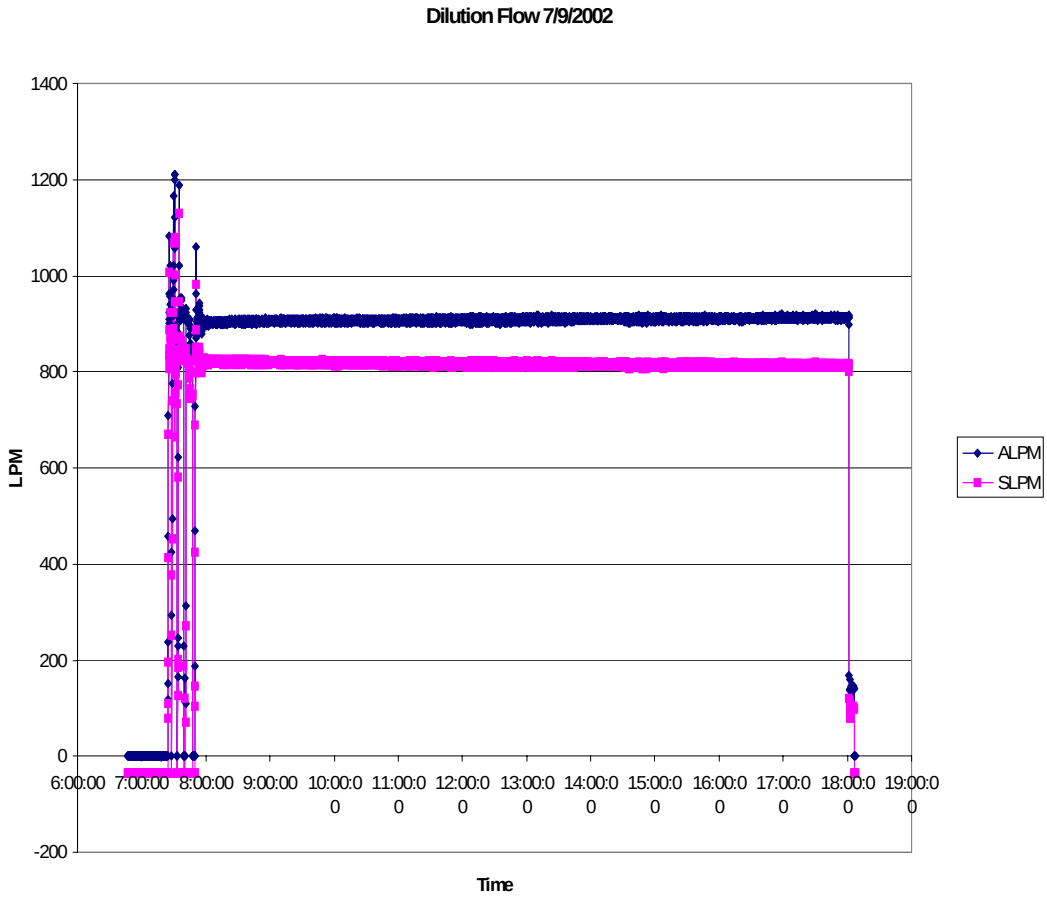

Figure 4-23. Dilution flow, Test 1–Day 1, July 9, 2002, Campaign #2.

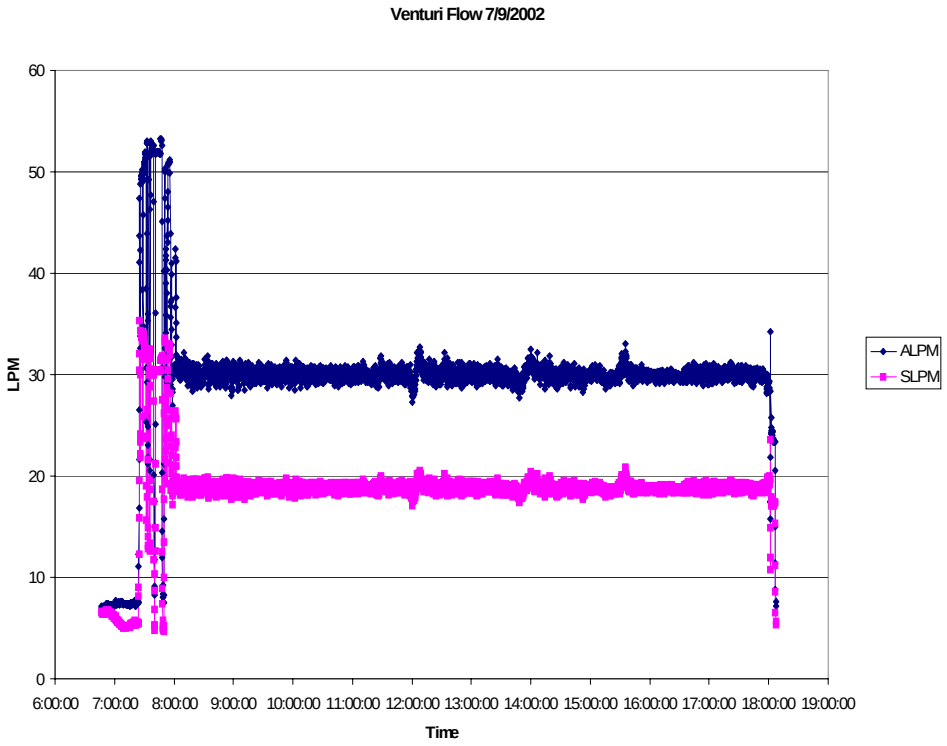

Figure 4-24. Venturi flow, Test 1–Day 1, July 9, 2002, Campaign #2.

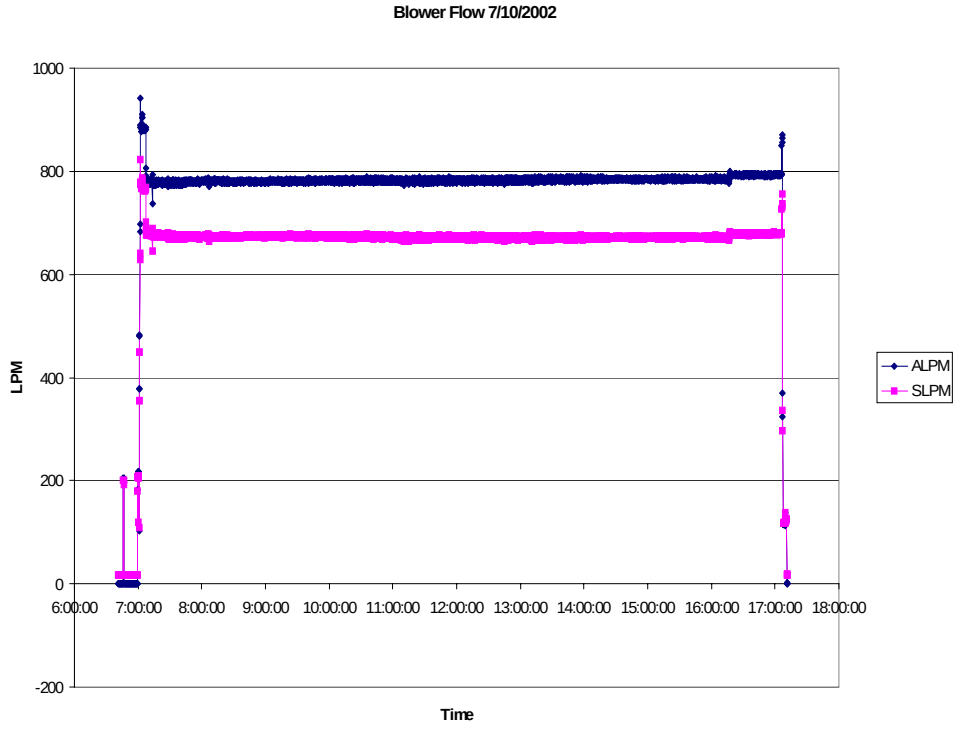

Figure 4-25. Blower flow, Test 2–Day 2, July 10, 2002, Campaign #2.

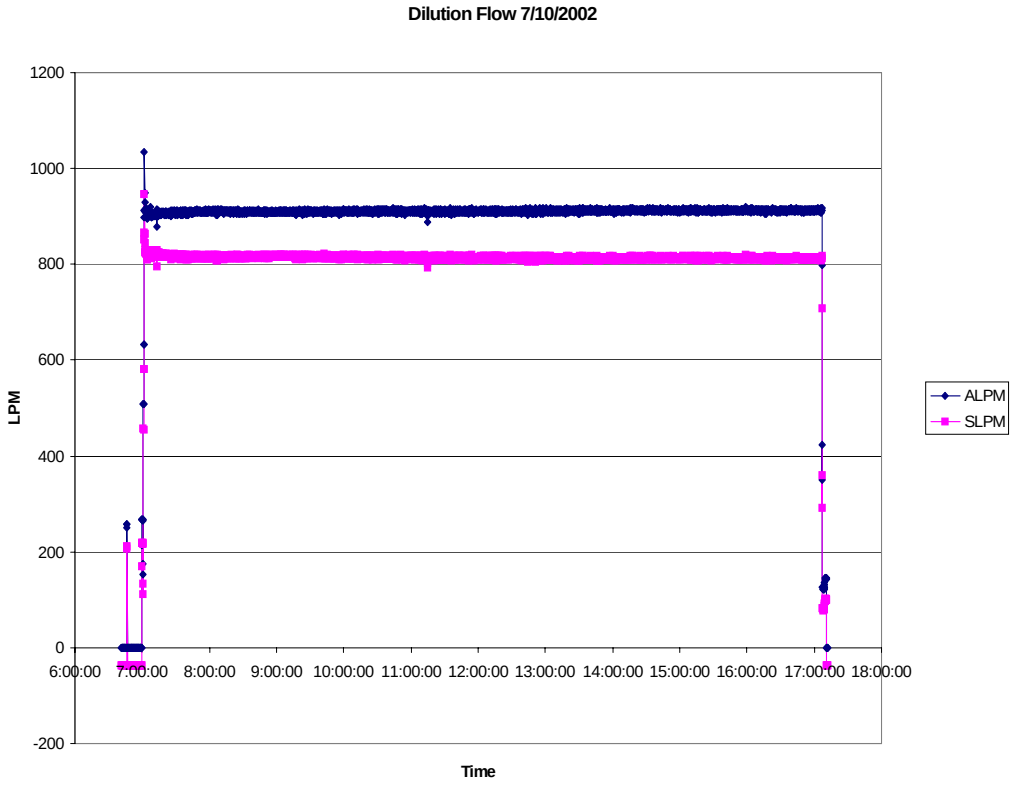

Figure 4-26. Dilution flow, Test 2–Day 2, July 10, 2002, Campaign #2.

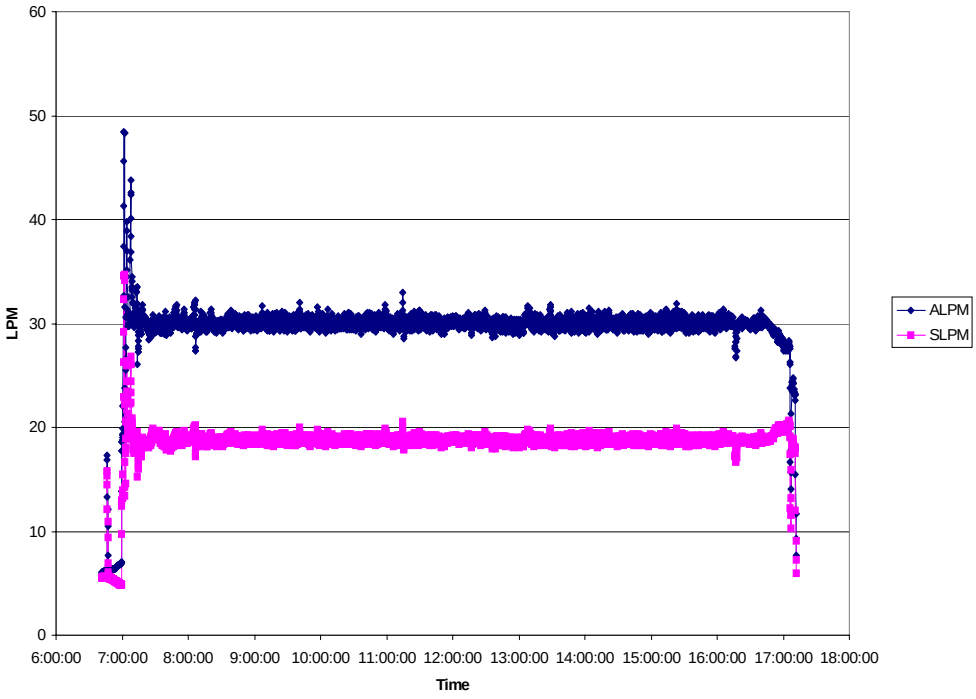

Figure 4-27. Venturi flow, Test 2–Day 2, July 10, 2002, Campaign #2.

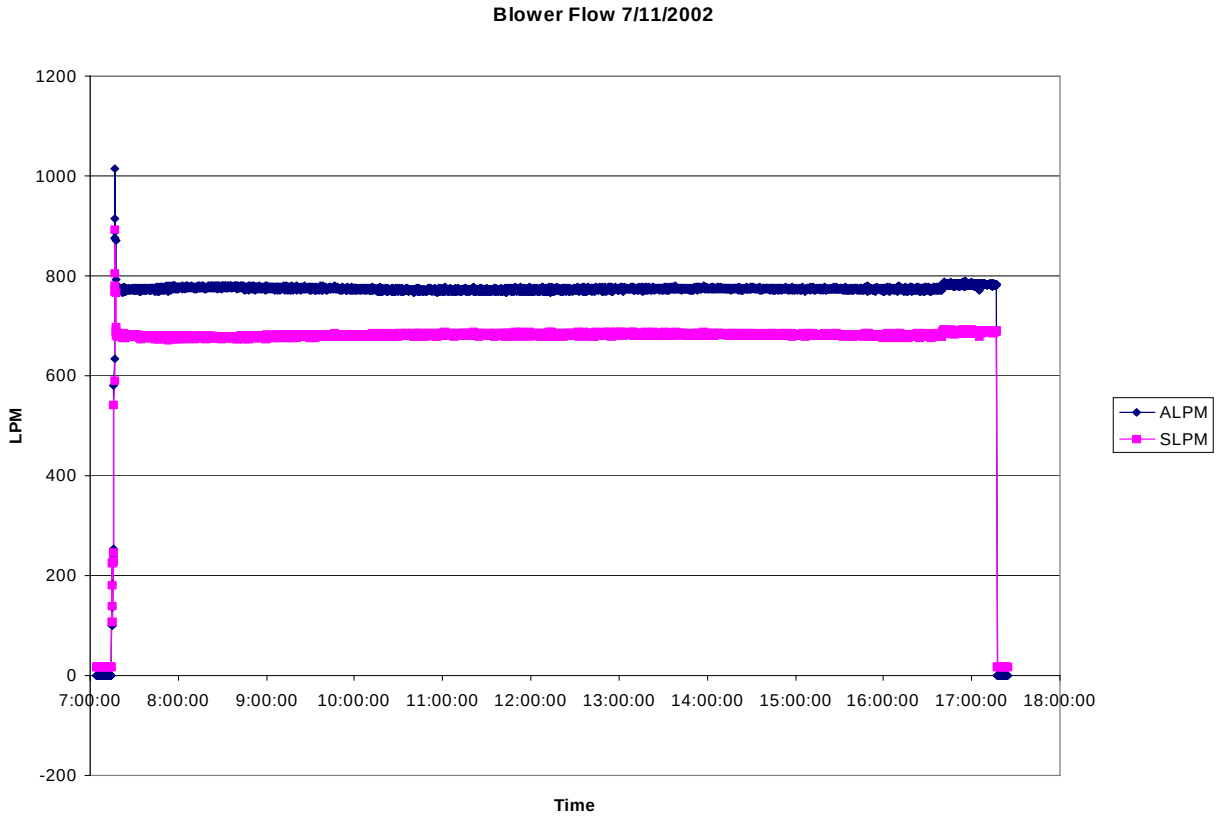

Figure 4-28. Blower flow, Test 3–Day 3, July 11, 2002, Campaign #2.

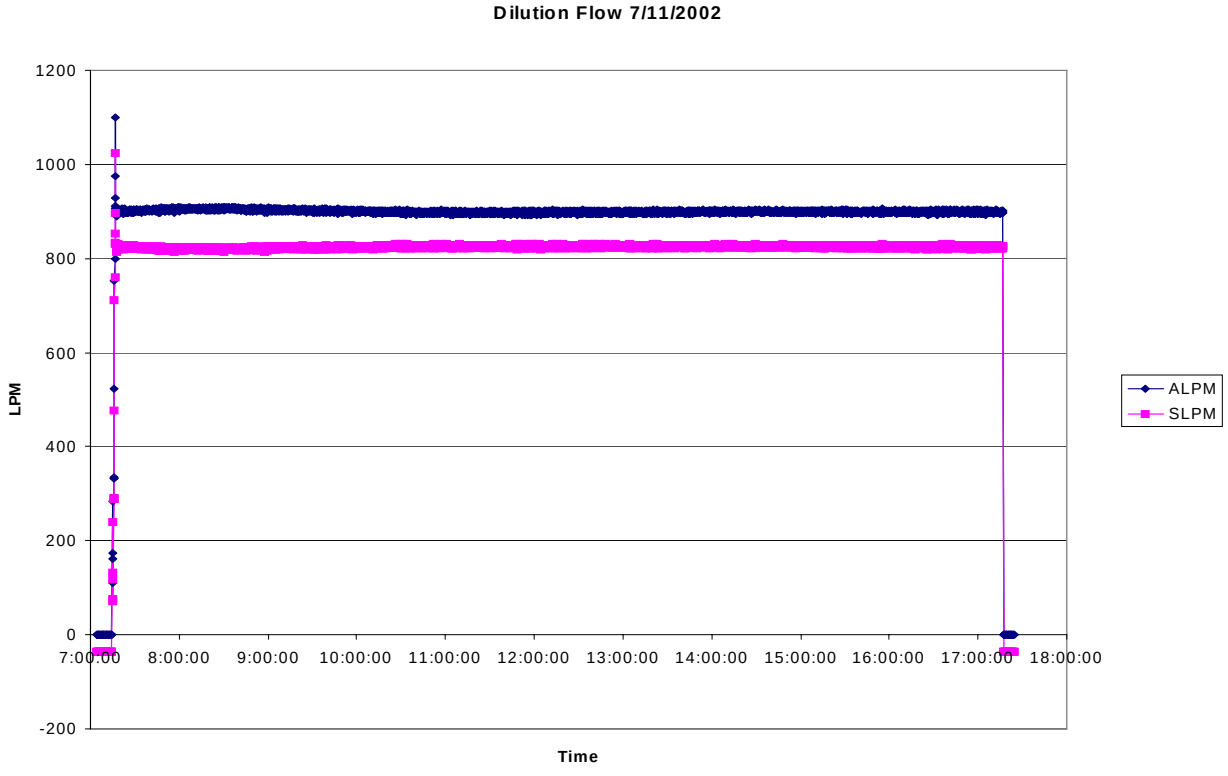

Figure 4-29. Dilution flow, Test 3–Day 3, July 11, 2002, Campaign #2.

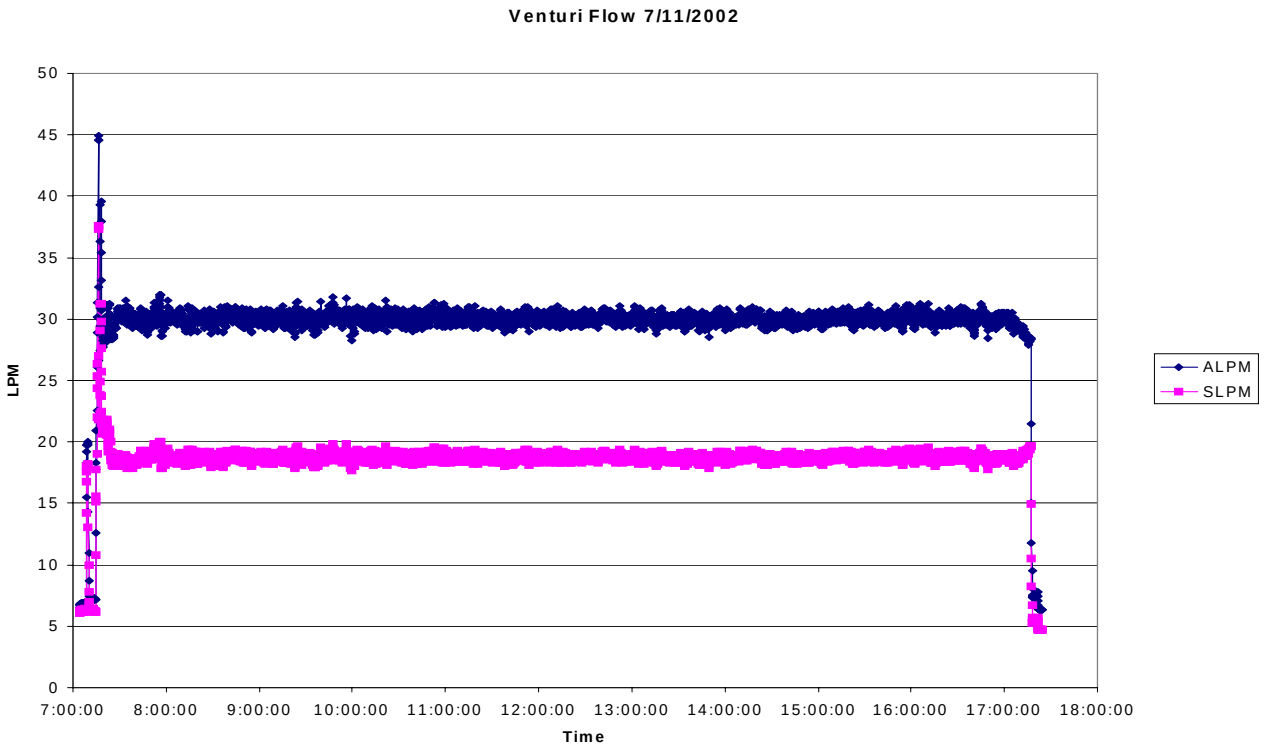

Figure 4-30. Venturi flow, Test 3–Day 3, July 11, 2002, Campaign #2.

In the sample recovery area, the sample collection arrays were disassembled into the following components:

- Polyurethane foam (PUF) modules were disassembled from the sample collection array as a module. Both ends of the PUF sampling module were capped, the module placed in a sealable plastic bag, the bag appropriately labeled, and chain of custody documentation initiated.

- Filters were positioned in specific filter holder assemblies as part of several of the sample collection arrays. In the sample recovery area, the filter holder assemblies were disassembled, and the filter was removed with Teflon tipped tweezers and placed in a pre-numbered custom filter container with a locking lid. The appropriate label was affixed to the filter container and chain of custody documentation initiated. The filter holder assembly was re-assembled without the filter, placed in a plastic bag, and labeled.

- Denuders were disassembled, the ends of the sorbent tube closed with Teflon caps and sealed with Teflon tape, the sealed denuder tubes placed in a plastic bag, labeled, and chain of custody documentation initiated.

- Carbonyl sampling tube assemblies were disassembled. The ends of the individual tubes were sealed with plastic caps, and the sealed tubes placed in an aluminum foil packet, labeled to preserve the front/back order from the sample collection array, placed in a plastic bag, labeled, and chain of custody documentation initiated.

- Canister sampling was terminated by closing the valve on the canister at the end of the sampling period. The canister with closed valve was disconnected from the dilution system and capped; chain of custody documentation was generated.

At a later time, extraction of the denuders was performed on-site. The denuders were rinsed with a mixture of methylene chloride: acetone: hexane in a volume ratio of 2:3:5. The solvent mixture was added to the denuder and the denuder tube was capped and shaken (four times). An internal standard was added to the first extraction. The rinses were combined in a pre-cleaned glass jar for paired denuders, the jar was labeled, sealed with Teflon tape, chain of custody documentation was initiated for the extract, and the jar was stored over ice. After extraction, the denuders and caps were dried using high-purity nitrogen and capped until ready for re-use.

Denuders, PUF modules, and filters were all bagged and stored on site in a chest freezer. Canisters and carbonyl tubes were transported to the ERG laboratory for analysis; the filters, PUF modules, and denuder extracts were transported to the EPA laboratory for analysis.

Chain of custody documentation for both test campaigns is supplied in Appendix E; field sample logs are presented in Appendix F.

Laboratory Experimental Methodology

The analytical methodology used in EPA and ERG laboratories to perform the analyses is summarized in Table 3-1.

Components of the sample collection arrays, filters, DNPH-impregnated silica gel tubes used to sample carbonyl compounds, and canisters used to sample volatile organic compounds were returned for analysis to EPA and ERG laboratories, respectively; the analyses described in the following sections were performed.

PM-2.5 Mass

Teflon membrane (Gelman Teflo) filters of 2-μm pore diameter were used to collect fine PM samples for mass determinations. Filters before and after sample collection were maintained at 20-23 °C and a relative humidity of 30-40% for a minimum of 24 hours prior to weighing on a micro-balance. Sample mass was determined by the difference in weight of a filter before and after sample collection.

Elemental Analysis

Individual elements above atomic number 9 (fluorine) were measured using a Philips 2404 wavelength-dispersive X-ray fluorescence (XRF) spectrometer running the UniQuant program. This program gives qualitative and quantitative information on the elements present on a Teflon membrane filter. The filter to be analyzed was covered with a 0.4-μm thick Prolene film, which was attached using glue. The glue was on only the outer rim of the filter and did not interfere

with the analysis. Only elements which gave amounts greater than one standard error above the detection limit were reported.

Water-Soluble Inorganic Ions

Teflon filter samples were analyzed for major inorganic anions and cations using a Dionex DX-120 ion chromatograph equipped with a 25-μL sample loop and a conductivity detector. Major ions determined were chloride, nitrate, sulfate, calcium, magnesium, potassium, and ammonium. Prior to extraction the filters were wetted with ethanol (350-500 μL). Two sequential extractions with HPLC grade water were performed using mild sonication of the filters followed by filtration of the extracts. The two extracts were combined for analysis.

Anions were separated using an Ion Pac AS14 (4 x 250 mm) column with an alkyl quaternary ammonium stationary phase and a carbonate-bicarbonate mobile phase. Cations were separated using an Ion Pac CS12 (4 x 250 mm) column with an 8-μm poly(ethylvinylbenzene-divinylbenzene) macroporous substrate resin functionalized with a relatively weak carboxylic acid stationary phase and a sulfuric acid mobile phase. Ion concentrations were determined from four-point calibration curves using an external standard method. All samples were extracted and analyzed in duplicate or triplicate.

Elemental Carbon/Organic Carbon

Elemental carbon (EC) and organic carbon (OC) content of PM samples collected on pre-fired quartz filters was determined by NIOSH Method 5040[10] using a Sunset Laboratory instrument with a 30-m, 0.32-mm I.D. Rtx - 5MS (Crossbond 5% diphenyl - 95% dimethyl polysilorane) capillary column, with a 1 μm film thickness. In this method, a 1.0- x 1.5-cm punch of the quartz filter sample is placed in the instrument, and organic and carbonate carbon are evolved in a helium atmosphere as the temperature is raised to 850 °C. Evolved carbon is catalytically oxidized to CO_2 in a bed of granular MnO_2, then reduced to methane in a methanator. Methane is subsequently quantified by a flame ionization detector (FID). In a second stage, the sample oven temperature is reduced, an oxygen-helium mixture is introduced, and the temperature is increased to 940 °C. With the introduction of oxygen, pyrolytically generated

carbon is oxidized and an increase in the transmittance of a laser light beam through the filter occurs. The point at which the filter transmittance reaches its initial value is defined as the split between OC and EC. Carbon evolved prior to the split is considered OC (including carbonate), and carbon volatilized after the split is considered elemental (EC). Elemental carbon evolved is similarly oxidized to CO_2 and subsequently reduced to methane to be measured by the FID.

Organic Compounds

Individual organic compounds present in the fine PM collected on pre-fired quartz filters were determined by extracting the filters with hexane (two extractions) followed with a 2:1 mixture of benzene and isopropanol (three extractions). Prior to extraction, the filters were composited as necessary to achieve a total of approximately 0.5 mg of OC and spiked with a mixture of isotropically labeled (deuterated) internal recovery standards. These standards were selected to represent the range of expected solubilities, stabilities, chromatographic retention times, and volatilities of organic compounds present in the samples. All extracts from the five extraction steps were combined and concentrated using an automated nitrogen blowdown apparatus.

An aliquot of the combined extract was derivatized with diazomethane to yield methyl esters of any fatty acids which might be present. After the methylation reaction was complete, the methylated extract aliquot was reconcentrated by nitrogen blowdown. A separate portion of the methylated extract was derivatized a second time using Sylon BFT reagent to convert compounds such as levoglucosan and cholesterol to their trimethylsilyl (TMS) derivatives. Both derivatizations were performed in order to allow the compounds to be separated and eluted from a gas chromatograph column. Since the TMS derivatives are somewhat unstable over time, the silylation was carried out just prior to analysis.

Gas chromatography coupled with a mass spectrometer detector (GC/MS) was used to identify and quantify the individual organic compounds present in the extracts. A Hewlett-Packard 6890 GC equipped with an HP 5973 mass spectrometer detector was used. A 5MS column (30-m, 0.25-mm diameter, 0.25-μm film thickness) was employed along with an injector temperature of 65 °C and a GC/MS interface temperature of 300 °C. The initial GC oven

temperature was set at 65 °C with an initial hold time of 10 min. The oven temperature was then ramped upward at 10 °C/min to 300 °C and held at the upper temperature for an additional 41.5 minutes. Helium was used as the carrier gas (1 mL/min), and the GC was operated in the split/splitless mode.

Positive identification of target compounds was obtained by comparing mass spectra of the analytes with those obtained from over 100 authentic compound standards. Iso- and anteiso-alkanes were identified using secondary standards derived from paraffin candle wax. Additional compounds were identified as "probable" based on a comparison of the GC retention times and mass spectra with commercially available spectral libraries. Quantification of the individual compounds involved referencing each compound against one or more of the deuterated internal standards spiked into the sample to correct for losses of the analytes which may have occurred in the compositing, extracting, concentrating, and derivatizing steps. An extensive set of standards of target compounds at known concentrations which also included the deuterated internal standard compounds was used to establish 3-point or 5-point calibration curves from which the concentrations of the analytes were determined.

Carbonyl Compounds

Carbonyl compounds were sampled and analyzed in campaign #1 only. Sep-Pak chromatographic-grade silica gel cartridges impregnated with DNPH were used in series for carbonyl sample collection; the tubes were used in series to check for compound breakthrough. Following sample collection in the field, the cartridges and accompanying chain of custody documentation were transported to the ERG laboratory, where they were logged into the laboratory sample tracking system. The cartridges were extracted and analyzed for the compounds listed in Table 4-12 using a modified version of EPA Compendium Method TO-11A[11], "Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC)". The analytical instrument was a Varian 5000 High Performance Liquid Chromatograph (HPLC) with a multiwavelength detector operated at 360 nanometers (nm). The HPLC was configured with a 25-cm, 4.6-mm I.D., C18 silica

Table 4-12. Carbonyl Compounds Analyzed by High Performance Liquid Chromatography

Compound	CAS No.
Formaldehyde	50-00-0
Acetaldehyde	75-07-0
Acetone	67-64-1
Propionaldehyde	123-38-6
Crotonaldehyde	4170-30-3
Butyraldehyde	123-72-8
Benzaldehyde	100-52-7
Isovalderaldehyde	590-86-3
Valeraldehyde	110-62-3
o-Tolualdehyde	529-20-4
m-Tolualdehyde	620-23-5
p-Tolualdehyde	104-87-0
Hexaldehyde	66-25-1
2,5-Dimethylbenzaldehyde	5779-94-2
Diacetyl	432-03-8
Methacrolein	78-85-3
2-Butanone	78-93-3
Glyoxal	107-22-2
Acetophenone	98-86-2
Methylglyoxal	78-98-8
Octanal	124-13-0
Nonanal	124-19-6

analytical column with a 5-micron particle size. Twenty-five (25) µL aliquots were injected into the HPLC with an automatic sample injector.

The chromatography data acquisition system was used to retrieve data from the HPLC; data were processed and peak identifications were made using retention times and relative retention times determined by analysis of analytical standards. After peak identifications were made, the concentration of each target analyte was determined using individual response factors for the carbonyl compounds.

Daily calibration checks were performed to ensure that the analytical procedures were in control. Daily quality control checks were performed after every ten samples on the days that

samples were analyzed, with compound responses within ±15% relative to the responses from the current calibration curve. Compound retention time drifts were also measured from the analysis of the quality control check sample and tracked to ensure that the HPLC was operating within acceptable parameters.

As part of the daily quality control check, if the analysis of the daily quality control sample was not acceptable, a second injection of the quality control standard was performed. If the second quality control check did not meet acceptance criteria or if more than one daily quality control check did not meet acceptance criteria, a new calibration curve (at five concentration levels) was analyzed. All samples analyzed with the unacceptable quality control checks would be re-analyzed.

An acetonitrile system blank was analyzed after the daily calibration check and before sample analysis. The system was considered in control if target analyte concentrations were less than the current method detection limits.

Canister Analyses: Air Toxics and Speciated Nonmethane Organic Compounds

Canister sampling and analysis were performed for campaign #1 only. The combined analysis[12,13] for air toxics and speciated nonmethane organic compounds was performed on a gas chromatograph(GC)/flame ionization detector(FID)/mass selective detector (MSD), using a Hewlett-Packard 5971 MSD and a Hewlett-Packard 5890 Series II GC with a 60-m by 0.32-mm i.d. and a 1 μm film thickness J&W DB-1 capillary column followed by a 2:1 splitter to send the larger portion of the column effluent to the MSD and the smaller fraction to the FID. The chromatograph oven containing the DB-1 capillary column was cooled to -50 °C with liquid nitrogen at the beginning of the sample injection. This temperature was held for five minutes and then increased at the rate of 15 °C per minute up to 0 °C. The oven temperature was then ramped at 6 °C/minute to 150 °C, then ramped at 20 °C/minute to 225 °C and held for 8 min. The gas eluting from the DB-1 capillary column passed through the 2:1 fixed splitter to divide the flow between the MSD and the FID.

The air toxics analysis was performed according to the procedures of EPA Compendium Method TO-15, "Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canister and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)" for the compounds shown in Table 4-13. The analysis of SNMOC was performed according to the procedures of "Technical Assistance Document for Sampling and Analysis of Ozone Precursors[13] " for the compounds shown in Table 4-14. Detection limits for air toxics and for the speciated nonmethane organic compounds are shown in Appendix C. Method detection limits were determined according to the Federal Register procedure.[14]

Particle Size Distribution Data

The SMPS was operated and collected data during both test days. Data were reduced using the TSI software package.

Table 4-13. Air Toxics Compounds Determined by Analytical Method TO-15

Compound	CAS No.
Acetylene	74-86-2
Propylene	115-07-1
Dichlorodifluoromethane	75-71-8
Chloromethane	74-87-3
Dichlorotetrafluoroethane	1320-37-2
Vinyl chloride	75-01-4
1,3-Butadiene	106-99-0
Bromomethane	74-83-9
Chloroethane	75-00-3
Acetonitrile	75-05-8
Acetone	67-64-1
Trichlorofluoromethane	75-69-4
Acrylonitrile	107-13-1
1,1-Dichloroethene	75-35-4
Methylene chloride	75-09-2
Trichlorotrifluoroethane	26523-64-8
trans-1,2-Dichloroethylene	56-60-5
1,1-Dichloroethane	75-34-3
Methyl *tert*-butyl ether	1634-04-1
Methyl ethyl ketone	78-93-3
Chloroprene	126-99-8
cis-1,3-Dichloroethylene	156-59-2
Bromochloromethane	74-97-5
Chloroform	67-66-3
Ethyl *tert*-butyl ether	637-92-3
1,2-Dichloroethane	107-06-2
1,1,1-Trichloroethane	71-55-6
Benzene	71-43-2
Carbon tetrachloride	56-23-5
tert-Amyl methyl ether	994-05-8
1,2-Dichloropropane	78-87-5
Ethyl acrylate	140-88-5
Bromodichloromethane	75-27-4
Trichloroethylene	79-01-6
Methyl methacrylate	80-62-6
cis-1,2-Dichloropropene	10061-01-5

Table 4-13. (Continued)

Compound	CAS No.
Methyl isobutyl ketone	108-10-1
trans-1,2-Dichloropropene	10061-02-6
1,1,2-Trichloroethane	79-00-5
Toluene	108-88-3
Dibromochloromethane	124-48-1
1,2-Dibromoethane	106-93-4
n-Octane	111-65-9
Tetrachloroethylene	127-18-4
Chlorobenzene	108-90-7
Ethylbenzene	100-41-4
m-, *p*-Xylene	108-38-3/106-42-3
Bromoform	75-25-2
Styrene	100-42-5
1,1,2,2-Tetrachloroethane	79-34-5
o-Xylene	95-47-6
1,3,5-Trimethylbenzene	108-67-8
1,2,4-Trimethylbenzene	95-63-6
m-Dichlorobenzene	541-73-1
Chloromethylbenzene	100-44-7
p-Dichlorobenzene	106-46-7
o-Dichlorobenzene	95-50-1
1,2,4-Trichlorobenzene	120-82-1
Hexachloro-1,3-butadiene	87-68-3

Table 4-14. Speciated Nonmethane Organic Compounds Determined According to the Procedures of EPA Research Operating Procedure "Research Protocol Method for Analysis of C_2-C_{12} Hydrocarbons in Ambient Air by Gas Chromatography with Cryogenic Concentration"

Compound	CAS No.
Ethylene	74-85-1
Acetylene	74-86-2
Ethane	74-84-0
Propylene	115-07-1
Propane	74-98-6
Propyne	74-99-7
Isobutane	75-28-5
Isobutene/1-butene	115-11-7/106-98-0
1,3-Butadiene	106-99-0
n-Butane	106-97-8
trans-2-Butene	624-64-6
cis-2-Butene	590-18-1
3-Methyl-1-butene	563-45-1
Isopentane	78-78-4
1-Pentene	109-67-1
2-Methyl-1-butene	563-46-2
n-Pentane	109-66-0
Isoprene	78-79-4
trans-2-Pentene	646-04-8
cis-2-Pentene	627-20-3
2-Methyl-2-butene	513-35-9
2,2-Dimethylbutane	75-83-2
Cyclopentene	142-29-0
4-Methyl-1-pentene	691-37-2
Cyclopentane	287-92-3
2,3-Dimethylbutane	79-29-8
2-Methylpentane	107-83-5
3-Methylpentane	96-14-0
2-Methyl-1-pentene	763-29-1
1-Hexene	592-41-6
2-Ethyl-1-butene	760-21-4
n-Hexane	110-54-3
trans-2-Hexene	4050-45-7
cis-2-Hexene	7688-21-3
Methylcyclopentane	96-37-7

Table 4-14. (Continued)

Compound	CAS No.
2,4-Dimethylpentane	108-08-7
Benzene	71-43-2
Cyclohexane	110-82-7
2-Methylhexane	591-76-4
2,3-Dimethylpentane	565-59-3
3-Methylhexane	589-34-4
1-Heptene	592-76-7
2,2,4-Trimethylpentane	540-84-1
n-Heptane	142-82-5
Methylcyclohexane	108-87-2
2,2,3-Trimethylpentane	564-02-3
2,3,4-Trimethylpentane	565-75-3
Toluene	108-88-3
2-Methylheptane	592-27-8
3-Methylheptane	589-81-1
1-Octene	111-66-0
n-Octane	111-65-9
Ethylbenzene	100-41-4
m-, *p*-Xylene	108-38-3/106-42-3
Styrene	100-42-5
o-Xylene	95-47-6
1-Nonene	124-11-8
n-Nonane	111-84-2
Isopropylbenzene	98-82-8
α-Pinene	80-56-8
n-Propylbenzene	103-65-1
m-Ethyltoluene	620-14-4
p-Ethyltoluene	622-96-8
1,3,5-Trimethylbenzene	108-67-8
o-Ethyltoluene	611-14-3
β-Pinene	127-91-3
1,2,4-Trimethylbenzene	95-63-6
1-Decene	872-05-9
n-Decane	124-18-5
1,2,3-Trimethylbenzene	526-73-8
m-Diethylbenzene	141-93-5

Table 4-14. (Continued)

Compound	CAS No.
p-Diethylbenzene	105-05-5
1-Undecene	821-95-4
n-Undecane	1120-21-4
1-Dodecene	112-41-4
n-Dodecane	112-40-3
1-Tridecene	2437-56-1
n-Tridecane	629-50-5

Section 5
Results and Discussion

Analyses for each campaign were performed in either the EPA or ERG laboratories as shown in Table 3-1, using the analytical procedures described in Section 4. Results of these analyses are discussed in this section.

PM Mass, Elemental/Organic Carbon, Major Inorganic Ions, and Major Elements

Emissions of PM mass, elemental/organic carbon (EC/OC), major elements, and major inorganic ions as components of the fine particulate matter are reported in Table 5-1 both as weight percent and as mass fraction of measured PM-2.5 mass. Results reported in Table 5-1 show the following:

- The PM-2.5 mass emission factor was fairly consistent throughout both test campaigns with the exception of one day during campaign #2 (7/11/02) for which the emission factor was nearly 5 times higher than the average of the other 5 test days. Excluding the single day of markedly higher emissions, the average PM-2.5 mass emission factor was 36.4 mg per kg of fuel (0.81 μg/kJ) with a range of 26.9 to 42.7 mg/kg (0.60 - 0.96 μg/kJ). The single day of substantially higher PM-2.5 emissions gave an emission factor of 178.0 mg per kg of fuel (3.99 μg/kJ). No unusual event on that day was identified to explain the higher PM-2.5 emissions for that test. However, during campaign #2 (which occurred in July) the boiler was operated at very low load where combustion conditions are difficult to maintain. Under such conditions, erratic behavior in boiler operation and emissions may occur.

- Although the PM-2.5 mass emission factor was fairly consistent for both test campaigns, the composition of the PM-2.5 was very different for the two campaigns. Sulfate comprised 45.5 to 58.0% by mass of the PM-2.5 emitted during campaign #1, but accounted for only 3.5 to 10.8% of the PM-2.5 mass during campaign #2.

Table 5-1. Summary of Oil-Fired Institutional Boiler Results

Parameter	Campaign #1 (1/01)			Campaign #2 (7/02)		
	Test #1	Test #2	Test #3	Test #1	Test #2	Test #3
Fuel Feed Rate (kg/min)	10.94	11.55	13.21	7.40	7.43	7.43
Fuel Carbon[a] (wt %)	85.93	85.93	85.93	86.53	86.53	86.53
Fuel Sulfur[a] (wt %)	0.09	0.09	0.09	0.05	0.05	0.05
Flue Gas Composition						
Flue Gas O_2 (volume %, wet)	4.8	5.3	5.5	8.1	9.0	8.9
Flue Gas CO_2 (volume %, wet)	16.2	15.7	15.5	11.0	10.7	10.4
Flue Gas CO (volume %, wet)	0.03	0.03	0.03	0.0	0.03	0.03
Flue Gas O_2 (volume %, dry)	5.4	6.0	6.2	10.2	10.1	9.1
Flue Gas CO_2 (volume %, dry)	18.2	17.6	17.4	12.1	11.8	11.2
Flue Gas CO (volume %, dry)	0.034	0.034	0.034	0.0	0.034	0.034
Flue Gas N_2 (volume %, dry)	76.4	76.4	76.4	77.6	78.1	79.7
Excess Air (%)	36.1	41.4	43.6	97.6	94.4	74.8
PM-2.5 Emission Factor (mg/kg fuel)	26.86 ± 3.44	32.09 ± 1.89	39.77 ± 0.88	40.36 ± 1.27	42.67 ± 2.51	178.02 ± 2.51

Table 5-1. (Continued)

Mean PM-2.5 Emission Factor (mg/kg fuel) 32.91 ± 5.93				**Mean PM-2.5 Emission Factor (mg/kg fuel) 87.02 ± 67.3**		
PM-2.5 Composition (wt %)						
Elemental Carbon	1.8	10.5	34.0	5.8 ± 1.4	3.1 ± 0.7	1.6 ± 0.2
Mean Elemental Carbon 15.4 ± 16.6 wt %				Mean Elemental Carbon 4.0 ± 2.2 wt %		
Organic Carbon	0	0.5	0	43.3 ± 5.9	45.7 ± 12.0	63.1 ± 4.3
Mean Organic Carbon 0.17 ± 0.29 wt %				Mean Organic Carbon 50.7 ± 10.1 wt %		
Sulfate	58.0 ± 6.1	56.9 ± 5.3	45.5 ± 4.2	6.8 ± 0.2	10.7 ± 0.1	3.5 ± 0.0
Mean Sulfate 53.5 ± 7.4 wt %				Mean Sulfate wt %		
Ammonium	NQ	NQ	NQ	2.0 ± 0.2	2.6 ± 0.1	0.46 ± 0.0
Mean Ammonium NQ				Mean Ammonium 1.7 ± 1.0 wt %		
Sulfur	5.2 ± 2.2	3.4 ± 0.2	8.3 ± 6.0	2.7 ± 0.2	3.7 ± 0.1	1.3 ± 0.1
Mean Sulfur 5.6 ± 3.6				Mean Sulfur 2.6 ± 1.1 wt %		
Silicon	NQ	NQ	NQ	0.89 ± 0.10	0.75 ± 0.10	0.24 ± 0.00
Mean Silicon NQ				Mean Silicon 0.63 ± 0.31 wt %		
PM-2.5 Composition (mass fraction)						
Elemental Carbon	0.018	0.105	0.34	0.066	0.038	0.017
Mean Elemental Carbon 0.15 ± 0.17 mass fraction				Mean Elemental Carbon 0.040 ± 0.025 mass fraction		
Organic Carbon	0	0.005	0	0.433	0.452	0.631
Mean Organic Carbon 0.0017 ± 0.0029 mass fraction				Mean Organic Carbon 0.505 ± 0.109		

Table 5-1. (Continued)

PM-2.5 Composition (mass fraction)						
Sulfate	0.58 ± 0.061	0.569 ± 0.053	0.455 ± 0.042	0.068 ± 0.002	0.107 ± 0.001	0.035 ± 0.000
Mean Sulfate 0.535 ± 0.069 mass fraction				Mean Sulfate 0.070 ± 0.036 mass fraction		
Ammonium	NQ	NQ	NQ	0.02 ± 0.002	0.026 ± 0.001	0.046 ± 0.000
Mean Ammonium NQ				Mean Ammonium 0.017 ± 0.011 mass fraction		
Sulfur	0.052 ± 0.022	0.034 ± 0.002	0.083 ± 0.063	0.027 ± 0.002	0.037 ± 0.001	0.013 ± 0.001
Mean Sulfur 0.056 ± 0.025 mass fraction				Mean Sulfur 0.026 ± 0.012 mass fraction		
Silicon	NQ	NQ	NQ	0.0089 ± 0.0010	0.0075 ± 0.0000	0.0024 ± 0.0000
Mean Silicon NQ				Mean Silicon 0.0063 ± 0.0034 mass fraction		

[a] Fuel was sampled one time per campaign and the results applied to all the test runs in each of the two campaigns.
NQ = Below quantitation limit.

- Conversely, there was much more carbon in the PM-2.5 emitted during campaign #2, most of which was organic carbon (43.3 to 63.1% of the PM-2.5 mass). The organic carbon (OC) content of the fine PM was highest for Test Day #3 of campaign #2 (7/11/02), for which the PM-2.5 emission factor was also the highest of all tests.

- Two factors may have contributed to the marked difference in PM composition. The sulfur content of the fuel oil was 1.8 times higher during the campaign #1 test series than during the campaign #2 tests (0.09 vs 0.05 wt %, respectively). This factor could have contributed to a higher sulfate content in the campaign #1 tests. In the campaign #2 tests, the fuel feed rate averaged 37.6% lower than in the campaign #1 tests and the excess oxygen levels were much higher (campaign #2 = 15.7 to 20.5%; campaign #1 = 7.6 to 9.2% excess oxygen). During the campaign #1 tests, the boiler was fired at 37 - 42% of its rated capacity, while during the campaign #2 tests, the boiler was fired at only 25% capacity. A lower combustion efficiency associated with the low combustion load during the summertime is likely responsible for the PM emissions being enriched in organic carbon.

Supporting data for Table 5-1 are found in the following appendices:

- Appendix J, Data Tables for Individual PM-2.5 Mass Measurements, Both Campaigns;

- Appendix K, Data Tables for PM-2.5 Mass Emission Factors, Both Campaigns;

- Appendix L, Data Tables for Individual PM-2.5 EC/OC Samples, Both Campaigns;

- Appendix M, Data Tables for Individual PM-2.5 Elemental Samples, Both Campaigns; and

- Appendix N, Data Tables for Individual PM-2.5 Inorganic Ion Samples, Both Campaigns.

General Equation for Uncertainty

If a result, R, is calculated from a set of measurements, x_1, x_2, …, x_n, it can be expressed as:

$$R = R(x_1, x_2, \ldots x_n) \qquad (5\text{-}1)$$

The uncertainty in the calculated result, w_R, is given as:

$$w_R = \left[\left(\frac{\partial R}{\partial x_1} w_1\right)\right]^2 + \left[\left(\frac{\partial R}{\partial x_2} w_2\right)^2 + \ldots + \left(\frac{\partial R}{\partial x_n} w_n\right)^2\right]^{\frac{1}{2}} \quad (5\text{-}2)$$

where w_1, w_2, and w_3 are the uncertainties in each of the respective measurements.

Uncertainty in PM Mass Emission Factor Estimation

The three-day average emission factor, E_a, is calculated by:

$$E_a = \frac{E_1 + E_2 + E_3}{3} \quad (5\text{-}3)$$

where E_1, E_2, and E_3 are the emission factors for Day-1, Day-2, and Day-3, respectively. Thus, the uncertainty in E_R can be obtained as:

$$\begin{aligned} w_R &= \left[\left(\frac{\partial E_a}{\partial E_1} w_1\right)\right]^2 + \left[\left(\frac{\partial E_a}{\partial E_2} w_2\right)^2 + \left(\frac{\partial E_a}{\partial E_3} w_3\right)^2\right]^{\frac{1}{2}} \\ &= \left[\left(\frac{1}{3} w_1\right)\right]^2 + \left[\left(\frac{1}{3} w_2\right)^2 + \left(\frac{1}{3} w_3\right)^2\right]^{\frac{1}{2}} \end{aligned} \quad (5\text{-}4)$$

where w_1, w_2, w_3 are the uncertainties in PM emission factors for Day-1, Day-2, and Day-3, respectively. In this report the values for uncertainties w_1, w_2, and w_3 are taken to be the standard deviations (S_1, S_2, and S_3) for the daily emission factor averages.

Uncertainty in PM-2.5 Organic Carbon Concentration

The OC concentration in PM-2.5 is given by:

$$OC = \frac{C_f - C_b - C_d}{C_p} \times 100\% \qquad (5\text{-}5)$$

where C_f, C_b, and C_d represent the daily average OC concentrations on the primary (front) quartz filters (QF), backup QFs, and dilution chamber QF, and C_p represents the daily average PM concentrations on the Teflon filters (TF). These concentrations are obtained by dividing the sample mass by the volume of flow in the sampling array. The uncertainty in the day-average OC concentration in the PM is then derived as:

$$\begin{aligned} w_R &= \left[\left(\frac{\partial C}{\partial C_f} w_f \right) \right]^2 + \left[\left(\frac{\partial C}{\partial C_b} w_b \right)^2 + \left(\frac{\partial C}{\partial C_p} w_p \right)^2 \right]^{\frac{1}{2}} \\ &= \left[\left(\frac{w_f}{C_p} \right)^2 + \left(\frac{w_b}{C_p} \right)^2 + \left(\frac{C_f - C_b - C_d}{C^2{}_p} w_p \right)^2 \right]^{\frac{1}{2}} \end{aligned} \qquad (5\text{-}6)$$

where wf, wb, and wp represent the uncertainties in day-average OC concentrations in the front QF, backup QF, and day-average PM concentration. These uncertainties are taken to be the standard deviations (S_f, S_b, and S_p) of the respective daily averages. There was no standard deviation associated with the OC concentration for the dilution air sample because of only one QF and one TF was used to sample the dilution air each day.

The uncertainty for the three-day average of OC concentration is calculated using the same equation as for three-day average PM emission factor.

Uncertainty in Gas-Phase Semivolatile Organic Species Emission Factors

Uncertainties of three-day averages of emission factors for gas-phase semivolatile organic species analyzed on the PUF samples were calculated using an equation in the same form as that for the three-day average PM emission factor (Equation 4).

Since the QF samples were composited for each day of the first two days, the average and standard deviation of the first two days was first calculated. The three-day average is then given by:

$$E_a = \frac{E_{1+2} + E_3}{2} \tag{5-7}$$

where E_{1+2} is the average emission factor for the first two days. The uncertainty for the three-day average is calculated as:

$$\begin{aligned} w_R &= \left[\left(\frac{\partial E_a}{\partial E_{1+2}} w_{1+2} \right)^2 + \left(\frac{\partial E_a}{\partial E_3} w_3 \right)^2 \right]^{\frac{1}{2}} \\ &= \left[\left(\frac{1}{3} w_{1+2} \right) \right]^2 + \left[\left(\frac{1}{3} w_2 \right)^2 \right]^{\frac{1}{2}} \end{aligned} \tag{5-8}$$

where w_{1+2} and w_3 are the standard deviations for the first two days and for the third day, respectively.

Uncertainty in PM-2.5 Elemental and Ion Concentrations

Element and inorganic ion concentrations in the PM-2.5 for each test day are reported as averages of replicate samples taken on each test day. Uncertainties reported for these averages represent the standard deviation of the replicate sample analyses.

Speciated Gas- and Particle-Phase Organic Compounds

Semivolatile organic compounds were not determined during campaign #1 because the gas-phase semivolatiles exceeded the collection capacity of the XAD-coated denuders and the PUF plugs. Sampling for ten hours in an attempt to maximize collection of PM for organic compound analysis resulted in overloading the denuders and PUF plugs so that an undetermined quantity of gas-phase material was allowed to escape collection and analysis.

For campaign #2, fine PM samples collected on quartz filters and gas-phase semivolatile organic compounds collected on PUF plugs and organic denuders were extracted from the collection media with a solvent system consisting of benzene:hexane:isopropanol (for filter samples) or dichloromethane:hexane:acetone (for PUFs and denuders) followed by GC/MS analysis of the extracts. Table 5-2 lists those organic compounds which were positively identified above detection limits and above the amounts found in the cleaned dilution air in the fine PM, all of which are relatively high molecular weight hydrocarbons. Compositing the quartz filters was necessary in order to achieve even the results reported; the compositing scheme for the quartz filters is presented in the Sample log in Appendix F. All PUF plug pairs were analyzed individually; none were composited. Emission factors for the gas-phase semivolatiles from the oil-fired industrial boiler are shown in Table 5-2, together with the calculated uncertainty. Particle-phase semivolatiles expressed as mass fractions are shown in Table 5-3, and as emission factors, in Table 5-4.

Most of the speciated and quantified organic carbon associated with the fine PM was made up of the C_{16} through C_{31} *n*-alkanes (63.8 wt.% of the speciated PM organics). *n*-Tetracosane (C_{24}) was the single most prominent *n*-alkane with the other C_{16}-C_{31} species in a near-Gaussian distribution by carbon number around C_{24}. Benzene di- and tri-carboxylic acids

comprised the second largest category of organic constituents found in the fine PM (21.4 wt % of the quantified species). Polynucleararomatic hydrocarbons (PAHs) and *n*-alkanoic acids made up most of the remaining 14.8% of the quantified and speciated particle phase organic compounds. The benzene di- and tri-carboxylic acids and chrysene were the only semivolatile organic species confined to the particle-phase. All of the other semivolatile species were found in both the gas and particle phases with the predominant amounts in the gas phase. The only two elements in the PM which were found at levels above method quantitation limits were silicon and sulfur.

Supporting data for the semivolatile organic compounds are found in the following appendices:

- Appendix O, Data Tables for Individual or Composited Particle-Phase (Quartz Filter) Semivolatile Organic Compound Samples; and
- Appendix P, Data Tables for Individual Gas-Phase (PUF) Semivolatile Organic Compound Samples.

Table 5-2. Gas Phase Semivolatiles: Emission Factors from an Institutional Oil-Fired Boiler (Campaign #2, July 2002)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
dimethyl phthalate	0.000	0.000
diethyl phthalate	0.076	0.031
naphthalene	0.667	0.167
2-methylnaphthalene	3.688	0.846
1-methylnaphthalene	2.526	0.530
2,7-dimethylnaphthalene	3.499	0.514
1,3-dimethylnaphthalene	2.561	0.580
2,6-dimethylnaphthalene	3.715	0.576
additional dimethylnaphthalenes	2.559	0.466
acenaphthylene	0.047	0.013
acenaphthene	0.066	0.086
fluorene	0.516	0.114
1-methylfluorene	0.857	0.281
additional methylfluorenes (peak 1)	0.960	0.326
additional methylfluorenes (peak 2)	0.274	0.096
phenanthrene	1.258	0.263
additional dimethylphenanthrenes	0.127	0.061
anthracene	0.127	0.253
methylanthracene - peak 1	1.188	0.473
methylanthracene - peak 2	1.702	0.431
methylanthracene - peak 3	0.843	0.222
methylanthracene - peak 4	0.672	0.156
octylcyclohexane	0.043	0.036
norpristane	3.219	1.593
decylcyclohexane	0.338	0.050
pristane	2.986	1.204
phytane	2.163	1.314
tridecylcyclohexane	0.040	0.070

Table 5-2. (Continued)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
dibutyl phthalate	0.140	0.070
butyl benzyl phthalate	0.078	0.078
bis(2-ethylhexyl) phthalate	0.063	0.034
dioctyl phthalate	0.074	ND
fluoranthene	0.065	0.041
pyrene	0.058	0.041
chrysene	0.002	0.002
benzo[a]anthracene	ND	ND
benzo[k]fluoranthene	ND	ND
benzo[b]fluoranthene		
benzo[a]pyrene		
nonadecylcyclohexane	0.002	0.003
squalane		
indeno[1,2,3-cd]pyrene		
dibenzo[a,h]anthracene		
benzo[ghi]perylene		
coronene		
cholestane - peak 1		
cholestane - peak 2		
cholestane - peak 3		
cholestane - peak 4		
ABB-2OR-24S-methylcholestane		
ABB-2OR-ethylcholestane		
17A(H)-22,29,30-*tris*(norhopane)		
17(B)-21A(H)-norhopane		
17B(H)-21B(H)-hopane		
17B(H)-21A(H)-hopane		
17A(H)-21B(H)-hopane		

Table 5-2. (Continued)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
n-decane (*n*-C10)		
n-undecane (*n*-C11)	0.014	0.011
n-dodecane (*n*-C12)	0.855	0.130
n-tridecane (*n*-C13)	0.686	0.054
9H-fluoren-9-one	0.127	0.028
n-tetradecane (*n*-C14)	2.405	0.539
n-pentadecane (*n*-C15)	6.089	1.963
n-hexadecane (*n*-C16)	8.948	2.201
n-heptadecane (*n*-C17)	7.787	2.854
1-octadecene	0.002	0.003
n-octadecane (*n*-C18)	4.242	2.384
2-methylnonadecane	0.000	0.000
3-methylnonadecane	0.000	0.000
n-nonadecane (*n*-C19)	3.331	2.032
n-eicosane (*n*-C20)	2.965	1.603
n-heneicosane (*n*-C21)	2.424	1.084
n-docosane (*n*-C22)	2.034	0.689
n-tricosane (*n*-C23)	1.959	0.504
iso-docosane (C22)		
anteiso-docosane (C22)		
pyrene	0.080	0.010
anthraquinone		
naphthalic anhydride		
methylfluoranthene		
retene		
cyclopenta[c,d]acepyrene		
benzanthraquinone		
1-methylchrysene		

Table 5-2. (Continued)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
n-tetracosane (*n*-C24	0.926	0.231
iso-tricosane (C23)		
anteiso-tricosane (C23)		
n-pentacosane (*n*-C25)	0.501	0.178
iso-tetracosane (C24)		
anteiso-tetracosane (C24)		
n-hexacosane (*n*-C26)	0.405	0.154
iso-pentacosane (C25)		
anteiso-pentacosane (C25)		
n-heptacosane (*n*-C27)	0.506	0.228
iso-hexacosane (C26)		
anteiso-hexacosane (C26)		
iso-heptacosane (C27)		
anteiso-heptacosane (C27)		
iso-octacosane (C28)		
anteiso-octacosane (C28)		
n-octacosane (*n*-C28)	0.609	0.303
n-nonacosane (*n*-C29)	0.483	0.238
iso-nonacosane (C29)		
anteiso-nonacosane (C29)		
squalene	0.273	0.382
indeno[1,2,3-cd]fluoranthene		
dibenzo[a,e]pyrene		
n-triacontane (*n*-C30)	1.641	0.823
n-hentriacontane (*n*-C31)	1.317	0.806
iso-triacontane (C30)		
anteiso-triacontane (C30)		
iso-hentriacontane (C31)		

Table 5-2. (Continued)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
anteiso-hentriacontane (C31)		
iso-dotriacontane (C32)		
anteiso-dotriacontane (C32)		
n-dotriacontane (*n*-C32)	0.693	0.249
n-tritriacontaine (*n*-C33)	0.438	0.212
n-tetratriacontaine (*n*-C34)	0.522	0.263
iso-tritriacontane (C33)		
anteiso-tritriacontane (C33)		
n-pentatriacontane (*n*-C35)		
n-hexatracontane (*n*-C36)	0.649	0.223
n-tetracontane (*n*-C40)	0.145	0.099
hexanoic acid	0.482	0.097
succinic acid	0.040	0.007
octanoic acid	0.522	0.096
glutaric acid	0.012	0.009
nonanoic acid	0.884	0.272
adipic acid	0.002	0.004
decanoic acid	0.412	0.061
undecanoic acid	0.544	0.148
pimelic acid		
suberic acid		
dodecanoic acid	0.366	0.127
azelaic acid	0.036	0.062
tridecanoic acid		
pinonic acid		
phthalic acid		
1,4-benzenedicarboxylic acid		
1,3-benzenedicarboxylic acid		

Table 5-2. (Continued)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
1,2-benzenedicarboxylic acid, 4-methyl		
1,2,4-benzenetricarboxylic acid		
benzenetetracarboxylic acid		
abietic acid		
pimaric acid		
sandaracopimaric acid		
isopimaric acid		
dehydroabietic acid		
sebacic acid		
tetradecanoic acid	0.366	0.251
pentadecanoic acid	0.239	0.169
palmitoleic acid	0.151	0.238
hexadecanoic acid	0.985	0.636
heptadecanoic acid	0.068	0.035
linoleic acid	0.030	0.018
oleic acid	0.070	0.103
linolenic acid	0.000	0.000
octadecanoic acid	0.525	0.226
nonadecanoic acid		
eicosanoic acid	0.021	0.008
docosanoic acid	0.021	0.011
tricosanoic acid		
tetracosanoic acid	0.054	0.027
pentacosanoic acid		
hexacosanoic acid		
heptacosanoic acid		
octacosanoic acid		
nonacosanoic acid		

Table 5-2. (Continued)

Compound	Emission Factor (mg/kg fuel)	Uncertainty (mg/kg fuel)
triacontanoic acid		
Total	**96.03**	**27.76**

Table 5-3. Particle-Phase Semivolatiles from an Institutional Oil-Fired Boiler: Mass Fractions (Campaign #2, July 2002)

Compound	Summer Campaign Average Mass Fraction	Uncertainty (%)
dimethyl phthalate	ND	ND
diethyl phthalate	0.00234	0.00082
naphthalene	ND	ND
2-methylnaphthalene	0.00128	0.00082
1-methylnaphthalene	0.00064	0.00036
2,7-dimethylnaphthalene	0.00146	0.00094
1,3-dimethylnaphthalene	0.00290	0.00162
2,6-dimethylnaphthalene	0.00140	0.00088
additional dimethylnaphthalenes		
acenaphthylene		
acenaphthene		
fluorene		
1-methylfluorene	0.00385	0.00069
additional methylfluorenes (peak 1)		
additional methylfluorenes (peak 2)		
phenanthrene	0.01509	0.00190
additional dimethylphenanthrenes	0.01376	0.00112
anthracene		
methylanthracene - peak 1	0.03651	0.00498
methylanthracene - peak 2	0.04635	0.00635
methylanthracene - peak 3	0.02841	0.00354
methylanthracene - peak 4	0.02411	0.00339
octylcyclohexane		
norpristane		
decylcyclohexane		
pristane	0.00702	0.00132

Table 5-3. (Continued)

Compound	Average Mass Fraction	Uncertainty (%)
phytane	0.02373	0.00490
tridecylcyclohexane	0.01745	0.00187
dibutyl phthalate	0.00848	0.00876
butyl benzyl phthalate	0.01038	0.00887
bis(2-ethylhexyl) phthalate	0.04065	0.03904
dioctyl phthalate		
fluoranthene	0.00191	0.00130
pyrene	0.03512	0.00358
chrysene	0.00881	0.00095
benzo[a]anthracene		
benzo[k]fluoranthene		
benzo[b]fluoranthene		
benzo[a]pyrene		
nonadecylcyclohexane		
squalane		
indeno[1,2,3-cd]pyrene		
dibenzo[a,h]anthracene		
benzo[ghi]perylene		
coronene		
cholestane - peak 1		
cholestane - peak 2		
cholestane - peak 3		
cholestane - peak 4		
ABB-2OR-24S-methylcholestane		
ABB-2OR-ethylcholestane		
17A(H)-22,29,30-*tris*(norhopane)		
17(B)-21A(H)-norhopane		

Table 5-3. (Continued)

Compound	Average Mass Fraction	Uncertainty (%)
17B(H)-21B(H)-hopane		
17B(H)-21A(H)-hopane		
17A(H)-21B(H)-hopane		
n-decane (*n*-C10)		
n-undecane (*n*-C11)		
n-dodecane (*n*-C12)		
n-tridecane (*n*-C13)	0.00052	0.00066
9H-fluoren-9-one	0.00069	0.00138
n-tetradecane (*n*-C14)	0.00004	0.00008
n-pentadecane (*n*-C15)		
n-hexadecane (*n*-C16)	0.00436	0.00124
n-heptadecane (*n*-C17)	0.01469	0.00412
1-octadecene		
n-octadecane (*n*-C18)	0.02085	0.00564
2-methylnonadecane		
3-methylnonadecane		
n-nonadecane (*n*-C19)	0.05049	0.00901
n-eicosane (*n*-C20)	0.15462	0.04156
n-heneicosane (*n*-C21)	0.16568	0.04720
n-docosane (*n*-C22)	0.20432	0.04845
n-tricosane (*n*-C23)	0.25152	0.03866
iso-docosane (C23)		
anteiso-docosane (C23)		
pyrene		
anthraquinone		
naphthalic anhydride	0.08036	0.00869
methylfluoranthene		

Table 5-3. (Continued)

Compound	Average Mass Fraction	Uncertainty (%)
benzanthraquinone		
1-methylchrysene		
n-tetracosane (*n*-C24	0.41407	0.03666
iso-tricosane (C24)		
anteiso-tricosane (C24)		
n-pentacosane (*n*-C25)	0.22033	0.01569
iso-tetracosane (C25)		
anteiso-tetracosane (C25)		
n-hexacosane (*n*-C26)	0.18047	0.01074
iso-pentacosane (C26)		
anteiso-pentacosane (C26)		
n-heptacosane (*n*-C27)		
iso-hexacosane (C27)	0.13140	0.00846
anteiso-hexacosane (C27)		
iso-heptacosane (C28)		
anteiso-heptacosane (C28)		
iso-octacosane (C29)		
anteiso-octacosane (C29)		
n-octacosane (*n*-C28)	0.10031	0.00794
n-nonacosane (*n*-C29)	0.06173	0.00555
iso-nonacosane (C30)		
anteiso-nonacosane (C30)		
squalene	0.09177	0.03406
indeno[1,2,3-cd]fluoranthene		
dibenzo[a,e]pyrene		
n-triacontane (*n*-C30)	0.00135	0.00097
n-hentriacontane (*n*-C31)	0.00142	0.00160

Table 5-3. (Continued)

Compound	Average Mass Fraction	Uncertainty (%)
iso-triacontane (C31)		
anteiso-triacontane (C31)		
iso-hentriacontane (C32)		
anteiso-hentriacontane (C32)		
iso-dotriacontane (C33)		
anteiso-dotriacontane (C33)		
n-dotriacontane (*n*-C32)	0.00041	0.00064
n-tritriacontaine (*n*-C33)	0.00064	0.00036
n-tetratriacontaine (*n*-C34)		
iso-tritriacontane (C34)		
anteiso-tritriacontane (C34)		
n-pentatriacontane (*n*-C35)	0.00093	0.00043
n-hexatracontane (*n*-C36)		
n-tetracontane (*n*-C40)		
hexanoic acid	0.00351	0.00054
succinic acid	0.01805	0.00188
octanoic acid	0.00416	0.00051
glutaric acid	0.01289	0.00355
nonanoic acid	0.00578	0.00027
adipic acid	0.00943	0.00520
decanoic acid	0.00422	0.00213
undecanoic acid	0.00803	0.00439
pimelic acid	0.00798	0.00083
suberic acid	0.00859	0.00158
dodecanoic acid	0.00674	0.00389
azelaic acid	0.00437	0.00093
tridecanoic acid		
pinonic acid	0.01795	0.02539

Table 5-3. (Continued)

Compound	Average Mass Fraction	Uncertainty (%)
phthalic acid	0.00079	0.00112
1,4-benzenedicarboxylic acid	0.04304	0.00223
1,3-benzenedicarboxylic acid	0.07511	0.00351
1,2-benzenedicarboxylic acid, 4-methyl		
1,2,4-benzenetricarboxylic acid	0.43862	0.02279
benzenetetracarboxylic acid	0.11274	0.01355
abietic acid		
pimaric acid		
sandaracopimaric acid		
isopimaric acid		
dehydroabietic acid		
sebacic acid		
tetradecanoic acid	0.00879	0.00743
pentadecanoic acid	0.01823	0.01804
palmitoleic acid		
hexadecanoic acid	0.13150	0.05328
heptadecanoic acid	0.01520	0.00328
linoleic acid	0.01516	0.00417
oleic acid	0.00550	0.00071
linolenic acid		
octadecanoic acid	0.08921	0.01976
nonadecanoic acid		
eicosanoic acid	0.00331	0.00076
docosanoic acid	0.00311	0.00073
tricosanoic acid		
tetracosanoic acid	0.00267	0.00203
pentacosanoic acid		
hexacosanoic acid		

Table 5-3. (Continued)

Compound	Average Mass Fraction	Uncertainty (%)
heptacosanoic acid		
octacosanoic acid		
nonacosanoic acid		
triacontanoic acid		
Total	**3.56**	**0.34**

Table 5-4. Particle-Phase Semivolatiles from an Institutional Oil-Fired Boiler: Emission Factors (Campaign #2, July 2002)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
dimethyl phthalate		
diethyl phthalate	3.10	0.90
naphthalene		
2-methylnaphthalene	0.69	0.52
1-methylnaphthalene	0.36	
2,7-dimethylnaphthalene	0.79	0.61
1,3-dimethylnaphthalene	1.57	1.08
2,6-dimethylnaphthalene	0.76	0.57
additional dimethylnaphthalenes		
acenaphthylene		
acenaphthene		
fluorene		
1-methylfluorene	4.34	0.81
additional methylfluorenes (peak 1)		
additional methylfluorenes (peak 2)		
phenanthrene	14.69	1.81
additional dimethylphenanthrenes	16.01	1.25
anthracene		
methylanthracene - peak 1	41.41	5.21
methylanthracene - peak 2	52.29	5.99
methylanthracene - peak 3	32.39	3.75
methylanthracene - peak 4	27.32	3.60
octylcyclohexane		
norpristane		
decylcyclohexane		
pristane	7.82	1.39
phytane	26.02	4.69

Table 5-4. (Continued)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
tridecylcyclohexane	9.66	
dibutyl phthalate	13.42	9.71
butyl benzyl phthalate	15.83	9.59
bis(2-ethylhexyl) phthalate	30.13	35.33
dioctyl phthalate		
fluoranthene	1.89	1.64
pyrene	37.83	4.26
chrysene	7.90	0.39
benzo[a]anthracene		
benzo[k]fluoranthene		
benzo[b]fluoranthene		
benzo[a]pyrene		
nonadecylcyclohexane		
squalane		
indeno[1,2,3-cd]pyrene		
dibenzo[a,h]anthracene		
benzo[ghi]perylene		
coronene		
cholestane - peak 1		
cholestane - peak 2		
cholestane - peak 3		
cholestane - peak 4		
ABB-2OR-24S-methylcholestane		
ABB-2OR-ethylcholestane		
17A(H)-22,29,30-*tris*(norhopane)		
17(B)-21A(H)-norhopane		
17B(H)-21B(H)-hopane		
17B(H)-21A(H)-hopane		

Table 5-4. (Continued)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
17A(H)-21B(H)-hopane		
n-decane (*n*-C10)		
n-undecane (*n*-C11)		
n-dodecane (*n*-C12)		
n-tridecane (*n*-C13)	0.27	0.47
9H-fluoren-9-one	1.09	1.89
n-tetradecane (*n*-C14)	0.07	0.11
n-pentadecane (*n*-C15)		
n-hexadecane (*n*-C16)	4.28	1.47
n-heptadecane (*n*-C17)	15.52	4.84
1-octadecene		
n-octadecane (*n*-C18)	21.94	6.64
2-methylnonadecane		
3-methylnonadecane		
n-nonadecane (*n*-C19)	46.48	9.19
n-eicosane (*n*-C20)	168.23	50.85
n-heneicosane (*n*-C21)	182.46	58.66
n-docosane (*n*-C22)	225.50	55.96
n-tricosane (*n*-C23)	283.78	41.33
iso-docosane (C23)		
anteiso-docosane (C23)		
pyrene		
anthraquinone		
naphthalic anhydride	72.43	11.82
methylfluoranthene		
retene		
cyclopenta[c,d]acepyrene		
benzanthraquinone		

Table 5-4. (Continued)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
1-methylchrysene		
n-tetracosane (*n*-C24	403.25	40.02
iso-tricosane (C24)		
anteiso-tricosane (C24)		
n-pentacosane (*n*-C25)	209.06	16.78
iso-tetracosane (C25)		
anteiso-tetracosane (C25)		
n-hexacosane (*n*-C26)	160.30	11.33
iso-pentacosane (C26)		
anteiso-pentacosane (C26)		
n-heptacosane (*n*-C27)	105.60	8.65
iso-hexacosane (C27)		
anteiso-hexacosane (C27)		
iso-heptacosane (C28)		
anteiso-heptacosane (C28)		
iso-octacosane (C29)		
anteiso-octacosane (C29)		
n-octacosane (*n*-C28)	81.32	8.35
n-nonacosane (*n*-C29)	41.14	5.41
iso-nonacosane (C30)		
anteiso-nonacosane (C30)		
squalene	73.59	40.25
indeno[1,2,3-cd]fluoranthene		
dibenzo[a,e]pyrene		
n-triacontane (*n*-C30)	1.58	1.15
n-hentriacontane (*n*-C31)	1.56	1.90
iso-triacontane (C31)		
anteiso-triacontane (C31)		

Table 5-4. (Continued)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
iso-hentriacontane (C32)		
anteiso-hentriacontane (C32)		
iso-dotriacontane (C33)		
anteiso-dotriacontane (C33)		
n-dotriacontane (*n*-C32)	0.65	0.76
n-tritriacontaine (*n*-C33)	0.36	
n-tetratriacontaine (*n*-C34)		
iso-tritriacontane (C34)		
anteiso-tritriacontane (C34)		
n-pentatriacontane (*n*-C35)	0.51	
n-hexatracontane (*n*-C36)		
n-tetracontane (*n*-C40)		
hexanoic acid	4.16	0.63
succinic acid	21.42	2.12
octanoic acid	4.94	0.58
glutaric acid	15.30	4.19
nonanoic acid	6.86	0.23
adipic acid	11.19	6.16
decanoic acid	5.01	2.53
undecanoic acid	9.53	5.20
pimelic acid	7.60	0.32
suberic acid	8.47	1.65
dodecanoic acid	8.00	4.61
azelaic acid	2.42	
tridecanoic acid		
pinonic acid	21.30	30.13
phthalic acid	0.94	1.33
1,4-benzenedicarboxylic acid	36.74	0.22

Table 5-4. (Continued)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
1,3-benzenedicarboxylic acid	64.33	2.12
1,2-benzenedicarboxylic acid, 4-methyl		
1,2,4-benzenetricarboxylic acid	437.83	23.28
benzenetetracarboxylic acid	115.71	15.47
abietic acid		
pimaric acid		
sandaracopimaric acid		
isopimaric acid		
dehydroabietic acid		
sebacic acid		
tetradecanoic acid	10.43	8.81
pentadecanoic acid	21.64	21.40
palmitoleic acid		
hexadecanoic acid	156.06	63.02
heptadecanoic acid	18.04	3.84
linoleic acid	17.99	4.91
oleic acid	6.53	0.81
linolenic acid		
octadecanoic acid	101.47	23.19
nonadecanoic acid		
eicosanoic acid	3.93	0.89
docosanoic acid	2.81	0.60
tricosanoic acid		
tetracosanoic acid	3.16	2.40
pentacosanoic acid		
hexacosanoic acid		
heptacosanoic acid		
octacosanoic acid		

Table 5-4. (Continued)

Compound	Emission Factor (μg/kg fuel)	Uncertainty (μg/kg fuel)
nonacosanoic acid		
triacontanoic acid		
Total	**3058.78**	**481.44**

Gas-Phase Carbonyl Compounds

Analytical results for the carbonyl field samples for each of the three test days of campaign #1 are shown in Table 5-5 (A, B, C). The DNPH-impregnated silica gel tubes were sampled as pairs (in series), using the back tube of each pair as a check for breakthrough. Final values are reported as the difference between the sum of the paired tubes sampling the residence chamber and the sum of the paired tubes sampling the Dilution Air. At the bottom of each table, the entry reported as "Total Speciated" is the total mass (front tube plus back tube) of the sum of the specifically identified compounds; the final value represents the difference between the

Table 5-5A. Carbonyl Compounds Analyzed by High Performance Liquid Chromatography (Campaign #1, January 16, 2001)

Compound	CAS No.	Residence Chamber Pair (µg)	Dilution Air (µg)	Residence Chamber Minus Dilution Air (µg)	% Total[a]
formaldehyde	50-00-0	0.6150	0.0745	0.5405 ± 0.06	34.06 ± 3.75
acetaldehyde	75-07-0	0.3575	0.1980	0.1595 ± 0.00[b]	10.05 ± 0.11
acetone	67-64-1	0.3585	0.2260	0.1325 ± 0.01	8.35 ± 0.35
propionaldehyde	123-38-6	ND	ND	ND	ND
crotonaldehyde	4170-30-0	ND	ND	ND	ND
butyraldehyde	123-72-8	0.0560	0.0470	0.0090 ± 0.00	0.57 ± 0.03
benzaldehyde	100-52-7	0.0450	0.0200	0.0250 ± 0.00	1.58 ± 0.05
isovaleraldehyde	590-86-3	0.0090	ND	0.0090 ±0.00	0.57 ± 0.08
valeraldehyde	110-62-3	ND	0.0015	ND	ND
o-tolualdehyde	529-20-4	ND	0.0120	ND	ND
m-tolualdehyde	620-23-5	ND	0.0015	ND	ND
p-tolualdehyde	104-87-0	ND	ND	ND	ND
hexaldehyde	66-25-1	0.0560	0.0560	ND	ND
2,5-dimethylbenz-aldehyde	5779-94-2	ND	ND	ND	ND
diacetyl	431-03-8	ND	ND	ND	ND
methacrolein	78-85-3	ND	ND	ND	ND
2-butanone	78-93-3	0.0720	0.0640	0.0080 ± 0.00	0.50 ± 0.04
glyoxal	107-22-2	0.2730	0.1990	0.0740 ± 0.00	4.66 ± 0.13
acetophenone	98-86-2	0.0060	ND	0.0060	0.38 ± 0.02
methylglyoxal	78-98-8	0.0880	0.0700	0.0180 ± 0.00	1.13 ± 0.14
octanal	124-13-0	0.0140	0.0250	ND	ND
nonanal	124-19-6	0.2100	0.2430	ND	ND
Total Speciated			2.1600	1.2375	0.9225

Table 5-5A. (Continued)

Compound	CAS No.	Residence Chamber Pair (μg)	Dilution Air (μg)	Residence Chamber Minus Dilution Air (μg)
Total Unspeciated		1.5375	0.8730	0.6645
Total Speciated + Unspeciated		3.6975	2.1105	1.5870
Mass emission rate of Speciated Carbonyls				0.84 mg/kg fuel
Mass emission rate of Total Carbonyls (Speciated + Unspeciated) (1/16/01)				1.42 mg/kg fuel

ND = Not Detected
[a]Percent of each compound expressed as a percentage of Total Speciated + Unspeciated Carbonyl Compounds.
[b]Calculated value for analytical uncertainty is less than 0.01.

Table 5-5B. Carbonyl Compounds Analyzed by High Performance Liquid Chromatography (Campaign #1, January 17, 2001)

Compound	CAS No.	Residence Chamber Pair (μg)	Dilution Air (μg)	Residence Chamber Minus Dilution Air (μg)	% Total[a]
formaldehyde	50-00-0	0.2870	0.0890	0.1980 ± 0.02	21.39 ± 2.36
acetaldehyde	75-07-0	0.2385	0.1790	0.0595 ± 0.00[b]	6.429 ± 0.07
acetone	67-64-1	0.4085	0.2380	0.1705 ± 0.007	18.42 ± 0.78
propionaldehyde	123-38-6	ND	0.0005	ND	ND
crotonaldehyde	4170-30-0	ND	ND	ND	ND
butyraldehyde	123-72-8	0.0645	0.0485	0.0160 ± 0.00	1.73 ± 0.10
benzaldehyde	100-52-7	0.0330	0.0150	0.0180 ± 0.00	1.94 ± 0.06
isovaleraldehyde	590-86-3	ND	ND	ND	ND
valeraldehyde	110-62-3	0.0045	0.0015	0.0045 ± 0.00	0.49 ± 0.05
o-tolualdehyde	529-20-4	ND	0.0120	ND	ND
m-tolualdehyde	620-23-5	ND	0.0015	ND	ND
p-tolualdehyde	104-87-0	ND	ND	ND	ND
hexaldehyde	66-25-1	0.0585	0.0450	0.0135 ± 0.00	1.46 ± 0.14
2,5-dimethylbenz-aldehyde	5779-94-2	ND	ND	ND	ND
diacetyl	431-03-8	ND	ND	ND	ND
methacrolein	78-85-3	ND	ND	ND	ND
2-butanone	78-93-3	0.0640	0.0560	0.0080 ± 0.00	0.86 ± 0.07
glyoxal	107-22-2	0.2370	0.1720	0.0650 ± 0.00	7.02 ± 0.19
acetophenone	98-86-2	ND	ND	ND	ND
methylglyoxal	78-98-8	0.0840	0.0590	0.0250 ± 0.00	2.70 ± 0.33
octanal	124-13-0	0.0220	0.0070	0.0150 ± 0.00	1.62 ± 0.00
nonanal	124-19-6	0.1550	0.1430	0.0120 ± 0.00	1.30 ± 0.10
Total Speciated			1.6565	1.0520	0.6045
Total Unspeciated			1.0515	0.730	0.3210
Total Speciated + Unspeciated			2.7080	1.7825	0.9255
Mass emission rate of Speciated Carbonyls					0.56 mg/kg fuel
Mass emission rate of Total Carbonyls (Speciated + Unspeciated)					0.86 mg/kg fuel

ND = Not Detected

[a]Percent of each compound expressed as a percentage of Total Speciated + Unspeciated Carbonyl Compounds.
[b]Calculated value for analytical uncertainty is less than 0.01.

Table 5-5C. Carbonyl Compounds Analyzed by High Performance Liquid Chromatography (Campaign #1, January 18, 2001)

Compound	CAS No.	Residence Chamber Pair (µg)	Dilution Air (µg)	Residence Chamber Minus Dilution Air (± Analytical Uncertainty (µg)	% Total[a] (± Analytical Uncertainty
formaldehyde	50-00-0	0.2155	0.1140	0.1015 ± 0.01	14.43 ± 1.59
acetaldehyde	75-07-0	0.2885	0.2390	0.0495 ± 0.00[b]	7.04 ± 0.08
acetone	67-64-1	0.2230	0.1910	0.0320 ± 0.00	4.55 ± 0.19
propionaldehyde	123-38-6	ND	0.0005	ND	ND
crotonaldehyde	4170-30-0	ND	ND	ND	ND
butyraldehyde	123-72-8	0.0865	0.0590	0.0275 ± 0.00	3.91 ± 0.23
benzaldehyde	100-52-7	0.0130	0.0200	ND	ND
isovaleraldehyde	590-86-3	ND	ND	ND	ND
valeraldehyde	110-62-3	ND	ND	ND	ND
o-tolualdehyde	529-20-4	ND	ND	ND	ND
m-tolualdehyde	620-23-5	ND	ND	ND	ND
p-tolualdehyde	104-87-0	ND	ND	ND	ND
hexaldehyde	66-25-1	0.0515	0.0545	ND	ND
2,5-dimethylbenz-aldehyde	5779-94-2	ND	ND	ND	ND
diacetyl	431-03-8	ND	ND	ND	ND
2-butanone	78-93-3	0.0630	0.0590	0.0040 ± 0.00	0.57 ± 0.05
glyoxal	107-22-2	0.2890	0.2100	0.0790 ± 0.00	11.23 ± 0.31
acetophenone	98-86-2	ND	ND	ND	ND
methylglyoxal	78-98-8	0.0700	0.0650	0.0050 ± 0.00	0.71 ± 0.09
octanal	124-13-0	0.0060	0.0090	ND	ND
nonanal	124-19-6	0.1120	0.1320	ND	ND

Table 5-5C. (Continued)

Compound	CAS No.	Residence Chamber Pair (µg)	Dilution Air (µg)	Residence Chamber Minus Dilution Air (± Analytical Uncertainty (µg)
Total Speciated		1.4180	1.1540	0.2640
Total Unspeciated		1.4795	1.0400	0.4395
Total Speciated + Unspeciated		2.8975	2.1940	0.7035
Mass emission rate of Speciated Carbonyls				0.23 mg/kg fuel
Mass emission rate of Total Carbonyls (Speciated + Unspeciated)				0.56 mg/kg fuel

[a] Percent of each compound expressed as a percentage of Total Speciated + Unspeciated Carbonyl Compounds.
[b] Calculated value for analytical uncertainty is less than 0.01.

residence chamber air and dilution air. At the bottom of each table, the entry reported as "Total Unspeciated" is the total mass (front plus back tube) of the compounds characterized as carbonyl compounds but not identified as a specific compound because no analytical standard was available; the final value represents the difference between residence chamber air and dilution air. The entry reported as "Total Speciated + Unspeciated" includes the total mass (front tube plus back tube) of specifically identified carbonyl compounds as well as unspeciated carbonyl compounds; the final value represents the difference between residence chamber air and dilution air.

Supporting data showing results for each individual carbonyl sampling tube (blanks, front and back tubes) are included in Appendix I.

The total mass of the carbonyl compounds (Speciated, Unspeciated, and (Speciated + Unspeciated) for each test day is summarized in Table 5-6. The speciated carbonyl compounds decrease with each successive test day, as do the total (Speciated + Unspeciated) carbonyl compounds. The unspeciated carbonyl compounds decrease from Day #1 to Day #2, but increase from Day #2 to Day #3. This behavior says that one or more unidentified carbonyl compounds increase in concentration from Day #2 to Day #3, while the speciated (i.e., identified) carbonyl

compounds decrease in concentration. Fuel consumption increases over the three test days as both

Table 5-6. Total Mass of Carbonyl Compounds for Each Campaign #1 Test Day

Test Day	Fuel Consumption (kg)	Speciated	Unspeciated	Speciated + Unspeciated
January 16, 2001	6,569	0.9225 µg	0.6645 µg	1.5870 µg
Emission Rate		0.84 mg/kg fuel		1.42 mg/kg fuel
January 17, 2001	6,934	0.6045 µg	0.3210 µg	0.9255 µg
Emission Rate		0.56 mg/kg fuel		0.86 mg/kg fuel
January 18, 2001	7,926	0.2640 µg	0.4395 µg	0.7035 µg
Emission Rate		0.23 mg/kg fuel		0.56 mg/kg fuel

speciated and total (Speciated + Unspeciated) carbonyl compounds are decreasing. Emission rates also show a decline over the three test days, even with increased consumption of fuel.

Gas-Phase Air Toxics Whole Air Samples

Air toxics values were determined only for campaign #1. Analytical results for the air toxics canister samples are shown in Table 5-7. The ERG concurrent analysis produces analytical results for both air toxics and nonmethane organic compound ozone precursors; the NMOC results are presented separately. Table 5-7 shows only the air toxics compounds that were observed, with the ambient sample analytical data included for reference. By comparison with the ambient air sample, the concentrations of the air toxics compounds are seen to be very low, with most of the compounds on the air toxics target list not observed in the field samples at measurable levels. No consistent trends for the three test days are evident for these compounds. Samples labeled “Dilution Air (DA)” reflect the dilution air entering the sample dilution system; this dilution air has not been exposed to the stationary source matrix. The second canister for each test day is labeled “Residence Chamber Air” and reflects the diluted stationary source matrix at the end of the residence chamber (RC).

Supporting data for the air toxics analysis are shown in Appendix H.

Table 5-7. Air Toxics Compounds (Campaign #1)

Compounds	CAS No.	Ambient µg/m³	RC-DA 1/16/01 µg/m³	RC-DA 1/17/01 µg/m³	RC-DA 1/18/01 µg/m³
acetylene	74-86-2	1.52	ND	1.27	ND
propylene	115-07-1	2.20	0.08	0.07	ND
dichlorodifluoromethane	75-71-8	2.45	ND	ND	ND
chloromethane	74-87-3	0.98	ND	ND	0.12
dichlorotetrafluoroethane	1320-37-2	0.13	ND	ND	ND
1,3-butadiene	106-99-0	0.16	ND	ND	ND
trichlorofluoromethane	75-69-4	1.56	0.05	ND	ND
methylene chloride	75-09-2	0.42	0.11	1.00	0.16
trichlorotrifluoroethane	26253-64-8	0.65	ND	ND	ND
methyl *tert*-butyl ether	1634-04-1	0.15	ND	ND	ND
methyl ethyl ketone	78-93-3	12.31	ND	ND	ND
benzene	71-43-2	1.29	0.19	0.33	0.05
carbon tetrachloride	56-23-5	0.53	ND	0.05	ND
toluene	108-88-3	2.11	0.08	0.05	0.05
n-octane	111-65-9	0.22	0.18	ND	ND
styrene	100-42-5	0.11	ND	ND	ND
o-xylene	95-47-6	0.86	ND	0.04	ND
1,3,5-trimethylbenzene	108-67-8	0.31	0.03	0.13	0.15
1,2,4-trimethylbenzene	95-63-6	0.88	0.18	0.33	0.11
p-dichlorobenzene	106-46-7	0.10	ND	ND	ND
1,2,4-trichlorobenzene	120-82-1	0.28	ND	ND	ND

ND = Not Detected

Gas-Phase Speciated Nonmethane Organic Compounds

Nonmethane organic compounds were determined only for campaign #1. Analysis of whole air samples of dilution air and residence chamber air using ERG's concurrent analysis generated analytical data for speciated nonmethane organic compounds (SNMOC), shown in Tables 5-8 (A, B, C). Analytical results are calculated as the difference between the weight of the compound collected from the residence chamber minus the weight of the compound collected from the dilution air, expressed as micrograms (µg). The weight percent of total SNMOC (Speciated + Unspeciated) is also calculated. Mass emission rates of speciated SNMOC and total (Speciated + Unspeciated) nonmethane organic compounds are also shown in Table 5-9. Supporting data for the NMOC analysis are found in Appendix G. Samples labeled "Dilution Air" reflect the dilution air entering the sample dilution system; this dilution air has not been exposed to the stationary source matrix. The second canister for each test day is labeled "Residence Chamber Air" and reflects the diluted stationary source matrix at the end of the residence chamber. The general profiles of the collected concentrations of analytes do not

Table 5-8A. SNMOC (Campaign #1, January 16, 2001)

Compound	CAS No.	Residence Chamber minus Dilution Air (μg)	%Total
ethylene	4-84-0	652.00 ± 13.02	2.65 ± 0.05
acetylene	74-86-2	9.34 ± 12.01	0.04 ± 0.05
ethane	74-85-1	136.89 ± 10.90	0.56 ± 0.04
propylene	115-07-1	8.14 ± 6.90	0.03 ± 0.03
propane	74-98-6	18751.70 ± 12.24	76.36 ± 0.05
propyne	74-99-7	ND	ND
isobutane	75-28-5	511.43 ± 6.23	2.08 ± 0.03
isobutene/1-butene	115-11-7/106-98-0	48.81 ± 4.00	0.20 ± 0.02
1,3-butadiene	106-99-0	31.20 ± 5.90	0.13 ± 0.02
n-butane	106-97-8	275.28 ± 11.24	1.12 ± 0.05
trans-2-butene	624-64-6	1.45 ± 7.23	0.01 ± 0.03
cis-2-butene	590-18-1	6.65 ± 10.79	0.03 ± 0.04
3-methyl-1-butene	563-45-1	ND	ND
isopentane	78-78-4	191.81 ± 16.13	0.78 ± 0.07
1-pentene	109-67-1	21.81 ± 9.01	0.09 ± 0.04
2-methyl-1-butene	563-46-2	ND	ND
n-pentane	109-66-0	71.29 ± 11.24	0.29 ± 0.05
isoprene	78-79-4	ND	ND
trans-2-pentene	646-04-8	11.63 ± 9.12	0.05 ± 0.04
cis-2-pentene	627-20-3	22.03 ± 13.46	0.09 ± 0.05
2-methyl-2-butene	513-35-9	ND	ND
2,2-dimethylbutane	75-83-2	38.63 ± 16.46	0.16 ± 0.07
cyclopentene	142-29-0	6.42 ± 15.57	0.03 ± 0.06
4-methyl-1-pentene	691-37-2	ND	ND
cyclopentane	287-92-3	26.90 ± 7.68	0.11 ± 0.03
2,3-dimethylbutane	79-29-8	ND	ND
2-methylpentane	107-83-5	54.24 ± 8.79	0.22 ± 0.04
3-methylpentane	96-14-0	80.69 ± 16.80	0.33 ± 0.07

Table 5-8A. (Continued)

Compound	CAS No.	Residence Chamber minus Dilution Air (μg)	%Total
2-methyl-1-pentene	763-29-1	ND	ND
1-hexene	592-41-6	17.72 ± 17.01	0.07 ± 0.07
2-ethyl-1-butene	760-21-4	ND	ND
n-hexane	110-54-3	843.46 ± 12.90	3.43 ± 0.05
trans-2-hexene	4050-45-7	ND	ND
cis-2-hexene	7688-21-3	ND	ND
methylcyclopentane	96-37-7	153.95 ± 10.68	0.63 ± 0.04
2,4-dimethylpentane	108-08-7	11.74 ± 13.35	0.05 ± 0.05
benzene	71-43-2	137.35 ±8.45	0.56 ± 0.03
cyclohexane	110-82-7	ND	ND
2-methylhexane	591-76-4	88.42 ± 2.22	0.36 ± 0.01
2,3-dimethylpentane	565-59-3	2.00 ± 11.12	0.01 ± 0.05
3-methylhexane	589-34-4	ND	ND
1-heptene	592-76-7	ND	ND
2,2,4-trimethylpentane	540-84-1	38.75 ± 11.24	0.16 ± 0.05
n-heptane	142-82-5	32.77 ± 5.67	0.13 ± 0.02
methylcyclohexane	108-87-2	27.56 ± 10.79	0.11 ± 0.04
2,2,3-trimethylpentane	564-02-3	ND	ND
2,3,4-trimethylpentane	565-75-3	37.63 ± 7.79	0.15 ± 0.03
toluene	108-88-3	54.04 ± 4.45	0.22 ± 0.02
2-methylheptane	592-27-8	ND	ND
3-methylheptane	589-81-1	1.22 ± 4.23	0.00[a] ± 0.02
1-octene	111-66-0	ND	ND
n-octane	111-65-9	14.52 ± 2.22	0.06 ± 0.01
ethylbenzene	100-41-4	ND	ND
m-xylene/*p*-xylene	108-38-3/106-42-3	ND	ND
styrene	100-42-5	ND	ND
o-xylene	95-47-6	14.30 ± 3.00	0.06 ± 0.01

Table 5-8A. (Continued)

Compound	CAS No.	Residence Chamber minus Dilution Air (µg)	%Total
1-nonene	124-11-8	21.70 ± 2.34	0.09 ± 0.01
n-nonane	111-84-2	18.27 ± 2.34	0.07 ± 0.01
isopropylbenzene	98-82-8	ND	ND
α-pinene	80-56-8	ND	ND
n-propylbenzene	103-65-1	11.40 ± 2.22	0.05 ± 0.01
m-ethyltoluene	620-14-4	90.09 ± 5.12	0.37 ± 0.02
p-ethyltoluene	622-96-8	58.88 ± 5.90	0.24 ± 0.02
1,3,5-trimethylbenzene	108-67-8	51.48 ± 3.23	0.21 ± 0.01
o-ethyltoluene	611-14-3	61.11 ± 3.45	0.25 ± 0.01
β-pinene	127-91-3	ND	ND
1,2,4-trimethylbenzene	95-63-6	100.52 ± 3.23	0.41 ± 0.01
1-decene	872-05-9	ND	ND
n-decane	124-18-5	ND	ND
1,2,3-trimethylbenzene	526-73-8	58.88 ± 2.67	0.24 ± 0.01
m-diethylbenzene	141-93-5	16.94 ± 1.45	0.07 ± 0.01
p-diethylbenzene	105-05-5	ND	ND
1-undecene	821-95-4	ND	ND
n-undecane	1120-21-4	140.43 ± 2.11	0.57 ± 0.01
1-dodecene	112-41-4	ND	ND
n-dodecane	112-40-3	ND	ND
1-tridecene	2437-56-1	ND	ND
n-tridecane	629-50-5	ND	ND
Total Speciated SNMOC			23.40 µg/m^3
Total Unspeciated SNMOC			2.36 µg/m^3
Total Speciated + Unspeciated SNMOC			25.76 µg/m^3
Mass Emission Rate of Speciated Nonmethane Organic Compounds			0.25 mg/kg fuel
Mass Emission Rate of Total (Speciated + Unspeciated) Nonmethane Organic Compounds			0.27 mg/kg fuel

[a]Calculated value less than 0.00.

Table 5-8B. SNMOC (Campaign #1, January 17, 2001

Compound	CAS No.	Residence Chamber Minus Dilution Air (μg)	% Total
ethylene	4-84-0	1773.89 ± 12.56	10.80 ± 0.08
acetylene	74-86-2	1335.54 ± 11.60	8.12 ± 0.07
ethane	74-85-1	1974.33 ± 10.52	12.02 ± 0.06
propylene	115-07-1	154.47 ± 6.66	0.94 ± 0.04
propane	74-98-6	2894.27 ± 11.81	17.62 ± 0.07
propyne	74-99-7	ND	ND
isobutane	75-28-5	39.96 ± 6.01	0.24 ± 0.04
isobutene/1-butene	115-11-7/106-98-0	131.87 ± 3.87	0.80 ± 0.02
1,3-butadiene	106-99-0	ND	ND
n-butane	106-97-8	82.53 ± 10.84	0.50 ± 0.07
trans-2-butene	624-64-6	42.90 ± 6.98	0.26 ± 0.04
cis-2-butene	590-18-1	48.21 ± 10.41	0.29 ± 0.06
3-methyl-1-butene	563-45-1	ND	ND
isopentane	78-78-4	106.50 ± 15.57	0.65 ± 0.09
1-pentene	109-67-1	37.38 ± 8.70	0.23 ± 0.05
2-methyl-1-butene	563-46-2	ND	ND
n-pentane	109-66-0	64.35 ± 10.84	0.39 ± 0.07
isoprene	78-79-4	1.40 ± 1.29	0.01 ± 0.01
trans-2-pentene	646-04-8	26.97 ± 8.80	0.16 ± 0.05
cis-2-pentene	627-20-3	63.60 ± 12.99	0.39 ± 0.08
2-methyl-2-butene	513-35-9	ND	ND
2,2-dimethylbutane	75-83-2	126.88 ± 15.89	0.77 ± 0.10
cyclopentene	142-29-0	47.78 ± 15.03	0.29 ± 0.09
4-methyl-1-pentene	691-37-2	ND	ND
cyclopentane	287-92-3	37.49 ± 7.41	0.23 ± 0.05
2,3-dimethylbutane	79-29-8	54.59 ± 18.36	0.33 ± 0.11
2-methylpentane	107-83-5	99.80 ± 8.48	0.61 ± 0.05
3-methylpentane	96-14-0	106.18 ± 16.21	0.65 ± 0.10
2-methyl-1-pentene	763-29-1	ND	ND

Table 5-8B. (Continued)

Compound	CAS No.	Residence Chamber Minus Dilution Air (μg)	% Total
1-hexene	592-41-6	84.16 ± 16.42	0.51 ± 0.10
2-ethyl-1-butene	760-21-4	ND	ND
n-hexane	110-54-3	451.16 ± 12.45	2.75 ± 0.08
trans-2-hexene	4050-45-7	ND	ND
cis-2-hexene	7688-21-3	ND	ND
methylcyclopentane	96-37-7	148.22 ± 10.31	0.90 ± 0.06
2,4-dimethylpentane	108-08-7	63.71 ± 12.88	0.39 ± 0.08
benzene	71-43-2	157.55 ± 8.16	0.96 ± 0.05
cyclohexane	110-82-7	ND	ND
2-methylhexane	591-76-4	42.47 ± 2.15	0.26 ± 0.01
2,3-dimethylpentane	565-59-3	85.16 ± 10.74	0.52 ± 0.07
3-methylhexane	589-34-4	16.79 ± 9.02	0.10 ± 0.05
1-heptene	592-76-7	ND	ND
2,2,4-trimethylpentane	540-84-1	58.72 ± 10.84	0.36 ± 0.07
n-heptane	142-82-5	84.19 ± 5.48	0.51 ± 0.03
methylcyclohexane	108-87-2	32.50 ± 10.41	0.20 ± 0.06
2,2,3-trimethylpentane	564-02-3	ND	ND
2,3,4-trimethylpentane	565-75-3	42.69 ± 7.52	0.26 ± 0.05
toluene	108-88-3	61.08 ± 4.29	0.37 ± 0.03
2-methylheptane	592-27-8	32.18 ± 4.19	0.20 ± 0.03
3-methylheptane	589-81-1	47.89 ± 4.08	0.29 ± 0.02
1-octene	111-66-0	ND	ND
n-octane	111-65-9	226.36 ± 2.15	1.38 ± 0.01
ethylbenzene	100-41-4	32.82 ± 2.90	0.20 ± 0.02
m-xylene/*p*-xylene	108-38-3/106-42-3	40.38 ± 4.51	0.25 ± 0.03
styrene	100-42-5	53.31 ± 7.41	0.32 ± 0.05
o-xylene	95-47-6	43.63 ± 2.90	0.27 ± 0.02
1-nonene	124-11-8	ND	ND

Table 5-8B. (Continued)

Compound	CAS No.	Residence Chamber Minus Dilution Air (µg)	% Total
n-nonane	111-84-2	100.12 ± 2.55	0.61 ± 0.01
isopropylbenzene	98-82-8	37.39 ± 4.29	0.23 ± 0.03
α-pinene	80-56-8	ND	ND
n-propylbenzene	103-65-1	26.76 ± 2.15	0.16 ± 0.01
m-ethyltoluene	620-14-4	74.33 ± 4.94	0.45 ± 0.03
p-ethyltoluene	622-96-8	43.01 ± 5.69	0.26 ± 0.03
1,3,5-trimethylbenzene	108-67-8	126.13 ± 3.11	0.77 ± 0.02
o-ethyltoluene	611-14-3	95.13 ± 3.33	0.58 ± 0.02
β-pinene	127-91-3	114.44 ± 2.25	0.70 ± 0.01
1,2,4-trimethylbenzene	95-63-6	174.56 ± 3.11	1.06 ± 0.02
1-decene	872-05-9	ND	ND
n-decane	124-18-5	66.13 ± 2.36	0.40 ± 0.01
1,2,3-trimethylbenzene	526-73-8	78.99 ± 2.58	0.48 ± 0.02
m-diethylbenzene	141-93-5	78.03 ± 1.40	0.48 ± 0.01
p-diethylbenzene	105-05-5	67.62 ± 1.61	0.41 ± 0.01
1-undecene	821-95-4	ND	ND
n-undecane	1120-21-4	150.48 ± 2.04	0.92 ± 0.01
1-dodecene	112-41-4	93.63 ± 4.51	0.57 ± 0.03
n-dodecane	112-40-3	3950.78 ± 4.62	24.05 ± 0.03
1-tridecene	2437-56-1	ND	ND
n-tridecane	629-50-5	93.63 ± 4.62	0.57 ± 0.03

Total Speciated SNMOC	29.48 µg/m^3
Total Unspeciated SNMOC	ND
Total Speciated + Unspeciated SNMOC	29.48 µg/m^3
Mass Emission Rate of Speciated Nonmethane Organic Compounds	0.30 µg/kg fuel
Mass Emission Rate of Total (Speciated + Unspeciated) Nonmethane Organic Compounds	0.30* µg/kg fuel

* More unspeciated NMOC was found in dilution air than in residence chamber samples. Unspeciated analysis was determined invalid and not used in this calculation due to an unidentified contaminant.

Table 5-8C. SNMOC (Campaign #1, January 18, 2001)

Compound	CAS No.	Residence Chamber Minus Dilution Air (μg)	% Total
ethylene	4-84-0	418.90 ± 13.35	1.37 ± 0.04
acetylene	74-86-2	222.76 ± 12.32	0.73 ± 0.04
ethane	74-85-1	ND	ND
propylene	115-07-1	268.93 ± 7.07	0.88 ± 0.02
propane	74-98-6	23162.61 ± 12.55	75.68 ± 0.04
propyne	74-99-7	ND	ND
isobutane	75-28-5	ND	ND
isobutene/1-butene	115-11-7/106-98-0	48.57 ± 4.11	0.16 ± 0.01
1,3-butadiene	106-99-0	ND	ND
n-butane	106-97-8	ND	ND
trans-2-butene	624-64-6	1.14 ± 7.42	0.00[a] ± 0.02
cis-2-butene	590-18-1	ND	ND
3-methyl-1-butene	563-45-1	ND	ND
isopentane	78-78-4	ND	ND
1-pentene	109-67-1	11.24 ± 9.24	0.04 ± 0.03
2-methyl-1-butene	563-46-2	ND	ND
n-pentane	109-66-0	1.83 ± 11.52	0.01 ± 0.04
isoprene	78-79-4	ND	ND
trans-2-pentene	646-04-8	6.13 ± 9.36	0.02 ± 0.03
cis-2-pentene	627-20-3	ND	ND
2-methyl-2-butene	513-35-9	ND	ND
2,2-dimethylbutane	75-83-2	12.38 ± 16.89	0.04 ± 0.06
cyclopentene	142-29-0	16.57 ± 15.97	0.05 ± 0.05
4-methyl-1-pentene	691-37-2	ND	ND
cyclopentane	287-92-3	6.13 ± 7.87	0.02 ± 0.03
2,3-dimethylbutane	79-29-8	7.27 ± 19.51	0.02 ± 0.06
2-methylpentane	107-83-5	612.16 ± 9.01	2.00 ± 0.03

Table 5-8C. (Continued)

Compound	CAS No.	Residence Chamber Minus Dilution Air (μg)	% Total
3-methylpentane	96-14-0	33.48 ± 17.22	0.11 ± 0.06
2-methyl-1-pentene	763-29-1	ND	ND
1-hexene	592-41-6	2.17 ± 17.46	0.01 ± 0.06
2-ethyl-1-butene	760-21-4	ND	ND
n-hexane	110-54-3	362.46 ± 13.23	1.18 ± 0.04
trans-2-hexene	4050-45-7	ND	ND
cis-2-hexene	7688-21-3	ND	ND
methylcyclopentane	96-37-7	75.13 ± 10.95	0.25 ± 0.04
2,4-dimethylpentane	108-08-7	1.14 ± 13.69	0.00 ± 0.04
benzene	71-43-2	33.03 ± 8.67	0.11 ± 0.03
cyclohexane	110-82-7	1.48 ± 19.40	0.00 ± 0.06
2-methylhexane	591-76-4	0.91 ± 2.28	0.00 ± 0.01
2,3-dimethylpentane	565-59-3	ND	ND
3-methylhexane	589-34-4	ND	ND
1-heptene	592-76-7	41.76 ± 9.47	0.13 ± 0.03
2,2,4-trimethylpentane	540-84-1	6.70 ± 11.52	0.02 ± 0.04
n-heptane	142-82-5	22.13 ± 5.82	0.07 ± 0.02
methylcyclohexane	108-87-2	11.47 ± 11.07	0.04 ± 0.04
2,2,3-trimethylpentane	564-02-3	ND	ND
2,3,4-trimethylpentane	565-75-3	1.14 ± 7.99	0.00 ± 0.03
toluene	108-88-3	ND	ND
2-methylheptane	592-27-8	ND	ND
3-methylheptane	589-81-1	ND	ND
1-octene	111-66-0	ND	ND
n-octane	111-65-9	43.81 ± 2.28	0.14 ± 0.01
ethylbenzene	100-41-4	ND	ND
m-xylene/*p*-xylene	108-38-3/106-42-3	ND	ND

Table 5-8C. (Continued)

Compound	CAS No.	Residence Chamber Minus Dilution Air (μg)	% Total
styrene	100-42-5	58.44 ± 7.87	0.19 ± 0.03
o-xylene	95-47-6	12.26 ± 3.08	0.04 ± 0.01
1-nonene	124-11-8	0.91 ± 2.40	0.00 ± 0.01
n-nonane	111-84-2	32.69 ± 2.40	0.11 ± 0.01
isopropylbenzene	98-82-8	1.03 ± 4.56	0.00 ± 0.01
α-pinene	80-56-8	ND	ND
n-propylbenzene	103-65-1	ND	ND
m-ethyltoluene	620-14-4	ND	ND
p-ethyltoluene	622-96-8	1.14 ± 6.04	0.00 ± 0.02
1,3,5-trimethylbenzene	108-67-8	42.44 ± 3.31	0.14 ± 0.01
o-ethyltoluene	611-14-3	21.68 ± 3.54	0.07 ± 0.01
β-pinene	127-91-3	104.39 ± 2.40	0.34 ± 0.01
1,2,4-trimethylbenzene	95-63-6	44.27 ± 3.31	0.14 ± 0.01
1-decene	872-05-9	ND	ND
n-decane	124-18-5	56.19 ± 2.51	0.18 ± 0.01
1,2,3-trimethylbenzene	526-73-8	ND	ND
m-diethylbenzene	141-93-5	52.19 ± 1.48	0.17 ± 0.00
p-diethylbenzene	105-05-5	36.54 ± 1.71	0.12 ± 0.01
1-undecene	821-95-4	ND	ND
n-undecane	1120-21-4	71.16 ± 2.17	0.23 ± 0.01
1-dodecene	112-41-4	78.29 ± 4.79	0.26 ± 0.02
n-dodecane	112-40-3	2067.01 ± 4.90	6.75 ± 0.02
1-tridecene	2437-56-1	ND	ND
n-tridecane	629-50-5	93.95 ± 4.90	0.31 ± 0.02
Total Speciated SNMOC			48.28 μg/m^3
Total Unspeciated SNMOC			4.41 μg/m^3
Total Speciated + Unspeciated SNMOC			52.69 μg/m^3
Mass Emission Rate of Speciated Nonmethane Organic Compounds			0.50 mg/kg fuel
Mass Emission Rate of Total (Speciated + Unspeciated) Nonmethane Organic Compounds			0.55 mg/kg fuel

[a]Calculated value less than 0.00.

Table 5-9. Total Mass of Nonmethane Organic Compounds for Each Campaign #1 Test Day

	Mass of Fuel Consumed (kg)	Speciated	Unspeciated	Speciated + Unspeciated
January 16, 2001	6,569	1617 mg	163 mg	1780 mg
Emission Rate		0.25 mg/kg fuel		0.27 mg/kg fuel
January 17, 2001	6,934	2085 mg	0[a]	2085 mg
Emission Rate		0.23 mg/kg fuel		0.28 mg/kg fuel
January 18, 2001	7,926	3961 mg	361 mg	4322 mg
Emission Rate		0.50 mg/kg fuel		0.55 mg/kg fuel

[a]Weight of unspeciated NMOC in dilution air was higher than the weight of unspeciated NMOC in the residence chamber air for January 17, 2001.

parallel the results for the carbonyl compounds. Weight % for each analyte was calculated by dividing the value of that analyte by the total speciated plus unspeciated NMOC value. The analytical uncertainty was calculated using the standard deviation of the replicate determinations performed in the determination of the method detection limits. Both the "Total" and "Speciated" NMOC values are calculated on the basis of subtraction of analyte in the dilution air (DA) from the analyte collected in the residence chamber (RC) air. Because the EPA dilution sampling system was operated at a dilution factor of approximately 40 for both campaign #1 and campaign #2, dilution air in 40-fold excess is present in the final sample. In some instances, when the sum of the speciated (or unspeciated) analytes in the dilution air is subtracted from the sum of the speciated (or unspeciated) analytes from the residence chamber, a negative value is obtained. The total value is obtained by adding the sum of the values for the residence chamber minus dilution air for speciated analytes to the sum of unspeciated analytes for the residence chamber minus dilution air. If the (RC-DA) difference is negative, the value for Total NMOC is less than the value for speciated NMOC (as in data from January 16, 2001 and January 17, 2001). Complete NMOC calculations are shown in Appendix G for each day; NMOC emission factor calculations are shown in Appendix B. Note that on January 16, 2001, the mass of analyte in total combustion air for speciated NMOC is 0.025004 μg; for speciated and unspeciated NMOC the value is 0.020531 μg. The total emission factor is therefore less than the speciated emission factor.

The mass of total speciated NMOC results and the total speciated plus unspeciated results have been used to calculate the mass emission rates for SNMOC as well as speciated plus unspeciated NMOC (Table 5-9). Samples taken from the residence chamber were corrected for the SNMOC observed in the dilution air to determine the total SNMOC collected. These values were used to calculate a mass emission rate for SNMOC and speciated plus unspeciated NMOC for each test day. The supporting calculations are shown in Appendix G.

The profile of the concentrations for the SNMOC differs from the profile of the concentrations for the carbonyl compounds. Both speciated and total carbonyl compounds show a decreasing trend over the three test days, while the concentration of the unspeciated carbonyl compounds increases on the third test day. For all SNMOC (speciated, unspeciated, and speciated plus unspeciated), concentrations drop on the second test day and reach their highest level on the third test day. During these compound concentration changes, fuel consumption is increasing on each test day, as shown in Table 5-9.

Particle Size Distribution Data

The SMPS system was operated on all three test days of campaign #1, collecting data on particle size distribution in the range below 2.5 μm (the range monitored was 10 nm to 392 nm), with one complete scan over the entire range every three minutes. The analytical data are presented in Table 5-10 and are presented graphically as a plot of midpoint diameter of the particles vs counts (an indirect version of number of particles in each size range) or as midpoint diameter in nanometers vs number of particles (Figures 5-1 through 5-3).

Table 5-10. Particle Size Diameter Measurements, TSI SMPS (Campaign #1, January 16-18, 2001)

Particle Size Range (10 - 392 nm)

Channel Range (32 - 83)

Channels per decade: 32

Weighted by number

Units: Counts

		Average Values for All Scans		
Channel	**Sample Time Midpoint Diameter (nm)**	**Counts (1/16/01)**	**Counts (1/17/01)**	**Counts (1/18/01)**
1	10.3663	101.6	96083.3	117694.3
2	11.1397	75.2	156779.5	201348.7
3	11.9709	80.3	245424.3	314480.1
4	12.8640	110.8	355450.4	466870.4
5	13.8237	80.9	484897.1	659765.6
6	14.8551	74.1	647382.2	885842.2
7	15.9634	60.4	841926	1155580
8	17.1544	505	1047940	1451086
9	18.4342	448.8	1247522	1743655
10	19.8096	271.7	1420894	2000971
11	21.2875	259.1	1547679	2221012
12	22.8757	248.2	1593648	2358421
13	24.5824	324.9	1541539	2391306
14	26.4165	492.6	1401504	2292371
15	28.3874	650.5	1188134	2066818
16	30.5053	689.8	924710.5	1748867
17	32.7812	498.1	654602	1364195
18	35.2269	362	411559.7	978867
19	37.8552	337.5	227993.9	638168.4
20	40.6794	337.7	109850.2	372354.5
21	43.7144	341.7	45115.7	193396.2

Table 5-10. (Continued)

Channel	Sample Time Midpoint Diameter (nm)	Counts (1/16/01)	Counts (1/17/01)	Counts (1/18/01)
22	46.9759	338.1	16148	89624.2
23	50.4087	279	5514.5	40419.2
24	54.2469	290.8	2282.8	21423.4
25	58.2942	250	2159.4	16296.9
26	62.6434	250.8	1231	15712.8
27	67.317	216.1	1053.1	15653.5
30	83.5363	210.7	822.6	17714.2
31	89.7687	199.5	2625.5	18073.2
32	96.4662	232.2	2181.4	18423.3
33	103.663	206.1	1297	18337.5
34	111.397	185.4	1258.3	18547.1
35	119.709	219.8	952.2	18312.1
36	128.64	167.1	884.4	17837.9
37	138.237	169.2	914.1	17157.6
38	148.551	154.8	785.7	16610.4
39	159.634	164.5	724.8	15352.5
40	171.544	162.6	668.5	14226.8
41	184.342	127.4	649.4	12581.4
42	198.096	146.3	614	11571.9
43	212.875	131.3	761.2	10084.2
44	228.757	121.1	592.7	8847.7
45	245.824	130.8	3130.4	7273.6
46	264.165	148.5	2964.6	6256.8
47	283.874	101.6	765.9	5033.7
48	305.053	94.6	501.2	4185.9
49	327.812	107.2	454.4	3394.8
50	352.269	91.5	458.9	2734.5
51	378.552	109.9	452.7	2189.1

1-16-01

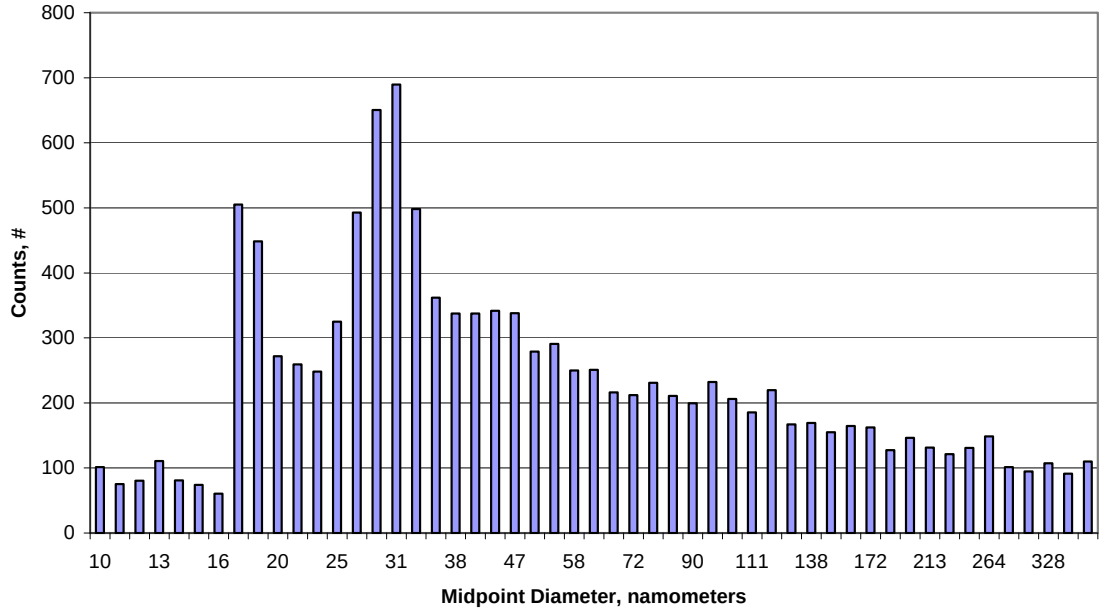

Figure 5-1. Graphical presentation of particle size data, SMPS (January 16, 2001).

1-17-01

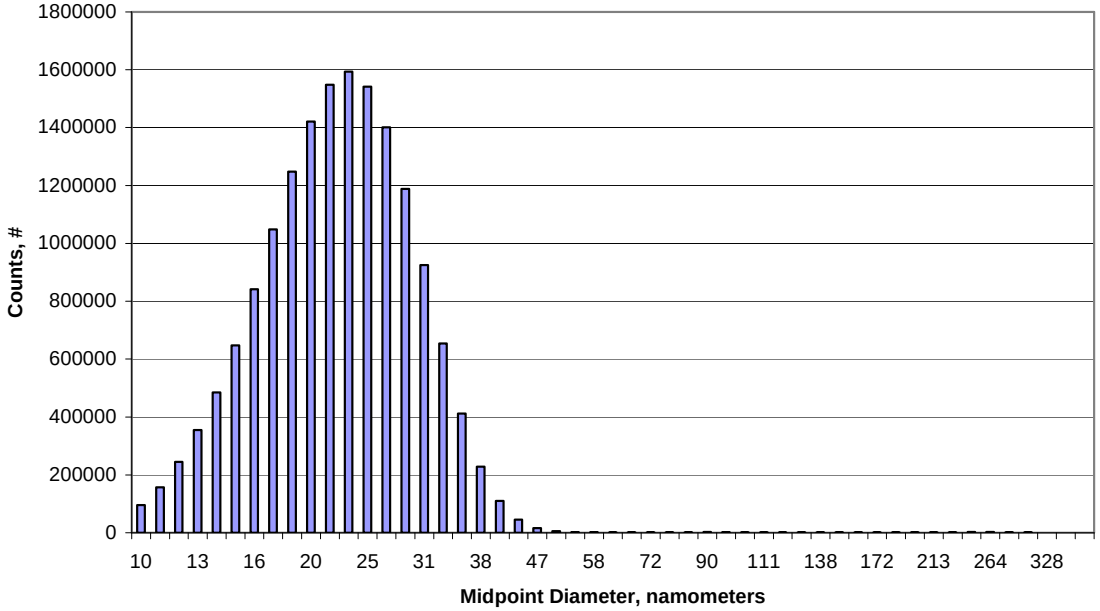

Figure 5-2. Graphical presentation of particle size data, SMPS (January 17, 2001).

The profile observed on Day 1 (January 16, 2001) appears to be an outlier with respect to

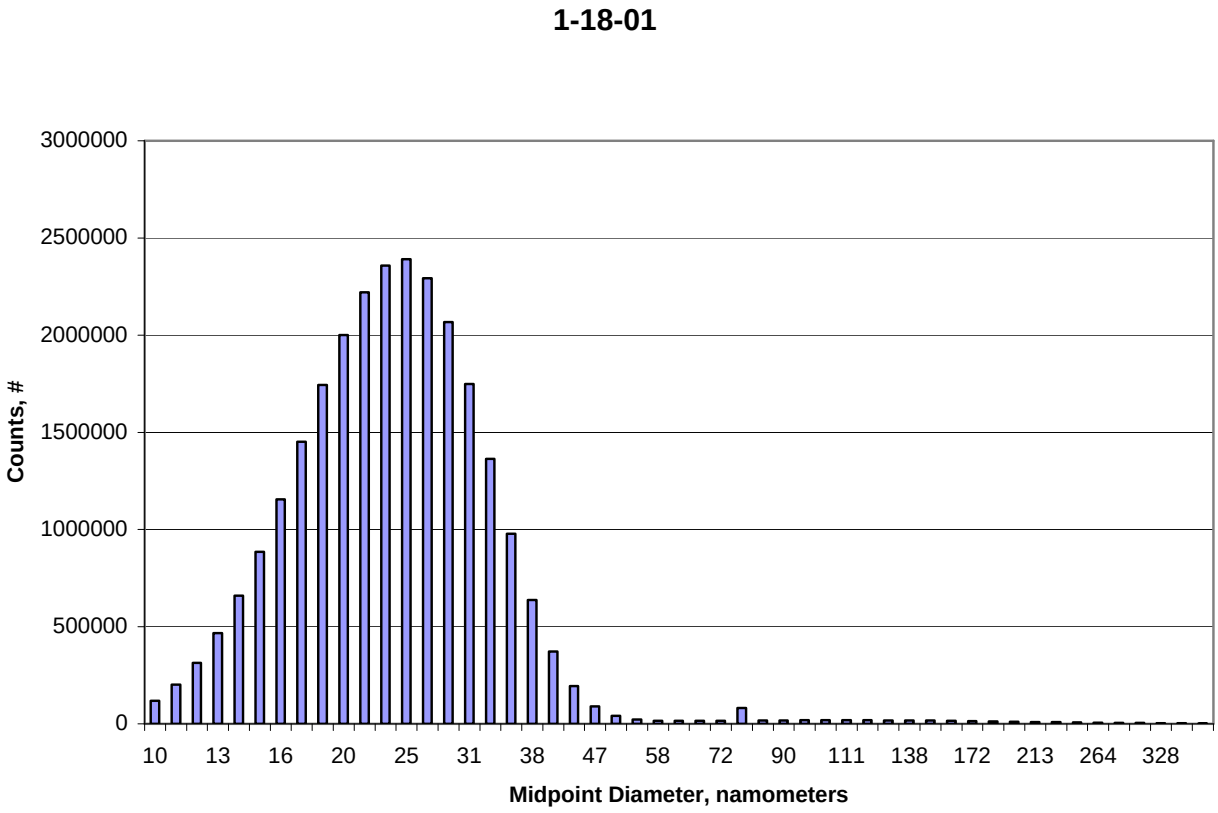

Figure 5-3. Graphical presentation of particle size data, SMPS (January 18, 2001).

the other two test days: the shape of the plot is very different from the plots obtained on the other two days, and the number of counts observed in each channel is approximately four orders of magnitude lower on Day 1 than on the other two test days. The SMPS instrumental operating parameters appeared to be normal and there was no obvious indication of instrumental malfunction. There is not an obvious explanation for the outstandingly low signal level on Day 1. On Day 2 (January 17, 2001) and Day 3 (January 18, 2001), the shapes of the profiles appear to be qualitatively similar. However, the signal maximum on Day 2 is observed at approximately 1.6×10^6 counts, at a midpoint diameter of 23 nm. On Day 3, the signal maximum occurs at approximately 2.4×10^6 counts (50% higher than the signal level on Day 2), at a slightly larger midpoint diameter (approximately 25 nm).

During campaign #2, particle size data were collected using an Electrical Low Pressure Impactor (ELPI). The particle size distribution was bimodal. The greatest amount of mass was found on the second stage, but it is not clear where the peak of the actual mode is located, given the data collected. ELPI data are shown in Table 5-11 and graphically in Figures 5-4, 5-5, and 5-6. The three-day average is shown graphically in Figure 5-7. Note that the SMPS gives an electrical mobility diameter and the ELPI gives an aerodynamic diameter, so the two values should not necessarily agree.

Table 5-11. Gravimetric Data, ELPI (Campaign #2, July 9-11, 2002) PM-2.5 Mass Concentration by Size

Stage	D50 (nm)	Di (nm)	Stage Mass Concentration (mg/m^3) 7/9/02	7/10/02	7/11/02	Mean
1	30.0	42.78	0.0061	0.0028	0.0172	0.0087
2	61.0	80.03	0.0064	0.0042	0.0316	0.0140
3	105.0	132.82	0.0040	0.0017	0.0120	0.0059
7	645.0	803.12	0.0007	0.0010	0.0005	0.0008
8	1000.0	1276.71	0.0003	0.0007	0.0007	0.0006
9	1630.0	2010.57	0.0036	0.0014	0.0010	0.0020
10	2480.0	3157.47	0.0023	0.0000	0.0002	0.0008
11	4020.0	5212.98	0.0017	0.0007	0.0000	0.0008
12	6760.0	8328.12	0.0017	0.0012	0.0002	0.0010
13	10260.0		0.0000	0.0007	0.0002	0.0003
Total Mass Concentration (mg/m^3)			0.0331	0.0170	0.0741	0.0414

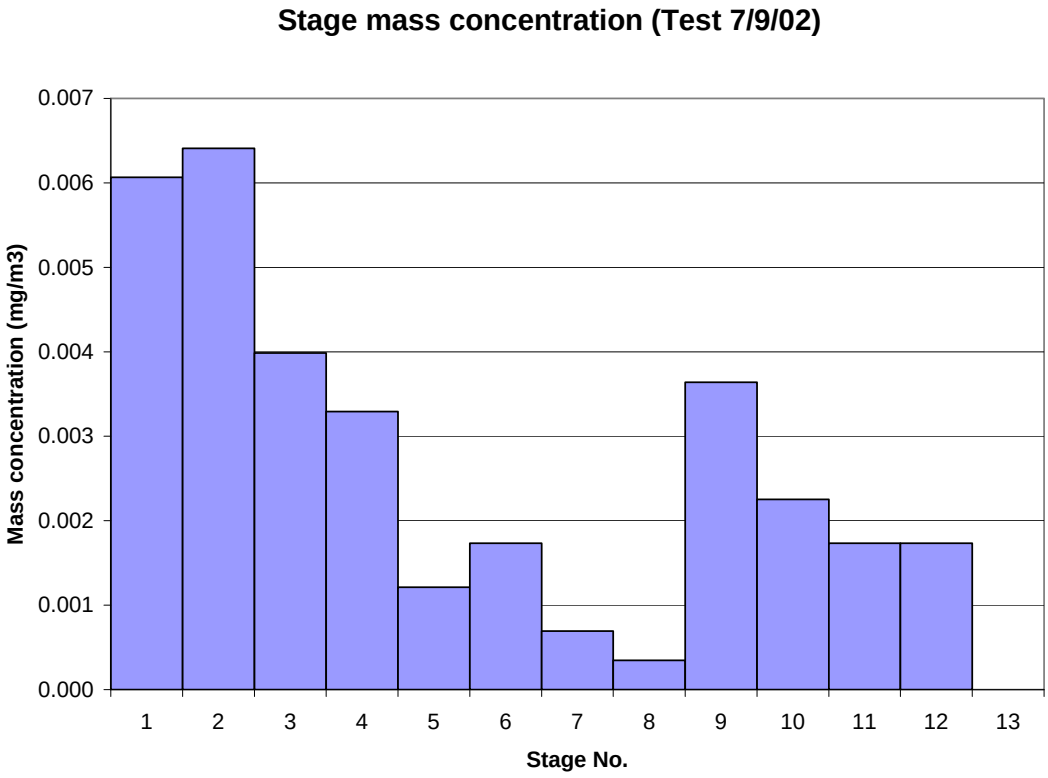

Figure 5-4. ELPI Mass Concentration by Stage (July 9, 2002)

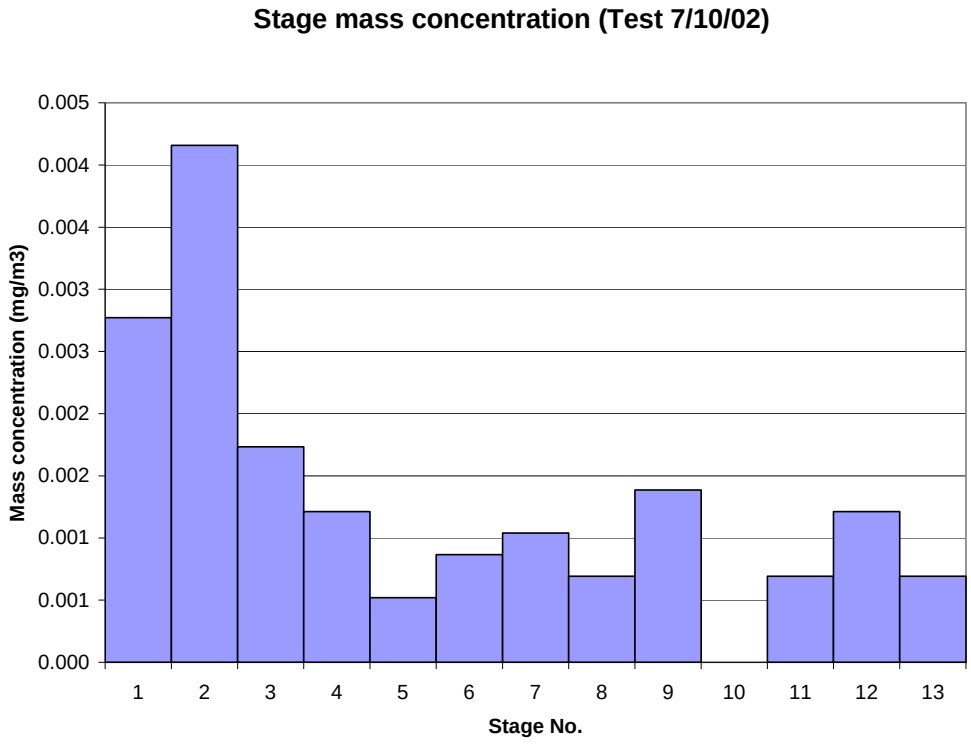

Figure 5-5. ELPI Mass Concentration by Stage (July 10, 2002)

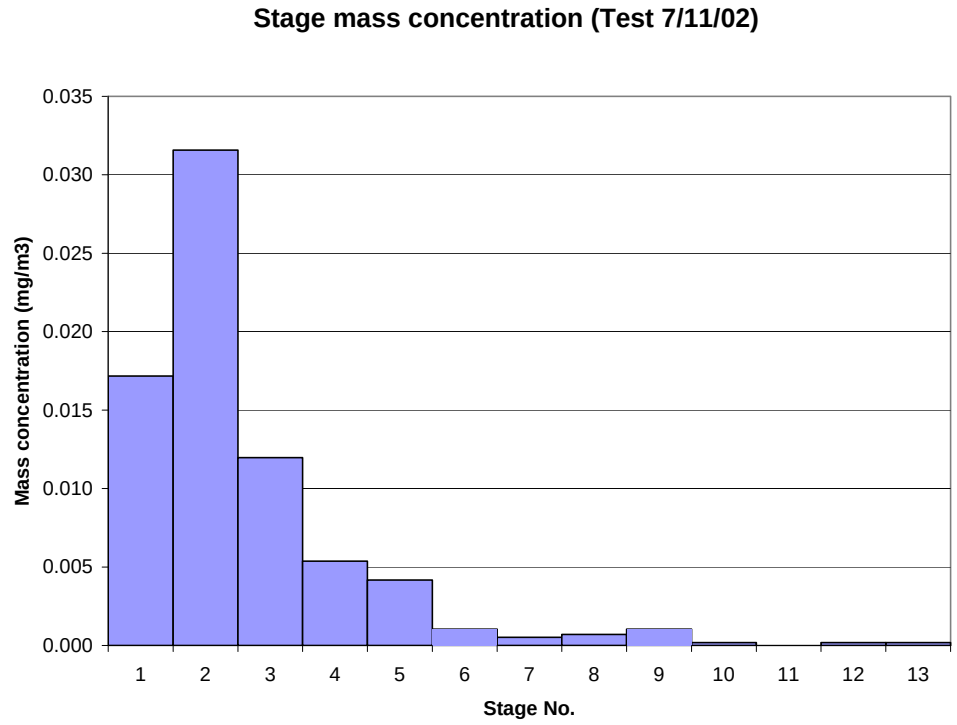

Figure 5-6. ELPI Mass Concentration by Stage (July 11, 2002)

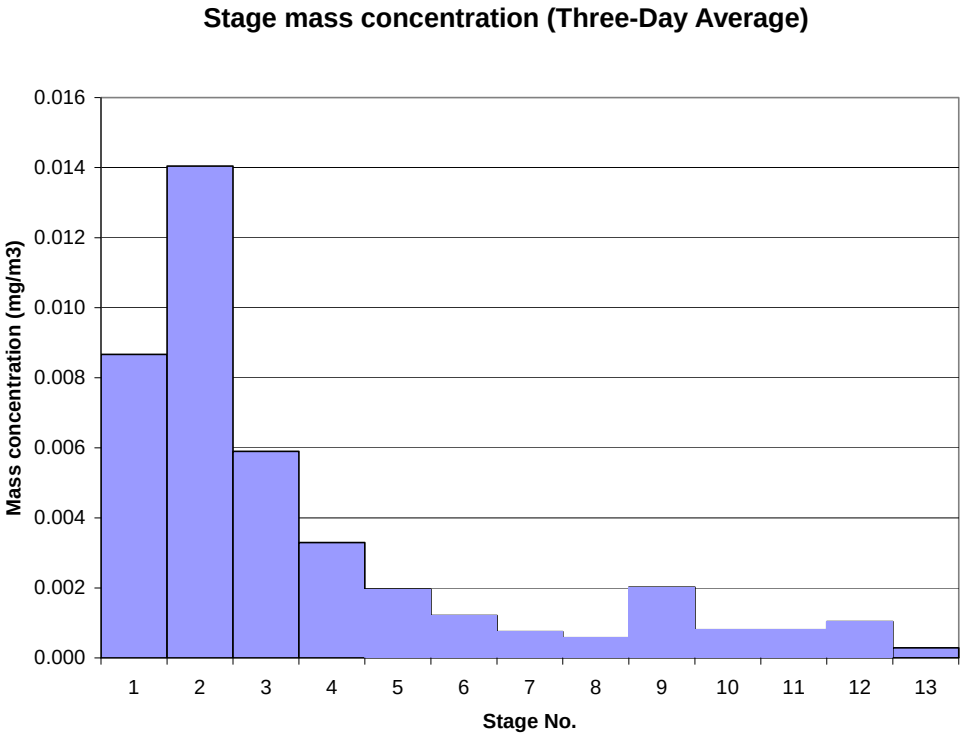

Figure 5-7. ELPI Mass Concentration by Stage (Three-Day Average)

Section 6
Quality Assurance/Quality Control

A detailed description of the objectives and activities of the institutional oil-fired boiler tests is presented in Sections 3 and 4 of this report. Separate quality assurance project plans for the source sampling and PM-2.5 sample analyses were developed for each of the two testing campaigns (i.e., QTRAX numbers 99051[15] and 99002[16]) and were approved by EPA/NRMRL. The testing that was conducted adhered to the specifications of these two QAPPS. QA procedures for the analyses of gaseous nonmethane organic compounds and air toxics were followed as prescribed by EPA Compendium Method TO-15[12]. Analyses of the gaseous carbonyl compounds adhered to the QA procedures of EPA Compendium Method TO-11A[11].

A summary of the quality control measures, acceptance criteria, and whether these criteria were achieved is provided in Tables 6-1 through 6-7 for source sampling activities, concurrent speciated NMOC/air toxics analyses, carbonyl analyses, PM mass measurement, PM elemental analysis, PM inorganic ion analysis, and semivolatile organic compound analysis, respectively.

Sampling and analytical procedures for critical measurements are presented in Section 4. In field sampling with the dilution sampling system, the following quality control procedures were implemented:

- A leak check of the dilution sampling system was performed before field testing was initiated;
- Pitot tubes and meter boxes were calibrated;
- The analytical balance(s) were calibrated;
- Flow control collection devices for the canisters were calibrated using a primary flow standard;
- Multipart forms recording field conditions and observations were used for canisters and carbonyl samples; and
- Strict chain of custody documentation for all field samples was maintained.

Table 6-1. Sample Collection Equipment: Quality Criteria

Equipment	Effect	Acceptance Criteria	Criteria Achieved ?
Orifice meters (volumetric gas flow calibration)	Ensures the accuracy of flow measurements for sample collection	± 1%	Yes
Venturi meters (volumetric gas flow calibration)	Ensures the accuracy of flow measurements for sample collection	± 1% of reading	Yes
Flow transmitter (Heise gauge with differential pressure)	Ensures the accuracy of flow measurements for sample collection	±0.5% of range	Yes
Analytical Balances	Ensures control of bias for all project weighing	Calibrated with Class S weights	Yes
Thermocouples	Ensures sampler temperature control	±1.5°C	Yes
Relative humidity probes	Ensures the accuracy of moisture measurements in the residence chamber	± 2% relative humidity	Yes
Sampling equipment leak check and calibration (before each sampling run)	Ensures accurate measurement of sample volume	1%	Yes
Sampling equipment field blanks	Ensures absence of contamination in sampling system	< 5.0% of sample values	Yes

Table 6-2. Carbonyl Analysis: Quality Criteria

Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
HPLC Column Efficiency	Analyze SSQC	At setup and one per sample batch	Resolution between acetone and propionaldehyde ≥ 1.0 Column efficiency > 500 plates	Eliminate dead volume, backflush, or replace column; repeat analysis	Yes
Linearity Check	Analyze 5-point calibration curve and SSQC in triplicate	At setup or when calibration check does not meet acceptance criteria	Correlation coefficient ≥0.999, relative error for each level against calibration curve ± 20% or less Relative Error	Check integration, re-integrate or re-calibrate	Yes
			Intercept acceptance should be ≤10,000 area counts/compound; correlates to 0.06 mg/mL	Check integration, re-integrate or re-calibrate	Yes
Retention time	Analyze calibration midpoint	Once per 10 samples	Acetaldehyde, Benzaldehyde, Hexaldehyde within retention time window established by determining 3 σ or ±2% of the mean calibration and midpoint standards, whichever is greater	Check system for plug, regulate column temperature, check gradient and solvents	Yes
Calibration Check	Analyze midpoint standard	Once per 10 samples	85-115% recovery	Check integration, re-calibrate or re-prepare standard, re-analyze samples not bracketed by acceptable standard	Yes
					Yes
Calibration Accuracy	SSQC	Once after calibration in triplicate	85-115% recovery	Check integration; re-calibrate or re-prepare standard, re-analyze samples not bracketed by acceptable standard	
	Analyze 0.1 µg/mL standard	Once after calibration in triplicate	±25% difference		Yes

Table 6-2. (Continued)

Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
System Blank	Analyze acetonitrile	Bracket sample batch, one at beginning and one at end	Measured concentration ≤5 x MDL	Locate contamination and document levels of contamination in file	Yes
Duplicate Analyses	Duplicate Samples	As collected	± 20% difference	Check integration; check instrument function; re-analyze duplicate samples	Yes
Replicate Analyses	Replicate injections	Duplicate samples only	≤ 10% RPD for concentrations greater than 1.0 µg/mL	Check integration, check instrument function, re-analyze duplicate samples	Yes
MS/MSD	Analyze MS/MSD	One MS/MSD per 20 samples	80-120% recovery for all compounds	Check calibration, check extraction procedures	Yes

HPLC = High Performance Liquid Chromatography
SSQC = Second Source Quality Control
MDL = Method Detection Limit
RPD = Relative Percent Difference
MS/MSD = Method Spike/Method Spike Duplicate

Table 6-3. Air Toxics and SNMOC Analysis: Quality Criteria

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Air Toxics Analysis				
BFB Instrument Tune Check	Daily prior to calibration check	Evaluation criteria in data system software; consistent with Method TO-15	Retune mass spectrometer; clean ion source and quadrupoles	Yes
Five-point calibration bracketing the expected sample concentration	Following any major change, repair, or maintenance if daily quality control check is not acceptable. Calibration is valid for six weeks if calibration check criteria are met.	RSD of response factors ≤ 30% RRTs for target peaks ± 0.06 units from mean RRT	Repeat individual sample analysis; repeat linearity check; prepare new calibration standards and repeat analysis	Yes
Calibration check using mid-point of calibration range	Daily	Response factor ≤ 30% bias from calibration curve average response factor	Repeat calibration check; repeat calibration curve	Yes
System Blank	Daily following tune check and calibration check	0.2 ppbv/analyte or MDL, whichever is greater IS area response ±40% and ±0.33 min of most recent calibration check	Repeat analysis with new blank; check system for leaks, contamination; re-analyze blank.	Yes
LCS	Daily	Recovery limits 70% - 130% IS RT ±0.33 min of most recent calibration	Repeat analysis; repeat calibration curve.	Yes
Replicate Analysis	All duplicate field samples	<30% RPD for compounds >5xMDL	Repeat sample analysis	Yes
Samples	All samples	IS RT ±0.33 min of most recent calibration	Repeat analysis	Yes
SNMOC Analysis				Yes
System Blank Analysis	Daily, following calibration check	20 ppbC total	Repeat analysis; check system for leaks; clean system with wet air	Yes

Table 6-3. (Continued)

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Multiple point calibration (minimum 5); propane bracketing the expected sample concentration range	Prior to analysis and monthly	Correlation coefficient (r^2) ≥0.995	Repeat individual sample analysis; repeat linearity check; prepare new calibration standards and repeat	Yes
Calibration check: midpoint of calibration curve spanning the carbon range (C_2-C_{10})	Daily	Response for selected hydrocarbons spanning the carbon range within ±30% difference of calibration curve slope	Repeat calibration check; repeat calibration curve.	Yes
Replicate analysis	All duplicate field samples	Total NMOC within ±30% RSD	Repeat sample analysis	Yes

BFB = 1,4-Bromofluorobenzene
RSD = Relative Standard Deviation
RRT = Relative Retention Time
MDL = Method Detection Limit[14]
IS = Internal Standard
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

Table 6-4. PM Mass Measurements: Quality Criteria

Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Deposition on Filter during Conditioning	Analyze Laboratory Filter Blank	Bracket sample batch, one at beginning and one at end	Mass within ±15 mg of previous weight	Adjust mass for deposition	Yes
Laboratory Stability	Analyze Laboratory Control Filter	Bracket sample batch, one at beginning and one at end	Mass within ±15 mg of previous weight	Adjust mass to account for laboratory difference	Yes
Balance Stability	Analyze Standard Weights	Bracket sample batch, one at beginning and one at end	Mass within ±3 mg of previous weight	Perform internal calibration of balance, perform external calibration of balance	Yes

Table 6-5. Elemental Analysis: Quality Criteria

Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Performance Evaluation check	Analyze Monitor Sample	Once per month	≤ 2% change in each element from previous measurement	Recalibrate	Yes

Table 6-6. Water-Soluble Ion Analysis: Quality Criteria

Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Linearity Check	Analyze 4-point calibration curve	At setup or when calibration check does not meet acceptance criteria	Correlation coefficient ≥0.999	Recalibrate	Yes
System Dead Volume	Analyze water	Bracket sample batch, one at beginning and one at end	Within 5% of previous analysis	Check system temperature, eluent, and columns	Yes
Retention Time	Analyze standard	At setup	Each ion within ± 5% of standard retention time	Check system temperature and eluent	Yes
Calibration check	Analyze one standard	Once every 4-10 samples	85-115% recovery	Recalibrate or re-prepare standard, re-analyze sample not bracketed by acceptable standard	Yes
System Blank	Analyze HPLC grade water	Bracket sample batch, one at beginning and one at end	No quantifiable ions	Re-analyze	Yes
Duplicate analyses	Duplicate Samples	As collected			Yes

Table 6-6. (Continued)

Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Replicate Analyses	Replicate Injections	Each sample	≤ 10% RPD for concentrations greater than 1.0mg/L	Check instrument function, re-analyze samples	Yes

HPLC = High Performance Liquid Chromatography
RPD = Relative Percent Difference

Table 6-7. Semivolatile Organic Compounds Analysis: Quality Criteria

Quality Control Check	Frequency	Acceptance Criteria	Corrective Action	Criteria Achieved ?
Mass spectrometer instrument tune check (FC-43)	Daily prior to calibration check	Mass assignments m/z = 69, 219, 502 (± 0.2) Peak widths = 0.59-0.65 Relative mass abundances = 100 % (69); ≥30 % (219); ≥ 1% (502).	Retune mass spectrometer; clean ion source	Yes
Five-point calibration bracketing the expected concentration range	Following maintenance or repair of either gas chromatograph or mass spectrometer or when daily quality control check is not acceptable	Correlation coefficient of either quadratic or linear regression ≥ 0.999	Check integration, re-integrate or recalibrate	Yes
Calibration check using midpoint of calibration range	Daily	Compounds in a representative organic compound suite > 80% are ± 15% of individually certified values. Values ≥ 20% are not accepted.	Repeat analysis, repeat calibration curve	Yes
System Blank	As needed after system maintenance or repair	Potential analytes ≤ detection limit values	Repeat analysis; check system integrity. Reanalyze blank	Yes
Retention time check	Daily	Verify that select compounds are within ±2% of established retention time window	Check inlet and column flows and the various GC/MS temperature zones	Yes

Field sampling equipment quality control requirements that were met in the course of preparing for the field test and execution of testing activities are summarized in Table 6-1.

For this testing program:

- No performance evaluation audits were performed for any of the analytical procedures for the NCA&T field tests. During the development phases of the EPA dilution sampling system and the associated analytical procedures, PE audits were conducted, but not on a test-specific basis.

- Collocated sample collection was not feasible as EPA owns only one dilution sampling system.

- Duplicate or replicate sample collection arrays for the measurement of particulate matter were collected on each of the three test runs for each campaign (see Figure 4-11). However, comparison of individual samples was not achievable because of the need to composite samples to aggregate sufficient quantities of material to perform analytical procedures. There were not sufficient sample collection ports or physical space on the EPA Dilution Sampling System to accommodate duplicate collection of air toxics or carbonyl samples.

- The primary function of testing with the dilution sampling system was collection of PM for determination of mass collected. There is no commercial source of PM standards spiked on filters and there is presently no accepted procedure for the preparation of spiked PM filters.

- TO-15 samples were collected for informational purposes only and the TO-15 results were not used in any calculations of emission factors. A field blank was collected for the TO-15 samples for campaign #1 as presented in the sample chain of custody (COC) forms (see Appendix E). TO-15 sampling/analysis was not performed for campaign #2. Data for the field blanks are presented in Appendix H [Supporting Data for Air Toxics Analysis]; field blanks for TO-15 are erroneously labeled as “Laboratory Blanks”. These samples are clearly identified.

- A field blank was collected for the TO-11A samples for campaign #1 as presented in the sample chain of custody (COC) forms (see Appendix E). TO-11A sampling/analysis was not performed for campaign #2. Data for the field blanks are presented in Appendix I [Supporting Data for Carbonyl Analysis]; field blanks for TO-11A are erroneously labeled as “Laboratory Blanks”. These samples are clearly identified.

The inability to conduct robust sampling QC affects the ability to calculate analytical uncertainties associated with the analysis of individual samples. As a result, uncertainties associated with individual emission factors for individual test days were calculated by the EPA

Work Assignment Manager and reported. It is recommended that procedures for conducting robust sampling QC be developed for future field testing.

Strict chain of custody procedures were followed in collecting and transporting samples and sampling media to and from the field sampling location. Sample substrates (filters, denuders, PUF canister, DNPH cartridges) were prepared in advance in accordance with the number and types of samples designated in the sampling matrix of the approved field test plan. Clean SUMMA collection canisters and DNPH cartridges used to collect carbonyl compounds were prepared and supplied by ERG. The PUF, XAD-4, denuder, and PM-2.5 sampling substrates were prepared and supplied by EPA. Chain of custody forms (Figure 6-1) were initiated when the sampling media were prepared each sample substrate was assigned a unique identification number by the laboratory supplying the substrates. Copies of the chain of custody forms are included in Appendix E.

Sample identification numbers include a code to track:

- Source type;
- Test date;
- Sampler type;
- Substrate type;
- Sampler chamber (i.e., dilution chamber or residence chamber);
- Sampler port;
- Lane/leg;
- Position; and
- Holder number.

For samples to be analyzed in the EPA laboratories, whole sampling arrays were assembled by EPA, assigned a unique tracking number and used for sample collection. Sample collection arrays were recovered in the field as a complete unit and transferred to the EPA laboratory for disassembly and analysis.

Chain of Custody Record

EASTERN RESEARCH GROUP, INC.

Page _____ of _____

PROJECT			NO. OF CONTAINERS	ANALYSES						REMARKS	SAM ID NO. *(For lab use only)*
SITE											
COLLECTED BY (*Signature)*											
FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME									

REMARKS:									RELINQUISHED BY:	DATE	TIME
RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION
REMARKS:									

Figure 6-1. ERG chain of custody form.

After collection, samples were transported to the analysis laboratories by ERG, with careful documentation of sample collection and chain of custody records for the samples being transported. Samples were stored in a secure area until they were transported to the laboratories performing analyses.

Carbonyl Compound Analysis

Quality control criteria for the carbonyl analysis performed by ERG are shown in Table 6-2. Supporting analytical calibration and quality control data are a part of the project file at ERG.

Concurrent Air Toxics/Speciated Nonmethane Organic Compound (SNMOC) Analysis

The analytical system performing the concurrent analysis is calibrated monthly and blanked daily prior to sample analysis. A quality control standard is analyzed daily prior to sample analysis to ensure the validity of the current monthly response factor. Following the daily quality control standard analysis and prior to the sample analysis, cleaned, dried air from the canister cleaning system is humidified and then analyzed to determine the level of organic compounds present in the analytical system. Upon achieving acceptable system blank results -- less than or equal to 20 ppbC -- sample analysis begins. Ten percent of the total number of samples received are analyzed in replicate to determine the precision of analysis for the program. After the chromatography has been reviewed, the sample canister is returned to the canister cleaning laboratory to be prepared for subsequent sample collection episodes or sent to another laboratory for further analysis. Quality control procedures for the air toxics and SNMOC analyses are summarized in Table 6-3; supporting analytical calibration and quality control data are a part of the project file at ERG.

PM Mass Measurements, Elemental Analysis, Water-Soluble Ion Analysis, and GC/MS Analysis

Quality control criteria for EPA analyses (PM mass, elemental analyses, ion chromatography analysis, and GC/MS analysis are summarized in Tables 6-4 through 6-7; supporting data are included in the project file in the EPA laboratory.

Sample collection completeness was 100% (i.e., all planned samples were collected for both campaign #1 and campaign #2). Most of the solvent extracts of the XAD-coated annular denuders, quartz filters, and PUF plugs from campaign #1 were subjected to analysis for semivolatile organic compounds. However, these results are not reported due to the observation that breakthrough of the sampling substrates had occurred, thus rendering reliable quantitative measurements impossible. For campaign #2, 99% of the samples were analyzed. Of the samples not analyzed, two were quartz which were archived and two were PUF extracts which were misplaced at the EPA laboratory.

Section 7
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EPA/600/R-07/005
February 2007

Source Sampling Fine Particulate Matter

Institutional Oil-Fired Boiler

Appendix A
Table of Unit Conversions

Appendix B
Example CalculationsNMOC, SNMOC, and Carbonyl Emission Factors

Appendix C
Method Detection Limits

Appendix D
EPA Method Operating ProceduresERG Standard Operating Procedures

Appendix A

Table of Unit Conversions

Unit Conversion Table

Multiply	By	To Obtain
atmospheres	101.3	kilopascals
atmospheres	29.92	inches of mercury
atmospheres	760	mm of mercury
atmospheres	33.94	feet of water
atmospheres	14.70	$lb/in.^2$ (psi)
Btu	1054	joules
Btu	2.982×10^{-4}	kilowatt-hours
centimeters	0.3937	inches
cm/sec	1.969	ft/min
cm/sec	0.03281	ft/sec
cm/sec	0.036	km/hr
cm/sec	0.6	m/min
cm^3	3.53×10^{-2}	ft^3
cm^3	10^{-3}	liters
ft^3	0.02832	m^3
ft^3/min	0.4720	liters per second
$in.^3$	16.39	cm^3
m^3	35.31	ft^3
ft	12	in.
ft	0.3048	m
ft of water	0.8826	in. mercury
grams	0.03527	ounces
inches	2.540	cm
inches of water	0.07355	inches of mercury
kg	2.20462	lb
km	3280.84	ft
km	0.6214	miles
kilowatts	56.92	Btu per min. (Continued)

Multiply	By	To Obtain
liters	0.03531	ft^3
liters	61.02	$in.^3$
liters	10^{-3}	m^3
liters per minute	5.855×10^{-4}	ft^3 per second
m	3.28084	ft
m	39.37	in.
m^3	0.02832	ft^3
miles	5280	feet
miles	1.6093	km
ounces	28.35	grams
pounds	453.6	grams
pounds per square inch	703.1	kg/m^2
cm^2	0.1550	$in.^2$
ft^2	929.0	cm^2
ft^2	0.09290	m^2
temperature (°C + 273)	1	absolute temperature (K)
temperature (°C + 17.8)	1.8	temperature (°F)
temperature (°F + 460)	1	temperature (°Rankine)
temperature (°F-32)	5/9	temperature (°C)
watts	0.05692	Btu per min.
watts	44.26	foot-pounds per min.

Appendix B

Example Calculations
NMOC, SNMOC, and Carbonyl Emission Factors

Table B-1. Calculation of Mass Emission Rates for Speciated NMOC (1/16/01)

Test	**Greensboro A&T**
Analyte	**Speciated NMOC**
Date	**1/16/01**
Entry Date	**9/17/01**

Speciated NMOC Parameters Required		**Units**
Mass of Analyte in Total Combustion Air	0.025004	**:** g
Mass Fuel Consumed	6,568.63	kg
Combustion Air Flow Rate (Average)	4065	scfm
Run Time	600.33	min
Venturi Flow Rate (Average)	18.53	slpm
Dilution Air Flow Rate (Average)	847.89	slpm
Flow Rate at Sample Collection Unit	0.007	lpm

Calculations

Total Volume of Air Sampled	69102783	liters
Volume of Combustion Air Sampled	11124.115	liters
Volume of Dilution Air	509013.8	liters
Dilution Ratio	46.75769	
Mass Flow Rate of SNMOC in Diluted Sample	0.0059501	**:** g/liter
Mass Flow Rate of SNMOC in Undiluted Sample	0.2782111	**:** g/liter
Total Mass of Speciated SNMOC in Sampled Air	3094.8522	**:** g
Speciated SNMOC in Total Combustion Air	19225161	**:** g
Mass Emission Rate of Speciated SNMOC	246.20	**:** g/kg
	0.246	mg/kg

Calculation of Mass of Speciated NMOC Collected
Test 1 1/16/01

Volume Canister = flow rate into canister * test duration			**Volume**	
Test duration	600.33	min		
Flow rate, dilution air canister	0.008	lpm	4.80264	liters
Flow rate, residence chamber canister	0.007	lpm	4.20231	liters
Mass Speciated SNMOC Collected = [Speciated SNMOC Conc.]*Volume Canister				
SNMOC RC = 145.55 **:** g/m^3 = 145.55 ng/L = 0.14555 **:** g/L		0.6116462	**:** g	
SNMOC DA = 122.15 **:** g/m^3 = 122.15 ng/L = 0.12215 **:** g/L		0.5866425	**:** g	
Mass Speciated NMOC Collected		0.0250037	**:** g	

Residence Chamber	145.55 **:** g/m^3	
Dilution Air	122.15 **:** g/m^3	
Residence Chamber - Dilution Air	23.40 **:** g/m^3	

Table B-2. Calculation of Mass Emission Rates for Speciated NMOC (1/17/01)

Date	**1/17/01**		
Entry Date	**9/17/01**		
Speciated NMOC			
Parameters Required			Units
Mass of Analyte in Total Combustion Air		0.176128	: g
Mass Fuel Consumed		6,934.45	kg
Combustion Air Flow Rate (Average)		4159.00	scfm
Run Time		600.5	min
Venturi Flow Rate (Average)		17.88	slpm
Dilution Air Flow Rate (Average)		848.35	slpm
Flow Rate at Sample Collection Unit		0.008333	lpm
Calculations			
Total Volume of Combustion Air		70720752.38	liters
Volume of Combustion Air Sampled		10736.94	liters
Volume of Dilution Air		509434.175	liters
Dilution Ratio		48.44686801	
Mass Flow Rate of SNMOC in Diluted Sample		0.035197678	: g/liter
Mass Flow Rate of SNMOC in Undiluted Sample		1.705217245	: g/liter
Total Mass of Speciated SNMOC in Sampled Air		18308.81525	: g
Speciated SNMOC in Total Combustion Air		120594246.5	: g
Mass Emission Rate of Speciated SNMOC		300.68	: g/kg
		0.30	mg/kg

Calculation of Mass of Speciated NMOC Collected
Test 2 1/17/01

Volume Canister = flow rate into canister * test duration			**Volume**	
Test duration	600.5	min		
Flow rate, dilution air canister	0.007833	lpm	4.7037165	liters
Flow rate, residence chamber canister	0.008333	lpm	5.0039665	liters
Mass Speciated SNMOC Collected = [Speciated SNMOC Conc.]*Volume Canister				
SNMOC RC = 124.77 : g/m^3 = 124.77 ng/L = 0.12477 : g/L		0.6243449	: g	
SNMOC DA = 95.29 : g/m^3 = 95.29 ng/L = 0.09529 : g/L		0.448217145	: g	
Mass Speciated NMOC Collected		0.176127755	: g	

Residence Chamber	124.77	: g/m^3
Dilution Air	95.29	: g/m^3
Residence Chamber - Dilution Air	29.48	: g/m^3

Table B-3. Calculation of Mass Emission Rates for Speciated NMOC (1/18/01)

Date	**1/18/01**
Entry Date	**9/17/01**

Speciated NMOC

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.334446	**:** g
Mass Fuel Consumed	7,926.21	kg
Combustion Air Flow Rate (Average)	4827	scfm
Run Time	600.17	min
Venturi Flow Rate (Average)	19.01	slpm
Dilution Air Flow Rate (Average)	850.66	slpm
Flow Rate at Sample Collection Unit	0.008667	lpm

Calculations

Total Volume of Combustion Air	82034497	liters
Volume of Combustion Air Sampled	11409.232	liters
Volume of Dilution Air	510540.61	liters
Dilution Ratio	45.748027	
Mass Flow Rate of SNMOC in Diluted Sample	0.0642958	**:** g/liter
Mass Flow Rate of SNMOC in Undiluted Sample	2.9414082	**:** g/liter
Total Mass of Speciated SNMOC in Sampled Air	33559.208	**:** g
Speciated SNMOC in Total Combustion Air	241296944	**:** g
Mass Emission Rate of Speciated SNMOC	499.7	**:** g/kg
	0.50	mg/kg

Calculation of Mass of Speciated NMOC Collected
Test 3 1/18/01

Volume Canister = flow rate into canister * test duration			**Volume**	
Test duration	600.17	min		
Flow rate, dilution air canister	0.008	lpm	4.80136	liters
Flow rate, residence chamber canister	0.008667	lpm	5.2016734	liters
Mass Speciated SNMOC Collected = [Speciated SNMOC Conc.]*Volume Canister				
SNMOC RC = 256.39 **:** g/m^3 = 256.39 ng/L = 0.25639 **:** g/L	1.333657	**:** g		
SNMOC DA = 208.11 **:** g/m^3 = 208.11 ng/L = 0.20811 **:** g/L	0.999211	**:** g		

Mass Speciated NMOC Collected	0.334446	**:** g

Residence Chamber	256.39	**:** g/m^3
Dilution Air	208.11	**:** g/m^3
Residence Chamber - Dilution Air	48.28	**:** g/m^3

Table B-4. Calculation of Mass Emission Rates for Total (Speciated + Unspeciated) NMOC (1/16/01)

Test	**Greensboro A&T**
Analyte	**Total NMOC**
Date	**1/16/01**
Entry Date	**9/17/01**

Total (Speciated + Unspeciated) NMOC

Parameters Required		**Units**
Mass of Analyte in Total Combustion Air	0.020531	**:** g
Mass Fuel Consumed	6,569	kg
Combustion Air Flow Rate (Average)	4065	scfm
Run Time	600.33	min
Venturi Flow Rate (Average)	18.53	slpm
Dilution Air Flow Rate (Average)	847.89	slpm
Flow Rate at Sample Collection Unit	0.007	lpm

Calculations

Total Volume of Air Sampled	7E+07	liters
Volume of Combustion Air Sampled	11124.1	liters
Volume of Dilution Air	509014	liters
Dilution Ratio	46.7577	
Mass Flow Rate of NMOC in Diluted Sample	0.00489	**:** g/liter
Mass Flow Rate of NMOC in Undiluted Sample	0.22844	**:** g/liter
Total Mass of Total NMOC in Sampled Air	2541.21	**:** g
Total NMOC in Total Combustion Air	1.6E+07	**:** g
Mass Emission Rate of Total NMOC	271.0	**:** g/kg
	0.27	mg/kg

Calculation of Mass of Total NMOC Collected

Test 1 1/16/01

Volume Canister = flow rate into canister * test duration			**Volume**	
Test duration	600.33	min		
Flow rate, dilution air canister	0.008	lpm	4.80264	liters
Flow rate, residence chamber canister	0.007	lpm	4.20231	liters

Mass Total NMOC Collected = [Total NMOC Conc.]*Volume Canister

NMOC RC = 171.88 **:** g/m^3 = 171.88 ng/L = 0.17188 **:** g/L	0.72229	**:** g
NMOC DA = 146.12 ug/m^3 = 146.12 ng/L = 0.14612 ug/L	0.70176	**:** g
Mass Total NMOC Collected	0.02053	**:** g

Residence Chamber	171.88 **:** g/m^3	
Dilution Air	146.12 **:** g/m^3	
Residence Chamber - Dilution Air	25.76 **:** g/m^3	

Table B-5. Calculation of Mass Emission Rates for Total (Speciated + Unspeciated) NMOC (1/17/01)

Test	**Dean Smith #2 (Greensboro A&T)**
Analyte	**Total NMOC**
Date	**1/17/01**
Entry Date	**9/17/01**

Total (Speciated + Unspeciated) NMOC

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.168868	:g
Mass Fuel Consumed	6,934	kg
Combustion Air Flow Rate (Average)	4159.00	scfm
Run Time	600.5	min
Venturi Flow Rate (Average)	17.88	slpm
Dilution Air Flow Rate (Average)	848.35	slpm
Flow Rate at Sample Collection Unit	0.008333	lpm

Calculations

Total Volume of Combustion Air	70720752.4	liters
Volume of Combustion Air Sampled	10736.94	liters
Volume of Dilution Air	509434.18	liters
Dilution Ratio	48.446868	
Mass Flow Rate of NMOC in Diluted Sample	0.0337468	:g/liter
Mass Flow Rate of NMOC in Undiluted Sample	1.6349282	:g/liter
Total Mass of Total NMOC in Sampled Air	17554.125	:g
Total NMOC in Total Combustion Air	11562349	:g
Mass Emission Rate of Total NMOC	279.23	:g/kg
	0.28	mg/kg

Calculation of Mass of Total NMOC Collected
Test 2 1/17/01

Volume Canister = flow rate into canister * test duration			**Volume**	
Test duration	600.5	min		
Flow rate, dilution air canister	0.007833	lpm	4.7037165	liters
Flow rate, residence chamber canister	0.008333	lpm	5.0039665	liters
Mass Total NMOC Collected = [Total NMOC Conc.]*Volume Canister				
NMOC RC = 133.49 ug/m^3 = 133.49 ng/L = 0.13349 :g/L		0.6679795	:g	
NMOC DA =106.11 ug/m^3 = 106.11 ng/L = 0.10611 :g/L		0.4991114	:g	
Mass Total NMOC Collected		0.1688681	:g	

Residence Chamber	124.77 :g/m^3
Dilution Air	95.29 :g/m^3
Residence Chamber - Dilution Air	29.48 :g/m^3

Table B-6. Calculation of Mass Emission Rates for Total (Speciated + Unspeciated) NMOC (1/18/01)

Date **1/18/01**
Entry Date **9/17/01**

Total (Speciated + Unspeciated) NMOC

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.36074	:g
Mass Fuel Consumed	7,926	kg
Combustion Air Flow Rate (Average)	4827	scfm
Run Time	600.17	min
Venturi Flow Rate (Average)	19.01	slpm
Dilution Air Flow Rate (Average)	850.66	slpm
Flow Rate at Sample Collection Unit	0.008667	lpm

Calculations

Total Volume of Combustion Air	82034497.5	liters
Volume of Combustion Air Sampled	11409.2317	liters
Volume of Dilution Air	510540.612	liters
Dilution Ratio	45.7480274	
Mass Flow Rate of NMOC in Diluted Sample	0.06935076	:g/liter
Mass Flow Rate of NMOC in Undiluted Sample	3.17266044	:g/liter
Total Mass of Total NMOC in Sampled Air	36197.6181	:g
Total NMOC in Total Combustion Air	260267605	:g
Mass Emission Rate of Total NMOC	545.33	:g/kg
	0.55	mg/kg

Calculation of Mass of Total NMOC Collected
Test 3 1/18/01

Volume Canister = flow rate into canister * test duration			**Volume**	
Test duration	600.17	min		
Flow rate, dilution air canister	0.008	lpm	4.80136	liters
Flow rate, residence chamber canister	0.008667	lpm	5.2016734	liters
Mass Total NMOC Collected = [Total NMOC Conc.]*Volume Canister				
NMOC RC = 269.18 :g/m^3 = 269.18 ng/L = 0.26918 :g/L	1.40018644	:g		
NMOC DA = 216.491:g/m^3 = 216.49 ng/L = 0.21649 :g/L	1.03944643	:g		
Mass Total NMOC Collected	0.36074002	:g		
Residence Chamber	269.18 :g/m^3			
Dilution Air	216.49 :g/m^3			
Residence Chamber - Dilution Air	52.69 :g/m^3			

Table B-7. Calculation of Mass Emission Rates for Speciated Carbonyl Compounds (1/16/01)

Test	**Greensboro A&T**
Analyte	**Speciated Carbonyls**
Date	**1/16/01**
Entry Date	**9/17/01**

Parameters Required		**Units**
Mass of Analyte in Total Combustion Air	0.9815	**:** g
Mass Fuel Consumed	6,569	kg
Combustion Air Flow Rate (Average)	4065	scfm
Run Time	600.33	min
Venturi Flow Rate (Average)	18.53	slpm
Dilution Air Flow Rate (Average)	847.89	slpm
Flow Rate at Sample Collection Unit	0.9601	lpm
Calculations		
Total Volume of Air Sampled	69659855	liters
Volume of Combustion Air Sampled	11124.11	liters
Volume of Dilution Air	509013.8	liters
Dilution Ratio	46.75769	
Mass Flow Rate of Speciated Carbonyls in Diluted Sample	0.001703	**:** g/liter
Mass Flow Rate of Speciated Carbonyls in Undiluted Sample	0.079623	**:** g/liter
Total Mass of Speciated Carbonyls in Sampled Air	885.7319	**:** g
Total Speciated Carbonyls in Total Combustion Air	5546505	**:** g
Mass Emission Rate of Total Speciated Carbonyls	844.3929	**:** g/kg
	0.844393	mg/kg

Table B-8. Calculation of Mass Emission Rates for Speciated Carbonyl Compounds (1/17/01)

Date **1/17/01**
Entry Date **9/17/01**

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.6050	:g
Mass Fuel Consumed	6,934	kg
Combustion Air Flow Rate (Average)	4159	scfm
Run Time	600.5	min
Venturi Flow Rate (Average)	17.88	slpm
Dilution Air Flow Rate (Average)	848.35	slpm
Flow Rate at Sample Collection Unit	0.9592	lpm

Calculations

Total Volume of Combustion Air	76162118	liters
Volume of Combustion Air Sampled	10736.94	liters
Volume of Dilution Air	509434.2	liters
Dilution Ratio	48.44687	
Mass Flow Rate of Speciated Carbonyls in Diluted Sample	0.00105	:g/liter
Mass Flow Rate of Speciated Carbonyls in Undiluted Sample	0.050886	:g/liter
Total Mass of Speciated Carbonyls in Sampled Air	546.3607	:g
Total Speciated Carbonyls in Total Combustion Air	3875591	:g
Mass Emission Rate of Total Speciated Carbonyls	558.8891	:g/kg
	0.558889	mg/kg

Table B-9. Calculation of Mass Emission Rates for Speciated Carbonyl Compounds (1/18/01)

Date **1/18/01**
Entry Date **9/17/01**

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.2985	:g
Mass Fuel Consumed	7,926	kg
Combustion Air Flow Rate (Average)	4827	scfm
Run Time	600.17	min
Venturi Flow Rate (Average)	19.01	slpm
Dilution Air Flow Rate (Average)	850.66	slpm
Flow Rate at Sample Collection Unit	1.1209	lpm

Calculations

Total Volume of Combustion Air	88185640	liters
Volume of Combustion Air Sampled	11409.23	liters
Volume of Dilution Air	510540.6	liters
Dilution Ratio	45.74803	
Mass Flow Rate of Speciated Carbonyls in Diluted Sample	0.000444	:g/liter
Mass Flow Rate of Speciated Carbonyls in Undiluted Sample	0.020299	:g/liter
Total Mass of Speciated Carbonyls in Sampled Air	231.5965	:g
Total Speciated Carbonyls in Total Combustion Air	1790084	:g
Mass Emission Rate of Total Speciated Carbonyls	225.8438	:g/kg
	0.225844	mg/kg

Table B-10. Calculation of Mass Emission Rates for Total (Speciated + Unspeciated) Carbonyl Compounds (1/16/01)

Date	**1/16/01**
Entry Date	**9/17/01**

Parameters Required		**Units**
Mass of Analyte in Total Combustion Air	1.6460	:g
Mass Fuel Consumed	6,569	kg
Combustion Air Flow Rate (Average)	4065	scfm
Run Time	600.33	min
Venturi Flow Rate (Average)	18.53	slpm
Dilution Air Flow Rate (Average)	847.89	slpm
Flow Rate at Sample Collection Unit	0.9601	lpm
Calculations		
Total Volume of Air Sampled	69659855	liters
Volume of Combustion Air Sampled	11124.11	liters
Volume of Dilution Air	509013.8	liters
Dilution Ratio	46.75769	
Mass Flow Rate of Total Carbonyls in Diluted Sample	0.002856	:g/liter
Mass Flow Rate of Total Carbonyls in Undiluted Sample	0.133529	:g/liter
Total Mass of Total Carbonyls in Sampled Air	1485.395	:g
Total Carbonyls in Total Combustion Air	9301627	:g
Mass Emission Rate of Total Carbonyls	1416.068	:g/kg
	1.416068	mg/kg

Table B-11. Calculation of Mass Emission Rates for Total (Speciated + Unspeciated) Carbonyl Compounds (1/17/01)

Date **1/17/01**
Entry Date **9/17/01**

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.9260	:g
Mass Fuel Consumed	6,934	kg
Combustion Air Flow Rate (Average)	4159	scfm
Run Time	600.5	min
Venturi Flow Rate (Average)	17.88	slpm
Dilution Air Flow Rate (Average)	848.35	slpm
Flow Rate at Sample Collection Unit	0.9592	lpm

Calculations

Total Volume of Combustion Air	76162118	liters
Volume of Combustion Air Sampled	10736.94	liters
Volume of Dilution Air	509434.2	liters
Dilution Ratio	48.44687	
Mass Flow Rate of Total Carbonyls in Diluted Sample	0.001608	:g/liter
Mass Flow Rate of Total Carbonyls in Undiluted Sample	0.077885	:g/liter
Total Mass of Total Carbonyls in Sampled Air	836.2479	:g
Total Carbonyls in Total Combustion Air	5931896	:g
Mass Emission Rate of Total Carbonyls	855.4237	:g/kg
	0.855424	mg/kg

Table B-12. Calculation of Mass Emission Rates for Total (Speciated + Unspeciated) Carbonyl Compounds (1/18/01)

Date	**1/18/01**
Entry Date	**9/17/01**

Parameters Required		Units
Mass of Analyte in Total Combustion Air	0.7380	**:** g
Mass Fuel Consumed	7,926	kg
Combustion Air Flow Rate (Average)	4827	scfm
Run Time	600.17	min
Venturi Flow Rate (Average)	19.01	slpm
Dilution Air Flow Rate (Average)	850.66	slpm
Flow Rate at Sample Collection Unit	1.1209	lpm

Calculations

Total Volume of Combustion Air	88185640	liters
Volume of Combustion Air Sampled	11409.23	liters
Volume of Dilution Air	510540.6	liters
Dilution Ratio	45.74803	
Mass Flow Rate of Total Carbonyls in Diluted Sample	0.001097	**:** g/liter
Mass Flow Rate of Total Carbonyls in Undiluted Sample	0.050187	**:** g/liter
Total Mass of Total Carbonyls in Sampled Air	572.5903	**:** g
Total Carbonyls in Total Combustion Air	4425735	**:** g
Mass Emission Rate of Total Carbonyls	558.3675	**:** g/kg
	0.558368	mg/kg

Appendix C

Method Detection Limits

Table C-1. Carbonyl Compounds Analyzed by High Performance Liquid Chromatography: Method Detection Limits

Compound	CAS No.	Method Detection Limits (μg)
Formaldehyde	50-00-0	0.0838
Acetaldehyde	75-07-0	0.0916
Acetone	67-64-1	0.0428
Propionaldehyde	123-38-6	0.0934
Crotonaldehyde	4170-30-3	0.1283
Butyraldehyde	123-72-8	0.0956
Benzaldehyde	100-52-7	0.0959
Isovalderaldehyde	590-86-3	0.1076
Valeraldehyde	110-62-3	0.1758
o-Tolualdehyde	529-20-4	0.1439
m-Tolualdehyde	620-23-5	0.1439
p-Tolualdehyde	104-87-0	0.1439
Hexaldehyde	66-25-1	0.1377
2,5-Dimethylbenzaldehyde	5779-94-2	0.1337*
Diacetyl	432-03-8	0.0154*
Methacrolein	78-85-3	0.0125*
2-Butanone	78-93-3	0.0125*
Glyoxal	107-22-2	0.0412*
Acetophenone	98-86-2	0.0250*
Methylglyoxal	78-98-8	0.0244*
Octanal	124-13-0	0.0100*
Nonanal	124-19-6	0.0182*

*Estimated value.

Table C-2. Detection Limits (ppbv) for Air Toxics Compounds (Analytical Method EPA Compendium Method TO-15)

Compound	CAS No.	Method Detection Limit (ppbv)
Acetylene	74-86-2	0.07
Propylene	115-07-1	0.03
Dichlorodifluoromethane	75-71-8	0.04
Chloromethane	74-87-3	0.06
Dichlorotetrafluoroethane	1320-37-2	0.03
Vinyl chloride	75-01-4	0.07
1,3-Butadiene	106-99-0	0.05
Bromomethane	74-83-9	0.04
Chloroethane	75-00-3	0.06
Acetonitrile	75-05-8	0.21
Acetone	67-64-1	0.15
Trichlorofluoromethane	75-69-4	0.06
Acrylonitrile	107-13-1	0.06
1,1-Dichloroethene	75-35-4	0.04
Methylene chloride	75-09-2	0.02
Trichlorotrifluoroethane	26523-64-8	0.02
trans-1,2-Dichloroethylene	56-60-5	0.05
1,1-Dichloroethane	75-34-3	0.03
Methyl *tert*-butyl ether	1634-04-1	0.03
Methyl ethyl ketone	78-93-3	0.03
Chloroprene	126-99-8	0.03
cis-1,3-Dichloroethylene	156-59-2	0.04
Bromochloromethane	74-97-5	0.04
Chloroform	67-66-3	0.04
Ethyl *tert*-butyl ether	637-92-3	0.05
1,2-Dichloroethane	107-06-2	0.08
1,1,1-Trichloroethane	71-55-6	0.06
Benzene	71-43-2	0.06
Carbon tetrachloride	56-23-5	0.09
tert-Amyl methyl ether	994-05-8	0.06
1,2-Dichloropropane	78-87-5	0.09
Ethyl acrylate	140-88-5	0.04
Bromodichloromethane	75-27-4	0.05
Trichloroethylene	79-01-6	0.06
Methyl methacrylate	80-62-6	0.06

Table C-2. (Continued)

Compound	CAS No.	Method Detection Limit (ppbv)
cis-1,2-Dichloropropene	10061-01-5	0.03
Methyl isobutyl ketone	108-10-1	0.07
trans-1,2-Dichloropropene	10061-02-6	0.03
1,1,2-Trichloroethane	79-00-5	0.03
Toluene	108-88-3	0.10
Dibromochloromethane	124-48-1	0.04
1,2-Dibromoethane	106-93-4	0.05
n-Octane	111-65-9	0.09
Tetrachloroethylene	127-18-4	0.10
Chlorobenzene	108-90-7	0.04
Ethylbenzene	100-41-4	0.10
m-, p-Xylene	108-38-3/106-42-3	0.08
Bromoform	75-25-2	0.12
Styrene	100-42-5	0.11
1,1,2,2-Tetrachloroethane	79-34-5	0.05
o-Xylene	95-47-6	0.03
1,3,5-Trimethylbenzene	108-67-8	0.08
1,2,4-Trimethylbenzene	95-63-6	0.09
m-Dichlorobenzene	541-73-1	0.09
Chloromethylbenzene	100-44-7	0.18
p-Dichlorobenzene	106-46-7	0.08
o-Dichlorobenzene	95-50-1	0.10
1,2,4-Trichlorobenzene	120-82-1	0.09
Hexachloro-1,3-butadiene	87-68-3	0.11

Table C-3. Detection Limits (μg/m^3) for Speciated Nonmethane Organic Compounds (EPA Research Operating Procedure, *Research Protocol Method for Analysis of C_2-C_{12} Hydrocarbons in Ambient Air by Gas Chromatography with Cryogenic Concentration*)

Compound	CAS No.	Method Detection Limits (μg/m^3)
Ethylene	74-85-1	0.50
Acetylene	74-86-2	0.47
Ethane	74-84-0	0.54
Propylene	115-07-1	0.44
Propane	74-98-6	0.46
Propyne	74-99-7	0.42
Isobutane	75-28-5	0.43
Isobutene/1-butene	115-11-7/106-98-0	0.21
1,3-Butadiene	106-99-0	0.40
n-Butane	106-97-8	0.43
trans-2-Butene	624-64-6	0.42
cis-2-Butene	590-18-1	0.42
3-Methyl-1-butene	563-45-1	0.32
Isopentane	78-78-4	0.33
1-Pentene	109-67-1	0.32
2-Methyl-1-butene	563-46-2	0.45
n-Pentane	109-66-0	0.33
Isoprene	78-79-4	0.31
trans-2-Pentene	646-04-8	0.33
cis-2-Pentene	627-20-3	0.33
2-Methyl-2-butene	513-35-9	0.32
2,2-Dimethylbutane	75-83-2	0.46
Cyclopentene	142-29-0	0.31
4-Methyl-1-pentene	691-37-2	0.45
Cyclopentane	287-92-3	0.32
2,3-Dimethylbutane	79-29-8	0.46
2-Methylpentane	107-83-5	0.46
3-Methylpentane	96-14-0	0.46
2-Methyl-1-pentene	763-29-1	0.46
1-Hexene	592-41-6	0.46
2-Ethyl-1-butene	760-21-4	0.45
n-Hexane	110-54-3	0.46
trans-2-Hexene	4050-45-7	0.46
cis-2-Hexene	7688-21-3	0.46 (Continued)

Table C-3. (Continued)

Compound	CAS No.	Method Detection Limits ($\mu g/m^3$)
Methylcyclopentane	96-37-7	0.45
2,4-Dimethylpentane	108-08-7	0.35
Benzene	71-43-2	0.42
Cyclohexane	110-82-7	0.45
2-Methylhexane	591-76-4	0.40
2,3-Dimethylpentane	565-59-3	0.40
3-Methylhexane	589-34-4	0.40
1-Heptene	592-76-7	0.39
2,2,4-Trimethylpentane	540-84-1	0.51
n-Heptane	142-82-5	0.40
Methylcyclohexane	108-87-2	0.39
2,2,3-Trimethylpentane	564-02-3	0.51
2,3,4-Trimethylpentane	565-75-3	0.51
Toluene	108-88-3	0.37
2-Methylheptane	592-27-8	0.51
3-Methylheptane	589-81-1	0.51
1-Octene	111-66-0	0.50
n-Octane	111-65-9	0.51
Ethylbenzene	100-41-4	0.52
m-, p-Xylene	108-38-3/106-42-3	0.47
Styrene	100-42-5	0.46
o-Xylene	95-47-6	0.47
1-Nonene	124-11-8	0.40
n-Nonane	111-84-2	0.41
Isopropylbenzene	98-82-8	0.38
α-Pinene	80-56-8	0.39
n-Propylbenzene	103-65-1	0.38
m-Ethyltoluene	620-14-4	0.38
p-Ethyltoluene	622-96-8	0.38
1,3,5-Trimethylbenzene	108-67-8	0.38
o-Ethyltoluene	611-14-3	0.38
β-Pinene	127-91-3	0.39
1,2,4-Trimethylbenzene	95-63-6	0.38
1-Decene	872-05-9	0.33
n-Decane	124-18-5	0.33 (Continued)

Table C-3. (Continued)

Compound	CAS No.	Method Detection Limits ($\mu g/m^3$)
1,2,3-Trimethylbenzene	526-73-8	0.38
m-Diethylbenzene	141-93-5	0.32
p-Diethylbenzene	105-05-5	0.32
1-Undecene	821-95-4	0.49
n-Undecane	1120-21-4	0.50
1-Dodecene	112-41-4	0.49
n-Dodecane	112-40-3	0.50
1-Tridecene	2437-56-1	0.49
n-Tridecane	629-50-5	0.50

Appendix D

EPA Method Operating Procedures
ERG Standard Operating Procedures

Table D-1. List of EPA Method Operating Procedures

EPA Lab Method No.	Method Title
2501	Preparation of Clean Substrates, Glassware, and Other Materials
2502	Purification of Benzene Solvent
2503	Mass Measurements of Blank and Exposed Sampling Substrates
2504	Solvent Extraction of Samples and Extract Concentration
2505	Diazomethane Preparation and Extract Methylation
2506	Silylation of Methylated Extracts
2507	GC/MS Calibration and Analysis of Extracts
2508	Denuder Coating, Cleanup, and Extraction
2509	PUF Cleanup and Extraction
NIOSH Method 5040	Elemental/Organic Carbon Analysis

Table D-2. List of ERG Standard Operating Procedures

SOP No.	Dept	SOP Title	Rev	Issue Date
1	All	Documentation of Field Recovery Activities	0	2/26/98
2	Prep	Gravimetric Determination for Particulate Emissions Measurements	0	2/26/98
3	VOC	Field Procedure for Collecting Ambient Air Toxics and Carbonyl Compounds Samples using the ERG:AT/C Sampling System	0	4/18/01
3B	VOC	Field Procedure for Collecting Ambient Air Toxics and Carbonyl Compounds Samples using the ERG:AT/C Sampling System	0	
4	GC/MS	SOP for Preventive Maintenance in the Gas Chromatography/Mass Spectrometry Laboratory	0	10/12/99
5	MS/VOC	SOP for the Concurrent GC/FID/MS Analysis of Canister Air Toxic Samples	0	5/8/03
6	GC/MS	SOP for the Analysis of Tenax® Tubes According to EPA Method TO-1/TO-17	0	2/24/00
7	GC/MS	SOP for the Preparation of Review Packages for Mass Spectrometry Data Sets	0	10/12/99
8	All	Procedure for Preparation of Standard Operating Procedures	1	11/1/01
9	All	SOP for the Operation of the Documentation System	1	9/22/99
10	All	SOP for the Determination of Method Detection Limits in the GC/MS Air Toxics Laboratory	0	6/17/99
11	All	SOP for Sample Storage and Checkout from Freezers/Refrigerators at the Laboratory	0	9/22/99
12	Prep	SOP for Basic Training Requirements for Sample Preparation Laboratory Personnel	0	7/13/99
13	VOC	Field Procedure for Collecting Ambient Air Hexavalent Chromium Samples Using the ERG:CR6 Sampling System	0	10/19/03
14	Prep	SOP for Sample Preparation Quality Control	0	6/17/99
15	Prep	SOP for Documentation Procedures for the Sample Preparation Laboratory	0	7/13/99
16	GC	SOP for the Varian 9000 Series High Performance Liquid Chromatography (HPLC)	1	9/28/99
17	All	SOP for Developing, Documenting, and Evaluating the Accuracy of Spreadsheet Data	0	7/7/97
18	All	Maintaining and Recording Data Records	0	2/26/98
19	All	SOP for Transferring, Storing, and Using Confidential Business Information (CBI)	0	1/16/98
20	All	SOP for Conducting a Laboratory Systems Audit	0	3/3/98

Table D-2. List of ERG Standard Operating Procedures

SOP No.	Dept	SOP Title	Rev	Issue Date
21	VOC	Field Procedure for Collecting Ambient Air Toxics Canister Samples Using the ERG:AT Sampling System	0	9/16/03
22	Prep	SOP for the Preparation of Standards in the ERG Organic Preparatory Laboratory	0	2/2/00
23	All	SOP for the Use of Significant Figures and Rounding Off Numbers When Reporting Data	0	11/5/98
24	GC	SOP for Preparing Aldehyde Derivatizing Reagents and Extracting Derivatized Samples	0	9/28/99
24	Chrom Lab	SOP for Preparing, Extracting, and Analyzing DNPH Carbonyl Cartridges	1	5/8/03
25	GC	SOP for the Operation of the Rainin High Performance Liquid Chromatography System	0	9/28/99
26	All	SOP for Documentation: Labeling of Samples and Standards Prepared in the Laboratory	0	10/12/99
27	GC	SOP for the Operation of a Gas Chromatograph	0	7/13/99
28	GC/MS	SOP for Quality Assurance/Quality Control in Gas Chromatography/Mass Spectrometry	0	2/23/00
29	Prep	SOP for Concentration of Sample Extracts Using the Kuderna-Danish Concentrates	0	10/4/99
30	VOC	SOP for Canister Sampling System Certification Procedures	0	10/4/99
31	All	SOP for Cleaning Glassware and Syringes for Organic Analysis	0	1/24/01
32	All	Statistical Manual Standard Operating Procedure	1	4/18/01
33	All	SOP for Solid and Hazardous Waste Disposal	0	2/2/00
34	All	Analytical Chemistry Training at PPK Laboratory	0	
34	GC/MS, GC, Prep, VOC	SOP for Analytical Chemistry Training in the ERG Laboratory	0	Not Dated
35	All	SOP for Quality Assurance/Quality Control	1	9/22/99
36	All	SOP for Laboratory Security	1	4/18/01
37	All	SOP for Chemical Inventory	1	2/15/01
38	All	SOP for Personal Protective Equipment Program	0	2/23/00
39	All	SOP for Maintaining Laboratory Notebooks	0	2/2/00
40	Prep	SOP for Chemical Storage Facilities	0	

Table D-2. List of ERG Standard Operating Procedures

SOP No.	Dept	SOP Title	Rev	Issue Date
41	Optical	SOP for Tracer Gas Release and Integrated Bag Sampling for Analysis by FTIR Spectroscopy	0	6/20/00
42	GC	SOP for the Dionex-300 Ion Chromatograph	0	5/5/00
43	GC/MS	SOP for the Analysis of Semivolatile Organic Compounds in Gaseous Emissions using the SemiVOST Method	0	1/24/01
44	GC/MS, VOC	SOP for Method 8270C - GC/MS Analysis of Semivolatile Organics	0	5/15/03
45	Prep	SOP for Sample Log-in at the ERG Chemistry Laboratory	0	2/24/00
46	VOC	Field Procedure for Collecting Speciated and/or Total Nonmethane Organic Compounds Ambient Air Samples Using the ERG:S/NMOC Sampling System	0	4/18/01
47	VOC	Field Procedure for Collecting Ambient Carbonyl Compounds Samples Using the ERG:C Sampling System	0	4/18/01
47B	VOC	Field Procedure for Collecting Ambient Carbonyl Compounds Samples Using the ERG:C Sampling System	0	10/9/02
48	GC/MS, Prep	SOP for Cleaning XAD-2® and Polyurethane Foam Cartridges with Quality Control Measures to Assure Cleanliness	0	2/24/00
49	Prep	SOP for the Extraction and Analysis of PAH's from XAD-27 Traps	0	
50	Prep	SOP for Separatory Funnel Liquid-Liquid Extraction by EPA SW-846 Method 3510C	0	7/13/99
51	Prep	SOP for Continuous Liquid-Liquid Extraction by EPA SW-846 Method 3520C	0	7/13/99
52	Prep	SOP for Acid-Base Partition Cleanup by EPA SW-846 Method 3650B	0	8/18/99
53	Prep	SOP for Soxhlet Extraction by EPA SW-846 Method 3540C	0	9/23/99
54	Transfill	SOP for Preparation, Evaluation, and Shipping of Performance Evaluation Samples for Method 24	0	
54	Chrom Lab, LIMS	Sample Extraction and Preparation for Energetic Organic Material	1	01/04
55	GC/MS, CCL	SOP for Maintenance of NANOpure-A Deionized Water System	0	10/12/99
56	All	SOP for Daily Maintenance of Cold Storage Units	0	9/22/99
57	All	SOP for Project Peer Review	0	8/18/99
58	Transfill	SOP for Preparing Method 25 Audit Samples Using the Transfill System	0	
59	GC	SOP for High Performance Liquid Chromatography	0	4/24/98
60	VOC	SOP for PDFID Sample Analysis	0	5/5/00
61	VOC	SOP for Standard Preparation Using Dynamic Flow Dilution	0	7/8/99

Table D-2. List of ERG Standard Operating Procedures

SOP No.	Dept	SOP Title	Rev	Issue Date
		System		
62	VOC	SOP for UATMP and NMOC Canister Cleaning	0	7/8/99
63	GC	SOP for the Analysis of Ambient Air for Hexavalent Chromium by IC	0	5/8/03
64	Transfill	SOP for Shipping Method 6, 7, 8, and 26 Audit Samples	0	
65	VOC, Prep, GC, MS	SOP for the ERG Sample Database	0	10/31/01
66	Transfill	Cylinder Recycling	0	
67	VOC	SOP for Producing Standard Mixtures of Organic Compounds in Air by Liquid Injection	0	7/8/99
68	All	SOP for Refrigerator and Freezer Temperature Monitoring	0	
69	Transfill	SOP for Shipping Method 23 Audit Samples	0	
70	Transfill	SOP for Storing and Shipping Method 13A, 13B, and 29 Audit Samples	0	
71	GC/MS, VOC	SOP for Documentation Requirements for the GC/MS Laboratory and for GC/MS Systems in the VOC Laboratory	0	5/5/00
72	Optical	SOP for Stack Sampling Using FTIR Spectroscopy	0	6/20/00
73	GC	SOP for the ECD Wipe Test	0	2/29/00
74	Prep	SOP for the Preparation of Spiked Sorbent Samples Using Liquid Spiking into Tenax-GC® Tubes	0	9/23/99
75	Prep	SOP for the Preparation of Spiked Sorbent Samples Using Liquid Spiking onto XAD-2®	0	9/23/99
76	Prep	SOP for the Preparation of Spiked Sorbent Samples Using Flash Evaporation Spiking onto XAD-2®	0	8/18/99
77	GC/MS	SOP for Method 624	0	
78	GC/MS	SOP for Method 625	0	
79	GC/MS	SOP for Method 1624C	0	
80	GC/MS	SOP for Method 1625C	0	
81	Prep	SOP for the Preparation of Spiked Method 8 Samples as Stationary Source Audit Materials	2	3/31/03

EPA/600/R-07/005
February 2007

Source Sampling Fine Particulate Matter

Institutional Oil-Fired Boiler

Appendix E Chain of Custody Forms

Appendix E

Chain of Custody Forms

Campaign 1

Chain of Custody Forms

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NCAQT OIL BOILER PM2.5 TESTING

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mantz

ANALYSES: BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBONYL			REMARKS	SAM ID NO. (For lab use only)
IB 011801 H	Pd 1A1 J	1/18/01	1	✓									P092600 B	
	Pd 1A2 J		1	✓									P092600 D	
	Qd 1A1 633				✓								Q010801 H	
	Td 1B1 641					✓							T070500 A	
	Tr 2A1 585					✓							T062900 C	
	Tr 2B1 614					✓							T062900 E	
	Tr 4A1 610					✓							T062900 A	
	Tr 4B1 613					✓							T062900 B	
	Pr 6 A1 L		1	✓									P121200 A	
	Pr 6 A2 L		1	✓									P121200 B	

REMARKS: TEST # 3 THURSDAY 1/18/01 NO DENUDERS

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mantz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC AQT OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mantz

ANALYSES: BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	POF	QF	TF			SUMMA	CARBONIC			REMARKS	SAM ID NO. (For lab use only)
IB 011801 H	Qr 6 A1 642	1/18/01			✓								Q010801 I	
	Pr 6 B1 I		1	✓									P010901 C	
	Pr 6 B2 I		1	✓									P010901 E	
	Qr 6 B1 481				✓								Q010801 J	
	Pr 8 A1 B		1	✓									P100400 B	
	Pr 8 A2 B		1	✓									P100400 E	
	Qr 8 A1 622				✓								Q010801 L	
	Pr 8 B1 H		1	✓									P100600 A	
	Pr 8 B2 H		1	✓									P100600 E	
	Qr 8 B1 640				✓								Q010801 M	

REMARKS: TEST # 3 THURSDAY 1/18/01

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mantz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC AGT OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mantz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBONYL			REMARKS	SAM ID NO. (For lab use only)
IB011801 H	Pr 10 A1 A	1/18/01	1	✓									P010901 A	
	Pr 10 A2 A		1	✓									P010901 B	
	Qr 10 A1 564				✓								Q010801 N	
	Pr 10 B1 C		1	✓									P121200C	
	Pr 10 B2 C		1	✓									P121200D	
	Qr 10 B1 618				✓								Q010801 O	
	Qd ϕ A1 8x10				✓								5830764	5830764
	Qd ϕ A1 FB				✓								5830763	8X10 FIELD BL

REMARKS: TEST # 3 THURSDAY 1/18/01

RELINQUISHED BY: Rob Mantz — DATE — TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A&T OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mantz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBONYL			REMARKS	SAM ID NO. (For lab use only)
IB 011801 H	Sd 3 A1 S T3	1/18/01							✓				# 3953	
	Hd 2 A1 H1 T3									✓			CARB TUBE 1 FRONT	
	Hd 2 A2 H2 T3									✓			CARB TUBE 2 REAR	
	Sn 5 A1 S T3								✓				# 3950	
	Hn 3 A1 H1 T3									✓			CARB TUBE 1 FRONT	
	Hn 3 A2 H2 T3									✓			CARB TUBE 2 REAR	

REMARKS: TEST # 3 THURSDAY 1/18/01 T3 = TEST 3 FOR SUMMA & CARBS

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mantz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

TEST 1 1/16
TEST 2 1/17
TEST 3 1/18

CLEAN SUBSTRATES

Date Substrate Distributed: 1/11/01
To Whom Substrate Distributed: Rob Martz
FPMCC Lab Personnel: Yuanji Dong

Type	Clean Substrate ID	Type	Clean Substrate ID
PUF	P121200A	PUF	P100400F
PUF	P121200B	PUF	P100600A
PUF	P121200C	PUF	P100600B
PUF	P121200D	PUF	P100600C
PUF	P121200E	PUF	P100600D
PUF	P121200F	PUF	P100600E
PUF	P121200G	PUF	P010801A
PUF	P121200H	PUF	P010801B
PUF	P121200I	PUF	P010801C
PUF	P121200J	PUF	P010801D
PUF	P121200K	PUF	P010801E
PUF	P121200L	PUF	P010801F
PUF	P092600A	PUF	P010801G
PUF	P092600B	PUF	P010901A
PUF	P092600C	PUF	P010901B
PUF	P092600D	PUF	P010901C
PUF	P092600E	PUF	P010901D
PUF	P092600F	PUF	P010901E
PUF	P092700A		P080900M
PUF	P092700B		P080900N
PUF	P092700C		
PUF	P092700D		
PUF	P092700E		
PUF	P121800M		
PUF	P121800O		
PUF	P121800P		
PUF	P100400A		
PUF	P100400B		
PUF	P100400C		
PUF	P100400D		
PUF	P100400E		

01/18/01 (L1 L2
C1 C2 01/18/01 (DK DL
01/12/01 B1
Reload 01/18/01 J1 01/18/01 J2
01/12/01 G'2
01/17/01 D2
01/17/01 I2
01/18/01 J1
01/12/01 K1
01/18/01 J2
01/17/01 E1
01/17/01 L1
01/12/01 J'2
01/17/01 L2
01/12/01 B2
01/17/01 D1
01/17/01 H1
01/18/01 B1
01/12/01 L1
01/17/01 H2
01/18/01 B2
B2

L2 01/12/01
H1 01/18/01
I1 01/12/01
A2 01/17/01
I2 01/12/01
H2 01/18/01
A1 01/17/01
H1 01/12/01
H2 01/12/01
B1 01/17/01
B2
A1 01/18/01
A2 01/18/01
I1 01/18/01
K2 01/12/01
I2 01/18/01
A 01/16/01 1 2

Total

Denuder		Teflo	
Quartz Filter		Zeflo	
KOH QF		PUF	50
Teflo-washed			

FLOW ↑ 2 1 PUF LOADING

TEST 1 1/16
TEST 2 1/17
TEST 3 1/18

CLEAN SUBSTRATES

Date Substrate Distributed 1/11/01
To Whom Substrate Distributed Rob Martz
FPMCC Lab Personnel Yuanji Dong

Type	Clean Substrate ID	Type	Clean Substrate ID
Denuder	D071000-1013-6	QF	Q010901F
Denuder	D071000-1069-6	QF	Q010901G
Denuder	D071800-995-2	QF	Q010901H
Denuder	D071800-1063-2	QF	Q010901I
Denuder	D010901-1259-1	QF	Q010901J
Denuder	D010901-1261-1	QF	Q010901K
QF	Q010801A	TF	T041700G
QF	Q010801B	TF	T041700H
QF	Q010801C	TF	T041700I
QF	Q010801D	TF	T041700J
QF	Q010801E	TF	T062700A
QF	Q010801F	TF	T062700F
QF	Q010801G	TF	T062900A
QF	Q010801H	TF	T062900B
QF	Q010801I	TF	T062900C
QF	Q010801J	TF	T062900D
QF	Q010801K	TF	T062900E
QF	Q010801L	TF	T062900F
QF	Q010801M	TF	T070500A
QF	Q010801N	TF	T070500B
QF	Q010801O	TF	T070500C
QF	Q010801P	TF	T070500D
QF	Q010801Q	TF	T070500E
QF	Q010801R	TF	T070500F
QF	Q010801S	TF	T070700B
QF	Q010801T	TF	T070700C
QF	Q010801U	TF	T070700D
QF	Q010901A	TF	T070700E
QF	Q010901B	TF	T070700F
QF	Q010901C	TF	T070700G
QF	Q010901D		
QF	Q010901E		

01/16/01 633
01/16/01 642
01/16/01 481
01/16/01 622
01/16/01 640
01/16/01 564
01/16/01 618
01/18/01 633
01/18/01 642
01/18/01 481
01/17/01 633
01/18/01 622
01/18/01 640
01/18/01 564
01/18/01 618
01/17/01 642
01/17/01 481
01/17/01 564

640 01/17/01
622 01/17/01
618 01/17/01
641 01/16/01
585 01/16/01
614 01/16/01
610 01/16/01
~~641 01/18/01~~ BAD FI
613 01/16/01
610 01/18/01
613 01/18/01
585 01/18/01
610 01/17/01
614 01/18/01
613 01/17/01
641 01/18/01
585 01/17/01
614 01/17/01
641 01/17/01

Total

Denuder	6	Teflo	24
Quartz Filter	32	Zeflo	
KOH QF		PUF	
Teflo-washed			

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 01 18 01 H

JOB NO:

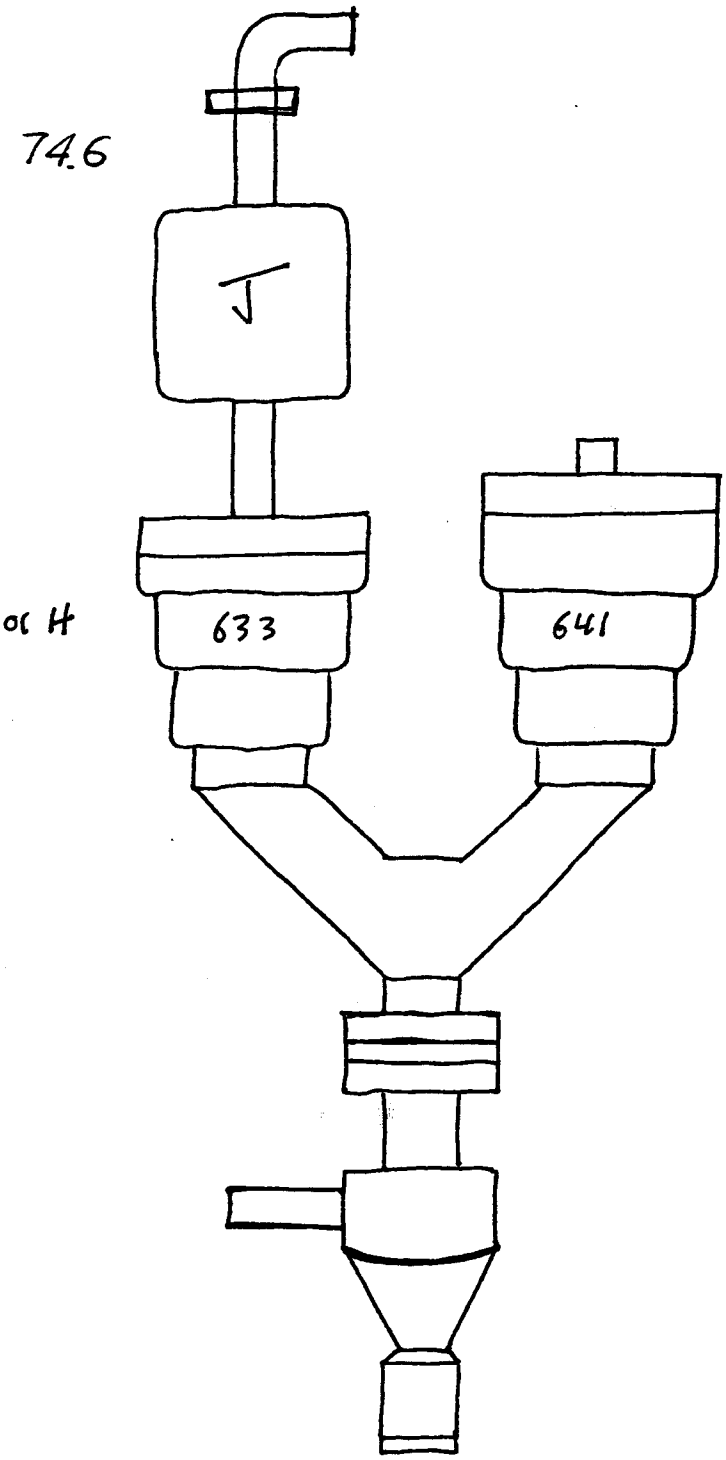
BY: B DATE:

CHKD: DATE:

PAGE

SHEET 1

#1 DILUTION



@ 010801 H

T067700A RM

BAD FILTER (TORN)

T070500A

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011801 H

JOB NO:

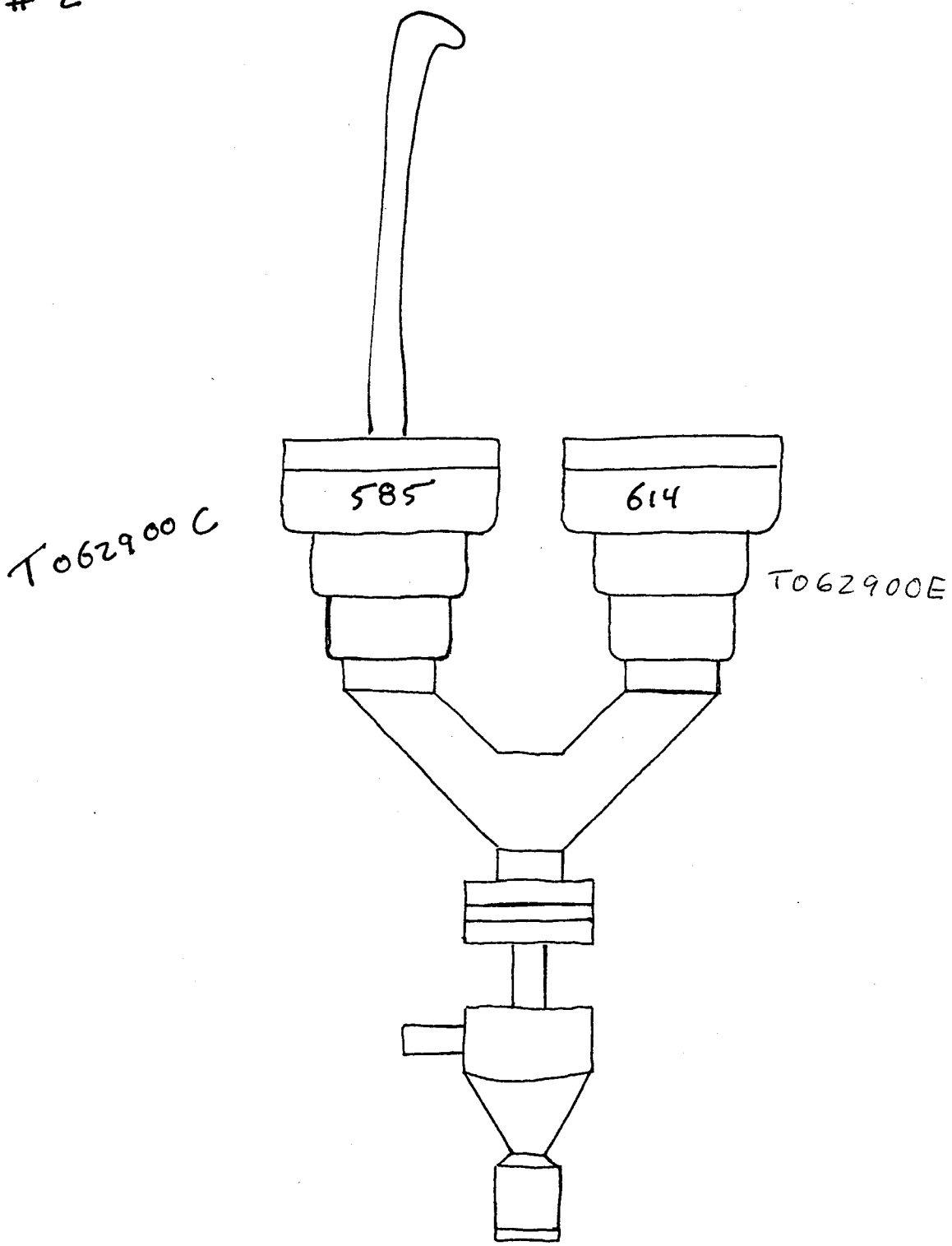
BY: J DATE:

CHKD: DATE:

PAGE

SHEET 1

#2



ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011801 H

JOB NO:

BY: J DATE:

CHKD: DATE:

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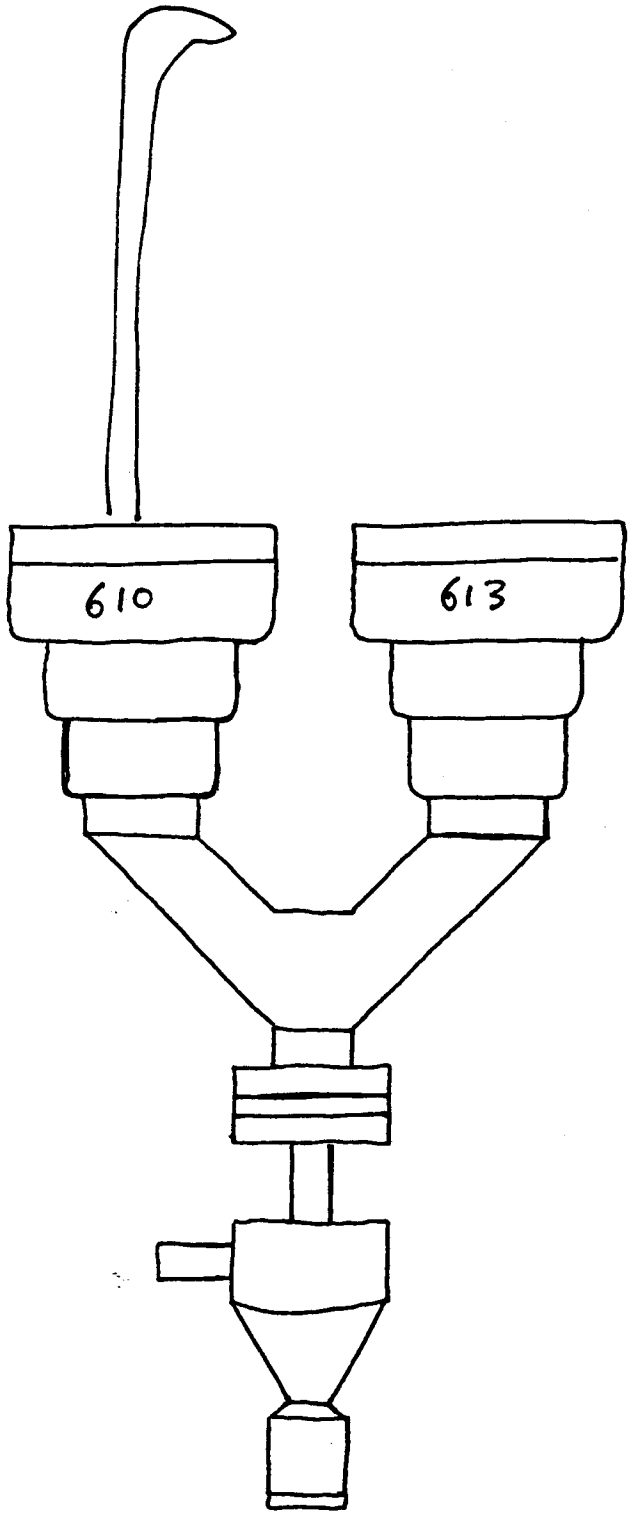

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ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011801 H

JOB NO:

BY: J DATE:

CHKD: DATE:

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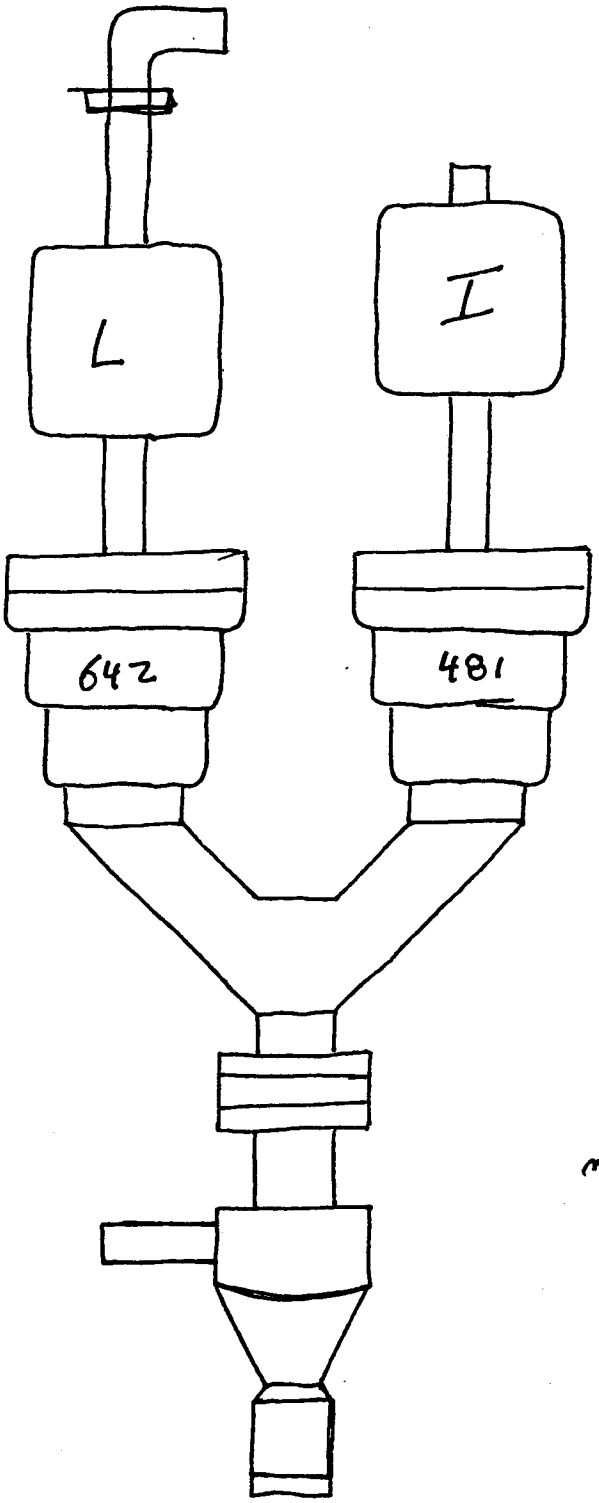

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Q 010801 J

no denuders

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011801 H

JOB NO:

BY: B DATE:

CHKD: DATE:

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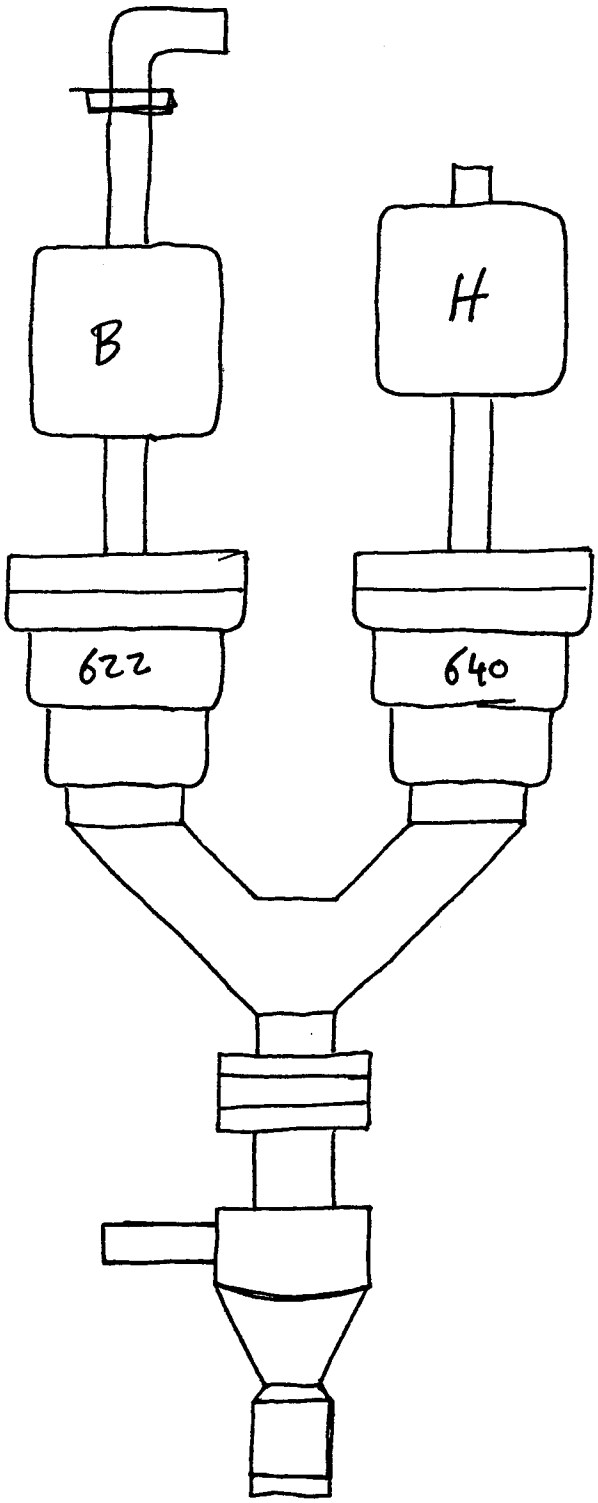

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ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011801 H

JOB NO:

BY: DATE:

CHKD: DATE:

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SHEET 1

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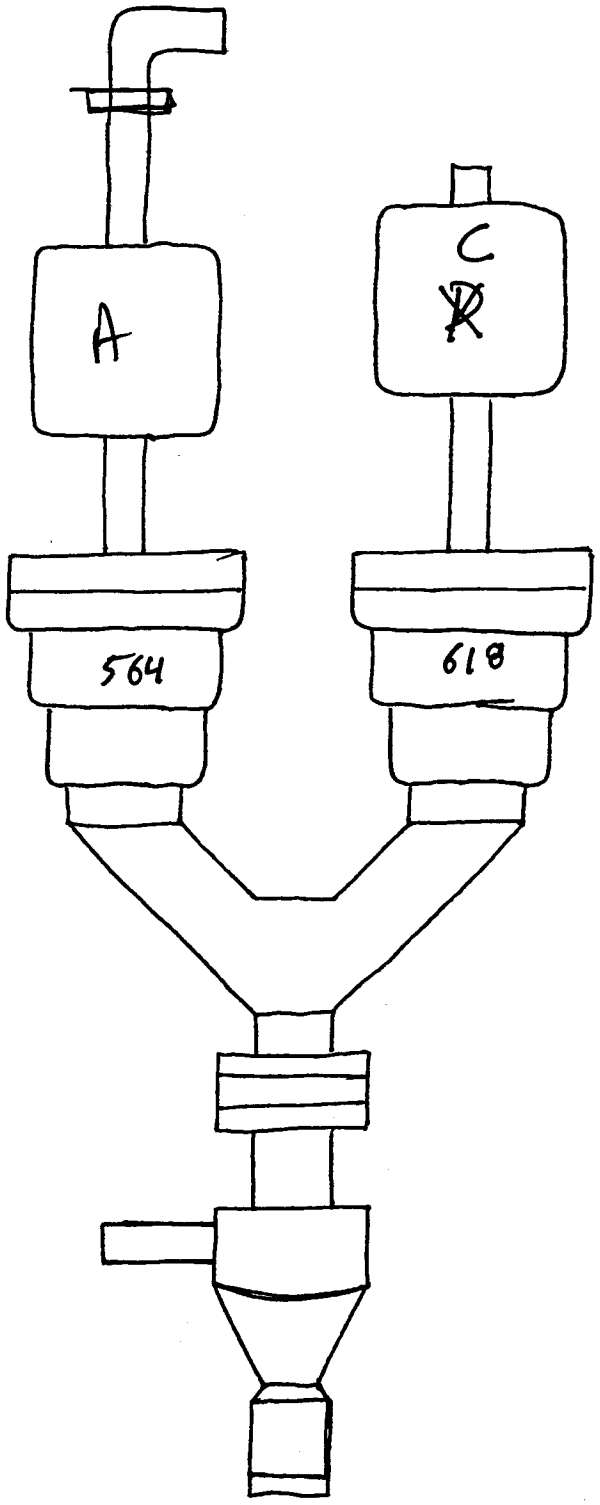

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no denudera

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC ART
OIL BOILER
PM2.5 TESTING

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Bob Mattz

ANALYSES: BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBONYL			REMARKS	SAM ID NO. (For lab use only)
IB011701H	Pd 1A1 J	1/17/01	1	✓									P121200F	
	Pd 1A2 J		1	✓									P121200G	
	Qd 1A1 633				✓								Q010801K	
	Td 1B1 641					✓							T070700F	
	Tr 2A1 585					✓							T070700C	
	Tr 2B1 614					✓							T070700E	
	Tr 4A1 610					✓							T062900D	
	Tr 4B1 613					✓							T062900F	
	Pr 6A1 L		1	✓									P092600F	
	Pr 6A2 L		1	✓									P092700E	

REMARKS: TEST # 2 WEDNESDAY 1/17/01 NO DENUDERS

RELINQUISHED BY: Bob Mattz — DATE — TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A&T OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Matz

ANALYSES: BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBOXYL			REMARKS	SAM ID NO. (For lab use only)
IB011701H	Qr 6 A1 642	1/17/01			✓								Q010901A	
	Pr 6 B1 I		1	✓									P092600E	
	Pr 6 B2 I		1	✓									P092600A	
	Qr 6 B1 481				✓								Q010901B	
	Pr 8 A1 B		1	✓									P010801E	
	Pr 8 A2 B		1	✓									P010801F	
	Qr 8 A1 622				✓								Q010901I	
	Pr 8 B1 H		1	✓									P100400A	
	Pr 8 B2 H		1	✓									P100400D	
	Qr 8 B1 640				✓								Q010901H	

REMARKS: TEST #2 WEDNESDAY 1/17/01

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME

RELINQUISHED BY: Rob Matz — DATE — TIME

RELINQUISHED BY: — DATE — TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC AOT OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mentz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBON			REMARKS	SAM ID NO. (For lab use only)
IB011701 H	Pr10A1A	1/17/01	1	✓									P010801 A	
	Pr10A2A		1	✓									P100600 C	
	Qr10A1 564				✓								Q010901 E	
	Pr10B1D		1	✓									P121800 P	
	Pr10B2D		1	✓									P121200 K	
	Qr10B1 618				✓								Q010901 K	
	Qd ϕ A1 8x10				✓								5830765	

REMARKS: TEST # 2 WEDNESDAY 1/17/01

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A&T
OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Bob Mantz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBON			REMARKS	SAM ID NO. (For lab use only)
IB011701 H	Sd 3 A1 S T2	1/17/01							✓				# 4031	
	Hd 2 A1 H1 T2									✓			CARB TUBE 1 FRONT	
	Hd 2 A2 H2 T2									✓			CARB TUBE 2 REAR	
	Sr 5 A1 S T2								✓				# 4040	
	Hr 3 A1 H1 T2									✓			CARB TUBE 1 FRONT	
	Hr 3 A2 H2 T2									✓			CARB TUBE 1 REAR	

REMARKS: TEST # 2 WEDNESDAY 1/17/01 T2 Box TEST #2 CARB/SUMMA

RELINQUISHED BY: Bob Mantz — DATE — TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC AQT OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Bob Mouty

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF			SUMMA	CARBONYL			REMARKS	SAM ID NO. (For lab use only)
IBOI1701 H														
	Page not used → RM													

REMARKS: TEST # 2 WEDNESDAY 1/17/01

RELINQUISHED BY: Bob Mouty — DATE — TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011701 H

JOB NO:

BY: B DATE:

CHKD: DATE:

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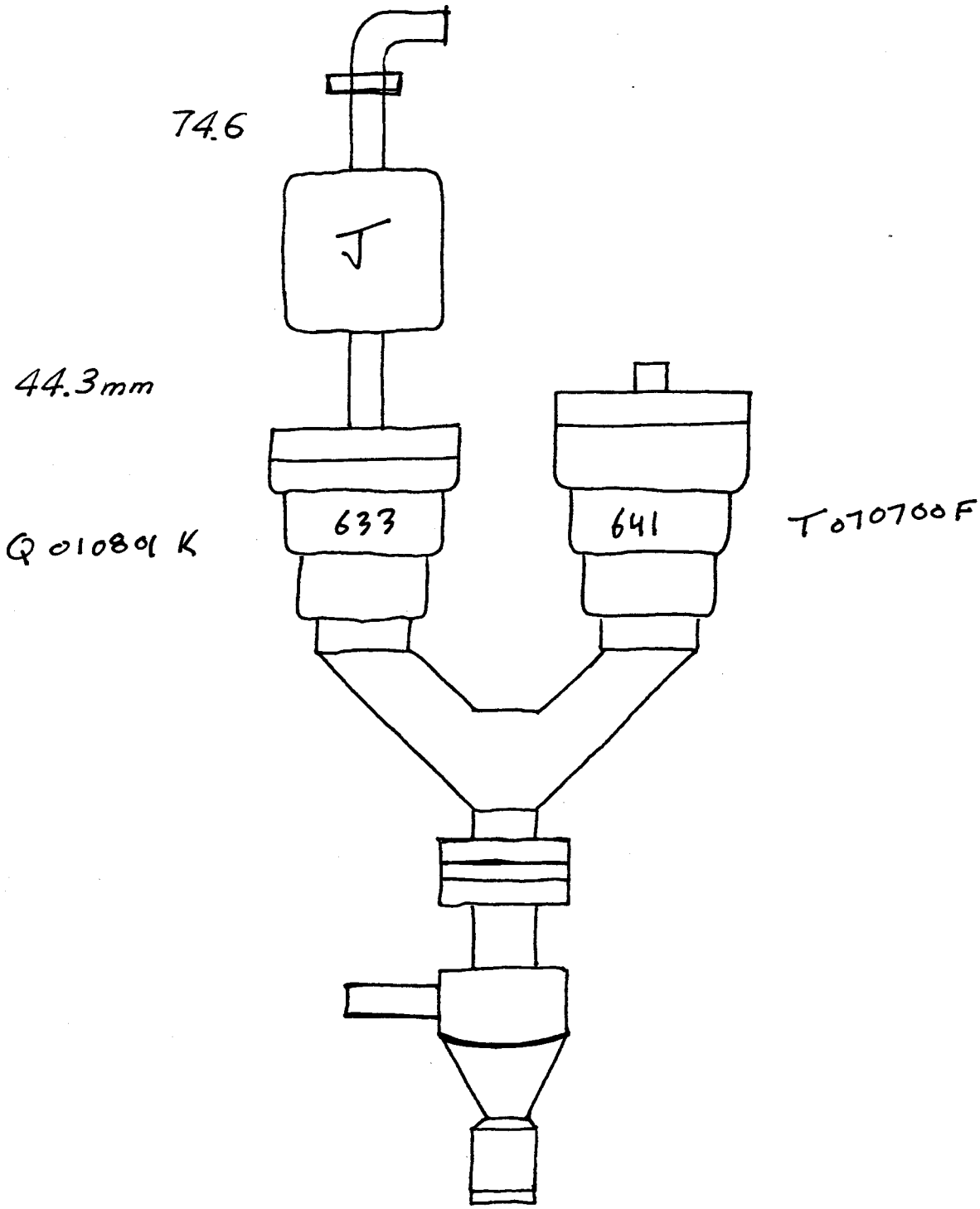

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB011701H

JOB NO:

BY: J DATE:

CHKD: DATE:

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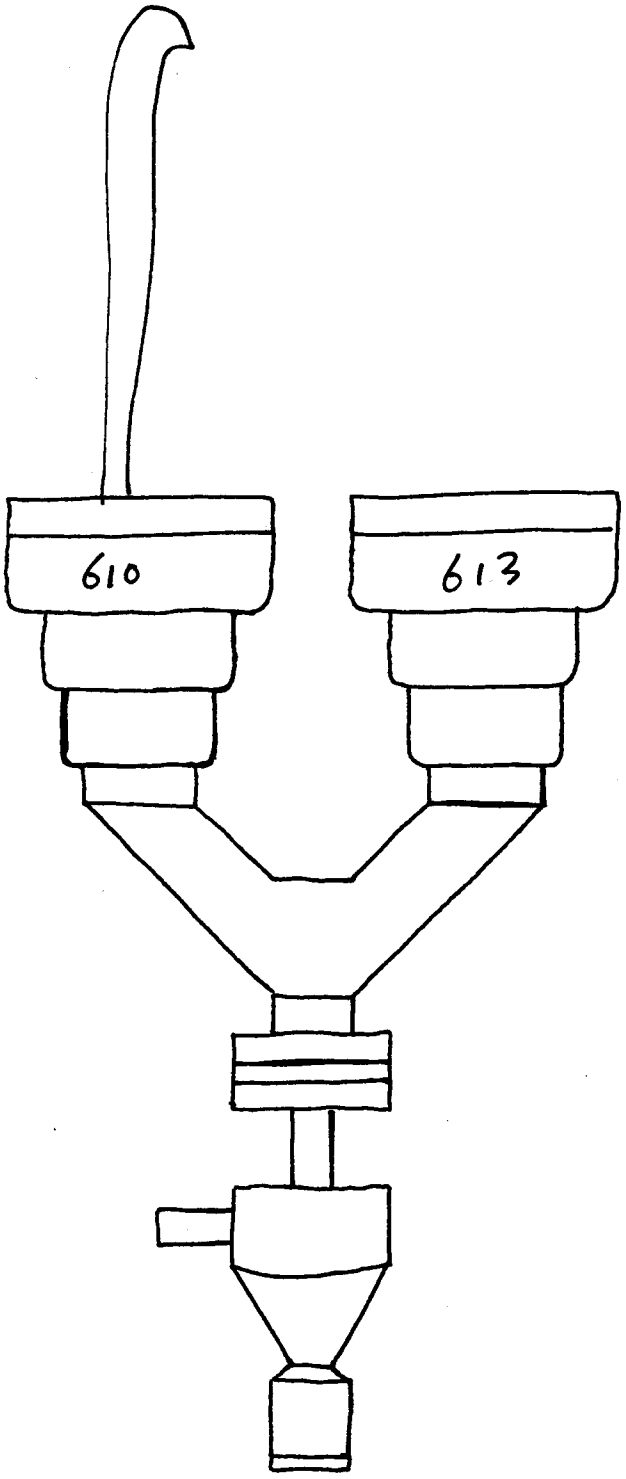

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ARCADIS
GERAGHTY & MILLER

SUBJECT: IB011701 H

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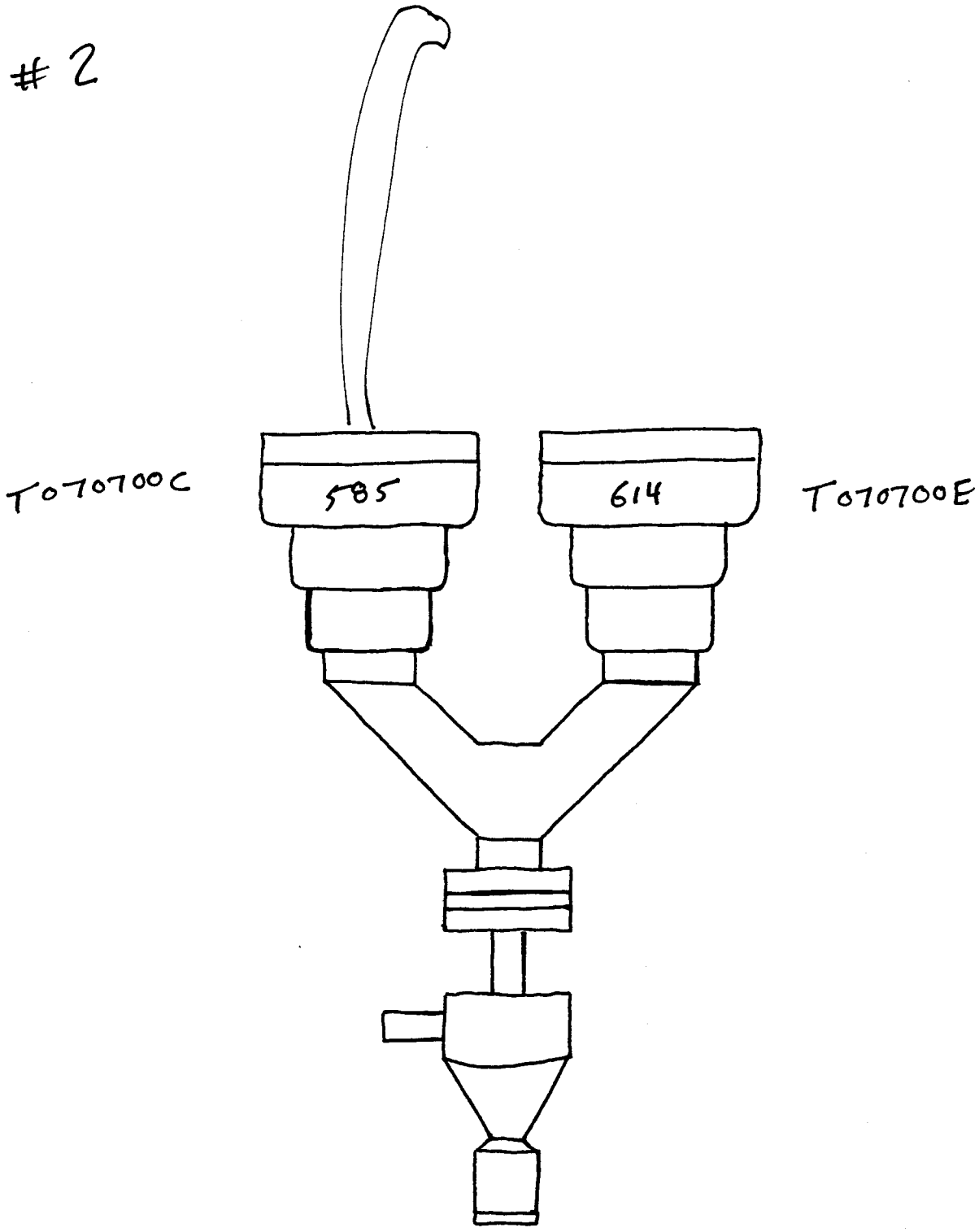

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB011701 #

JOB NO:

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CHKD: DATE:

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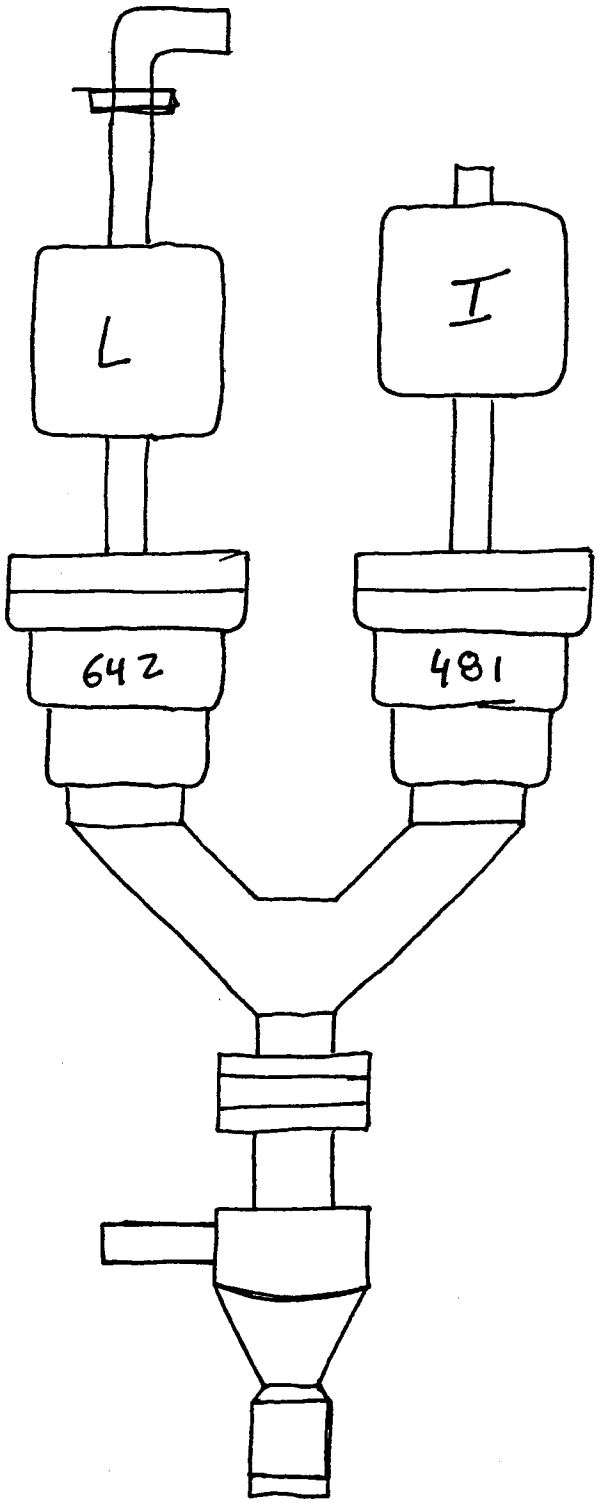

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ARCADIS
GERAGHTY & MILLER

SUBJECT: IB011701H

JOB NO:

BY: DATE:

CHKD: DATE:

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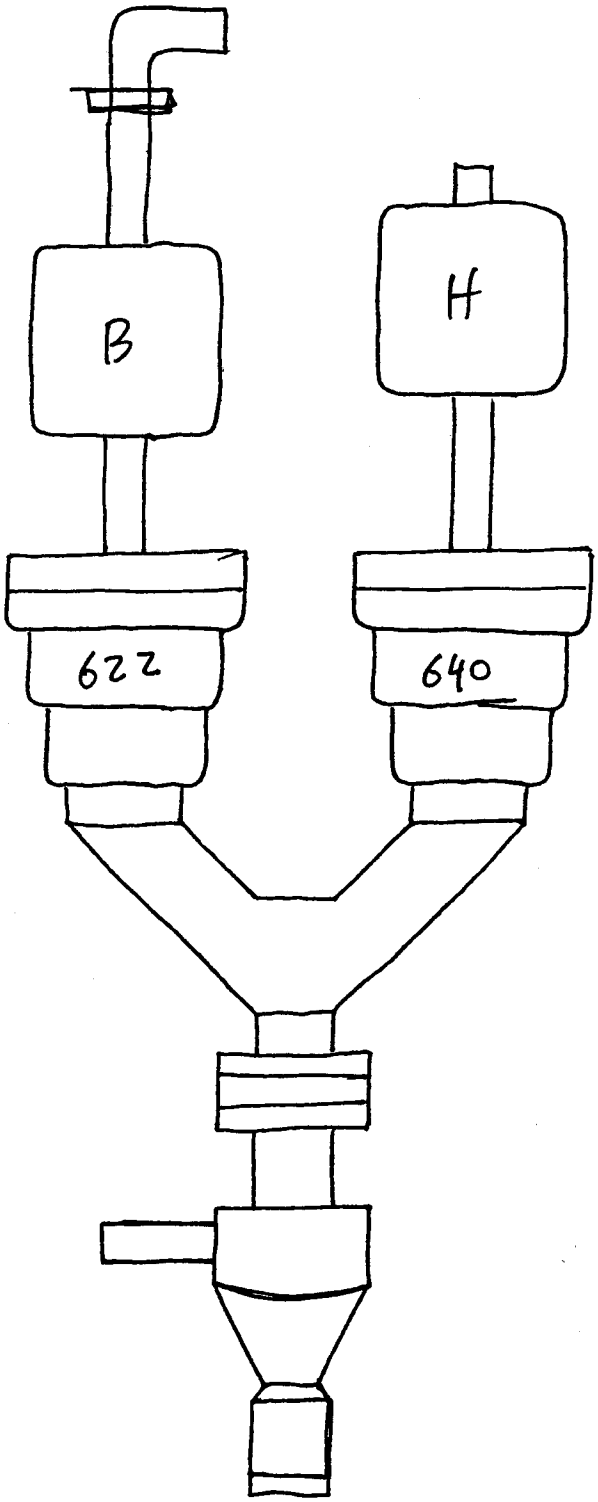

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ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011701 H

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BY: DATE:

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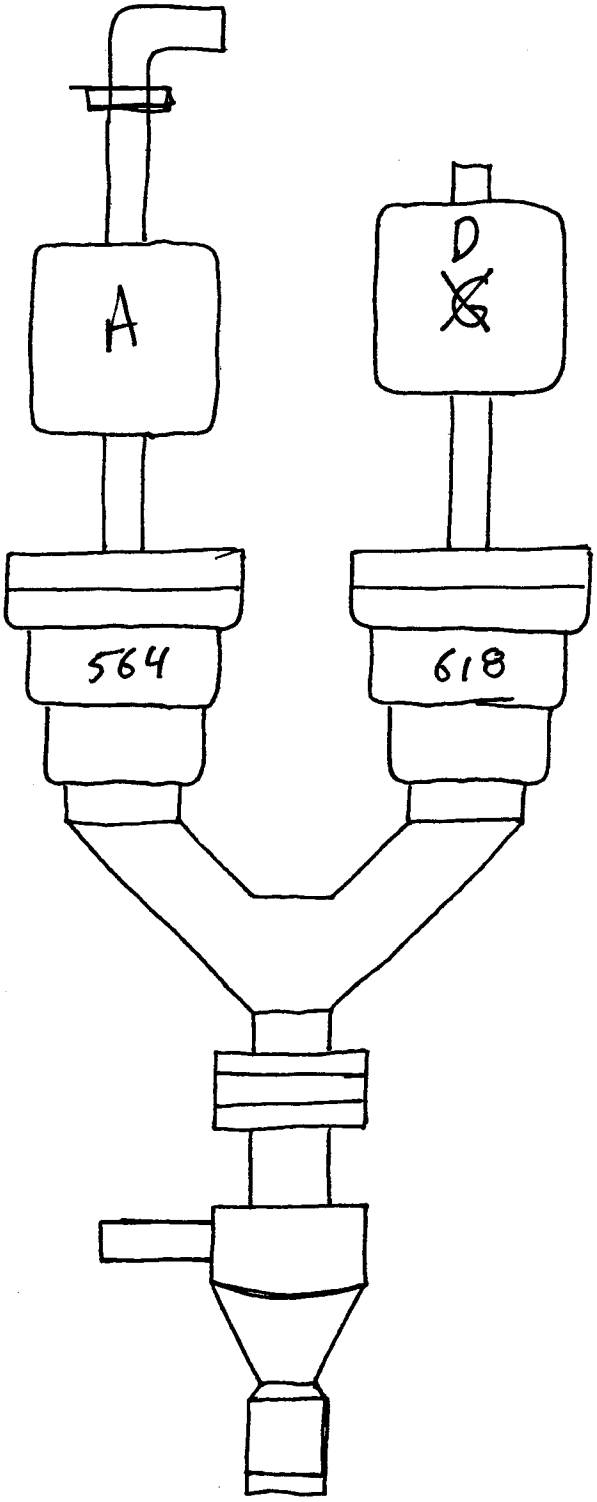

76.2

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no denuders

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A&T — OIL BOILER PM2.5 TESTING

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Bob Mantz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF		DENUDER		SUMMA	CARBONYL		REMARKS	SAM ID NO. (For lab use only)
IB 011601 H	Pd 1 A 1 J	1/16/01	1	✓									P092700 A	
	Pd 1 A 2 J		1	✓									P092700 B	
	Qd 1 A 1 633				✓								Q010801 A	
	Td 1 B 1 641					✓							T041700 G	
	Tr 2 A 1 585					✓							T041700 H	
	Tr 2 B 1 614					✓							T041700 I	
	Tr 4 A 1 610					✓							T041700 J	
	Tr 4 B 1 613					✓							T062700 F	
	Pr 6 A 1 L		1	✓									P100400 C	
	Pr 6 A 2 L		1	✓									P100400 F	

REMARKS: TEST # 1 TUESDAY 1/16/01 ONLY TEST DAY WITH DENUDERS

RELINQUISHED BY: Bob Mantz — DATE — TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC AFT oil Boiler

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mantz

ANALYSES: BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF		DENUDER		SUMMA	CARBONYL		REMARKS	SAM ID NO. (For lab use only)
IB 011601H	Qr 6 A1 642	1/16/01	RM	✗	✓								Q010801B	
	Pr 6 B1 I			✓									P100600B	
	Pr 6 B2 I			✓									P100600D	
	Qr 6 B1 481				✓								Q010801C	
	Dr 6 A1 1063-2							✓					D071800-1063-2	
	Dr 6 A2 995-2							✓					D071800-995-2	
	Pr 8 A1 B		1	✓									P121200E	
	Pr 8 A2 B		1	✓									P121800N	
	Qr 8 A1 622				✓								Q010801D	
	Pr 8 B1 H		1	✓									P010801B	

REMARKS: TEST #1 TUESDAY 1/16/01

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

RELINQUISHED BY: Rob Mantz — DATE — TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A&T
OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Bob Mouty

ANALYSES: BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF		DENUDER		SUMMA	CARBONYL		REMARKS	SAM ID NO. (For lab use only)
IB 011601 H	Pr 8 B2 H	1/16/01	1	✓									P010801 D	
	Qr 8 B1 640				✓								Q010801 E	
	Dr 8 A1 1049-6							✓					D07100-1049-6	
	Dr 8 A2 1261-1							✓					D010901-1261-1	
	Pr 10 A1 A		1	✓									P080900M	
	Pr 10 A2 A		1	✓									P080900N	
	Qr 10 A1 564				✓								Q010801 F	
	Pr 10 B1 G		1	✓									P121200 I	
	Pr 10 B2 G		1	✓									P121200 J	
	Qr 10 B1 618				✓								Q010801 G	

REMARKS: TEST #1 TUESDAY 1/16/01

RELINQUISHED BY: Bob Mouty — DATE — TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A & T — OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mentz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QFF	TF	OTHER	DENUDER		SUMMA	CARBONYL		REMARKS	SAM ID NO. (For lab use only)
IB 011601 H	Dr 10 A1 1013-6	1/16/01						✓					D07100 - 1013-6	
	Dr 10 A2 1259-1							✓					D010901 - 1259-1	
	Qd ϕ A1 8 x 10				✓							RM	~~5830766~~	6731987
	Pr ϕ A1 FB K		1	✓									P092600C	PUF FIELD BL
	Pr ϕ A2 FB K			✓									P010901D	PUF FIELD BL
	OIL FUEL SAMPLE						✓						IN AMBER JAR	
	Qr ϕ A1 FB												Q010901F	QUARTZ FB
	Tr ϕ A1 FB												T070700D	TEFLON FB

REMARKS: TEST #1 TUESDAY 1/16/01

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ERG
EASTERN RESEARCH GROUP, INC.

Chain of Custody Record

PROJECT: NC A+T OIL BOILER

SITE: GREENSBORO, NC

COLLECTED BY (*Signature*): Rob Mantz

ANALYSES BY MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF		DENUDER		SUMMA	CARBONYL	REMARKS	SAM ID NO. (For lab use only)
IB 011601 H	Sd 3 A1 S T1	1/16/01								✓		# 4024	Sd 3 A1 S T1
	Hd 2 A1 H1 T1										✓	CARB TUBE 1 F	Hd 2 A1 H1 T1
	Hd 2 A2 H2 T1										✓	CARB TUBE 2 R	Hd 2 A2 H2 T1
	Sn 5 A1 S T1									✓		# 4039	
	Hn 3 A1 H1 T1										✓	CARB TUBE 1 F	Hn 3 A1 H1 T1
	Hn 3 A2 H2 T1										✓	CARB TUBE 2 R	Hn 3 A2 H2 T1
	BLANK CARB TUBE										✓	FB 1/16 TUBE	
	BLANK SUMMA CAN									✓		FB 1/16 # 1404	
	AMBIENT SUMMA CAN									✓		# 5000	5 Ø A1 S T1

REMARKS: 5Ø A1 S T1 TEST #1 TUESDAY 1/16/01 T1 for TEST 1 of CARBS / SUMMA

RELINQUISHED BY:	DATE	TIME
Rob Mantz		

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

ARCADIS
GERAGHTY & MILLER

SUBJECT: IB 011601H

JOB NO:

BY: B DATE:

CHKD: DATE:

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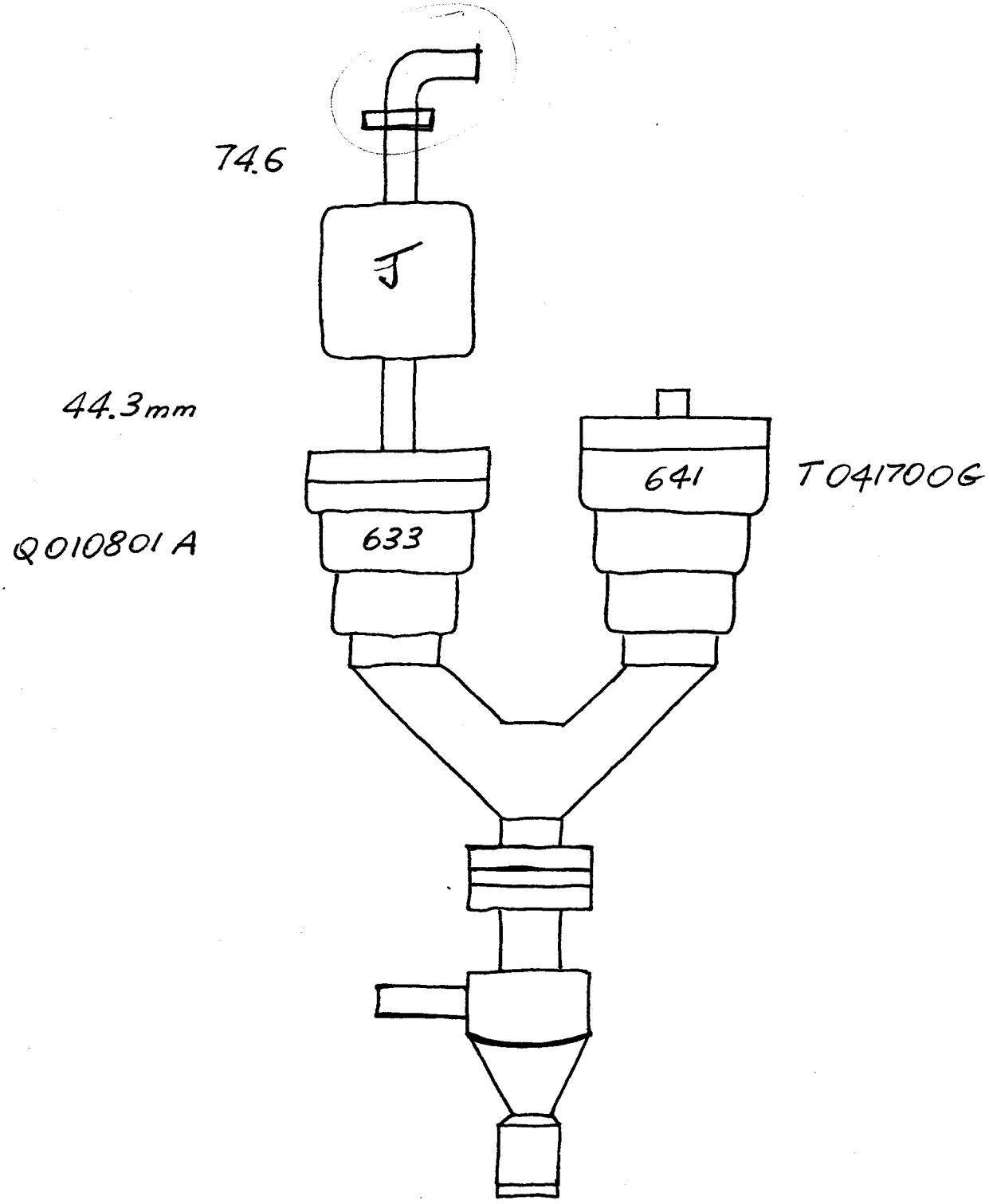


ARCADIS
GERAGHTY & MILLER

SUBJECT: IB011601H

JOB NO:

BY: JS DATE: 1/16/01

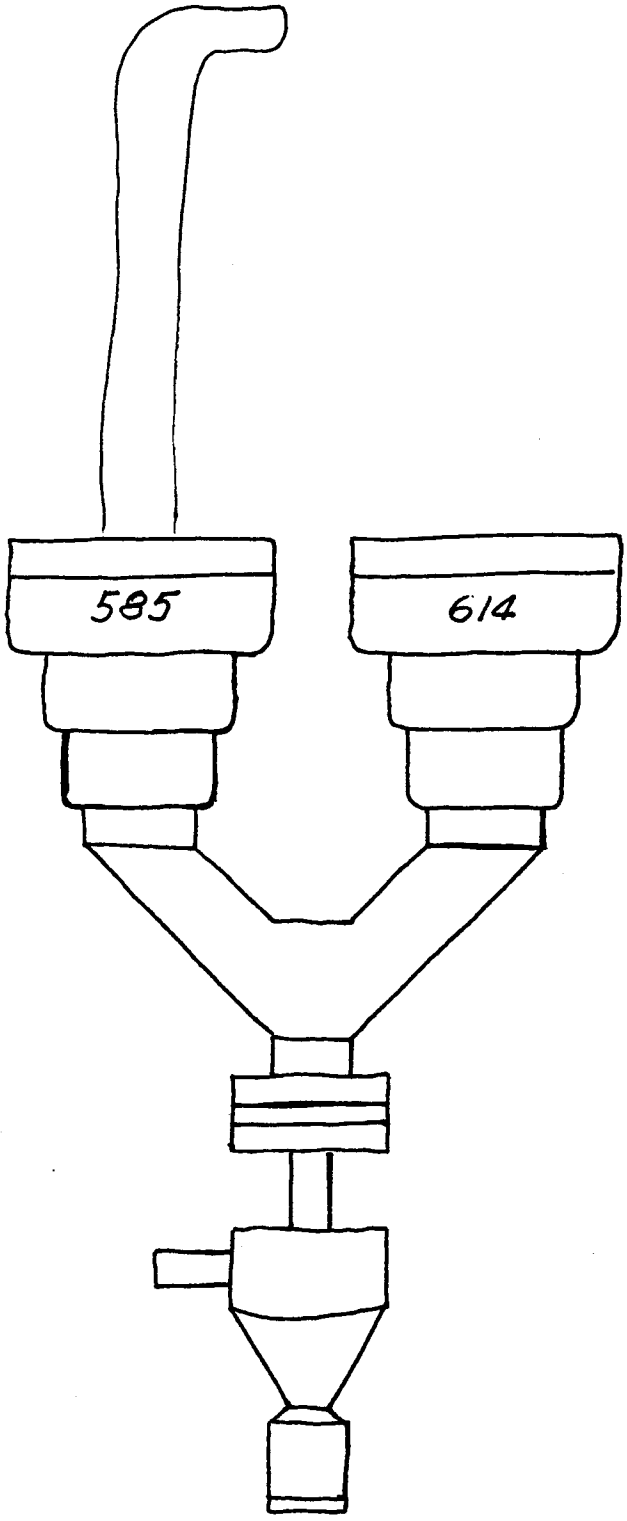
CHKD: DATE:

PAGE

SHEET 1

✓ #2

T041700H



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ARCADIS
GERAGHTY & MILLER

SUBJECT: 1B 011601 H

JOB NO:

BY: J DATE:

CHKD: DATE:

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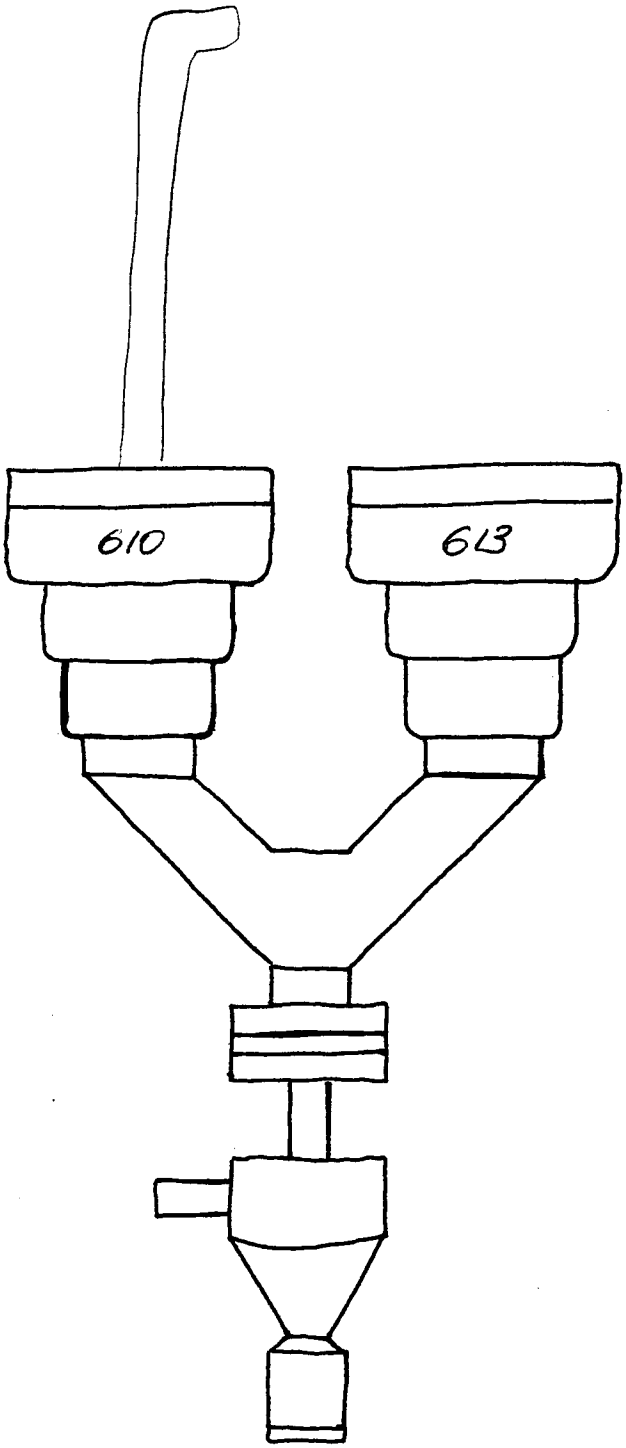
T 041700J



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ARCADIS
GERAGHTY & MILLER

SUBJECT: IB011601H

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BY: JB DATE:

CHKD: DATE:

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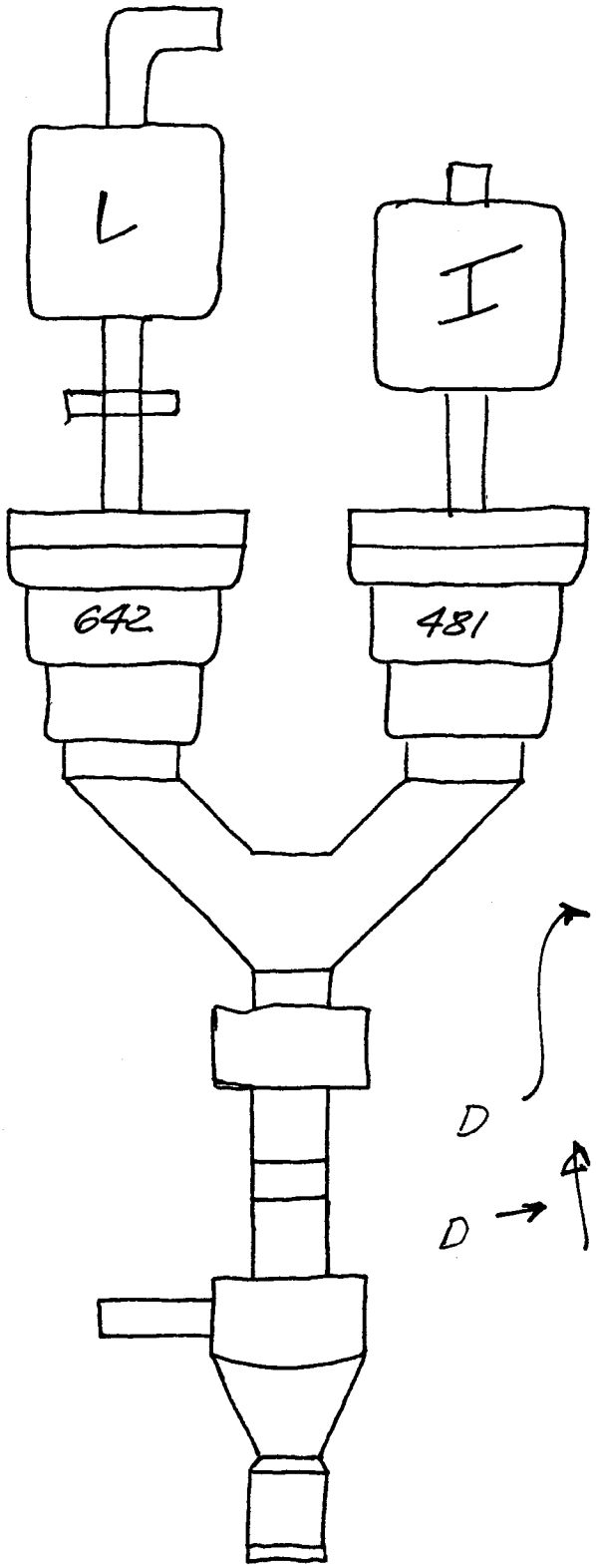

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Q010801B

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Q010801C

ARCADIS
GERAGHTY & MILLER

SUBJECT: 1B 011601H

JOB NO:

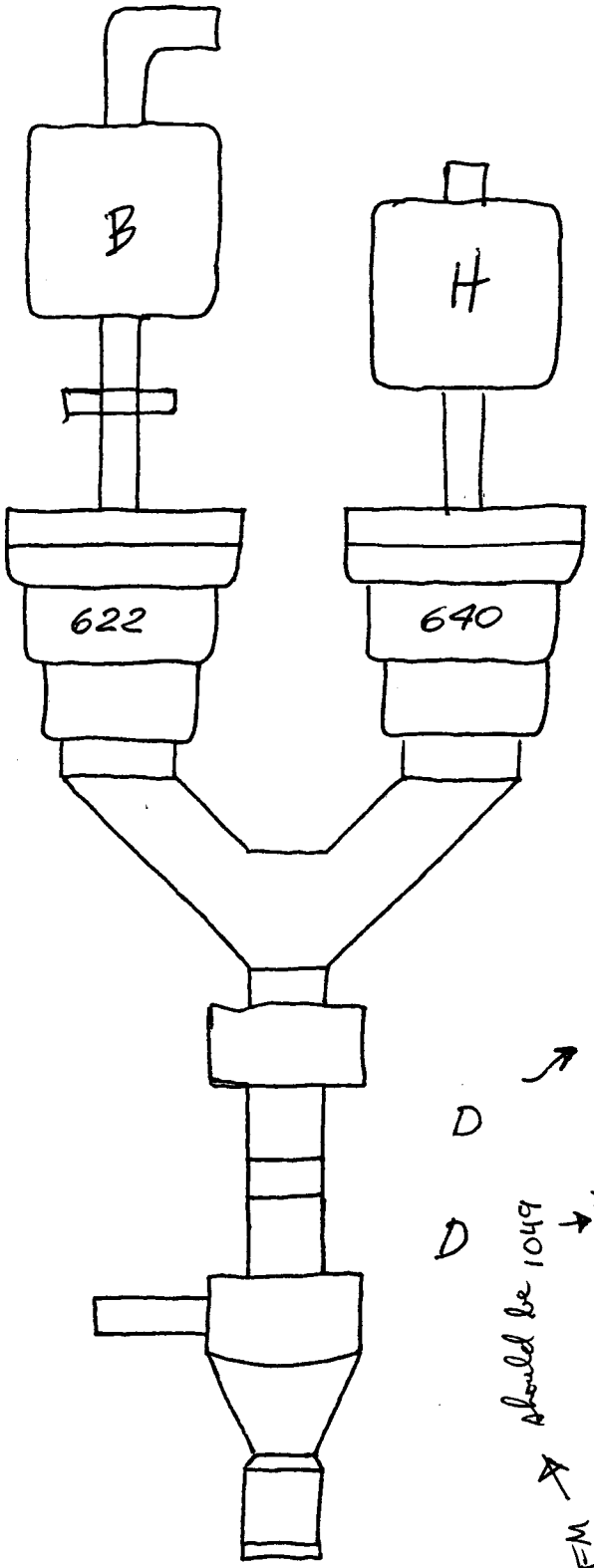
BY: B DATE:

CHKD: DATE:

PAGE

SHEET 1

V #8



101.5

49.1

Q0108010

Q0108011E

D0109011-1261-1

D

D

R=M ↗ should be 1049

Paper label — D07100-1049-6 — 1049

engraved #

ARCADIS
GERAGHTY & MILLER

SUBJECT: 1B011601H

JOB NO:

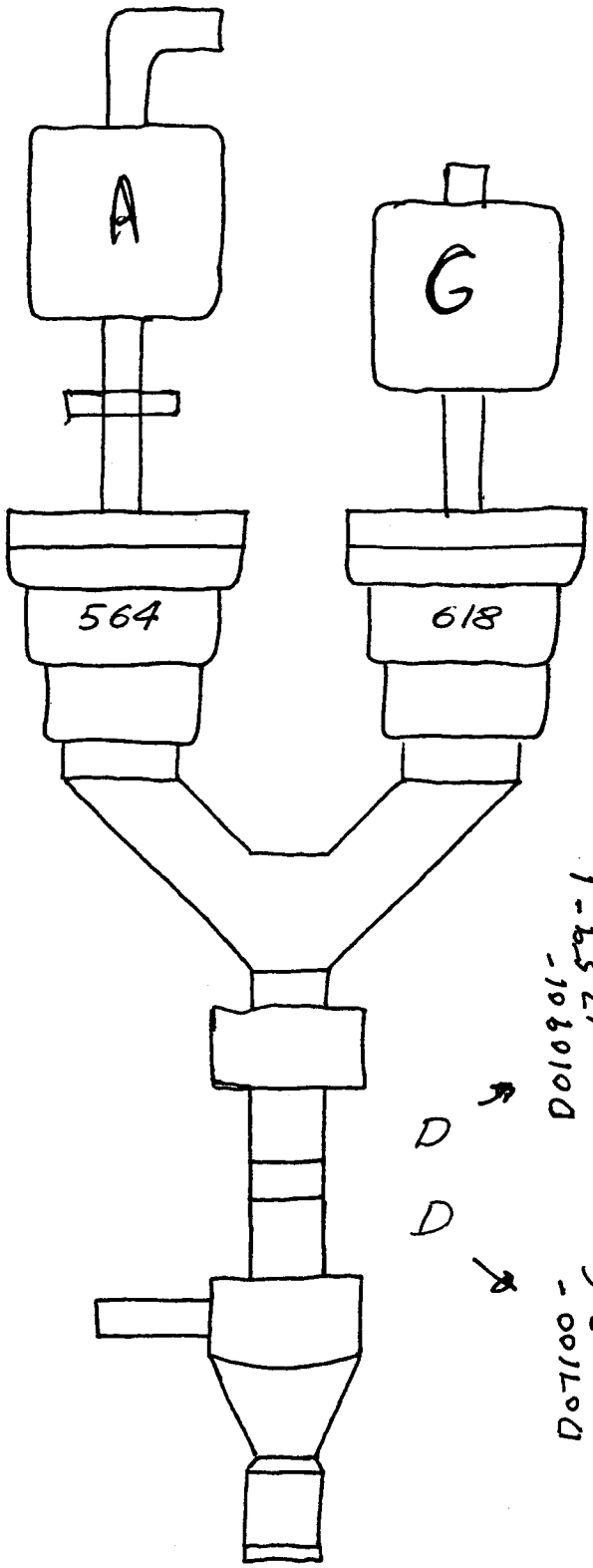
BY: B DATE:

CHKD: DATE:

PAGE

SHEET 1

✓ #10



101.5

49.1

Q010801F

Q010801G

6521
1-6521
-10801OD

E101
9-E101
-001700

Campaign 2

Chain of Custody Forms

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NC AQT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

ANALYSES

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF	NF (NYLON)	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERG-IB070902H	Pd 1A1 A	7/9/02	1	✓					P012302F	SPIKED
	Pd 1A2 A		1	✓					P012302G	
	Qd 1A1 640		1		✓				Q060602G	
	Td 1B1 614		1			✓			T1007992	
	Tr2 A1 584		1			✓			T1007993	
	Qr2 A2 584		1		✓				Q060602K	
	Tr2 B1 613		1			✓			T1007994	
	Qr2 B2 613		1		✓				Q060602L	
	Tr4 A1 633		1			✓			T1007995	

REMARKS: TEST #1 TUESDAY 7/09/02 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 2 of 10

PROJECT	NCAAT COLLABORATIVE STUDY
SITE	GREENSBORO, NC
COLLECTED BY (Signature)	Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF (NYLON)	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERG IB 070902 H	Qn 4 A2 633	7/9/02	1	✓					Q 060602 M	
	Tn 4 B1 641		1		✓				T1008951	
	Qn 4 B2 641		1	✓					Q 060602 N	
	Tn 5 A1 1185		1		✓				T1008952	
	Dn 5 A1 G10		1					✓	G10 - 73	LARGE DEN.
	Dn 5 A2 F16		1					✓	F16	SM. DEN.
	Tn 5 B1 1246		1			✓			T1008953	
	Nn 5 B2 1246		1				✓		N NF-1	
	Dn 5 B1 G14		1					✓	G14 - 79	LARGE DEN.

REMARKS: TEST #1 7/9/02 TUESDAY OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION
REMARKS:									

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NC A&T COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TE	NF (Nylon)	DENUDER			REMARKS	SAM ID NO. (for lab use only)
ERG IB 070902 4	Dn 5 B2 F18	7/9/02	1					✓			F18	SM. DENUDER
	Qn 6 A1 618		1		✓						Q060602 A	
	Pn 6 A1 F		1	✓							P011702 A	SPIKED
	Pn 6 A2 F		1	✓							P011702 B	
	Pn 6 A3 G		1	✓							P011702 C	
	Pn 6 A4 G		1	✓							P011702 D	
	Qn 6 B1 642		1		✓						Q060602 B	
	Pn 6 B1 H		1	✓							P011702 E	SPIKED
	Pn 6 B2 H		1	✓							P011702 F	

REMARKS: TEST # 1 TUESDAY — OIL Boiler

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 4 of 10

| PROJECT | NCAQT COLLABORATIVE STUDY | | |

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 5 of 10

PROJECT: NCAT Collaborative Study
SITE: Greensboro, NC
COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF (Nylon)	DENUDER				REMARKS	SAM ID NO. (for lab use only)
ERG-IB070902H	Pr 8 B2 D	7/9/02	1	✓								Po 11202 B	Po 12202 B
	Pr 8 B3 E		1	✓								Po 11202 C	Po 12202 C
	Pr 8 B4 E		1	✓								Po 11202 D	Po 12202 D
	Qr 10 A1 610		1		✓							Q 060502 E	
	Pr 10 A1 J		1	✓								Po 12202 E	SPIKED
	Pr 10 A2 J		1	✓								Po 12202 F	
	Pr 10 A3 K		1	✓								Po 12202 G	
	Pr 10 A4 K		1	✓								Po 12302 A	
	Qr 10 B1 622		1		✓							Q 060502 F	

CORRECTED pm.

REMARKS: TEST #1 TUES. 7/9/02 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NC A&T COLLABORATIVE STUDY
SITE: GREENSBORO, NC
COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF (NYLON)	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERG IB070902 H	PM10 B1 L	7/9/02	1	✓					P012302 B	SPIKED
	PM10 B2 L		1	✓					P012302 C	
	PM10 B3 M		1	✓					P012302 D	
	PM10 B4 M		1	✓					P012302 E	
ERG PES IB070902 H	QM Φ A1 FB		1		✓				Q060702C	Q FIELD BL.
ERG PES IB070902 H	TM Φ A1 FB		1			✓			1008954	T FIELD BL.
ERG PES IB070902 H	NM Φ A1 FB		1				✓		NF-2	NF FIELD BL.
ERG PES IB070902 H	PM Φ A1 FB		1	✓					P020102T	PUF FIELD BL.
ERG PES IB070902 H	PM Φ A2 FB		1	✓					P020802A	PUF FIELD BL.

REMARKS: TEST #1 TUES. 7/9/02 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCIAT COLLABORATIVE STUDY
SITE: GREENSBORO, NC
COLLECTED BY (Signature): Bob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	MATRIX TYPE / ANALYSES: PUF	QF	TF	NF (NYLON)	DENUDER	8X10 FILTER	FUEL SAMPLE	REMARKS	SAM ID NO. (for lab use only)
ERG IB070902 H	OIL FUEL SAMPLE	070902	1								DAY 1	
↓	Qd ϕ A1 8X10 FB	↓	1					✓			ERG-21	FIELD BL
↓	Qd ϕ A1 8X10	↓	1					✓			ERG-20	
PES IB070902 H	Q GREEN-1	070902	1		✓						Q060602H	
↓	P GREEN-1 N1	↓	1	✓							P102401 F	SPIKED PUF
↓	P GREEN-1 N2	↓	1	✓							P102401 G	PUF
↓	P GREEN-1 01	↓	1	✓							P102401 H	PUF
↓	P GREEN-1 02	↓	1	✓							P102401 I	PUF
↓	Q BLUE-3	↓	1		✓						Q060602I	

REMARKS: NOTE: Q GREEN TEST #1 TUES 7/9 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Bob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NC AIT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	MATRIX: PUF	MATRIX: OIL	ANALYSES	REMARKS	SAM ID NO. (for lab use only)
PESIB070902H	P-BLUE-3 P1	070902	1	✓			PO 11002 A	SPIKED
PESIB070902H	P BLUE-3 P2		1	✓			PO 11002 B	
PESIB070902H	P BLUE-3 Q1		1	✓			PO 11002 C	
PESIB070902H	P BLUE-3 Q2		1	✓			PO 11002 D	
PESIB070902H	Q RED-#4	*	1		✓		Q060602 J	
PESIB070902H	P RED-#4 R1		1	✓			PO 11002 E	SPIKED
PESIB070902H	P RED-#4 R2		1	✓			PO 11002 F	
PESIB070902H	P RED-#4 S1		1	✓			PO 11002 G	
PESIB070902H	P RED-#4 S2		1	✓			PO 11002 H	

REMARKS: TEST # 1 TUESDAY 7/9/02 * P. RED IS ACTUALLY PORT #4 RED OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 9 of 10

PROJECT: NCAQT COLLABORATIVE STUDY
SITE: GREENSBORO, NC
COLLECTED BY (Signature): Joe Mantz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: AL FOILS	REMARKS	SAM ID NO. (for lab use only)
ERG IB 070902 H	FnT A1 FOIL13	7/9/02	1	✓	A062102 A	TORE FILTER (FOIL) UPON REMOVAL IT
	FnT A1 FOIL12	"	1	✓	A062102 B	
	FnT A1 FOIL11	"	1	✓	A062102 C	
	FnT A1 FOIL10	"	1	✓	A062102 D	
	FnT A1 FOIL9	"	1	✓	A062102 E	
	FnT A1 FOIL8	"	1	✓	A062102 F	
	FnT A1 FOIL7	"	1	✓	A062102 G	
	FnT A1 FOIL6	"	1	✓	A062102 H	
	FnT A1 FOIL5	"	1	✓	A062102 I	

REMARKS: TEST #1 7/9/02 TUES OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT: NCAST COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: Al Foils	REMARKS	SAM ID NO. (for lab use only)
ERGIB070902H	Fn 7 A. Foil 4	7/9/02		✓	A062102 J	
	Fn 7 A. Foil 3			✓	A062102 K	
	Fn 7 A. Foil 2			✓	A062102 L	
	Fn 7 A. Foil 1			✓	A062102 M	
	Fn ϕ A. Foil FB			✓	A062102 N	

REMARKS: TEST #1 7/9/02 OIL Boiler

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ANALYTICAL REQUEST AND CHAIN OF CUSTODY

PLANT: NC A&T | PROJECT #: $605,001

RECOVERY PERSON: Frank Meadows

SAMPLE TECHNICIAN:

SAMPLE IDENTIFICATION	COLLECTION DATE	COLLECTION TIME	SAMPLE NAME	NUMBER OF CONTAINERS	ANALYTICAL REQUEST	COMMENTS (Type of container, special preparation, special handling, etc.)
PESIB070902H LEG-2	7/9/02		Teflon filter 1008978	1	1	
PESIB070902H LEG-5	7/9/02		Teflon filter 1008987		1	
PESIB070902H LEG-6	7/9/02		Teflon filter 1008976		1	
PESIB070902H LEG-5	7/9/02		Nylon filter NF 6		1	

FRANK MEADOWS
RELINQUISHER'S NAME

7-9-02 2152
DATE/TIME

RELINQUISHER'S SIGNATURE

SHIPPER'S NAME AND ID NUMBER

ROB MARTZ
RECEIVER'S NAME

7/9/02 955p.
DATE/TIME

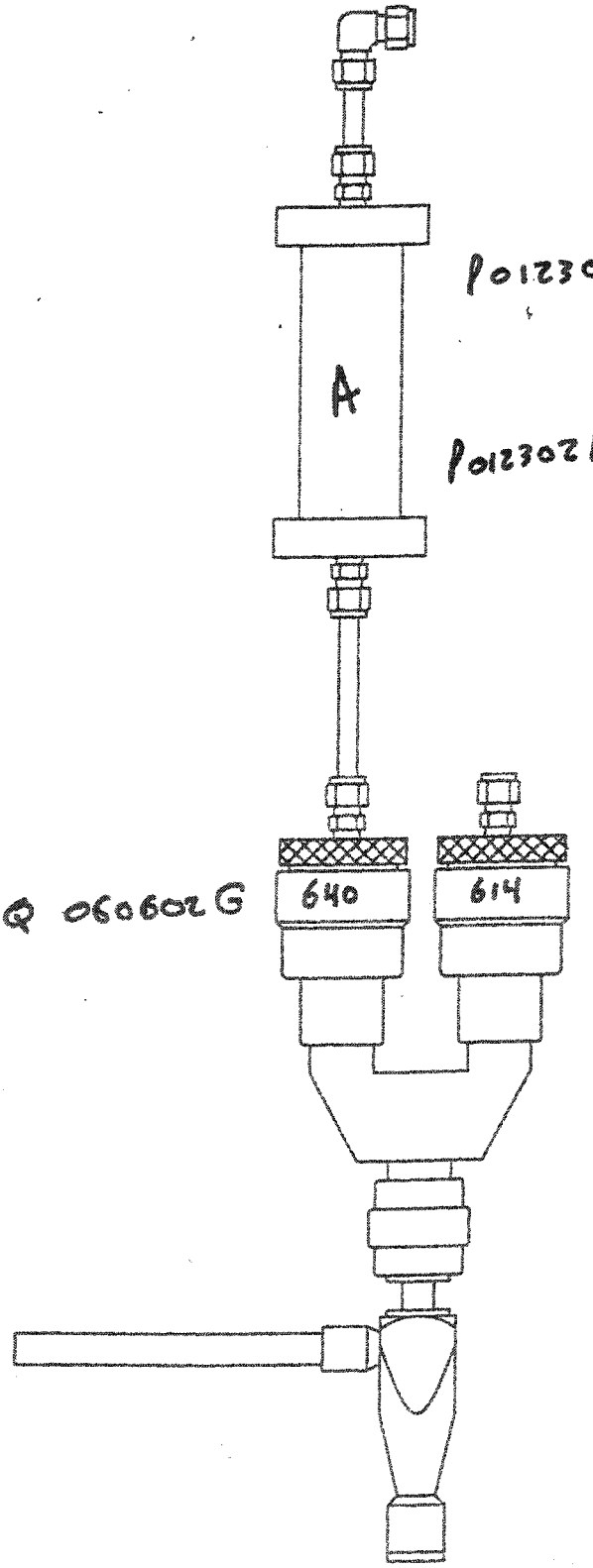
Rob Martz
RECEIVER'S SIGNATURE

TEST ID	FB070902H
DATE	7/9/02
PORT #	1
DONE BY	RPM

TEST 1 NCAT COLLABORATIVE

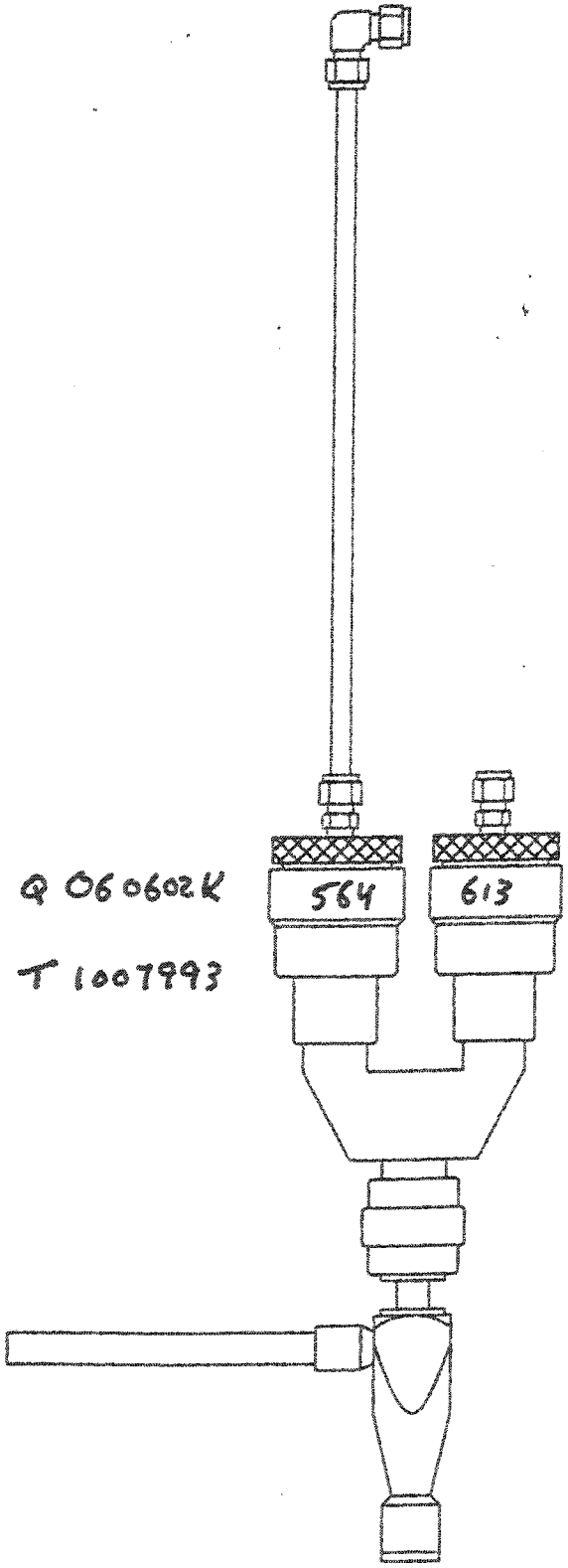
PORT 1

DILUTION



TEST ID	IB 070902 H
DATE	7/9/02
PORT #	2
DONE BY	RFM

PORT 2



Q 060602K

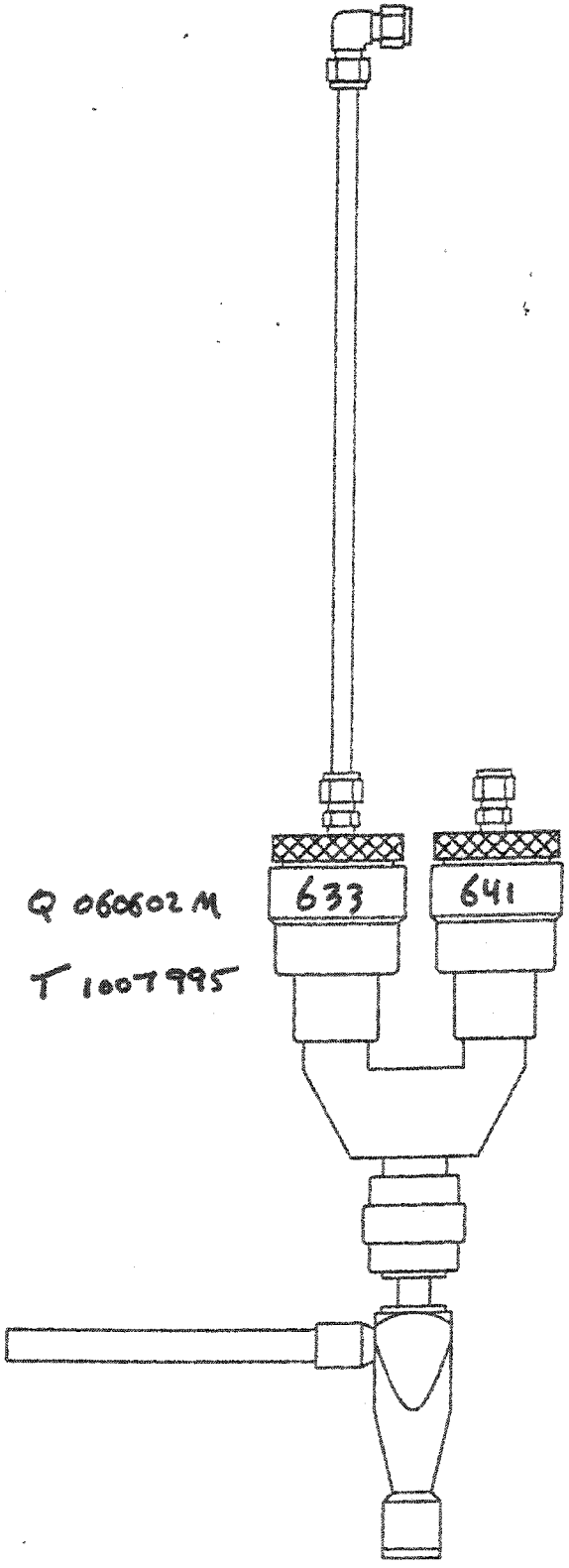
T 1007993

Q 060602L

T 1007994

TEST ID	FB 070902H
DATE	7/9/02
PORT #	4
DONE BY	RFM

PORT # 4



Q 060602M

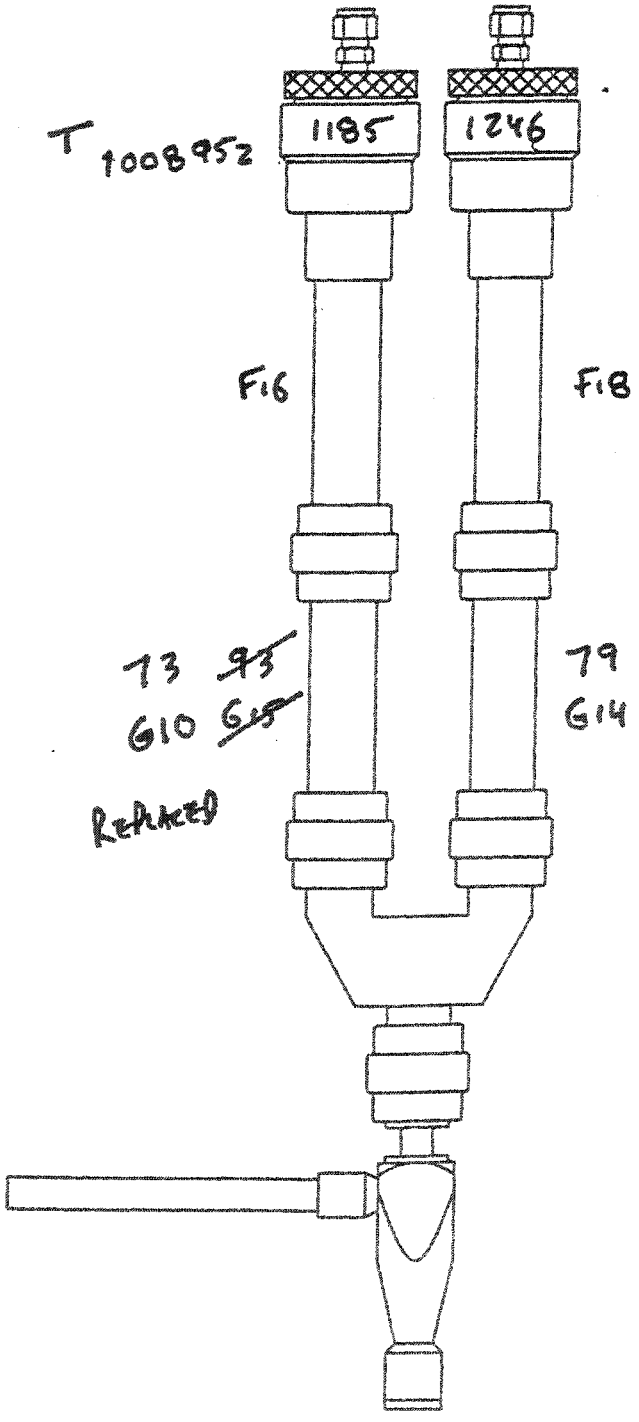
T 1007995

Q 060602N

T 1008951

TEST ID	IB 0709 024
DATE	7/9/02
PORT #	5
DONE BY	RFM

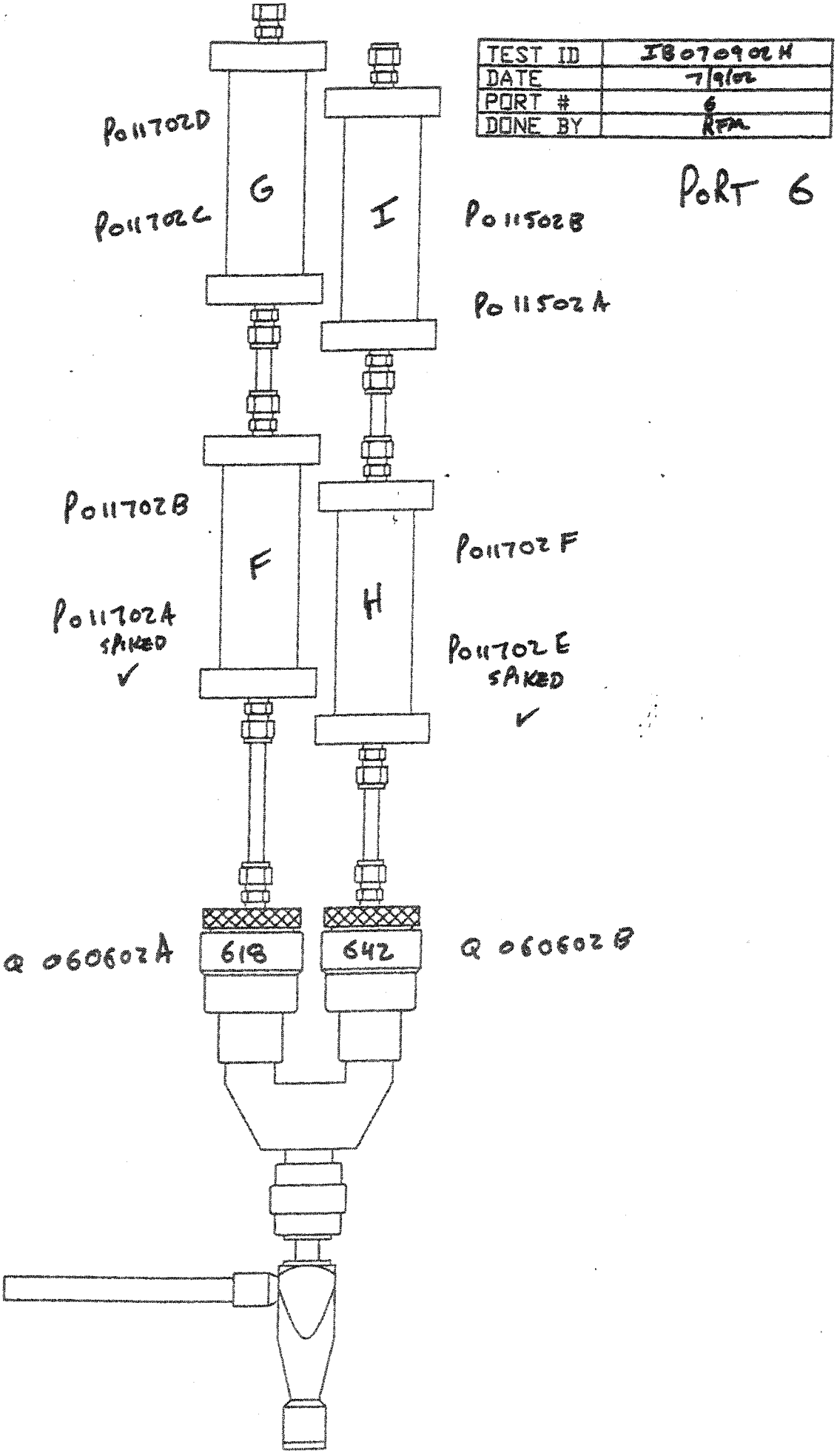
PORT 5

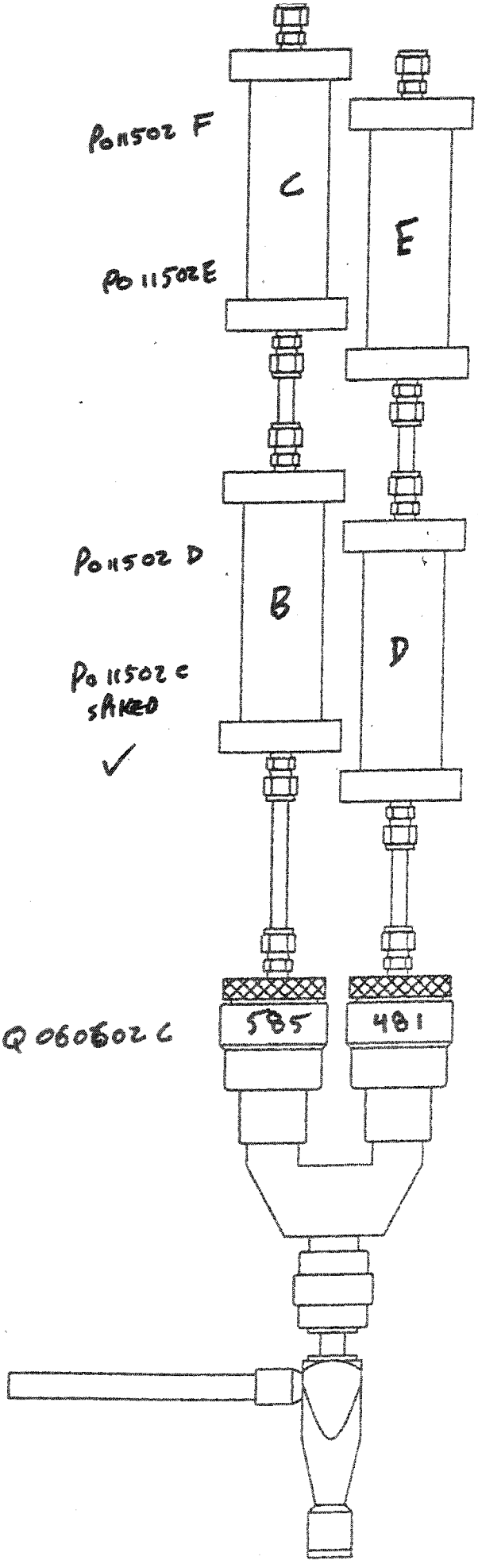


N NF-1

SMALL DENUDER

LARGE DENUDER


TEST ID | IB070902H
DATE | 7/9/02
PORT # | 6
DONE BY | RFM
PORT 6
P011702D
G
P011702C
I
P011502B
P011502A
P011702B
F
H
P011702F
P011702A
SAKED
P011702E
SAKED
Q060602A
618
642
Q060602B



TEST ID	IB070902H
DATE	7/9/02
PORT #	8
DONE BY	RFM

PO11502 F

PO11502E

PO11502 D

PO11502 C
SAKED
✓

Q060502C

PO11202D ~~PO11202D~~ PORT 8 PO12202D

PO11202C ~~PO11202C~~ RM PO12202C

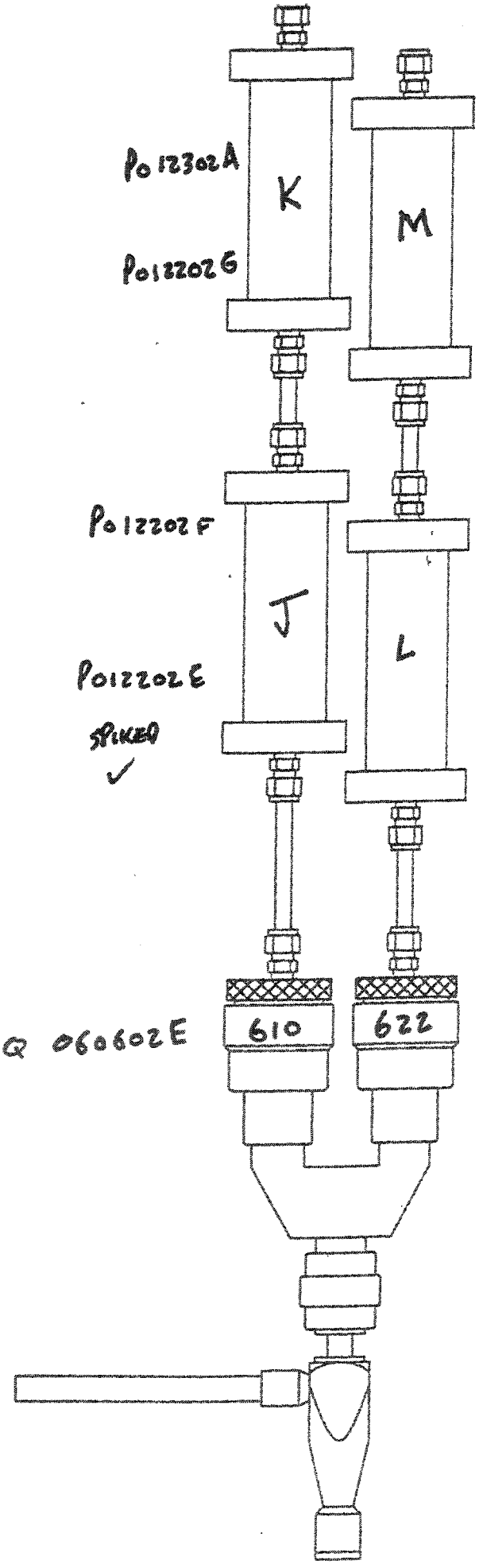
PO11202B ~~PO11202B~~ RM PO12202B

PO12202A
SAKED
✓

Q060602D

TEST ID	I8070902H
DATE	7/9/02
PORT #	10
DONE BY	RFM

PORT 10



ERG
EASTERN RESEARCH GROUP, INC.

CALCULATION SHEET

CALC. NO. _____

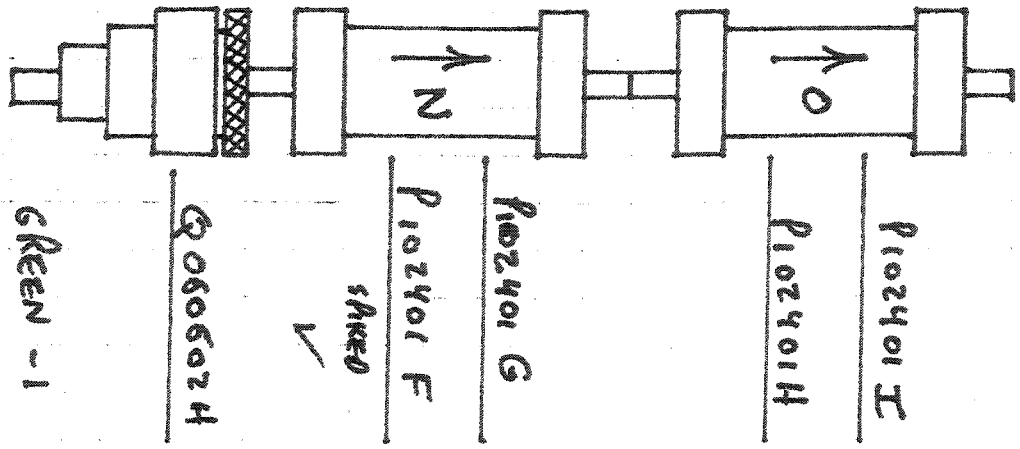
SIGNATURE _____ DATE _____ CHECKED _____ DATE _____

PROJECT _____ JOB NO. _____

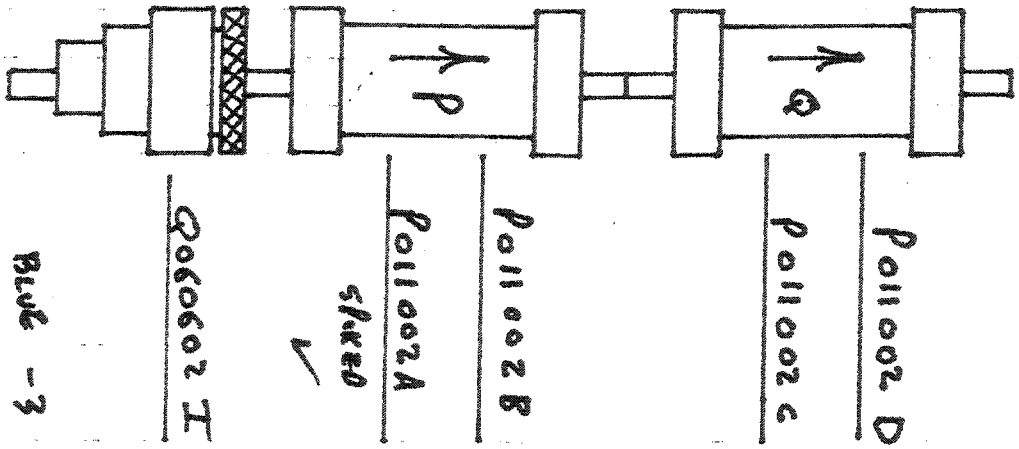
SUBJECT _____ SHEET _____ OF _____ SHEETS

DATE: 7/9/02
TEST #: ONE PES IB0709024

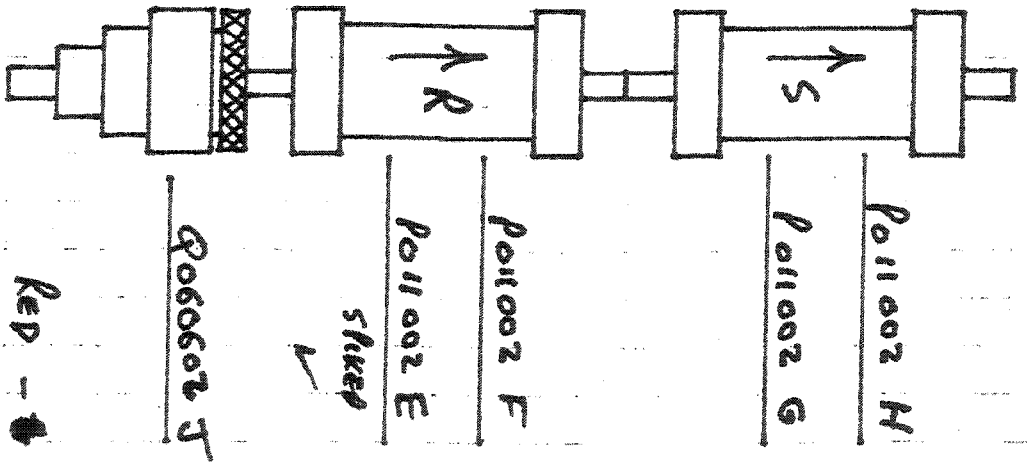
PES ARRAY #:



PES ARRAY #:



PES ARRAY #:



1363-181

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT: NC AQT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Bob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERGIB 071002H	Qn4 A2 633	7/10/02	1	+	✓				Q0606024	
	Tn4 B1 641	"	1	+		✓			T1008957	
	Qn4 B2 641	"	1	+	✓				Q0606027	
	Tn5 A1 1185	"	1	+		✓			T1008960	
	Dn5 A1 G16	"	1	+				✓	G16-72	LARGE DEN.
	Dn5 A2 F17	"	1	+				✓	F17	SMALL DEN.
	Tn5 B1 1246	"	1	+		✓			T1008961	
	Nn5 B2 1246	"	1	+			✓		N NF-3	
	Dn5 B1 G13	"	1	+				✓	G13-75	LARGE DEN.

REMARKS: TEST #2 WED. 7/10 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Bob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 3 of 9

PROJECT: NCAPT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QUF	TUF	NUF	DEWATER	REMARKS	SAM ID NO. (for lab use only)
ERGIB071002H	DA5 B2 F15	7/10/02	1					✓	F15	Small Dev.
	QA6 A1 618	.	1		✓				Q060602V	
	PA6 A1 F	.	1	✓					P020102 J	SPIKED
	PA6 A2 F	.	1	✓					P020102 K	
	PA6 A3 G	.	1	✓					P020102 L	
	PA6 A4 G	.	1	✓					P020102 M	
	QA6 B1 642	.	1		✓				Q060602W	
	PA6 B1 H	.	1	✓					P020102 N	SPIKED
	PA6 B2 H	.	1	✓					P020102 O	

REMARKS: TEST #2 WED. 7/10 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT	NCAQT COLLABORATIVE STUDY
SITE	GREENSBORO, NC
COLLECTED BY (Signature)	Bob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TE	NE	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERGIB071002H	PA6B3I	7/10/02	1	✓					P020102P	
	PA6B4I	"	1	✓					P020102Q	
	QA8A1585	"	1		✓				Q060602T	
	PA8A1B	"	1	✓					P020102B	SPIKED
	PA8A2B	"	1	✓					P020102C	
	PA8A3C	"	1	✓					P020102D	
	PA8A4C	"	1	✓					P020102E	
	QA8B1481	"	1		✓				Q060602U	
	PA8B1D	"	1	✓					P020102F	SPIKED

REMARKS: TEST # 2 WED. 7/10 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCAQT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERG IB 071902 H	PM8 B2D	7/10/02	1	✓					P020102G	
	PM8 B3E	"	1	✓					P020102H	
	PM8 B4E	"	1	✓					P020102I	
	QM10 A1 B10	"	1		✓				Q060602R	
	PM10 A1J	"	1	✓					P012902B	SPIKED
	PM10 A2J	"	1	✓					P012902C	
	PM10 A3K	"	1	✓					P012902D	
	PM10 A4K	"	1	✓					P012902E	
	QM10 B1 B22	"	1		✓				Q060602S	

REMARKS: TEST # 2 WED. 7/10 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCA&T COLLABORATIVE TEST

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF	DENUDER	8x10 FILTER	FUEL SAMPLE	REMARKS	SAM ID NO. (for lab use only)
ERGIB071002H	PM10 B1L	7/10/02	1	✓							P012902F	SPIKED
	PM10 B2L	"	1	✓							P012902G	
	PM10 B3M	"	1	✓							P012902H	
	PM10 B4M	"	1	✓							P020102A	
	OIL FUEL SAMPLE		1							✓	DAY 2	NOT NEEDED
PESIB071002H	QGREEN-1	7/10/02	1		✓						Q060602O	
	PGREEN-1N1	"	1	✓							P012302H	SPIKED
	PGREEN-1N2	"	1	✓							P102401D	
	PGREEN-101	"	1	✓							P012502A	

REMARKS: TEST # 2 WED. 7/10 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCAT COLLABORATIVE STUDY
SITE: GREENSBORO, NC
COLLECTED BY (Signature): Rob Mouty

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	ANALYSES: QF	REMARKS	SAM ID NO. (for lab use only)
PES IB 071002 H	P GREEN-1 02	7/10/02	1	✓		P012502 B	
	Q BLUE-3		1		✓	Q060602 P	
	P BLUE-3 P1		1	✓		P012502 C	SPIKED
	P BLUE-3 P2		1	✓		P012502 D	
	P BLUE-3 Q1		1	✓		P012502 E	
	P BLUE-3 Q2		1	✓		P012502 F	
	Q RED-4		1		✓	Q060602 Q	
	P RED-4 R1		1	✓		P012502 G	SPIKED
	P RED-4 R2		1	✓		P012502 H	

REMARKS: TEST # 2 WED. 7/10 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mouty		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

488-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCATT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE / ANALYSES: PUF; AL FOILS

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	AL FOILS	REMARKS	SAM ID NO. (for lab use only)
PESIB071002H	PRED-4 S1	7/10/02	1	✓		P102401E	
↓	PRED-4 S2	↓	1	✓		P012902A	
ERG IB071002H	FAT A1 FOIL 13	7/10/02	1		✓	A062102 O	
	FAT A1 FOIL 12		1		✓	A062102 P	
	FAT A1 FOIL 11		1		✓	A062102 Q	
	FAT A1 FOIL 10		1		✓	A062102 R	
	FAT A1 FOIL 9		1		✓	A062102 S	
	FAT A1 FOIL 8		1		✓	A062102 T	
	FAT A1 FOIL 7		1		✓	A062102 U	

REMARKS: TEST #2 WED. 7/10/02 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 9 of 9

PROJECT: NCA&T COLLABORATIVE

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: Al Foils	ANALYSES: 8x10 Filter	REMARKS	SAM ID NO. (for lab use only)
ERG FB071002 H	FnT A1 Foil 6	7/10/02	1	✓		A062102 V	
	FnT A1 Foil 5		1	✓		A062102 W	
	FnT A1 Foil 4		1	✓		A062102 X	
	FnT A1 Foil 3		1	✓		A062102 Y	
	FnT A1 Foil 2		1	✓		A062102 Z	
	FnT A1 Foil 1		1	✓		A062402 A	
	Qd ϕ A1 8x10		1		✓	ERG-22	

REMARKS: TEST # 2 7/10/02 WED. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ANALYTICAL REQUEST AND CHAIN OF CUSTODY

PLANT: NC A&T

PROJECT #: $605.001

RECOVERY PERSON: FRANK MEADOWS

SAMPLE TECHNICIAN:

SAMPLE IDENTIFICATION	COLLECTION DATE	COLLECTION TIME	SAMPLE NAME	NUMBER OF CONTAINERS	ANALYTICAL REQUEST	COMMENTS (Type of container, special preparation, special handling, etc.)
PESIB071002H LEG 2	7/10/02		Teflon Filter 100898 1	1		Run 2
PESIB071002H LEG 5	7/10/02		Teflon Filter 100897 9	1		Run 2
PESIB071002H LEG 6	7/10/02		Teflon Filter 100898 0	1		Run 2
PESIB071002H LEG 5	7/10/02		Nylasorb Filter NF-7	1		RUN 2

FRANK MEADOWS
RELINQUISHER'S NAME

07/10/02 1757
DATE/TIME

RELINQUISHER'S SIGNATURE

ROB MARTZ
RECEIVER'S NAME

7/10/02 600 p.
DATE/TIME

RECEIVER'S SIGNATURE

SHIPPER'S NAME AND ID NUMBER

ANALYTICAL REQUEST AND CHAIN OF CUSTODY

PLANT: NC A&T

PROJECT #: 6605.001

RECOVERY PERSON: F MEADOWS

SAMPLE TECHNICIAN:

SAMPLE IDENTIFICATION	COLLECTION DATE	COLLECTION TIME	SAMPLE NAME	NUMBER OF CONTAINERS	ANALYTICAL REQUEST	COMMENTS (Type of container, special preparation, special handling, etc.)
PESIB0710021HLEG 1	7/10/02		Q060602O	1		
PESIB0710021H LEG 3	7/10/02		Q060602P	1		
PESIB0710021H LEG 4	7/10/02		Q060602Q	1		

FRANK MEADOWS
RELINQUISHER'S NAME

7/10/02 1757
DATE/TIME

RELINQUISHER'S SIGNATURE

SHIPPER'S NAME AND ID NUMBER

Rob Mark
RECEIVER'S NAME

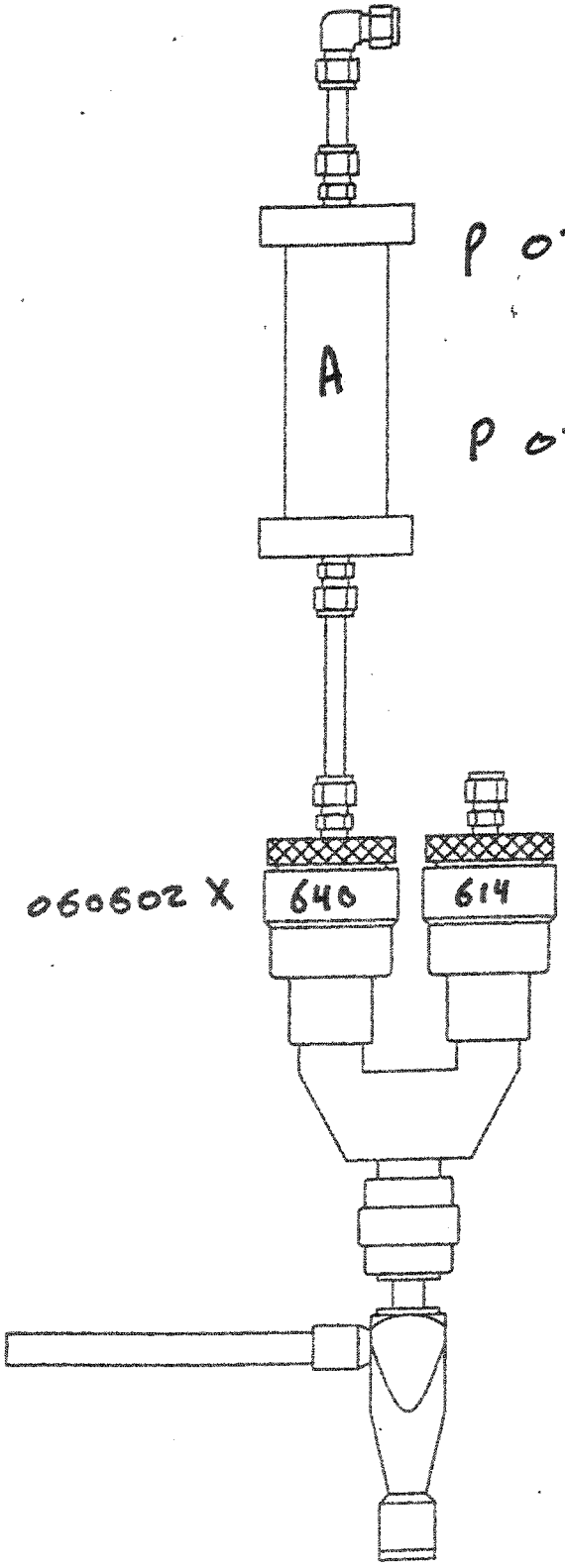
7/10/02 6 pm
DATE/TIME

Rob Mark
RECEIVER'S SIGNATURE

TEST ID	IB07102H
DATE	7/10/02
PORT #	1
DONE BY	RFM

TEST 2
NC A&T
COLLABORATIVE

PORT 1
DILUTION



P 020102S

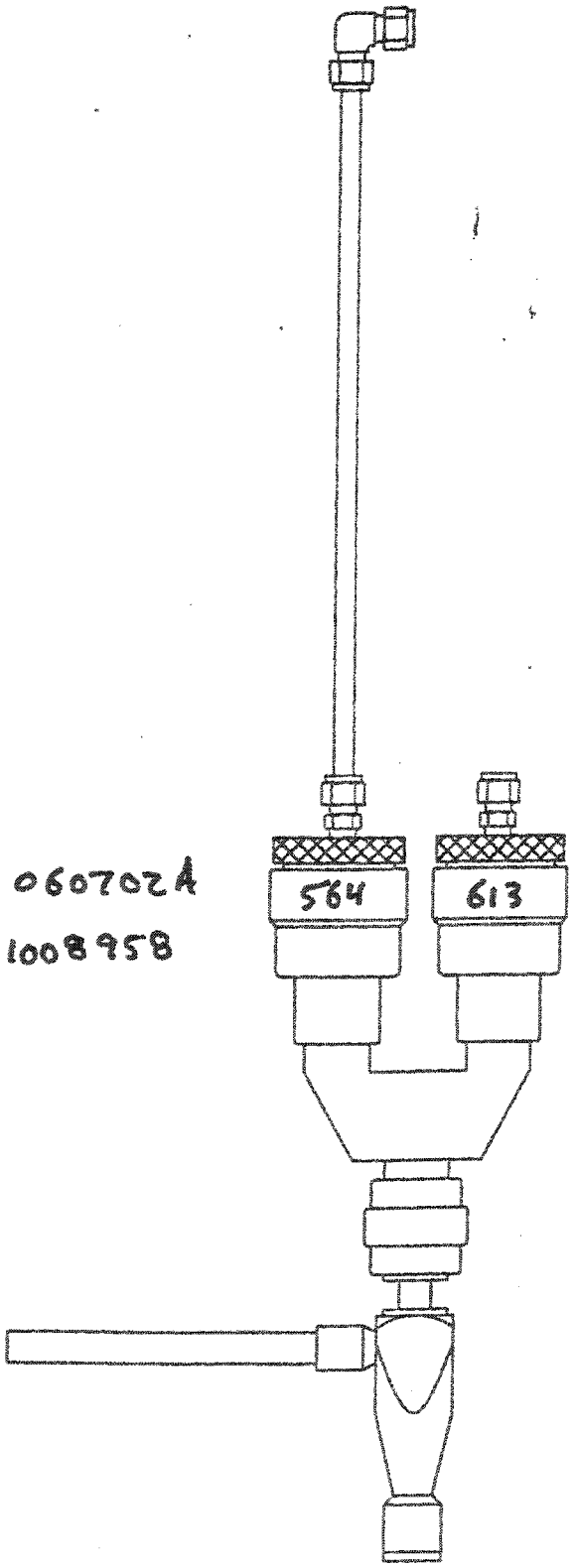
P 020102R
SPIKED
✓

Q 060602 X

T 1008955

TEST ID	IB0710024
DATE	7/10/02
PORT #	3
DONE BY	RFM

PORT 2

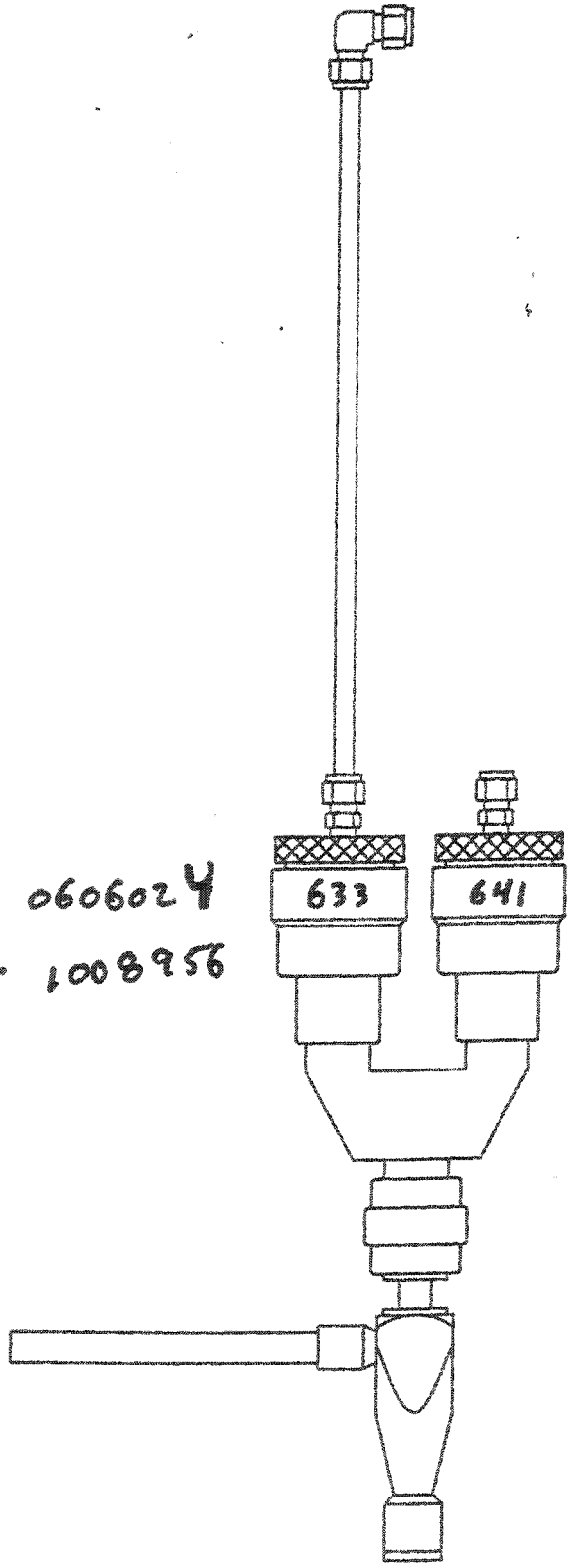


Q 060702A
T 1008958

Q 060702B
T 1008959

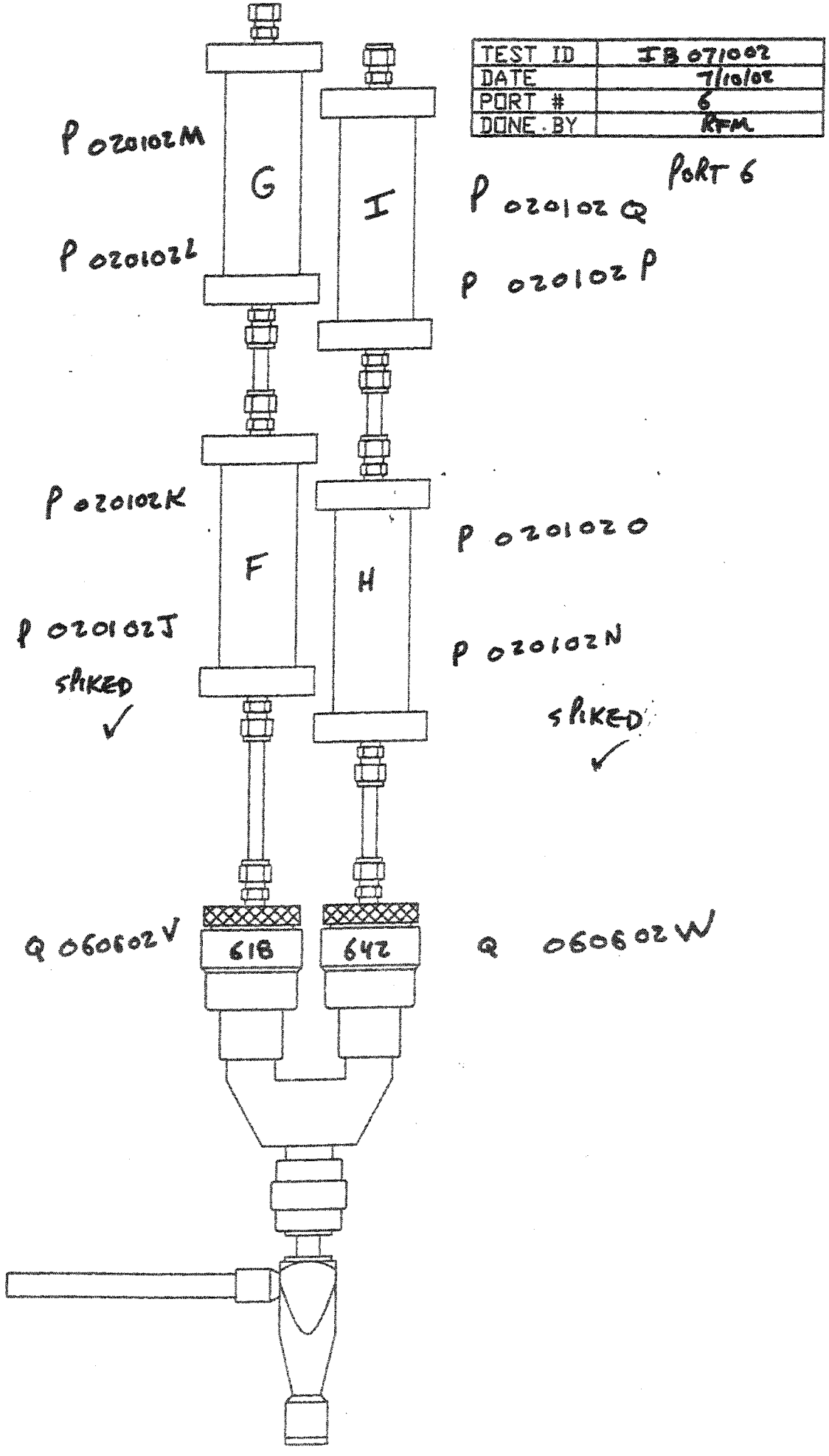
TEST ID	IB 071002 4
DATE	7/10/02
PORT #	4
DONE BY	RFM

PORT 4



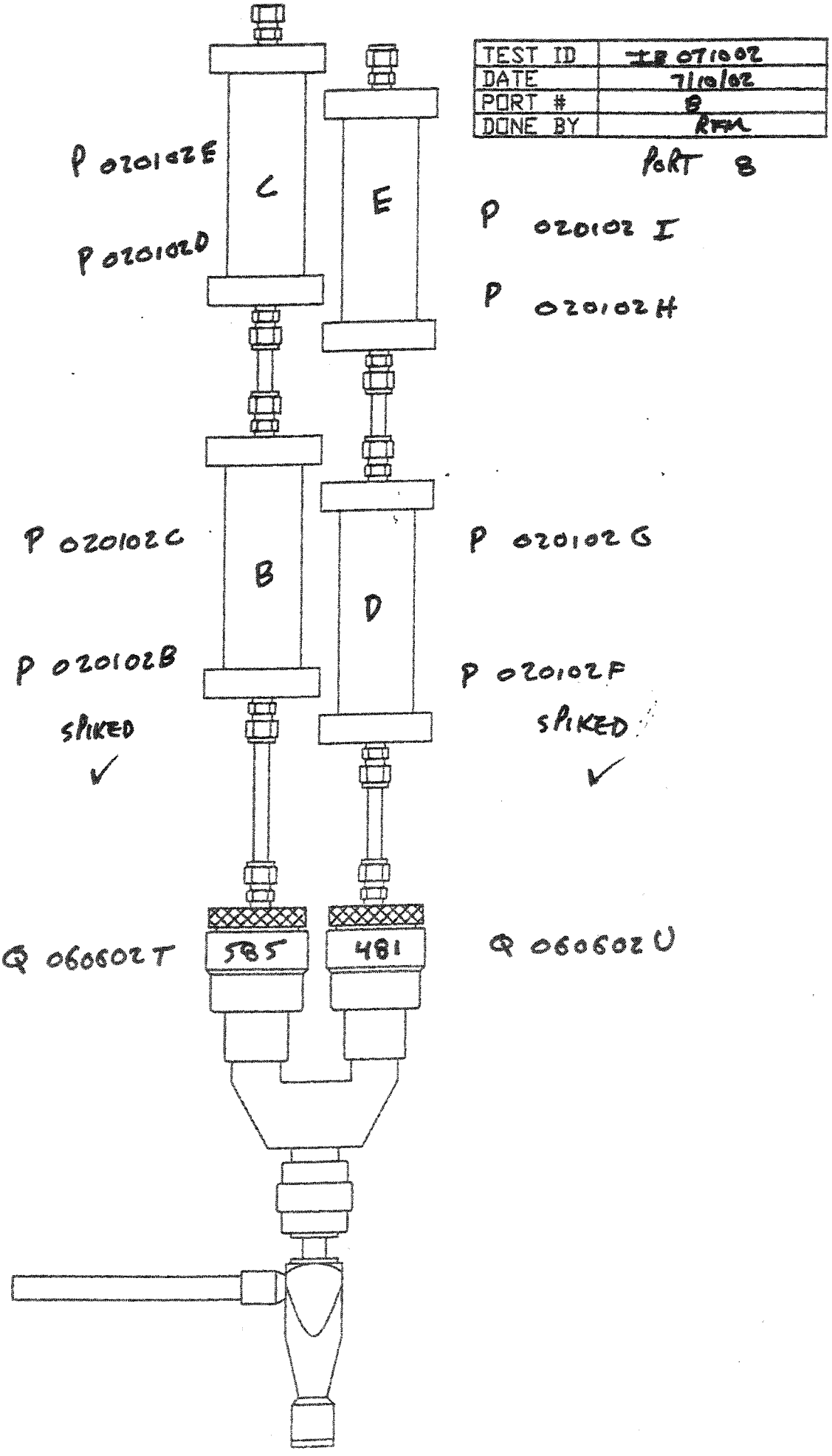
Q 060602 4
T 1008956

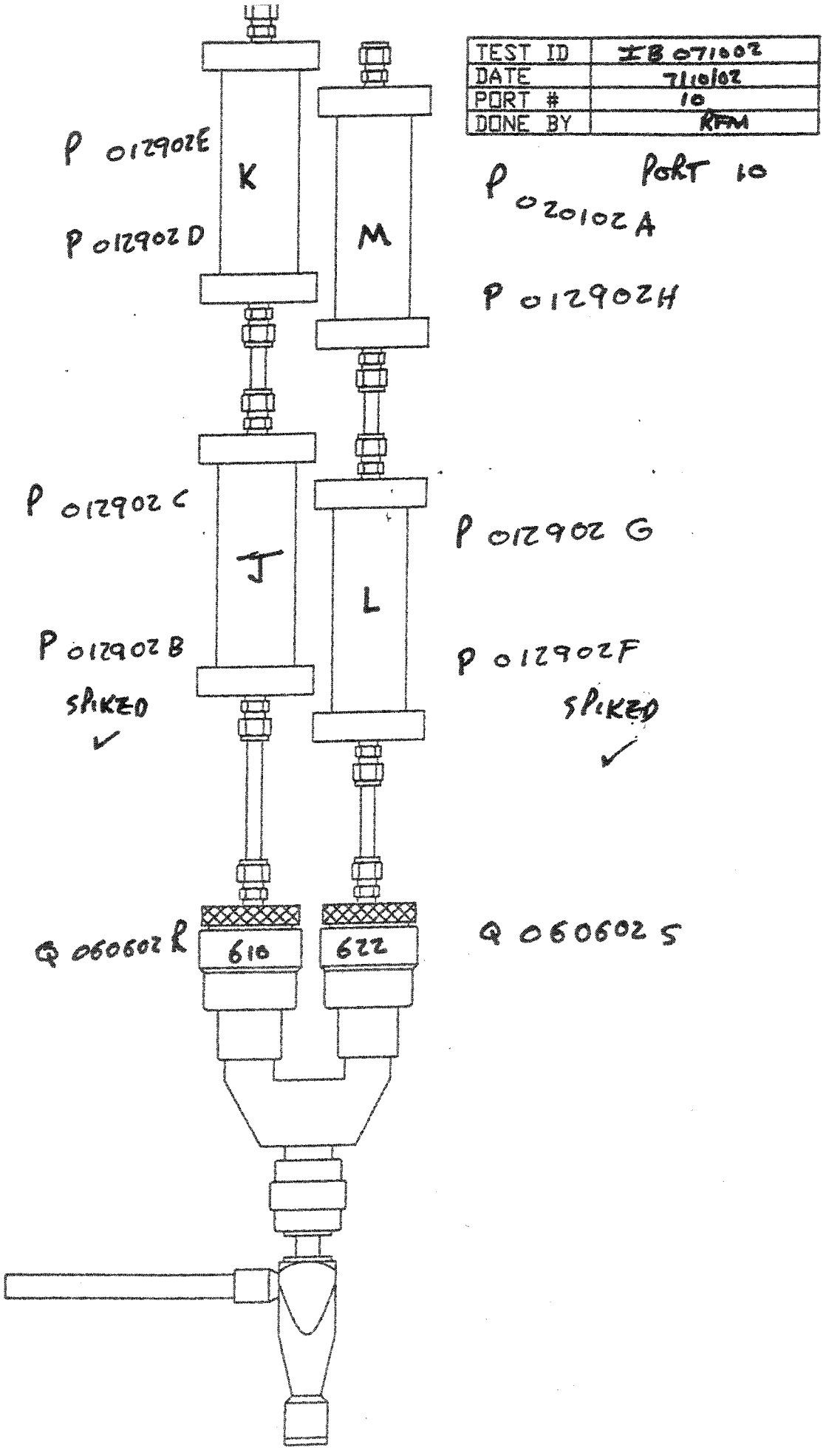
Q 060602 E
T 1008957



TEST ID	IB 071002
DATE	7/10/02
PORT #	6
DONE BY	RFM

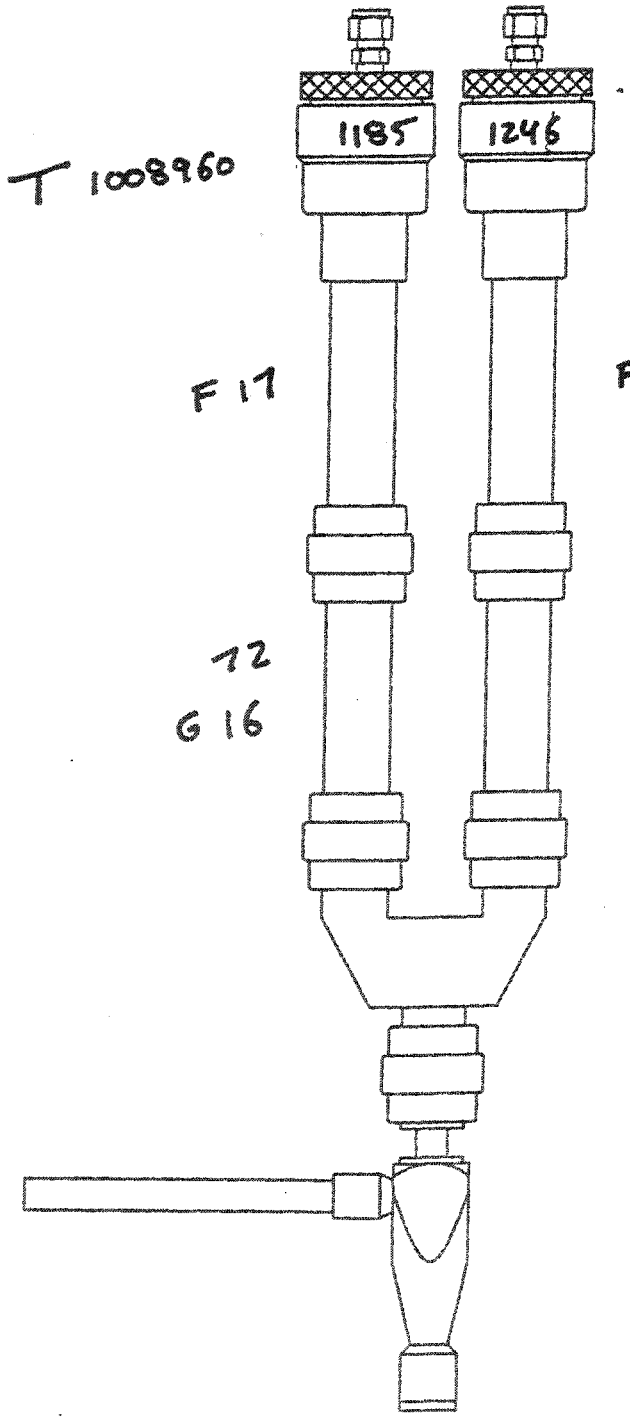
PORT 6


TEST ID
TR 071002
DATE
7/10/02
PORT #
8
DONE BY
RFM
PORT 8
P 020102E
C
E
P 020102I
P 020102D
P 020102H
P 020102C
B
D
P 020102G
P 020102B
SPIKED
✓
P 020102F
SPIKED
✓
Q 060602T
585
481
Q 060602U


TEST ID
EB 071002
DATE
7/10/02
PORT #
10
DONE BY
KFM
P 012902E
K
P 012902D
M
P 020102A
PORT 10
P 012902H
P 012902C
J
L
P 012902G
P 012902B
SPIKED
P 012902F
SPIKED
Q 060602R
610
622
Q 060602S

TEST ID	IB071002
DATE	7/10/02
PORT #	5
DONE BY	RFM

PORT 5



T 1008960

N NF-3

T 1008961

F 17

F 15

SMALL DENUDER

T2

G 16

T5

G 13

LARGE DENUDER

EERG
EASTERN RESEARCH GROUP, INC.

CALCULATION SHEET

CALC. NO. _____

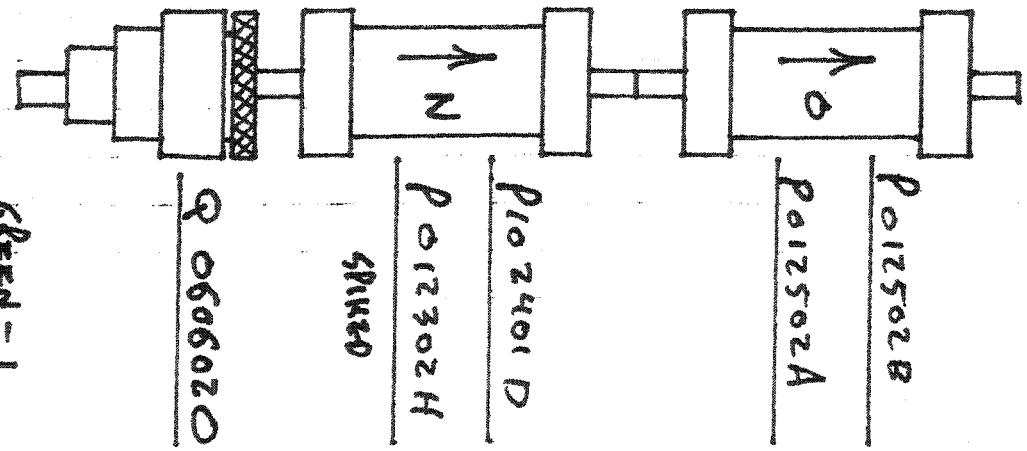
SIGNATURE _____ DATE _____ CHECKED _____ DATE _____

PROJECT _____ JOB NO. _____

SUBJECT _____ SHEET _____ OF _____ SHEETS

DATE: 7/10/02
TEST #: Two
PES ARRAY #:

PES IB 071002 H



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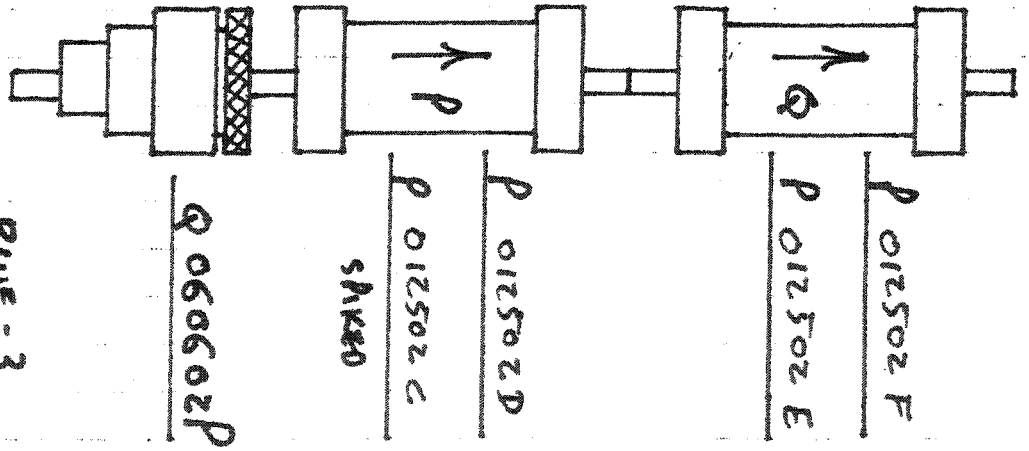
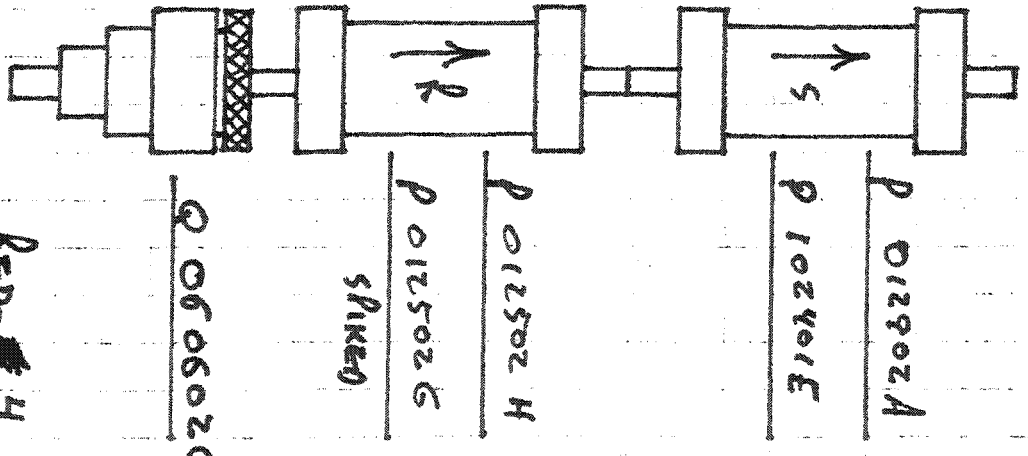


PES ARRAY #:



4-81-3381

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT: NCA QT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF	NF (NYLON)	DENUDER	ANALYSES	REMARKS	SAM ID NO. (for lab use only)
ERGIB071002H	Pd 1A1A	7/10/02	1	✓						P020102R	SPIKED
	Pd 1A2A	"	1	✓						P020102S	
	Qd 1A1 640	"	1		✓					Q060602X	
	Td 1B1614	"	1			✓				T1008955	
	Tn 2A1 584	"	1			✓				T1008958	
	Qn 2A2 584	"	1		✓					Q060702A	
	Tn 2B1 613	"	1			✓				T1008959	
	Qn 2B2 613	"	1		✓					Q060702B	
	Tn 4A1 633	"	1			✓				T1008956	

REMARKS: TEST # 2 WED. 7/10 OILBOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCAQ T COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Bob Mintz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QF	TF	NF (NYLON)	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERGIB 071102 H	Pd 1A1 A	7/11/02	1	✓					P062102D	
	Pd 1A2A		1	✓					P062102E	
	Qd 1A1640		1		✓				Q060702M	
	Td 1B1614		1			✓			T1008964	
	Tn 2A1584		1			✓			T1008967	
	Qn2A2584		1		✓				Q060702P	
	Tn2B1613		1			✓			T1008968	
	Qn2B2613		1		✓				Q060702Q	
	Tn4A1633		1			✓			T1008965	

REMARKS: TEST #3 THURS. 7/11 OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Bob Mintz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NC A&T COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

ANALYSES

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	TF	NF	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERGIB071102H	QA4A2633	7/11/02	1		✓				Q060702N	
	TA4B1641		1			✓			T1008966	
	QA4B2641		1		✓				Q060702O	
	TA5A1185		1			✓			T1008962	
	DA5A1617		1					✓	617-95	LG. DENUDER
	DA5A2F13		1					✓	F13	SMALL DEN.
	TA5B1246		1			✓			T1008963	
	NA5B21246		1				✓		N NF-4	
	DA5B1618		1					✓	618-83	LG. DENUDER

REMARKS: TEST # 3 7/11 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT: NCAT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Log Monk

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	OF	TF	NF	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERGIB 071102H	DN5B2F14	7/11/02	1					✓	F14	SMALL DEN.
	QN6A1618	"	1		✓				Q060702K	
	PN6A1F	"	1	✓					P062502K	SPIKED
	PN6A2F	"	1	✓					P062502L	
	PN6A3G	"	1	✓					P062502M	
	PN6A4G	"	1	✓					P062502N	
	QN6B1642	"	1		✓				Q060702L	
	PN6B1H	"	1	✓					P062502O	SPIKED
	PN6B2H	"	1	✓					P062102A	

REMARKS: TEST # 3 7/11 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Log Monk	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCAQT COLLABORATIVE STUDY
SITE: GREENSBORO, NC
COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QFF	TFE	NFE	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERG071102H	PrG B3 I	7/11/02	1	✓					P062102B	
	PrG B4 I	.	1	✓					P062102C	
	QrB A1 585	.	1		✓				Q060702I	
	PrB A1 B	.	1	✓					P062502C	SPIKED
	PrB A2 B	.	1	✓					P062502D	
	PrB A3C	.	1	✓					P062502E	
	PrB A4C	.	1	✓					P062502F	
	QrB B1 481	.	1		✓				Q060702J	
	PrB B1D	.	1	✓					P062502G	SPIKED

REMARKS: TEST # 3 7/11 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

Page 5 of 9

PROJECT: NCAST COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: PUF	QFF	TFE	NF	DENUDER	REMARKS	SAM ID NO. (for lab use only)
ERG IB07102H	PrB B2D	7/10/02	1	✓					P062502 H	
	PrB B3E	"	1	✓					P062502 I	
	PrB B4E	"	1	✓					P062502 J	
	QrIO A1 610	"	1		✓				Q060702 G	
	PrIO A1 J	"	1	✓					P041202 G	SPIKED
	PrIO A2 J	"	1	✓					P041202 H	
	PrIO A3 K	"	1	✓					P041202 I	
	PrIO A4 K	"	1	✓					P041202 J	
	QrIO B1 622	"	1		✓				Q060702 H	

REMARKS: TEST # 3 7/11 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT	NCAT COLLABORATIVE STUDY																
SITE	GREENSBORO, NC																
COLLECTED BY (Signature)	Rob Mentz																
FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QFF	TF	NF	DENUDER	ANALYSES							REMARKS	SAM ID NO. (for lab use only)
ERG IB 071102 H	PM10 B1L	7/11/02	1	✓												P041202 K	SPIKED
	PM10 B2L		1	✓												P041202 L	
	PM10 B3M		1	✓												P062502 A	
	PM10 B4M		1	✓												P062502 B	
PES IB 071102	Q GREEN-1	7/11/02	1		✓											Q060702 D	
	P-GREEN1 N1		1	✓												P020802 B	SPIKED
	P-GREEN1 N2		1	✓												P020802 C	
	P-GREEN1 O1		1	✓												P020802 D	
	P-GREEN1 O2		1	✓												P020802 E	

REMARKS: TEST #3 7/11/02 THUR. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION
REMARKS									

4-88-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCAQT COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	QF	ANALYSES	REMARKS	SAM ID NO. (for lab use only)
PESTB071102H	Q BLUE-3	7/11/02			✓		Q060702E	
	P-BLUE 3 P1	"		✓			P020802F	SPIKED
	P-BLUE 3 P2	"		✓			P020802G	
	P-BLUE 3 Q1	"		✓			P041202A	
	P-BLUE 3 Q2	"		✓			P041202B	
	Q RED 4	"			✓		Q060702F	
	P-RED 4 R1	"		✓			P041202C	SPIKED
	P-RED 4 R2	"		✓			P041202D	
	P-RED 4 S1	"		✓			P041202E	

REMARKS: TEST #3 7/11 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Rob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-98-30337

EKG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

PROJECT: NCA&T COLLABORATIVE STUDY

SITE: GREENSBORO, NC

COLLECTED BY (Signature): Rob Mentz

MATRIX TYPE / ANALYSES

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	PUF	Al FOILS	REMARKS	SAM ID NO. (for lab use only)
PESIB071102H –	P.RED 4 $2	• 7/11/02		✓		P041202 F	
ERGIB071102H –	Fn7A1 FOIL13	• 7/11/02			✓	A062402 B	
	Fn7A1 FOIL12	•			✓	A062402 C	
	Fn7A1 FOIL 11	•			✓	A062402 D	
	Fn7A1 FOIL 10	•			✓	A062402 E	
	Fn7A1 FOIL9	•			✓	A062402 F	
	Fn7A1 FOIL 8	•			✓	A062402 G	
	Fn7A1 FOIL7	•			✓	A062402 H	

REMARKS: TEST # 3 7/11/02 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY: Rob Mentz	DATE	TIME
									RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS

4-88-30337

ERG

1600 Perimeter Park
Morrisville, NC 27560-8421

Chain of Custody Record

MATRIX TYPE

PROJECT: NCAT COLLABORATIVE STUDY
SITE: GREENSBORO, NC
COLLECTED BY (Signature): Bob Mentz

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	NO. OF CONTAINERS	ANALYSES: AL FOILS	ANALYSES: 8X10 FILTER	REMARKS	SAM ID NO. (for lab use only)
ERG IB-071102 H	FA7A1 FOIL 6	7/11/02		✓		A062402 I	
	FA7A1 FOIL 5			✓		A062402 J	
	FA7A1 FOIL 4			✓		A062402 O	NOTE 9 FOIL HERE
	FA7A1 FOIL 3			✓		A062402 L	
	FA7A1 FOIL 2			✓		A062402 M	
	FA7A1 FOIL 1			✓		A062402 N	
	QD ΦA18X10				✓	ERG-23	

REMARKS: TEST # 3 7/11/02 THURS. OIL BOILER

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
									Bob Mentz		

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION

REMARKS:

4-88-30337

ANALYTICAL REQUEST AND CHAIN OF CUSTODY

PLANT: NC A&T

PROJECT #: $605.001

RECOVERY PERSON: FRANK MEADOWS

SAMPLE TECHNICIAN:

SAMPLE IDENTIFICATION	COLLECTION DATE	COLLECTION TIME	SAMPLE NAME	NUMBER OF CONTAINERS	ANALYTICAL REQUEST	COMMENTS (Type of container, special preparation, special handling, etc.)
PESIB071102H LEG 5	7/11/02		Teflon Filter 1008982	1		
PESIB071102H LEG 6	7/11/02		Teflon Filter 1008983	1		
PESIB071102H LEG 6	7/11/02		N4/4 sorb Filter NF-8	1		
PESIB071102H LEG 2	7/11/02		Teflon Filter 1008984	1		

FRANK MEADOWS
RELINQUISHER'S NAME

7/11/02 1834
DATE/TIME

RELINQUISHER'S SIGNATURE

SHIPPER'S NAME AND ID NUMBER

ROB MAHTZ
RECEIVER'S NAME

7/11/02 6:40pm
DATE/TIME

RECEIVER'S SIGNATURE

ANALYTICAL REQUEST AND CHAIN OF CUSTODY

PLANT: NC A&T | PROJECT #: 6605.001

RECOVERY PERSON: F. MEADOWS

SAMPLE TECHNICIAN:

SAMPLE IDENTIFICATION	COLLECTION DATE	COLLECTION TIME	SAMPLE NAME	NUMBER OF CONTAINERS	ANALYTICAL REQUEST	COMMENTS (Type of container, special preparation, special handling, etc.)
PESIB071102IHLEG1	7/11/02		Quartz Filter @060702D	1		
PESIB071102H LEG 3	7/11/02		Quartz Filter @060702E	1		
PESIB071102H LEG 4	7/11/02		Quartz Filter @060702F	1		

FRANK MEADOWS
RELINQUISHER'S NAME

7/11/02 1134
DATE/TIME

RELINQUISHER'S SIGNATURE

ROB MARTZ
RECEIVER'S NAME

7/11/02 640 pm
DATE/TIME

Rob Martz
RECEIVER'S SIGNATURE

SHIPPER'S NAME AND ID NUMBER

TEST ID	FB 071102 4
DATE	7/11/02
PORT #	1
DONE BY	RFM

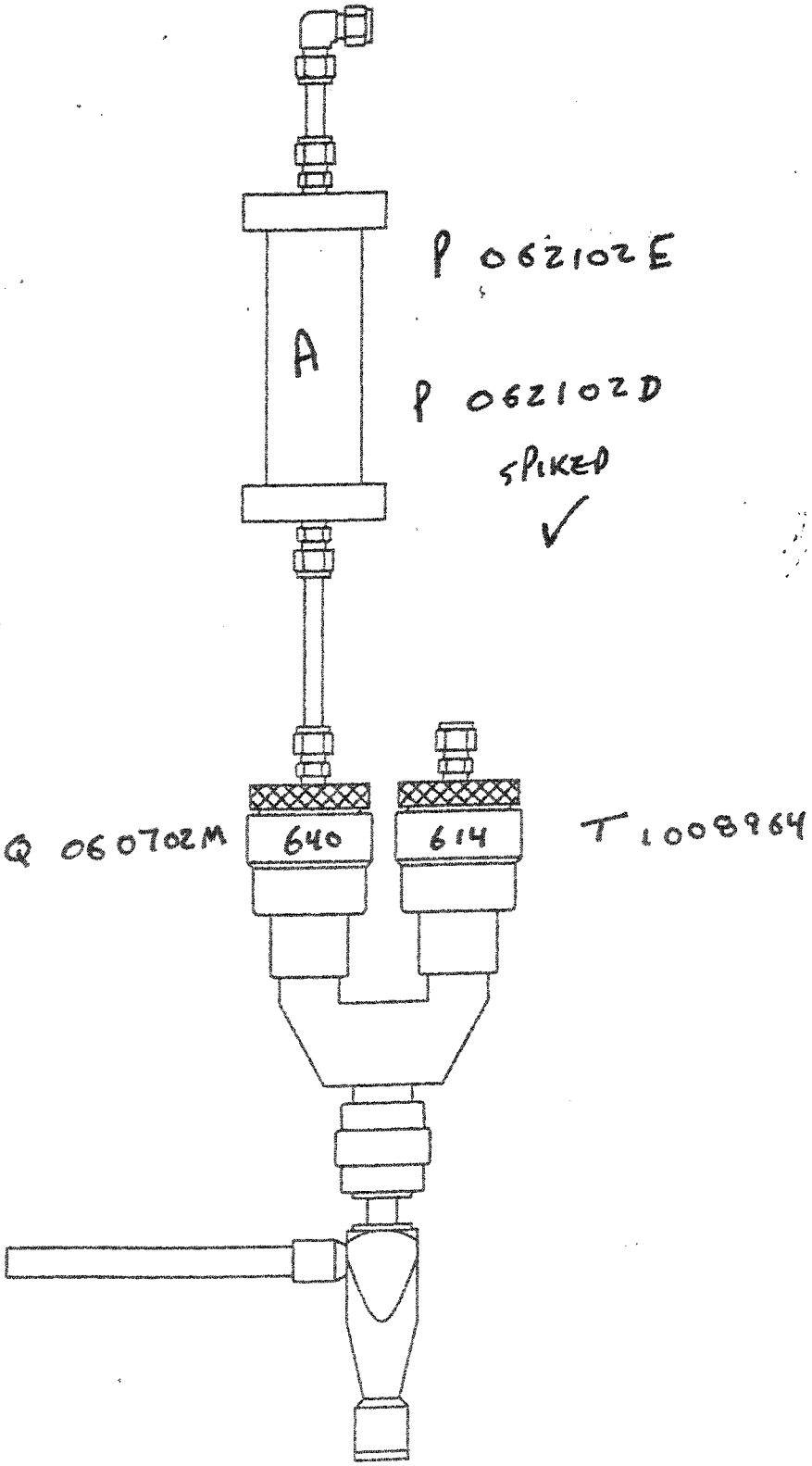
TEST 3

NCAT

COLLABORATIVE

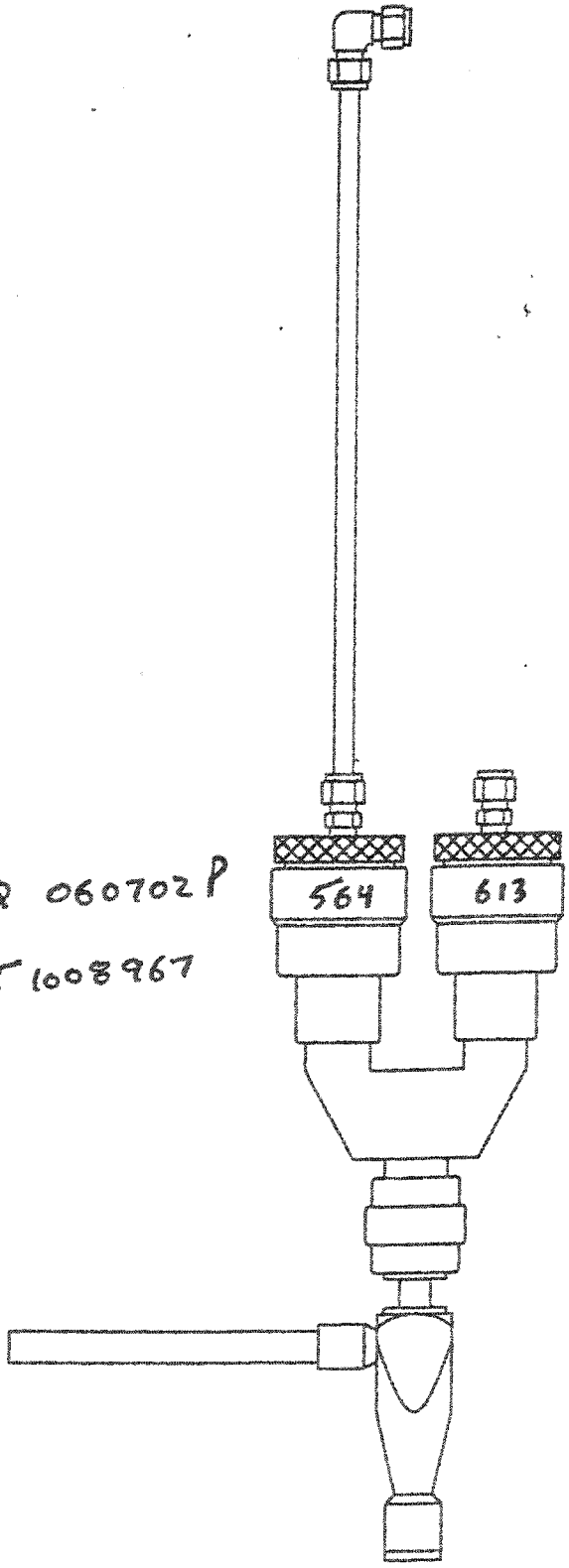
PORT 1

DILUTION



TEST ID	IB 07 11 02 H
DATE	7/11/02
PORT #	2
DONE BY	KFM

PORT 2



Q 060702 P

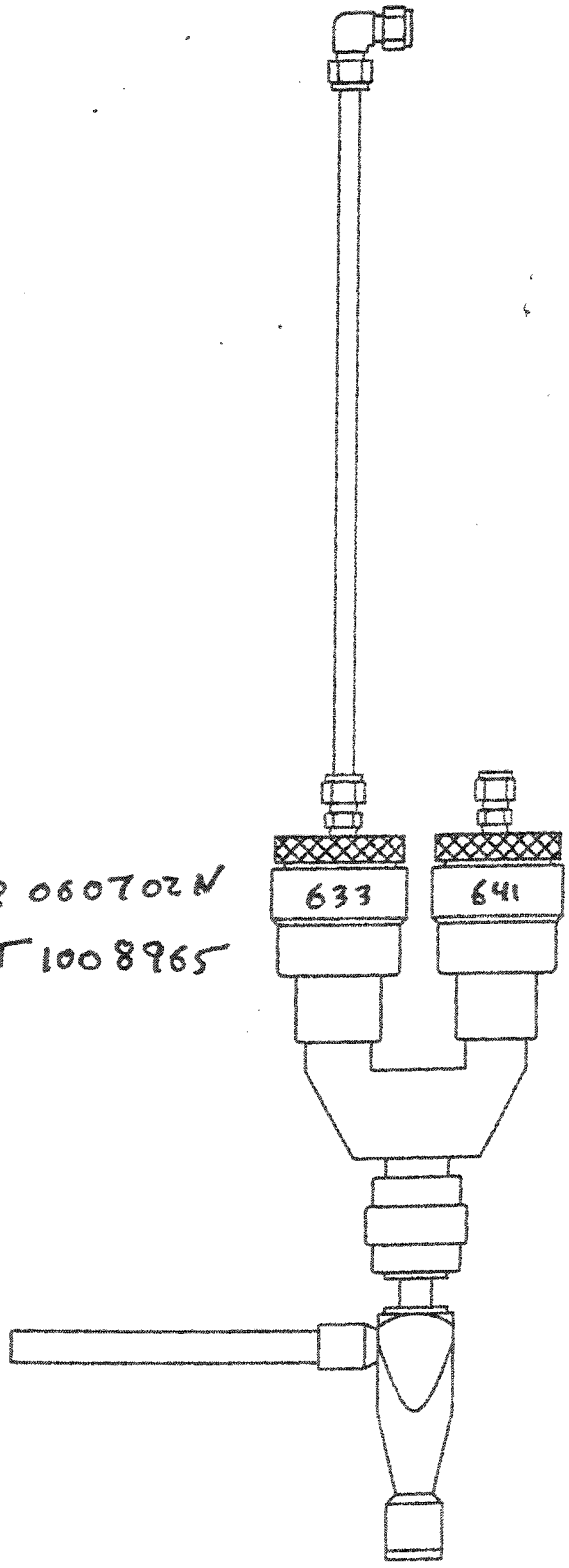
T 1008967

Q 060702 Q

T 1008968

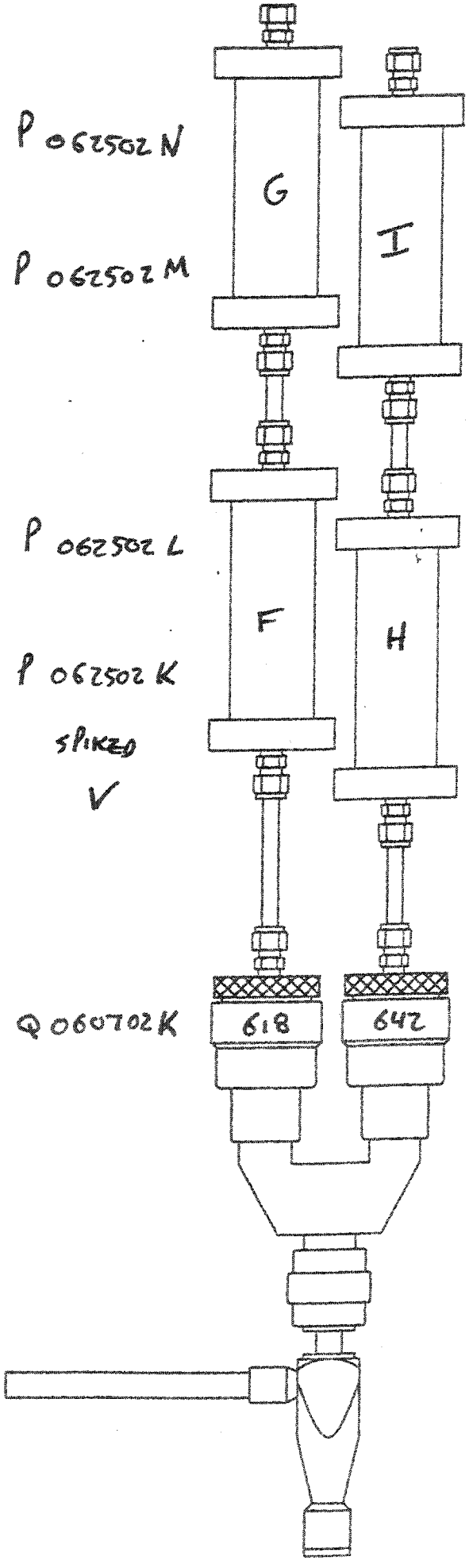
TEST ID	ERG IB 071102 H
DATE	7/11/02
PORT #	4
DONE BY	REM

PORT 4



Q060702N
T1008965

Q060702O
T1008966



TEST ID	IB071102H
DATE	7/11/02
PORT #	6
DONE BY	RFM

PORT 6

P 062102C

P 062102B

P 062102A

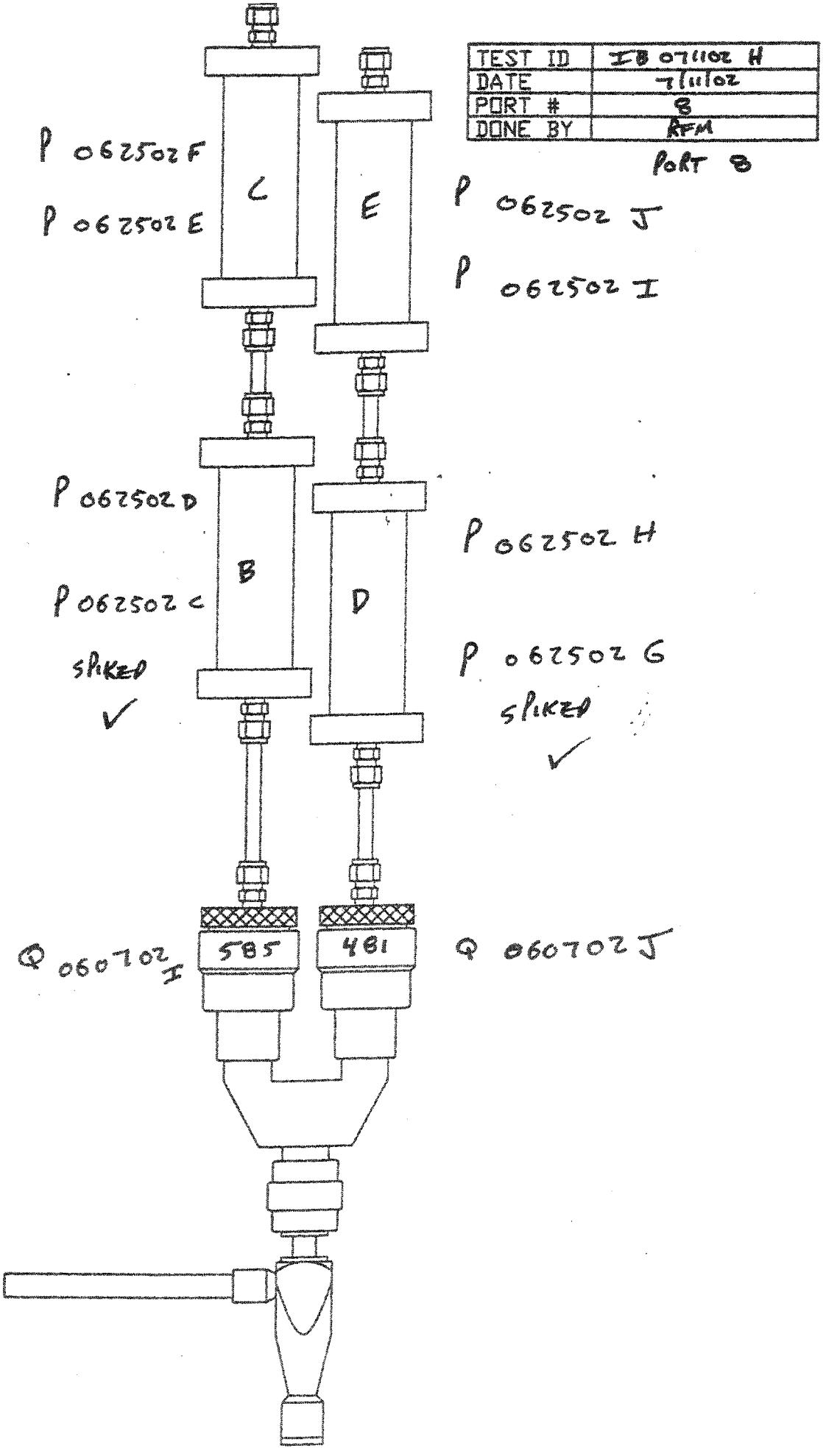
P 062502O

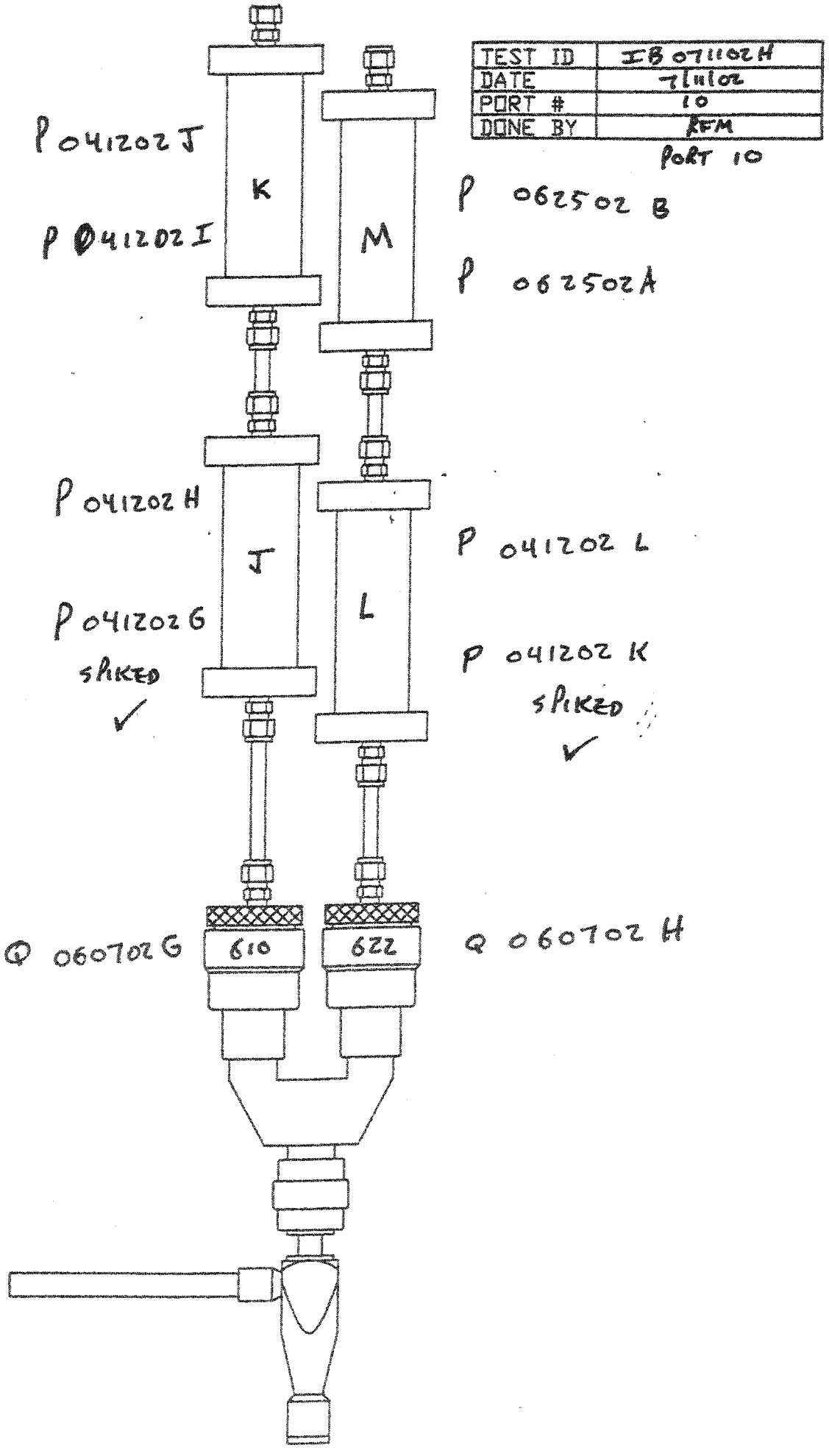
SPIKED

V

Q 060702K

Q 060702L


TEST ID | IB 071102 H
DATE | 7/11/02
PORT # | 8
DONE BY | RFM
PORT 8
P 062502 F
P 062502 E
C
E
P 062502 J
P 062502 I
P 062502 D
P 062502 C
SPIKED
✓
B
D
P 062502 H
P 062502 G
SPIKED
✓
Q 060702 I
585
481
Q 060702 J



TEST ID	IB071102H
DATE	7/11/02
PORT #	10
DONE BY	RFM

PORT 10

CALCULATION SHEET

CALC. NO. _____

DATE _____ CHECKED _____ DATE _____

SIGNATURE _____ JOB NO. _____

PROJECT _____

SUBJECT _____ SHEET _____ OF _____ SHEETS

EARTH RESEARCH GROUP, INC.

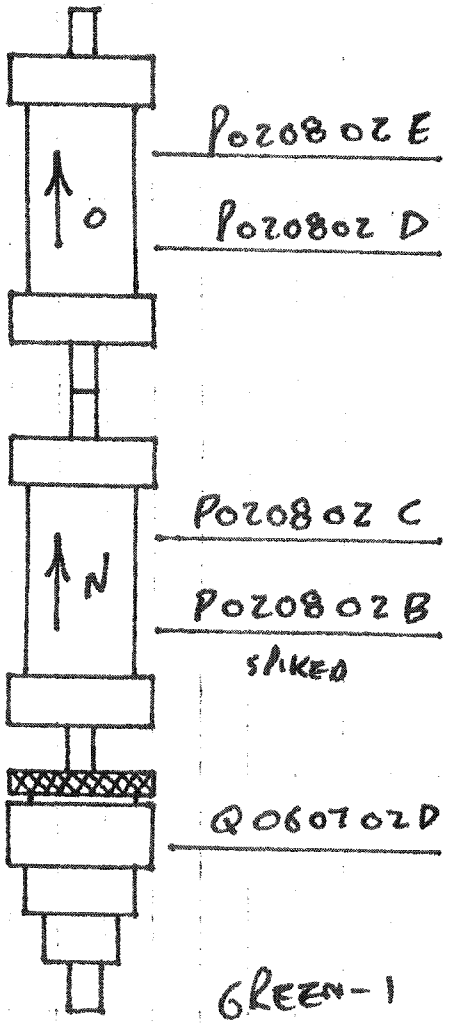
4-81-3361

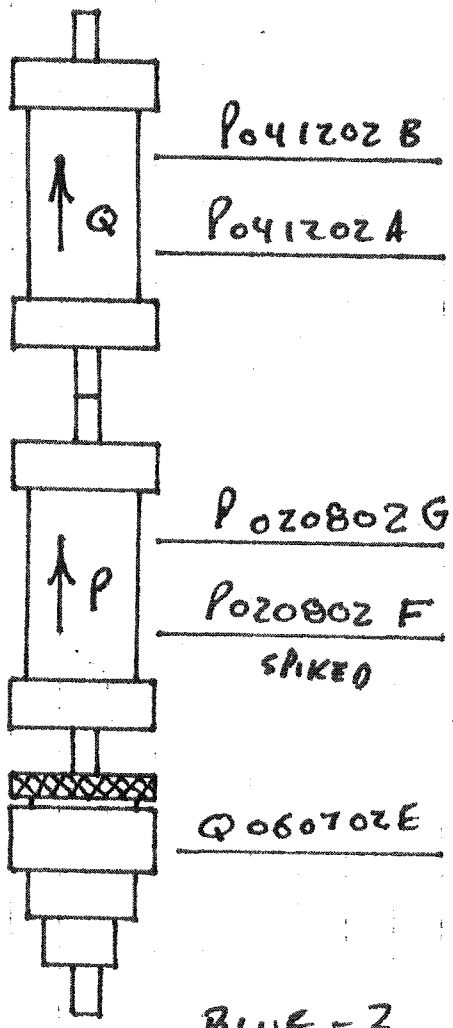
DATE: 7/11/02

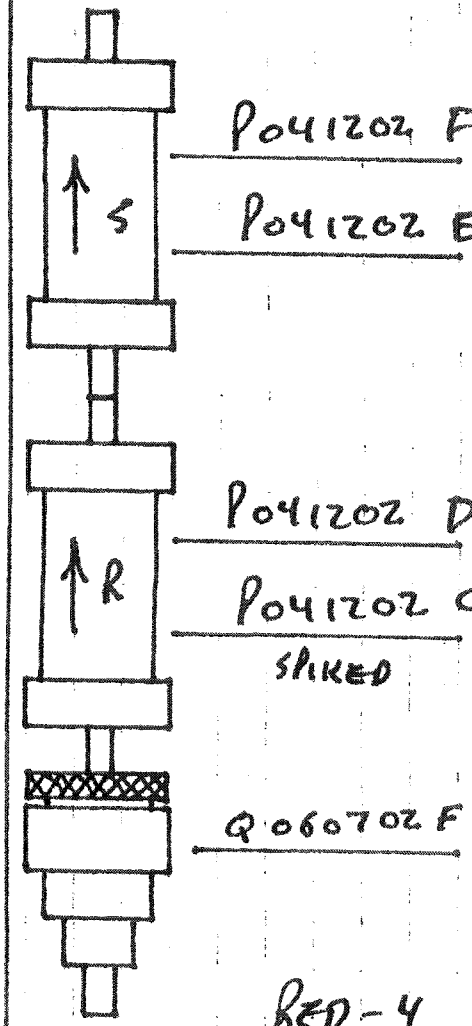
TEST #: THREE

PES IB 071102H

PES ARRAY #:	PES ARRAY #:	PES ARRAY #:
O — P020802E / P020802D	Q — P041202B / P041202A	S — P041202F / P041202E
N — P020802C / P020802B SPIKED	P — P020802G / P020802F SPIKED	R — P041202D / P041202C SPIKED
Q060702D	Q060702E	Q060702F
GREEN-1	BLUE-3	RED-4

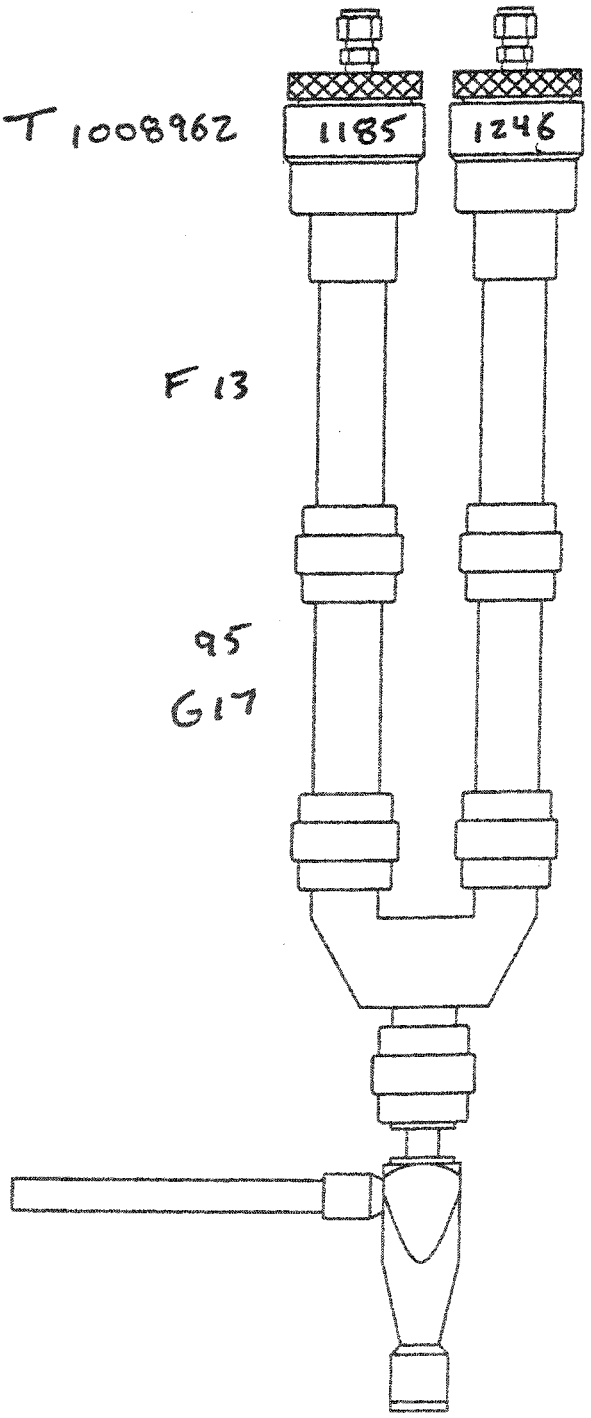






TEST ID	
DATE	
PORT #	
DONE BY	

PORT 5



EPA/600/R-07/005
February 2007

Source Sampling Fine Particulate Matter

Institutional Oil-Fired Boiler

Appendix F through Appendix K

Appendix F

Sample Logs for Both Campaigns

Table F-1. Campaign #1 Sample Log Summary

Test Date	1/16/01	1/17/01	1/18/01
Type of Test:	Oil-fired boiler	Oil-fired boiler	Oil-fired boiler
Combustion:			
Fuel Type	#2 Oil	#2 Oil	#2 Oil
Fuel Mass, kg	6565.0	6925.5	7914.4
Flue Gas Rate, scfm	4290	4363	4658
Flue Gas, O_2 %	6.0	6.0	6.0
CO_2%	15.0	15.0	15.0
CO ppm	0.03	0.03	0.03
THC ppm			
Sampling:			
Sampling Time, min	600.33	600.5	600.17
Venturi Flow, slpm	18.53	17.88	19.01
Dilution Flow, slpm	847.89	848.35	850.66
Dilution Ratio	46.81	48.67	45.91
Emission:			
8x10" Filter PM Mass, g	no tare	0.0209	0.03
Mass/Flow, µg/L		0.0402	0.0611
PM2.5 Mass/Flow, µg/L	0.0542	0.0604	0.0783
Mass/Fuel, g/kg	0.0282	0.0315	0.0359
PM2.5 OC/Flow, µg/L	0.0008	0.0065	0.0063
OC/Fuel, mg/kg	0.0004	0.0034	0.0029
OC/TC, %	34.4	48.8	18.7
OC/PM, %	1.6	10.8	8.0

Table F-2. Oil-Fired Institutional Boiler, Campaign #1, January 16, 2001

Sample Log **Test ID:** **IB011601H** **Oil fired industrial boiler**

Test Location: **Time, min:** **600.33**

Fuel Type: **No. 2 Oil** **Fuel Mass, kg:** **6565** **2058** **gals** **3.19** **kg/gal** **Heating Value: 19374 Btu/lb**

Dilution Ratio: **46.81** **Stack Flow, cfm:** **4290**

46.81

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm²	EC µg/cm²	TC mg	Flow SLPM	PM µg/L	OC ug/L	Extraction	Filter Split
RT	2	A1	TF	585	T041700H-IB011601Hr2A1	0.243					8.479	0.0477			
		B1	TF	614	T041700I-IB011601Hr2B1	0.267					8.479	0.0525			
	3	M1	DNPH								0.960				
		M2	DNPH								0.960				
	4	A1	TF	610	T041700J-IB011601Hr4A1	0.267					8.479	0.0525			
		B1	TF	613	T062700F-IB011601Hr4B1	0.326					8.479	0.0640			
	5	M2	SUMMA												
	6	M1	D	1063	D071800-1063-2-IB011601Hr6M1 *						16.511			1/16/01	
		M2	D	995	D071800-995-2-IB011601Hr6M2 *						16.511			1/16/01	

Table F-2. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm²	EC µg/cm²	TC mg	Flow SLPM	PM µg/L	OC ug/L	Extraction	Filter Split
		A3	QF	642	Q010801B-IB011601Hr6A3 **		1	0.31	0.59	0.012	8.255		0.00084	1/31/01**	1
		A4	PUF	L	P100400C-IB011601Hr6A4						8.255			1/31/01	
		A5	PUF	L	P100400F-IB011601Hr6A5						8.255			1/31/01	
		B3	QF	481	Q010801C-IB011601Hr6B3 **						8.255			**	1
		B4	PUF	I	P100600B-IB011601Hr6B4						8.255			1/31/01	
		B5	PUF	I	P100600D-IB011601Hr6B5						8.255			1/31/01	
	7	M1	SMPS												
	8	M1	D	1049	D071000-1049-6-IB011601Hr8M1						16.958			1/16/01	
		M2	D	1261	D010901-1261-1-IB011601Hr8M2						16.958			1/16/01	
		A3	QF	622	Q010801D-IB011601Hr8A3 **		0				8.479			**	1
		A4	PUF	B	P121200E-IB011601Hr8A4						8.479			2/7/01	
		A5	PUF	B	P121800N-IB011601Hr8A5						8.479			1/31/01	
		B3	QF	640	Q010801E-IB011601Hr8B3		0				8.479			**	1
		B4	PUF	H	P010801B-IB011601Hr8B4						8.479			2/7/01	

Table F-2. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm²	EC µg/cm²	TC mg	Flow SLPM	PM µg/L	OC ug/L	Extraction	Filter Split
		B5	PUF	H	P010800D-IB011601Hr8B5						8.479			1/31/01	
	10	M1	D	1013	D071000-1013-6-IB011601Hr10M1 *						16.511				
		M2	D	1259	D010901-1259-1-IB011601Hr10M2 *						16.511			1/16/01	
		A3	QF	564	Q010801F-IB011601Hr10A3 **		0				8.255			1/16/01	1
		A4	PUF	A	P080900M-IB011601Hr10A4						8.255			**	
		A5	PUF	A	P080900N-IB011601Hr10A5						8.255			2/7/01	
		B3	QF	618	Q010801G-IB011601Hr10B3 **		0				8.255			2/7/01	1
		B4	PUF	G	P121200I-IB011601Hr10B4						8.255			2/7/01	
		B5	PUF	G	P121200J-IB011601Hr10B5						8.255			2/7/01	
					Average							0.0542			
					Standard Deviation							0.0069			
					Relative Standard Deviation, %							12.82			
Dilution	1	A1	QF	633	Q010801A-IB011601Hd1A1		1	3.09	0.25	0.045	8.442		0.00820	5/18/01	1

Table F-2. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm²	EC µg/cm²	TC mg	Flow SLPM	PM µg/L	OC ug/L	Extraction	Filter Split
		A2	PUF	J	P092700A-IB011601Hd1A2						8.442			3/1/01	
		A3	PUF	J	P092700B-IB011601Hd1A3						8.442			3/7/01	
		B1	TF	641	T041700G-IB011601Hd1B1	-0.003					8.442				
	2	A1	DNPH								1.447				
		B1	DNPH								1.447				
	2	M2	SUMMA												
Field Blank			QF		Q010901F-IB011601HFB										
			TF		T070700D-IB011601HFB	-0.007									
			PUF		IB011601H-P-FB1									3/2/01	
			PUF		IB011601H-P-FB2									3/2/01	

* Composite of 6 denuders: IB011601HR6M1,-R6M2,-R8M1,-R8M2,-R10M1, and -R10M2 with 40uL x 6 of Std.#1

** Composite of 6 QF samples:IB011601HR6A3,-R6B3,-R8A3,-R8B3, -R10A3, and R10B3

Table F-2. (Continued)

Extracted Mass mg	OC mg	Internal Std. µL #1	#2	Filtration	Concentration, µL Extract	Derivat.	Neutral
		240		1/29/01*	240	120	110
				1/29/01*	composite with R6M1		
0.240	0.004	125	125	1/31/01	240	115	115
		125	125	2/1/01	225	100	110
		125	125	2/1/01	220	100	110
0.268	0.004			**	composite with R6A3		
		125	125	2/5/01	240	110	115
		125	125	2/5/01	260	130	115
				1/29/01*	composite with R6M1		
				1/29/01*	composite with R6M1		
0.276	0.004			**	composite with R6A3		
		125	125	2/15/01	260	130	115
		125	125	2/6/01	250	115	125
0.276	0.004			**	composite with R6A3		
		125	125	2/12/01	220	110	100
		125	125	2/6/01	255	120	120
				1/29/01*	composite with R6M1		
				1/29/01*	composite with R6M1		
0.268	0.004			**	composite with R6A3		
		125	125	2/9/01	255	125	120
		125	125	2/9/01	245	115	115
0.268	0.004			**	composite with R6A3		
		125	125	2/9/01	265	135	120
		125	125	2/9/01	250	130	105
	0.0371	125	125	5/18/01	270	160	100
		125	125		260	130	120
		250	250	3/8/01	240	120	110
		125	125	3/16/01	220	100	110
		125	125	3/16/01	240	115	115

Figure F-2. (Continued)

Test ID: **IB011601H** **Type of Test:** **Institutional Boiler stack**

Test Location: **Time, min** **600.33**

Fuel Type: **No2 Oil** **Fuel Mass, kg:** **6565** **Heating Value:** **19374 Btu/lb**

Dilution Ratio: **46.81** **Air Rate, cfm:** **4290**

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	Extracted, mg PM	Extracted, mg OC	Internal Std. µL #1	Internal Std. µL #2	Concentration Extract µL	Concentration Derivat. µL
Composite			D		IB011601H-R6M1/2+R8M1/2+R10M1/2			240		240	120
			QF		IB011601H-R6A3/B3+R8A3/B3+R10A3/B3	1.596	0.025	125	125	240	115
RT	2	A1	TF	585	T041700H-IB011601Hr2A1	0.239					
		B1	TF	614	T041700I-IB011601Hr2B1	0.265					
	3	M1	DNPH								
		M2	DNPH								
	4	A1	TF	610	T041700J-IB011601Hr4A1	0.266					
		B1	TF	613	T062700F-IB011601Hr4B1	0.326					
	5	M2	SUMMA								
	6	A4	PUF	L	P100400C-IB011601Hr6A4			125	125	225	100
		A5	PUF	L	P100400F-IB011601Hr6A5			125	125	220	100
		B4	PUF	I	P100600B-IB011601Hr6B4			125	125	240	110
		B5	PUF	I	P100600D-IB011601Hr6B5			125	125	260	130
	7	M1	SMPS								
	8	A4	PUF	B	P121200E-IB011601Hr8A4			125	125	260	130

Table F-2. (Continued)

	Port			Holder		Extracted, mg		Internal Std. µL		Concentration	
Chamber	#	Position	Substrate	#	Substrate ID	PM	OC	#1	#2	Extract µL	Derivat. µL
		A5	PUF	B	P121800N-IB011601Hr8A5			125	125	250	115
		B4	PUF	H	P010801B-IB011601Hr8B4			125	125	220	110
		B5	PUF	H	P010800D-IB011601Hr8B5			125	125	255	120
	10	A4	PUF	A	P080900M-IB011601Hr10A4			125	125	255	125
		A5	PUF	A	P080900N-IB011601Hr10A5			125	125	245	115
		B4	PUF	G	P121200I-IB011601Hr10B4			125	125	265	135
		B5	PUF	G	P121200J-IB011601Hr10B5			125	125	250	130
					Average						
					Standard Deviation						
					Relative Standard Deviation, %						
Dilution	1	A1	QF	633	Q010801A-IB011601Hd1A1			125	125	270	160
		A2	PUF	J	P092700A-IB011601Hd1A2			125	125	260	130
		A3	PUF	J	P092700B-IB011601Hd1A3			250	250	240	120
		B1	TF	641	T041700G-IB011601Hd1B1	-0.008					
	2	A1	DNPH								
		B1	DNPH								
	2	M2	SUMMA								
Field Blank			QF		Q010901F-IB011601HFB						
			TF		T070700D-IB011601HFB	-0.007					
			PUF		IB011601H-P-FB1						
			PUF		IB011601H-P-FB2						

Table F-2. (Continued)

Methylation Date	Vol. µL	Silylation Date	GC/MS File ID	IC File ID	Extract mL	XRF Job No.
2/15/01	130					
3/27/01	139					
2/15/01	127					

Table F-3. Oil-Fired Institutional Boiler, Campaign #1, January 17, 2001

Sample Log **Test ID:** **IB011701H**

Test Location: **Time, min:** **600.5**
Fuel Type: **No. 2 Oil** **Fuel Mass, kg:** **6925.5** **2171** **gals** **3.19**
Dilution Ratio: **48.67** **Stack Flow, cfm:** **4363**

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm²	EC µg/cm²	TC mg
RT	2	A1	TF	585	T070700C-IB011701Hr2A1	0.303				
		B1	TF	614	T070700E-IB011701Hr2B1	0.304				
	3	M1	DNPH							
		M2	DNPH							
	4	A1	TF	610	T062900D-IB011701Hr4A1	0.298				
		B1	TF	613	T062900F-IB011701Hr4B1	0.337				
	5	M2	SUMMA							
	6	A1	QF	642	Q010901A-IB011701Hr6A1 *		1	2.39	2.51	0.066
		A2	PUF	L	P092600F-IB011701Hr6A2					
		A3	PUF	L	P092700E-IB011701Hr6A3					
		B1	QF	481	Q010901B-IB011701Hr6B1 *					
		B2	PUF	I	P092600E-IB011701Hr6B2					
		B3	PUF	I	P092600A-IB011701Hr6B3					
	7	M1	SMPS							
	8	A1	QF	622	Q010901I-IB011701Hr8A1 *					
		A2	PUF	B	P010801E-IB011701Hr8A2					
		A3	PUF	B	P010801F-IB011701Hr8A3					
		B1	QF	640	Q010901H-IB011701Hr8B1 *					
		B2	PUF	H	P100400A-IB011701Hr8B2					

Table F-3. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm^2	EC µg/cm^2	TC mg
		B3	PUF	H	P100400D-IB011701Hr8B3					
	10	A1	QF	564	Q010901E-IB011701Hr10A1 *					
		A2	PUF	A	P010801A-IB011701Hr10A2					
		A3	PUF	A	P100600C-IB011701Hr10A3					
		B1	QF	618	Q010901K-IB011701Hr10B1 *					
		B2	PUF	D	P121800P-IB011701Hr10B2					
		B3	PUF	D	P121200K-IB011701Hr10B3					
					Average					
					Standard Deviation					
					Relative Standard Deviation, %					
Dilution	1	A1	QF	633	Q010801K-IB011701Hd1A1 **		1	2.39	0.20	0.035
		A2	PUF	J	P121200F-IB011701Hd1A2					
		A3	PUF	J	P121200G-IB011701Hd1A3					
		B1	TF	641	T070700F-IB011701Hd1B1	-0.007				
	2	A1	DNPH							
		B1	DNPH							
	2	M2	SUMMA							

* Composited with residence chamber QF samples from January 18. 2001

** Composited with dilution air QF sample from January 18, 2001

Table F-3. (Continued)

8x10" Filter Catch, g: 0.0209

kg/gal **Heating Value: 19374 Btu/lb**

Flow SLPM	PM µg/L	OC µg/L	Extraction	Filter Split	Extracted Mass mg	OC mg	Internal Std. µL #1	#2	Filtration	Concentration, µL Extract	Derivat.	Neutral
8.580	0.0588											
8.580	0.0590											
0.959												
0.959												
8.542	0.0581											
8.542	0.0657											
8.242		0.00649		1	0.267	0.029			composite, refer to Page 2 of 11/17			
8.242			2/22/01				125	125	3/9/01	215	110	95
8.242			2/22/01				125	125	4/24/01	250	165	105
8.242			*	1	0.299	0.032			composite, refer to Page 2 of 11/17			
8.242			2/22/01				125	125	3/13/01	260	135	115
8.242			2/22/01				125	125	3/13/01	245	125	110
8.542			*	1	0.310	0.033			composite, refer to Page 2 of 11/17			
8.542			2/22/01				125	125	3/13/01	260	135	100
8.542			3/7/01				250	250	3/13/01	260	140	110
8.542			*	1	0.310	0.033			composite, refer to Page 2 of 11/17			
8.542			3/9/01				125	125	3/12/01	230	105	115
8.542			3/9/01				125	125	4/24/01	240	120	110

Table F-3. (Continued)

Flow	PM	OC	Extraction	Filter	Extracted		Internal Std. µL		Filtration	Concentration, µL		
SLPM	µg/L	µg/L		Split	Mass mg	OC mg	#1	#2		Extract	Derivat.	Neutral
8.242			*	1	0.299	0.032			composite, refer to Page 2 of 11/17			
8.242			3/7/01				250	250	4/24/01	250	140	100
8.242			2/22/01				125	125	3/9/01	220	100	110
8.242			*	1	0.299	0.032			composite, refer to Page 2 of 11/17			
8.242			3/2/01				125	125	3/15/01	205	100	95
8.242			3/12/01				125	125	3/15/01	260	140	110
	0.0604											
	0.0036											
	5.88											
8.656		0.00618		1		0.029			composite, refer to Page 2 of 11/17			
8.656			3/1/01				125	125	3/16/01	255	140	105
8.656			3/7/01				250	250	3/7/01	230	110	110

Table F-3. (Continued)

Test ID:		**IB011701H**			**Type of Test:**	**Oil fired Institutional Boiler**			
Test Location:		**NC A&T Greensboro**			**Time, min:**	**600.5**			
Fuel Type:		**No2 Oil**			**Fuel Mass, kg:**	**6925.5**			
Dilution Ratio:		**48.67**			**Stack Flow, cfm:**	**4363**			
	Port			**Holder**			**Extracted, mg**	**Internal Std. µL**	
Chamber	**#**	**Position**	**Substrate**	**#**	**Substrate ID**	**PM**	**OC**	**#1**	**#2**
Composite ID: IB011701&011801-RT-QF						4.105	0.377	125	125
RT	6	A1	QF	642	Q010901A-IB011701Hr6A1				
		B1	QF	481	Q010901B-IB011701Hr6B1				
	8	A1	QF	622	Q010901I-IB011701Hr8A1				
		B1	QF	640	Q010901H-IB011701Hr8B1				
	10	A1	QF	564	Q010901E-IB011701Hr10A1				
		B1	QF	618	Q010901K-IB011701Hr10B1				
	6	A1	QF	642	Q010801I-IB011801Hr6A1				
		B1	QF	481	Q010801J-IB011801Hr6B1				
	8	A1	QF	622	Q010801L-IB011801Hr8A1				
		B1	QF	640	Q010801M-IB011801Hr8B1				
	10	A1	QF	564	Q010801N-IB011801Hr10A1				
		B1	QF	618	Q010801O-IB011801Hr10B1				
Composite ID: IB011701&011801-DL-QF							0.058	125	125
Dilution	1	A1	QF	633	Q010801K-IB011701Hd1A1				
	1	A1	QF	633	Q010801H-IB011801Hd1A1				
RT	2	A1	TF	585	T070700C-IB011701Hr2A1				
		B1	TF	614	T070700E-IB011701Hr2B1				
	3	M1	DNPH						
		M2	DNPH						

Table F-3. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	Extracted, mg PM	Extracted, mg OC	Internal Std. µL #1	Internal Std. µL #2
	4	A1	TF	610	T062900D-IB011701Hr4A1				
		B1	TF	613	T062900F-IB011701Hr4B1				
	5	M2	SUMMA						
	6	A2	PUF	L	P092600F-IB011701Hr6A2			125	125
		A3	PUF	L	P092700E-IB011701Hr6A3			125	125
		B2	PUF	I	P092600E-IB011701Hr6B2			125	125
		B3	PUF	I	P092600A-IB011701Hr6B3			125	125
	7	M1	SMPS						
	8	A2	PUF	B	P010801E-IB011701Hr8A2			125	125
		A3	PUF	B	P010801F-IB011701Hr8A3			250	250
		B2	PUF	H	P100400A-IB011701Hr8B2			125	125
		B3	PUF	H	P100400D-IB011701Hr8B3			125	125
	10	A2	PUF	A	P010801A-IB011701Hr10A2			250	250
		A3	PUF	A	P100600C-IB011701Hr10A3			125	125
		B2	PUF	D	P121800P-IB011701Hr10B2			125	125
		B3	PUF	D	P121200K-IB011701Hr10B3			125	125
Dilution	1	A2	PUF	J	P121200F-IB011701Hd1A2			125	125
		A3	PUF	J	P121200G-IB011701Hd1A3			250	250
		B1	TF	641	T070700F-IB011701Hd1B1				
	2	A1	DNPH						
		B1	DNPH						
	2	M2	SUMMA						

Table F-3. (Continued)

8x10" Filter Catch, g: 0.0209

Heating Value: 19374 Btu/lb

Extract, µL			Methylation		Silylation	GC/MS	IC		XRF
Total	Derivat.	Neutral	Date	Vol. µL	Date	File ID	File ID	Extract mL	Job No.
245	125	110							
240	120	110							
215	110	95							
250	165	105							
260	135	115							
245	125	110							
260	135	100							
260	140	110							
230	105	115							
240	120	110							
250	140	100							
220	100	110							
205	100	95							
260	140	110							
255	140	105							
230	110	110							

Table F-4. Oil-Fired Institutional Boiler, Campaign #1, January 18, 2001

Sample Log **Test ID: IB011801H**

Test Location: **NC A&T Greensboro** **Time, min:** **600.17**
Fuel Type: **No. 2 Oil** **Fuel Mass, kg:** **7914.4** **2481** **gals** **3.19**
Dilution Ratio: **45.91** **Stack Flow, cfm:** **4658**

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm²	EC µg/cm²	TC mg
RT	2	A1	TF	585	T062900C-IB011801Hr2A1	0.398				
		B1	TF	614	T062900E-IB011801Hr2B1	0.402				
	3	M1	DNPH							
		M2	DNPH							
	4	A1	TF	610	T062900A-IB011801Hr4A1	0.387				
		B1	TF	613	T062900B-IB011801Hr4B1	0.408				
	5	M2	SUMMA							
	6	A1	QF	642	Q010801I-IB011801Hr6A1 *		1	2.37	10.31	0.171
		A2	PUF	L	P121200A-IB011801Hr6A2					
		A3	PUF	L	P121200B-IB011801Hr6A3					
		B1	QF	481	Q010801J-IB011801Hr6B1 *					
		B2	PUF	I	P010901C-IB011801Hr6B2					
		B3	PUF	I	P010901E-IB011801Hr6B3					
	7	M1	SMPS							
	8	A1	QF	622	Q010801L-IB011801Hr8A1 *					
		A2	PUF	B	P100400B-IB011801Hr8A2					
		A3	PUF	B	P100400E-IB011801Hr8A3					
		B1	QF	640	Q010801M-IB011801Hr8B1 *					
		B2	PUF	H	P100600A-IB011801Hr8B2					

Table F-4. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC µg/cm^2	EC µg/cm^2	TC mg
		B3	PUF	H	P100600E-IB011801Hr8B3					
	10	A1	QF	564	Q010801N-IB011801Hr10A1					
		A2	PUF	A	P010901A-IB011801Hr10A2					
		A3	PUF	A	P010901B-IB011801Hr10A3					
		B1	QF	618	Q010801O-IB011801Hr10B1 *					
		A2	PUF	C	P121200C-IB011801Hr10B2					
		A3	PUF	C	P121200D-IB011801Hr10B3					
					Average					
					Standard Deviation					
					Relative Standard Deviation, %					
Dilution	1	A1	QF	633	Q010801H-IB011801Hd1A1 **		1	2.46	0.18	0.036
		A2	PUF	J	P092600B-IB011801Hd1A2					
		A3	PUF	J	P092600D-IB011801Hd1A3					
		B1	TF	641	T070500A-IB011801Hd1B1	-0.007				
	2	A1	DNPH							
		B1	DNPH							
	2	M2	SUMMA							

* Composited with residence chamber QF samples from January 17, 2001

** Composited with dilution air QF sample from January 17, 2001

Table F-4. (Continued)

8x10" Filter Catch, g: 0.0319

kg/gal **Heating Value: 19374 Btu/lb**

Flow SLPM	PM µg/L	OC µg/L	Extraction	Filter Split	Extracted Mass mg	OC mg	Internal Std. µL #1	#2	Filtration	Concentration, µL Extract	Derivat.	Neutral
8.489	0.0781											
8.489	0.0789											
1.121												
1.121												
8.489	0.0760											
8.489	0.0801											
8.489		0.00626		1	0.356	0.028			composite, refer to Page 2 of 11/17			
8.489			3/1/01				125	125	4/25/01	250	130	110
8.489			3/9/01				250	250	3/9/01	250	130	110
8.489			*	1	0.399	0.032			composite, refer to Page 2 of 11/17			
8.489			3/1/01				125	125	3/19/01	250	130	110
8.489			3/1/01				125	125	3/19/01	260	135	115
8.489			*	1	0.399	0.032			composite, refer to Page 2 of 11/17			
8.489			3/1/01				125	125	3/15/01	220	105	105
8.489			3/2/01				125	125	3/15/01	260	140	110
8.489			*	1	0.399	0.032			composite, refer to Page 2 of 11/17			
8.489			3/9/01				125	125	3/12/01	270	140	120
8.489			3/7/01				250	250	3/9/01	200	90	100
8.191			*	1	0.385	0.031			composite, refer to Page 2 of 11/17			

Table F-4. (Continued)

Flow SLPM	PM µg/L	OC µg/L	Extraction	Filter Split	Extracted Mass mg	OC mg	Internal Std. µL #1	Internal Std. µL #2	Filtration	Concentration, µL Extract	Concentration, µL Derivat.	Concentration, µL Neutral
8.191			3/12/01				125	125	3/16/01	200	90	100
8.191			3/2/01				125	125	3/16/01	250	130	110
8.191			*	1	0.385	0.031			composite, refer to Page 2 of 11/17			
8.191			3/2/01				125	125	4/25/01	210	100	100
8.191			3/9/01				125	125	4/25/01	245	125	115
	0.0783											
	0.0017											
	2.22											
8.564		0.00644		1		0.030			composite, refer to Page 2 of 11/17			
8.564			3/12/01				125	125	4/25/01	270	145	115
8.564			3/12/01				125	125	3/12/01	240	115	115
8.564	0.00000											
1.168												
1.168												

Table F-4. (Continued)

Test ID:			**IB011801H**			**Type of Test:**	**Oil fired Institutional Boiler**		
Test Location:			**NC A&T Greensboro**			**Time, min**	**600.17**		
Fuel Type:		**No. 2 Oil**				**Fuel Mass, kg:**	**0**		
Dilution Ratio:		**45.91**				**Air Rate, SLPM:**	**4658**		
Chamber	**Port #**	**Position**	**Substrate**	**Holder #**	**Substrate ID**	**PM mg**	**OC mg**	**Internal Std. µL #1**	**#2**
RT	2	A1	TF	585	T062900C-IB011801Hr2A1	0.398			
		B1	TF	614	T062900E-IB011801Hr2B1	0.402			
	3	M1	DNPH						
		M2	DNPH						
	4	A1	TF	610	T062900A-IB011801Hr4A1	0.387			
		B1	TF	613	T062900B-IB011801Hr4B1	0.408			
	5	M2	SUMMA						
	6	A2	PUF	L	P121200A-IB011801Hr6A2				
		A3	PUF	L	P121200B-IB011801Hr6A3				
		B2	PUF	I	P010901C-IB011801Hr6B2				
		B3	PUF	I	P010901E-IB011801Hr6B3				
	7	M1	SMPS						
	8	A2	PUF	B	P100400B-IB011801Hr8A2				
		A3	PUF	B	P100400E-IB011801Hr8A3				
		B2	PUF	H	P100600A-IB011801Hr8B2				
		B3	PUF	H	P100600E-IB011801Hr8B3				
	10	A2	PUF	A	P010901A-IB011801Hr10A2				
		A3	PUF	A	P010901B-IB011801Hr10A3				
		A2	PUF	C	P121200C-IB011801Hr10B2				
		A3	PUF	C	P121200D-IB011801Hr10B3				

Table F-4. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	OC mg	Internal Std. µL #1	Internal Std. µL #2
					Average				
					Standard Deviation				
					Relative Standard Deviation, %				
Dilution	1	A2	PUF	J	P092600B-IB011801Hd1A2				
		A3	PUF	J	P092600D-IB011801Hd1A3				
		B1	TF	641	T070500A-IB011801Hd1B1	-0.007			
	2	A1	DNPH						
		B1	DNPH						
	2	M2	SUMMA						
Blank			PUF		P080200B-IB080900HBLNK				

Table F-5. Oil-Fired Institutional Boiler, Campaign #2, July 9, 2002

Sample Log **Test ID: IB070902H** **Venturi, std. m^3:**

Test Location: **Time, min 600.6** **Dilution, std. m^3:**

Fuel Type: No. 2 Oil **Dilution Ratio:**

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm2	EC ug/cm2	OCX ug/cm^2	Flow SLPM
RT	2	A1	TF	564	1007993	0.292					8.251
		A2	QF	564	Q060602K-IB070902HR2A2 *		1	10.28	0.22	0.39	8.251
		B1	TF	613	1007994	0.284					8.251
		B2	QF	613	Q060602L-IB070902HR2B2 *						8.251
	4	A1	TF	633	1007995	0.278					8.106
		A2	QF	633	Q060602M-IB070902HR4A2 *		1	10.47	0.1	0.24	8.106
		B1	TF	641	1008951	0.266					8.106
		B2	QF	641	Q060602N-IB070902HR4B2 *						8.106
	5	A1	D	73G10	73G10						4.518
		A2	D	F16	F16						4.518
		A3	TF	1185	1008952	0.120					4.518
		B1	D	79G14	79G14						4.518
		B2	D	F18	F18						4.518
		B3	TF	1246	1008953	0.156					4.518
		B4	NF	1246	NF-1						4.518
	6	A1	QF	618	Q060602A-IB070902HR6A1 **		1	20.42	1.77	3.23	8.215
		A2	PUF	F	P011702A-IB070902HR6A2						8.215
		A3	PUF	F	P011702B-IB070902HR6A3						8.215

Table F-5. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm2	EC ug/cm2	OCX ug/cm^2	Flow SLPM
		A4	PUF	G	P011702C-IB070902HR6A4						8.215
		A5	PUF	G	P011702D-IB070902HR6A5						8.215
		B1	QF	642	Q060602B-IB070902HR6B1 **						8.215
		B2	PUF	H	P011702E-IB070902HR6B2						8.215
		B3	PUF	H	P011702F-IB070902HR6B3						8.215
		B4	PUF	I	P011502A-IB070902HR6B4						8.215
		B5	PUF	I	P011502B-IB070902HR6B5						8.215
	8	A1	QF	585	Q060602C-IB070902HR8A1 #		1	21.04	1.3	3.12	8.288
		A2	PUF	B	P011502C-IB070902HR8A2						8.288
		A3	PUF	B	P011502D-IB070902HR8A3						8.288
		A4	PUF	C	P011502E-IB070902HR8A4						8.288
		A5	PUF	C	P011502F-IB070902HR8A5						8.288
		B1	QF	481	Q060602D-IB070902HR8B1 #						8.288
		B2	PUF	D	P012202A-IB070902HR8B2						8.288
		B3	PUF	D	P012202B-IB070902HR8B3						8.288
		B4	PUF	E	P012202C-IB070902HR8B4						8.288
		B5	PUF	E	P012202D-IB070902HR8B5						8.288

Table F-5. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm2	EC ug/cm2	OCX ug/cm^2	Flow SLPM
Sample Log, July 9, continued											
	10	A1	QF	610	Q060602E-IB070902HR10A1 **		1	19.55	1.34	3.04	8.215
		A2	PUF	J	P012202E-IB070902HR10A2						8.215
		A3	PUF	J	P012202F-IB070902HR10A3						8.215
		A4	PUF	K	P012202G-IB070902HR10A4						8.215
		A5	PUF	K	P012302A-IB070902HR10A5						8.215
		B1	QF	622	Q060602F-IB070902HR10B1 **						8.215
		B2	PUF	L	P012302B-IB070902HR10B2						8.215
		B3	PUF	L	P012302C-IB070902HR10B3						8.215
		B4	PUF	M	P012302D-IB070902HR10B4						8.215
		B5	PUF	M	P012302E-IB070902HR10B5						8.215
Dilution	1	A1	QF	640	Q060602G-IB070902HD1A1		1	0.90	0.11	0.00	8.215
		A2	PUF	A	P012302F-IB070902HD1A2						8.215
		A3	PUF	A	P012302G-IB070902HD1A3						8.215
		B1	TF	614	1007992	0.003					8.215

Table F-5. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm2	EC ug/cm2	OCX ug/cm^2	Flow SLPM
Field Blank			QF		Q060702C-IB070902H-FB						
			TF		1008954	0.006					
			NF		NF-2						
			PUF		P020102T-IB070902H-FB1						
			PUF		P020802A-IB070902H-FB2						

* Composited with residence chamber port 2, A2

** Composited with residence chamber port 6, A1

archived

Table F-5. (Continued)

11.32	**Fuel Mass, kg:**	**4445.0**			
490.26	**Air Flow, scfm:**	**4551**			
44.31	**8x10" Filter Catch, g:**	**0.051**	**8x10" blank:**	**0.0011**	

PM	OC	Extraction	Fliter	Extracted, mg		Internal Std. µL		Filtration	Concentration, µL		
mg/L	mg/L		Split	Mass	OC	#1	#2		Extract	Derivat.	Neutral
0.000059											
			1		0.123	composite					
0.000057											
			1		0.138	composite with R2A2					
0.000057											
			1		0.126	composite with R2A2					
0.000055											
			1		0.141	composite with R2A2					
0.000044											
0.000057											
			1	0.251	0.245	composite					
		9/3/02				125	125	9/6/02	250	140	120
		9/3/02				125	125	9/6/02	270	140	130
		9/3/02				125	125	9/6/02	280	140	140
		9/3/02				125	125	9/6/02	240	120	120
			1	0.281	0.275	composite with R6A1					
		9/3/02				125	125	9/9/02	260	130	130
		9/3/02				125	125	9/9/02	270	140	130
		9/3/02				125	125	9/9/02	190	100	90
		9/3/02				125	125	9/9/02	230	120	120
			1	0.253	0.252	Archive					
		8/30/02				125	125	9/5/02	270	140	130

Table F-5. (Continued)

PM	OC	Extraction	Fliter	Extracted, mg		Internal Std. µL		Filtration	Concentration, µL		
mg/L	mg/L		Split	Mass	OC	#1	#2		Extract	Derivat.	Neutral
		8/30/02				125	125	9/5/02	250	130	120
		8/30/02				125	125	9/5/02	250	130	120
		8/30/02				125	125	9/5/02	250	130	120
			1	0.284	0.283	Archive					
		8/30/02				125	125	8/30/02	240	120	120
		8/30/02				125	125	8/30/02	270	140	130
		8/30/02				125	125	8/30/02	260	130	130
		8/30/02				125	125	8/30/02	260	130	130
			1	0.251	0.235	composite with R6A1					
		8/28/02				125	125	8/29/02	260	130	130
		8/28/02				125	125	8/29/02	280	140	140
		8/28/02				125	125	8/29/02	260	130	130
		8/28/02				125	125	8/29/02	250	130	120
			1	0.281	0.263	composite with R6A1					
		8/28/02				125	125	9/5/02	250	130	120
		8/28/02				125	125	9/5/02	220	120	100
		8/28/02				125	125	9/5/02	220	120	100
		8/28/02				125	125	9/5/02	220	120	100
			1	0.003	0.011						
		9/10/02				125	125	9/11/02	260	130	130
		9/10/02				125	125	9/11/02	260	130	130
0.000001											
		9/13/02				125	125	9/23/02	250	130	120
		9/13/02				125	125	9/23/02	220	110	110

Table F-5. (Continued)

Test ID:	**IB070902H**	**Type of Test:**	**Oil fired Institutional Boiler**	**Venturi, std. m^3:**	**11.32**
Location:	**NC A&T Greensboro**	**Time, min**	**600.6**	**Dilution, std. m^3:**	**490.26**
Fuel Type:	**No2 Oil**			**Dilution Ratio:**	**44.31**

Substrate	Substrate ID	Chamber	Port #	Position	Holder #	No. of punch	Composite ID	Extracted , mg	
								Mass	OC
TF	1007993	RT	2	A1	564			0.292	
	1007994	RT	2	B1	613			0.284	
	1007995	RT	4	A1	633			0.278	
	1008951	RT	4	B1	641			0.266	
	1008952	RT	5	A3	1185			0.12	
	1008953	RT	5	B3	1246			0.156	
	1007992	DL	1	B1	614			0.003	
	1008954	Field Blank						0.006	
QF	Q060602K-IB070902HR2A2	RT	2	A2	564	2	IB070902HR2&R4		0.528
	Q060602L-IB070902HR2B2	RT	2	B2	613				
	Q060602M-IB070902HR4A2	RT	4	A2	633				
	Q060602N-IB070902HR4B2	RT	4	B2	641				
	Q060602A-IB070902HR6A1	RT	6	A1	618	2	IB070902H R6&R10	1.064	1.017
	Q060602B-IB070902HR6B1	RT	6	B1	642				
	Q060602E-IB070902HR10A1	RT	10	A1	610				
	Q060602F-IB070902HR10B1	RT	10	B1	622				
	Q060602C-IB070902HR8A1	RT	8	A1	585				
	Q060602D-IB070902HR8B1	RT	8	B1	481				
	Q060602G-IB070902HD1A1	DL	1	A1	640	1	IB070902HD1	0.003	0.011
	Q060702C-IB070902H-FB	Field Blank							
PUF	P011702A-IB070902HR6A2	RT	6	A2	F				

Table F-5. (Continued)

Substrate	Substrate ID	Chamber	Port #	Position	Holder #	No. of punch	Composite ID	Extracted , mg	
								Mass	OC
	P011702B-IB070902HR6A3	RT	6	A3	F				
	P011702C-IB070902HR6A4	RT	6	A4	G				
	P011702D-IB070902HR6A5	RT	6	A5	G				
	P011702E-IB070902HR6B2	RT	6	B2	H				
	P011702F-IB070902HR6B3	RT	6	B3	H				
	P011502A-IB070902HR6B4	RT	6	B4	I				
	P011502B-IB070902HR6B5	RT	6	B5	I				
	P011502C-IB070902HR8A2	RT	8	A2	B				
	P011502D-IB070902HR8A3	RT	8	A3	B				
	P011502E-IB070902HR8A4	RT	8	A4	C				
	P011502F-IB070902HR8A5	RT	8	A5	C				
	P012202A-IB070902HR8B2	RT	8	B2	D				
	P012202B-IB070902HR8B3	RT	8	B3	D				
	P012202C-IB070902HR8B4	RT	8	B4	E				
	P012202D-IB070902HR8B5	RT	8	B5	E				
	P012202E-IB070902HR10A2	RT	10	A2	J				
	P012202F-IB070902HR10A3	RT	10	A3	J				
	P012202G-IB070902HR10A4	RT	10	A4	K				
	P012302A-IB070902HR10A5	RT	10	A5	K				
	P012302B-IB070902HR10B2	RT	10	B2	L				
	P012302C-IB070902HR10B3	RT	10	B3	L				
	P012302D-IB070902HR10B4	RT	10	B4	M				
	P012302E-IB070902HR10B5	RT	10	B5	M				
	P012302F-IB070902HD1A2	DL	1	A2	A				
	P012302G-IB070902HD1A3	DL	1	A3	A				
	P020102T-IB070902H-FB1	Field Blank							
	P020802A-IB070902H-FB2	Field Blank							

Table F-5. (Continued)

Fuel Mass, kg: 4445.0
Air Flow, scfm: 4551
8x10" Filter Catch, g: 0.051 **8x10" blank:** 0.0011

Internal Std. uL		Concentrated Extract, uL			Methylation	Silylation	GC/MS	IC	XRF
#1	#2	Total	Derivat.	Neutral					
150	150								
150	150								
100	100								
125	125	250	140	120					
125	125	270	140	130					
125	125	280	140	140					
125	125	240	120	120					
125	125	260	130	130					
125	125	270	140	130					
125	125	190	100	90					
125	125	230	120	120					
125	125	270	140	130					
125	125	250	130	120					
125	125	250	130	120					
125	125	250	130	120					
125	125	240	120	120					
125	125	270	140	130					
125	125	260	130	130					
125	125	260	130	130					
125	125	260	130	130					
125	125	280	140	140					
125	125	260	130	130					
125	125	250	130	120					

Table F-5. (Continued)

Internal Std. uL		Concentrated Extract, uL			Methylation	Silylation	GC/MS	IC	XRF
#1	#2	Total	Derivat.	Neutral					
125	125	250	130	120					
125	125	220	120	100					
125	125	220	120	100					
125	125	220	120	100					
125	125	260	130	130					
125	125	260	130	130					
125	125	250	130	120					
125	125	220	110	110					

Table F-6. Oil-Fired Institutional Boiler, Campaign #2, July 9, 2002

ELPI Stage Mass

Test ID:	**IB070902H**
Test Location:	
Type of Test:	**Industrial Boiler**
Fuel Type:	**No. 2 Oil**
Sampling Location:	**Residence chamber - Port #7**
ELPI flow, SLPM:	9.61
ELPI Dilution Ratio:	1
ELPI Unit No.:	292
ELPI Flow Data	
Sampling start	8:01:08
Sampling end	18:01:44
Sampling time, min	600.6
Sampler	1
DR	
Gravimetric Analysis	

Table F-6. (Continued)

Stage	Substrate ID	PM, mg	Net PM mg	Mass Conc mg/m3	TDS
1	A062102M-IB070902H-ELPI1	0.037	0.035	0.0061	
2	A062102L-IB070902H-ELPI2	0.039	0.037	0.0064	
3	A062102K-IB070902H-ELPI3	0.025	0.023	0.0040	
4	A062102J-IB070902H-ELPI4	0.021	0.019	0.0033	
5	A062102I-IB070902H-ELPI5	0.009	0.007	0.0012	
6	A062102H-IB070902H-ELPI6	0.012	0.01	0.0017	
7	A062102G-IB070902H-ELPI7	0.006	0.004	0.0007	
8	A062102F-IB070902H-ELPI8	0.004	0.002	0.0003	
9	A062102E-IB070902H-ELPI9	0.023	0.021	0.0036	
10	A062102F-IB070902H-ELPI10	0.015	0.013	0.0023	
11	A062102C-IB070902H-ELPI11	0.012	0.01	0.0017	
12	A062102B-IB070902H-ELPI12	0.012	0.01	0.0017	
13	A062102A-IB070902H-ELPI13	-0.006	0	0.0000	
BLANK	A062102N-IB070902H-ELPI-FB	0.002			

Table F-7. Oil-Fired Institutional Boiler - Campaign #2, July 10, 2002

Sample Log **Test ID:** **IB071002H** **Venturi, std. m^3:**

Test Location: **Time, min 600.67** **Dilution, std. m^3:**

Fuel Type: **No2 Oil** **Dilution Ratio:**

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm²	EC ug/cm²	OCX ug/cm²	Flow SLPM
RT	2	A1	TF	564	1008958	0.3					8.183
		A2	QF	564	Q060702A-IB071002HR2A2 *		1	10.57	0.18	0.32	8.183
		B1	TF	613	1008959	0.302					8.183
		B2	QF	613	Q060702B-IB071002HR2B2 *						8.183
	4	A1	TF	633	1008956	0.267					8.075
		A2	QF	633	Q060602Y-IB071002HR4A2 *		1	8.68	0.12	0.20	8.075
		B1	TF	641	1008957	0.27					8.075
		B2	QF	641	Q060602Z-IB071002HR4B2 *						8.075
	5	A1	D		72G16						4.593
		A2	D		F17						4.593
		A3	TF	1185	1008960	0.135					4.593
		B1	D		75G13						4.593
		B2	D		F15						4.593
		B3	TF	1246	1008961	0.138					4.593
		B4	NF	1246	NF-3						4.593
	6	A1	QF	618	Q060602V-IB071002HR6A1 *		1	20.58	1.03	4.07	8.219
		A2	PUF		P020102J-IB071002HR6A2						8.219
		A3	PUF		P020102K-IB071002HR6A3						8.219
		A4	PUF		P020102L-IB071002HR6A4						8.219
		A5	PUF		P020102M-IB071002HR6A5						8.219
		B1	QF	642	Q060602W-IB071002HR6B1 **						8.219
		B2	PUF		P020102N-IB071002HR6B2						8.219
		B3	PUF		P020102O-IB071002HR6B3						8.219

Table F-7. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm^2	EC ug/cm^2	OCX ug/cm^2	Flow SLPM
		B4	PUF		P020102P-IB071002HR6B4						8.219
		B5	PUF		P020102Q-IB071002HR6B5						8.219
	8	A1	QF	585	Q060602T-IB071002HR8A1 #		1	21.35	0.86	4.33	8.183
		A2	PUF		P020102B-IB071002HR8A2						8.183
		A3	PUF		P020102C-IB071002HR8A3						8.183
		A4	PUF		P020102D-IB071002HR8A4						8.183
		A5	PUF		P020102E-IB071002HR8A5						8.183
		B1	QF	481	Q060602U-IB071002HR8B1 #						8.183
		B2	PUF		P020102F-IB071002HR8B2						8.183
		B3	PUF		P020102G-IB071002HR8B3						8.183
Sample Log, July 10, continued											
		B4	PUF		P020102H-IB071002HR8B4						8.183
		B5	PUF		P020102I-IB071002HR8B5						8.183
	10	A1	QF	610	Q060602R-IB071002HR10A1 **		1	18.87	0.8	3.65	8.183
		A2	PUF		P012902B-IB071002HR10A2						8.183
		A3	PUF		P012902C-IB071002HR10A3						8.183
		A4	PUF		P012902D-IB071002HR10A4						8.183
		A5	PUF		P012902E-IB071002HR10A5						8.183
		B1	QF	622	Q060602S-IB071002HR10B1 **						8.183
		B2	PUF		P012902F-IB071002HR10B2						8.183
		B3	PUF		P012902G-IB071002HR10B3						8.183
		B4	PUF		P012902H-IB071002HR10B4						8.183
		B5	PUF		P020102A-IB071002HR10B5						8.183
Dilution	1	A1	QF	640	Q060602X-IB071002HD1A1		1	0.88	0.08	0.00	8.219
		A2	PUF		P020102R-IB071002HD1A2						8.219
		A3	PUF		P020102S-IB071002HD1A3						8.219
		B1	TF	614	1008955	0.002					8.219

* Composite with residence chamber port 2, A2

** Composite with residence chamber port 6, A1

Table F-7. (Continued)

11.29	**Fuel Mass, kg:**	**4464.6**			
489.2	**Air Flow, scfm:**	**4574.5**			
44.37	**8x10" Filter Catch, g:**	**0.0463**	**8x10" blank:**	**0.0011**	

PM	OC	Extrac-	Filter	Extracted, mg		Internal Std. µL		Filtration	Concentration, µL		
mg/L	mg/L	tion	Split	Mass	OC	#1	#2		Extract	Derivat.	Neutral
0.000061											
			1		0.127	composite					
0.000061											
			1		0.142	composite with R2A2					
0.000055											
			1		0.104	composite with R2A2					
0.000056											
			1		0.117	composite with R2A2					
0.000049											
0.000050											
			1	0.257	0.247	composite					
		9/16/02				125	125	9/19/02	290	150	150
		9/16/02				125	125	9/19/02	260	130	130
		9/16/02				125	125	9/19/02	260	130	130
		9/16/02				125	125	9/19/02	260	130	130
			1	0.288	0.277	composite with R6A1					
		9/23/02				125	125	9/24/02	230	120	110
		9/23/02				125	125	9/24/02	230	120	110
		9/23/02				125	125	9/24/02	230	120	110
		9/23/02				125	125	9/24/02	250	130	120
			1	0.256	0.256	archive					
		9/30/02				125	125				
		9/30/02				125	125				
		9/30/02				125	125				
		9/30/02				125	125				

Table F-7. (Continued)

PM	OC	Extrac-	Fliter	Extracted, mg		Internal Std. µL		Filtration	Concentration, µL		
mg/L	mg/L	tion	Split	Mass	OC	#1	#2		Extract	Derivat.	Neutral
			1	0.287	0.287	archive					
		9/16/02				125	125	9/20/02	260	130	130
		9/16/02				125	125	9/20/02	260	130	130
		9/16/02				125	125	9/20/02	250	130	120
		9/16/02				125	125	9/19/02	260	130	130
			1	0.256	0.226	composite with R6A1					
		9/30/02				125	125				
		9/30/02				125	125				
		9/30/02				125	125				
		9/30/02				125	125				
			1	0.287	0.254	composite with R6A1					
		9/30/02				125	125				
		9/30/02				125	125				
		9/30/02				125	125				
		9/30/02				125	125				
			1	0.002	0.011						
		9/10/02				125	125	9/11/02	230	120	110
		9/10/02				125	125	9/11/02	250	130	120

Table F-7. (Continued)

Test ID:	**IB071002H**	**Type of Test:**	**Oil fired Institutional Boiler**				**Venturi, std. m^3:**		**11.29**
Location:	**NC A&T Greensboro**	**Time, min**	**600.67**				**Dilution, std. m^3:**		**489.2**
Fuel Type:	**No. 2 Oil**						**Dilution Ratio:**		**44.37**

Substrate	Substrate ID	Chamber	Port #	Position	Holder #	No. of punch	Composite ID	Extracted , mg Mass	Extracted , mg OC
TF	1008958	RT	2	A1	564				
	1008959	RT	2	B1	613				
	1008956	RT	4	A1	633				
	1008957	RT	4	B1	641				
	1008960	RT	5	A3	1185				
	1008961	RT	5	B3	1246				
	1008955	DL	1	B1	614				
QF	Q060702A-IB071002HR2A2	RT	2	A2	564	2	IB071002HR2&R4		0.490
	Q060702B-IB071002HR2B2	RT	2	B2	613				
	Q060602Y-IB071002HR4A2	RT	4	A2	633				
	Q060602Z-IB071002HR4B2	RT	4	B2	641				
	Q060602V-IB071002HR6A1	RT	6	A1	618	2	IB071002HR6&R10	1.087	1.004
	Q060602W-IB071002HR6B1	RT	6	B1	642				
	Q060602R-IB071002HR10A1	RT	10	A1	610				
	Q060602S-IB071002HR10B1	RT	10	B1	622				
	Q060602T-IB071002HR8A1	RT	8	A1	585	1			
	Q060602U-IB071002HR8B1	RT	8	B1	481				
	Q060602X-IB071002HD1A1	DL	1	A1	640	1	IB071002HD1	0.002	0.011
PUF	P020102J-IB071002HR6A2	RT	6	A2					
	P020102K-IB071002HR6A3	RT	6	A3					
	P020102L-IB071002HR6A4	RT	6	A4					
	P020102M-IB071002HR6A5	RT	6	A5					
	P020102N-IB071002HR6B2	RT	6	B2					
	P020102O-IB071002HR6B3	RT	6	B3					

Table F-7. (Continued)

Substrate	Substrate ID	Chamber	Port #	Position	Holder #	No. of punch	Composite ID	Extracted , mg Mass	OC
	P020102P-IB071002HR6B4	RT	6	B4					
	P020102Q-IB071002HR6B5	RT	6	B5					
	P020102B-IB071002HR8A2	RT	8	A2					
	P020102C-IB071002HR8A3	RT	8	A3					
	P020102D-IB071002HR8A4	RT	8	A4					
	P020102E-IB071002HR8A5	RT	8	A5					
	P020102F-IB071002HR8B2	RT	8	B2					
	P020102G-IB071002HR8B3	RT	8	B3					
	P020102H-IB071002HR8B4	RT	8	B4					
	P020102I-IB071002HR8B5	RT	8	B5					
	P012902B-IB071002HR10A2	RT	10	A2					
	P012902C-IB071002HR10A3	RT	10	A3					
	P012902D-IB071002HR10A4	RT	10	A4					
	P012902E-IB071002HR10A5	RT	10	A5					
	P012902F-IB071002HR10B2	RT	10	B2					
	P012902G-IB071002HR10B3	RT	10	B3					
	P012902H-IB071002HR10B4	RT	10	B4					
	P020102A-IB071002HR10B5	RT	10	B5					
	P020102R-IB071002HD1A2	DL	1	A2					
	P020102S-IB071002HD1A3	DL	1	A3					

Table F-7. (Continued)

Fuel Mass, kg: **4464.6**

Air Flow, scfm: **4574.5**

8x10" Filter Catch, g: **0.0463** **8x10" blank:** **0.0011**

Internal Std. µL		Concentrated Extract, µL			Methylation	Silylation	GC/MS	IC	XRF
#1	#2	Total	Derivat.	Neutral					
150	150								
150	150								
100	100								
125	125	290	150	150					
125	125	260	130	130					
125	125	260	130	130					
125	125	260	130	130					
125	125	230	120	110					
125	125	230	120	110					
125	125	230	120	110					
125	125	250	130	120					
125	125								
125	125								
125	125								
125	125								
125	125	260	130	130					
125	125	260	130	130					
125	125	250	130	120					
125	125	260	130	130					
125	125								
125	125								
125	125								
125	125								
125	125								

Table F-7. (Continued)

Internal Std. µL		Concentrated Extract, µL			Methylation	Silylation	GC/MS	IC	XRF
#1	#2	Total	Derivat.	Neutral					
125	125								
125	125								
125	125								
125	125	230	120	110					
125	125	250	130	120					

Figure F-8. Oil-Fired Institutional Boiler, Campaign #2, July 10, 2002

ELPI Stage Mass

Test ID: **IB071002H**

Test Location:

Type of Test: **Industrial Boiler**

Fuel Type: **No. 2 Oil**

Sampling Location: **Residence chamber - Port #7**

ELPI flow, SLPM: **9.61**

ELPI Dilution Ratio: **1**

ELPI Unit No.: **292**

ELPI Flow Data

Sampling start **7:06:05**

Sampling end **17:06:45**

Sampling time, min **600.7**

Sampler

DR

Gravimetric Analysis

Stage	Substrate ID	PM, mg	Net PM mg	Mass Conc mg/m^3	TDS
1	A062402A-IB071002H-ELPI1	0.018	0.016	0.0028	
2	A062102Z-IB071002H-ELPI2	0.026	0.024	0.0042	
3	A062102Y-IB071002H-ELPI3	0.012	0.010	0.0017	
4	A062102X-IB071002H-ELPI4	0.009	0.007	0.0012	
5	A062102W-IB071002H-ELPI5	0.005	0.003	0.0005	
6	A062102V-IB071002H-ELPI6	0.007	0.005	0.0009	
7	A062102U-IB071002H-ELPI7	0.008	0.006	0.0010	
8	A062102T-IB071002H-ELPI8	0.006	0.004	0.0007	
9	A062102S-IB071002H-ELPI9	0.010	0.008	0.0014	
10	A062102R-IB071002H-ELPI10	0.002	0.000	0.0000	
11	A062102Q-IB071002H-ELPI11	0.006	0.004	0.0007	
12	A062102P-IB071002H-ELPI12	0.009	0.007	0.0012	
13	A062102O-IB071002H-ELPI13	0.006	0.004	0.0007	

Table F-9. Oil-Fired Institutional Boiler, Campaign #2, July 11, 2002

Test Location: **Time, min** **600** **Dilution, std. m^3:** **494.82**

Fuel Type: **No. 2 Oil** **Dilution Ratio:** **44.95**

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm^2	EC ug/cm^2	OCX ug/cm^2	Flow SLPM	PM mg/L
RT	2	A1	TF	564	1008967	1.176					8.276	0.000237
		A2	QF	564	Q060702P-IB071102HR2A2 *		1	12.64	0.03	0.10	8.276	
		B1	TF	613	1008968	1.15					8.276	0.000232
		B2	QF	613	Q060702Q-IB071102HR2B2 *						8.276	
	4	A1	TF	633	1008965	1.082					8.058	0.000224
		A2	QF	633	Q060702N-IB071102HR4A2 *		1	12.64	0.09	0.00	8.058	
		B1	TF	641	1008966	1.064					8.058	0.000220
		B2	QF	641	Q060702O-IB071102HR4B2 *						8.058	
	5	A1	D		95G17						4.573	
		A2	D		F13						4.573	
		A3	TF	1185	1008962	0.361					4.573	0.000132
		B1	D		83G18						4.573	
		B2	D		F14						4.573	
		B3	TF	1246	1008963	0.357					4.573	0.000130
		B4	NF	1246	NF-4						4.573	
	6	A1	QF	618	Q060702K-IB071102HR6A1		1	67.37	1.59	9.19	8.276	
		A2	PUF		P062502K-IB071102HR6A2						8.276	
		A3	PUF		P062502L-IB071102HR6A3						8.276	
		A4	PUF		P062502M-IB071102HR6A4						8.276	
		A5	PUF		P062502N-IB071102HR6A5						8.276	
		B1	QF	642	Q060702L-IB071102HR6B1						8.276	
		B2	PUF		P062502O-IB071102HR6B2						8.276	
		B3	PUF		P062102A-IB071102HR6B3						8.276	

Table F-9. (Continued)

Chamber	Port #	Position	Substrate	Holder #	Substrate ID	PM mg	No. of punch	OC ug/cm^2	EC ug/cm^2	OCX ug/cm^2	Flow SLPM	PM mg/L
		B4	PUF		P062102B-IB071102HR6B4						8.276	
		B5	PUF		P062102C-IB071102HR6B5						8.276	
	8	A1	QF	585	Q060702I-IB071102HR8A1		1	67.54	1.38	9.64	8.239	
		A2	PUF		P062502C-IB071102HR8A2						8.239	
		A3	PUF		P062502D-IB071102HR8A3						8.239	
		A4	PUF		P062502E-IB071102HR8A4						8.239	
		A5	PUF		P062502F-IB071102HR8A5						8.239	
		B1	QF	481	Q060702J-IB071102HR8B1						8.239	
		B2	PUF		P062502G-IB071102HR8B2						8.239	
		B3	PUF		P062502H-IB071102HR8B3						8.239	
Sample Log, July 11, continued												
		B4	PUF		P062502I-IB071102HR8B4						8.239	
		B5	PUF		P062502J-IB071102HR8B5						8.239	
	10	A1	QF	610	Q060702G-IB071102HR10A1		1	63.21	1.43	9.68	8.239	
		A2	PUF		P041202G-IB071102HR10A2						8.239	
		A3	PUF		P041202H-IB071102HR10A3						8.239	
		A4	PUF		P041202I-IB071102HR10A4						8.239	
		A5	PUF		P041202J-IB071102HR10A5						8.239	
		B1	QF	622	Q060702H-IB071102HR10B1						8.239	
		B2	PUF		P041202K-IB071102HR10B2						8.239	
		B3	PUF		P041202L-IB071102HR10B3						8.239	
		B4	PUF		P062502A-IB071102HR10B4						8.239	
		B5	PUF		P062502B-IB071102HR10B5						8.239	
Dilution	1	A1	QF	640	Q060702M-IB071102HD1A1		1	0.51	0.05	0.00	8.203	
		A2	PUF		P062102D-IB071102HD1A2						8.203	

* Composited with residence chamber port 2, A2

Table F-2. (Continued)

		Fuel Mass, kg:		**4459.7**						
		Air Flow, scfm:		**4282.3**						
		8x10" Filter Catch, g:		**0.123**				**8x10" blank:**	**0.0011**	
OC	**Extrac-**	**Fliter**	**Extracted, mg**		**Internal Std. µL**		**Filtra-**	**Concentration, µL**		
mg/L	**tion**	**Split**	**Mass**	**OC**	**#1**	**#2**	**tion**	**Extract**	**Derivat.**	**Neutral**
		1		0.152	composite					
		1		0.170	composite with R2A2					
		1		0.152	composite with R2A2					
		1		0.170	composite with R2A2					
		1								
		1	1.010	0.808						
	9/25/02				125	125	9/26/02	200	100	100
	9/25/02				125	125	9/26/02	230	120	110
	9/25/02				125	125	9/26/02	240	120	120
	9/25/02				125	125	9/26/02	240	120	120
		1	1.132	0.906						
	9/25/02				125	125	9/30/02	230	120	110
	9/25/02				125	125	9/30/02	200	100	100
	9/25/02				125	125	9/30/02	210	110	100
	9/25/02				125	125	9/30/02	230	120	110
		1	1.006	0.810						
	9/23/02				125	125	9/25/02	290	150	140
	9/23/02				125	125	9/25/02	250	130	120
	9/23/02				125	125	9/25/02	220	110	110
	9/23/02				125	125	9/25/02	260	130	130
		1	1.127	0.908	archive					
	9/13/02				125	125	9/16/02	250	130	120
	9/13/02				125	125	9/16/02	260	130	130
	9/13/02				125	125	9/16/02	250	130	120

Table F-9. (Continued)

OC	Extrac-	Fliter	Extracted, mg		Internal Std. µL		Filtra-	Concentration, µL		
mg/L	tion	Split	Mass	OC	#1	#2	tion	Extract	Derivat.	Neutral
	9/13/02				125	125	9/16/02	260	130	130
		1	1.006	0.759						
	9/11/02				125	125	9/13/02	250	130	120
	9/11/02				125	125	9/13/02	230	120	110
	9/11/02				125	125	9/13/02	210	110	100
	9/11/02				125	125	9/13/02	220	110	110
		1	1.127	0.850	archive					
	9/10/02				125	125	9/24/02	240	120	120
	9/10/02				125	125	9/24/02	240	120	120
	9/10/02				125	125	9/24/02	260	130	130
	9/10/02				125	125	9/24/02	240	120	120
		1	0.005	0.006						
	9/13/02				125	125	9/23/02	220	110	110
	9/13/02				125	125	9/23/02	250	130	120

Table F-9. (Continued)

Test ID: IB071102H **Type of Test: Oil fired Institutional Boiler** **Venturi, std. m^3: 11.27**

Location: NC A&T Greensboro **Time, min 600** **Dilution, std. m^3: 494.82**

Fuel Type: No. 2 Oil **Dilution Ratio: 44.95**

Substrate	Substrate ID	Chamber	Port #	Position	Holder #	No. of punch	Composite ID	Extracted , mg Mass	Extracted , mg OC
TF	1008967	RT	2	A1	564				
	1008968	RT	2	B1	613				
	1008965	RT	4	A1	633				
	1008966	RT	4	B1	641				
	1008962	RT	5	A3	1185				
	1008963	RT	5	B3	1246				
	1008964	DL	1	B1	614				
QF	Q060702P-IB071102HR2A2	RT	2	A2	564	2	IB071102HR2&R4		0.643
	Q060702Q-IB071102HR2B2	RT	2	B2	613				
	Q060702N-IB071102HR4A2	RT	4	A2	633				
	Q060702O-IB071102HR4B2	RT	4	B2	641				
	Q060702K-IB071102HR6A1	RT	6	A1	618	1		1.010	0.808
	Q060702L-IB071102HR6B1	RT	6	B1	642			1.132	0.906
	Q060702I-IB071102HR8A1	RT	8	A1	585	1		1.006	0.810
	Q060702J-IB071102HR8B1	RT	8	B1	481			1.127	0.908
	Q060702G-IB071102HR10A1	RT	10	A1	610	1		1.006	0.759
	Q060702H-IB071102HR10B1	RT	10	B1	622			1.127	0.850
	Q060702M-IB071102HD1A1	DL	1	A1	640	1		0.005	0.006
PUF	P062502K-IB071102HR6A2	RT	6	A2					
	P062502L-IB071102HR6A3	RT	6	A3					
	P062502M-IB071102HR6A4	RT	6	A4					
	P062502N-IB071102HR6A5	RT	6	A5					

Table F-9. (Continued)

Substrate	Substrate ID	Chamber	Port #	Position	Holder #	No. of punch	Composite ID	Extracted , mg Mass	Extracted , mg OC
	P062502O-IB071102HR6B2	RT	6	B2					
	P062102A-IB071102HR6B3	RT	6	B3					
	P062102B-IB071102HR6B4	RT	6	B4					
	P062102C-IB071102HR6B5	RT	6	B5					
	P062502C-IB071102HR8A2	RT	8	A2					
	P062502D-IB071102HR8A3	RT	8	A3					
	P062502E-IB071102HR8A4	RT	8	A4					
	P062502F-IB071102HR8A5	RT	8	A5					
	P062502G-IB071102HR8B2	RT	8	B2					
	P062502H-IB071102HR8B3	RT	8	B3					
	P062502I-IB071102HR8B4	RT	8	B4					
	P062502J-IB071102HR8B5	RT	8	B5					
	P041202G-IB071102HR10A2	RT	10	A2					
	P041202H-IB071102HR10A3	RT	10	A3					
	P041202I-IB071102HR10A4	RT	10	A4					
	P041202J-IB071102HR10A5	RT	10	A5					
	P041202K-IB071102HR10B2	RT	10	B2					
	P041202L-IB071102HR10B3	RT	10	B3					
	P062502A-IB071102HR10B4	RT	10	B4					
	P062502B-IB071102HR10B5	RT	10	B5					
	P062102D-IB071102HD1A2	DL	1	A2					
	P062102E-IB071102HD1A3	DL	1	A3					

Table F-9. (Continued)

Fuel Mass, kg: 4459.7

Air Flow, scfm: 4282.3

8x10" Filter Catch, g: 0.1230 **8x10" blank: 0.0011**

Internal Std. uL		Concentrated Extract, uL			Methylation	Silylation	GC/MS	IC	XRF
#1	#2	Total	Derivat.	Neutral					
150	150								
150	150								
150	150								
150	150								
150	150								
150	150								
125	125	200	100	100					
125	125	230	120	110					
125	125	240	120	120					
125	125	240	120	120					
125	125	230	120	110					
125	125	200	100	100					
125	125	210	110	100					
125	125	230	120	110					
125	125	290	150	140					
125	125	250	130	120					
125	125	220	110	110					
125	125	260	130	130					
125	125	250	130	120					
125	125	260	130	130					
125	125	250	130	120					
125	125	260	130	130					
125	125	250	130	120					
125	125	230	120	110					

Table F-9. (Continued)

Internal Std. µL		Concentrated Extract, µL			Methylation	Silylation	GC/MS	IC	XRF
#1	#2	Total	Derivat.	Neutral					
125	125	210	110	100					
125	125	220	110	110					
125	125	240	120	120					
125	125	240	120	120					
125	125	260	130	130					
125	125	240	120	120					
125	125	220	110	110					
125	125	250	130	120					

Table F-10. Oil-Fired Institutional Boiler, Campaign #2, July 11, 2002. ELPI Stage Mass

Test ID: IB071102 H
Test Location: NC A&T Greensboro
Type of Test: Institutional Boiler
Fuel Type: No. 2 Oil
Sampling Location: Residence chamber - Port #7
ELPI flow, SLPM: 9.61
ELPI Dilution Ratio: 1
ELPI Unit No.: 292
ELPI Flow Data
Sampling start 7:17:03
Sampling end 17:17:03
Sampling time, min 600.0
Sampler 1
DR
Gravimetric Analysis

Stage	Substrate ID	PM, mg	Net PM mg	Mass Conc mg/m^3	TDS
1	A062402N-IB071102H-ELPI1	0.101	0.099	0.0172	
2	A062402M-IB071102H-ELPI2	0.184	0.182	0.0316	
3	A062402L-IB071102H-ELPI3	0.071	0.069	0.0120	
4	A062402O-IB071102H-ELPI4	0.033	0.031	0.0054	
5	A062402J-IB071102H-ELPI5	0.026	0.024	0.0042	
6	A062402I-IB071102H-ELPI6	0.008	0.006	0.0010	
7	A062402H-IB071102H-ELPI7	0.005	0.003	0.0005	
8	A062402G-IB071102H-ELPI8	0.006	0.004	0.0007	
9	A062402F-IB071102H-ELPI9	0.008	0.006	0.0010	
10	A062402E-IB071102H-ELPI10	0.003	0.001	0.0002	
11	A062402D-IB071102H-ELPI11	-0.059	-0.061	0.0000	
12	A062402C-IB071102H-ELPI12	0.003	0.001	0.0002	
13	A062402B-IB071102H-ELPI13	0.003	0.001	0.0002	

Appendix G

Data Tables for Individual NMOC Samples
Campaign #1 Only

Table G-1. Greensboro A&T Field Test: January 16-18, 2001
SNMOC. Laboratory and Field (Ambient) Blank.

Compound	CAS No.	Laboratory Blank 1/16/01 µg/m³	Ambient 1/16/01 µg/m³
ethylene	4-84-0	0.49	2.84
acetylene	74-86-2	0.35	2.14
ethane	74-85-1	0.94	13.70
propylene	115-07-1	0.21	2.86
propane	74-98-6	1.26	288.06
propyne	74-99-7	0	0
isobutane	75-28-5	0.27	8.71
isobutene/1-butene	115-11-7/106-98-0	0.10	0.61
1,3-butadiene	106-99-0	0	0.22
n-butane	106-97-8	0.68	7.88
trans-2-butene	624-64-6	0	0.30
cis-2-butene	590-18-1	0	0.32
3-methyl-1-butene	563-45-1	0	0.07
isopentane	78-78-4	0.50	10.53
1-pentene	109-67-1	0	0.26
2-methyl-1-butene	563-46-2	0	0.23
n-pentane	109-66-0	0.22	2.37
isoprene	78-79-4	0	0.29
trans-2-pentene	646-04-8	0	0.38
cis-2-pentene	627-20-3	0	0.28
2-methyl-2-butene	513-35-9	0	0.43
2,2-dimethylbutane	75-83-2	0	2.92
cyclopentene	142-29-0	0.25	0.38
4-methyl-1-pentene	691-37-2	0	0
cyclopentane	287-92-3	0.12	0.31
2,3-dimethylbutane	79-29-8	0.17	0.51
2-methylpentane	107-83-5	0.35	1.10
3-methylpentane	96-14-0	0.15	0.90
2-methyl-1-pentene	763-29-1	0	0
1-hexene	592-41-6	0	0.43
2-ethyl-1-butene	760-21-4	0	0
n-hexane	110-54-3	0.23	1.24
trans-2-hexene	4050-45-7	0	0
cis-2-hexene	7688-21-3	0	0
methylcyclopentane	96-37-7	0.11	0.72
2,4-dimethylpentane	108-08-7	0	0.27
benzene	71-43-2	0.31	1.69
cyclohexane	110-82-7	0.21	0.86
2-methylhexane	591-76-4	0	0.34
2,3-dimethylpentane	565-59-3	0	0.33
3-methylhexane	589-34-4	0	0.56

Table G-1. (Continued)

Compound	CAS No.	Laboratory Blank 1/16/01 µg/m^3	Ambient 1/16/01 µg/m^3
1-heptene	592-76-7	0	0.18
2,2,4-trimethylpentane	540-84-1	0.16	1.28
n-heptane	142-82-5	0	0.47
methylcyclohexane	108-87-2	0	0.45
2,2,3-trimethylpentane	564-02-3	0	0.58
2,3,4-trimethylpentane	565-75-3	0	0.48
toluene	108-88-3	0.48	2.75
2-methylheptane	592-27-8	0	1.69
3-methylheptane	589-81-1	0	0.27
1-octene	111-66-0	0	0.10
n-octane	111-65-9	0	0.59
ethylbenzene	100-41-4	0.14	0.71
m-xylene/*p*-xylene	108-38-3/106-42-3	0.27	1.72
styrene	100-42-5	0.11	0.53
o-xylene	95-47-6	0.11	0.82
1-nonene	124-11-8	0.22	0.22
n-nonane	111-84-2	0	0.41
isopropylbenzene	98-82-8	0	0.14
α-pinene	80-56-8	0.18	0.13
n-propylbenzene	103-65-1	0	0.28
m-ethyltoluene	620-14-4	0	0.66
p-ethyltoluene	622-96-8	0	0.42
1,3,5-trimethylbenzene	108-67-8	0.08	0.43
o-ethyltoluene	611-14-3	0	0.72
β-pinene	127-91-3	0.13	0.25
1,2,4-trimethylbenzene	95-63-6	0.15	1.05
1-decene	872-05-9	0	0
n-decane	124-18-5	0.10	2.80
1,2,3-trimethylbenzene	526-73-8	0	0.20
m-diethylbenzene	141-93-5	0	0.21
p-diethylbenzene	105-05-5	0	0.15
1-undecene	821-95-4	0	0.08
n-undecane	1120-21-4	0.15	0.66
1-dodecene	112-41-4	0.11	0.26
n-dodecane	112-40-3	0.31	4.50
1-tridecene	2437-56-1	0	0
n-tridecane	629-50-5	0	0.13
Total speciated		9.62	381.36
Total unspeciated		5.08	28.08
Total speciated + unspeciated*		14.70	409.44

*Total NMOC with unknowns in μg/m^3 is an estimate based on propane only.

Table G-2A. Greensboro A&T Field Test, January 16-18, 2001
Sample Concentrations by Test Day

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m³	Residence Chamber 1/16/01 µg	Dilution Air 1/16/01 V=4.8L µg/m³	Dilution Air 1/16/01 µg	SNMOC RC-DA 1/16/01 µg	No Negs⁺ SNMOC RC-DA 1/16/01 µg
ethylene	4-84-0	4.1600	0.0175	2.9700	0.0143	0.0032	0.0032
acetylene	74-86-2	2.6700	0.0112	2.7100	0.0130	-0.0018	0.0000
ethane	74-85-1	22.8300	0.0959	23.0600	0.1107	-0.0148	0.0000
propylene	115-07-01	4.8500	0.0204	4.9400	0.0237	-0.0033	0.0000
propane	74-98-6	65.4000	0.2747	29.9900	0.1440	0.1307	0.1307
propyne	74-99-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isobutane	75-28-5	1.5900	0.0067	0.6200	0.0030	0.0037	0.0037
isobutene/1-butene	115-11-7/106-98-0	0.2700	0.0011	0.1800	0.0009	0.0003	0.0003
1,3-butadiene	106-99-0	0.0600	0.0003	0.0000	0.0000	0.0003	0.0003
n-butane	106-97-8	1.4100	0.0059	0.9000	0.0043	0.0016	0.0016
trans-2-butene	624-64-6	0.1300	0.0005	0.1300	0.0006	-0.0001	0.0000
cis-2-butene	590-18-1	0.1400	0.0006	0.1300	0.0006	0.0000	0.0000
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopentane	78-78-4	0.7700	0.0032	0.4100	0.0020	0.0013	0.0013
1-pentene	109-67-1	0.1300	0.0005	0.0900	0.0004	0.0001	0.0001
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.1100	0.0005	-0.0005	0.0000
n-pentane	109-66-0	0.4600	0.0019	0.3300	0.0016	0.0003	0.0003
isoprene	78-79-4	0.0000	0.0000	0.1500	0.0007	-0.0007	0.0000
trans-2-pentene	646-04-8	0.1300	0.0005	0.1100	0.0005	0.0000	0.0000
cis-2-pentene	627-20-3	0.1500	0.0006	0.1100	0.0005	0.0001	0.0001
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0800	0.0004	-0.0004	0.0000
2,2-dimethylbutane	75-83-2	0.2700	0.0011	0.2000	0.0010	0.0002	0.0002
cyclopentene	142-29-0	0.1200	0.0005	0.1100	0.0005	0.0000	0.0000
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.1300	0.0005	0.0800	0.0004	0.0002	0.0002

Table G-2A. (Continued)

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m^3	Residence Chamber 1/16/01 µg	Dilution Air 1/16/01 V=4.8L µg/m^3	Dilution Air 1/16/01 µg	SNMOC RC-DA 1/16/01 µg	No Negs$^+$ SNMOC RC-DA 1/16/01 µg
2,3-dimethylbutane	79-29-8	0.2600	0.0011	0.3400	0.0016	-0.0005	0.0000
2-methylpentane	107-83-5	0.3000	0.0013	0.2000	0.0010	0.0003	0.0003
3-methylpentane	96-14-0	0.3900	0.0016	0.2400	0.0012	0.0005	0.0005
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.2200	0.0009	0.1900	0.0009	0.0000	0.0000
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-hexane	110-54-3	2.6100	0.0110	1.0100	0.0048	0.0061	0.0061
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.2600	0.0012	-0.0012	0.0000
methylcyclopentane	96-37-7	0.5700	0.0024	0.2800	0.0013	0.0011	0.0011
2,4-dimethylpentane	108-08-7	0.1400	0.0006	0.1200	0.0006	0.0000	0.0000
benzene	71-43-2	0.4500	0.0019	0.1900	0.0009	0.0010	0.0010
cyclohexane	110-82-7	0.2000	0.0008	9.9800	0.0479	-0.0471	0.0000
2-methylhexane	591-76-4	0.1700	0.0007	0.0000	0.0000	0.0007	0.0007
2,3-dimethylpentane	565-59-3	0.1800	0.0008	0.1800	0.0009	-0.0001	0.0000
3-methylhexane	589-34-4	0.1000	0.0004	0.1400	0.0007	-0.0003	0.0000
1-heptene	592-76-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2,4-trimethylpentane	540-84-1	0.2800	0.0012	0.2100	0.0010	0.0002	0.0002
n-heptane	142-82-5	0.2000	0.0008	0.1400	0.0007	0.0002	0.0002
methylcyclohexane	108-87-2	0.1900	0.0008	0.1400	0.0007	0.0001	0.0001
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.1800	0.0008	0.1100	0.0005	0.0002	0.0002
toluene	108-88-3	0.7400	0.0031	0.6500	0.0031	0.0000	0.0000
2-methylheptane	592-27-8	0.1000	0.0004	0.1200	0.0006	-0.0002	0.0000
3-methylheptane	589-81-1	0.1100	0.0005	0.1100	0.0005	-0.0001	0.0000
1-octene	111-66-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-octane	111-65-9	0.3900	0.0016	0.3700	0.0018	-0.0001	0.0000

Table G-2A. (Continued)

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m^3	Residence Chamber 1/16/01 µg	Dilution Air 1/16/01 V=4.8L µg/m^3	Dilution Air 1/16/01 µg	SNMOC RC-DA 1/16/01 µg	No Negs$^+$ SNMOC RC-DA 1/16/01 µg
ethylbenzene	100-41-4	0.2200	0.0009	0.2300	0.0011	-0.0002	0.0000
styrene	100-42-5	0.3700	0.0016	0.6200	0.0030	-0.0014	0.0000
o-xylene	95-47-6	0.3700	0.0016	0.3500	0.0017	-0.0001	0.0000
1-nonene	124-11-8	0.1200	0.0005	0.0800	0.0004	0.0001	0.0001
n-nonane	111-84-2	0.2700	0.0011	0.2400	0.0012	0.0000	0.0000
isopropylbenzene	98-82-8	0.0800	0.0003	0.1000	0.0005	-0.0001	0.0000
α-pinene	80-56-8	0.0000	0.0000	0.0600	0.0003	-0.0003	0.0000
n-propylbenzene	103-65-1	0.1100	0.0005	0.0900	0.0004	0.0000	0.0000
m-ethyltoluene	620-14-4	0.3200	0.0013	0.1500	0.0007	0.0006	0.0006
p-ethyltoluene	622-96-8	0.2600	0.0011	0.1500	0.0007	0.0004	0.0004
1,3,5-trimethylbenzene	108-67-8	0.5100	0.0021	0.4200	0.0020	0.0001	0.0001
o-ethyltoluene	611-14-3	0.4600	0.0019	0.3500	0.0017	0.0003	0.0003
β-pinene	127-91-3	0.1200	0.0005	0.3600	0.0017	-0.0012	0.0000
1,2,4-trimethylbenzene	95-63-6	0.8000	0.0034	0.6200	0.0030	0.0004	0.0004
1-decene	872-05-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-decane	124-18-5	5.9200	0.0249	6.8100	0.0327	-0.0078	0.0000
1,2,3-trimethylbenzene	526-73-8	0.2600	0.0011	0.1500	0.0007	0.0004	0.0004
m-diethylbenzene	141-93-5	0.1500	0.0006	0.1200	0.0006	0.0001	0.0001
p-diethylbenzene	105-05-5	0.0000	0.0000	0.0700	0.0003	-0.0003	0.0000
1-undecene	821-95-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-undecane	1120-21-4	2.1000	0.0088	1.8700	0.0090	-0.0002	0.0000
1-dodecene	112-41-4	0.1300	0.0005	0.2700	0.0013	-0.0008	0.0000
n-dodecane	112-40-3	18.9100	0.0794	25.8600	0.1241	-0.0447	0.0000
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.1200	0.0005	0.2100	0.0010	-0.0005	0.0000

Table G-2A. (Continued)

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m^3	Residence Chamber 1/16/01 µg	Dilution Air 1/16/01 V=4.8L µg/m^3	Dilution Air 1/16/01 µg	SNMOC RC-DA 1/16/01 µg	No Negs$^+$ SNMOC RC-DA 1/16/01 µg
Total speciated		145.5500	0.6113	122.1500	0.5863	0.0250	0.1546
Total unspeciated		26.3300	0.1106	23.9700	0.1151	-0.0045	0.0000
Total speciated + unspeciated*		171.8800	0.7219	146.1200	0.7014	0.0205	0.1546

*Total NMOC with unknowns in μg/m^3 is an estimate based on propane only.

$^+$All negative values obtained in subtracting DA from RC have been changed to 0 for subsequent calculations.

Table G-2B. Greensboro A&T Field Test January 16-18, 2001
Sample Concentrations by Test Day

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m³	Residence Chamber 1/17/01 µg	Dilution Air 1/17/01 V=4.7L µg/m³	Dilution Air 1/17/01 µg	SNMOC RC-DA 1/17/01 µg	No Negs* SNMOC RC-DA 1/17/01 µg
ethylene	4-84-0	7.6900	0.0385	4.3700	0.0205	0.0179	0.0179
acetylene	74-86-2	7.1000	0.0355	4.6300	0.0218	0.0137	0.0137
ethane	74-85-1	33.9500	0.1698	30.7900	0.1447	0.0250	0.0250
propylene	115-07-01	3.0000	0.0150	2.7600	0.0130	0.0020	0.0020
propane	74-98-6	43.2400	0.2162	38.4700	0.1808	0.0354	0.0354
propyne	74-99-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isobutane	75-28-5	0.4000	0.0020	0.3300	0.0016	0.0004	0.0004
isobutene/1-butene	115-11-7/106-98-0	0.4200	0.0021	0.1700	0.0008	0.0013	0.0013
1,3-butadiene	106-99-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-butane	106-97-8	0.5700	0.0029	0.4200	0.0020	0.0009	0.0009
trans-2-butene	624-64-6	0.2000	0.0010	0.1200	0.0006	0.0004	0.0004
cis-2-butene	590-18-1	0.2200	0.0011	0.1300	0.0006	0.0005	0.0005
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopentane	78-78-4	0.4300	0.0022	0.2300	0.0011	0.0011	0.0011
1-pentene	109-67-1	0.1600	0.0008	0.0900	0.0004	0.0004	0.0004
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-pentane	109-66-0	0.3000	0.0015	0.1800	0.0008	0.0007	0.0007
isoprene	78-79-4	0.1300	0.0007	0.1300	0.0006	0.0000	0.0000
trans-2-pentene	646-04-8	0.1400	0.0007	0.0900	0.0004	0.0003	0.0003
cis-2-pentene	627-20-3	0.2300	0.0012	0.1100	0.0005	0.0006	0.0006
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2-dimethylbutane	75-83-2	0.4300	0.0022	0.1900	0.0009	0.0013	0.0013
cyclopentene	142-29-0	0.1800	0.0009	0.0900	0.0004	0.0005	0.0005
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.1700	0.0009	0.1000	0.0005	0.0004	0.0004
2,3-dimethylbutane	79-29-8	0.3400	0.0017	0.2400	0.0011	0.0006	0.0006
2-methylpentane	107-83-5	0.2800	0.0014	0.0900	0.0004	0.0010	0.0010
3-methylpentane	96-14-0	0.4000	0.0020	0.2000	0.0009	0.0011	0.0011

Table G-2B. (Continued)

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m³	Residence Chamber 1/17/01 µg	Dilution Air 1/17/01 V=4.7L µg/m³	Dilution Air 1/17/01 µg	SNMOC RC-DA 1/17/01 µg	No Negs+ SNMOC RC-DA 1/17/01 µg
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.3400	0.0017	0.1800	0.0008	0.0009	0.0009
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-hexane	110-54-3	1.6900	0.0085	0.8400	0.0039	0.0045	0.0045
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylcyclopentane	96-37-7	0.5200	0.0026	0.2400	0.0011	0.0015	0.0015
2,4-dimethylpentane	108-08-7	0.2400	0.0012	0.1200	0.0006	0.0006	0.0006
benzene	71-43-2	0.4400	0.0022	0.1400	0.0007	0.0015	0.0015
cyclohexane	110-82-7	0.1900	0.0010	0.3300	0.0016	-0.0006	0.0000
2-methylhexane	591-76-4	0.1600	0.0008	0.0800	0.0004	0.0004	0.0004
2,3-dimethylpentane	565-59-3	0.3400	0.0017	0.1800	0.0008	0.0009	0.0009
3-methylhexane	589-34-4	0.1400	0.0007	0.1100	0.0005	0.0002	0.0002
1-heptene	592-76-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2,4-trimethylpentane	540-84-1	0.2500	0.0013	0.1400	0.0007	0.0006	0.0006
n-heptane	142-82-5	0.2500	0.0013	0.0900	0.0004	0.0008	0.0008
methylcyclohexane	108-87-2	0.1800	0.0009	0.1200	0.0006	0.0003	0.0003
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.1800	0.0009	0.1000	0.0005	0.0004	0.0004
toluene	108-88-3	0.4700	0.0024	0.3600	0.0017	0.0007	0.0007
2-methylheptane	592-27-8	0.1500	0.0008	0.0900	0.0004	0.0003	0.0003
3-methylheptane	589-81-1	0.1900	0.0010	0.1000	0.0005	0.0005	0.0005
1-octene	111-66-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-octane	111-65-9	0.6800	0.0034	0.2500	0.0012	0.0022	0.0022
ethylbenzene	100-41-4	0.2100	0.0011	0.1500	0.0007	0.0003	0.0003
m-xylene/*p*-xylene	108-38-3/106-42-3	0.4400	0.0022	0.3700	0.0017	0.0005	0.0005
styrene	100-42-5	0.2200	0.0011	0.1200	0.0006	0.0005	0.0005
o-xylene	95-47-6	0.2700	0.0014	0.1900	0.0009	0.0005	0.0005

Table G-2B. (Continued)

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m³	Residence Chamber 1/17/01 µg	Dilution Air 1/17/01 V=4.7L µg/m³	Dilution Air 1/17/01 µg	SNMOC RC-DA 1/17/01 µg	No Negs⁺ SNMOC RC-DA 1/17/01 µg
1-nonene	124-11-8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-nonane	111-84-2	0.3100	0.0016	0.1200	0.0006	0.0010	0.0010
isopropylbenzene	98-82-8	0.1600	0.0008	0.0900	0.0004	0.0004	0.0004
α-pinene	80-56-8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-propylbenzene	103-65-1	0.1200	0.0006	0.0700	0.0003	0.0003	0.0003
m-ethyltoluene	620-14-4	0.2800	0.0014	0.1400	0.0007	0.0007	0.0007
p-ethyltoluene	622-96-8	0.2100	0.0011	0.1300	0.0006	0.0004	0.0004
1,3,5-trimethylbenzene	108-67-8	0.3600	0.0018	0.1200	0.0006	0.0012	0.0012
o-ethyltoluene	611-14-3	0.3200	0.0016	0.1400	0.0007	0.0009	0.0009
β-pinene	127-91-3	0.2200	0.0011	0.0000	0.0000	0.0011	0.0011
1,2,4-trimethylbenzene	95-63-6	0.6000	0.0030	0.2700	0.0013	0.0017	0.0017
1-decene	872-05-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-decane	124-18-5	0.9400	0.0047	0.8300	0.0039	0.0008	0.0008
1,2,3-trimethylbenzene	526-73-8	0.2400	0.0012	0.0900	0.0004	0.0008	0.0008
m-diethylbenzene	141-93-5	0.1500	0.0008	0.0000	0.0000	0.0008	0.0008
p-diethylbenzene	105-05-5	0.1300	0.0007	0.0000	0.0000	0.0007	0.0007
1-undecene	821-95-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-undecane	1120-21-4	0.7300	0.0037	0.4500	0.0021	0.0015	0.0015
1-dodecene	112-41-4	0.1800	0.0009	0.0000	0.0000	0.0009	0.0009
n-dodecane	112-40-3	12.1100	0.0606	4.6100	0.0217	0.0389	0.0389
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.1800	0.0009	0.0000	0.0000	0.0009	0.0009
Total speciated		124.7700	0.6239	95.2900	0.4479	0.1760	0.1766
Total unspeciated		8.7200	0.0436	10.8200	0.0509	-0.0073	0.0000
Total speciated + unspeciated*		133.4900	0.6675	106.1100	0.4987	0.1687	0.1766

*Total NMOC with unknowns in *u*g/m3 is an estimate based on propane only.

⁺All negative values obtained in subtracting DA from RC have been changed to 0 for subsequent calculations.

Table G-2C. Greensboro A&T Field Test, January 16-18, 2001
Sample Concentrations by Test Day

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m³	Residence Chamber 1/18/01 µg	Dilution Air 1/18/01 V=4.8L µg/m³	Dilution Air 1/18/01 µg	SNMOC RC-DA 1/18/01 µg	No Negs⁺ SNMOC RC-DA 1/18/01 µg
ethylene	4-84-0	5.8400	0.0304	5.1500	0.0247	0.0056	0.0056
acetylene	74-86-2	4.3100	0.0224	3.9700	0.0191	0.0034	0.0034
ethane	74-85-1	25.2600	0.1314	26.6700	0.1280	0.0033	0.0033
propylene	115-07-01	4.3300	0.0225	3.9000	0.0187	0.0038	0.0038
propane	74-98-6	198.1800	1.0305	157.2400	0.7548	0.2758	0.2758
propyne	74-99-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isobutane	75-28-5	0.3100	0.0016	0.3300	0.0016	0.0000	0.0000
isobutene/1-butene	115-11-7/106-98-0	0.2300	0.0012	0.1400	0.0007	0.0005	0.0005
1,3-butadiene	106-99-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-butane	106-97-8	0.4000	0.0021	0.4200	0.0020	0.0001	0.0001
trans-2-butene	624-64-6	0.1000	0.0005	0.1000	0.0005	0.0000	0.0000
cis-2-butene	590-18-1	0.1200	0.0006	0.1400	0.0007	0.0000	0.0000
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopentane	78-78-4	0.2200	0.0011	0.2500	0.0012	-0.0001	0.0000
1-pentene	109-67-1	0.0900	0.0005	0.0700	0.0003	0.0001	0.0001
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-pentane	109-66-0	0.1600	0.0008	0.1600	0.0008	0.0001	0.0001
isoprene	78-79-4	0.0000	0.0000	0.1400	0.0007	-0.0007	0.0000
trans-2-pentene	646-04-8	0.0900	0.0005	0.0800	0.0004	0.0001	0.0001
cis-2-pentene	627-20-3	0.1100	0.0006	0.1200	0.0006	0.0000	0.0000
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2-dimethylbutane	75-83-2	0.1900	0.0010	0.1700	0.0008	0.0002	0.0002
cyclopentene	142-29-0	0.1100	0.0006	0.0800	0.0004	0.0002	0.0002
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.0900	0.0005	0.0800	0.0004	0.0001	0.0001
2,3-dimethylbutane	79-29-8	0.1900	0.0010	0.1800	0.0009	0.0001	0.0001
2-methylpentane	107-83-5	1.3000	0.0068	0.1300	0.0006	0.0061	0.0061

Table G-2C. (Continued)

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m^3	Residence Chamber 1/18/01 µg	Dilution Air 1/18/01 V=4.8L µg/m^3	Dilution Air 1/18/01 µg	SNMOC RC-DA 1/18/01 µg	No Negs$^+$ SNMOC RC-DA 1/18/01 µg
3-methylpentane	96-14-0	0.2500	0.0013	0.1900	0.0009	0.0004	0.0004
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.1900	0.0010	0.1900	0.0009	0.0001	0.0001
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-hexane	110-54-3	1.3400	0.0070	0.6600	0.0032	0.0038	0.0038
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylcyclopentane	96-37-7	0.3200	0.0017	0.1800	0.0009	0.0008	0.0008
2,4-dimethylpentane	108-08-7	0.1000	0.0005	0.1000	0.0005	0.0000	0.0000
benzene	71-43-2	0.2100	0.0011	0.1500	0.0007	0.0004	0.0004
cyclohexane	110-82-7	0.1300	0.0007	0.1300	0.0006	0.0001	0.0001
2-methylhexane	591-76-4	0.0800	0.0004	0.0800	0.0004	0.0000	0.0000
2,3-dimethylpentane	565-59-3	0.1500	0.0008	0.1600	0.0008	0.0000	0.0000
3-methylhexane	589-34-4	0.0600	0.0003	0.0700	0.0003	0.0000	0.0000
1-heptene	592-76-7	0.0800	0.0004	0.0000	0.0000	0.0004	0.0004
2,2,4-trimethylpentane	540-84-1	0.1400	0.0007	0.1300	0.0006	0.0001	0.0001
n-heptane	142-82-5	0.1500	0.0008	0.1100	0.0005	0.0003	0.0003
methylcyclohexane	108-87-2	0.1100	0.0006	0.0900	0.0004	0.0001	0.0001
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.1000	0.0005	0.1000	0.0005	0.0000	0.0000
toluene	108-88-3	0.2700	0.0014	0.3100	0.0015	-0.0001	0.0000
2-methylheptane	592-27-8	0.0700	0.0004	0.0900	0.0004	-0.0001	0.0000
3-methylheptane	589-81-1	0.0800	0.0004	0.1000	0.0005	-0.0001	0.0000
1-octene	111-66-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-octane	111-65-9	0.2600	0.0014	0.1800	0.0009	0.0005	0.0005
ethylbenzene	100-41-4	0.1100	0.0006	0.1300	0.0006	-0.0001	0.0000
m-xylene/*p*-xylene	108-38-3/106-42-3	0.2500	0.0013	0.3000	0.0014	-0.0001	0.0000
styrene	100-42-5	0.2000	0.0010	0.0900	0.0004	0.0006	0.0006

Table G-2C. (Continued)

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m³	Residence Chamber 1/18/01 µg	Dilution Air 1/18/01 V=4.8L µg/m³	Dilution Air 1/18/01 µg	SNMOC RC-DA 1/18/01 µg	No Negs+ SNMOC RC-DA 1/18/01 µg
o-xylene	95-47-6	0.1800	0.0009	0.1600	0.0008	0.0002	0.0002
1-nonene	124-11-8	0.0800	0.0004	0.0800	0.0004	0.0000	0.0000
n-nonane	111-84-2	0.1800	0.0009	0.1200	0.0006	0.0004	0.0004
isopropylbenzene	98-82-8	0.0900	0.0005	0.0900	0.0004	0.0000	0.0000
α-pinene	80-56-8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-propylbenzene	103-65-1	0.0700	0.0004	0.0800	0.0004	0.0000	0.0000
m-ethyltoluene	620-14-4	0.1100	0.0006	0.1300	0.0006	-0.0001	0.0000
p-ethyltoluene	622-96-8	0.1000	0.0005	0.1000	0.0005	0.0000	0.0000
1,3,5-trimethylbenzene	108-67-8	0.1400	0.0007	0.0600	0.0003	0.0004	0.0004
o-ethyltoluene	611-14-3	0.1100	0.0006	0.0700	0.0003	0.0002	0.0002
β-pinene	127-91-3	0.2000	0.0010	0.0000	0.0000	0.0010	0.0010
1,2,4-trimethylbenzene	95-63-6	0.3000	0.0016	0.2200	0.0011	0.0005	0.0005
1-decene	872-05-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-decane	124-18-5	0.4500	0.0023	0.3500	0.0017	0.0007	0.0007
1,2,3-trimethylbenzene	526-73-8	0.0800	0.0004	0.0900	0.0004	0.0000	0.0000
m-diethylbenzene	141-93-5	0.1000	0.0005	0.0000	0.0000	0.0005	0.0005
p-diethylbenzene	105-05-5	0.0700	0.0004	0.0000	0.0000	0.0004	0.0004
1-undecene	821-95-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-undecane	1120-21-4	0.4200	0.0022	0.2900	0.0014	0.0008	0.0008
1-dodecene	112-41-4	0.1500	0.0008	0.0000	0.0000	0.0008	0.0008
n-dodecane	112-40-3	7.1000	0.0369	3.2100	0.0154	0.0215	0.0215
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.1800	0.0009	0.0000	0.0000	0.0009	0.0009

Table G-2. (Continued)

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m^3	Residence Chamber 1/18/01 µg	Dilution Air 1/18/01 V=4.8L µg/m^3	Dilution Air 1/18/01 µg	SNMOC RC-DA 1/18/01 µg	No Negs$^+$ SNMOC RC-DA 1/18/01 µg
Total speciated		256.3900	1.3332	208.1100	0.9989	0.3343	0.3356
Total unspeciated		12.7900	0.0665	8.3800	0.0402	0.0263	0.0263
Total speciated + unspeciated*		269.1800	1.3997	216.4900	1.0392	0.3606	0.3619

*Total NMOC with unknowns in μg/m^3 is an estimate based on propane only.

$^+$All negative values obtained in subtracting DA from RC have been changed to 0 for subsequent calculations.

Table G-3. Greensboro A&T Field Test, January 16-18, 2001
Sample Concentrations by Test Day: Summary
All negative values from the RC-DA subtraction have been replaced by "0.0000".

Compound	CAS No.	SNMOC RC-DA 1/16/01 µg	SNMOC RC-DA 1/17/01 µg	No Negs SNMOC RC-DA 1/18/01 µg
ethylene	4-84-0	0.0032	0.0179	0.0056
acetylene	74-86-2	0.0000	0.0137	0.0034
ethane	74-85-1	0.0000	0.0250	0.0033
propylene	115-07-1	0.0000	0.0020	0.0038
propane	74-98-6	0.1307	0.0354	0.2758
propyne	74-99-7	0.0000	0.0000	0.0000
isobutane	75-28-5	0.0037	0.0004	0.0000
isobutene/1-butene	115-11-7/106-98-0	0.0003	0.0013	0.0005
1,3-butadiene	106-99-0	0.0003	0.0000	0.0000
n-butane	106-97-8	0.0016	0.0009	0.0001
trans-2-butene	624-64-6	0.0000	0.0004	0.0000
cis-2-butene	590-18-1	0.0000	0.0005	0.0000
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000
isopentane	78-78-4	0.0013	0.0011	0.0000
1-pentene	109-67-1	0.0001	0.0004	0.0001
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000
n-pentane	109-66-0	0.0003	0.0007	0.0001
isoprene	78-79-4	0.0000	0.0000	0.0000
trans-2-pentene	646-04-8	0.0000	0.0003	0.0001
cis-2-pentene	627-20-3	0.0001	0.0006	0.0000
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000
2,2-dimethylbutane	75-83-2	0.0002	0.0013	0.0002
cyclopentene	142-29-0	0.0000	0.0005	0.0002
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.0002	0.0004	0.0001
2,3-dimethylbutane	79-29-8	0.0000	0.0006	0.0001
2-methylpentane	107-83-5	0.0003	0.0010	0.0061
3-methylpentane	96-14-0	0.0005	0.0011	0.0004
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.0000	0.0009	0.0001
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000
n-hexane	110-54-3	0.0061	0.0045	0.0038
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000
methylcyclopentane	96-37-7	0.0011	0.0015	0.0008
2,4-dimethylpentane	108-08-7	0.0000	0.0006	0.0000
benzene	71-43-2	0.0010	0.0015	0.0004
cyclohexane	110-82-7	0.0000	0.0000	0.0001
2-methylhexane	591-76-4	0.0007	0.0004	0.0000
2,3-dimethylpentane	565-59-3	0.0000	0.0009	0.0000
3-methylhexane	589-34-4	0.0000	0.0002	0.0000
1-heptene	592-76-7	0.0000	0.0000	0.0004

Table G-3. (Continued)

Compound	CAS No.	SNMOC RC-DA 1/16/01 µg	SNMOC RC-DA 1/17/01 µg	No Negs SNMOC RC-DA 1/18/01 µg
2,2,4-trimethylpentane	540-84-1	0.0002	0.0006	0.0001
n-heptane	142-82-5	0.0002	0.0008	0.0003
methylcyclohexane	108-87-2	0.0001	0.0003	0.0001
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.0002	0.0004	0.0000
toluene	108-88-3	0.0000	0.0007	0.0000
2-methylheptane	592-27-8	0.0000	0.0003	0.0000
3-methylheptane	589-81-1	0.0000	0.0005	0.0000
1-octene	111-66-0	0.0000	0.0000	0.0000
n-octane	111-65-9	0.0000	0.0022	0.0005
ethylbenzene	100-41-4	0.0000	0.0003	0.0000
m-xylene/*p*-xylene	108-38-3/106-42-3	0.0000	0.0005	0.0000
styrene	100-42-5	0.0000	0.0005	0.0006
o-xylene	95-47-6	0.0000	0.0005	0.0002
1-nonene	124-11-8	0.0001	0.0000	0.0000
n-nonane	111-84-2	0.0000	0.0010	0.0004
isopropylbenzene	98-82-8	0.0000	0.0004	0.0000
α-pinene	80-56-8	0.0000	0.0000	0.0000
n-propylbenzene	103-65-1	0.0000	0.0003	0.0000
m-ethyltoluene	620-14-4	0.0006	0.0007	0.0000
p-ethyltoluene	622-96-8	0.0004	0.0004	0.0000
1,3,5-trimethylbenzene	108-67-8	0.0001	0.0012	0.0004
o-ethyltoluene	611-14-3	0.0003	0.0009	0.0002
β-pinene	127-91-3	0.0000	0.0011	0.0010
1,2,4-trimethylbenzene	95-63-6	0.0004	0.0017	0.0005
1-decene	872-05-9	0.0000	0.0000	0.0000
n-decane	124-18-5	0.0000	0.0008	0.0007
1,2,3-trimethylbenzene	526-73-8	0.0004	0.0008	0.0000
m-diethylbenzene	141-93-5	0.0001	0.0008	0.0005
p-diethylbenzene	105-05-5	0.0000	0.0007	0.0004
1-undecene	821-95-4	0.0000	0.0000	0.0000
n-undecane	1120-21-4	0.0000	0.0015	0.0008
1-dodecene	112-41-4	0.0000	0.0009	0.0008
n-dodecane	112-40-3	0.0000	0.0389	0.0215
1-tridecene	2437-56-1	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.0000	0.0009	0.0009
Total speciated		0.1546	0.1766	0.3356
Total unspeciated		0.0000	0.0000	0.0263
Total speciated + unspeciated*		0.1546	0.1766	0.3619

*Total NMOC with unknowns in $\mu g/m^3$ is an estimate based on propane only.

Table G-4A. Greensboro A&T Field Test, January 16-18, 2001
Sample Concentrations by Test Day
All negative values resulting from the subtraction RC-DA have been replaced by "0.0000".

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m³	Total Collected µg	Dilution Air 1/16/01 V=4.8L µg/m³	Total Collected µg	1/16/01 RC-DA µg	No Negs 1/16/01 RC-DA µg
ethylene	4-84-0	4.1600	2163.7737	2.9700	1511.7710	652.0027	652.0027
acetylene	74-86-2	2.6700	1388.7682	2.7100	1379.4274	9.3408	9.3408
ethane	74-85-1	22.8300	11874.7487	23.0600	11737.8583	136.8904	136.8904
propylene	115-07-1	4.8500	2522.6689	4.9400	2514.5282	8.1407	8.1407
propane	74-98-6	65.4000	34017.0199	29.9900	15265.3240	18751.6959	18751.7000
propyne	74-99-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isobutane	75-28-5	1.5900	827.0193	0.6200	315.5886	511.4307	511.4307
isobutene/1-butene	115-11-7/106-98-0	0.2700	140.4372	0.1800	91.6225	48.8148	48.8148
1,3-butadiene	106-99-0	0.0600	31.2083	0.0000	0.0000	31.2083	31.2083
n-butane	106-97-8	1.4100	733.3945	0.9000	458.1124	275.2820	275.2820
trans-2-butene	624-64-6	0.1300	67.6179	0.1300	66.1718	1.4461	1.4461
cis-2-butene	590-18-1	0.1400	72.8193	0.1300	66.1718	6.6475	6.6475
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopentane	78-78-4	0.7700	400.5062	0.4100	208.6957	191.8105	191.8105
1-pentene	109-67-1	0.1300	67.6179	0.0900	45.8112	21.8067	21.8067
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.1100	55.9915	-55.9915	0.0000
n-pentane	109-66-0	0.4600	239.2634	0.3300	167.9746	71.2889	71.2889
isoprene	78-79-4	0.0000	0.0000	0.1500	76.3521	-76.3521	0.0000
trans-2-pentene	646-04-8	0.1300	67.6179	0.1100	55.9915	11.6264	11.6264
cis-2-pentene	627-20-3	0.1500	78.0207	0.1100	55.9915	22.0292	22.0292
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0800	40.7211	-40.7211	0.0000
2,2-dimethylbutane	75-83-2	0.2700	140.4372	0.2000	101.8028	38.6345	38.6345
cyclopentene	142-29-0	0.1200	62.4166	0.1100	55.9915	6.4250	6.4250
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.1300	67.6179	0.0800	40.7211	26.8968	26.8968
2,3-dimethylbutane	79-29-8	0.2600	135.2359	0.3400	173.0647	-37.8288	0.0000
2-methylpentane	107-83-5	0.3000	156.0414	0.2000	101.8028	54.2386	54.2386

Table G-4A. (Continued)

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m^3	Total Collected µg	Dilution Air 1/16/01 V=4.8L µg/m^3	Total Collected µg	1/16/01 RC-DA µg	No Negs 1/16/01 RC-DA µg
3-methylpentane	96-14-0	0.3900	202.8538	0.2400	122.1633	80.6905	80.6905
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.2200	114.4303	0.1900	96.7126	17.7177	17.7177
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-hexane	110-54-3	2.6100	1357.5600	1.0100	514.1039	843.4560	843.4560
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.2600	132.3436	-132.3436	0.0000
methylcyclopentane	96-37-7	0.5700	296.4786	0.2800	142.5239	153.9547	153.9547
2,4-dimethylpentane	108-08-7	0.1400	72.8193	0.1200	61.0817	11.7377	11.7377
benzene	71-43-2	0.4500	234.0621	0.1900	96.7126	137.3494	137.3494
cyclohexane	110-82-7	0.2000	104.0276	9.9800	5079.9578	-4975.9302	0.0000
2-methylhexane	591-76-4	0.1700	88.4234	0.0000	0.0000	88.4234	88.4235
2,3-dimethylpentane	565-59-3	0.1800	93.6248	0.1800	91.6225	2.0023	2.0023
3-methylhexane	589-34-4	0.1000	52.0138	0.1400	71.2619	-19.2481	0.0000
1-heptene	592-76-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2,4-trimethylpentane	540-84-1	0.2800	145.6386	0.2100	106.8929	38.7457	38.7457
n-heptane	142-82-5	0.2000	104.0276	0.1400	71.2619	32.7657	32.7657
methylcyclohexane	108-87-2	0.1900	98.8262	0.1400	71.2619	27.5643	27.5643
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.1800	93.6248	0.1100	55.9915	37.6333	37.6333
toluene	108-88-3	0.7400	384.9021	0.6500	330.8590	54.0431	54.0431
2-methylheptane	592-27-8	0.1000	52.0138	0.1200	61.0817	-9.0679	0.0000
3-methylheptane	589-81-1	0.1100	57.2152	0.1100	55.9915	1.2237	1.2237
1-octene	111-66-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-octane	111-65-9	0.3900	202.8538	0.3700	188.3351	14.5187	14.5187
ethylbenzene	100-41-4	0.2200	114.4303	0.2300	117.0732	-2.6428	0.0000
m-xylene/*p*-xylene	108-38-3/106-42-3	0.5000	260.0690	0.5800	295.2280	-35.1590	0.0000
styrene	100-42-5	0.3700	192.4510	0.6200	315.5886	-123.1375	0.0000
o-xylene	95-47-6	0.3700	192.4510	0.3500	178.1548	14.2962	14.2962

Table G-4C. (Continued)

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m^3	Total Collected µg	Dilution Air 1/16/01 V=4.8L µg/m^3	Total Collected µg	1/16/01 RC-DA µg	No Negs 1/16/01 RC-DA µg
1-nonene	124-11-8	0.1200	62.4166	0.0800	40.7211	21.6954	21.6955
n-nonane	111-84-2	0.2700	140.4372	0.2400	122.1633	18.2739	18.2739
isopropylbenzene	98-82-8	0.0800	41.6110	0.1000	50.9014	-9.2903	0.0000
α-pinene	80-56-8	0.0000	0.0000	0.0600	30.5408	-30.5408	0.0000
n-propylbenzene	103-65-1	0.1100	57.2152	0.0900	45.8112	11.4039	11.4039
m-ethyltoluene	620-14-4	0.3200	166.4441	0.1500	76.3521	90.0921	90.0921
p-ethyltoluene	622-96-8	0.2600	135.2359	0.1500	76.3521	58.8838	58.8838
1,3,5-trimethylbenzene	108-67-8	0.5100	265.2703	0.4200	213.7858	51.4845	51.4845
o-ethyltoluene	611-14-3	0.4600	239.2634	0.3500	178.1548	61.1086	61.1086
β-pinene	127-91-3	0.1200	62.4166	0.3600	183.2450	-120.8284	0.0000
1,2,4-trimethylbenzene	95-63-6	0.8000	416.1103	0.6200	315.5886	100.5218	100.5218
1-decene	872-05-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-decane	124-18-5	5.9200	3079.2165	6.8100	3466.3840	-387.1675	0.0000
1,2,3-trimethylbenzene	526-73-8	0.2600	135.2359	0.1500	76.3521	58.8838	58.8838
m-diethylbenzene	141-93-5	0.1500	78.0207	0.1200	61.0817	16.9390	16.9390
p-diethylbenzene	105-05-5	0.0000	0.0000	0.0700	35.6310	-35.6310	0.0000
1-undecene	821-95-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-undecane	1120-21-4	2.1000	1092.2896	1.8700	951.8558	140.4338	140.4338
1-dodecene	112-41-4	0.1300	67.6179	0.2700	137.4337	-69.8158	0.0000
n-dodecane	112-40-3	18.9100	9835.8080	25.8600	13163.0970	-3327.2889	0.0000
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.1200	62.4166	0.2100	106.8929	-44.4763	0.0000

Table G-4C. (Continued)

Compound	CAS No.	Residence Chamber 1/16/01 V=4.2L µg/m³	Total Collected µg	Dilution Air 1/16/01 V=4.8L µg/m³	Total Collected µg	1/16/01 RC-DA µg	No Negs 1/16/01 RC-DA µg
Total speciated		145.5500	75706.0741	122.1500	62176.0361	13530.0379	23063.5037
Total unspeciated		26.3300	13695.2314	23.9700	12201.0609	1494.1705	1494.1705
Total speciated + unspeciated*		171.8800	89401.3054	146.1200	74377.0970	15024.2085	24557.6742

*Total NMOC with unknowns in μg/m^3 is an estimate based on propane only.

	16-Jan	
Venturi Flow (Average)	18.53	sLpm
Dilution Flow (Average)	847.89	sLpm
Run Time	600.33	min
Volume Combustion Air	11124.115	L
Volume Dilution Air	509013.8	L
Residence Chamber	520137.92	L
RC-DA	11124.115	L

Table G-4B. Greensboro A&T Field Test, January 16-18, 2001
Sample Concentrations by Test Day
All negative values resulting from the RC-DA subtraction have been replaced by "0.0000."

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m^3	Total µg	Dilution Air 1/17/01 V=4.7L µg/m^3	Total µg	1/17/01 RC-DA µg	No Negs 1/17/01 RC-DA µg
ethylene	4-84-0	7.6900	4000.1159	4.3700	2226.2273	1773.8885	1773.8885
acetylene	74-86-2	7.1000	3693.2149	4.6300	2358.6802	1334.5347	1334.5347
ethane	74-85-1	33.9500	17659.8094	30.7900	15685.4782	1974.3311	1974.3311
propylene	115-07-01	3.0000	1560.5133	2.7600	1406.0383	154.4750	154.4750
propane	74-98-6	43.2400	22492.1990	38.4700	19597.9327	2894.2663	2894.2663
propyne	74-99-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isobutane	75-28-5	0.4000	208.0684	0.3300	168.1133	39.9552	39.9552
isobutene/1-butene	115-11-7/106-98-0	0.4200	218.4719	0.1700	86.6038	131.8681	131.8681
1,3-butadiene	106-99-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-butane	106-97-8	0.5700	296.4975	0.4200	213.9624	82.5352	82.5352
trans-2-butene	624-64-6	0.2000	104.0342	0.1200	61.1321	42.9021	42.9021
cis-2-butene	590-18-1	0.2200	114.4376	0.1300	66.2264	48.2112	48.2110
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopentane	78-78-4	0.4300	223.6736	0.2300	117.1699	106.5037	106.5032
1-pentene	109-67-1	0.1600	83.2274	0.0900	45.8491	37.3783	37.3783
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-pentane	109-66-0	0.3000	156.0513	0.1800	91.6982	64.3532	64.3532
isoprene	78-79-4	0.1300	67.6222	0.1300	66.2264	1.3958	1.3958
trans-2-pentene	646-04-8	0.1400	72.8240	0.0900	45.8491	26.9749	26.9749
cis-2-pentene	627-20-3	0.2300	119.6394	0.1100	56.0378	63.6016	63.6016
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2-dimethylbutane	75-83-2	0.4300	223.6736	0.1900	96.7925	126.8811	126.8811
cyclopentene	142-29-0	0.1800	93.6308	0.0900	45.8491	47.7817	47.7817
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.1700	88.4291	0.1000	50.9434	37.4857	37.4857
2,3-dimethylbutane	79-29-8	0.3400	176.8582	0.2400	122.2642	54.5940	54.5940
2-methylpentane	107-83-5	0.2800	145.6479	0.0900	45.8491	99.7988	99.7988

Table G-4B. (Continued)

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m^3	Total µg	Dilution Air 1/17/01 V=4.7L µg/m^3	Total µg	1/17/01 RC-DA µg	No Negs 1/17/01 RC-DA µg
3-methylpentane	96-14-0	0.4000	208.0684	0.2000	101.8868	106.1816	106.1816
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.3400	176.8582	0.1800	91.6982	85.1600	84.1600
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-hexane	110-54-3	1.6900	879.0892	0.8400	427.9247	451.1645	451.1645
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylcyclopentane	96-37-7	0.5200	270.4890	0.2400	122.2642	148.2248	148.2248
2,4-dimethylpentane	108-08-7	0.2400	124.8411	0.1200	61.1321	63.7090	63.7090
benzene	71-43-2	0.4400	228.8753	0.1400	71.3208	157.5545	157.5545
cyclohexane	110-82-7	0.1900	98.8325	0.3300	168.1133	-69.2808	0.0000
2-methylhexane	591-76-4	0.1600	83.2274	0.0800	40.7547	42.4726	42.4726
2,3-dimethylpentane	565-59-3	0.3400	176.8582	0.1800	91.6982	85.1600	85.1600
3-methylhexane	589-34-4	0.1400	72.8240	0.1100	56.0378	16.7862	16.7862
1-heptene	592-76-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2,4-trimethylpentane	540-84-1	0.2500	130.0428	0.1400	71.3208	58.7220	58.7220
n-heptane	142-82-5	0.2500	130.0428	0.0900	45.8491	84.1937	84.1937
methylcyclohexane	108-87-2	0.1800	93.6308	0.1200	61.1321	32.4987	32.4987
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.1800	93.6308	0.1000	50.9434	42.6874	42.6874
toluene	108-88-3	0.4700	244.4804	0.3600	183.3963	61.0841	61.0841
2-methylheptane	592-27-8	0.1500	78.0257	0.0900	45.8491	32.1766	32.1766
3-methylheptane	589-81-1	0.1900	98.8325	0.1000	50.9434	47.8891	47.8891
1-octene	111-66-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-octane	111-65-9	0.6800	353.7164	0.2500	127.3585	226.3578	226.3578
ethylbenzene	100-41-4	0.2100	109.2359	0.1500	76.4151	32.8208	32.8208
m-xylene/*p*-xylene	108-38-3/106-42-3	0.4400	228.8753	0.3700	188.4906	40.3846	40.3846
styrene	100-42-5	0.2200	114.4376	0.1200	61.1321	53.3055	53.3055
o-xylene	95-47-6	0.2700	140.4462	0.1900	96.7925	43.6537	43.6537

Table G-4B. (Continued)

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m^3	Total µg	Dilution Air 1/17/01 V=4.7L µg/m^3	Total µg	1/17/01 RC-DA µg	No Negs 1/17/01 RC-DA µg
1-nonene	124-11-8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-nonane	111-84-2	0.3100	161.2530	0.1200	61.1321	100.1209	100.1209
isopropylbenzene	98-82-8	0.1600	83.2274	0.0900	45.8491	37.3783	37.3783
α-pinene	80-56-8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-propylbenzene	103-65-1	0.1200	62.4205	0.0700	35.6604	26.7601	26.7601
m-ethyltoluene	620-14-4	0.2800	145.6479	0.1400	71.3208	74.3271	74.3271
p-ethyltoluene	622-96-8	0.2100	109.2359	0.1300	66.2264	43.0095	43.0095
1,3,5-trimethylbenzene	108-67-8	0.3600	187.2616	0.1200	61.1321	126.1295	126.1295
o-ethyltoluene	611-14-3	0.3200	166.4548	0.1400	71.3208	95.1340	95.1340
β-pinene	127-91-3	0.2200	114.4376	0.0000	0.0000	114.4376	114.4376
1,2,4-trimethylbenzene	95-63-6	0.6000	312.1027	0.2700	137.5472	174.5554	174.5554
1-decene	872-05-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-decane	124-18-5	0.9400	488.9608	0.8300	422.8304	66.1305	66.1305
1,2,3-trimethylbenzene	526-73-8	0.2400	124.8411	0.0900	45.8491	78.9920	78.9920
m-diethylbenzene	141-93-5	0.1500	78.0257	0.0000	0.0000	78.0257	78.0257
p-diethylbenzene	105-05-5	0.1300	67.6222	0.0000	0.0000	67.6222	67.6222
1-undecene	821-95-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-undecane	1120-21-4	0.7300	379.7249	0.4500	229.2454	150.4795	150.4795
1-dodecene	112-41-4	0.1800	93.6308	0.0000	0.0000	93.6308	93.6308
n-dodecane	112-40-3	12.1100	6299.2722	4.6100	2348.4915	3950.7807	3950.7807
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.1800	93.6308	0.0000	0.0000	93.6308	93.6308

Table G-4B. (Continued)

Compound	CAS No.	Residence Chamber 1/17/01 V=5L µg/m³	Total µg	Dilution Air 1/17/01 V=4.7L µg/m³	Total µg	1/17/01 RC-DA µg	No Negs 1/17/01 RC-DA µg
Total speciated		124.7700	64901.7500	95.2900	48543.9825	16357.7675	16426.0475
Total unspeciated		8.7200	4535.8921	10.8200	5512.0778	-976.1857	0.0000
Total speciated + unspeciated*		133.4900	69437.6421	106.1100	54056.0603	15381.5818	16426.0475

*Total NMOC with unknowns in $\mu g/m^3$ is an estimate based on propane only.

	17-Jan	
Venturi Flow (Average)	17.88	sLpm
Dilution Flow (Average)	848.35	sLpm
Run Time	600.5	min
Volume Combustion Air	10736.94	L
Volume Dilution Air	509434.175	L
Residence Chamber	520171.115	L

Table G-4C. Greensboro A&T Field Test, January 16-18, 2001
Sample Concentrations by Test Day
All negative values resulting from the RC-DA subtraction have been replaced by "0.0000".

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m³	RC Total µg	Dilution Air 1/18/01 V=4.8L µg/m³	DA Total µg	RC-DA 1/18/01 Total µg	No Negs RC-DA 1/18/01 Total µg
ethylene	4-84-0	5.8400	3048.1870	5.1500	2629.2842	418.9029	418.9029
acetylene	74-86-2	4.3100	2249.6038	3.9700	2026.8462	222.7575	222.7575
ethane	74-85-1	25.2600	13184.4527	26.6700	13616.1181	-431.6654	0.0000
propylene	115-07-01	4.3300	2260.0428	3.9000	1991.1084	268.9344	268.9344
propane	74-98-6	198.1800	103440.0173	157.2400	80277.4058	23162.6115	23162.6100
propyne	74-99-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isobutane	75-28-5	0.3100	161.8044	0.3300	168.4784	-6.6740	0.0000
isobutene/1-butene	115-11-7/106-98-0	0.2300	120.0485	0.1400	71.4757	48.5728	48.5728
1,3-butadiene	106-99-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-butane	106-97-8	0.4000	208.7799	0.4200	214.4271	-5.6471	0.0000
trans-2-butene	624-64-6	0.1000	52.1950	0.1000	51.0541	1.1409	1.1409
cis-2-butene	590-18-1	0.1200	62.6340	0.1400	71.4757	-8.8417	0.0000
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
isopentane	78-78-4	0.2200	114.8290	0.2500	127.6352	-12.8062	0.0000
1-pentene	109-67-1	0.0900	46.9755	0.0700	35.7378	11.2376	11.2376
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-pentane	109-66-0	0.1600	83.5120	0.1600	81.6865	1.8255	1.8255
isoprene	78-79-4	0.0000	0.0000	0.1400	71.4757	-71.4757	0.0000
trans-2-pentene	646-04-8	0.0900	46.9755	0.0800	40.8432	6.1322	6.1322
cis-2-pentene	627-20-3	0.1100	57.4145	0.1200	61.2649	-3.8504	0.0000
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,2-dimethylbutane	75-83-2	0.1900	99.1705	0.1700	86.7919	12.3786	12.3786
cyclopentene	142-29-0	0.1100	57.4145	0.0800	40.8432	16.5712	16.5712
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cyclopentane	287-92-3	0.0900	46.9755	0.0800	40.8432	6.1322	6.1322
2,3-dimethylbutane	79-29-8	0.1900	99.1705	0.1800	91.8973	7.2732	7.2732
2-methylpentane	107-83-5	1.3000	678.5348	0.1300	66.3703	612.1645	612.1645

Table G-4C. (Continued)

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m^3	RC Total µg	Dilution Air 1/18/01 V=4.8L µg/m^3	DA Total µg	RC-DA 1/18/01 Total µg	No Negs RC-DA 1/18/01 Total µg
3-methylpentane	96-14-0	0.2500	130.4875	0.1900	97.0027	33.4847	33.4847
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1-hexene	592-41-6	0.1900	99.1705	0.1900	97.0027	2.1678	2.1678
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-hexane	110-54-3	1.3400	699.4128	0.6600	336.9568	362.4560	362.4560
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylcyclopentane	96-37-7	0.3200	167.0239	0.1800	91.8973	75.1266	75.1266
2,4-dimethylpentane	108-08-7	0.1000	52.1950	0.1000	51.0541	1.1409	1.1409
benzene	71-43-2	0.2100	109.6095	0.1500	76.5811	33.0284	33.0284
cyclohexane	110-82-7	0.1300	67.8535	0.1300	66.3703	1.4832	1.4832
2-methylhexane	591-76-4	0.0800	41.7560	0.0800	40.8432	0.9127	0.9127
2,3-dimethylpentane	565-59-3	0.1500	78.2925	0.1600	81.6865	-3.3940	0.0000
3-methylhexane	589-34-4	0.0600	31.3170	0.0700	35.7378	-4.4209	0.0000
1-heptene	592-76-7	0.0800	41.7560	0.0000	0.0000	41.7560	41.7560
2,2,4-trimethylpentane	540-84-1	0.1400	73.0730	0.1300	66.3703	6.7027	6.7027
n-heptane	142-82-5	0.1500	78.2925	0.1100	56.1595	22.1330	22.1330
methylcyclohexane	108-87-2	0.1100	57.4145	0.0900	45.9487	11.4658	11.4658
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,3,4-trimethylpentane	565-75-3	0.1000	52.1950	0.1000	51.0541	1.1409	1.1409
toluene	108-88-3	0.2700	140.9265	0.3100	158.2676	-17.3411	0.0000
2-methylheptane	592-27-8	0.0700	36.5365	0.0900	45.9487	-9.4122	0.0000
3-methylheptane	589-81-1	0.0800	41.7560	0.1000	51.0541	-9.2981	0.0000
1-octene	111-66-0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-octane	111-65-9	0.2600	135.7070	0.1800	91.8973	43.8096	43.8097
ethylbenzene	100-41-4	0.1100	57.4145	0.1300	66.3703	-8.9558	0.0000
m-xylene/*p*-xylene	108-38-3/106-42-3	0.2500	130.4875	0.3000	153.1622	-22.6747	0.0000
styrene	100-42-5	0.2000	104.3900	0.0900	45.9487	58.4413	58.4413
o-xylene	95-47-6	0.1800	93.9510	0.1600	81.6865	12.2645	12.2645

Table G-4C. (Continued)

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m³	RC Total µg	Dilution Air 1/18/01 V=4.8L µg/m³	DA Total µg	RC-DA 1/18/01 Total µg	No Negs RC-DA 1/18/01 Total µg
1-nonene	124-11-8	0.0800	41.7560	0.0800	40.8432	0.9127	0.9127
n-nonane	111-84-2	0.1800	93.9510	0.1200	61.2649	32.6861	32.6861
isopropylbenzene	98-82-8	0.0900	46.9755	0.0900	45.9487	1.0268	1.0268
α-pinene	80-56-8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-propylbenzene	103-65-1	0.0700	36.5365	0.0800	40.8432	-4.3068	0.0000
m-ethyltoluene	620-14-4	0.1100	57.4145	0.1300	66.3703	-8.9558	0.0000
p-ethyltoluene	622-96-8	0.1000	52.1950	0.1000	51.0541	1.1409	1.1409
1,3,5-trimethylbenzene	108-67-8	0.1400	73.0730	0.0600	30.6324	42.4405	42.4405
o-ethyltoluene	611-14-3	0.1100	57.4145	0.0700	35.7378	21.6766	21.6766
β-pinene	127-91-3	0.2000	104.3900	0.0000	0.0000	104.3900	104.3900
1,2,4-trimethylbenzene	95-63-6	0.3000	156.5849	0.2200	112.3189	44.2660	44.2660
1-decene	872-05-9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-decane	124-18-5	0.4500	234.8774	0.3500	178.6892	56.1882	56.1882
1,2,3-trimethylbenzene	526-73-8	0.0800	41.7560	0.0900	45.9487	-4.1927	0.0000
m-diethylbenzene	141-93-5	0.1000	52.1950	0.0000	0.0000	52.1950	52.1950
p-diethylbenzene	105-05-5	0.0700	36.5365	0.0000	0.0000	36.5365	36.5365
1-undecene	821-95-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-undecane	1120-21-4	0.4200	219.2189	0.2900	148.0568	71.1622	71.1622
1-dodecene	112-41-4	0.1500	78.2925	0.0000	0.0000	78.2925	78.2925
n-dodecane	112-40-3	7.1000	3705.8438	3.2100	1638.8354	2067.0084	2067.0080
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
n-tridecane	629-50-5	0.1800	93.9510	0.0000	0.0000	93.9510	93.9510

Table G-4C. (Continued)

Compound	CAS No.	Residence Chamber 1/18/01 V=5.2L µg/m³	RC Total µg	Dilution Air 1/18/01 V=4.8L µg/m³	DA Total µg	RC-DA 1/18/01 Total µg	No Negs RC-DA 1/18/01 Total µg
Total speciated		256.3900	133822.7169	208.1100	106248.6068	27574.1102	28208.0208
Total unspeciated		12.7900	6675.7383	8.3800	4278.3303	2397.4080	2397.4080
Total speciated + unspeciated*		269.1800	140498.4552	216.4900	110526.9371	29971.5181	30605.4288

*Total NMOC with unknowns in $\mu g/m^3$ is an estimate based on propane only.

	18-Jan	
Venturi Flow (Average)	19.01	sLpm
Dilution Flow (Average)	850.66	sLpm
Run Time	600.17	min
Volume Combustion Air	11409.2317	L
Volume Dilution Air	510540.6122	L
Residence Chamber	521949.8439	L

Table G-5A. SPECIATE Format
SNMOC Values for 1/16, 1/17, 1/18

Compound	CAS No.	1/16/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
ethylene	4-84-0	652.0027	13.0152	2.6550	0.0530
acetylene	74-86-2	9.3408	12.0140	0.0380	0.0489
ethane	74-85-1	136.8904	10.9016	0.5574	0.0444
propylene	115-07-1	8.1407	6.8970	0.0331	0.0281
propane	74-98-6	18751.7000	12.2365	76.3578	0.0498
propyne	74-99-7	0.0000		0.0000	
isobutane	75-28-5	511.4307	6.2295	2.0826	0.0254
isobutene/1-butene	115-11-7/106-98-0	48.8148	4.0047	0.1988	0.0163
1,3-butadiene	106-99-0	31.2083	5.8958	0.1271	0.0240
n-butane	106-97-8	275.2820	11.2354	1.1210	0.0458
trans-2-butene	624-64-6	1.4461	7.2307	0.0059	0.0294
cis-2-butene	590-18-1	6.6475	10.7904	0.0271	0.0439
3-methyl-1-butene	563-45-1	0.0000		0.0000	
isopentane	78-78-4	191.8105	16.1300	0.7811	0.0657
1-pentene	109-67-1	21.8067	9.0105	0.0888	0.0367
2-methyl-1-butene	563-46-2	0.0000	9.0105	0.0000	
n-pentane	109-66-0	71.2889	11.2354	0.2903	0.0458
isoprene	78-79-4	0.0000	1.3349	0.0000	
trans-2-pentene	646-04-8	11.6264	9.1218	0.0473	0.0371
cis-2-pentene	627-20-3	22.0292	13.4602	0.0897	0.0548
2-methyl-2-butene	513-35-9	0.0000	13.0152	0.0000	
2,2-dimethylbutane	75-83-2	38.6345	16.4637	0.1573	0.0670
cyclopentene	142-29-0	6.4250	15.5738	0.0262	0.0634
4-methyl-1-pentene	691-37-2	0.0000	16.0187	0.0000	
cyclopentane	287-92-3	26.8968	7.6756	0.1095	0.0313
2,3-dimethylbutane	79-29-8	0.0000	19.0222	0.0000	
2-methylpentane	107-83-5	54.2386	8.7881	0.2209	0.0358
3-methylpentane	96-14-0	80.6905	16.7974	0.3286	0.0684
2-methyl-1-pentene	763-29-1	0.0000	16.7974	0.0000	
1-hexene	592-41-6	17.7177	17.0199	0.0721	0.0693
2-ethyl-1-butene	760-21-4	0.0000	16.6862	0.0000	

Table G-5A. (Continued)

Compound	CAS No.	1/16/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
n-hexane	110-54-3	843.4560	12.9040	3.4346	0.0525
trans-2-hexene	4050-45-7	0.0000	12.9040	0.0000	
cis-2-hexene	7688-21-3	0.0000	12.9040	0.0000	
methylcyclopentane	96-37-7	153.9547	10.6792	0.6269	0.0435
2,4-dimethylpentane	108-08-7	11.7377	13.3489	0.0478	0.0544
benzene	71-43-2	137.3494	8.4543	0.5593	0.0344
cyclohexane	110-82-7	0.0000	18.9110	0.0000	
2-methylhexane	591-76-4	88.4235	2.2248	0.3601	0.0091
2,3-dimethylpentane	565-59-3	2.0023	11.1241	0.0082	0.0453
3-methylhexane	589-34-4	0.0000	9.3443	0.0000	
1-heptene	592-76-7	0.0000	9.2330	0.0000	
2,2,4-trimethylpentane	540-84-1	38.7457	11.2354	0.1578	0.0458
n-heptane	142-82-5	32.7657	5.6733	0.1334	0.0231
methylcyclohexane	108-87-2	27.5643	10.7904	0.1122	0.0439
2,2,3-trimethylpentane	564-02-3	0.0000	11.2354	0.0000	
2,3,4-trimethylpentane	565-75-3	37.6333	7.7869	0.1532	0.0317
toluene	108-88-3	54.0431	4.4496	0.2201	0.0181
2-methylheptane	592-27-8	0.0000	4.3384	0.0000	
3-methylheptane	589-81-1	1.2237	4.2272	0.0050	0.0172
1-octene	111-66-0	0.0000	4.1159	0.0000	
n-octane	111-65-9	14.5187	2.2248	0.0591	0.0091
ethylbenzene	100-41-4	0.0000	3.0035	0.0000	
m-xylene/*p*-xylene	108-38-3/106-42-3	0.0000	4.6721	0.0000	
styrene	100-42-5	0.0000	7.6756	0.0000	
o-xylene	95-47-6	14.2962	3.0035	0.0582	0.0122
1-nonene	124-11-8	21.6955	2.3361	0.0883	0.0095
n-nonane	111-84-2	18.2739	2.3361	0.0744	0.0095
isopropylbenzene	98-82-8	0.0000	4.4496	0.0000	
α-pinene	80-56-8	0.0000	2.3361	0.0000	
n-propylbenzene	103-65-1	11.4039	2.2248	0.0464	0.0091
m-ethyltoluene	620-14-4	90.0921	5.1171	0.3669	0.0208
p-ethyltoluene	622-96-8	58.8838	5.8958	0.2398	0.0240

Table G-5A. (Continued)

Compound	CAS No.	1/16/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
1,3,5-trimethylbenzene	108-67-8	51.4845	3.2260	0.2096	0.0131
o-ethyltoluene	611-14-3	61.1086	3.4485	0.2488	0.0140
β-pinene	127-91-3	0.0000	2.3361	0.0000	
1,2,4-trimethylbenzene	95-63-6	100.5218	3.2260	0.4093	0.0131
1-decene	872-05-9	0.0000	2.4473	0.0000	
n-decane	124-18-5	0.0000	2.4473	0.0000	
1,2,3-trimethylbenzene	526-73-8	58.8838	2.6698	0.2398	0.0109
m-diethylbenzene	141-93-5	16.9390	1.4461	0.0690	0.0059
p-diethylbenzene	105-05-5	0.0000	1.6686	0.0000	
1-undecene	821-95-4	0.0000	2.1136	0.0000	
n-undecane	1120-21-4	140.4338	2.1136	0.5719	0.0086
1-dodecene	112-41-4	0.0000	4.6721	0.0000	
n-dodecane	112-40-3	0.0000	4.7834	0.0000	
1-tridecene	2437-56-1	0.0000	4.6721	0.0000	
n-tridecane	629-50-5	0.0000	4.7834	0.0000	

Total speciated	23063.5037
Total unspeciated	1494.1705
Total speciated + unspeciated*	24557.6742

*Total NMOC with unknowns in $\mu g/m^3$ is an estimate based on propane only.

Table G-5B. SPECIATE Format
SNMOC Values for 1/16, 1/17, 1/18

Compound	CAS No.	1/17/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
ethylene	4-84-0	1773.8885	0.0000	10.7992	0.0000
acetylene	74-86-2	1334.5347	0.0000	8.1245	0.0000
ethane	74-85-1	1974.3311	0.0000	12.0195	0.0000
propylene	115-07-01	154.4750	0.0000	0.9404	0.0000
propane	74-98-6	2894.2663	0.0000	17.6200	0.0000
propyne	74-99-7	0.0000	0.0000	0.0000	
isobutane	75-28-5	39.9552	0.0000	0.2432	0.0000
isobutene/1-butene	115-11-7/106-98-0	131.8681	0.0000	0.8028	0.0000
1,3-butadiene	106-99-0	0.0000	0.0000	0.0000	
n-butane	106-97-8	82.5352	0.0000	0.5025	0.0000
trans-2-butene	624-64-6	42.9021	0.0000	0.2612	0.0000
cis-2-butene	590-18-1	48.2110	0.0000	0.2935	0.0000
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	
isopentane	78-78-4	106.5032	0.0000	0.6484	0.0000
1-pentene	109-67-1	37.3783	0.0000	0.2276	0.0000
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000	
n-pentane	109-66-0	64.3532	0.0000	0.3918	0.0000
isoprene	78-79-4	1.3958	0.0000	0.0085	0.0000
trans-2-pentene	646-04-8	26.9749	0.0000	0.1642	0.0000
cis-2-pentene	627-20-3	63.6016	0.0000	0.3872	0.0000
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000	
2,2-dimethylbutane	75-83-2	126.8811	0.0000	0.7724	0.0000
cyclopentene	142-29-0	47.7817	0.0000	0.2909	0.0000
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	
cyclopentane	287-92-3	37.4857	0.0000	0.2282	0.0000
2,3-dimethylbutane	79-29-8	54.5940	0.0000	0.3324	0.0000
2-methylpentane	107-83-5	99.7988	0.0000	0.6076	0.0000
3-methylpentane	96-14-0	106.1816	0.0000	0.6464	0.0000
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	
1-hexene	592-41-6	84.1600	0.0000	0.5124	0.0000
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	

Table G-5B. (Continued)

Compound	CAS No.	1/17/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
n-hexane	110-54-3	451.1645	0.0000	2.7466	0.0000
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000	
methylcyclopentane	96-37-7	148.2248	0.0000	0.9024	0.0000
2,4-dimethylpentane	108-08-7	63.7090	0.0000	0.3879	0.0000
benzene	71-43-2	157.5545	0.0000	0.9592	0.0000
cyclohexane	110-82-7	0.0000	0.0000	0.0000	
2-methylhexane	591-76-4	42.4726	0.0000	0.2586	0.0000
2,3-dimethylpentane	565-59-3	85.1600	0.0000	0.5184	0.0000
3-methylhexane	589-34-4	16.7862	0.0000	0.1022	0.0000
1-heptene	592-76-7	0.0000	0.0000	0.0000	
2,2,4-trimethylpentane	540-84-1	58.7220	0.0000	0.3575	0.0000
n-heptane	142-82-5	84.1937	0.0000	0.5126	0.0000
methylcyclohexane	108-87-2	32.4987	0.0000	0.1978	0.0000
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	
2,3,4-trimethylpentane	565-75-3	42.6874	0.0000	0.2599	0.0000
toluene	108-88-3	61.0841	0.0000	0.3719	0.0000
2-methylheptane	592-27-8	32.1766	0.0000	0.1959	0.0000
3-methylheptane	589-81-1	47.8891	0.0000	0.2915	0.0000
1-octene	111-66-0	0.0000	0.0000	0.0000	
n-octane	111-65-9	226.3578	0.0000	1.3780	0.0000
ethylbenzene	100-41-4	32.8208	0.0000	0.1998	0.0000
m-xylene/*p*-xylene	108-38-3/106-42-3	40.3846	0.0000	0.2459	0.0000
styrene	100-42-5	53.3055	0.0000	0.3245	0.0000
o-xylene	95-47-6	43.6537	0.0000	0.2658	0.0000
1-nonene	124-11-8	0.0000	0.0000	0.0000	
n-nonane	111-84-2	100.1209	0.0000	0.6095	0.0000
isopropylbenzene	98-82-8	37.3783	0.0000	0.2276	0.0000
α-pinene	80-56-8	0.0000	0.0000	0.0000	
n-propylbenzene	103-65-1	26.7601	0.0000	0.1629	0.0000
m-ethyltoluene	620-14-4	74.3271	0.0000	0.4525	0.0000

Table G-5B. (Continued)

Compound	CAS No.	1/17/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
p-ethyltoluene	622-96-8	43.0095	0.0000	0.2618	0.0000
1,3,5-trimethylbenzene	108-67-8	126.1295	0.0000	0.7679	0.0000
o-ethyltoluene	611-14-3	95.1340	0.0000	0.5792	0.0000
β-pinene	127-91-3	114.4376	0.0000	0.6967	0.0000
1,2,4-trimethylbenzene	95-63-6	174.5554	0.0000	1.0627	0.0000
1-decene	872-05-9	0.0000	0.0000	0.0000	
n-decane	124-18-5	66.1305	0.0000	0.4026	0.0000
1,2,3-trimethylbenzene	526-73-8	78.9920	0.0000	0.4809	0.0000
m-diethylbenzene	141-93-5	78.0257	0.0000	0.4750	0.0000
p-diethylbenzene	105-05-5	67.6222	0.0000	0.4117	0.0000
1-undecene	821-95-4	0.0000	0.0000	0.0000	
n-undecane	1120-21-4	150.4795	0.0000	0.9161	0.0000
1-dodecene	112-41-4	93.6308	0.0000	0.5700	0.0000
n-dodecane	112-40-3	3950.7807	0.0000	24.0519	0.0000
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	
n-tridecane	629-50-5	93.6308	0.0000	0.5700	0.0000
Total speciated		16426.0475			
Total unspeciated		0.0000			
Total speciated + unspeciated*		16426.0475			

*Total NMOC with unknowns in $\mu g/m^3$ is an estimate based on propane only.

Table G-5C. SPECIATE Format
SNMOC Values for 1/16, 1/17, 1/18

Compound	CAS No.	1/18/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
ethylene	4-84-0	418.9029	0.0000	1.3687	0.0000
acetylene	74-86-2	222.7575	0.0000	0.7278	0.0000
ethane	74-85-1	0.0000	0.0000	0.0000	
propylene	115-07-01	268.9344	0.0000	0.8787	0.0000
propane	74-98-6	23162.6100	0.0000	75.6814	0.0000
propyne	74-99-7	0.0000	0.0000	0.0000	
isobutane	75-28-5	0.0000	0.0000	0.0000	
isobutene/1-butene	115-11-7/106-98-0	48.5728	0.0000	0.1587	0.0000
1,3-butadiene	106-99-0	0.0000	0.0000	0.0000	
n-butane	106-97-8	0.0000	0.0000	0.0000	
trans-2-butene	624-64-6	1.1409	0.0000	0.0037	0.0000
cis-2-butene	590-18-1	0.0000	0.0000	0.0000	
3-methyl-1-butene	563-45-1	0.0000	0.0000	0.0000	
isopentane	78-78-4	0.0000	0.0000	0.0000	
1-pentene	109-67-1	11.2376	0.0000	0.0367	0.0000
2-methyl-1-butene	563-46-2	0.0000	0.0000	0.0000	
n-pentane	109-66-0	1.8255	0.0000	0.0060	0.0000
isoprene	78-79-4	0.0000	0.0000	0.0000	
trans-2-pentene	646-04-8	6.1322	0.0000	0.0200	0.0000
cis-2-pentene	627-20-3	0.0000	0.0000	0.0000	
2-methyl-2-butene	513-35-9	0.0000	0.0000	0.0000	
2,2-dimethylbutane	75-83-2	12.3786	0.0000	0.0404	0.0000
cyclopentene	142-29-0	16.5712	0.0000	0.0541	0.0000
4-methyl-1-pentene	691-37-2	0.0000	0.0000	0.0000	
cyclopentane	287-92-3	6.1322	0.0000	0.0200	0.0000
2,3-dimethylbutane	79-29-8	7.2732	0.0000	0.0238	0.0000
2-methylpentane	107-83-5	612.1645	0.0000	2.0002	0.0000
3-methylpentane	96-14-0	33.4847	0.0000	0.1094	0.0000
2-methyl-1-pentene	763-29-1	0.0000	0.0000	0.0000	
1-hexene	592-41-6	2.1678	0.0000	0.0071	0.0000
2-ethyl-1-butene	760-21-4	0.0000	0.0000	0.0000	

Table G-5C. (Continued)

Compound	CAS No.	1/18/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
n-hexane	110-54-3	362.4560	0.0000	1.1843	0.0000
trans-2-hexene	4050-45-7	0.0000	0.0000	0.0000	
cis-2-hexene	7688-21-3	0.0000	0.0000	0.0000	
methylcyclopentane	96-37-7	75.1266	0.0000	0.2455	0.0000
2,4-dimethylpentane	108-08-7	1.1409	0.0000	0.0037	0.0000
benzene	71-43-2	33.0284	0.0000	0.1079	0.0000
cyclohexane	110-82-7	1.4832	0.0000	0.0048	0.0000
2-methylhexane	591-76-4	0.9127	0.0000	0.0030	0.0000
2,3-dimethylpentane	565-59-3	0.0000	0.0000	0.0000	
3-methylhexane	589-34-4	0.0000	0.0000	0.0000	
1-heptene	592-76-7	41.7560	0.0000	0.1364	0.0000
2,2,4-trimethylpentane	540-84-1	6.7027	0.0000	0.0219	0.0000
n-heptane	142-82-5	22.1330	0.0000	0.0723	0.0000
methylcyclohexane	108-87-2	11.4658	0.0000	0.0375	0.0000
2,2,3-trimethylpentane	564-02-3	0.0000	0.0000	0.0000	
2,3,4-trimethylpentane	565-75-3	1.1409	0.0000	0.0037	0.0000
toluene	108-88-3	0.0000	0.0000	0.0000	
2-methylheptane	592-27-8	0.0000	0.0000	0.0000	
3-methylheptane	589-81-1	0.0000	0.0000	0.0000	
1-octene	111-66-0	0.0000	0.0000	0.0000	
n-octane	111-65-9	43.8097	0.0000	0.1431	0.0000
ethylbenzene	100-41-4	0.0000	0.0000	0.0000	
m-xylene/*p*-xylene	108-38-3/106-42-3	0.0000	0.0000	0.0000	
styrene	100-42-5	58.4413	0.0000	0.1910	0.0000
o-xylene	95-47-6	12.2645	0.0000	0.0401	0.0000
1-nonene	124-11-8	0.9127	0.0000	0.0030	0.0000
n-nonane	111-84-2	32.6861	0.0000	0.1068	0.0000
isopropylbenzene	98-82-8	1.0268	0.0000	0.0034	0.0000
α-pinene	80-56-8	0.0000	0.0000	0.0000	
n-propylbenzene	103-65-1	0.0000	0.0000	0.0000	
m-ethyltoluene	620-14-4	0.0000	0.0000	0.0000	

Table G-5C. (Continued)

Compound	CAS No.	1/18/01 RC-DA µg	Uncertainty µg	Percent Total	Uncertainty as % Total
p-ethyltoluene	622-96-8	1.1409	0.0000	0.0037	0.0000
1,3,5-trimethylbenzene	108-67-8	42.4405	0.0000	0.1387	0.0000
o-ethyltoluene	611-14-3	21.6766	0.0000	0.0708	0.0000
β-pinene	127-91-3	104.3900	0.0000	0.3411	0.0000
1,2,4-trimethylbenzene	95-63-6	44.2660	0.0000	0.1446	0.0000
1-decene	872-05-9	0.0000	0.0000	0.0000	
n-decane	124-18-5	56.1882	0.0000	0.1836	0.0000
1,2,3-trimethylbenzene	526-73-8	0.0000	0.0000	0.0000	
m-diethylbenzene	141-93-5	52.1950	0.0000	0.1705	0.0000
p-diethylbenzene	105-05-5	36.5365	0.0000	0.1194	0.0000
1-undecene	821-95-4	0.0000	0.0000	0.0000	
n-undecane	1120-21-4	71.1622	0.0000	0.2325	0.0000
1-dodecene	112-41-4	78.2925	0.0000	0.2558	0.0000
n-dodecane	112-40-3	2067.0080	0.0000	6.7537	0.0000
1-tridecene	2437-56-1	0.0000	0.0000	0.0000	
n-tridecane	629-50-5	93.9510	0.0000	0.3070	0.0000
Total speciated		29208.0208			
Total unspeciated		2397.4080			
Total speciated + unspeciated*		30605.4288			

*Total NMOC with unknowns in $\mu g/m^3$ is an estimate based on propane only.

Appendix H

Supporting Data for Air Toxics Analysis

Table H-1. Greensboro A&T Field Test, January 16-18, 2001
Air Toxics
Laboratory Blank and Field (Ambient) Blank (1/16/01)

Compounds	CAS No.	Laboratory Blank µg/m3	Ambient Air 1/16/01 µg/m3
acetylene	74-86-2	0.22	1.52
propylene	115-07-1	0.04	2.20
dichlorodifluoromethane	75-71-8	0.65	2.45
chloromethane	74-87-3	0.35	0.98
dichlorotetrafluoroethane	1320-37-2	0	0.13
vinyl chloride	75-01-4	0	0
1,3-butadiene	106-99-0	0	0.16
bromomethane	74-83-9	0	0
chloroethane	75-00-3	0	0
acetonitrile	75-05-8	0	0
acetone	67-64-1	0	0
trichlorofluoromethane	75-69-4	0.75	1.56
acrylonitrile	107-13-1	0	0
1,1-dichloroethene	75-35-4	0	0
methylene chloride	75-09-2	0	0.42
trichlorotrifluoroethane	26523-64-8	0	0.65
trans-1,2-dichloroethylene	56-60-5	0	0
1,1-dichloroethane	75-34-3	0	0
methyl *tert*-butyl ether	1634-04-1	0	0.15
methyl ethyl ketone	78-93-3	0	12.31
chloroprene	126-99-8	0	0
cis-1,3-dichloroethylene	156-59-2	0	0
bromochloromethane	74-97-5	0	0
chloroform	67-66-3	0	0
erthyl *tert*-butyl ether	637-92-3	0	0
1,2-dichloroethane	107-06-2	0	0
1,1,1-trichloroethane	71-55-6	0	0
benzene	71-43-2	0.25	1.29
carbon tetrachloride	56-23-5	0	0.53
tert-amyl methyl ether	994-05-8	0.16	0
1,2-dichloropropane	78-87-5	0	0
ethyl acrylate	140-88-5	0	0
bromodichloromethane	75-27-4	0	0
trichloroethylene	79-01-6	0	0
methyl methacrylate	80-62-6	0	0

Table H-1. (Continued)

Compounds	CAS No.	Laboratory Blank µg/m3	Ambient Air 1/16/01 µg/m3
cis-1,2-dichloropropene	10061-01-5	0	0
methyl isobutyl ketone	108-10-1	0	0
trans-1,2-dichloropropene	10061-02-6	0	0
1,1,2-trichloroethane	79-00-5	0	0
toluene	108-88-3	0.42	2.11
dibromochloromethane	124-48-1	0	0
1,2-dibromoethane	106-93-4	0	0
n-octane	111-65-9	0	0.22
tetrachloroethylene	127-18-4	0	0
chlorobenzene	108-90-7	0	0
ethylbenzene	100-41-4	0.10	0.60
m-, *p*-xylene	108-38-3/106-42-3	0.57	3.37
bromoform	75-25-2	0	0
styrene	100-42-5	0	0.11
1,1,2,2-tetrachloroethane	79-34-5	0	0
o-xylene	95-47-6	0.08	0.86
1,3,5-trimethylbenzene	108-67-8	0	0.31
1,2,4-trimethylbenzene	95-63-6	0	0.88
m-dichlorobenzene	541-73-1	0	0
chloromethylbenzene	100-44-7	0	0
p-dichlorobenzene	106-46-7	0	0.10
o-dichlorobenzene	95-50-1	0	0
1,2,4-trichlorobenzene	120-82-1	0	0.28
hexachloro-1,3-butadiene	87-68-3	0	0

Table H-2. A&T Air Toxics Residence Chamber, Dilution, Difference 1/16/01, 1/17/01, 1/18/01

Compounds	CAS No.	Residence Chamber 1/16/01 µg/m³	Dilution Air 1/16/01 µg/m³	Air Toxics RC-DA 1/16/01 µg/m³	Ambient 1/16/01 µg/m³	Residence Chamber 1/17/01 µg/m³	Dilution Air 1/17/01 µg/m³	Air Toxics RC-DA 1/17/01 µg/m³	Residence Chamber 1/18/01 µg/m³	Dilution Air 1/18/01 µg/m³
acetylene	74-86-2	1.77	1.82	-0.05	1.52	4.15	2.88	1.27	2.52	2.53
propylene	115-07-1	3.90	3.82	0.08	2.20	2.21	2.14	0.07	3.01	3.01
dichlorodifluoromethane	75-71-8	3.71	4.02	-0.31	2.45	3.96	4.18	-0.22	4.69	4.78
chloromethane	74-87-3	0.90	0.99	-0.09	0.98	0.77	0.82	-0.05	0.92	0.80
dichlorotetrafluoroethane	1320-37-2	0	0	0	0.13	0	0	0	0	0
vinyl chloride	75-01-4	0	0	0	0	0	0	0	0	0
1,3-butadiene	106-99-0	0	0	0	0.16	0	0	0	0	0
bromomethane	74-83-9	0	0	0	0	0	0	0	0	0
chloroethane	75-00-3	0	0	0	0	0	0	0	0	0
acetonitrile	75-05-8	0	0	0	0	0	0	0	0	0
acetone	67-64-1	0	0	0	0	0	0	0	0	0
trichlorofluoromethane	75-69-4	0.31	0.26	0.05	1.56	0	0.13	-0.13	0	0
acrylonitrile	107-13-1	0	0	0	0	0	0	0	0	0
1,1-dichloroethene	75-35-4	0	0	0	0	0	0	0	0	0
methylene chloride	75-09-2	1.91	1.80	0.11	0.42	2.84	1.84	1	2.88	2.72
trichlorotrifluoroethane	26523-64-8	0	0.21	-0.21	0.65	0	0	0	0	0
trans-1,2-dichloroethylene	56-60-5	0	0	0	0	0	0	0	0	0
1,1-dichloroethane	75-34-3	0	0	0	0	0	0	0	0	0
methyl *tert*-butyl ether	1634-04-1	0	0.22	-0.22	0.15	0	0.11	-0.11	0	0
methyl ethyl ketone	78-93-3	0.90	8.36	-7.46	12.31	0.83	5.38	-4.55	0.35	4.27
chloroprene	126-99-8	0	0	0	0	0	0	0	0	0

Table H-2. (Continued)

Compounds	CAS No.	1/16/01 µg/m³	1/16/01 µg/m³	1/16/01 µg/m³	1/16/01 µg/m³	1/17/01 µg/m³	1/17/01 µg/m³	1/17/01 µg/m³	1/18/01 µg/m³	1/18/01 µg/m³
cis-1,3-dichloroethylene	156-59-2	0	0	0	0	0	0	0	0	0
bromochloromethane	74-97-5	0	0	0	0	0	0	0	0	0
chloroform	67-66-3	0	0	0	0	0	0	0	0	0
ethyl *tert*-butyl ether	637-92-3	0	0.30	-0.3	0	0	0	0	0	0
1,2-dichloroethane	107-06-2	0	0	0	0	0	0	0	0	0
1,1,1-trichloroethane	71-55-6	0	0	0	0	0	0	0	0	0
benzene	71-43-2	0.41	0.22	0.19	1.29	0.48	0.15	0.33	0.22	0.17
carbon tetrachloride	56-23-5	0	0	0	0.53	0	0	0	0	0
tert-amyl methyl ether	994-05-8	0	0.48	-0.48	0	0	0	0	0	0
1,2-dichloropropane	78-87-5	0	0	0	0	0	0	0	0	0
ethyl acrylate	140-88-5	0	0	0	0	0	0	0	0	0
bromodichloromethane	75-27-4	0	0	0	0	0	0	0	0	0
trichloroethylene	79-01-6	0	0	0	0	0	0	0	0	0
methyl methacrylate	80-62-6	0	0	0	0	0	0	0	0	0
cis-1,2-dichloropropene	10061-01-5	0	0	0	0	0	0	0	0	0
methyl isobutyl ketone	108-10-1	0.24	1.70	-1.46	0	0	0	0	0	0
trans-1,2-dichloropropene	10061-02-6	0	0	0	0	0	0	0	0	0
1,1,2-trichloroethane	79-00-5	0	0	0	0	0	0	0	0	0
toluene	108-88-3	0.60	0.52	0.08	2.11	0.42	0.37	0.05	0.30	0.25
dibromochloromethane	124-48-1	0	0	0	0	0	0	0	0	0
1,2-dibromoethane	106-93-4	0	0	0	0	0	0	0	0	0
n-octane	111-65-9	0.18	0	0.18	0.22	0	0.15	-0.15	0	0
tetrachloroethylene	127-18-4	0	0	0	0	0	0	0	0	0
chlorobenzene	108-90-7	0	0	0	0	0	0	0	0	0
ethylbenzene	100-41-4	0.23	0.21	0.02	0.60	0.15	0.13	0.02	0.04	0.11
m-, *p*-xylene	108-38-3/ 106-42-3	1.09	1.21	-0.12	3.37	0.71	0.75	-0.04	0.43	0.65
bromoform	75-25-2	0	0	0	0	0	0	0	0	0
styrene	100-42-5	0	0.27	-0.27	0.11	0	0	0	0	0

Table H-2. (Continued)

Compounds	CAS No.	1/16/01 µg/m³	1/16/01 µg/m³	1/16/01 µg/m³	1/16/01 µg/m³	1/17/01 µg/m³	1/17/01 µg/m³	1/17/01 µg/m³	1/18/01 µg/m³	1/18/01 µg/m³
1,1,2,2-tetrachloroethane	79-34-5	0	0	0	0	0	0	0	0	0
o-xylene	95-47-6	0.21	0.25	-0.04	0.86	0.14	0.10	0.04	0.17	0.17
1,3,5-trimethylbenzene	108-67-8	0.33	0.30	0.03	0.31	0.27	0.14	0.13	0.15	0
1,2,4-trimethylbenzene	95-63-6	0.81	0.63	0.18	0.88	0.57	0.24	0.33	0.29	0.18
m-dichlorobenzene	541-73-1	0	0	0	0	0	0	0	0	0
chloromethylbenzene	100-44-7	0	0	0	0	0	0	0	0	0
p-dichlorobenzene	106-46-7	0	0.12	-0.12	0.10	0	0	0	0	0
o-dichlorobenzene	95-50-1	0	0	0	0	0	0	0	0	0
1,2,4-trichlorobenzene	120-82-1	0	0.44	-0.44	0.28	0	0	0	0	0
hexachloro-1,3-butadiene	87-68-3	0	0.34	-0.34	0	0	0	0	0	0

Table H-3. Greensboro A&T Air Toxics
Air Toxics for Each Day (Residence Chamber - Dilution Air) Compared to Ambient

Compounds	CAS No.	Ambient 1/16/01 µg/m^3	Air Toxics RC-DA 1/16/01 µg/m^3	Air Toxics RC-DA 1/17/01 µg/m^3	Air Toxics RC-DA 1/18/01 µg/m^3
acetylene	74-86-2	1.52	-0.05	1.27	-0.01
propylene	115-07-1	2.20	0.08	0.07	0
dichlorodifluoromethane	75-71-8	2.45	-0.31	-0.22	-0.09
chloromethane	74-87-3	0.98	-0.09	-0.05	0.12
dichlorotetrafluoroethane	1320-37-2	0.13	0	0	0
vinyl chloride	75-01-4	0	0	0	0
1,3-butadiene	106-99-0	0.16	0	0	0
bromomethane	74-83-9	0	0	0	0
chloroethane	75-00-3	0	0	0	0
acetonitrile	75-05-8	0	0	0	0
acetone	67-64-1	0	0	0	0
trichlorofluoromethane	75-69-4	1.56	0.05	-0.13	0
acrylonitrile	107-13-1	0	0	0	0
1,1-dichloroethene	75-35-4	0	0	0	0
methylene chloride	75-09-2	0.42	0.11	1.00	0.16
trichlorotrifluoroethane	26523-64-8	0.65	-0.21	0	0
trans-1,2-dichloroethylene	56-60-5	0	0	0	0
1,1-dichloroethane	75-34-3	0	0	0	0
methyl *tert*-butyl ether	1634-04-1	0.15	-0.22	-0.11	0
methyl ethyl ketone	78-93-3	12.31	-7.46	-4.55	-3.92
chloroprene	126-99-8	0	0	0	0
cis-1,3-dichloroethylene	156-59-2	0	0	0	0
bromochloromethane	74-97-5	0	0	0	0
chloroform	67-66-3	0	0	0	0
erthyl *tert*-butyl ether	637-92-3	0	-0.30	0	0
1,2-dichloroethane	107-06-2	0	0	0	0
1,1,1-trichloroethane	71-55-6	0	0	0	0
benzene	71-43-2	1.29	0.19	0.33	0.05
carbon tetrachloride	56-23-5	0.53	0	0	0
tert-amyl methyl ether	994-05-8	0	-0.48	0	0
1,2-dichloropropane	78-87-5	0	0	0	0
ethyl acrylate	140-88-5	0	0	0	0
bromodichloromethane	75-27-4	0	0	0	0
trichloroethylene	79-01-6	0	0	0	0
methyl methacrylate	80-62-6	0	0	0	0
cis-1,2-dichloropropene	10061-01-5	0	0	0	0
methyl isobutyl ketone	108-10-1	0	-1.46	0	0
trans-1,2-dichloropropene	10061-02-6	0	0	0	0
1,1,2-trichloroethane	79-00-5	0	0	0	0
toluene	108-88-3	2.11	0.08	0.05	0.05

Table H-3. (Continued)

Compounds	CAS No.	1/16/01 µg/m^3	1/16/01 µg/m^3	1/17/01 µg/m^3	1/18/01 µg/m^3
dibromochloromethane	124-48-1	0	0	0	0
1,2-dibromoethane	106-93-4	0	0	0	0
n-octane	111-65-9	0.22	0.18	-0.15	0
tetrachloroethylene	127-18-4	0	0	0	0
chlorobenzene	108-90-7	0	0	0	0
ethylbenzene	100-41-4	0.60	0.02	0.02	-0.07
m-, *p*-xylene	108-38-3/106-42-3	3.37	-0.12	-0.04	-0.22
bromoform	75-25-2	0	0	0	0
styrene	100-42-5	0.11	-0.27	0	0
1,1,2,2-tetrachloroethane	79-34-5	0	0	0	0
o-xylene	95-47-6	0.86	-0.04	0.04	0
1,3,5-trimethylbenzene	108-67-8	0.31	0.03	0.13	0.15
1,2,4-trimethylbenzene	95-63-6	0.88	0.18	0.33	0.11
m-dichlorobenzene	541-73-1	0	0	0	0
chloromethylbenzene	100-44-7	0	0	0	0
p-dichlorobenzene	106-46-7	0.10	-0.12	0	0
o-dichlorobenzene	95-50-1	0	0	0	0
1,2,4-trichlorobenzene	120-82-1	0.28	-0.44	0	0
hexachloro-1,3-butadiene	87-68-3	0	-0.34	0	0

Appendix I

Supporting Data for Carbonyl Analysis

Table I-1. Greensboro A&T Carbonyl Compounds Laboratory (Method) and Field Blanks

Compound	CAS No.	Method Blank µg	Field Blank µg
formaldehyde	50-00-0	0.0695	0.0135
acetaldehyde	75-07-0	0.0800	0.0760
acetone	67-64-1	0.0735	0.0865
propionaldehyde	123-38-6	0	0
crotonaldehyde	4170-30-0	0	0
butyraldehyde	123-72-8	0.0075	0.0140
benzaldehyde	100-52-7	0.0085	0.0025
isovaleraldehyde	590-86-3	0	0
valeraldehyde	110-62-3	0	0
o-tolualdehyde	529-20-4	0	0
m-tolualdehyde	620-23-5	0	0
p-tolualdehyde	104-87-0	0	0
hexaldehyde	66-25-1	0.0235	0.0215
2,5-dimethylbenzaldehyde	5779-94-2	0	0
diacetyl	431-03-8	0	0
methacrolein	78-85-3	0	0
2-butanone	78-93-3	0.0230	0.0230
glyoxal	107-22-2	0.1000	0.1050
acetophenone	98-86-2	0	0
methylglyoxal	78-98-8	0.0310	0.0320
octanal	124-13-0	0.0050	0.0050
nonanal	124-19-6	0.0610	0.0360
Sum, speciated		0.4825	0.4150
Sum, unspeciated		0.4960	0.3380
Total (speciated + unspeciated)		0.9785	0.7530

Table I-2A. Greensboro A&T Carbonyl Compounds
Individual Tube Results
Field Samples (1/16/01)
"No Negs" means that negative values generated from RC-DA have been replaced by "0.0000".

Site ID		**A&T**	**A&T**	**Dilution Air**	**A&T**	**A&T**	**Residence Chamber**	**Carbonyls**	
Field ID		**HD2A1H1T1**	**HD2A2H2T1**	**Paired Tubes**	**HR3A1H1T1**	**HR3A2H2T1**	**Paired Tubes**	**RC-DA**	
Characterization		**DA, FRONT**	**DA, BACK**	**1/16/01**	**RC, FRONT**	**RC, REAR**	**1/16/01**	**1/16/01**	**No Negs**
Sampling Date		**1/16/01**	**1/16/01**		**1/16/01**	**1/16/01**			**Carbonyls**
Analysis Date		**1/31/01**	**1/31/01**		**1/31/01**	**1/31/01**			**RC-DA**
Data File		**F1A%008**	**F1A%009**		**F1A%010**	**F1A%006**			**1/16/01**
Compound	**CAS No.**	**µg**	**µg**	**µg**	**µg**	**µg**	**µg**	**µg**	**µg**
formaldehyde	50-00-0	0.0580	0.0165	0.0745	0.4955	0.1195	0.6150	0.5405	0.5405
acetaldehyde	75-07-0	0.0835	0.1145	0.1980	0.2720	0.0855	0.3575	0.1595	0.1595
acetone	67-64-1	0.1240	0.1020	0.2260	0.2535	0.1050	0.3585	0.1325	0.1325
propionaldehyde	123-38-6	0	0	0.0000	0	0.0000	0.0000	0.0000	0.0000
crotonaldehyde	4170-30-0	0	0	0.0000	0	0.0000	0.0000	0.0000	0.0000
butyraldehyde	123-72-8	0.0250	0.0220	0.0470	0.0430	0.0130	0.0560	0.0090	0.0090
benzaldehyde	100-52-7	0.0175	0.0025	0.0200	0.0450	0.0000	0.0450	0.0250	0.0250
isovaleraldehyde	590-86-3	0	0	0.0000	0	0.0090	0.0090	0.0090	0.0090
valeraldehyde	110-62-3	0.0015	0	0.0015	0	0.0000	0.0000	-0.0015	0.0000
o-tolualdehyde	529-20-4	0.0120	0	0.0120	0	0.0000	0.0000	-0.0120	0.0000
m-tolualdehyde	620-23-5	0.0015	0	0.0015	0	0.0000	0.0000	-0.0015	0.0000
p-tolualdehyde	104-87-0	0	0	0.0000	0	0.0000	0.0000	0.0000	0.0000
hexaldehyde	66-25-1	0.0270	0.0290	0.0560	0.0370	0.0190	0.0560	0.0000	0.0000
2,5-dimethylbenzaldehyde	5779-94-2	0	0	0.0000	0	0.0000	0.0000	0.0000	0.0000
diacetyl	431-03-8	0	0	0.0000	0	0.0000	0.0000	0.0000	0.0000
methacrolein	78-85-3	0	0	0.0000	0	0.0000	0.0000	0.0000	0.0000

Table I-2A. (Continued)

Compound	CAS No.	µg	µg	µg	µg	µg	µg	µg	µg
2-butanone	78-93-3	0.0360	0.0280	0.0640	0.0440	0.0280	0.0720	0.0080	0.0080
glyoxal	107-22-2	0.1040	0.0950	0.1990	0.2730	0.0000	0.2730	0.0740	0.0740
acetophenone	98-86-2	0	0	0.0000	0.0060	0.0000	0.0060	0.0060	0.0060
methylglyoxal	78-98-8	0.0280	0.0420	0.0700	0.0590	0.0290	0.0880	0.0180	0.0180
octanal	124-13-0	0.0160	0.0090	0.0250	0.0140	0.0000	0.0140	-0.0110	0.0000
nonanal	124-19-6	0.1820	0.0610	0.2430	0.1580	0.0520	0.2100	-0.0330	0.0000
Sum, speciated		0.7160	0.5215	1.2375	1.7000	0.4600	2.1600	0.9225	0.9815
Sum, unspeciated		0.4165	0.4565	0.8730	1.0690	0.4685	1.5375	0.6645	0.6645
Total (speciated + unspeciated)		1.1325	0.9780	2.1105	2.7690	0.9285	3.6975	1.5870	1.6460

Table I-2B. Greensboro A&T Carbonyl Compounds
Individual Tube Results
Field Samples (1/17/01)
"No Negs" means that negative values generated from RC-DA have been replaced by "0.0000".

Site ID		A&T	A&T	Dilution Air	A&T	A&T	Residence Chamber	Carbonyls	No Negs
Field ID		HD2A1H1T2	HD2A2H2T2	Paired Tubes	HR3A1H1T2	HR3A2H2T2	Paired Tubes	RC-DA	Carbonyls RC-DA
Characterization		DA, FRONT	DA, BACK	1/17/01	RC, FRONT	RC, REAR	1/17/01	1/17/01	1/17/01
Sampling Date		1/17/01	1/17/01		1/17/01	1/17/01			
Analysis Date		1/31/01	1/31/01		1/31/01	1/31/01			
Data File		F1A%014	F1A%012		F1A%013	F1A%011			
Compound	**CAS No.**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
formaldehyde	50-00-0	0.0350	0.0540	0.0890	0.2480	0.0390	0.2870	0.1980	0.1980
acetaldehyde	75-07-0	0.0900	0.0890	0.1790	0.1780	0.0605	0.2385	0.0595	0.0595
acetone	67-64-1	0.1470	0.0910	0.2380	0.3160	0.0925	0.4085	0.1705	0.1705
propionaldehyde	123-38-6	0.0005	0	0.0005	0.0000	0.0000	0.0000	-0.0005	0.0000
crotonaldehyde	4170-30-0	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
butyraldehyde	123-72-8	0.0280	0.0205	0.0485	0.0395	0.0250	0.0645	0.0160	0.0160
benzaldehyde	100-52-7	0.014	0.0010	0.0150	0.0210	0.0120	0.0330	0.0180	0.0180
isovaleraldehyde	590-86-3	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
valeraldehyde	110-62-3	0	0	0.0000	0.0045	0.0000	0.0045	0.0045	0.0045
o-tolualdehyde	529-20-4	0.0000	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
m-tolualdehyde	620-23-5	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
p-tolualdehyde	104-87-0	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
hexaldehyde	66-25-1	0.0240	0.0210	0.0450	0.0345	0.0240	0.0585	0.0135	0.0135
2,5-dimethylbenzaldehyde	5779-94-2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
diacetyl	431-03-8	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methacrolein	78-85-3	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-butanone	78-93-3	0.0310	0.0250	0.0560	0.0370	0.0270	0.0640	0.0080	0.0080

Table I-2B. (Continued)

Compound	CAS No.	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
glyoxal	107-22-2	0.0960	0.0760	0.1720	0.1470	0.0900	0.2370	0.0650	0.0650
acetophenone	98-86-2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylglyoxal	78-98-8	0.0300	0.0290	0.0590	0.0540	0.0300	0.0840	0.0250	0.0250
octanal	124-13-0	0.0070	0.0000	0.0070	0.0120	0.0100	0.0220	0.0150	0.0150
nonanal	124-19-6	0.0930	0.0500	0.1430	0.1010	0.0540	0.1550	0.0120	0.0120
Sum, speciated		0.5955	0.4565	1.0520	1.1925	0.4640	1.6565	0.6045	0.6050
Sum, unspeciated		0.4355	0.2950	0.7305	0.7260	0.3255	1.0515	0.3210	0.3210
Total (speciated + unspeciated)		1.0310	0.7515	1.7825	1.9185	0.7895	2.7080	0.9255	0.9260

Table I-2C. Greensboro A&T Carbonyl Compounds
Individual Tube Results
Field Samples
(1/18/01)
"No Negs" means that negative values generated from RC-DA have been replaced by "0.0000".

Site ID		A&T	A&T	Dilution Air	A&T	A&T	Residence Chamber	Carbonyls	
Field ID		HD2A1H2T3	HD2A2H2T3	Paired Tubes	HR3A1H1T3	HR3A2H2T3	Paired Tubes	RC-DA	No Negs
Characterization		DA, FRONT	DA, BACK	1/18/01	RC, FRONT	RC, REAR	1/18/01	1/18/01	Carbonyls
Sampling Date		1/18/01	1/18/01		1/18/01	1/18/01			RC-DA
Analysis Date		2/1/01	2/1/01		2/1/01	2/1/01			
Data File		F1A%020	F1A%017		F1A%018	F1A%019			1/18/01
Compound	**CAS No.**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
formaldehyde	50-00-0	0.1025	0.0115	0.1140	0.1970	0.0185	0.2155	0.1015	0.1015
acetaldehyde	75-07-0	0.1530	0.0860	0.2390	0.2110	0.0775	0.2885	0.0495	0.0495
acetone	67-64-1	0.0895	0.1015	0.1910	0.1230	0.1000	0.2230	0.0320	0.0320
propionaldehyde	123-38-6	0	0.0005	0.0005	0.0000	0.0000	0.0000	-0.0005	0.0000
crotonaldehyde	4170-30-0	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
butyraldehyde	123-72-8	0.0375	0.0215	0.0590	0.0460	0.0405	0.0865	0.0275	0.0275
benzaldehyde	100-52-7	0.0105	0.0095	0.0200	0.0100	0.0030	0.0130	-0.0070	0.0000
isovaleraldehyde	590-86-3	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
valeraldehyde	110-62-3	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
o-tolualdehyde	529-20-4	0.0000	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
m-tolualdehyde	620-23-5	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
p-tolualdehyde	104-87-0	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
hexaldehyde	66-25-1	0.0330	0.0215	0.0545	0.0270	0.0245	0.0515	-0.0030	0.0000
2,5-dimethylbenzaldehyde	5779-94-2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
diacetyl	431-03-8	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table I-2C. (Continued)

Compound	CAS No.	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
methacrolein	78-85-3	0	0.0010	0.0010	0.0000	0.0000	0.0000	-0.0010	0.0000
2-butanone	78-93-3	0.0330	0.0260	0.0590	0.0290	0.0340	0.0630	0.0040	0.0040
glyoxal	107-22-2	0.1030	0.1070	0.2100	0.1540	0.1350	0.2890	0.0790	0.0790
acetophenone	98-86-2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
methylglyoxal	78-98-8	0.0360	0.0290	0.0650	0.0360	0.0340	0.0700	0.0050	0.0050
octanal	124-13-0	0.0090	0.0000	0.0090	0.0060	0.0000	0.0060	-0.0030	0.0000
nonanal	124-19-6	0.0780	0.0540	0.1320	0.0690	0.0430	0.1120	-0.0200	0.0000
Sum, speciated		0.6850	0.4690	1.1540	0.9080	0.5100	1.4180	0.2640	0.2985
Sum, unspeciated		0.7620	0.2780	1.0400	1.0645	0.4150	1.4795	0.4395	0.4395
Total (speciated + unspeciated)		1.4470	0.7470	2.1940	1.9725	0.9250	2.8975	0.7035	0.7380

Table I-3A. Greensboro A&T Carbonyls (1/16/01): Uncertainty

Compound	CAS No.	RC-DA 1/16/01 µg	Uncertainty ±	% Total	Uncertainty ±
formaldehyde	50-00-0	0.5405	0.0596	32.8372	3.6187
acetaldehyde	75-07-0	0.1595	0.0018	9.6902	0.1105
acetone	67-64-1	0.1325	0.0056	8.0498	0.3405
propionaldehyde	123-38-6	0.0000	0.0000	0.0000	0.0000
crotonaldehyde	4170-30-0	0.0000	0.0000	0.0000	0.0000
butyraldehyde	123-72-8	0.0090	0.0005	0.5468	0.0319
benzaldehyde	100-52-7	0.0250	0.0008	1.5188	0.0465
isovaleraldehyde	590-86-3	0.0090	0.0012	0.5468	0.0727
valeraldehyde	110-62-3	0.0000	0.0000	0.0000	0.0000
o-tolualdehyde	529-20-4	0.0000	0.0000	0.0000	0.0000
m-tolualdehyde	620-23-5	0.0000	0.0000	0.0000	0.0000
p-tolualdehyde	104-87-0	0.0000	0.0000	0.0000	0.0000
hexaldehyde	66-25-1	0.0000	0.0000	0.0000	0.0000
2,5-dimethylbenzaldehyde	5779-94-2	0.0000	0.0000	0.0000	0.0000
diacetyl	431-03-8	0.0000	0.0000	0.0000	0.0000
methacrolein	78-85-3	0.0000	0.0000	0.0000	0.0000
2-butanone	78-93-3	0.0080	0.0007	0.4860	0.0395
glyoxal	107-22-2	0.0740	0.0020	4.4957	0.1227
acetophenone	98-86-2	0.0060	0.0003	0.3645	0.0174
methylglyoxal	78-98-8	0.0180	0.0022	1.0936	0.1343
octanal	124-13-0	0.0000	0.0000	0.0000	0.0000
nonanal	124-19-6	0.0000	0.0000	0.0000	0.0000
Sum, speciated		0.9815			
Sum, unspeciated		0.6645			
Total (speciated + unspeciated)		1.6460			

Table I-3B. Greensboro A&T Carbonyls (1/17/01): Uncertainty

Compound	CAS No.	RC-DA 1/17/01 µg	Uncertainty ±	% Total	Uncertainty ±
formaldehyde	50-00-0	0.1980	0.0000	21.3823	0.0000
acetaldehyde	75-07-0	0.0595	0.0000	6.4255	0.0000
acetone	67-64-1	0.1705	0.0000	18.4125	0.0000
propionaldehyde	123-38-6	0.0000	0.0000	0.0000	0.0000
crotonaldehyde	4170-30-0	0.0000	0.0000	0.0000	0.0000
butyraldehyde	123-72-8	0.0160	0.0000	1.7279	0.0000
benzaldehyde	100-52-7	0.0180	0.0000	1.9438	0.0000
isovaleraldehyde	590-86-3	0.0000	0.0000	0.0000	0.0000
valeraldehyde	110-62-3	0.0045	0.0000	0.4860	0.0000
o-tolualdehyde	529-20-4	0.0000	0.0000	0.0000	0.0000
m-tolualdehyde	620-23-5	0.0000	0.0000	0.0000	0.0000
p-tolualdehyde	104-87-0	0.0000	0.0000	0.0000	0.0000
hexaldehyde	66-25-1	0.0135	0.0000	1.4579	0.0000
2,5-dimethylbenzaldehyde	5779-94-2	0.0000	0.0000	0.0000	0.0000
diacetyl	431-03-8	0.0000	0.0000	0.0000	0.0000
methacrolein	78-85-3	0.0000	0.0000	0.0000	0.0000
2-butanone	78-93-3	0.0080	0.0000	0.8639	0.0000
glyoxal	107-22-2	0.0650	0.0000	7.0194	0.0000
acetophenone	98-86-2	0.0000	0.0000	0.0000	0.0000
methylglyoxal	78-98-8	0.0250	0.0000	2.6998	0.0000
octanal	124-13-0	0.0150	0.0000	1.6199	0.0000
nonanal	124-19-6	0.0120	0.0000	1.2959	0.0000
Sum, speciated		0.6050			
Sum, unspeciated		0.3210			
Total (speciated + unspeciated)		0.9260			

Table I-3C. Greensboro A&T Carbonyls (1/17/01): Uncertainty

Compound	CAS No.	RC-DA 1/18/01 µg	Uncertainty ±	% Total	Uncertainty ±	Analytical Uncertainty %
formaldehyde	50-00-0	0.1015	0.0112	13.7534	1.5156	11.02
acetaldehyde	75-07-0	0.0495	0.0006	6.7073	0.0765	1.14
acetone	67-64-1	0.0320	0.0014	4.3360	0.1834	4.23
propionaldehyde	123-38-6	0.0000	0.0000	0.0000	0.0000	0.66
crotonaldehyde	4170-30-0	0.0000	0.0000	0.0000	0.0000	2.48
butyraldehyde	123-72-8	0.0275	0.0016	3.7263	0.2176	5.84
benzaldehyde	100-52-7	0.0000	0.0000	0.0000	0.0000	3.06
isovaleraldehyde	590-86-3	0.0000	0.0000	0.0000	0.0000	13.30
valeraldehyde	110-62-3	0.0000	0.0000	0.0000	0.0000	9.58
o-tolualdehyde	529-20-4	0.0000	0.0000	0.0000	0.0000	0
m-tolualdehyde	620-23-5	0.0000	0.0000	0.0000	0.0000	1.3
p-tolualdehyde	104-87-0	0.0000	0.0000	0.0000	0.0000	5.61
hexaldehyde	66-25-1	0.0000	0.0000	0.0000	0.0000	9.3
2,5-dimethylbenzaldehyde	5779-94-2	0.0000	0.0000	0.0000	0.0000	0
diacetyl	431-03-8	0.0000	0.0000	0.0000	0.0000	0
methacrolein	78-85-3	0.0000	0.0000	0.0000	0.0000	5.84
2-butanone	78-93-3	0.0040	0.0003	0.5420	0.0441	8.13
glyoxal	107-22-2	0.0790	0.0022	10.7046	0.2922	2.73
acetophenone	98-86-2	0.0000	0.0000	0.0000	0.0000	4.76
methylglyoxal	78-98-8	0.0050	0.0006	0.6775	0.0832	12.28
octanal	124-13-0	0.0000	0.0000	0.0000	0.0000	0
nonanal	124-19-6	0.0000	0.0000	0.0000	0.0000	8.06
Sum, speciated		0.2985				
Sum, unspeciated		0.4395				
Total (speciated + unspeciated)		0.7380				

Appendix J

Individual PM-2.5 Mass Measurements

Both Campaigns

Table J-1. Oil-Fired Industrial Boiler, Campaign #1, January 2001
PM-2.5 Mass Samples - Gravimetric

Test ID: IB11601H	Initial wt.(g)	Final wt.(g)	Net wt.(g)	Net wt. (mg)
T041700H-IB011601HR2A1	0.17062	0.170859	0.000239	0.239
T041700I-IB011601HR2B1	0.17135	0.171615	0.000265	0.265
T041700J-IB011601HR4A1	0.16779	0.168056	0.000266	0.266
T062700F-IB011601HR4B1	0.170875	0.171201	0.000326	0.326
T041700G-IB011601HD1B1	0.16645	0.166442	-8E-06	-0.008
T070700D-IB011601HFB	0.167936	0.16793	-7E-06	-0.007
Test ID: IB011701H				
T070700C-IB011701HR2A1	0.163246	0.163549	0.000303	0.303
T070700E-IB011701HR2B1	0.167177	0.167481	0.000304	0.304
T062900D-IB011701HR4A1	0.166534	0.166832	0.000298	0.298
T062900F-IB011701HR4B1	0.167457	0.167794	0.000337	0.337
T070700F-IB010701HD1B1	0.162163	0.162156	-7E-06	-0.007
Test ID: IB011801H				
T062900C-IB011801HR2A1	0.167193	0.167591	0.000398	0.398
T062900E-IB011801HR2B1	0.168819	0.169221	0.000402	0.402
T062900A-IB011801HR4A1	0.166356	0.166743	0.000387	0.387
T062900B-IB011801HR4B1	0.158869	0.159277	0.000408	0.408
T070500A-IB011801HD1B1	0.167729	0.167725	-4E-06	-0.004
Test ID: BT011401H				
T063000A-BT011401HR8A1	0.16798	0.167991	0.000011	0.011

Table J-2. ELPI Data, Campaign #2

Filter ID		Tare Mass mg	Final Mass mg	PM Mass mg		Tare Mass mg	Final Mass mg	PM Mass mg	Jul- 9-02	Series 1	Series 2
A062102A	IB070902H ELPI 13	49.403	49.397	-0.006	torn	49.403	49.396	-0.007	13	-0.006	-0.007
A062102B	IB070902H ELPI 12	49.332	49.344	0.012		49.332	49.340	0.008	12	0.012	0.008
A062102C	IB070902H ELPI 11	49.223	49.235	0.012		49.223	49.231	0.008	11	0.012	0.008
A062102D	IB070902H ELPI 10	49.176	49.191	0.015		49.176	49.187	0.011	10	0.015	0.011
A062102E	IB070902H ELPI 9	49.307	49.330	0.023		49.307	49.327	0.020	9	0.023	0.02
A062102F	IB070902H ELPI 8	49.350	49.354	0.004		49.350	49.353	0.003	8	0.004	0.003
A062102G	IB070902H ELPI 7	49.665	49.671	0.006		49.665	49.670	0.005	7	0.006	0.005
A062102H	IB070902H ELPI 6	49.558	49.570	0.012		49.558	49.568	0.010	6	0.012	0.01
A062102I	IB070902H ELPI 5	49.374	49.383	0.009		49.374	49.382	0.008	5	0.009	0.008
A062102J	IB070902H ELPI 4	49.410	49.431	0.021		49.410	49.429	0.019	4	0.021	0.019
A062102K	IB070902H ELPI 3	49.552	49.577	0.025		49.552	49.572	0.020	3	0.025	0.02
A062102L	IB070902H ELPI 2	49.285	49.324	0.039		49.285	49.324	0.039	2	0.039	0.039
A062102M	IB070902H ELPI 1	49.258	49.295	0.037		49.258	49.293	0.035	1	0.037	0.035
A062102N	IB070902H ELPI FB	49.496	49.498	0.002		49.496	49.499	0.003	FB	0.002	0.003

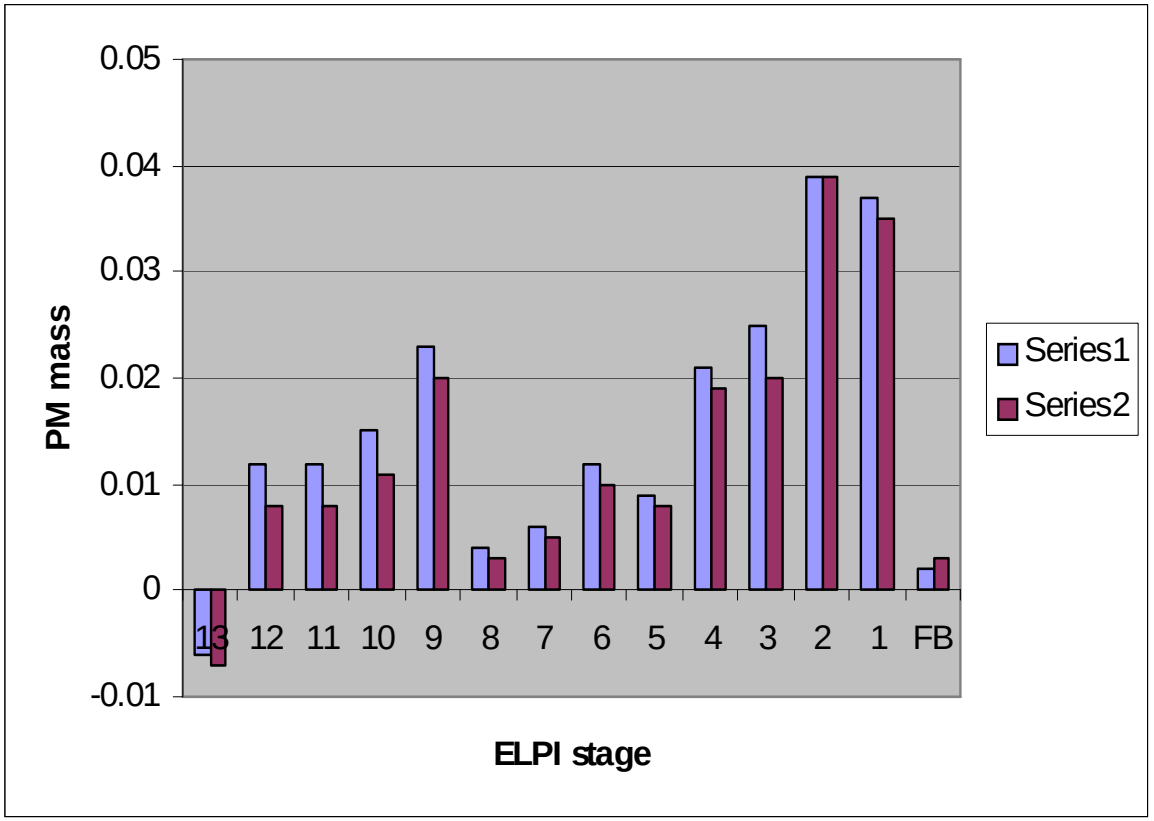


Figure J-1. July 9, 2002 – ELPI Data

Table J-3. ELPI Data – July 10, 2002

Filter ID		Tare Mass mg	Final Mass mg	PM Mass mg		Tare Mass mg	Final Mass mg
A062102P	IB071002H ELPI 12	49.460	49.469	0.009	49.460	49.470	0.010
A062102Q	IB071002H ELPI 11	49.179	49.185	0.006	49.179	49.186	0.007
A062102R	IB071002H ELPI 10	49.359	49.361	0.002	49.359	49.363	0.004
A062102S	IB071002H ELPI 9	49.727	49.737	0.010	49.727	49.737	0.010
A062102T	IB071002H ELPI 8	49.604	49.610	0.006	49.604	49.606	0.002
A062102U	IB071002H ELPI 7	49.333	49.341	0.008	49.333	49.335	0.002
A062102V	IB071002H ELPI 6	49.517	49.524	0.007	49.517	49.522	0.005
A062102W	IB071002H ELPI 5	49.078	49.083	0.005	49.078	49.081	0.003
A062102X	IB071002H ELPI 4	49.068	49.077	0.009	49.068	49.072	0.004
A062102Y	IB071002H ELPI 3	49.315	49.327	0.012	49.315	49.323	0.008
A062102Z	IB071002H ELPI 2	49.472	49.498	0.026	49.472	49.495	0.023
A062402A	IB071002H ELPI 1	49.415	49.433	0.018	49.415	49.451	0.036

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	Series 1	Series 2
13	0.006	0.005
12	0.009	0.01
11	0.006	0.007
10	0.002	0.004
9	0.01	0.01
8	0.006	0.002
7	0.008	0.002
6	0.007	0.005
5	0.005	0.003
4	0.009	0.004
3	0.012	0.008
2	0.026	0.023
1	0.018	0.036

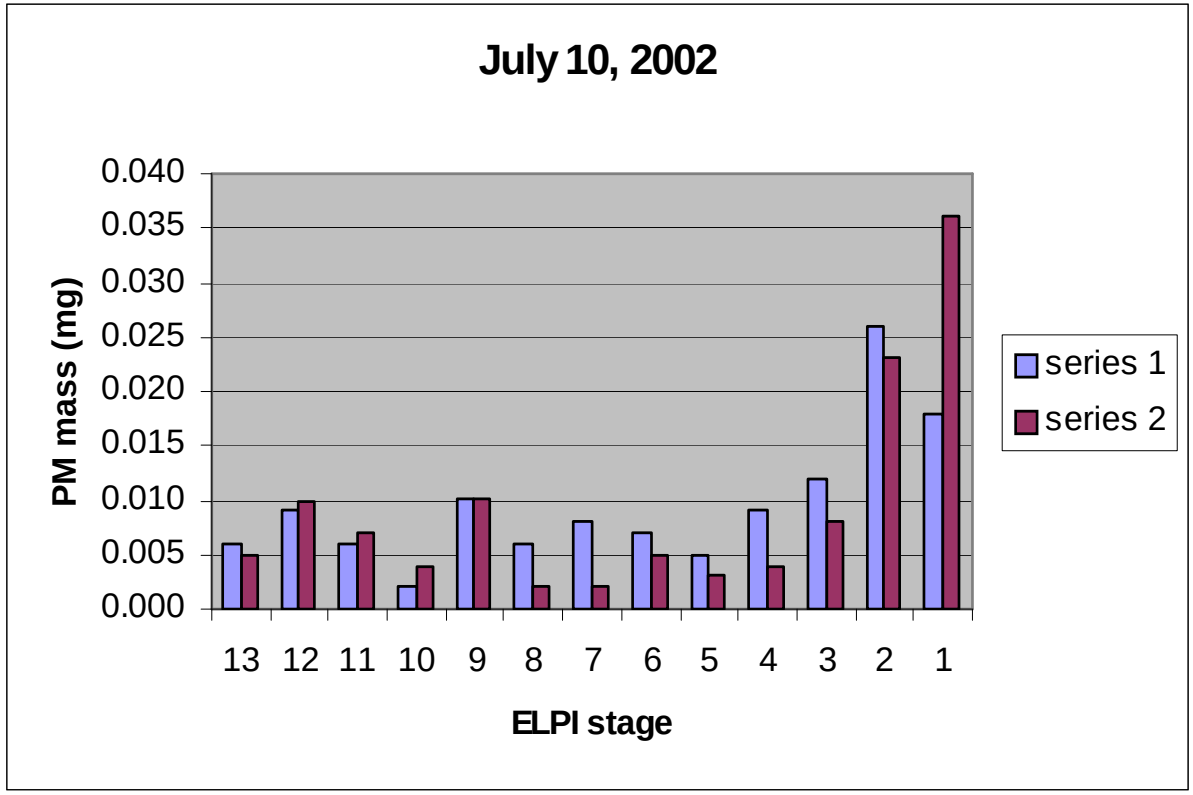

Figure J-2. ELPI Data – July 10, 2002

Table J-4. ELPI Data – July 11, 2002

Filter ID		Tare Mass mg	Final Mass mg	PM Mass mg		Tare Mass mg	Final Mass mg	0.003
A062402C	IB071102H ELPI 12	49.155	49.158	0.003		49.155	49.159	0.004
A062402D	IB071102H ELPI 11	49.342	49.283	-0.059	don't know what happened here - double checked my numbers	49.342	49.282	-0.060
A062402E	IB071102H ELPI 10	49.416	49.419	0.003		49.416	49.417	0.001
A062402F	IB071102H ELPI 9	49.631	49.639	0.008		49.631	49.638	0.007
A062402G	IB071102H ELPI 8	49.454	49.460	0.006		49.454	49.459	0.005
A062402H	IB071102H ELPI 7	49.493	49.498	0.005		49.493	49.497	0.004
A062402I	IB071102H ELPI 6	49.197	49.205	0.008		49.197	49.204	0.007
A062402J	IB071102H ELPI 5	49.672	49.698	0.026		49.672	49.697	0.025
A062402K		49.421			not used	49.421		
A062402L	IB071102H ELPI 3	49.114	49.185	0.071		49.114	49.182	0.068
A062402M	IB071102H ELPI 2	49.504	49.688	0.184		49.504	49.685	0.181
A062402N	IB071102H ELPI 1	49.769	49.870	0.101		49.769	49.870	0.101
A062402O	IB071102H ELPI 4	49.468	49.501	0.033		49.468	49.498	0.030

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	Series 1	Series 2
13	0.003	0.003
12	0.003	0.004
11	-0.059	-0.06
10	0.003	0.001
9	0.008	0.007
8	0.006	0.005
7	0.005	0.004
6	0.008	0.007
5	0.026	0.025
4	0.033	0.03
3	0.071	0.068
2	0.184	0.181
1	0.101	0.101

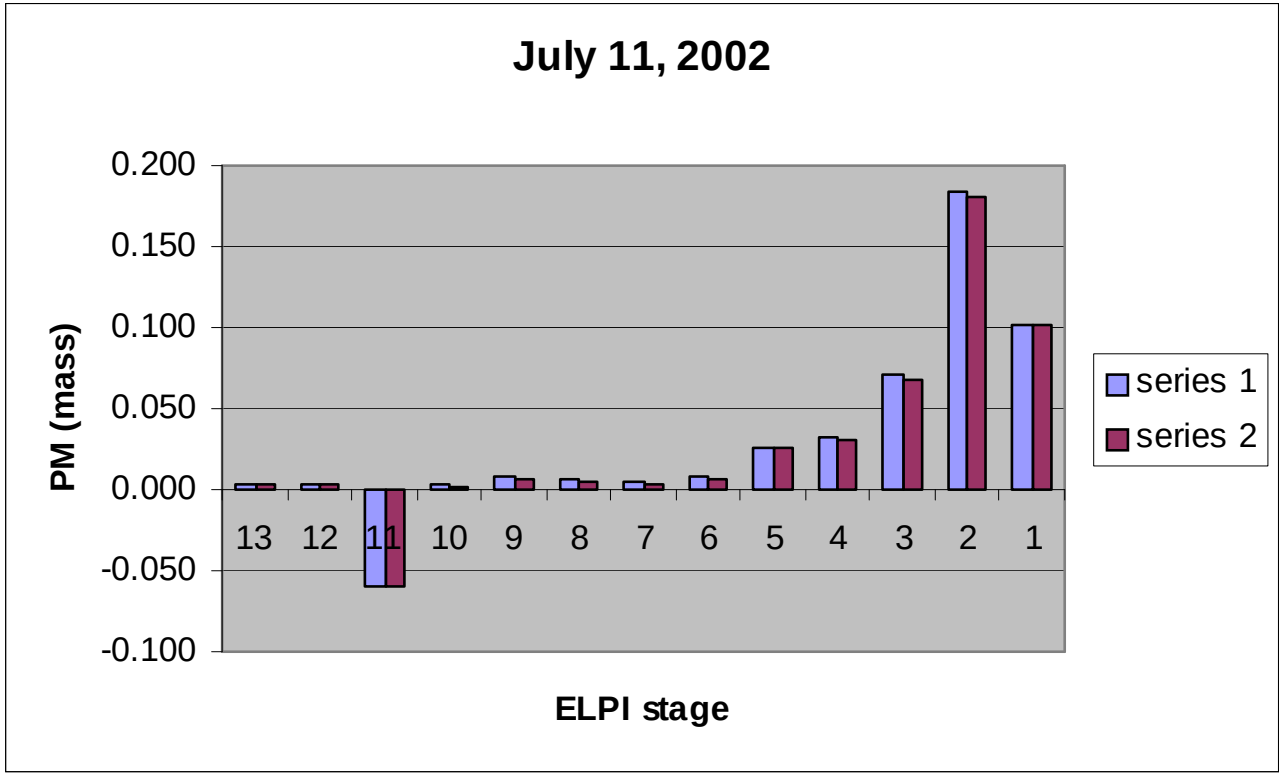

Figure J-3. ELPI Data – July 11, 2002

Table J-5. Oil-Fired Industrial Boiler, Campaign #2, July 2002
PM-2.5 Mass Samples - Gravimetric

Teflon filter ID	PM mass
IB070902HD1B1	0.003
IB070902HR2A1	0.292
IB070902HR2B1	0.284
IB070902HR4A1	0.278
IB070902HR4B1	0.266
IB070902HR5A3	0.120
IB070902HR5B3	0.156
IB070902 - FB	0.006
IB071002HD1B1	0.002
IB071002HR4A1	0.267
IB071002HR4B1	0.270
IB071002HR2A1	0.300
IB071002HR2B1	0.302
IB071002HR5A3	0.135
IB071002HR5B3	0.138
IB071102HR5A3	0.361
IB071102HR5B3	0.357
IB071102HRD1B1	0.005
IB071102HR4A1	1.082
IB071102HR4B1	1.064
IB071102HR2A1	1.176
IB071102HR2B1	1.150

Appendix K

Example Calculations: PM-2.5 Emission Factors

Both Campaigns

Table K-1. Oil-Fired Industrial Boiler, Campaign #1, January 16, 2001
PM-2.5 Mass Emission Factors

	Test	01/16/2001 (individual filters)				Notes
1	Sampling time (min)	600.3				
2	TF sample	T041700H	T041700I	T041700J	T062700F	
3	PM mass on filter (mg)	0.243	0.267	0.267	0.326	
4	Array flow (SLPM)	8.479	8.479	8.479	8.479	
5	PM conc @ filter (mg/L)	0.000048	0.000052	0.000052	0.000064	
6b	PM mass on dilution chamber filter (mg)	0.000				
6c	Array flow (SLPM)	8.442				
6d	PM conc @ dilution air (mg/L)	0.000000				(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000048	0.000052	0.000052	0.000064	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.54				
8	Probe flow (m^3)	11.13				(*7*) x (*1*) /1000
9	Dilution air (SLPM)	847.89				
10	Dilution air (m^3)	508.99				(*9*) x (*1*) /1000
11	Dilution ratio	46.75				((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0022	0.0025	0.0025	0.0030	(*6e*) x (*11*)
13	Stack flow (SCFM)	4065				(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	115120.8				(*17*) x 28.32
15	PM emission rate from stack (mg/min)	259.0	284.6	284.6	347.5	(*12*) x (*14*)
16	Fuel type	#2 Oil				
17	Fuel volumetric feed (gal/min)	3.43				
18	Fuel density (lb/gal)	7.034				
19	Fuel density (kg/gal)	3.19				
20	Fuel mass feed rate (kg/min)	10.94				(17) x (19)
21	Fuel mass feed rate (lb/min)	24.1				(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19374				

Table K-1. (Continued)

	Test	01/16/2001 (individual filters)				Notes
23	Fuel heat feed rate (Btu/min)	467517.0				(*21*) x (*22*)
24	Emission factor (mg/kg)	23.67	26.01	26.01	31.75	(*15*) x 1000 x 0.948 / (23)
25	Emission factor (µg/kJ)	0.53	0.58	0.58	0.70	(*19*) x 1000 x 0.948 / (*30*)
26	Ave. Emission factor (mg/kg)	26.86				
27	Ave. Emission factor (µg/kJ)	0.60				

Table K-2. Oil-Fired Industrial Boiler, Campaign #1, January 17, 2001
PM-2.5 Mass Emission Factors

	Test	01/17/2001 (individual filters)				Notes
1	Sampling time (min)	600.5				
2	TF sample	T070700C	T070700E	T062900D	T062900E	
3	PM mass on filter (mg)	0.303	0.304	0.298	0.337	
4	Array flow (SLPM)	8.580	8.580	8.542	8.542	
5	PM conc @ filter (mg/L)	0.000059	0.000059	0.000058	0.000066	
6b	PM mass on dilution chamber filter (mg)	0.000				
6c	Array flow (SLPM)	8.656				
6d	PM conc @ dilution air (mg/L)	0.000000				(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000059	0.00059	0.000058	0.000066	(*6a*) - (*6d*)
7	Probe flow (SLPM)	17.88				
8	Probe flow (m^3)	10.74				(*7*) x (*1*) /1000
9	Dilution air (SLPM)	848.35				
10	Dilution air (m^3)	509.43				(*9*) x (*1*) /1000
11	Dilution ratio	48.45				((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0028	0.0029	0.0028	0.0032	(*6e*) x (*11*)
13	Stack flow (SCFM)	4159				
14	Stack flow (SLPM)	117782.9				(*13*) x 28.32
15	PM emission rate from stack (mg/min)	360.8	362.0	356.4	403.1	(*12*) x (*14*)
16	Fuel type	#2 Oil				
17	Fuel volumetric feed (gal/min)	3.62				
18	Fuel density (lb/gal)	7.034				
19	Fuel density (kg/gal)	3.19				
20	Fuel mass feed rate (kg/min)	11.5				(17) x (19)
21	Fuel mass feed rate (lb/min)	25.5				(*20*) x 2.205

Table K-2. (Continued)

	Test		01/17/2001 (individual filters)			Notes
22	Fuel heating value (Btu/lb)	19374				
23	Fuel heat feed rate (Btu/min)	493318.2				(*21*) x (*22*)
24	Emission factor (mg/kg)	31.24	31.35	30.86	34.90	(15) / (*20*)
25	Emission factor (µg/kJ)	0.69	0.70	0.68	0.77	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	32.09				
27	Ave. Emission factor (µg/kJ)	0.71				

Table K-3. Oil-Fired Industrial Boiler, Campaign #1,
January 18, 2001
PM-2.5 Mass Emission Factors

	Test	01/18/2001 (individual filters)				Notes
1	Sampling time (min)	600.1				
2	TF sample	T062900C	T062900E	T062900A		T062900B
3	PM mass on filter (mg)	0.398	0.402	0.387	0.408	
4	Array flow (SLPM)	8.489	8.489	8.489	8.489	
5	PM conc @ filter (mg/L)	0.000078	0.000079	0.000076	0.000080	
6b	PM mass on dilution chamber filter (mg)	0.000				
6c	Array flow (SLPM)	8.564				
6d	PM conc @ dilution air (mg/L)	0.000000				(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000078	0.000079	0.000076	0.000080	(*6a*) - (*6d*)
7	Probe flow (SLPM)	19.01				
8	Probe flow (m^3)	11.41				(*7*) x (*1*) /1000
9	Dilution air (SLPM)	850.66				
10	Dilution air (m^3)	510.48				(*9*) x (*1*) /1000
11	Dilution ratio	45.75				((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0036	0.0036	0.0035	0.0037	(*6e*) x (*11*)
13	Stack flow (SCFM)	4827				(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	136700				(*17*) x 28.32
15	PM emission rate from stack (mg/min)	524.3	529.6	509.8	537.5	(*12*) x (*14*)
16	Fuel type	#2 Oil				
17	Fuel volumetric feed (gal/min)	4.14				
18	Fuel density (lb/gal)	7.034				
19	Fuel density (kg/gal)	3.19				
20	Fuel mass feed rate (kg/min)	13.2				(17) x (19)
21	Fuel mass feed rate (lb/min)	29.1				(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19374				

Table K-3. (Continued)

	Test	01/18/2001 (individual filters)				Notes
23	Fuel heat feed rate (Btu/min)	564181.6				(*21*) x (*22*)
24	Emission factor (mg/kg)	39.70	40.10	38.60	40.70	(15) / (*20*)
25	Emission factor (µg/kJ)	0.88	0.89	0.86	0.90	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	39.77				
27	Ave. Emission factor (µg/kJ)	0.88				

Table K-4. Oil-Fired Industrial Boiler - Campaign #2 (July 9, 2002) --Undenuded PM-2.5 Mass Emission Factors

	Test	07/09/2002 (individual filters)				Notes
1	Sampling time (min)	600.6				
2	TF sample	1007993	1007994	1007995	1008951	
3	PM mass on filter (mg)	0.292	0.284	0.278	0.266	
4	Array flow (SLPM)	8.251	8.251	8.106	8.106	
5	PM conc @ filter (mg/L)	0.000059	0.000057	0.000057	0.000055	
6b	PM mass on dilution chamber filter (mg)	0.003				
6c	Array flow (SLPM)	8.215				
6d	PM conc @ dilution air (mg/L)	0.0000006				(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000058	0.000057	0.000056	0.000054	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.85				
8	Probe flow (m3)	11.32				(*7*) x (*1*) /1000
9	Dilution air (SLPM)	816.28				
10	Dilution air (m3)	490.26				(*9*) x (*1*) /1000
11	Dilution ratio	44.30				((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0026	0.0025	0.0025	0.0024	(*6e*) x (*11*)
13	Stack flow (SCFM)	3935				(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	11439				(*17*) x 28.32
15	PM emission rate from stack (mg/min)	308.9	300.4	299.3	286.2	(*12*) x (*14*)
16	Fuel type	#2 Oil				
17	Fuel volumetric feed (gal/min)	2.32				
18	Fuel density (lb/gal)	7.034				
19	Fuel density (kg/gal)	3.19				
20	Fuel mass feed rate (kg/min)	7.4				(17) x (19)
21	Fuel mass feed rate (lb/min)	16.3				(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19193				

Table K-4. (Continued)

	Test	07/09/2002 (individual filters)				Notes
23	Fuel heat feed rate (Btu/min)	313267.1				(*21*) x (*22*)
24	Emission factor (mg/kg)	41.73	40.58	40.43	38.67	(15) / (*20*)
25	Emission factor (ug/kJ)	0.93	0.91	0.91	0.87	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	40.35				
27	Ave. Emission factor (ug/kJ)	0.90				

Table K-5. Oil-Fired Industrial Boiler - Campaign #2 (July 10, 2002) – Undenuded – PM-2.5 Mass Emission Factors

	Test	07/10/2002 (individual filters)				Notes
1	Sampling time (min)	600.67				
2	TF sample	1008958	1008959	1008956	1008957	
3	PM mass on filter (mg)	0.3	0.302	0.267	0.27	
4	Array flow (SLPM)	8.183	8.183	8.075	8.075	
5	PM conc @ filter (mg/L)	0.000061	0.000061	0.000055	0.000056	
6b	PM mass on dilution chamber filter (mg)	0.002				
6c	Array flow (SLPM)	8.203				
6d	PM conc @ dilution air (mg/L)	0.0000004				(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000061	0.000061	0.000055	0.000055	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.79				
8	Probe flow (m3)	11.29				(*7*) x (*1*) /1000
9	Dilution air (SLPM)	814.43				
10	Dilution air (m3)	489.20				(*9*) x (*1*) /1000
11	Dilution ratio	44.34				((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0027	0.0027	0.0024	0.0025	(*6e*) x (*11*)
13	Stack flow (SCFM)	4066				(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	115149				(*17*) x 28.32
15	PM emission rate from stack (mg/min)	332.1	334.4	299.3	302.7	(*12*) x (*14*)
16	Fuel type	#2 Oil				
17	Fuel volumetric feed (gal/min)	2.33				
18	Fuel density (lb/gal)	7.034				
19	Fuel density (kg/gal)	3.19				
20	Fuel mass feed rate (kg/min)	7.4				(17) x (19)
21	Fuel mass feed rate (lb/min)	16.4				(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19193				
23	Fuel heat feed rate (Btu/min)	314556.1				(*21*) x (*22*)

Table K-5. (Continued)

	Test	07/10/2002 (individual filters)				Notes
24	Emission factor (mg/kg)	44.68	44.98	40.27	40.73	(15) / (20)
25	Emission factor (ug/kJ)	1.00	1.01	0.90	0.91	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	42.67				
27	Ave. Emission factor (ug/kJ)	0.96				

Table K-6. Oil-Fired Industrial Boiler - Campaign #2 (July 11, 2002) --Undenuded PM-2.5 Mass Emission Factors

	Test	07/11/2002 (individual filters)				Notes
1	Sampling time (min)	600				
2	TF sample	1008967	1008968	1008965	1008966	
3	PM mass on filter (mg)	1.176	1.15	1.082	1.064	
4	Array flow (SLPM)	8.276	8.276	8.058	8.058	
5	PM conc @ filter (mg/L)	0.000237	0.000232	0.000224	0.000220	
6b	PM mass on dilution chamber filter (mg)	0.005				
6c	Array flow (SLPM)	8.203				
6d	PM conc @ dilution air (mg/L)	0.0000010				(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000236	0.000231	0.000223	0.000219	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.78				
8	Probe flow (m3)	11.27				(*7*) x (*1*) /1000
9	Dilution air (SLPM)	824.70				
10	Dilution air (m3)	494.82				(*9*) x (*1*) /1000
11	Dilution ratio	44.91				((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0106	0.0104	0.0100	0.0098	(*6e*) x (*11*)
13	Stack flow (SCFM)	4270				(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	120926				(*17*) x 28.32
15	PM emission rate from stack (mg/min)	1374.2	1343.7	1298.2	1276.5	(*12*) x (*14*)
16	Fuel type	#2 Oil				
17	Fuel volumetric feed (gal/min)	2.33				
18	Fuel density (lb/gal)	7.034				
19	Fuel density (kg/gal)	3.19				
20	Fuel mass feed rate (kg/min)	7.43				(17) x (19)
21	Fuel mass feed rate (lb/min)	16.4				(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19193				
23	Fuel heat feed rate (Btu/min)	314556.1				(*21*) x (*22*)
24	Emission factor (mg/kg)	184.88	180.78	174.66	171.74	(15) / (20)

Table K-6. (Continued)

	Test	07/11/2002 (individual filters)				Notes
25	Emission factor (ug/kJ)	4.14	4.05	3.91	3.85	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	178.02				
27	Ave. Emission factor (ug/kJ)	3.99				

Table K-7. Oil-Fired Industrial Boiler - Campaign #2 (July 9, 2002) – Denuded – PM-2.5 Mass Emission Factors

	Test	07/09/2002 (individual filters)		Notes
1	Sampling time (min)	600.6		
2	TF sample	1008952	1008953	
3	PM mass on filter (mg)	0.12	0.156	
4	Array flow (SLPM)	4.518	4.518	
5	PM conc @ filter (mg/L)	0.000044	0.000057	
6b	PM mass on dilution chamber filter (mg)	0.003		
6c	Array flow (SLPM)	8.215		
6d	PM conc @ dilution air (mg/L)	0.0000006		(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000044	0.000057	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.85		
8	Probe flow (m3)	11.32		(*7*) x (*1*) /1000
9	Dilution air (SLPM)	816.28		
10	Dilution air (m3)	490.26		(*9*) x (*1*) /1000
11	Dilution ratio	44.30		((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0019	0.0025	(*6e*) x (*11*)
13	Stack flow (SCFM)	4065		(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	115121		(*17*) x 28.32
15	PM emission rate from stack (mg/min)	231.0	301.3	(*12*) x (*14*)
16	Fuel type	#2 Oil		
17	Fuel volumetric feed (gal/min)	2.32		
18	Fuel density (lb/gal)	7.034		
19	Fuel density (kg/gal)	3.19		
20	Fuel mass feed rate (kg/min)	7.4		(17) x (19)
21	Fuel mass feed rate (lb/min)	16.3		(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19193		
23	Fuel heat feed rate (Btu/min)	313267.1		(*21*) x (*22*)
24	Emission factor (mg/kg)	31.21	40.71	(15) / (*20*)

Table K-7. (Continued)

	Test	07/09/2002 (individual filters)		Notes
25	Emission factor (ug/kJ)	0.70	0.91	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	35.96		
27	Ave. Emission factor (ug/kJ)	0.81		

Table K-8. Oil-Fired Industrial Boiler - Campaign #2 (July 10, 2002) – Denuded – PM-2.5 Mass Emission Factors

	Test	07/10/2002 (individual filters)		Notes
1	Sampling time (min)	600.67		
2	TF sample	1008960	1008961	
3	PM mass on filter (mg)	0.135	0.138	
4	Array flow (SLPM)	4.593	4.593	
5	PM conc @ filter (mg/L)	0.000049	0.000050	
6b	PM mass on dilution chamber filter (mg)	0.002		
6c	Array flow (SLPM)	8.203		
6d	PM conc @ dilution air (mg/L)	0.0000004		(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000049	0.000050	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.79		
8	Probe flow (m3)	11.29		(*7*) x (*1*) /1000
9	Dilution air (SLPM)	814.43		
10	Dilution air (m3)	489.20		(*9*) x (*1*) /1000
11	Dilution ratio	44.34		((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0022	0.0022	(*6e*) x (*11*)
13	Stack flow (SCFM)	4066		(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	115149		(*17*) x 28.32
15	PM emission rate from stack (mg/min)	265.8	271.8	(*12*) x (*14*)
16	Fuel type	#2 Oil		
17	Fuel volumetric feed (gal/min)	2.33		
18	Fuel density (lb/gal)	7.034		
19	Fuel density (kg/gal)	3.19		
20	Fuel mass feed rate (kg/min)	7.4		(17) x (19)
21	Fuel mass feed rate (lb/min)	16.4		(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19193		
23	Fuel heat feed rate (Btu/min)	314556.1		(*21*) x (*22*)
24	Emission factor (mg/kg)	35.77	36.57	(15) / (*20*)

Table K-8. (Continued)

	Test	07/10/2002 (individual filters)		Notes
25	Emission factor (ug/kJ)	0.80	0.82	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	36.17		
27	Ave. Emission factor (ug/kJ)	0.81		

Table K-9. Oil-Fired Industrial Boiler - Campaign #2 (July 11, 2002) – Denuded– PM-2.5 Mass Emission Factors

	Test	07/11/2002 (individual filters)		Notes
1	Sampling time (min)	600		
2	TF sample	1008962	1008963	
3	PM mass on filter (mg)	0.361	0.357	
4	Array flow (SLPM)	4.573	4.573	
5	PM conc @ filter (mg/L)	0.000132	0.000130	
6b	PM mass on dilution chamber filter (mg)	0.005		
6c	Array flow (SLPM)	8.203		
6d	PM conc @ dilution air (mg/L)	0.0000010		(*6b*) / (*6c*)
6e	Net PM mass conc after dilution (mg/L)	0.000131	0.000129	(*6a*) - (*6d*)
7	Probe flow (SLPM)	18.78		
8	Probe flow (m3)	11.27		(*7*) x (*1*) /1000
9	Dilution air (SLPM)	824.70		
10	Dilution air (m3)	494.82		(*9*) x (*1*) /1000
11	Dilution ratio	44.91		((*8*) + (*10*)) / (*8*)
12	PM conc @ stack (mg/L)	0.0059	0.0058	(*6e*) x (*11*)
13	Stack flow (SCFM)	4270		(*13*) x (*16*) x 528/(460+(*14*)) x ((*15*)/29.92)
14	Stack flow (SLPM)	120926		(*17*) x 28.32
15	PM emission rate from stack (mg/min)	760.8	752.3	(*12*) x (*14*)
16	Fuel type	#2 Oil		
17	Fuel volumetric feed (gal/min)	2.33		
18	Fuel density (lb/gal)	7.034		
19	Fuel density (kg/gal)	3.19		

Table K-9. (Continued)

	Test	07/11/2002 (individual filters)		Notes
20	Fuel mass feed rate (kg/min)	7.4		(17) x (19)
21	Fuel mass feed rate (lb/min)	16.4		(*20*) x 2.205
22	Fuel heating value (Btu/lb)	19193		
23	Fuel heat feed rate (Btu/min)	314556.1		(*21*) x (*22*)
24	Emission factor (mg/kg)	102.36	101.21	(15) / (*20*)
25	Emission factor (ug/kJ)	2.29	2.27	(*15*) x 1000 x 0.948 / (23)
26	Ave. Emission factor (mg/kg)	101.78		
27	Ave. Emission factor (ug/kJ)	2.28		

EPA/600/R-07/005
February 2007

Source Sampling Fine Particulate Matter

Institutional Oil-Fired Boiler

Appendix L through Appendix P

Appendix L

Individual PM-2.5 EC/OC Measurements

Both Campaigns

Table L-1. Oil-Fired Institutional Boiler. Organic/Elemental Carbon Content of PM-2.5 Both Campaigns

Campaign	Campaign #1			Campaign #2		
Test Day	**1/16/01**	**1/17/01**	**1/18/01**	**7/9/02**	**7/10/02**	**7/11/02**
Test time (min)	600.33	600.5	600.17	600.6	600.67	600.0
OC concentration after dilution (μg/L)	-0.00736	0.00031	-0.00018	0.002453	0.002397	0.001394
EC concentration after dilution (μg/L)	0.00094	0.00630	0.02675	0.000300	0.000218	0.000137
PM-2.5 mass emission factor (mg/kg)	30.18	36.06	44.68	45.46	48.06	200.51
OC mass emission factor (mg/kg)	-4.10	0.19	-0.10	42.58	43.98	157.20
EC mass emission factor (mg/kg)	0.52	3.76	15.27	2.98	1.85	3.40
OC/PM-2.5 (%)	-13.8	0.5	-0.2	43.3	45.2	63.1
EC/PM-2.5 (%)	1.8	10.5	34.0	6.6	3.8	1.7
(OC + EC)/PM-2.5 (%)	1.8	11.1	34.0	49.9	49.0	64.8

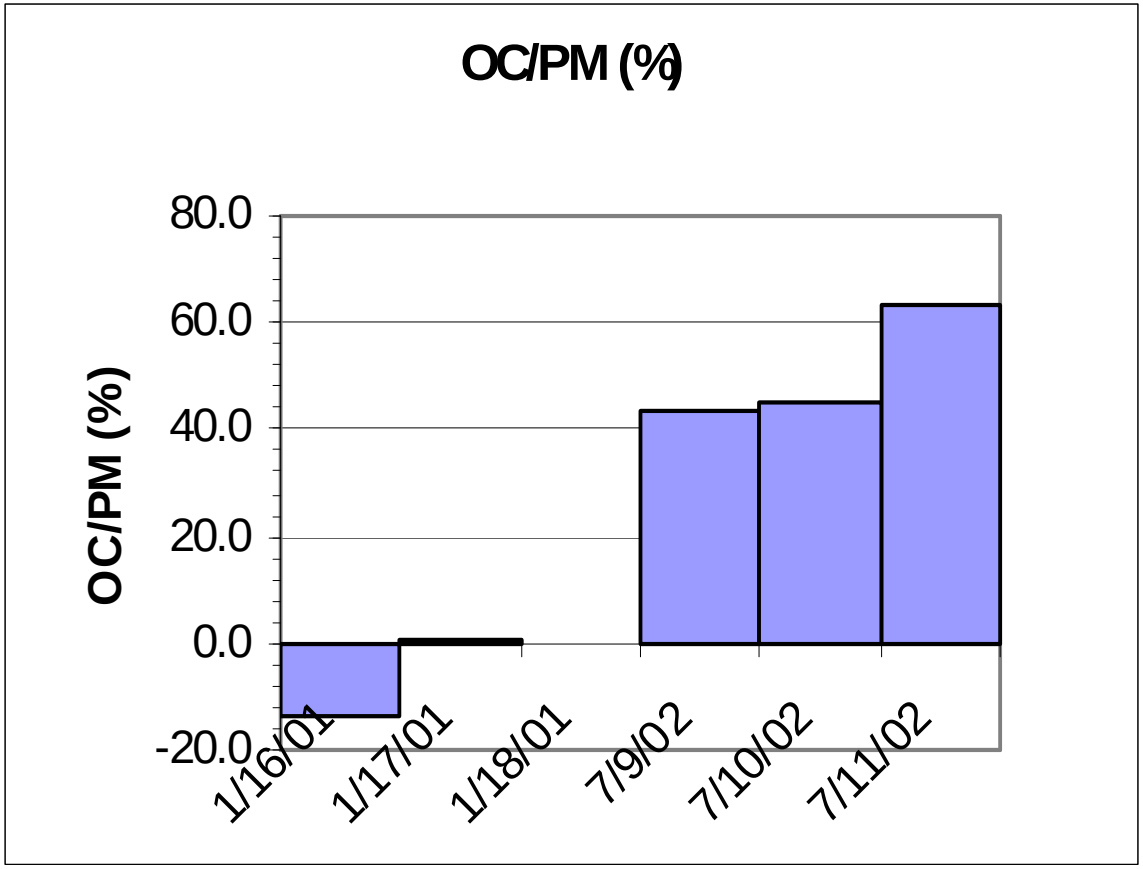

Figure L-1. OC as Percentage of PM

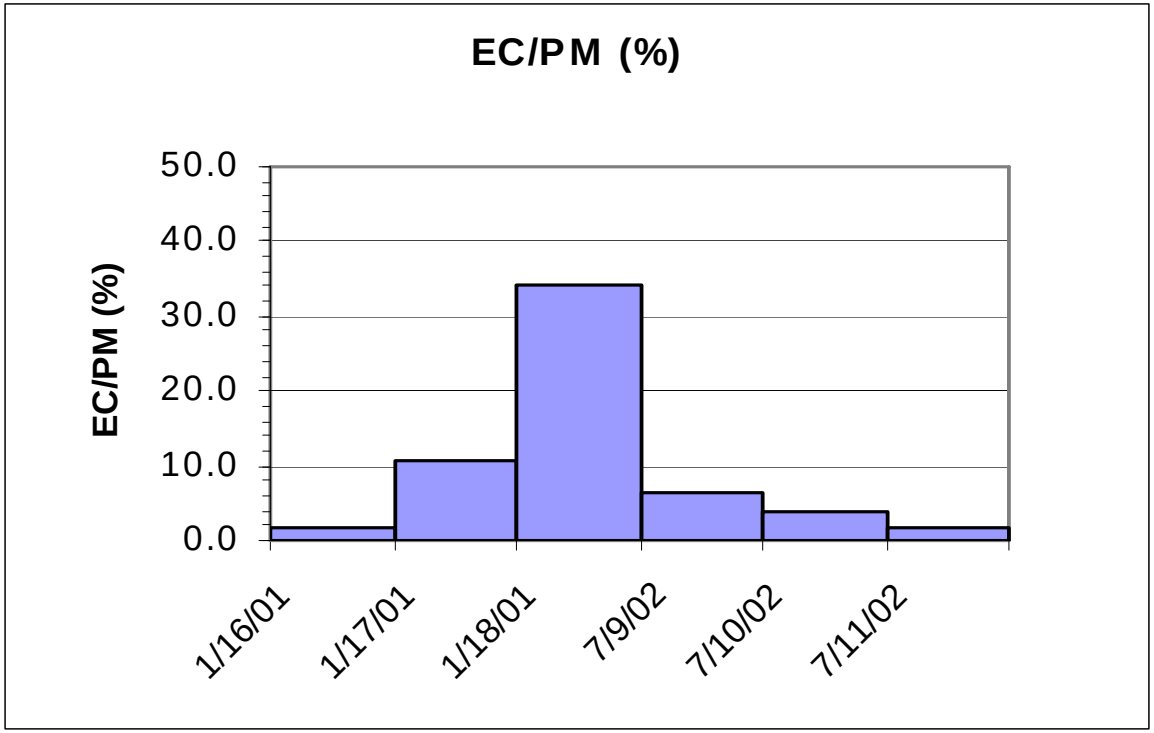

Figure L-2. EC as Percentage of PM

Table L-2. Organic and Inorganic Carbons for NC A&T Boiler Campaign #1 (1/16/01 - 1/18/01)

Test	Day 1	Day 2	Day 3
Date	1/16/01	1/17/01	1/18/01
Sampling Time (min)	600.33	600.5	600.17
OC on filter (μg/cm^2)	0.31	2.39	2.37
EC on filter (μg/cm^2)	0.59	2.51	10.31
Array flow (sLpm)	8.255	8.242	8.489
OC concentration at filter (μg/L)	0.000841	0.006495	0.006257
EC concentration at filter (μg/L)	0.001601	0.006821	0.027217
OC on dilution chamber filter (μg/cm^2)	3.09	2.39	2.46
EC on dilution chamber filter (μg/cm^2)	0.25	0.20	0.18
Array flow (sLpm)	8.442	8.656	8.564
OC concentration at dilution air (μg/L)	0.008201	0.006184	0.006437
EC concentration at dilution air (μg/L)	0.000636	0.000518	0.000471
Net OC concentration after dilution (μg/L)	-0.007359	0.000310	-0.000181
Net EC concentration after dilution (μg/L)	0.000938	0.006303	0.026746
Probe flow (sLpm)	18.54	17.88	19.01
Dilution air (sLpm)	847.887	848.349	850.660
Dilution ratio	46.75	48.45	45.75
OC concentration at the stack (μg/L)	-0.3440	0.0150	-0.0083
EC concentration at the stack (μg/L)	0.0438	0.3054	1.2236
Stack flow (scfm)	4065	4159	4827
Stack flow (sLpm)	115121	117783	136701
OC emission rate from stack (mg/min)	-39.9	1.91	-1.21
EC emission rate from stack (mg/min)	5.09	38.68	179.48
Fuel type	No. 2 Oil	No. 2 Oil	No. 2 Oil
Fuel volumetric feed (gal/min)	3.43	3.62	4.14

Table L-2. (Continued)

Date	1/16/01	1/17/01	1/18/01
Fuel density (kg/gal)	3.19	3.19	3.19
Fuel mass feed rate (kg/min)	10.94	11.55	13.20
OC mass emission factor (mg/kg)	-3.65	0.16	-0.09
EC mass emission factor (mg/kg)	0.46	3.35	13.59
PM concentration at stack (mg/L0	0.0025	0.0029	0.0036
OC/PM (%)	-13.8	0.5	-0.2
EC/PM (%)	1.8	10.5	34.0

Table L-3. Organic and Inorganic Carbons for NC A&T Boiler Campaign #2 (7/9/02 - 7/11/02)

Test	Day 1			Day 2			Day 3		
Date	7/9/02			7/10/02			7/11/02		
Sampling Time (min)		600.6			600.67			600.0	
Quartz Filter Sample	1	2	3	1	2	3	1	2	3
OC on filter ($\mu g/cm^2$)	20.42	21.04	19.55	20.58	21.35	18.87	67.37	67.54	63.21
EC on filter ($\mu g/cm^2$)	1.77	1.30	1.34	1.03	0.86	0.80	1.59	1.38	1.43
Array flow (sLpm)	8.215	8.288	8.215	8.219	8.183	8.183	8.276	8.239	8.239
OC concentration at filter ($\mu g/L$)	0.05567	0.05685	0.05329	0.05607	0.05842	0.05164	0.18248	0.18376	0.17198
EC concentration at filter ($\mu g/L$)	0.00483	0.00351	0.00365	0.00281	0.00235	0.00219	0.00431	0.00375	0.00389
Average OC concentration at filter ($\mu g/L$)		0.055271			0.055375			0.179408	
Average OC concentration at filter - corrected ($\mu g/L$)		0.026871			0.028875			0.144708	
Average EC concentration at filter ($\mu g/L$)		0.003997			0.002449			0.003984	
OC on dilution chamber filter ($\mu g/cm^2$)		0.90			0.88			0.51	
EC on dilution chamber filter ($\mu g/cm^2$)		0.11			0.08			0.05	
Array flow (sLpm)		8.215			8.219			8.203	
OC concentration at dilution air ($\mu g/L$)		0.002453			0.002397			0.001394	
EC concentration at dilution air ($\mu g/L$)		0.000300			0.000218			0.000137	

Table L-3. (Continued)

Test	Day 1	Day 2	Day 3
Date	7/9/02	7/10/02	7/11/02
Net OC concentration after dilution (µg/L)	0.024417	0.026477	0.143315
Net EC concentration after dilution (µg/L)	0.003697	0.002232	0.003847
Probe flow (sLpm)	18.85	18.79	18.78
Dilution air (sLpm)	816.280	814.430	824.700
Dilution ratio	44.30	44.34	44.91
OC concentration at the stack (µg/L)	1.0818	1.1741	6.4368
EC concentration at the stack (µg/L)	0.1638	0.0990	0.1728
Stack flow (scfm)	4065	4159	4827
Stack flow (sLpm)	115121	117783	136701
OC emission rate from stack (mg/min)	129.3	145.0	835.1
EC emission rate from stack (mg/min)	19.58	12.22	22.42
Fuel type	No. 2 Oil	No. 2 Oil	No. 2 Oil
Fuel volumetric feed (gal/min)	2.32	2.33	2.33
Fuel density (kg/gal)	3.19	3.19	3.19
Fuel mass feed rate (kg/min)	7.40	7.43	7.43
OC mass emission factor (mg/kg)	17.48	19.51	112.36
EC mass emission factor (mg/kg)	2.65	1.64	3.02
PM concentration at stack (mg/L)	0.0025	0.0026	0.0102

Table L-3. (Continued)

Test Date	Day 1 7/9/02	Day 2 7/10/02	Day 3 7/11/02
OC/PM (%)	43.3	45.2	63.1
EC/PM (%)	6.6	3.8	1.7

Note: OC collected on quartz filter was corrected for gas-phase OC adsorption by subtracting OC found on quartz filter behind a Teflon filter

Table L-4. Campaign #2 July 9, 2002, Organic/Elemental Carbon Samples
NIOSH 5040 Method

ID	IB070902H									
	D1B1	D1A1	R2A1	R2B1	R4A1	R4B1	R6A1	R8A1	R10A1	
Time min	600.6									Test data
dilu.PM mg	0.003									PM on filter D1B1
Flow slpm	8.215025									Flow for D1B1
dilu.PM ug/L	0.001									dilu.PM ug/L = dilu. PM mg *1000/(D1B1.Flow slpm * Time min)
res.PM mg			0.292	0.284	0.278	0.266				PM on each res.filter
Flow slpm			8.251	8.251	8.106	8.106				Flow for each res.filter
res. PM ug/L			0.058	0.057	0.056	0.054				res. PM ug/L = res.PM mg*1000 /(Flow slpm * Time min) - dilu.PM ug/L]
ave.res.PM ug/L			0.056							Average of res.PM ug/L
dilu.OC ug/cm2		0.9								OC reading
dilu.EC ug/cm2		0.11								EC reading
dilu.OC ug		12.11								dilu.OC ug = dilu.OC ug/cm2 * 13.45 where 13.45 cm2 is total aera of QF
dilu.EC ug		1.48								dilu.EC ug = dilu.EC ug/cm2 * 13.45
Flow slpm		8.215								Flow for D1A1
dilu.OC ug/L		0.002								dilu.OC ug/L = dilu.OC ug / (D1A1.Flow slpm * Time min)
dilu.EC ug/L		0.000								dilu.EC ug/L = dilu.EC ug / (D1A1.Flow slpm * Time min)
OC ug/cm2							20.42	21.04	19.55	OC reading
EC ug/cm2							1.77	1.3	1.34	EC reading
Flow slpm							8.215	8.288	8.215	Flows for R4A1 and R10A1
OC ug							274.649	282.988	262.9475	OC ug = OC ug/cm2 * 13.45
EC ug							23.81	17.49	18.02	EC ug = EC ug/cm2 * 13.45

Table L-4. (Continued)

	D1B1	D1A1	R2A1	R2B1	R4A1	R4B1	R6A1	R8A1	R10A1	
OC ug/L							0.025	0.026	0.022	OC ug/L = OC ug / (Flow slpm * Time min) - dilu.OC ug/L - correction for OC on backup filter
EC ug/L							0.005	0.003	0.003	EC ug/L = EC ug / (Flow slpm * Time min) - dilu.EC ug/L
OC/PM wt%							44.0	45.9	39.6	OC/PM wt% = OC ug/L / ave.res.PM ug/L *100
EC/PM wt%							8.0	5.7	5.9	EC/PM wt% = EC ug/L / ave.res.PM ug/L*100
							43.2			ave wt % OC
							6.6			Ave wt% EC

Table L-5. Oil-Fired Institutional Boiler, Campaign #2, July 10, 2002 Organic/Elemental Carbon Samples - NIOSH 5040 Method

ID	IB071002H D1B1	D1A1	R2A1	R2B1	R4A1	R4B1	R6A1	R8A1	R10A1	
Time min	600.67									Test data
dilu.PM mg	0.002									PM on filter D1B1
Flow slpm	8.219									Flow for D1B1
dilu.PM ug/L	0.000									dilu.PM ug/L = dilu. PM mg *1000/(D1B1.Flow slpm * Time min)
res.PM mg			0.300	0.302	0.267	0.270				PM on each res.filter
Flow slpm			8.183	8.183	8.075	8.075				Flow for each res.filter
res. PM ug/L			0.061	0.061	0.055	0.055				res. PM ug/L = res.PM mg*1000 /(Flow slpm * Time min) - dilu.PM ug/L]
ave.res.PM ug/L			0.058							Average of res.PM ug/L
dilu.OC ug/cm2		0.88								OC reading
dilu.EC ug/cm2		0.08								EC reading
dilu.OC ug		11.84								dilu.OC ug = dilu.OC ug/cm2 * 13.45 where 13.45 cm2 is total aera of QF
dilu.EC ug		1.08								dilu.EC ug = dilu.EC ug/cm2 * 13.45
Flow slpm		8.219								Flow for D1A1
dilu.OC ug/L		0.002								dilu.OC ug/L = dilu.OC ug / (D1A1.Flow slpm * Time min)
dilu.EC ug/L		0.000								dilu.EC ug/L = dilu.EC ug / (D1A1.Flow slpm * Time min)
OC ug/cm2							20.58	21.35	18.87	OC reading
EC ug/cm2							1.03	0.86	0.8	EC reading
Flow slpm							8.219	8.183	8.183	Flows for R4A1 and R10A1
OC ug							276.801	287.1575	253.8015	OC ug = OC ug/cm2 * 13.45

Table L-5. (Continued)

ID	IB071002H D1B1	D1A1	R2A1	R2B1	R4A1	R4B1	R6A1	R8A1	R10A1	
EC ug							13.85	11.57	10.76	EC ug = EC ug/cm2 * 13.45
OC ug/L							0.027	0.030	0.023	OC ug/L = OC ug / (Flow slpm * Time min) - dilu.OC ug/L
EC ug/L							0.003	0.002	0.002	EC ug/L = EC ug / (Flow slpm * Time min) - dilu.EC ug/L
OC/PM wt%							46.9	51.0	39.3	OC/PM wt% = OC ug/L / ave.res.PM ug/L *100
EC/PM wt%							4.5	3.7	3.4	EC/PM wt% = EC ug/L / ave.res.PM ug/L*100
							45.7			ave wt % OC
							3.9			Ave wt% EC

Table L-6. Oil-Fired Institutional Boiler, Campaign #2, July11, 2002 Organic/Elemental Carbon Samples - NIOSH 5040 Method

ID	IB071102H									
	D1B1	D1A1	R2A1	R2B1	R4A1	46B1	R6A1	R8A1	R10A1	
Time min	600									Test data
dilu.PM mg	0.005									PM on filter D1B1
Flow slpm	8.203									Flow for D1B1
dilu.PM ug/L	0.001									dilu.PM ug/L = dilu. PM mg *1000/(D1B1.Flow slpm * Time min)
res.PM mg			1.176	1.150	1.082	1.064				PM on each res.filter
Flow slpm			8.276	8.276	8.058	8.058				Flow for each res.filter
res. PM ug/L			0.236	0.231	0.223	0.219				res. PM ug/L = res.PM mg*1000 /(Flow slpm * Time min) -dilu.PM ug/L]
ave.res.PM ug/L			0.227							Average of res.PM ug/L
dilu.OC ug/cm2		0.51								OC reading
dilu.EC ug/cm2		0.05								EC reading
dilu.OC ug		6.86								dilu.OC ug = dilu.OC ug/cm2 * 13.45 where 13.45 cm2 is total aera of QF
dilu.EC ug		0.67								dilu.EC ug = dilu.EC ug/cm2 * 13.45
Flow slpm		8.203								Flow for D1A1
dilu.OC ug/L		0.001								dilu.OC ug/L = dilu.OC ug / (D1A1.Flow slpm * Time min)
dilu.EC ug/L		0.000								dilu.EC ug/L = dilu.EC ug / (D1A1.Flow slpm * Time min)
OC ug/cm2							67.37	67.54	63.21	OC reading
EC ug/cm2							1.59	1.38	1.43	EC reading
Flow slpm							8.276	8.239	8.239	Flows for R4A1 and R10A1
OC ug							906.1265	908.413	850.1745	OC ug = OC ug/cm2 * 13.45

Table L-6. (Continued)

ID	IB071102H								
	D1B1	**D1A1**	**R2A1**	**R2B1**	**R4A1**	**46B1**	**R6A1**	**R8A1**	**R10A1**	
EC ug							21.39	18.56	19.23	EC ug = EC ug/cm2 * 13.45
OC ug/L							0.146	0.148	0.136	OC ug/L = OC ug / (Flow slpm * Time min) - dilu.OC ug/L
EC ug/L							0.004	0.004	0.004	EC ug/L = EC ug / (Flow slpm * Time min) - dilu.EC ug/L
OC/PM wt%							64.5	65.0	59.8	OC/PM wt% = OC ug/L / ave.res.PM ug/L *100
EC/PM wt%							1.8	1.6	1.7	EC/PM wt% = EC ug/L / ave.res.PM ug/L*100
										ave wt % OC
										Ave wt% EC

Appendix M

Individual PM-2.5 Elemental Measurements

Both Campaigns

Table M-1. Campaign #1 Elemental Analysis
WXDRF Data

Oil-Fired Institutional Boiler, Campaign #1, January 2001
Elemental Analysis Samples - XRF

Element	T041700G IB011601 HD1B1	T041700H IB011601 HR2A1	T041701 IB01 1601 HR2B1	T070700F IB011701 HD1B1	T070700C IB011701HR 2A1	T070700E IB011701 HR2B1	T070500A IB011801 HD1B1	T062900C IB011801 HR2A1	T062900E IB011801 HR2B1
S (wt%PM mass)	ND	6.72	3.62	<3e	3.27	3.61	0.01	4.09	12.53
mg on filter		0.016	0.010		0.010	0.011	0.000	0.016	0.050
PM mass (mg)		0.243	0.267		0.303	0.304	0.001	0.398	0.402
sample flow rate		8.479	8.479		8.58	8.58	8.564	8.489	8.489
DR		46.81	46.81		48.67	48.67	45.91	45.91	45.91
Time (min)		600.33	600.33		600.5	600.5	600.17	600.17	600.17
stack flow (cfm)		4065	4065		4159	4159	4827	4827	4827
stack flow (SLPM)		115121	115121		117783	117783	136701	136701	136701
fuel mass (kg)		6565	6565		6925.5	6925.5	7914.4	7914.4	7914.4
emission factor (mg/kg)		1.67	0.99		1.00	1.11	0.00	1.47	4.54

All elements above atomic number 9 were analyzed.
Sulfur was the only element found in an amount at least one standard error above detection limit

Table M-2. Campaign #1 Elemental Analysis
ED and WD Data

	T041700G IB011601H D1B1		T041700H IB011601 HR2A1		T041701 IB011601 HR2B1		T070700F IB011701 HD1B1		T070700C IB011701 HR2A1		T070700E IB011701 HR2B1		T070500A IB011801 HD1B1		T062900C IB011801 HR2A1		T062900E IB011801 HR2B1	
Element	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**	**WD**	**ED**
S	ND		6.72	20.13	3.62	18.97	<3e		3.27	17.44	3.61	18.60	0.01		4.09	14.56	12.53	14.79
Ca				0.05		0.06				0.04		0.04				0.03		0.02
Ti												0.03				0.02		0.02
Fe				0.03								0.03				0.07		0.05
Ce				0.05														

Table M-3. Campaign #1 Elemental Analyses
WD Second, Third Runs

Element	T082101E Blank 2		T082101F Blank 3		T082101G Blank 4		T082101D Blank 1	T041700F Blank D			
	A	B	A	B	A	B	A	A	ave.	ave A	ave B
Mg	32.4	27	31	28.6	31	24.4	26.5	33	29.24	30.78	26.67
Si	94.8	92.3	76.2	81.3	93.5	84.1	84.7	76.6	85.44	85.16	85.90
S	24.5	28.7	15.7	13.6	17.8	16.7	14.1	32.4	20.44	20.9	19.67
Sx	18.8	19.8	13.6	15.7	15.1	15.1	18.3	31.3	18.46	19.42	16.87
Cl	79.8	64.3	37.3	32.7	28	28.5	40.4	39.9	43.86	45.08	41.83
Ar	46.5	38.2	40.8	45.5	39.3	36.7	34.6	35.1	39.59	39.26	40.13
Ca	30.1	28	20.2	32.2	21.3	19.7	16.6	24.4	24.06	22.52	26.63
Cr	655.9	636.7	614.4	625	638.7	618.4	644.8	621.5	631.93	635.06	626.70
Mn	48.1	40	45.1	34.9	42.5	44.6	38.5	38.5	41.53	42.54	39.83
Fe	984.9	944	964.7	963.2	942.5	917.7	935.9	956.1	951.13	956.82	941.63
Ni	38.8	36.3	40.9	39.8	44.4	47.9	33.3	38.8	40.03	39.24	41.33
Cu	27.2	16.1	18.6	25.7	19.6	18.1	24.7	23.7	21.71	22.76	19.97
Sr	6.13	5.62	6.13	7.15	6.13	6.64	4.6	3.06	5.68	5.21	6.47
Zr	3.59	6.15	4.61	4.61	3.59	6.66	7.17	2.05	4.80	4.202	5.81
Nb	4.11	5.13	3.08	7.19	4.62	4.62	2.05	5.13	4.49	3.798	5.65
Mo	3.09	4.63	5.66	2.06	1.54	4.63	4.11	3.6	3.67	3.6	3.77
Px	7.37	8.42	12.1	8.95	2.63	10	5.26	8.42	7.89	7.156	9.12
P	11.1	11.6	7.37	8.95	12.6	10	9.47	6.32	9.68	9.372	10.18
V	16.2	15.7	15.7	14.1	12.1	13.1	13.6	12.6	14.14	14.04	14.30
Hg	8.59	6.07	6.07	5.56	7.58	5.06	6.07	8.09	6.64	7.28	5.56
Pu	5.11	7.15	2.04	5.62	2.55	5.11	5.11	4.6	4.66	3.882	5.96
Ga	9.08	10.1	12.1	6.56	8.57	9.08	7.57	7.06	8.77	8.876	8.58
Ir	6.56	10.1	4.54	10.6	6.05	8.07	6.56	10.6	7.89	6.862	9.59
Ba	13.5	12.5	17.6	13.5	11.9	12.5	9.86	15	13.30	13.572	12.83
Na	25.4	24	17.4	13.9	16	15.7	17	17	18.30	18.56	17.87
Re	5.06	7.08	4.55	8.6	7.58	8.09	4.55	8.6	6.76	6.068	7.92

These are the data from the oil-fired boiler samples. I ran these filters two extra times with only an Al mask rather than the plastic I have used in the past and that I used for the first analysis of these samples on the other sheet. Filters where the data do not appear twice broke during, or prior to analysis.
Blanks - intensities

Table M-4. Campaign #1 Elemental Analyses
WD Second and Third Runs

Element	T041700G IB011601HD1B1	T041700H IB011601HR2A1		T041701 IB011601HR2B1	T070700F IB011701HD1B1	T070700C IB011701HR2A1			T070700E IB011701HR2B1			T070500A IB011801HD1B1			T062900C IB011801HR2A1			T062900E IB011801HR2B1		
		A	C	A		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Mg			0.03																	
Si			0.06																	
Sx	NA	6.72	4.59	3.62	NA	3.27	2.5	2.3	3.6	2.59	2.37	0.01	0.01	0.02	4.09	3.01	2.85	12.53	11.09	9.73

Table M-5. Campaign #2 Elemental Analysis
Oil-Fired Institutional Burner

Element	Blank 1 Peak	Blank 2 intensity	Blank 3 intensity	Blank 4 intensity	Blank 4b intensity	Blank 5 intensity	Blank 5b intensity	dilution intensity	Mean	Standard deviation	% RSD
Na	12.2	15.3	14.3	14	13.9	16.8	16.9	13.4	14.60	1.6	11.2
Mg	28.2	30.1	32	44	27.7	35.8	33.9	30.7	32.80	5.3	16.1
Al	106.7	78.5	261.9	560.7	151.4	311.3	287.5	17.4	221.93	172.9	77.9
Si	44.4	5934	52.2	47.6	67.5	53.2	69.1	70	57.93	10.1	17.4
P	6.18	10.3	4.64	7.22	6.23	6.18	9.35	4.68	6.85	2.0	29.8
P/PO_4^{-3}	7.73	5.67	9.28	6.18	5.19	5.15	8.31	10.9	7.30	2.1	28.9
S	14.8	16.9	12.3	12.3	24.1	18.9	22.6	17.4	17.41	4.4	25.1
S/SO_4^{-2}	11.7	13.8	10.7	14.3	20.5	26.6	25.6	12.8	17.00	6.3	37.3
Cl	29.9	33.4	41.5	34.4	38.5	39.5	40.5	52.6	38.79	6.9	17.7
Ar	66.9	64.4	67.9	67.4	63.7	65.9	71.2	72.7	67.51	3.1	4.6
K	18	18.5	23.6	19	16	18.5	20	25	19.83	3.0	15.2
Ca	16.5	17.5	18	18.5	21.9	23.5	20.9	40.3	22.14	7.7	34.9
Ti	19.8	24.3	30.2	21.3	23.2	20.3	17.8	36.1	24.13	6.1	25.4
V	16.4	10.8	16.4	13.3	14.4	14.9	13.8	26.2	15.78	4.6	29.0
Cr	589	585.4	542.9	550.1	559.9	515.8	542	604.4	561.9	29.6	5.3
Mn	47	35.7	43.4	63.8	44.4	58.2	60.7	52.5	50.71	9.7	19.2
Fe	846.6	867	813	817.5	861.5	854.7	848.8	927.1	854.53	35.2	4.1

Table M-5. (Continued)

Element	Blank 1 Peak	Blank 2 intensity	Blank 3 intensity	Blank 4 intensity	Blank 4b intensity	Blank 5 intensity	Blank 5b intensity	dilution intensity	Mean	Standard deviation	% RSD
Ni	31.4	41.1	33	36.5	41.5	42.6	48.6	46.1	40.10	6.1	15.1
Cu	18.7	21.8	217.2	329.1	19.1	22.3	17.2	28.8	84.28	120.4	142.9
Zn	7.07	9.6	18.7	15.2	10.6	11.6	12.1	15.1	12.50	3.7	29.5
Ga	6.55	7.55	8.56	13.6	8.56	6.04	9.06	10.1	8.75	2.4	27.0
Br	7.08	5.06	4.55	4.55	6.57	5.06	8.59	8.09	6.19	1.6	26.1
Sr	5.58	6.09	5.07	6.6	6.56	4.57	4.06	8.62	5.89	1.4	24.3
Mo	3.05	2.03	5.59	3.56	2.54	4.57	5.08	1.52	3.49	1.5	42.2
Rh	1.52	2.03	2.54	3.55	2.03	1.52	1.52	3.55	2.28	0.9	37.6
Cd	4.06	2.54	5.07	5.58	3.55	1.01	5.58	2.54	3.74	1.6	44.0

Note: values in shaded cells are outliers.

Table M-5. (Continued)

Element	Blank 1 Peak	Blank 2 intensity	Blank 3 intensity	Blank 4 intensity	Blank 4b intensity	Blank 5 intensity	Blank 5b intensity	dilution intensity	Mean	Standard deviation	%RSD
Na	12.2	15.3	14.3	14	13.9	16.8	16.9	13.4	14.60	1.6	11.2
Mg	28.2	30.1	32	44	27.7	35.8	33.9	30.7	32.80	5.3	16.1
Al	106.7		261.9		151.4	311.3	287.5		223.76	89.6	40.0
Si	44.4	59.4	52.2	47.6	67.5	53.2	69.1	70	57.93	10.1	17.4
P	6.18	10.3	4.64	7.22	6.23	6.18	9.35	4.68	6.85	2.0	29.8
P/PO_4^{-3}	7.73	5.67	9.28	6.18	5.19	5.15	8.31	10.9	7.30	2.1	28.9
S	14.8	16.9	12.3	12.3	24.1	18.9	22.6	17.4	17.41	4.4	25.1
S/SO_4^{-2}	11.7	13.8	10.7	14.3	20.5	26.6	25.6	12.8	17.00	6.3	37.3
Cl	29.9	33.4	41.5	34.4	38.5	39.5	40.5	52.6	38.79	6.9	17.7
Ar	66.9	64.4	67.9	67.4	63.7	65.9	71.2	72.7	67.51	3.1	4.6
K	18	18.5	23.6	19	16	18.5	20	25	19.83	3.0	15.2
Ca	16.5	17.5	18	18.5	21.9	23.5	20.9		19.54	2.6	13.2
Ti	19.8	24.3	30.2	21.3	23.2	20.3	17.8		22.41	4.1	18.1
V	16.4	10.8	16.4	13.3	14.4	14.9	13.8		14.29	1.9	13.6
Cr	589	585.4	542.9	550.1	559.9	515.8	542	604.4	561.9	29.6	5.3
Mn	47	35.7	43.4	63.8	44.4	58.2	60.7	52.5	50.71	9.7	19.2
Fe	846.6	867	813	817.5	861.5	854.7	848.8	927.1	854.53	35.2	4.1
Ni	31.4	41.1	33	36.5	41.5	42.6	48.6	46.1	40.10	6.1	15.1

Table M-5. (Continued)

Element	Blank 1 Peak	Blank 2 intensity	Blank 3 intensity	Blank 4 intensity	Blank 4b intensity	Blank 5 intensity	Blank 5b intensity	dilution intensity	Mean	Standard deviation	%RSD
Cu	18.7	21.8			19.1	22.3	17.2	28.8	21.32	4.1	19.4
Zn	7.07	9.6	18.7	15.2	10.6	11.6	12.1	15.1	12.50	3.7	29.5
Ga	6.55	7.55	8.56	13.6	8.56	6.04	9.06	10.1	8.75	2.4	27.0
Br	7.08	5.06	4.55	4.55	6.57	5.06	8.59	8.09	6.19	1.6	26.1
Sr	5.58	6.09	5.07	6.6	6.56	4.57	4.06	8.62	5.89	1.4	24.3
Mo	3.05	2.03	5.59	3.56	2.54	4.57	5.08	1.52	3.49	1.5	42.2
Rh	1.52	2.03	2.54	3.55	2.03	1.52	1.52	3.55	2.28	0.9	37.6
Cd	4.06	2.54	5.07	5.58	3.55		5.58	2.54	4.13	1.3	32.0

Note: Shaded areas indicate outliers.

Table M-6. Campaign #2 Elemental, wt% results
NC A&T, Test #2
July, 2002

		IB070902HR2A1		
Units		**EDXRF**		**WDXRF**
		ng/cm^2	**wt%**	**wt%**
Si	CONC	193.8	0.893338	0.85
Si	UNC	25.6		
P	CONC	5		
P	UNC	12.4		
S	CONC	532.5	2.454606	2.55
S	UNC	43.2		
K	CONC	9.2	0.04208	
K	UNC	2.1		
Ca	CONC	21.9	0.10095	
Ca	UNC	2.3		
Cr	CONC	1.4		
Cr	UNC	0.9		
Fe	CONC	18.9	0.09	
Fe	UNC	2.4		
Cu	CONC	2.7		
Cu	UNC	1.2		
Zn	CONC	20.6		
Zn	UNC	3.4		

Table M-6. (Continued)

		IB070902HR2B1		
Units		**EDXRF**		**WDXRF**
		ng/cm²	**wt%**	**wt%**
Si	CONC	230.3	1.09	0.934
Si	UNC	28.4		
P	CONC	5.9		
P	UNC	13		
S	CONC	638.5	3.03	2.86
S	UNC	50.4		
K	CONC	7.4	0.04	
K	UNC	2		
Ca	CONC	29.9	0.14	0.292
Ca	UNC	2.7		
Cr	CONC	2.4		
Cr	UNC	0.9		
Fe	CONC	18.1	0.09	
Fe	UNC	2.4		
Cu	CONC	3.4		
Cu	UNC	1.3		
Zn	CONC	64	0.30	
Zn	UNC	6.4		

Table M-6. (Continued)

		IB071002HR2A1		
Units		**EDXRF**		**WDXRF**
		ng/cm^2	**wt%**	**wt%**
Si	CONC	163.5	0.73	0.716
Si	UNC	24.7		
P	CONC	11.5		
P	UNC	13.6		
S	CONC	868.4	3.90	3.62
S	UNC	66.8		
K	CONC	1.9		
K	UNC	1.9		
Ca	CONC	3.5	0.02	
Ca	UNC	1.7		
Cr	CONC	0.4		
Cr	UNC	0.9		
Fe	CONC	7.5		
Fe	UNC	1.7		
Cu	CONC	6.6	0.03	
Cu	UNC	1.4		
Zn	CONC	0.1		
Zn	UNC	2.3		

Table M-6. (Continued)

		IB071002HR2B1		
Units		**EDXRF**		**WDXRF**
		ng/cm^2	**wt%**	**wt%**
Si	CONC	194.5	0.87	0.777
Si	UNC	25.8		
P	CONC	-18.2		
P	UNC	12.9		
S	CONC	931.7	4.15	3.81
S	UNC	71.2		
K	CONC	-0.9		
K	UNC	1.8		
Ca	CONC	5.4	0.02	
Ca	UNC	1.7		
Cr	CONC	10	0.04	
Cr	UNC	1.3		
Fe	CONC	36.6	0.16	
Fe	UNC	3.7		
Cu	CONC	6.9	0.03	
Cu	UNC	1.5		
Zn	CONC	4.1		
Zn	UNC	2.5		

Table M-6. (Continued)

		IB071102HR2A1		
Units		**DXRF**		**WDXRF**
		ng/cm^2	**wt%**	**wt%**
Si	CONC	255.6	0.29	0.242
Si	UNC	33.9		
P	CONC	4.1		
P	UNC	15.2		
S	CONC	1271.5	1.46	1.36
S	UNC	100.2		
K	CONC	7	0.01	
K	UNC	1.9		
Ca	CONC	5.7	0.01	
Ca	UNC	1.7		
Cr	CONC	9.2	0.01	
Cr	UNC	1.2		
Fe	CONC	41.2	0.05	
Fe	UNC	3.9		
Cu	CONC	5.9	0.01	
Cu	UNC	1.4		
Zn	CONC	00.5		
Zn	UNC	2.3		

Table M-6. (Continued)

		IB071102HR2B1		
Units		**EDXRF**		**WDXRF**
		ng/cm^2	**wt%**	**wt%**
Si	CONC	181.2	0.21	0.244
Si	UNC	28.5		
P	CON	20.2		
P	UNC	14.3		
S	CONC	1180.8	1.38	1.28
S	UNC	93.3		
K	CONC	-0.1		
K	UNC	1.7		
Ca	CONC	5.1		
Ca	UNC	1.7	0.01	
Cr	CONC	-0.4		
Cr	UNC	0.9		
Fe	CONC	10.4		
Fe	UNC	1.9		
Cu	CONC	6	0.01	
Cu	UNC	1.4		
Zn	CONC	2.1	0.01	
Zn	UNC	2.2		

Table M-7. OAQPS Samples
Background Corrected

	1008978	1008981	1008984	OAQPS 071102 Port 2 Position 1
Na		0.085		
Si		0.118	0.0223	
S	0.528	0.877	0.583	

Table M-8. Campaign #2 Elemental Comparison
Oil-Fired Institutional Boiler
Campaign #2, July 2002
XRF (Both Energy and Wavelength Dispersive)

	IB070902HR2A1			IB070902HR2B1		
Element	**EDXRF wt%**	**WDXRF wt%**	**% diff**	**EDXRF wt%**	**WDXRF wt%**	**% diff**
Si	0.893338	0.85	4.9	1.09	0.934	14.4
S	2.454606	2.55	-3.9	3.03	2.86	5.5
K	0.042408			0.04		
Ca	0.10095			0.14	0.292	
Cr						
Fe	0.09			0.09		
Cu						
Zn				0.30		

Table M-8. (Continued)

Element	IB071001HR2A1			IB071002HR2B1		
	EDXRF wt%	WDXRF wt%	% diff	EDXRF wt%	WDXRF wt%	% diff
Si	0.73	0.716	2.4	0.87	0.777	10.4
S	3.90	3.62	7.1	4.15	3.81	8.2
K						
Ca	0.02			0.02		
Cr				0.04		
Fe				0.16		
Cu	0.03			0.03		
Zn						

Table M-8. (Continued)

Element	IB071102HR2A1			IB071102HR2B1		
	EDXRF wt%	WDXRF wt%	% diff	EDXRF wt%	WDXRF wt%	% diff
Si	0.29	0.242	17.3	0.21	0.244	-15.0
S	1.46	1.36	6.5	1.38	1.28	7.4
K	0.01					
Ca	0.01			0.01		
Cr	0.01					
Fe	0.05			0.01		
Cu	0.01			0.01		
Zn						

Appendix N

Individual PM-2.5 Inorganic Ion Measurements

Both Campaigns

Table N-1. Oil-Fired Institutional Boiler, Campaign #1, January 2001
Inorganic Ion Samples Analyzed by Ion Chromatography

	T041700J IB011601Hr4A1			T062900D IB011701Hr4A1			T062901A IB011801Hr4A1	
	mg/kg	wt% PM mass		mg/kg	wt% PM mass		mg/kg	wt% PM mass
sulfate	1.72	63.50	sulfate	18.28	60.44	sulfate	17.13	49.17
	1.67	61.39		18.42	60.91		16.88	48.48
	1.69	62.07		18.30	60.50		16.69	47.93
ave	1.69	62.32	ave	18.33	60.62	ave	16.90	48.53
std dev	0.03	1.07	std dev	0.08	0.25	std dev	0.22	0.62
RSD	0.02	0.02	RSD	0.00	0.00	RSD	0.01	0.01

	T062700F IB011601Hr4B1			T062900F IB011701Hr4B1			T062900B IB011801Hr4B1	
	mg/kg	wt% PM mass		mg/kg	wt% PM mass		mg/kg	wt% PM mass
sulfate	1.79	53.65	sulfate	18.20	53.20	sulfate	15.42	41.99
	1.79	53.83		18.13	53.00		15.72	42.82
	1.78	53.50		18.14	53.03		15.73	42.84
ave	1.79	53.66	ave	18.15	53.08	ave	15.62	42.55
std dev	0.01	0.17	std dev	0.04	0.11	std dev	0.18	0.49
RSD	0.01	0.01	RSD	0.00	0.00	RSD	0.01	0.01

Table N-2. Ions, Campaign #2
Raw ppm Filter Samples
A&T Oil Boiler Test 2 July 2002

for K, NH_4, Cl, NO_3
ND - < 0.3ppm
NQ - < 0.45ppm

for Mg, Ca, SO_4 (later eluting ions)
ND - < 0.5ppm
NQ - < 0.60ppm

sample ID		PM mass mg	K (a) mg/L	NH4 (a)	NH4 (b)	NH4 (c)	NH4 (d)	NH4 (ave) mg/L	std dev	%RSD
1007995	IB070902HR4A1	0.278	NQ	0.53	0.53	0.53		0.53	0.00	0.00
1008951	IB070902HR4B1	0.266	NQ	0.56	0.57	0.57		0.57	0.01	1.75
1008952	IB070902HR5A3	0.12	ND	ND						
1008953	IB070902HR5B3	0.156	ND	ND						
1008954	IB070902 -FB	0.006	ND	ND						
1008956	IB071002HR4A1	0.267	ND	0.66	0.68	0.67	0.68	0.67	0.01	1.49
1008957	IB071002HR4B1	0.27	ND	0.71	0.71	0.72		0.71	0.01	1.41
1008960	IB071002HR5A3	0.135	ND	NQ						
1008961	IB071002HR5B3	0.138	ND	NQ						
1008962	IB071102HR5A3	0.361	ND	NQ						
1008963	IB071102HR5B3	0.357	ND	0.52	0.52	0.52		0.52	0.00	0.00

Table N-2. (Continued)

sample ID		PM mass	K (a)	NH4 (a)	NH4 (b)	NH4 (c)	NH4 (d)	NH4 (ave)	std dev	%RSD
		mg	mg/L					mg/L		
1008965	IB071102HR4A1	1.082	ND	0.52	0.53	0.53		0.53	0.01	1.89
1008966	IB071102HR4B1	1.064	ND	0.47	0.47	0.47	0.47	0.47	0.00	0.00
1008976	070902 P6, P1*	0.046	ND	ND						
1008977	070902 P5, P1*	0.041	ND	ND						
1008979	071002 P5, P1*	0.024	ND	ND						
1008980	071002 P6, P1*	0.024	ND	ND						
1008982	071102 P5, P1*	0.047	ND	ND						
1008983	071102 P6, P1*	0.053	ND	ND						

* OAQPS samples: date, port, position

Table N-3. Campaign #2 Ions
Raw ppm Filter Samples

	Sample ID	mg ion on filter	wt% PM Mass	Mg	Ca (a)	Ca (b)	Ca (c)	Ca (ave) mg/L	std dev
1007995	IB070902HR4A1	0.005	1.91	ND	ND				
1008951	IB070902HR4B1	0.006	2.13	ND	ND				
1008952	IB070902HR5A3			ND	ND				
1008953	IB070902HR5B3			ND	ND				
1008954	IB070902 -FB			ND	ND				
1008956	IB071002HR4A1	0.007	2.52	ND	ND				
1008957	IB071002HR4B1	0.007	2.64	ND	ND				
1008960	IB071002HR5A3			ND	ND				
1008961	IB071002HR5B3			ND	ND				
1008962	IB071102HR5A3			ND	ND				
1008963	IB071102HR5B3	0.005	1.46	ND	ND				
1008965	IB071102HR4A1	0.005	0.49	ND	ND				

Table N-3. (Continued)

	Sample ID		mg ion on filter	wt% PM Mass	Mg		Ca (a)	Ca (b)	Ca (c)	Ca (ave) mg/L	std dev
1008966	IB071102HR4B1	0.005	0.44		ND	ND					
1008976	070902 P6, P1*				ND	ND					
1008977	070902 P5, P1*				ND	ND					
1008979	071002 P5, P1*				ND	ND					
1008980	071002 P6, P1*				ND	ND					
1008982	071102 P5, P1*				ND	ND					
1008983	071102 P6, P1*				ND	ND					

Table N-4. Campaign #2 Ions
Raw ppm Filter Samples

	Sample ID	%RSD	mg ion on filter	wt% PM Mass	Cl (a)	Cl (b)	Cl (c)	Cl (d)	Cl (ave) mg/L	std dev	%RSD
1007995	IB070902HR4A1				ND						
1008951	IB070902HR4B1				NQ						
1008952	IB070902HR5A3				NQ						
1008953	IB070902HR5B3				ND						
1008954	IB070902 -FB				ND						
1008956	IB071002HR4A1				NQ						
1008957	IB071002HR4B1				NQ						
1008960	IB071002HR5A3				NQ						
1008961	IB071002HR5B3				NQ						
1008962	IB071102HR5A3				ND						
1008963	IB071102HR5B3				ND						
1008965	IB071102HR4A1				NQ						
1008966	IB071102HR4B1				NQ						
1008976	070902 P6, P1*				ND						

Table N-4. (Continued)

	Sample ID	%RSD	mg ion on filter	wt% PM Mass	Cl (a)	Cl (b)	Cl (c)	Cl (d)	Cl (ave) mg/L	std dev	%RSD
1008977	070902 P5, P1*				ND						
1008979	071002 P5, P1*				ND						
1008980	071002 P6, P1*				ND						
1008982	071102 P5, P1*				ND						
1008983	071102 P6, P1*				ND						

Table N-5. Campaign #2 Ions
Raw ppm Filter Samples

Sample ID		mg ion on filter	wt% PM Mass	SO4 (a)	SO4 (b)	SO4 (c)	SO4 (d)	SO4 (e)	SO4 (f)	SO4 (ave) mg/L	std dev	%RSD
1007995	IB070902HR4A1			1.86	1.86	1.87				1.86	0.01	0.54
1008951	IB070902HR4B1			1.86	1.85	1.84				1.85	0.01	0.54
1008952	IB070902HR5A3			0.91	0.95	0.93	0.92	0.92		0.93	0.02	2.15
1008953	IB070902HR5B3			0.8	0.81	0.8				0.80	0.01	1.25
1008954	IB070902 -FB			ND								
1008956	IB071002HR4A1			2.88	2.89	2.88				2.88	0.01	0.35
1008957	IB071002HR4B1			2.87	2.9	2.89	2.89			2.89	0.01	0.35
1008960	IB071002HR5A3			1.31	1.28	1.26	1.25			1.28	0.03	2.34
1008961	IB071002HR5B3			1.23	1.2	1.21	1.21			1.21	0.01	0.83
1008962	IB071102HR5A3			1.9	1.9	1.87				1.89	0.02	1.06
1008963	IB071102HR5B3			1.97	1.98	1.97				1.97	0.01	0.51
1008965	IB071102HR4A1			3.74	3.7	3.69				3.71	0.03	0.81
1008966	IB071102HR4B1			3.73	3.68	3.76	3.72	3.73		3.72	0.03	0.81
1008976	070902 P6, P1*			ND								
1008977	070902 P5, P1*			ND								

Table N-5. (Continued)

Sample ID		mg ion on filter	wt% PM Mass	SO4 (a)	SO4 (b)	SO4 (c)	SO4 (d)	SO4 (e)	SO4 (f)	SO4 (ave) mg/L	std dev	%RSD
1008979	071002 P5, P1*			ND								
1008980	071002 P6, P1*			ND								
1008982	071102 P5, P1*			NQ								
1008983	071102 P6, P1*			NQ								

Table N-6. Campaign #2 Ions
Raw ppm Filter Samples

		mg ion on filter	wt% PM Mass	NO3
1007995	IB070902HR4A1	0.02	6.70	ND
1008951	IB070902HR4B1	0.02	6.95	ND
1008952	IB070902HR5A3	0.01	7.72	ND
1008953	IB070902HR5B3	0.01	5.15	ND
1008954	IB070902 -FB			ND
1008956	IB071002HR4A1	0.03	10.80	ND
1008957	IB071002HR4B1	0.03	10.69	ND
1008960	IB071002HR5A3	0.01	9.44	ND
1008961	IB071002HR5B3	0.01	8.79	ND
1008962	IB071102HR5A3	0.02	5.24	
1008963	IB071102HR5B3	0.02	5.53	
1008965	IB071102HR4A1	0.04	3.43	ND
1008966	IB071102HR4B1	0.04	3.50	ND
1008976	070902 P6, P1*			ND
1008977	070902 P5, P1*			ND
1008979	071002 P5, P1*			ND
1008980	071002 P6, P1*			ND
1008982	071102 P5, P1*			ND
1008983	071102 P6, P1*			ND

Table N-7. Campaign #2 Ions
Wt% Filter Samples

Oil-Fired Institutional Boiler, Campaign #2, July 2002
Inorganic Ion Samples - Ion Chromatography

Teflon Filter ID		IB070902 HR4A1	IB070902 HR4B1	HIB07090 2R5A3	IB070902 HR5B3	IB070902 - FB	IB071002 HR4A1	IB071002 HR4B1	IB071002 HR5A3	IB071002 HR5B3	IB071102 HR5A3	IB071102 HR4A1
Wt. %, PM-2.5 mass												
	NH4	1.91	2.13	ND	ND	ND	2.52	2.64	NQ	NQ	NQ	0.49
	K	NQ	NQ	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Mg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Ca	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Cl	ND	NQ	NQ	ND	ND	NQ	NQ	NQ	NQ	ND	NQ
	NO3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SO4	6.70	6.95	7.72	5.15	ND	10.80	10.69	9.44	8.79	5.24	3.43

		IB071102 HR4B1	070902 P6, P1*	070902 P5, P1*	071002 P5, P1*	0701002 P6, P1*	071102 P5, P1*	071102 P6, P1*
Wt. %, PM-2.5 mass								
	NH4	0.44	ND	ND	ND	ND	ND	ND
	K	ND	ND	ND	ND	ND	ND	ND
	Mg	ND	ND	ND	ND	ND	ND	ND
	Ca	ND	ND	ND	ND	ND	ND	ND
	Cl	NQ	ND	ND	ND	ND	ND	ND
	NO3	ND	ND	ND	ND	ND	ND	ND
	SO4	3.5	ND	ND	ND	ND	NQ	NQ

Appendix O

Individual or Composited Particle-Phase Semivolatile Organic Compounds

Quartz Filters

Table O-1. Quartz Filter Species Emission Factors (μg/kg)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array Compound	**Compo-site**	**Compo-site**	**Avg.**	**SD**	**6A**	**6B**	**Port Avg**	**Port SD**	**8A**	**10A**	**Day Avg**	**Day SD**		
Dimethyl phthalate														
Diethyl phthalate	0.000	0.000	0.000	0.000	12.981	5.440	9.210	5.333	6.630	12.016	8.324	2.921	4.16	1.46
Naphthalene														
2-Methylnaphthalene	0.000	1.186	0.593	0.839	0.000	5.384	2.692	3.807	0.000	0.000	2.019	2.578	1.31	1.36
1-Methylnaphthalene	0.000	1.067	0.534	0.755	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.27	0.38
2,7-Dimethylnaphthalene	0.000	1.305	0.652	0.923	0.000	6.363	3.182	4.499	0.000	0.000	2.386	3.046	1.52	1.59
1,3-Dimethylnaphthalene	0.000	2.846	1.423	2.013	0.000	11.258	5.629	7.961	0.000	0.000	4.222	5.389	2.82	2.88
2,6-Dimethylnaphthalene	0.000	1.305	0.652	0.923	0.000	5.874	2.937	4.153	0.000	0.000	2.203	2.812	1.43	1.48
Add'l Dimethylnaphthalenes														
Acenaphthylene														
Acenaphthene														
Fluorene														
1-Methylfluorene	0.000	0.000	0.000	0.000	15.692	15.792	15.742	0.071	12.167	11.136	13.709	2.413	6.85	1.21
Add'l Methylfluorenes - Peak 1														
Add'l Methylfluorenes - Peak 2														
Phenanthrene	4.370	2.413	3.392	1.384	41.642	44.818	43.230	2.245	36.040	32.574	39.165	5.822	21.28	2.99
Add'l Dimethylphenanthrenes	0.000	0.000	0.000	0.000	52.862	51.885	52.374	0.691	45.861	45.879	49.000	3.619	24.50	1.81
Anthracene														
Methylanthracene-Peak 1	0.000	0.000	0.000	0.000	136.519	147.333	141.926	7.647	118.386	112.378	130.006	17.205	65.00	8.60
Methylanthracene-Peak 2	0.000	0.000	0.000	0.000	165.773	189.428	177.600	16.727	145.583	147.431	165.011	21.918	82.51	10.96
Methylanthracene-Peak 3	0.000	0.000	0.000	0.000	107.265	113.069	110.167	4.105	90.123	91.242	101.150	12.154	50.58	6.08
Methylanthracene-Peak 4	0.000	0.000	0.000	0.000	91.355	97.406	94.380	4.279	76.791	74.747	85.831	11.714	42.92	5.86

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
Octylcyclohexane														
Norpristane														
Decylcyclohexane														
Pristane	0.000	0.000	0.000	0.000	26.407	29.664	28.036	2.302	22.458	19.862	25.005	4.612	12.50	2.31
Phytane	0.000	0.000	0.000	0.000	84.523	103.719	94.121	13.574	72.153	67.922	84.479	17.217	42.24	8.61
Tridecylcyclohexane	28.981	0.000	14.491	20.493	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.25	10.25
Dibutyl phthalate	0.000	0.000	0.000	0.000	114.25	0.000	57.13	80.79	57.04	6.64	30.202	31.157	15.10	15.58
Butyl benzyl phthalate	0.000	0.000	0.000	0.000	94.86	5.28	50.07	63.34	74.88	17.54	36.941	31.574	18.47	15.79
bis-2-Ethylhexyl phthalate	0.000	0.000	0.000	0.000	117.68	307.68	212.68	134.35	24.74	33.78	144.720	138.898	72.36	69.45
Dioctyl phthalate														
Fluoranthene	0.000	0.000	0.000	0.000	7.698	10.279	8.989	1.825	7.999	0.000	6.817	4.639	3.41	2.32
Pyrene	4.936	2.795	3.865	1.513	117.02	116.50	116.76	0.37	108.79	91.76	108.449	11.725	56.16	5.91
Chrysene	3.565	2.846	3.206	0.508	17.963	18.600	18.282	0.451	17.598	15.980	17.615	1.167	10.41	0.64
Benzo[a]anthracene														
Benzo[k]fluoranthene														
Benzo[b]fluoranthene														
Benzo[a]pyrene														
Nonadecylcyclohexane														
Squalane														
Indeno[1,2,3-cd]pyrene														
Dibenzo[a,h]anthracene														
Benzo[ghi]perylene														
Coronene														
Cholestane 1														
Cholestane 2														

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
Cholestane 3														
Cholestane 4														
ABB-20R-24S-Methylcholestane														
ABB-20R-Ethylcholestane														
17A(H)-22,29,30-Trisnorhopane														
17B(H)-21A(H)-Norhopane														
17B(H)-21B(H)-Hopane														
17B(H)-21A(H)-Hopane														
17A(H)-21B(H)-Hopane														
n-Decane (*n*-C10)														
n-Undecane (*n*-C11)														
n-Dodecane (*n*-C12)														
n-Tridecane (*n*-C13)	0.000	0.000	0.000	0.000	0.000	4.895	2.447	3.461	0.000	0.000	1.836	2.343	0.92	1.17
9H-Fluoren-9-one	0.000	0.000	0.000	0.000	19.688	0.000	9.844	13.922	0.000	0.000	2.461	4.922	1.23	2.46
n-Tetradecane (*n*-C14)	0.000	0.000	0.000	0.000	1.172	0.000	0.586	0.829	0.000	0.000	0.147	0.293	0.07	0.15
n-Pentadecane (*n*-C15)	0.000													
n-Hexadecane (*n*-C16)	1.472	0.000	0.736	1.041	14.529	15.361	14.945	0.589	12.692	6.435	12.358	4.119	6.55	2.12
n-Heptadecane (*n*-C17)	1.353	0.000	0.676	0.956	57.699	61.950	59.824	3.006	45.016	30.813	49.401	14.501	25.04	7.27
1-Octadecene														
n-Octadecane (*n*-C18)	2.392	0.000	1.196	1.692	71.762	86.245	79.004	10.241	70.249	40.990	69.122	19.862	35.16	9.97
2-Methylnonadecane														
3-Methylnonadecane														
n-Nonadecane (*n*-C19)	0.000	25.813	12.906	18.252	127.824	156.747	142.285	20.452	111.329	87.279	124.410	31.172	68.66	18.06

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
n-Eicosane (*n*-C20)	6.039	0.000	3.020	4.270	569.687	654.213	611.950	59.768	558.810	325.202	537.544	146.844	270.28	73.45
n-Heneicosane (*n*-C21)	0.052	0.000	0.026	0.037	636.080	717.080	676.580	57.276	618.526	346.896	589.771	166.892	294.90	83.45
n-Docosane (*n*-C22)	0.000	0.000	0.000	0.000	768.500	880.251	824.375	79.020	711.113	494.037	727.444	170.774	363.72	85.39
n-Tricosane (*n*-C23)	0.000	0.000	0.000	0.000	911.845	1028.04	969.945	82.165	861.527	722.575	895.523	134.372	447.76	67.19
iso-Docosane (C22)														
anteiso-Docosane (C22)														
Pyrene														
Anthraquinone														
Naphthalic anhydride	44.047	16.361	30.204	19.577	183.821	155.820	169.820	19.799	184.046	116.766	156.613	28.957	93.41	17.48
Methylfluoranthene														
Retene														
Cyclopenta[c,d]acepyrene														
Benzanthraquinone														
1-Methylchrysene														
Benzo[a]pyrene														
n-Tetracosane (*n*-C24)	197.708	0.000	98.854	139.801	1089.89	1165.28	1127.59	53.311	1020.58	887.937	1050.3	124.418	574.60	93.57
iso-Tricosane (C23)														
anteiso-Tricosane (C23)														
n-Pentacosane (*n*-C25)	124.145	0.000	62.073	87.784	539.209	564.095	551.652	17.597	506.291	451.151	518.297	51.194	290.18	50.81
iso-Tetracosane (C24)														
anteiso-Tetracosane (C24)														
n-Hexacosane (*n*-C26)	98.582	34.575	66.578	45.260	379.427	384.986	382.206	3.931	346.740	314.264	357.049	33.418	211.81	28.13
iso-Pentacosane (C25)														
anteiso-Pentacosane (C25)														
Heptacosane (*n*-C27)	70.696	57.189	63.943	9.551	229.879	207.882	218.881	15.554	174.055	173.824	193.660	25.947	128.80	13.82

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
iso-Hexacosane (C26)														
anteiso-Hexacosane (C26)														
iso-Heptacosane (C27)														
anteiso-Heptacosane (C27)														
iso-Octacosane (C28)														
anteiso-Octacosane (C28)														
Octacosane (*n*-C28)	54.140	44.078	49.109	7.115	194.474	149.095	171.784	32.087	143.594	121.819	146.573	25.051	97.84	13.02
Nonacosane (*n*-C29)	38.386	44.594	41.490	4.390	71.306	46.235	58.771	17.728	34.585	27.919	41.878	16.233	41.68	8.41
iso-Nonacosane (C29)														
anteiso-Nonacosane (C29)														
Squalene	0.000	0.000	0.000	0.000	0.000	644.616	322.308	455.813	87.239	252.802	326.741	120.761	163.37	60.38
Indeno[1,2,3-c,d]-fluoranthene														
Dibenzo[a,e]pyrene														
n-Triacontane (*n*-C30)	0.000	0.134	0.067	0.095	12.656	4.293	8.475	5.914	3.386	1.928	4.521	3.437	2.29	1.72
n-Hentriacontane (*n*-C31)	0.000	0.000	0.000	0.000	15.804	6.248	11.026	6.757	2.981	0.000	5.064	5.703	2.53	2.85
iso-Triacontane (C30)														
anteiso-Triacontane (C30)														
iso-Hentriacontane (C31)														
anteiso-Hentriacontane (C31)														
iso-Dotriacontane (C32)														
anteiso-Dotriacontane (C32)														
Dotriacontane (*n*-C32)	0.000	0.000	0.000	0.000	8.961	0.000	4.480	6.336	1.398	0.000	1.470	2.292	0.73	1.15
Tritriacontane (C33)	0.000	1.067	0.534	0.755	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.27	0.38

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
Tetratriacontane (C34)														
iso-Tritriacontane (C33)														
anteiso-Tritriacontane (C34)														
Pentatriacontane (C35)	0.000	1.542	0.771	1.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.39	0.55
Hexatriacontane (*n*-C36)														
Tetracontane (C40)														
Hexanoic acid	0.000	0.000	0.000	0.000	11.160		11.160			13.823	12.492	1.883	6.25	0.94
Succinic acid	0.000	0.000	0.000	0.000	59.774		59.774			68.754	64.264	6.350	32.13	3.17
Octanoic acid	0.000	0.000	0.000	0.000	16.034		16.034			13.587	14.811	1.730	7.41	0.87
Glutaric acid	0.000	0.000	0.000	0.000	54.785		54.785			37.020	45.902	12.562	22.95	6.28
Nonanoic Acid	0.000	0.000	0.000	0.000	20.082		20.082			21.049	20.565	0.684	10.28	0.34
Adipic acid	0.000	0.000	0.000	0.000	46.646		46.646			20.522	33.584	18.473	16.79	9.24
Decanoic acid	0.000	0.000	0.000	0.000	20.395		20.395			9.676	15.035	7.580	7.52	3.79
Undecanoic acid	0.000	0.000	0.000	0.000	39.607		39.607			17.544	28.575	15.601	14.29	7.80
Pimelic acid	1.428	3.483	2.456	1.453	17.192		17.192			18.569	17.881	0.973	10.17	0.87
Suberic acid	0.985	3.535	2.260	1.803	24.378		24.378			17.398	20.888	4.936	11.57	2.63
Dodecanoic acid	0.000	0.000	0.000	0.000	33.786		33.786			14.233	24.010	13.826	12.00	6.91
Azelaic acid	3.999	3.264	3.631	0.520	0.000		0.000			0.000	0.000	0.000	1.82	0.26
Tridecanoic acid														
Pinonic acid	0.000	0.000	0.000	0.000	127.82		127.82			0.000	63.912	90.385	31.96	45.19
Phthalic acid	0.000	0.000	0.000	0.000	5.622		5.622			0.000	2.811	3.975	1.41	1.99
1,4-Benzenedicarboxylic acid	18.620	18.995	18.808	0.265	73.065		73.065			72.133	72.599	0.659	45.70	0.36

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02							Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
1,3-Benzenedicarboxylic acid	36.816	28.219	32.518	6.079	123.48		123.48			132.46	127.97	6.348	80.24	4.39
1,2- Benzenedicarboxylic acid, 4-methyl	0.000	0.000	0.000	0.000	0.000		0.000			0.000	0.000	0.000		
1,2,4-Benzenetricarboxylic acid	216.929	0.000	108.464	153.392	1047.2		1047.2			1145.9	1096.5	69.840	602.51	84.27
Benzenetetracarboxylic acid	47.440	0.000	23.720	33.545	266.88		266.88			332.49	299.69	46.397	161.70	28.63
Abietic acid														
Pimaric acid														
Sandaracopimaric acid														
Isopimaric acid														
Dehydroabietic acid														
Sebacic acid														
Tetradecanoic acid	0.000	0.000	0.000	0.000	49.970		49.970			12.587	31.278	26.434	15.64	13.22
Pentadecanoic acid	0.000	0.000	0.000	0.000	110.316		110.316			19.520	64.918	64.203	32.46	32.10
Palmitoleic acid														
Hexadecanoic acid	0.000	0.000	0.000	0.000	601.87		601.87			334.51	468.19	189.051	234.09	94.53
Heptadecanoic acid	0.000	0.000	0.000	0.000	62.264		62.264			45.958	54.111	11.530	27.06	5.77
Linoleic acid	0.000	0.000	0.000	0.000	64.393		64.393			43.565	53.979	14.728	26.99	7.36
Oleic acid	0.000	0.000	0.000	0.000	17.880		17.880			21.309	19.594	2.424	9.80	1.21
Linolenic acid														
Octadecanoic acid	11.556	0.000	5.778	8.171	342.032		342.032			243.658	292.845	69.561	149.31	35.02
Nonoadecanoic acid														
Eicosanoic aicd	0.000	0.000	0.000	0.000	13.675		13.675			9.885	11.780	2.680	5.89	1.34
Docosanoic acid	2.288	0.000	1.144	1.618	7.418		7.418			4.889	6.153	1.788	3.65	1.21

Table O-1. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02								Summer Campaign Average	Uncertainty
Sampling Array	Compo-site	Compo-site	Avg.	SD	6A	6B	Port Avg	Port SD	8A	10A	Day Avg	Day SD		
Compound														
Tricosanoic acid														
Tetracosanoic acid	0.000	0.000	0.000	0.000	14.584		14.584			4.396	9.490	7.204	4.75	3.60
Pentacosanoic acid														
Hexacosanoic acid														
Heptacosanoic acid														
Octacosanoic acid														
Nonacosanoic acid														
Triacontanoic acid														
Total	1020.93	298.61	659.77	510.75	10381.0	8219.1	9300.0	1528.7	6411.4	7859.0	7947.4	1193.1	4303.58	648.92

Table O-2. Quartz Filter Species in PM%

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
Dimethyl phthalate								
Diethyl phthalate	0.00000	0.00000	0.00000	0.00000	0.00468	0.00165	0.00234	0.00082
Naphthalene								
2-Methylnaphthalene	0.00000	0.00278	0.00143	0.00075	0.00113	0.00145	0.00128	0.00082
1-Methylnaphthalene	0.00000	0.00250	0.00129	0.00071	0.00000		0.00064	0.00036
2,7-Dimethylnaphthalene	0.00000	0.00306	0.00157	0.00079	0.00134	0.00171	0.00146	0.00094
1,3-Dimethylnaphthalene	0.00000	0.00667	0.00343	0.00116	0.00237	0.00303	0.00290	0.00162
2,6-Dimethylnaphthalene	0.00000	0.00306	0.00157	0.00079	0.00124	0.00158	0.00140	0.00088
Add'l Dimethylnaphthalenes								
Acenaphthylene								
Acenaphthene								
Fluorene								
1-Methylfluorene	0.00000	0.00000	0.00000	0.00000	0.00770	0.00138	0.00385	0.00069
Add'l Methylfluorene - Peak 1								
Add'l Methylfluorene - Peak 2								
Phenanthrene	0.01083	0.00566	0.00817	0.00179	0.02200	0.00335	0.01509	0.00190
Add'l Dimethylphenanthrenes	0.00000	0.00000	0.00000	0.00000	0.02752	0.00223	0.01376	0.00112
Anthracene								
Methylanthracene-Peak 1	0.00000	0.00000	0.00000	0.00000	0.07303	0.00997	0.03651	0.00498
Methylanthracene-Peak 2	0.00000	0.00000	0.00000	0.00000	0.09269	0.01269	0.04635	0.00635
Methylanthracene-Peak 3	0.00000	0.00000	0.00000	0.00000	0.05682	0.00709	0.02841	0.00354
Methylanthracene-Peak 4	0.00000	0.00000	0.00000	0.00000	0.04821	0.00677	0.02411	0.00339
Octylcyclohexane								
Norpristane								

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
Decylcyclohexane								
Pristane	0.00000	0.00000	0.00000	0.00000	0.01405	0.00263	0.00702	0.00132
Phytane	0.00000	0.00000	0.00000	0.00000	0.04745	0.00980	0.02373	0.00490
Tridecylcyclohexane	0.07181	0.00000	0.03490	0.00374	0.00000	0.00000	0.01745	0.00187
Dibutyl phthalate	0.00000	0.00000	0.00000	0.00000	0.01697	0.01751	0.00848	0.00876
Butyl benzyl phthalate	0.00000	0.00000	0.00000	0.00000	0.02075	0.01775	0.01038	0.00887
bis-(2-Ethylhexyl) phthalate	0.00000	0.00000	0.00000	0.00000	0.08129	0.07807	0.04065	0.03904
Dioctyl phthalate								
Fluoranthene	0.00000	0.00000	0.00000	0.00000	0.00383	0.00261	0.00191	0.00130
Pyrene	0.01223	0.00655	0.00931	0.00191	0.06092	0.00689	0.03512	0.00358
Chrysene	0.00883	0.00667	0.00772	0.00174	0.00989	0.00073	0.00881	0.00095
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)								
n-Tridecane (*n*-C13)	0.00000	0.00000	0.00000	0.00000	0.00103	0.00132	0.00052	0.00066
9H-Fluoren-9-one	0.00000	0.00000	0.00000	0.00000	0.00138	0.00277	0.00069	0.00138
n-Tetradecane (*n*-C14)	0.00000	0.00000	0.00000	0.00000	0.00008	0.00016	0.00004	0.00008
n-Pentadecane (*n*-C15)								
n-Hexadecane (*n*-C16)	0.00365	0.00000	0.00177	0.00084	0.00694	0.00233	0.00436	0.00124
n-Heptadecane (*n*-C17)	0.00335	0.00000	0.00163	0.00080	0.02775	0.00820	0.01469	0.00412
1-Octadecene								
n-Octadecane (*n*-C18)	0.00593	0.00000	0.00288	0.00107	0.03883	0.01123	0.02085	0.00564
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	0.00000	0.06049	0.03109	0.00352	0.06989	0.01766	0.05049	0.00901
n-Eicosane (*n*-C20)	0.01496	0.00000	0.00727	0.00169	0.30196	0.08310	0.15462	0.04156

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
n-Heneicosane (*n*-C21)	0.00013	0.00000	0.00006	0.00016	0.33129	0.09440	0.16568	0.04720
n-Docosane (*n*-C22)	0.00000	0.00000	0.00000	0.00000	0.40863	0.09689	0.20432	0.04845
n-Tricosane (*n*-C23)	0.00000	0.00000	0.00000	0.00000	0.50305	0.07733	0.25152	0.03866
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene								
Anthraquinone								
Naphthalic anhydride	0.10914	0.03834	0.07275	0.00537	0.08798	0.01653	0.08036	0.00869
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	0.48986	0.00000	0.23812	0.01025	0.59002	0.07261	0.41407	0.03666
iso-Tricosane (C23)								
anteiso-Tricosane (C23)								
n-Pentacosane (*n*-C25)	0.30759	0.00000	0.14952	0.00796	0.29115	0.03035	0.22033	0.01569
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C25)	0.24426	0.08103	0.16037	0.00802	0.20057	0.01993	0.18047	0.01074
iso-Pentacosane (C25)								
anteiso-Pentacosane (C26)								
Heptacosane (*n*-C27)	0.17516	0.13403	0.15402	0.00779	0.10879	0.01502	0.13140	0.00846

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (*n*-C28)	0.13414	0.10330	0.11829	0.00682	0.08234	0.01434	0.10031	0.00794
Nonacosane (*n*-C29)	0.09511	0.10451	0.09994	0.00627	0.02352	0.00915	0.06173	0.00555
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	0.00000	0.00000	0.00000	0.00000	0.18354	0.06811	0.09177	0.03406
Indeno[1,2,3-c,d]fluoranthene								
Dibenzo[a,e]pyrene								
n-Triacontane (*n*-C30)	0.00000	0.00032	0.00016	0.00025	0.00254	0.00193	0.00135	0.00097
n-Hentriacontane (*n*-C31)	0.00000	0.00000	0.00000	0.00000	0.00284	0.00321	0.00142	0.00160
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (*n*-C32)	0.00000	0.00000	0.00000	0.00000	0.00083	0.00129	0.00041	0.00064
Tritriacontane (C33)	0.00000	0.00250	0.00129	0.00071	0.00000	0.00000	0.00064	0.00036
Tetratriacontane (C34)								

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)	0.00000	0.00361	0.00186	0.00086	0.00000	0.00000	0.00093	0.00043
Hexatriacontane (*n*-C36)								
Tetracontane (C40)								
Hexanoic acid	0.00000	0.00000	0.00000	0.00000	0.00702	0.00108	0.00351	0.00054
Succinic acid	0.00000	0.00000	0.00000	0.00000	0.03610	0.00376	0.01805	0.00188
Octanoic acid	0.00000	0.00000	0.00000	0.00000	0.00832	0.00101	0.00416	0.00051
Glutaric acid	0.00000	0.00000	0.00000	0.00000	0.02578	0.00711	0.01289	0.00355
Nonanoic Acid	0.00000	0.00000	0.00000	0.00000	0.01155	0.00054	0.00578	0.00027
Adipic acid	0.00000	0.00000	0.00000	0.00000	0.01887	0.01040	0.00943	0.00520
Decanoic acid	0.00000	0.00000	0.00000	0.00000	0.00845	0.00427	0.00422	0.00213
Undecanoic acid	0.00000	0.00000	0.00000	0.00000	0.01605	0.00878	0.00803	0.00439
Pimelic acid	0.00354	0.00816	0.00591	0.00153	0.01004	0.00064	0.00798	0.00083
Suberic acid	0.00244	0.00828	0.00544	0.00146	0.01173	0.00280	0.00859	0.00158
Dodecanoic acid	0.00000	0.00000	0.00000	0.00000	0.01349	0.00778	0.00674	0.00389
Azelaic acid	0.00991	0.00765	0.00875	0.00186	0.00000	0.00000	0.00437	0.00093
Tridecanoic acid								
Pinonic acid	0.00000	0.00000	0.00000	0.00000	0.03590	0.05079	0.01795	0.02539
Phthalic acid	0.00000	0.00000	0.00000	0.00000	0.00158	0.00223	0.00079	0.00112
1,4-Benzenedicarboxylic acid	0.04614	0.04452	0.04530	0.00422	0.04078	0.00141	0.04304	0.00223
1,3-Benzenedicarboxylic acid	0.09122	0.06613	0.07833	0.00555	0.07188	0.00430	0.07511	0.00351

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid	0.53748	0.00000	0.26127	0.01079	0.61597	0.04429	0.43862	0.02279
Benzenetetracarboxylic acid	0.11754	0.00000	0.05714	0.00481	0.16834	0.02666	0.11274	0.01355
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid	0.00000	0.00000	0.00000	0.00000	0.01757	0.01486	0.00879	0.00743
Pentadecanoic acid	0.00000	0.00000	0.00000	0.00000	0.03647	0.03609	0.01823	0.01804
Palmitoleic acid								
Hexadecanoic acid	0.00000	0.00000	0.00000	0.00000	0.26300	0.10656	0.13150	0.05328
Heptadecanoic acid	0.00000	0.00000	0.00000	0.00000	0.03040	0.00656	0.01520	0.00328
Linoleic acid	0.00000	0.00000	0.00000	0.00000	0.03032	0.00833	0.01516	0.00417
Oleic acid	0.00000	0.00000	0.00000	0.00000	0.01101	0.00141	0.00550	0.00071
Linolenic acid								
Octadecanoic acid	0.02863	0.00000	0.01392	0.00235	0.16450	0.03946	0.08921	0.01976
Nonoadecanoic acid								
Eicosanoic aicd	0.00000	0.00000	0.00000	0.00000	0.00662	0.00152	0.00331	0.00076
Docosanoic acid	0.00567	0.00000	0.00276	0.00104	0.00346	0.00101	0.00311	0.00073
Tricosanoic acid								
Tetracosanoic acid	0.00000	0.00000	0.00000	0.00000	0.00533	0.00405	0.00267	0.00203

Table O-2. (Continued)

Test Date	7/9/02	7/10/02	First Two-Day		7/11/02		Summer Campaign Average	Uncertainty (%)
PM emission factor (mg/kg))	**40.36**	**42.67**	**41.52**		**178.02**			
PM emission factor uncertainty (mg/kg)	**1.27**	**2.51**	**1.63**		**5.94**			
Compound	**in PM (%)**	**in PM (%)**	**Avg. in PM (%)**	**Uncertainty (%)**	**in PM (%)**	**Uncertainty (%)**		
Pentacosanoic acid								
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid								
Triacontanoic acid								
Total	2.53	0.70	1.59	0.03	5.53	0.69	3.56	0.34

Table O-3. Campaign #2 Particle-Phase Semivolatiles (July 9, 2002)

Test Date	**7/9/02**										
Substrate	**QF**										
Sample ID	**IB070902HR6&10**				**IB070902HR2&R4**			**IB070902HD1A1**			
Sampling Position	**Front**				**Backup**			**Dilution**			
Number of filters	**4**				**4**			**1**			
Punches after OC/EC analysis	**2**				**2**			**1**			
Sampling Flow (lpm)	**32.860**				**32.716**			**8.215**			
Sampling Time (min)	**600.6**				**600.6**			**600.6**			
Dilution Ratio	**44.30**				**44.30**			**44.30**			
Flue gas flow (lpm)	**111439**				**111439**			**111439**			
Fuel (kg/min)	**7.40**				**7.40**			**7.40**			
Volume (uL)	**300**				**300**			**300**			
Compound	**ng/uL**	**ng**	**ng/L**	**µg/kg**	**ng/µL**	**ng**	**ng/L**	**ng/µL**	**ng**	**ng/L**	**µg/kg**
Dimethyl phthalate											
Diethyl phthalate	0.35	110.98	0.00562	4.03	0.33	104.64	0.00533	0.81	272.36	0.05520	39.51
Naphthalene					0.09	28.54	0.00145				
2-Methylnaphthalene											
1-Methylnaphthalene											
2,7- Dimethylnaphthalene											
1,3- Dimethylnaphthalene											
2,6- Dimethylnaphthalene											
Add'l Dimethylnaphthalenes											
Acenaphthylene											
Acenaphthene											
Fluorene											
1-Methylfluorene											
Add'l Methylfluorene - Peak 1											
Add'l Methylfluorene - Peak 2											
Phenanthrene	0.38	120.50	0.00611	4.37							
Add'l Dimethylphenanthrenes											
Anthracene											

Table O-3. (Continued)

Compound	ng/uL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	ng/µL	ng	ng/L	µg/kg
Methylanthracene-Peak 1											
Methylanthracene-Peak 2											
Methylanthracene-Peak 3											
Methylanthracene-Peak 4											
Octylcyclohexane											
Norpristane											
Decylcyclohexane											
Pristane					0.21	66.59	0.00339				
Phytane											
Tridecylcyclohexane	2.52	799.07	0.04049	28.98							
Dibutyl phthalate	3.15	998.84	0.05061	36.23	2.55	808.59	0.04115	5.15	1731.69	0.35097	251.22
Butylbenzyl phthalate	4.40	1395.21	0.07069	50.60	3.37	1068.60	0.05438	12.26	4122.43	0.83552	598.06
bis (2- Ethylhexyl) phthalate					7.88	2498.69	0.12717	1.90	638.88	0.12949	92.68
Dioctyl phthalate											
Fluoranthene											
Pyrene	0.62	196.60	0.00996	7.13	0.19	60.25	0.00307				
Chrysene	0.31	98.30	0.00498	3.57							
Benzo[a]anthracene											
Benzo[k]fluoranthene											
Benzo[b]fluoranthene											
Benzo[a]pyrene											
Nonadecylcyclohexane											
Squalane											
Indeno[1,2,3-cd]pyrene											
Dibenzo[a,h]anthracene											
Benzo[ghi]perylene											
Coronene											
Cholestane 1											
Cholestane 2											
Cholestane 3											

Table O-3. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	ng/µL	ng	ng/L	µg/kg
Cholestane 4											
ABB-20R-24S-Methylcholestane											
ABB-20R-Ethylcholestane											
17A(H)-22,29,30-Trisnorhopane											
17B(H)-21A(H)-Norhopane											
17B(H)-21B(H)-Hopane											
17B(H)-21A(H)-Hopane											
17A(H)-21B(H)-Hopane											
n-Decane (*n*-C10)											
n-Undecane (*n*-C11)											
n-Dodecane (*n*-C12)					0.66	209.28	0.01065				
n-Tridecane (*n*-C13)											
9H-Fluoren-9-one											
n-Tetradecane (*n*-C14)					0.32	101.47	0.00516				
n-Pentadecane (*n*-C15)								0.22	73.98	0.01499	10.73
n-Hexadecane (*n*-C16)	0.58	183.91	0.00932	6.67	0.45	142.69	0.00726				
n-Heptadecane (*n*-C17)	0.66	209.28	0.01060	7.59	0.54	171.23	0.00871				
1-Octadecene											
n-Octadecane (*n*-C18)	0.66	209.28	0.01060	7.59	0.45	142.69	0.00726				
2-Methylnonadecane											
3-Methylnonadecane											
n-Nonadecane (*n*-C19)	1.68	532.72	0.02699	19.32	1.82	577.11	0.02937				
n-Eicosane (*n*-C20)	3.38	1071.77	0.05431	38.87	2.42	767.36	0.03905	0.10	33.63	0.00682	4.88
n-Heneicosane (*n*-C21)	4.25	1347.64	0.06828	48.88	3.34	1059.09	0.05390	0.21	70.61	0.01431	10.24
n-Docosane (*n*-C22)	8.49	2692.11	0.13641	97.64	7.97	2527.23	0.12862	0.27	90.79	0.01840	13.17
n-Tricosane (*n*-C23)	16.94	5371.54	0.27217	194.82	15.27	4842.00	0.24643	0.42	141.23	0.02862	20.49
iso-Docosane (C22)											
anteiso-Docosane (C22)											
Pyrene											

Table O-3. (Continued)

Compound	ng/uL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	ng/µL	ng	ng/L	µg/kg
Anthraquinone											
Naphthalic anhydride	3.83	1214.46	0.06154	44.05							
Methylfluoranthene											
Retene											
Cyclopenta[c,d]-acepyrene											
Benzanthraquinone											
1-Methylchrysene											
Benzo[a]pyrene											
n-Tetracosane (*n*-C24)	43.27	13720.59	0.69521	497.63	22.29	7067.99	0.35971	0.87	292.54	0.05929	42.44
iso-Tricosane (C23)											
anteiso-Tricosane (C23)											
n-Pentacosane (*n*-C25)	25.81	8184.15	0.41469	296.83	13.26	4204.64	0.21399	0.40	134.50	0.02726	19.51
iso-Tetracosane (C24)											
anteiso-Tetracosane (C24)											
n-Hexacosane (*n*-C26)	21.11	6693.82	0.33917	242.78	9.02	2860.17	0.14556	0.82	275.73	0.05588	40.00
iso-Pentacosane (C25)											
anteiso-Pentacosane (C25)											
Heptacosane (*n*-C27)	15.46	4902.25	0.24839	177.80	5.64	1788.40	0.09102	0.86	289.18	0.05861	41.95
iso-Hexacosane (C26)											
anteiso-Hexacosane (C26)											
iso-Heptacosane (C27)											
anteiso-Heptacosane (C27)											
iso-Octacosane (C28)											
anteiso-Octacosane (C28)											
Octacosane (*n*-C28)	14.66	4648.57	0.23554	168.60	5.39	1709.13	0.08698	1.07	359.79	0.07292	52.20
Nonacosane (*n*-C29)	6.11	1937.43	0.09817	70.27	2.76	875.17	0.04454				
iso-Nonacosane (C30)											
anteiso-Nonacosane (C30)											
Squalene					0.34	107.81	0.00549	2.39	803.64	0.16288	116.59

Table O-3. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	ng/µL	ng	ng/L	µg/kg
Indeno-[1,2,3-c,d]fluoranthene											
Dibenzo[a,e]pyrene											
n-Triacontane (*n*-C30)	1.13	358.31	0.01816	13.00	0.98	310.75	0.01582	0.17	57.16	0.01159	8.29
n-Hentriacontane (*n*-C31)	1.08	342.46	0.01735	12.42	1.35	428.07	0.02179	0.22	73.98	0.01499	10.73
iso-Triacontane (C30)											
anteiso-Triacontane (C30)											
iso-Hentriacontane (C31)											
anteiso-Hentriacontane (C31)											
iso-Dotriacontane (C32)											
anteiso-Dotriacontane (C32)											
Dotriacontane (*n*-C32)	0.97	307.58	0.01558	11.16	1.32	418.56	0.02130	0.52	174.85	0.03544	25.37
Tritriacontane (C33)					0.22	69.76	0.00355				
Tetratriacontane (C34)											
iso-Tritriacontane (C33)											
anteiso-Tritriacontane (C33)											
Pentatriacontane (C35)					0.22	69.76	0.00355				
Hexatriacontane (*n*-C36)											
Tetracontane (C40)											
Hexanoic acid	0.63	198.18	0.01004	7.19	0.99	313.13	0.01594				
Succinic acid	2.43	768.95	0.03896	27.89	1.15	364.66	0.01856	2.40	807.00	0.16356	117.08
Octanoic acid	0.60	190.26	0.00964	6.90	0.90	285.38	0.01452	0.23	75.66	0.01533	10.98
Glutaric acid	0.56	178.36	0.00904	6.47	0.39	122.87	0.00625	0.43	142.91	0.02896	20.73
Nonanoic Acid	1.96	622.29	0.03153	22.57	1.88	594.55	0.03026	1.94	651.48	0.13204	94.51
Adipic acid	0.81	257.64	0.01305	9.34	0.59	186.29	0.00948	0.75	252.19	0.05111	36.59
Decanoic acid	1.00	317.09	0.01607	11.50	1.18	372.58	0.01896	0.81	273.20	0.05537	39.63
Undecanoic acid	2.15	681.75	0.03454	24.73	2.16	685.71	0.03490	1.34	449.73	0.09115	65.25
Pimelic acid	0.31	99.09	0.00502	3.59	0.19	59.45	0.00303				
Suberic acid	0.51	162.51	0.00823	5.89	0.43	134.76	0.00686				
Dodecanoic acid	1.85	586.62	0.02972	21.28	1.86	590.58	0.03006	1.15	386.69	0.07837	56.10

Table O-3. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	ng/µL	ng	ng/L	µg/kg
Azelaic acid	0.88	277.46	0.01406	10.06	0.53	166.47	0.00847				
Tridecanoic acid											
Pinonic acid	2.64	836.33	0.04238	30.33	12.40	3931.94	0.20011	121.14	40732.48	8.25556	5909.25
Phthalic acid	0.93	293.31	0.01486	10.64	1.64	519.24	0.02643	3.41	1147.45	0.23256	166.47
1,4-Benzenedicarboxylic acid	2.96	939.39	0.04760	34.07	1.34	424.11	0.02158				
1,3-Benzenedicarboxylic acid	5.76	1827.24	0.09259	66.27	2.55	808.59	0.04115				
1,2-Benzenedicarboxylic acid, 4-methyl	0.75	237.82	0.01205	8.63	1.89	598.51	0.03046				
1,2,-Benzenetricarboxylic acid	18.86	5981.15	0.30306	216.93							
Benzenetetracarboxylic acid	4.13	1308.01	0.06628	47.44							
Abietic acid											
Pimaric acid											
Sandaracopimaric acid											
Isopimaric acid											
Dehydroabietic acid											
Sebacic acid											
Tetradecanoic acid	2.25	713.46	0.03615	25.88	1.94	614.37	0.03127	1.08	361.47	0.07326	52.44
Pentadecanoic acid	4.76	1510.15	0.07652	54.77	4.33	1371.42	0.06980	1.79	601.05	0.12182	87.20
Palmitoleic acid	3.59	1137.57	0.05764	41.26				0.93	311.03	0.06304	45.12
Hexadecanoic acid	34.86	11054.63	0.56013	400.94	28.44	9017.31	0.45892	7.18	2412.59	0.48898	350.01
Heptadecanoic acid	2.86	907.68	0.04599	32.92	1.90	602.48	0.03066	0.39	130.30	0.02641	18.90
Linoleic acid	0.99	313.13	0.01587	11.36				0.41	138.70	0.02811	20.12
Oleic acid	2.73	864.08	0.04378	31.34	1.21	384.47	0.01957	0.63	210.16	0.04259	30.49
Linolenic acid											
Octadecanoic acid	22.49	7130.61	0.36130	258.62	10.25	3250.20	0.16541	2.64	886.86	0.17975	128.66
Nonoadecanoic acid											
Eicosanoic aicd	0.55	174.40	0.00884	6.33	0.20	63.42	0.00323	0.14	46.23	0.00937	6.71
Docosanoic acid	0.44	138.73	0.00703	5.03	0.24	75.31	0.00383				
Tricosanoic acid											
Tetracosanoic acid	0.44	138.73	0.00703	5.03	0.24	75.31	0.00383	0.25	84.06	0.01704	12.20
Pentacosanoic acid											

Table O-3. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	ng/µL	ng	ng/L	µg/kg
Hexacosanoic acid											
Heptacosanoic acid											
Octacosanoic acid											
Nonacosanoic acid											
Triacontanoic acid											
Total	307.46	97494.0	4.94	3535.98	191.43	60699.4	3.09	177.66	59738.2	12.11	8666.50

Table O-4. Campaign #2 Particle-Phase Semivolatiles (July 10, 2002)

Test Date	**7/10/02**											
Substrate	**QF**											
Sample ID	**IB071002HR6&10**				**IB071002HR2&R4**				**IB071002HD1A1**			
Sampling Position	**Residence - Front filter**				**Residence - Backup filter**				**Dilution - Front filter**			
Number of filters	**4**				**4**				**1**			
Punches after OC/EC analysis	**2**				**2**				**1**			
Sampling Flow (lpm)	**32.805**				**32.516**				**8.219**			
Sampling Time (min)	**600.67**				**600.67**				**600.67**			
Dilution Ratio	**44.34**				**44.34**				**44.34**			
Flue gas flow (lpm)	**115149**				**115149**				**115149**			
Fuel (kg/min)	**7.43**				**7.43**				**7.43**			
Volume (uL)	**300**				**290**				**300**			
Compound	**ng/µL**	**ng**	**ng/L**	**µg/kg**	**ng/µL**	**ng**	**ng/L**	**µg/kg**	**ng/µL**	**ng**	**ng/L**	**µg/kg**
Dimethyl phthalate												
Diethyl phthalate	0.20	63.42	0.00322	2.37	0.20	61.30	0.00314	2.31	0.28	94.15	0.01907	14.05
Naphthalene												
2-Methylnaphthalene	0.10	31.71	0.00161	1.19								
1-Methylnaphthalene	0.09	28.54	0.00145	1.07								
2,7-Dimethylnaphthalene	0.11	34.88	0.00177	1.30								
1,3-Dimethylnaphthalene	0.24	76.10	0.00386	2.85								
2,6-Dimethylnaphthalene	0.11	34.88	0.00177	1.30								
Add'l Dimethylnaphthalenes												
Acenaphthylene												
Acenaphthene												
Fluorene												
1-Methylfluorene												
Add'l Methylfluorene - Peak 1												
Add'l Methylfluorene - Peak 2												
Phenanthrene	0.34	107.81	0.00547	4.03	0.14	42.91	0.00220	1.62				
Add'l Dimethylphenanthrenes												
Anthracene												

Table O-4. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Methylanthracene-Peak 1												
Methylanthracene-Peak 2												
Methylanthracene-Peak 3												
Methylanthracene-Peak 4												
Octylcyclohexane												
Norpristane												
Decylcyclohexane												
Pristane												
Phytane												
Tridecylcyclohexane												
Dibutyl phthalate	3.30	1046.40	0.05310	39.14	0.48	147.13	0.00753	5.55	4.67	1570.29	0.31806	234.42
Butylbenzyl phthalate	4.36	1382.52	0.07016	51.71	0.69	211.50	0.01083	7.98	5.49	1846.01	0.37390	275.58
bis (2-Ethylhexyl) phthalate	3.82	1211.29	0.06147	45.31	4.26	1305.79	0.06685	49.27	0.97	326.16	0.06606	48.69
Dioctyl phthalate												
Fluoranthene												
Pyrene	0.46	145.86	0.00740	5.46	0.23	70.50	0.00361	2.66				
Chrysene	0.24	76.10	0.00386	2.85								
Benzo[a]anthracene												
Benzo[k]fluoranthene												
Benzo[b]fluoranthene												
Benzo[a]pyrene												
Nonadecylcyclohexane												
Squalane												
Indeno[1,2,3-cd]pyrene												
Dibenzo[a,h]anthracene												
Benzo[ghi]perylene												
Coronene												
Cholestane 1												
Cholestane 2												
Cholestane 3												

Table O-4. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Cholestane 4												
ABB-20R-24S-Methylcholestane												
ABB-20R-Ethylcholestane												
17A(H)-22,29,30-Trisnorhopane												
17B(H)-21A(H)-Norhopane												
17B(H)-21B(H)-Hopane												
17B(H)-21A(H)-Hopane												
17A(H)-21B(H)-Hopane												
n-Decane (*n*-C10)									0.04	13.45	0.00272	2.01
n-Undecane (*n*-C11)												
n-Dodecane (*n*-C12)					0.08	24.52	0.00126	0.93				
n-Tridecane (*n*-C13)					0.62	190.04	0.00973	7.17				
9H-Fluoren-9-one												
n-Tetradecane (*n*-C14)	0.10	31.71	0.00161	1.19	0.11	33.72	0.00173	1.27	0.05	16.81	0.00341	2.51
n-Pentadecane (*n*-C15)												
n-Hexadecane (*n*-C16)	0.23	72.93	0.00370	2.73	0.31	95.02	0.00487	3.59	0.07	23.54	0.00477	3.51
n-Heptadecane (*n*-C17)	0.53	168.06	0.00853	6.29	0.61	186.98	0.00957	7.06	0.41	137.86	0.02792	20.58
1-Octadecene												
n-Octadecane (*n*-C18)	0.41	130.01	0.00660	4.86	0.55	168.59	0.00863	6.36				
2-Methylnonadecane												
3-Methylnonadecane												
n-Nonadecane (*n*-C19)	4.02	1274.71	0.06469	47.68	1.63	499.63	0.02558	18.85	0.06	20.18	0.00409	3.01
n-Eicosane (*n*-C20)	2.59	821.27	0.04168	30.72	2.74	839.87	0.04300	31.69	0.08	26.90	0.00545	4.02
n-Heneicosane (*n*-C21)	3.41	1081.28	0.05487	40.44	3.77	1155.59	0.05917	43.61	0.13	43.71	0.00885	6.53
n-Docosane (*n*-C22)	8.22	2606.50	0.13228	97.49	8.38	2568.66	0.13151	96.93	0.17	57.16	0.01158	8.53
n-Tricosane (*n*-C23)	15.00	4756.39	0.24138	177.90	16.85	5164.91	0.26444	194.90	0.30	100.88	0.02043	15.06
iso-Docosane (C22)												
anteiso-Docosane (C22)												
Pyrene												

Table O-4. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Anthraquinone												
Naphthalic anhydride	3.33	1055.92	0.05359	39.49	2.00	613.05	0.03139	23.13				
Methylfluoranthene												
Retene												
Cyclopenta[c,d]acepyrene					0.49	150.20	0.00769	5.67				
Benzanthraquinone												
1-Methylchrysene												
Benzo[a]pyrene												
n-Tetracosane (*n*-C24)	28.27	8964.20	0.45492	335.29	30.85	9456.22	0.48415	356.83	0.59	198.39	0.04018	29.62
iso-Tricosane (C23)												
anteiso-Tricosane (C23)												
n-Pentacosane (*n*-C25)	18.19	5767.91	0.29271	215.74	16.93	5189.43	0.26569	195.82	0.52	174.85	0.03542	26.10
iso-Tetracosane (C24)												
anteiso-Tetracosane (C24)												
n-Hexacosane (*n*-C26)	14.58	4623.21	0.23462	172.92	9.14	2801.62	0.14344	105.72	0.65	218.56	0.04427	32.63
iso-Pentacosane (C25)												
anteiso-Pentacosane (C25)												
Heptacosane (*n*-C27)	10.41	3300.93	0.16752	123.46	3.56	1091.22	0.05587	41.18	0.50	168.13	0.03405	25.10
iso-Hexacosane (C26)												
anteiso-Hexacosane (C26)												
iso-Heptacosane (C287												
anteiso-Heptacosane (C27)												
iso-Octacosane (C28)												
anteiso-Octacosane (C28)												
Octacosane (n-C28)	9.44	2993.35	0.15191	111.96	2.18	668.22	0.03421	25.22	0.85	285.81	0.05789	42.67
Nonacosane (n-C29)	3.76	1192.27	0.06051	44.59								
iso-Nonacosane (C29)												
anteiso-Nonacosane (C29)												
Squalene	2.08	659.55	0.03347	24.67	5.54	1698.14	0.08694	64.08	0.11	36.99	0.00749	5.52
Indeno[1,2,3-c,d]fluoranthene												

Table O-4. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Dibenzo[a,e]pyrene												
n-Triacontane (*n*-C30)	0.89	282.21	0.01432	10.56	0.25	76.63	0.00392	2.89	0.15	50.44	0.01022	7.53
n-Hentriacontane (*n*-C31)	1.00	317.09	0.01609	11.86	0.28	85.83	0.00439	3.24	0.20	67.25	0.01362	10.04
iso-Triacontane (C30)												
anteiso-Triacontane (C30)												
iso-Hentriacontane (C31)												
anteiso-Hentriacontane (C31)												
iso-Dotriacontane (C32)												
anteiso-Dotriacontane (C32)												
Dotriacontane (*n*-C32)	1.01	320.26	0.01625	11.98	0.53	162.46	0.00832	6.13	0.53	178.21	0.03610	26.60
Tritriacontane (C33)	0.09	28.54	0.00145	1.07								
Tetratriacontane (C34)												
iso-Tritriacontane (C33)												
anteiso-Tritriacontane (C33)												
Pentatriacontane (C35)	0.13	41.22	0.00209	1.54								
Hexatriacontane (*n*-C36)												
Tetracontane (C40)												
Hexanoic acid	0.13	39.64	0.00201	1.48	1.05	321.85	0.01648	12.15				
Succinic acid	2.39	757.06	0.03842	28.32	2.85	873.59	0.04473	32.97	1.54	516.98	0.10471	77.18
Octanoic acid	0.18	55.49	0.00282	2.08	0.91	279.70	0.01432	10.55	0.10	33.63	0.00681	5.02
Glutaric acid	0.64	202.15	0.01026	7.56	0.54	164.76	0.00844	6.22	0.14	46.23	0.00936	6.90
Nonanoic Acid	0.45	142.69	0.00724	5.34	1.50	459.78	0.02354	17.35	0.46	155.52	0.03150	23.22
Adipic acid	1.20	380.51	0.01931	14.23	0.68	206.90	0.01059	7.81	0.34	113.48	0.02299	16.94
Decanoic acid	0.54	170.44	0.00865	6.37	1.11	341.01	0.01746	12.87	0.30	100.88	0.02043	15.06
Undecanoic acid	1.65	523.20	0.02655	19.57	2.63	804.62	0.04120	30.36	0.44	147.11	0.02980	21.96
Pimelic acid	0.54	170.44	0.00865	6.37	0.25	76.63	0.00392	2.89				
Suberic acid	0.71	225.93	0.01147	8.45	0.43	130.27	0.00667	4.92				
Dodecanoic acid	1.43	451.86	0.02293	16.90	2.25	689.68	0.03531	26.03	0.38	126.09	0.02554	18.82
Azelaic acid	0.78	245.75	0.01247	9.19	0.51	157.09	0.00804	5.93				

Table O-4. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Tridecanoic acid												
Pinonic acid	1.23	388.44	0.01971	14.53					77.05	25908.06	5.24758	3867.62
Phthalic acid	0.48	150.62	0.00764	5.63	2.26	693.51	0.03551	26.17				
1,4-Benzenedicarboxylic acid	2.65	840.29	0.04264	31.43	1.08	329.51	0.01687	12.43				
1,3-Benzenedicarboxylic acid	5.01	1589.43	0.08066	59.45	2.70	827.61	0.04237	31.23				
1,2-Benzenedicarboxylic acid, 4-methyl	0.34	107.02	0.00543	4.00	2.26	693.51	0.03551	26.17				
1,2,4- Benzenetricarboxylic acid	19.75	6262.57	0.31781	234.24	0.84	256.71	0.01314	9.69	8.41	2828.70	0.57294	422.28
Benzenetetracarboxylic acid	5.05	1601.32	0.08126	59.89					3.79	1273.55	0.25795	190.12
Abietic acid												
Pimaric acid												
Sandaracopimaric acid												
Isopimaric acid												
Dehydroabietic acid												
Sebacic acid												
Tetradecanoic acid	3.95	1252.51	0.06356	46.85	3.89	1191.61	0.06101	44.97	1.29	432.92	0.08769	64.63
Pentadecanoic acid	6.49	2057.14	0.10440	76.94	6.89	2111.17	0.10809	79.67	2.19	735.55	0.14898	109.80
Palmitoleic acid	4.86	1541.86	0.07825	57.67	4.66	1429.16	0.07317	53.93	1.99	668.30	0.13536	99.77
Hexadecanoic acid	45.20	14332.57	0.72735	536.08	48.96	15008.11	0.76840	566.33	8.96	3013.64	0.61040	449.88
Heptadecanoic acid	3.15	998.84	0.05069	37.36	3.04	931.06	0.04767	35.13	0.38	126.09	0.02554	18.82
Linoleic acid	0.68	214.04	0.01086	8.01	0.81	249.05	0.01275	9.40	0.33	109.28	0.02213	16.31
Oleic acid	3.40	1078.11	0.05471	40.32	2.21	678.18	0.03472	25.59	1.05	353.06	0.07151	52.71
Linolenic acid												
Octadecanoic acid	21.83	6920.54	0.35121	258.85	15.74	4823.90	0.24698	182.03	2.41	811.20	0.16431	121.10
Nonoadecanoic acid												
Eicosanoic aicd	0.58	182.33	0.00925	6.82	0.34	103.45	0.00530	3.90	0.09	29.42	0.00596	4.39
Docosanoic acid	0.48	150.62	0.00764	5.63	0.44	134.10	0.00687	5.06	0.08	25.22	0.00511	3.76
Tricosanoic acid												
Tetracosanoic acid	0.79	249.71	0.01267	9.34	0.64	195.41	0.01000	7.37	0.21	71.45	0.01447	10.67

Table O-4. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Pentacosanoic acid												
Hexacosanoic acid												
Heptacosanoic acid												
Octacosanoic acid												
Nonacosanoic acid												
Triacontanoic acid												
Total	277.56	88012.15	4.47	3291.92	224.85	68921.61	3.53	2600.77	128.72	43282.10	8.77	6461.26

Table O-5. Campaign #2 Particle-Phase Semivolatiles (July 11, 2002)

Test Date: July 11, 2002
Substrate: Quartz Filter

Sample ID	**IB071102HR6A1**				**IB071102HR6B1**			
Sampling Position	**Residence - Front filter**				**Residence - Front filter**			
Number of filters	**1**				**1**			
Punches after OC/EC analysis	**1**				**0**			
Sampling Flow (lpm)	**8.276**				**8.276**			
Sampling Time (min)	**600**				**600**			
Dilution Ratio	**44.91**				**44.91**			
Flue gas flow (lpm)	**120926**				**120926**			
Fuel (kg/min)	**7.43**				**7.43**			
Volume (uL)	**290**				**310**			
Compound	**ng/µL**	**ng**	**ng/L**	**µg/kg**	**ng/µL**	**ng**	**ng/L**	**µg/kg**
Dimethyl phthalate								
Diethyl phthalate	0.29	94.26	0.01898	14.88	0.15	46.50	0.00936	7.34
Naphthalene								
2-Methylnaphthalene					0.11	34.10	0.00687	5.38
1-Methylnaphthalene								
2,7-Dimethylnaphthalene					0.13	40.30	0.00812	6.36
1,3-Dimethylnaphthalene					0.23	71.30	0.01436	11.26
2,6-Dimethylnaphthalene					0.12	37.20	0.00749	5.87
Add'l Dimethylnaphthalenes								
Acenaphthylene								
Acenaphthene								
Fluorene								
1-Methylfluorene	0.37	120.27	0.02422	18.99	0.39	120.90	0.02435	19.09
Add'l Methylfluorene - Peak 1								
Add'l Methylfluorene - Peak 2								
Phenanthrene	0.93	302.29	0.06088	47.73	1.04	322.40	0.06493	50.91
Add'l Dimethylphenanthrenes	1.03	334.79	0.06743	52.86	1.06	328.60	0.06618	51.88
Anthracene								

Table O-5. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Methylanthracene-Peak 1	2.66	864.61	0.17413	136.52	3.01	933.10	0.18792	147.33
Methylanthracene-Peak 2	3.23	1049.88	0.21144	165.77	3.87	1199.70	0.24161	189.43
Methylanthracene-Peak 3	2.09	679.34	0.13681	107.26	2.31	716.10	0.14422	113.07
Methylanthracene-Peak 4	1.78	578.57	0.11652	91.35	1.99	616.90	0.12424	97.41
Octylcyclohexane								
Norpristane								
Decylcyclohexane								
Pristane	0.69	224.28	0.04517	35.41	0.79	244.90	0.04932	38.67
Phytane	1.81	588.33	0.11849	92.89	2.29	709.90	0.14297	112.09
Tridecylcyclohexane								
Dibutyl phthalate	2.85	926.37	0.18657	146.27	0.61	189.10	0.03808	29.86
Butylbenzyl phthalate	2.27	737.84	0.14860	116.50	0.55	170.50	0.03434	26.92
bis (2-Ethylhexyl) phthalate	2.85	926.37	0.18657	146.27	6.87	2129.70	0.42891	336.27
Dioctylphthalate								
Fluoranthene	0.15	48.76	0.00982	7.70	0.21	65.10	0.01311	10.28
Pyrene	2.28	741.10	0.14925	117.02	2.38	737.80	0.14859	116.50
Chrysene	0.35	113.76	0.02291	17.96	0.38	117.80	0.02372	18.60
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								

Table O-5. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)								
n-Tridecane (*n*-C13)					0.10	31.00	0.00624	4.89
9H-Fluoren-9-one	0.48	156.02	0.03142	24.63				
n-Tetradecane (*n*-C14)	0.14	45.51	0.00916	7.19	0.12	37.20	0.00749	5.87
n-Pentadecane (*n*-C15)								
n-Hexadecane (*n*-C16)	0.68	221.03	0.04451	34.90	0.73	226.30	0.04558	35.73
n-Heptadecane (*n*-C17)	1.92	624.08	0.12569	98.54	2.10	651.00	0.13111	102.79
1-Octadecene								
n-Octadecane (*n*-C18)	2.97	965.37	0.19442	152.43	3.41	1057.10	0.21289	166.91
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	5.34	1735.72	0.34956	274.06	6.19	1918.90	0.38646	302.99
n-Eicosane (*n*-C20)	19.85	6452.08	1.29941	1018.76	22.54	6987.40	1.40722	1103.28
n-Heneicosane (*n*-C21)	20.51	6666.60	1.34262	1052.63	23.16	7179.60	1.44593	1133.63
n-Docosane (*n*-C22)	24.05	7817.25	1.57435	1234.31	27.50	8525.00	1.71689	1346.06
n-Tricosane (*n*-C23)	24.65	8012.28	1.61363	1265.11	28.22	8748.20	1.76184	1381.31
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene								

Table O-5. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Anthraquinone								
Naphthalic anhydride	4.37	1420.43	0.28607	224.28	4.01	1243.10	0.25035	196.28
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	25.55	8304.81	1.67254	1311.30	28.33	8782.30	1.76871	1386.69
iso-Tricosane (C24)								
anteiso-Tricosane (C24)								
n-Pentacosane (*n*-C25)	11.78	3828.99	0.77114	604.58	12.86	3986.60	0.80288	629.47
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C26)	8.17	2655.59	0.53482	419.31	8.68	2690.80	0.54191	424.87
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)								
Heptacosane (*n*-C27)	5.14	1670.71	0.33647	263.80	4.94	1531.40	0.30842	241.80
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (*n*-C28)	4.68	1521.20	0.30636	240.19	3.98	1233.80	0.24848	194.81
Nonacosane (*n*-C29)	1.90	617.58	0.12438	97.51	1.48	458.80	0.09240	72.44
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	1.56	507.07	0.10212	80.06	15.44	4786.40	0.96395	755.75
Indeno[1,2,3-c,d]fluoranthene								

Table O-5. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Dibenzo[a,e]pyrene								
n-Triacontane (*n*-C30)	0.43	139.77	0.02815	22.07	0.28	86.80	0.01748	13.71
n-Hentriacontane (*n*-C31)	0.52	169.02	0.03404	26.69	0.35	108.50	0.02185	17.13
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (*n*-C32)	0.75	243.78	0.04910	38.49	0.56	173.60	0.03496	27.41
Tritriacontane (C33)								
Tetratriacontane (C34)								
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)								
Hexatriacontane (*n*-C36)								
Tetracontane (C40)								
Hexanoic acid	0.38	121.89	0.02455	19.25	0.55	170.50	0.03434	26.92
Succinic acid	2.66	865.42	0.17429	136.65	2.91	902.88	0.18183	142.56
Octanoic acid	0.58	186.90	0.03764	29.51	0.54	166.63	0.03356	26.31
Glutaric acid	1.23	398.18	0.08019	62.87	1.19	368.13	0.07414	58.13
Nonanoic Acid	1.43	463.18	0.09328	73.14	1.29	399.13	0.08038	63.02
Adipic acid	1.30	422.55	0.08510	66.72	1.25	387.50	0.07804	61.18
Decanoic acid	1.04	337.23	0.06792	53.25	0.83	255.75	0.05151	40.38
Undecanoic acid	2.16	702.90	0.14156	110.99	2.48	767.25	0.15452	121.15
Pimelic acid	0.39	125.95	0.02537	19.89	0.40	124.00	0.02497	19.58
Suberic acid	0.48	154.39	0.03109	24.38	0.55	170.50	0.03434	26.92
Dodecanoic acid	1.86	605.39	0.12192	95.59	2.14	662.63	0.13345	104.63
Azelaic acid								

Table O-5. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Tridecanoic acid								
Pinonic acid	3.03	983.25	0.19802	155.25				
Phthalic acid	1.20	390.05	0.07855	61.59	0.85	263.50	0.05307	41.61
1,4-Benzenedicarboxylic acid	1.58	511.94	0.10310	80.83	1.90	589.00	0.11862	93.00
1,3-Benzenedicarboxylic acid	2.65	861.36	0.17347	136.01	3.34	1034.63	0.20837	163.36
1,2-Benzenedicarboxylic acid, 4-methyl	1.06	345.36	0.06955	54.53	0.81	251.88	0.05073	39.77
1,2,4-Benzenetricarboxylic acid	20.70	6728.36	1.35505	1062.38	21.13	6548.75	1.31888	1034.02
Benzenetetracarboxylic acid	5.20	1690.22	0.34040	266.88	4.78	1480.25	0.29811	233.73
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid	2.80	910.12	0.18329	143.70	5.04	1561.63	0.31450	246.57
Pentadecanoic acid	5.95	1934.00	0.38950	305.37	8.95	2774.50	0.55877	438.08
Palmitoleic acid	2.24	727.28	0.14647	114.83	6.89	2135.13	0.43000	337.13
Hexadecanoic acid	22.99	7471.90	1.50480	1179.78	33.64	10427.63	2.10007	1646.48
Heptadecanoic acid	1.98	641.96	0.12929	101.36	2.70	837.00	0.16857	132.16
Linoleic acid	1.93	625.71	0.12601	98.80	2.05	635.50	0.12799	100.34
Oleic acid	0.91	296.60	0.05973	46.83	3.65	1131.50	0.22788	178.66
Linolenic acid								
Octadecanoic acid	9.48	3079.77	0.62025	486.28	11.20	3472.00	0.69924	548.22
Nonoadecanoic acid								
Eicosanoic aicd	0.34	109.70	0.02209	17.32	0.55	170.50	0.03434	26.92
Docosanoic acid	0.21	69.07	0.01391	10.91	0.39	120.13	0.02419	18.97
Tricosanoic acid								
Tetracosanoic acid	0.54	174.71	0.03519	27.59	1.44	445.63	0.08975	70.36
Pentacosanoic acid								

Table O-5. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid								
Triacontanoic acid								
Total	289.32	94041.06	18.94	14848.72	346.87	107529.7	21.66	16978.52

Table O-6. Campaign #2 Particle-Phase Semivolatiles (July 11, 2002)

Test Date: July 11, 2002
Substrate: Quartz Filter

Sample ID	**IB071102HR8A1**				**IB071102HR10A1**			
Sampling Position	**Residence - Front filter**				**Residence - Front filter**			
Number of Filters	**1**				**1**			
Punches after OC/EC analysis	**1**				**1**			
Sampling Flow (lpm)	**8.239**				**8.239**			
Sampling Time (min)	**600**				**600**			
Dilution Ratio	**44.91**				**44.91**			
Flue gas flow (lpm)	**120926**				**120926**			
Fuel (kg/min)	**7.43**				**7.43**			
Volume (µL)	**300**				**290**			
Compound	**ng/µL**	**ng**	**ng/L**	**µg/kg**	**ng/µL**	**ng**	**ng/L**	**µg/kg**
Dimethyl phthalate								
Diethyl phthalate	0.16	53.80	0.01088	8.53	0.27	87.76	0.01775	13.92
Naphthalene								
2-Methylnaphthalene								
1-Methylnaphthalene								
2,7-Dimethylnaphthalene								
1,3-Dimethylnaphthalene								
2,6-Dimethylnaphthalene								
Add'l Dimethylnaphthalenes								
Acenaphthylene								
Acenaphthene								
Fluorene								
1-Methylfluorene	0.29	97.51	0.01973	15.46	0.28	91.01	0.01841	14.43
Add'l Methylfluorene - Peak 1								
Add'l Methylfluorene - Peak 2								
Phenanthrene	0.79	265.64	0.05373	42.13	0.75	243.78	0.04931	38.66
Add'l Dimethylphenanthrenes	0.86	289.18	0.05850	45.86	0.89	289.29	0.05852	45.88
Anthracene								

Table O-6. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Methylanthracene-Peak 1	2.22	746.48	0.15100	118.39	2.18	708.59	0.14334	112.38
Methylanthracene-Peak 2	2.73	917.96	0.18569	145.58	2.86	929.62	0.18805	147.43
Methylanthracene-Peak 3	1.69	568.26	0.11495	90.12	1.77	575.32	0.11638	91.24
Methylanthracene-Peak 4	1.44	484.20	0.09795	76.79	1.45	471.31	0.09534	74.75
Octylcyclohexane								
Norpristane								
Decylcyclohexane								
Pristane	0.59	198.39	0.04013	31.46	0.56	182.02	0.03682	28.87
Phytane	1.51	507.74	0.10271	80.52	1.48	481.06	0.09731	76.29
Tridecylcyclohexane								
Dibutylphthalate	1.67	561.54	0.11359	89.06	0.75	243.78	0.04931	38.66
Butylbenzylphthalate	1.81	608.61	0.12311	96.52	0.76	247.03	0.04997	39.18
Bis-2-Ethylhexylphthalate	1.00	336.25	0.06802	53.33	1.21	393.30	0.07956	62.37
Dioctylphthalate								
Fluoranthene	0.15	50.44	0.01020	8.00				
Pyrene	2.04	685.95	0.13876	108.79	1.78	578.57	0.11704	91.76
Chrysene	0.33	110.96	0.02245	17.60	0.31	100.76	0.02038	15.98
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								

Table O-6. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)								
n-Tridecane (*n*-C13)								
9H-Fluoren-9-one								
n-Tetradecane (*n*-C14)	0.11	36.99	0.00748	5.87	0.09	29.25	0.00592	4.64
n-Pentadecane (*n*-C15)								
n-Hexadecane (*n*-C16)	0.62	208.48	0.04217	33.06	0.52	169.02	0.03419	26.81
n-Heptadecane (*n*-C17)	1.61	541.36	0.10951	85.86	1.39	451.81	0.09139	71.65
1-Octadecene								
n-Octadecane (*n*-C18)	2.83	951.59	0.19249	150.92	2.36	767.10	0.15517	121.66
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	4.83	1624.09	0.32853	257.57	4.53	1472.44	0.29785	233.52
n-Eicosane (*n*-C20)	18.90	6355.13	1.28554	1007.88	15.02	4882.13	0.98757	774.27
n-Heneicosane (*n*-C21)	19.41	6526.61	1.32023	1035.08	14.81	4813.87	0.97377	763.45
n-Docosane (*n*-C22)	22.07	7421.04	1.50115	1176.93	18.62	6052.28	1.22428	959.85
n-Tricosane (*n*-C23)	22.78	7659.78	1.54945	1214.79	20.87	6783.62	1.37222	1075.84
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene								

Table O-6. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Anthraquinone								
Naphthalic anhydride	4.21	1415.61	0.28636	224.51	3.05	991.38	0.20054	157.23
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	23.29	7831.26	1.58414	1241.99	21.52	6994.90	1.41495	1109.34
iso-Tricosane (C23)								
anteiso-Tricosane (C23)								
n-Pentacosane (*n*-C25)	10.72	3604.60	0.72915	571.67	10.02	3256.92	0.65882	516.53
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C26)	7.25	2437.81	0.49313	386.62	6.87	2233.04	0.45171	354.14
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)								
Heptacosane (*n*-C27)	3.90	1311.38	0.26527	207.98	4.03	1309.92	0.26497	207.74
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (n-C28)	3.55	1193.69	0.24146	189.31	3.25	1056.39	0.21369	167.54
Nonacosane (n-C29)	1.14	383.33	0.07754	60.79	1.05	341.29	0.06904	54.13
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	3.72	1250.85	0.25303	198.38	7.06	2294.79	0.46420	363.94
Indeno[1,2,3-c,d]fluoranthene								

Table O-6. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Dibenzo[a,e]pyrene								
n-Triacontane (*n*-C30)	0.24	80.70	0.01632	12.80	0.22	71.51	0.01447	11.34
n-Hentriacontane (*n*-C31)	0.26	87.43	0.01768	13.87	0.20	65.01	0.01315	10.31
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (*n*-C32)	0.58	195.03	0.03945	30.93	0.57	185.27	0.03748	29.38
Tritriacontane (C33)								
Tetratriacontane (C34)								
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)								
Hexatriacontane (*n*-C36)								
Tetracontane (C40)								
Hexanoic acid	0.56	189.14	0.03826	30.00	0.43	138.14	0.02794	21.91
Succinic acid	2.85	958.31	0.19385	151.98	2.83	918.24	0.18575	145.63
Octanoic acid	0.50	168.13	0.03401	26.66	0.53	170.65	0.03452	27.06
Glutaric acid	1.06	357.27	0.07227	56.66	0.88	284.41	0.05753	45.11
Nonanoic Acid	1.05	353.06	0.07142	55.99	1.44	467.25	0.09452	74.10
Adipic acid	1.00	336.25	0.06802	53.33	0.79	255.97	0.05178	40.60
Decanoic acid	0.74	247.98	0.05016	39.33	0.83	268.16	0.05424	42.53
Undecanoic acid	1.51	508.58	0.10288	80.66	1.73	560.70	0.11342	88.92
Pimelic acid	0.48	159.72	0.03231	25.33	0.41	134.08	0.02712	21.26
Suberic acid	0.43	142.91	0.02891	22.66	0.34	109.70	0.02219	17.40
Dodecanoic acid	1.30	437.13	0.08842	69.33	1.48	479.44	0.09698	76.04
Azelaic acid								

Table O-6. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Tridecanoic acid								
Pinonic acid	1.63	546.41	0.11053	86.66	0.33	105.64	0.02137	16.75
Phthalic acid	0.86	290.02	0.05867	45.99	0.80	260.03	0.05260	41.24
1,4-Benzenedicarboxylic acid	1.61	542.20	0.10968	85.99	1.55	503.81	0.10191	79.90
1,3-Benzenedicarboxylic acid	2.74	920.48	0.18620	145.98	2.81	914.18	0.18492	144.98
1,2-Benzenedicarboxylic acid, 4-methyl	0.73	243.78	0.04931	38.66	0.71	231.59	0.04685	36.73
1,2,4-Benzenetricarboxylic acid	19.98	6716.59	1.35866	1065.21	22.53	7321.56	1.48103	1161.15
Benzenetetracarboxylic acid	5.64	1895.61	0.38345	300.63	6.45	2096.52	0.42409	332.49
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid	2.04	685.11	0.13859	108.65	2.06	670.40	0.13561	106.32
Pentadecanoic acid	4.08	1370.22	0.27717	217.31	4.16	1352.99	0.27369	214.57
Palmitoleic acid	1.25	420.31	0.08502	66.66	2.09	678.52	0.13725	107.61
Hexadecanoic acid	16.74	5627.98	1.13845	892.56	17.70	5753.24	1.16379	912.42
Heptadecanoic acid	1.58	529.59	0.10713	83.99	1.65	536.32	0.10849	85.06
Linoleic acid					1.51	491.63	0.09945	77.97
Oleic acid					0.98	316.92	0.06411	50.26
Linolenic acid								
Octadecanoic acid	7.31	2458.83	0.49738	389.95	7.53	2445.94	0.49477	387.91
Nonoadecanoic acid								
Eicosanoic aicd	0.25	84.06	0.01700	13.33	0.26	85.32	0.01726	13.53
Docosanoic acid	0.13	42.03	0.00850	6.67	0.16	52.82	0.01068	8.38
Tricosanoic acid								
Tetracosanoic acid	0.28	92.47	0.01870	14.66	0.34	109.70	0.02219	17.40
Pentacosanoic acid								
Hexacosanoic acid								

Table O-6. (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid								
Triacontanoic acid								
Total	249.59	83923.80	16.98	13309.75	238.61	77559.00	15.69	12300.34

Table O-7. Campaign #2 Particle-Phase Semivolatiles (July 11, 2002)

Test Date: July 11, 2002
Substrate: Quartz Filter

Sample ID	**IB071102HR2&R4**				**IB071002HD1A1**			
Sampling Position	**Residence - Backup filter**				**Dilution - Front filter**			
Number of Filters	**4**				**1**			
Punches after OC/EC Analysis	**2**				**1**			
Sampling Flow (lpm)	**32.668**				**8.203**			
Sampling Time (min)	**600**				**600**			
Dilution Ratio	**44.91**				**44.91**			
Flue Gas Flow (lpm)	**120926**				**120926**			
Fuel (kg/min)	**7.43**				**7.43**			
Volume (µL)	**300**				**270**			
Compound	**ng/µL**	**ng**	**ng/L**	**µg/kg**	**ng/µL**	**ng**	**ng/L**	**µg/kg**
Dimethyl phthalate								
Diethyl phthalate	0.15	47.56	0.00243	1.90				
Naphthalene								
2-Methylnaphthalene								
1-Methylnaphthalene								
2,7-Dimethylnaphthalene								
1,3-Dimethylnaphthalene								
2,6-Dimethylnaphthalene								
Add'l Dimethylnaphthalenes								
Acenaphthylene								
Acenaphthene								
Fluorene								
1-Methylfluorene	0.26	82.44	0.00421	3.30				
Add'l Methylfluorene - Peak 1								
Add'l Methylfluorene - Peak 2								
Phenanthrene	0.48	152.20	0.00777	6.09				
Add'l Dimethylphenanthrenes								
Anthracene								

Table O-7 (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Methylanthracene-Peak 1								
Methylanthracene-Peak 2								
Methylanthracene-Peak 3								
Methylanthracene-Peak 4								
Octylcyclohexane	1.52	481.98	0.02459	19.28				
Norpristane	3.89	1233.49	0.06293	49.34				
Decylcyclohexane								
Pristane	0.71	225.14	0.01149	9.01				
Phytane	0.66	209.28	0.01068	8.37				
Tridecylcyclohexane	2.50	792.73	0.04044	31.71				
Dibutylphthalate	0.32	101.47	0.00518	4.06	0.58	175.52	0.03566	27.96
Butylbenzylphthalate	0.11	34.88	0.00178	1.40	0.42	127.10	0.02582	20.25
Bis-2-Ethylhexylphthalate	1.19	377.34	0.01925	15.09	0.28	84.74	0.01722	13.50
Dioctylphthalate	0.12	38.05	0.00194	1.52				
Fluoranthene								
Pyrene								
Chrysene								
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								

Table O-7 (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)								
n-Tridecane (*n*-C13)								
9H-Fluoren-9-one	0.39	123.67	0.00631	4.95				
n-Tetradecane (*n*-C14)	0.17	53.91	0.00275	2.16	0.08	24.21	0.00492	3.86
n-Pentadecane (*n*-C15)								
n-Hexadecane (*n*-C16)	1.15	364.66	0.01860	14.59	0.12	36.32	0.00738	5.78
n-Heptadecane (*n*-C17)	3.22	1021.04	0.05209	40.84				
1-Octadecene								
n-Octadecane (*n*-C18)	6.36	2016.71	0.10289	80.67				
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	11.53	3656.07	0.18653	146.24				
n-Eicosane (*n*-C20)	35.14	11142.62	0.56848	445.70	0.07	21.18	0.00430	3.37
n-Heneicosane (*n*-C21)	32.31	10245.25	0.52270	409.80	0.14	42.37	0.00861	6.75
n-Docosane (*n*-C22)	36.08	11440.69	0.58369	457.62	0.17	51.45	0.01045	8.20
n-Tricosane (*n*-C23)	26.75	8482.22	0.43275	339.28	0.29	87.76	0.01783	13.98
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene								

Table O-7 (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Anthraquinone								
Naphthalic anhydride	3.19	1011.52	0.05161	40.46				
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	15.67	4968.84	0.25350	198.75	0.47	142.23	0.02890	22.66
iso-Tricosane (C23)								
anteiso-Tricosane (C23)								
n-Pentacosane (n-C25)	3.71	1176.41	0.06002	47.06	0.38	115.00	0.02337	18.32
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (n-C26)	1.51	478.81	0.02443	19.15	0.43	130.13	0.02644	20.73
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)								
Heptacosane (n-C27)	0.85	269.53	0.01375	10.78	0.48	145.26	0.02951	23.14
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (*n*-C28)	1.21	383.68	0.01957	15.35	0.63	190.65	0.03874	30.37
Nonacosane (*n*-C29)	0.66	209.28	0.01068	8.37	0.37	111.97	0.02275	17.84
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	6.71	2127.69	0.10855	85.11	0.54	163.42	0.03320	26.03
Indeno[1,2,3-c,d]fluoranthene								

Table O-7 (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Dibenzo[a,e]pyrene								
n-Triacontane (*n*-C30)	0.21	66.59	0.00340	2.66	0.14	42.37	0.00861	6.75
n-Hentriacontane (*n*-C31)	0.25	79.27	0.00404	3.17	0.16	48.42	0.00984	7.71
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (n-C32)	0.58	183.91	0.00938	7.36	0.46	139.21	0.02828	22.18
Tritriacontane (C33)	0.04	12.68	0.00065	0.51				
Tetratriacontane (C34)								
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)								
Hexatriacontane (*n*-C36)								
Tetracontane (C40)								
Hexanoic acid	0.64	202.15	0.01031	8.09				
Succinic acid	1.50	475.64	0.02427	19.03	1.20	363.15	0.07378	57.85
Octanoic acid	1.06	336.91	0.01719	13.48				
Glutaric acid	0.64	202.15	0.01031	8.09				
Nonanoic Acid	2.19	693.64	0.03539	27.75	0.53	158.88	0.03228	25.31
Adipic acid	0.78	245.75	0.01254	9.83	0.21	64.31	0.01307	10.24
Decanoic acid	1.69	535.09	0.02730	21.40	0.24	71.87	0.01460	11.45
Undecanoic acid	4.49	1422.95	0.07260	56.92	0.30	90.79	0.01845	14.46
Pimelic acid	0.21	67.38	0.00344	2.70				
Suberic acid								
Dodecanoic acid	3.88	1228.73	0.06269	49.15	0.26	79.44	0.01614	12.65
Azelaic acid								

Table O-7 (Continued)

Compound	ng/µL	ng	ng/L	µg/kg	ng/µL	ng	ng/L	µg/kg
Tridecanoic acid								
Pinonic acid	2.16	685.71	0.03498	27.43				
Phthalic acid	4.41	1399.17	0.07138	55.97				
1,4-Benzenedicarboxylic acid	0.61	194.22	0.00991	7.77				
1,3-Benzenedicarboxylic acid	0.99	313.13	0.01598	12.52				
1,2-Benzenedicarboxylic acid, 4-methyl	4.89	1549.79	0.07907	61.99				
1,2,4-Benzenetricarboxylic acid	1.20	380.51	0.01941	15.22				
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid	6.01	1906.52	0.09727	76.26	0.36	109.70	0.02229	17.47
Pentadecanoic acid	9.25	2933.10	0.14964	117.32	1.61	487.98	0.09915	77.73
Palmitoleic acid	8.59	2723.03	0.13892	108.92	0.36	109.70	0.02229	17.47
Hexadecanoic acid	35.11	11133.90	0.56803	445.35	2.75	832.22	0.16909	132.57
Heptadecanoic acid	2.51	796.69	0.04065	31.87	0.15	45.39	0.00922	7.23
Linoleic acid	2.71	860.11	0.04388	34.40				
Oleic acid	1.48	467.71	0.02386	18.71	0.21	64.31	0.01307	10.24
Linolenic acid								
Octadecanoic acid	7.76	2461.43	0.12558	98.46	0.95	287.49	0.05841	45.80
Nonoadecanoic acid								
Eicosanoic aicd	0.29	91.16	0.00465	3.65				
Docosanoic acid	0.28	87.20	0.00445	3.49				
Tricosanoic acid								
Tetracosanoic acid	0.55	174.40	0.00890	6.98	0.13	37.83	0.00769	6.03
Pentacosanoic acid								
Hexacosanoic acid								

Table O-7 (Continued)

Compound	ng/uL	ng	ng/L	ug/kg	ng/uL	ng	ng/L	ug/kg
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid								
Triacontanoic acid								
Total	305.46	96859.82	4.94	3874.32	15.47	4682.37	0.95	745.88

Appendix P

Individual Gas-Phase (PUF) Semivolatile Organic Compounds

Table P-1. PUF Species Emission Factors (mg/kg)

Test Date	July 9, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Dimethyl phthalate	0.000	0.000				0.000	0.000	0.000
Diethyl phthalate	0.107	0.055				0.000	0.018	0.032
Naphthalene	0.593	0.401				0.401	0.490	0.077
2-Methylnaphthalene	2.918	2.334				1.836	2. 200	0.319
1-Methylnaphthalene	1.979	1.533				1.247	1.473	0.202
2,7-Dimethylnaphthalene	3.708	2.842				2.493	2.860	0.377
1,3-Dimethylnaphthalene	3.272	2.234				1.880	2.147	0.235
2,6-Dimethylnaphthalene	4.086	3.008				2.563	2.907	0.306
Add'l Dimethylnaphthalenes	3.217	2.100				1.799	2.067	0.254
Acenaphthylene	0.053	0.075				0.026	0.061	0.031
Acenaphthene	0.000	0.000				0.000	0.000	0.000
Fluorene	0.581	0.606				0. 587	0.612	0.028
1-Methylfluorene	1.558	0.874				0.164	0.742	0.524
Add'l Methylfluorene - Peak 1	1.132	1.037				0.734	1.074	0.360
Add'l Methylfluorene - Peak 2	0.354	0.228				0.704	0.428	0.247
Phenanthrene	1.552	1.363				1.032	1.392	0.376
Add'l Dimethylphenanthrenes	0.098	0.125				0.137	0.135	0.009
Anthracene	0.000	0.000				0.000	0.000	0.000
Methylanthracene - Peak 1	0.000	1.561				1.133	1.542	0.400
Methylanthracene - Peak 2	3.892	1.777				1.370	1.791	0.428
Methylanthracene - Peak 3	1.139	0.972				0.728	0.968	0.237
Methylanthracene - Peak 4	0.839	0.792				0.573	0.793	0.220
Octylcyclohexane	0.000	0.000				0.000	0.000	0.000
Norpristane	3.587	1.828				1.663	1.968	0.394
Decylcyclohexane	0.356	0.290				0.343	0.314	0.027
Pristane	3.837	2.353				1.811	2.468	0.721
Phytane	2.224	1.682				1.262	1.908	0.784
Tridecylcyclohexane	0.000	0.000				0.000	0.000	0.000
Dibutyl phthalate	0.151	0.107				0.050	0.062	0.041
Butyl benzyl phthalate	0.000	0.077				0.174	0.084	0.087
bis(2-Ethylhexyl) phthalate	0.223	0.000				0.006	0.000	0.018
Dioctyl phthalate						0.074	0.074	
Fluoranthene	0.062	0.042				0.137	0.080	0.050
Pyrene	0.104	0.125				0.000	0.090	0.078
Chrysene	0.000	0.008				0.004	0.004	0.004
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane	0.000	0.000				0.000	0.000	0.000
Squalane								
Indeno[1,2,3-cd]pyrene								

Table P-1. (Continued)

Test Date	July 9, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)	0.000	0.005				0.000	0.002	0.003
n-Undecane (*n*-C11)	0.660	0.246				0.190	0.242	0.050
n-Dodecane (*n*-C12)	0.319	0.231				0.222	0.228	0.005
n-Tridecane (*n*-C13)	0.000	0.391				0.285	0.376	0.084
9H-Fluoren-9-one	0.941	0.816				0.709	0.828	0.125
n-Tetradecane (*n*-C14)	3.395	2.524				2.078	2.542	0.474
n-Pentadecane (*n*-C15)	8.528	6.001				4.944	6.005	1.062
n-Hexadecane (*n*-C16)	7.715	4.998				3.919	5.418	1.748
n-Heptadecane (*n*-C17)	0.000	0.000				0.000	0.000	0.000
1-Octadecene	4.813	3.537				3.299	3.904	0.851
n-Octadecane (*n*-C18)	0.000	0.000				0.000	0.000	0.000
2-Methylnonadecane	0.000	0.000				0.000	0.000	0.000
3-Methylnonadecane	3.251	2.618				2.846	3.219	0.852
n-Nonadecane (*n*-C19)	3.346	2.526				2.241	2.793	0.566
n-Eicosane (*n*-C20)	2.823	2.456				2.131	2.687	0.701
n-Heneicosane (*n*-C21)	2.511	2.171				2.165	2.531	0.629
n-Docosane (*n*-C22)	3.126	2.345				1.978	2.434	0.5.6
n-Tricosane (*n*-C23)								
iso-Docosane (C22)								
anteiso-Docosane (C22)	0.069	0.067				0.065	0.071	0.008
Pyrene								
Anthraquinone								
Naphthalic anhydride								
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								

Table P-1. (Continued)

Test Date	July 9, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
1-Methylchrysene								
Benzo[a]pyrene	1.376	0.985				0.882	1.081	0.261
n-Tetracosane (*n*-C24)								
iso-Tricosane (C23)								
anteiso-Tricosane (C23)	0.798	0.484				0.592	0.625	0.160
n-Pentacosane (*n*-C25)								
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)	0.567	0.340				0.417	0.441	0.115
n-Hexacosane (*n*-C26)								
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)	0.434	0.256				0.370	0.353	0.090
Heptacosane (*n*-C27)								
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)	0.598	0.307				0.320	0.408	0.164
Octacosane (*n*-C28)	0.528	0.229				0.282	0.346	0.160
Nonacosane (*n*-C29)								
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)	0.000	0.000				0.000	0.000	0.000
Squalene								
Indeno[1,2,3-c,d]fluoranthene								
Dibenzo[a,e]pyrene	2.909	1.167				1.226	1.767	0.989
n-Triacontane (*n*-C30)	1.239	1.066				1.100	1.135	0.092
n-Hentriacontane (*n*-C31)								
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)	1.370	0.557				0.572	0.833	0.465
Dotriacontane (*n*-C32)	0.837	0.320				0.301	0.486	0.304
Tritriacontane (C33)	1.127	0.444				0.402	0.658	0.407
Tetratriacontane (C34)								
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)	1.193	0.650				0.667	0.837	0.309
Hexatriacontane (*n*-C36)	0.000	0.000				0.000	0.000	0.000
Tetracontane (C40)	0.472	0.268				0.130	0.290	0.172
	0.000	0.000				0.000	0.000	0.000

Table P-1. (Continued)

Test Date	July 9, 2002							
Sampling Array	6A	6B	8A	8B	10A	10B	Day Avg	SD
Compound								
Hexanoic acid	0.433	0.355				0.110	0.298	0.171
Succinic acid	0.022	0.000				0.000	0.007	0.013
Octanoic acid	0.528	0.450				0.310	0.428	0.113
Glutaric acid	0.000	0.000				0.000	0.000	0.000
Nonanoic Acid	0.350	0.284				0.300	0.311	0.035
Adipic acid	0.372	0.209				0.640	0.408	0.218
Decanoic acid								
Undecanoic acid								
Pimelic acid	0.249	0.147				0.620	0.340	0.251
Suberic acid	0.324	0.000				0.000	0.108	0.187
Dodecanoic acid								
Azelaic acid								
Tridecanoic acid								
Pinonic acid								
Phthalic acid								
1,4-Benzenedicarboxylic acid								
1,3-Benzenedicarboxylic acid								
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid								
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid	0.000	0.000				0.000	0.000	0.000
Sebacic acid	0.000	0.000				0.000	0.000	0.000
Tetradecanoic acid	0.000	0.000				0.000	0.000	0.000
Pentadecanoic acid	0.000	0.000				0.000	0.000	0.000
Palmitoleic acid	0.000	0.000				0.000	0.000	0.000
Hexadecanoic acid	0.001	0.000				0.000	0.000	0.000
Heptadecanoic acid	0.000	0.000				0.000	0.000	0.000
Linoleic acid	0.000	0.000				0.000	0.000	0.000
Oleic acid	0.000	0.000				0.816	0.272	0.471
Linolenic acid								
Octadecanoic acid	0.000	0.000				0.000	0.000	0.000
Nonoadecanoic acid	0.000	0.000				0.000	0.000	0.000
Eicosanoic aicd								
Docosanoic acid	0.0000	0.000				0.000	0.000	0.000
Tricosanoic acid								
Tetracosanoic acid								
Pentacosanoic acid								

Table P-1. (Continued)

Test Date	July 9, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid	101.26	83.22			93.27	80.30	89.51	9.60

Table P-2. PUF Species Emission Factors (mg/kg)

Test Date	July 10, 2002							
Sampling Array	6A	6B	8A	8B	10A	10B	Day Avg	SD
Compound								
Dimethyl phthalate	0.000	0.000				0.000	0.000	0.000
Diethyl phthalate	0.000	0.055				0.000	0.018	0.032
Naphthalene	0.542	0.527				0.401	0.490	0.077
2-Methylnaphthalene	2.431	2.334				1.836	2.200	0.319
1-Methylnaphthalene	1.638	1.533				1.247	1.473	0.202
2,7-Dimethylnaphthalene	3.246	2.842				2.493	2.860	0.377
1,3-Dimethylnaphthalene	2.326	2.234				1.880	2.147	0.235
2,6-Dimethylnaphthalene	3.149	3.008				2.563	2.907	0.306
Add'l Dimethylnaphthalenes	2.304	2.100				1.799	2.067	0.254
Acenaphthylene	0.083	0.075				0.026	0.061	0.031
Acenaphthene	0.000	0.000				0.000	0.000	0.000
Fluorene	0.642	0.606				0.587	0.612	0.028
1-Methylfluorene	1.187	0.874				0.164	0.742	0.524
Add'l Methylfluorene - Peak 1	1.451	1.037				0.734	1.074	0.360
Add'l Methylfluorene - Peak 2								
Phenanthrene	0.353	0.228				0.704	0.428	0.247
Add'l Dimethylphenanthrenes	1.782	1.363				1.032	1.392	0.376
Anthracene	0.144	0.125				0.137	0.135	0.009
Methylanthracene - Peak 1	0.000	0.000				0.000	0.000	0.000
Methylanthracene - Peak 2	1.933	1.561				1.133	1.542	0.400
Methylanthracene - Peak 3	2.226	1.777				1.370	1.791	0.428
Methylanthracene - Peak 4	1.202	0.972				0.728	0.968	0.237
Octylcyclohexane	1.014	0.792				0.573	0.793	0.220
Norpristane	0.000	0.000				0.000	0.000	0.000
Decylcyclohexane	2.413	1.828				1.663	1.968	0.394
Pristane	0.311	0.290				0.343	0.314	0.027
Phytane	3.240	2.353				1.811	2.468	0.721
Tridecylcyclohexane	2.780	1.682				1.262	1.908	0.784
Dibutyl phthalate	0.000	0.000				0.000	0.000	0.000
Butyl benzyl phthalate	0.028	0.107				0.050	0.062	0.041
bis(2-Ethylhexyl) phthalate	0.000	0.077				0.174	0.084	0.087
Dioctyl phthalate	0.034	0.000				0.006	0.000	0.018
Fluoranthene						0.074	0.074	
Pyrene	0.062	0.042				0.137	0.080	0.050
Chrysene	0.144	0.125				0.000	0.090	0.078
Benzo[a]anthracene	0.000	0.008				0.004	0.004	0.004
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane	0.000	0.000				0.000	0.000	0.000

Table P-2. (Continued)

Test Date	July 10, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)	0.000	0.005				0.000	0.002	0.003
n-Dodecane (*n*-C12)	0.289	0.246				0.190	0.242	0.050
n-Tridecane (*n*-C13)	0.232	0.231				0.222	0.228	0.005
9H-Fluoren-9-one	0.451	0.391				0.285	0.376	0.084
n-Tetradecane (*n*-C14)	0.959	0.816				0.709	0.828	0.125
n-Pentadecane (*n*-C15)	3.025	2.524				2.078	2.542	0.474
n-Hexadecane (*n*-C16)	7.069	6.001				4.944	6.005	1.062
n-Heptadecane (*n*-C17)	7.338	4.998				3.919	5.418	1.748
1-Octadecene	0.000	0.000				0.000	0.000	0.000
n-Octadecane (*n*-C18)	4.877	3.537				3.299	3.904	0.851
2-Methylnonadecane	0.000	0.000				0.000	0.000	0.000
3-Methylnonadecane	0.000	0.000				0.000	0.000	0.000
n-Nonadecane (*n*-C19)	4.194	2.618				2.846	3.219	0.852
n-Eicosane (*n*-C20)	3.433	2.526				2.421	2.793	0.556
n-Heneicosane (*n*-C21)	3.474	2.456				2.131	2.687	0.701
n-Docosane (*n*-C22)	3.257	2.171				2.165	2.531	0.629
n-Tricosane (*n*-C23)	2.979	2.345				1.978	2.434	0.506
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene	0.080	0.067				0.065	0.071	0.008
Anthraquinone								
Naphthalic anhydride								
Methylfluoranthene								
Retene								

Table P-2. (Continued)

Test Date	July 10, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene	1.376	0.985				0.882	1.081	0.261
n-Tetracosane (*n*-C24)								
iso-Tricosane (C23)								
anteiso-Tricosane (C23)	0.798	0.484				0.592	0.625	0.160
n-Pentacosane (*n*-C25)								
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)	0.567	0.340				0.417	0.441	0.115
n-Hexacosane (*n*-C26)								
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)	0.434	0.256				0.370	0.353	0.090
Heptacosane (*n*-C27)								
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)	0.598	0.307				0.320	0.408	0.164
Octacosane (*n*-C28)	0.528	0.229				0.282	0.346	0.160
Nonacosane (*n*-C29)								
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)	0.000	0.000				0.000	0.000	0.000
Squalene								
Indeno[1,2,3-c,d]fluoranthene								
Dibenzo[a,e]pyrene	2.909	1.167				1.226	1.767	0.989
n-Triacontane (*n*-C30)	1.239	1.066				1.100	1.135	0.092
n-Hentriacontane (*n*-C31)								
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)	1.370	0.557				0.572	0.833	0.465
Dotriacontane (*n*-C32)	0.837	0.320				0.301	0.486	0.304
Tritriacontane (C33)	1.127	0.444				0.402	0.658	0.407
Tetratriacontane (C34)								
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)	1.193	0.650				0.667	0.837	0.309

Table P-2. (Continued)

Test Date	July 10, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Hexatriacontane (*n*-C36)	0.000	0.000				0.000	0.000	0.000
Tetracontane (C40)	0.472	0.268				0.13	0.290	0.172
Hexanoic acid	0.433	0.355				0.11	0.298	0.171
Succinic acid	0.022	0.000				0.00	0.007	0.013
Octanoic acid	0.528	0.450				0.31	0.428	0.113
Glutaric acid	0.000	0.000				0.00	0.000	0.000
Nonanoic Acid	0.350	0.284				0.30	0.311	0.035
Adipic acid	0.372	0.209				0.64	0.408	0.218
Decanoic acid								
Undecanoic acid								
Pimelic acid	0.249	0.147				0.62	0.340	0.251
Suberic acid	0.324	0.000				0.00	0.108	0.187
Dodecanoic acid								
Azelaic acid								
Tridecanoic acid								
Pinonic acid								
Phthalic acid								
1,4-Benzenedicarboxylic acid								
1,3-Benzenedicarboxylic acid								
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid								
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid	0.000	0.000				0.000	0.000	0.000
Sebacic acid	0.000	0.000				0.000	0.000	0.000
Tetradecanoic acid	0.000	0.000				0.000	0.000	0.000
Pentadecanoic acid	0.000	0.000				0.000	0.000	0.000
Palmitoleic acid	0.000	0.000				0.000	0.000	0.000
Hexadecanoic acid	0.000	0.000				0.000	0.000	0.000
Heptadecanoic acid	0.000	0.000				0.000	0.000	0.000
Linoleic acid	0.000	0.000				0.000	0.000	0.000
Oleic acid	0.000	0.000				0.816	0.272	0.471
Linolenic acid								
Octadecanoic acid	0.000	0.000				0.000	0.000	0.000
Nonoadecanoic acid	0.000	0.000				0.000	0.000	0.000
Eicosanoic aicd								
Docosanoic acid	0.000	0.000				0.000	0.000	0.000

Table P-2. (Continued)

Test Date	July 10, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compound								
Tricosanoic acid								
Tetracosanoic acid								
Pentacosanoic acid								
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid	94.05	70.00				62.23	75.43	16.59
Triacontanoic acid								

Table P-3. PUF Species Emission Factors (mg/kg)

Test Date	July 7, 2002							
Sampling Array	6A	6B	8A	8B	10A	10B	Day Avg	SD
Compounds								
Dimethyl phthalate	0.000	0.000	0.000				0.0000	0.000
Diethyl phthalate	0.066	0.000	0.106				0.057	0.054
Naphthalene	1.369	0.483	1.273				1.042	0.486
2-Methylnaphthalene	8.123	3.483	7.401				6.335	2.497
1-Methylnaphthalene	5.471	2.606	5.107				4.395	1.560
2,7-Dimethylnaphthalene	4.974	2.507	5.132				4.204	1.472
1,3-Dimethylnaphthalene	1.849	1.526	4.623				2.666	1.702
2,6-Dimethylnaphthalene	5.489	2.801	5.746				4.679	1.631
Add'l Dimethylnaphthalenes	3.575	1.202	3.512				2.763	1.352
Acenaphthylene	0.015	0.000	0.047				0.021	0.024
Acenaphthene	0.326	0.000	0.000				0.109	0.188
Fluorene	0.093	0.000	0.541				0.212	0.289
1-Methylfluorene	0.000	0.000	1.092				0.364	0.631
Add'l Methylfluorene - Peak 1	0.000	0.000	1.489				0.496	0.860
Add'l Methylfluorene - Peak 2	0.000	0.000	0.223				0.074	0.129
Phenanthrene	1.167	0.000	1.047				0.738	0.642
Add'l Dimethylphenanthrenes	0.000	0.000	0.303				0.101	0.175
Anthracene	0.009	0.000	0.000				0.003	0.005
Methylanthracene - Peak 1	0.000	0.000	1.303				0.434	0.753
Methylanthracene - Peak 2	0.000	0.000	1.564				0.521	0.903
Methylanthracene - Peak 3	0.000	0.000	0.957				0.319	0.552
Methylanthracene - Peak 4	0.000	0.000	0.612				0.204	0.353
Octylcyclohexane	0.206	0.000	0.163				0.123	0.109
Norpristane	2.155	1.679	10.104				4.646	4.732
Decylcyclohexane	0.348	0.265	0.385				0.333	0.062
Pristane	1.220	0.734	7.057				3.004	3.519
Phytane	0.035	0.010	6.709				2.251	3.860
Tridecylcyclohexane	0.363	0.000	0.000				0.121	0.209
Dibutyl phthalate	0.085	0.013	0.314				0.137	0.157
Butyl benzyl phthalate	0.000	0.000	0.000				0.000	0.000
bis(2-Ethylhexyl) phthalate	0.000	0.121	0.000				0.040	0.070
Dioctyl phthalate								
Fluoranthene	0.227	0.000	0.113				0.114	0.114
Pyrene	0.000	0.000	0.000				0.000	0.000
Chrysene	0.000	0.000	0.000				0.000	0.000
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane	0.000	0.000	0.000				0.000	0.000
Squalane								
Indeno[1,2,3-cd]pyrene								

Table P-3. (Continued)

Test Date	July 7, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compounds								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)	0.000	0.049	0.059				0.036	0.031
n-Undecane (*n*-C11)	1.749	1.936	1.520				1.735	0.208
n-Dodecane (*n*-C12)	1.515	1.411	1.719				1.549	0.156
n-Tridecane (*n*-C13)	0.008	0.004	0.000				0.004	0.004
9H-Fluoren-9-one	4.531	4.707	7.401				5.546	1.608
n-Tetradecane (*n*-C14)	7.417	11.786	19.018				12.740	5.859
n-Pentadecane (*n*-C15)	6.328	15.242	18.816				13.462	6.432
n-Hexadecane (*n*-C16)	1.357	13.431	17.409				10.732	8.360
n-Heptadecane (*n*-C17)	0.014	0.000	0.000				0.005	0.008
1-Octadecene	0.015	0.031	12.294				4.113	7.085
n-Octadecane (*n*-C18)	0.000	0.000	0.000				0.000	0.000
2-Methylnonadecane	0.000	0.000	0.000				0.000	0.000
3-Methylnonadecane	0.000	0.000	10.452				3.484	6.034
n-Nonadecane (*n*-C19)	0.000	0.000	8.271				2.757	4.775
n-Eicosane (*n*-C20)	0.021	0.029	5.518				1.856	3.172
n-Heneicosane (*n*-C21)	0.000	0.052	3.402				1.151	1.949
n-Docosane (*n*-C22)	0.162	0.144	2.494				0.933	1.352
n-Tricosane (*n*-C23)								
iso-Docosane (C22)								
anteiso-Docosane (C22)	0.077	0.081	0.129				0.096	0.029
Pyrene								
Anthraquinone								
Naphthalic anhydride								
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								

Table P-3. (Continued)

Test Date	July 7, 2002							
Sampling Array	**6A**	**6B**	**8A**	**8B**	**10A**	**10B**	**Day Avg**	**SD**
Compounds								
1-Methylchrysene	0.242	0.405	1.094				0.580	0.452
Benzo[a]pyrene								
1-Methylchrysene	0.242	0.405	1.094				0.580	0.452
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)								
iso-Tricosane (C23)	0.000	0.211	0.694				0.302	0.356
anteiso-Tricosane (C23)								
n-Pentacosane (*n*-C25)								
iso-Tetracosane (C24)	0.000	0.168	0.429				0.199	0.216
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C26)								
iso-Pentacosane (C25)	0.120	0.378	1.072				0.524	0.492
anteiso-Pentacosane (C25)								
Heptacosane (*n*-C27)								
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)	0.297	0.425	1.712				0.811	0.783
anteiso-Octacosane (C28)	0.000	0.379	1.131				0.503	0.576
Octacosane (*n*-C28)								
Nonacosane (*n*-C29)								
iso-Nonacosane (C29)	0.000	0.074	0.789				0.288	0.436
anteiso-Nonacosane (C29)								
Squalene								
Indeno[1,2,3-c,d]fluoranthene	0.714	1.054	4.367				2.045	2.018
Dibenzo[a,e]pyrene	0.000	1.042	4.252				1.765	2.216
n-Triacontane (*n*-C30)								
n-Hentriacontane (*n*-C31)								
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)	0.413	0.547	1.384				0.781	0.526
anteiso-Dotriacontane (C32)	0.188	0.336	1.140				0.555	0.512
Dotriacontane (*n*-C32)	0.168	0.406	1.364				0.646	0.633
Tritriacontane (C33)								
Tetratriacontane (C34)								
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)	0.047	0.527	1.133				0.569	0.544
Pentatriacontane (C35)	0.000	0.507	0.474				0.327	0.284
Hexatriacontane (*n*-C36)	0.686	0.751	0.940				0.792	0.132

Table P-3. (Continued)

Test Date	July 7, 2002							
Sampling Array	6A	6B	8A	8B	10A	10B	Day Avg	SD
Compounds								
Tetracontane (C40)	0.078	0.079	0.049				0.069	0.017
	0.655	0.667	0.971				0.764	0.179
Hexanoic acid	0.024	0.047	0.000				0.024	0.024
Succinic acid	1.401	0.949	2.503				1.618	0.799
Octanoic acid	0.018	0.000	0.000				0.006	0.011
Glutaric acid	0.475	0.491	0.784				0.583	0.174
Nonanoic Acid	0.709	0.644	1.338				0.897	0.383
Adipic acid								
Decanoic acid								
Undecanoic acid	0.414	0.406	0.906				0.575	0.286
Pimelic acid	0.000	0.000	0.000				0.000	0.000
Suberic acid								
Dodecanoic acid								
Azelaic acid								
Tridecanoic acid								
Pinonic acid								
Phthalic acid								
1,4-Benzenedicarboxylic acid								
1,3-Benzenedicarboxylic acid								
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid								
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid	0.686	0.644	1.968				1.099	0.752
Dehydroabietic acid	0.400	0.449	1.301				0.717	0.506
Sebacic acid	0.024	0.058	1.276				0.453	0.713
Tetradecanoic acid	2.259	1.493	5.115				2.956	1.909
Pentadecanoic acid	0.144	0.145	0.325				0.205	0.104
Palmitoleic acid	0.133	0.028	0.090				0.083	0.053
Hexadecanoic acid	0.068	0.000	0.564				0.211	0.308
Heptadecanoic acid	0.000	0.000	0.000				0.000	0.000
Linoleic acid	1.359	0.703	1.566				1.209	0.451
Oleic acid								
Linolenic acid	0.055	0.037	0.086				0.060	0.025
Octadecanoic acid	0.054	0.034	0.096				0.061	0.032
Nonoadecanoic acid								
Eicosanoic aicd	0.126	0.092	0.246				0.155	0.081
Docosanoic acid								
Tricosanoic acid								

Table P-3. (Continued)

Test Date	July 11, 2002							
Sampling Array	6A	6B	8A	8B	10A	10B	Day Avg	SD
Compounds								
Tetracosanoic acid								
Pentacosanoic acid								
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid	72.32	80.51	216.58				123.14	81.03

Table P-4. Semivolatile Organic Compounds, Uncertainty

Compounds	Campaign #2 Average	Uncertainty
Dimethyl phthalate	0.000	0.000
Diethyl phthalate	0.076	0.031
Naphthalene	0.667	0.167
2-Methylnaphthalene	3.688	0.846
1-Methylnaphthalene	2.526	0.530
2,7-Dimethylnaphthalene	3.499	0.514
1,3-Dimethylnaphthalene	2.561	0.580
2,6-Dimethylnaphthalene	3.715	0.576
Add'l Dimethylnaphthalenes	2.559	0.466
Acenaphthylene	0.047	0.013
Acenaphthene	0.066	0.086
Fluorene	0.516	0.114
1-Methylfluorene	0.857	0.281
Add'l Methylfluorene - Peak 1	0.960	0.326
Add'l Methylfluorene - Peak 2	0.274	0.096
Phenanthrene	1.258	0.263
Add'l Dimethylphenanthrenes	0.127	0.061
Anthracene	0.127	0.253
Methylanthracene - Peak 1	1.188	0.473
Methylanthracene - Peak 2	1.702	0.431
Methylanthracene - Peak 3	0.843	0.222
Methylanthracene - Peak 4	0.672	0.156
Octylcyclohexane	0.043	0.036
Norpristane	3.219	1.593
Decylcyclohexane	0.338	0.050
Pristane	2.986	1.204
Phytane	2.163	1.314
Tridecylcyclohexane	0.040	0.070
Dibutyl phthalate	0.140	0.070
Butyl benzyl phthalate	0.078	0.078
bis(2-Ethylhexyl) phthalate	0.063	0.034
Dioctyl phthalate	0.074	
Fluoranthene	0.065	0.041
Pyrene	0.058	0.041
Chrysene	0.002	0.002
Benzo[a]anthracene		
Benzo[k]fluoranthene		
Benzo[b]fluoranthene		
Benzo[a]pyrene		
Nonadecylcyclohexane	0.002	0.003
Squalane		
Indeno[1,2,3-cd]pyrene		
Dibenzo[a,h]anthracene		
Benzo[ghi]perylene		

Table P-4. (Continued)

Compounds	Campaign #2 Average	Uncertainty
Cholestane 2		
Cholestane 3		
Cholestane 4		
ABB-20R-24S-Methylcholestane		
ABB-20R-Ethylcholestane		
17A(H)-22,29,30-Trisnorhopane		
17B(H)-21A(H)-Norhopane		
17B(H)-21B(H)-Hopane		
17B(H)-21A(H)-Hopane		
17A(H)-21B(H)-Hopane		
n-Decane (*n*-C10)		
n-Undecane (*n*-C11)	0.014	0.011
n-Dodecane (*n*-C12)	0.855	0.130
n-Tridecane (*n*-C13)	0.686	0.054
9H-Fluoren-9-one	0.127	0.028
n-Tetradecane (*n*-C14)	2.405	0.539
n-Pentadecane (*n*-C15)	6.089	1.963
n-Hexadecane (*n*-C16)	8.948	2.201
n-Heptadecane (*n*-C17)	7.787	2.854
1-Octadecene	0.002	0.003
n-Octadecane (*n*-C18)	4.242	2.384
2-Methylnonadecane	0.000	0.000
3-Methylnonadecane	0.000	0.000
n-Nonadecane (*n*-C19)	3.331	2.032
n-Eicosane (*n*-C20)	2.965	1.603
n-Heneicosane (*n*-C21)	2.424	1.084
n-Docosane (*n*-C22)	2.034	0.689
n-Tricosane (*n*-C23)	1.959	0.504
iso-Docosane (C22)		
anteiso-Docosane (C22)	0.080	0.010
Pyrene		
Anthraquinone		
Naphthalic anhydride		
Methylfluoranthene		
Retene		
Cyclopenta[c,d]acepyrene		
Benzanthraquinone		
1-Methylchrysene	0.926	0.231
Benzo[a]pyrene		
n-Tetracosane (*n*-C24)		
iso-Tricosane (C23)	0.501	0.178
anteiso-Tricosane (C23)		
n-Pentacosane (*n*-C25)		

Table P-4. (Continued)

Compounds	Campaign #2 Average	Uncertainty
n-Hexacosane (*n*-C26)		
iso-Pentacosane (C25)	0.506	0.228
anteiso-Pentacosane (C25)		
Heptacosane (*n*-C27)		
iso-Hexacosane (C26)		
anteiso-Hexacosane (C26)		
iso-Heptacosane (C27)		
anteiso-Heptacosane (C27)		
iso-Octacosane (C28)	0.609	0.303
anteiso-Octacosane (C28)	0.483	0.238
Octacosane (*n*-C28)		
Nonacosane (*n*-C29)		
iso-Nonacosane (C29)	0.273	0.382
anteiso-Nonacosane (C29)		
Squalene		
Indeno[1,2,3-c,d]fluoranthene	1.641	0.823
Dibenzo[a,e]pyrene	1.317	0.806
n-Triacontane (*n*-C30)		
n-Hentriacontane (*n*-C31)		
iso-Triacontane (C30)		
anteiso-Triacontane (C30)		
iso-Hentriacontane (C31)		
anteiso-Hentriacontane (C31)		
iso-Dotriacontane (C32)	0.693	0.249
anteiso-Dotriacontane (C32)	0.438	0.212
Dotriacontane (*n*-C32)	0.522	0.263
Tritriacontane (C33)		
Tetratriacontane (C34)		
iso-Tritriacontane (C33)		
anteiso-Tritriacontane (C33)	0.649	0.223
Pentatriacontane (C35)	0.145	0.099
Hexatriacontane (*n*-C36)	0.482	0.097
Tetracontane (C40)	0.040	0.007
	0.522	0.096
Hexanoic acid	0.012	0.009
Succinic acid	0.884	0.272
Octanoic acid	0.002	0.004
Glutaric acid	0.412	0.061
Nonanoic Acid	0.544	0.148
Adipic acid		
Decanoic acid		
Undecanoic acid	0.366	0.127
Pimelic acid	0.036	0.062
Suberic acid		

Table P-4. (Continued)

Compounds	Campaign #2 Average	Uncertainty
Tridecanoic acid		
Pinonic acid		
Phthalic acid		
1,4-Benzenedicarboxylic acid		
1,3-Benzenedicarboxylic acid		
1,2-Benzenedicarboxylic acid, 4-methyl		
1,2,4-Benzenetricarboxylic acid		
Benzenetetracarboxylic acid		
Abietic acid		
Pimaric acid		
Sandaracopimaric acid		
Isopimaric acid	0.366	0.251
Dehydroabietic acid	0.239	0.169
Sebacic acid	0.151	0.238
Tetradecanoic acid	0.985	0.636
Pentadecanoic acid	0.068	0.035
Palmitoleic acid	0.030	0.018
Hexadecanoic acid	0.070	0.103
Heptadecanoic acid	0.000	0.000
Linoleic acid	0.525	0.226
Oleic acid		
Linolenic acid	0.021	0.008
Octadecanoic acid	0.021	0.011
Nonoadecanoic acid		
Eicosanoic aicd	0.054	0.027
Docosanoic acid		
Tricosanoic acid		
Tetracosanoic acid		
Pentacosanoic acid		
Hexacosanoic acid		
Heptacosanoic acid		
Octacosanoic acid	96.03	27.76

Table P-5. PUF Species Emission Factors (mg/kg)

Test Date			**July 9, 2002**		
Sample ID	**P011702A**	**P011702B**	**P011702C**	**P011702D**	
Port and Array	**6A**	**6A**	**6A**	**6A**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (lpm)	**8.215**				
Sampling Time (min)	**600.6**				
Dilution Ratio	**44.3**				
Flue gas flow (lpm)	**119569.9**				
Fuel (kg/min)	**7.4**				
Volume (µL)	**250**	**270**	**280**	**240**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate					
Diethyl phthalate	4.06				0.107
Naphthalene	4.2	4.07	4.84	4.61	0.593
2-Methylnaphthalene	18.33	18.34	21.38	19.71	2.918
1-Methylnaphthalene	12.41	12.62	14.01	13.41	1.979
2,7-Dimethylnaphthalene	16.83	30.62	30.42	19.04	3.708
1,3-Dimethylnaphthalene	29.88	22.47	21.71	12.23	3.272
2,6-Dimethylnaphthalene	30.41	28.87	29.18	19.14	4.086
Add'l Dimethylnaphthalenes	28.79	25.8	22.21	7.47	3.217
Acenaphthylene	1.46				0.053
Acenaphthene					
Fluorene	16.03				0.581
1-Methylfluorene	42.96				1.558
Add'l Methylfluorene - Peak 1	31.2				1.132
Add'l Methylfluorene - Peak 2	9.76				0.354
Phenanthrene	42.03	0.5	0.21	0.17	1.552
Add'l Dimethylphenanthrenes	2.88				0.098
Anthracene					
Methylanthracene - Peak 1					
Methylanthracene - Peak 2	107.3				3.892
Methylanthracene - Peak 3	31.4				1.139
Methylanthracene - Peak 4	23.12				0.839
Octylcyclohexane					
Norpristane	19.98	30.39	28.96	14.23	3.587
Decylcyclohexane	2.44	5.7		1.27	0.356
Pristane	31.19	42.2	23.99	2.71	3.837
Phytane	44.82	13.94	1.29		2.224
Tridecylcyclohexane					
Dibutyl phthalate		0.6	0.97	3.92	0.151
Butyl benzyl phthalate	1.94		0.72	1.73	0.058
bis(2-Ethylhexyl) phthalate	5.47		1.69	1.38	0.223
Dioctyl phthalate					
Fluoranthene					
Pyrene	2.88				0.104

Table P-5. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)	8.25	7.7	6	3.58	0.66
n-Tridecane (*n*-C13)	1.9	2.14	2.43	2.12	0.319
9H-Fluoren-9-one					
n-Tetradecane (*n*-C14)	5.59	6.32	6.81	7.56	0.941
n-Pentadecane (*n*-C15)	16.32	21.35	24.05	29.66	3.395
n-Hexadecane (*n*-C16)	33	60.74	70.88	62.22	8.528
n-Heptadecane (*n*-C17)	78.51	85.15	38.21	1.38	7.715
1-Octadecene					
n-Octadecane (*n*-C18)	116.55	15.64	1.4	0.16	4.813
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	91.24	1.24	0.32	0.18	3.251
n-Eicosane (*n*-C20)	94.78	1.13	0.63		3.346
n-Heneicosane (*n*-C21)	76.48	1.45	2.29	1.02	2.823
n-Docosane (*n*-C22)	63.52	1.46	4.88	1.68	2.511
n-Tricosane (*n*-C23)	71.36	3.69	10.73	5.2	3.126
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	1.9				0.069

Table P-5. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	25.45	2.89	10.93	4.22	1.283
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	17.57	4.21	13.37	5.6	1.103
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	15.47	5.55	14.6	6.62	1.141
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	16.11	6.28	15.94	7.06	1.319
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	13.11	6.76	14.31	6.04	1.217
Nonacosane (*n*-C29)	12.1	5.07	13.03	5.36	1.143
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	4.03	1.17	1.31	5.87	-0.571
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	27.19	11.02	30.6	11.93	2.45
n-Hentriacontane (*n*-C31)	25.8	10.55	27.44	11.45	2.322
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	8.89	5.51	10.09	5.09	0.827
Tritriacontane (C33)	5.98	2.89	7.58	2.49	0.599
Tetratriacontane (C34)	5.03	3.69	8.69	2.09	0.612
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					

Table P-5. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	5.21	5.57	8.73	3.48	0.883
Tetracontane (C40)		1.99	4.07		0.243
Hexanoic acid	6.16	4.73	3.63	0.93	0.476
Succinic acid	0.99	0.2	0.2	0.23	0.06
Octanoic acid	18.76	0.78	1.28	0.29	0.72
Glutaric acid	0	0	0	0.08	0.003
Nonanoic Acid	18.61	1.96	2.96	1.01	0.743
Adipic acid					
Decanoic acid	10.28	0.66	0.86	0.51	0.411
Undecanoic acid	11.63	1.1	1.19	0.96	0.369
Pimelic acid					
Suberic acid					
Dodecanoic acid	6.66	0.54	0.59	0.47	0.211
Azelaic acid					
Tridecanoic acid					
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	6.79	0.66	0.73	1.13	-0.124
Pentadecanoic acid	6.23	0.68	1.03	1.85	-0.115
Palmitoleic acid		0.76	0.56	1.67	-0.687
Hexadecanoic acid	29.9	4.99	5.68	9.48	-0.544
Heptadecanoic acid		0.31	0.3	0.47	-0.042
Linoleic acid			0.5	0.36	0.001
Oleic acid			0.33	0.88	-0.357
Linolenic acid				0.16	-0.037
Octadecanoic acid	5.28	1.43	1.61	2.07	-0.228
Nonoadecanoic acid					
Eicosanoic aicd	0.24	0.09	0.1	0.13	0.003
Docosanoic acid				0.15	-0.007
Tricosanoic acid					

Table P-5. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Tetracosanoic acid	0.38	0.14	0.14	0.32	0.008
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	**1525**	**536.29**	**572.56**	**336.23**	**98.55**

Table P-6. Gas-Phase Semivolatiles, Campaign #2, July 9, 2002

Test Date			**July 9, 2002**		
Substrate	**PUF**				
Sample ID	**P011702A**	**P011702B**	**P011702C**	**P011702D**	
Port and Array	**6A**	**6A**	**6A**	**6A**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (Lpm)	**8.215**				
Sampling Time (min)	**600.6**				
Dilution Ratio	**44.30**				
Flue Gas Flow (Lpm)	**119569.9**				
Fuel (kg/min)	**7.40**				
Volume (µL)	**250**	**270**	**280**	**240**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate					
Diethyl phthalate	4.06				0.107
Naphthalene	4.20	4.07	4.84	4.61	0.593
2-Methylnaphthalene	18.33	18.34	21.38	19.71	2.918
1-Methylnaphthalene	12.41	12.62	14.01	13.41	1.979
2,7-Dimethylnaphthalene	16.83	30.62	30.42	19.04	3.708
1,3-Dimethylnaphthalene	29.88	22.47	21.71	12.23	3.272
2,6-Dimethylnaphthalene	30.41	28.87	29.18	19.14	4.086
Add'l Dimethylnaphthalenes	28.79	25.80	22.21	7.47	3.217
Acenaphthylene	1.46				0.053
Acenaphthene					
Fluorene	16.03				0.581
1-Methylfluorene	42.96				1.558
Add'l Methylfluorene - Peak 1	31.20				1.132
Add'l Methylfluorene - Peak 2	9.76				0.354
Phenanthrene	42.03	0.50	0.21	0.17	1.552
Add'l Dimethylphenanthrenes	2.88				0.098
Anthracene					
Methylanthracene - Peak 1					
Methylanthracene - Peak 2	107.30				3.892
Methylanthracene - Peak 3	31.40				1.139
Methylanthracene - Peak 4	23.12				0.839
Octylcyclohexane					
Norpristane	19.98	30.39	28.96	14.23	3.587
Decylcyclohexane	2.44	5.70		1.27	0.356
Pristane	31.19	42.20	23.99	2.71	3.837
Phytane	44.82	13.94	1.29		2.224
Tridecylcyclohexane					
Dibutyl phthalate		0.60	0.97	3.92	0.151
Butyl benzyl phthalate	1.94		0.72	1.73	0.058
bis(2-Ethylhexyl) phthalate	5.47		1.69	1.38	0.223
Dioctyl phthalate					

Table P-6. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Fluoranthene					
Pyrene	2.88				0.104
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)	8.25	7.70	6.00	3.58	0.660
n-Tridecane (*n*-C13)	1.90	2.14	2.43	2.12	0.319
9H-Fluoren-9-one					
n-Tetradecane (*n*-C14)	5.59	6.32	6.81	7.56	0.941
n-Pentadecane (*n*-C15)	16.32	21.35	24.05	29.66	3.395
n-Hexadecane (*n*-C16)	33.00	60.74	70.88	62.22	8.528
n-Heptadecane (*n*-C17)	78.51	85.15	38.21	1.38	7.715
1-Octadecene					
n-Octadecane (*n*-C18)	116.55	15.64	1.40	0.16	4.813
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	91.24	1.24	0.32	0.18	3.251
n-Eicosane (*n*-C20)	94.78	1.13	0.63		3.346
n-Heneicosane (*n*-C21)	76.48	1.45	2.29	1.02	2.823
n-Docosane (*n*-C22)	63.52	1.46	4.88	1.68	2.511
n-Tricosane (*n*-C23)	71.36	3.69	10.73	5.20	3.126

Table P-6. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	1.90				0.069
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	25.45	2.89	10.93	4.22	1.283
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	17.57	4.21	13.37	5.60	1.103
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	15.47	5.55	14.60	6.62	1.141
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	16.11	6.28	15.94	7.06	1.319
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	13.11	6.76	14.31	6.04	1.217
Nonacosane (*n*-C29)	12.10	5.07	13.03	5.36	1.143
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	4.03	1.17	1.31	5.87	-0.571
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	27.19	11.02	30.60	11.93	2.450
n-Hentriacontane (*n*-C31)	25.80	10.55	27.44	11.45	2.322
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	8.89	5.51	10.09	5.09	0.827

Table P-6. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Tritriacontane (C33)	5.98	2.89	7.58	2.49	0.599
Tetratriacontane (C34)	5.03	3.69	8.69	2.09	0.612
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	5.21	5.57	8.73	3.48	0.883
Tetracontane (C40)		1.99	4.07		0.243
Hexanoic acid	6.16	4.73	3.63	0.93	0.476
Succinic acid	0.99	0.20	0.20	0.23	0.060
Octanoic acid	18.76	0.78	1.28	0.29	0.720
Glutaric acid	0.00	0.00	0.00	0.08	0.003
Nonanoic Acid	18.61	1.96	2.96	1.01	0.743
Adipic acid					
Decanoic acid	10.28	0.66	0.86	0.51	0.411
Undecanoic acid	11.63	1.10	1.19	0.96	0.369
Pimelic acid					
Suberic acid					
Dodecanoic acid	6.66	0.54	0.59	0.47	0.211
Azelaic acid					
Tridecanoic acid					
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	6.79	0.66	0.73	1.13	-0.124
Pentadecanoic acid	6.23	0.68	1.03	1.85	-0.115
Palmitoleic acid		0.76	0.56	1.67	-0.687
Hexadecanoic acid	29.90	4.99	5.68	9.48	-0.544
Heptadecanoic acid		0.31	0.30	0.47	-0.042
Linoleic acid			0.50	0.36	0.001
Oleic acid			0.33	0.88	-0.357
Linolenic acid				0.16	-0.037

Table P-6. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Octadecanoic acid	5.28	1.43	1.61	2.07	-0.228
Nonoadecanoic acid					
Eicosanoic aicd	0.24	0.09	0.10	0.13	0.003
Docosanoic acid				0.15	-0.007
Tricosanoic acid					
Tetracosanoic acid	0.38	0.14	0.14	0.32	0.008
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	1525.0	536.29	572.56	336.23	98.55

Table P-7. Campaign #2 Gas-Phase Semivolatiles, July 9, 2002

Test Date			**July 9, 2002**		
Substrate			**PUF**		
Sample ID	**P011702E**	**P011702F**	**P011502A**		**P011502B**
Port and Array	**6B**	**6B**	**6B**	**6B**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (Lpm)	**8.215**				
Sampling Time (min)	**600.6**				
Dilution Ratio	**44.30**				
Flue Gas Flow (Lpm)	**111439**				
Fuel (kg/min)	**7.40**				
Volume (µL)	**260**	**270**	**190**	**230**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate					
Diethyl phthalate	3.83				0.104
Naphthalene	3.53	3.68	3.63	4.71	0.459
2-Methylnaphthalene	17.21	19.44	18.78	23.16	2.681
1-Methylnaphthalene	11.14	13.01	12.77	15.00	1.780
2,7-Dimethylnaphthalene	22.84	30.51	24.62	18.87	3.365
1,3-Dimethylnaphthalene	25.24	23.82	18.36	12.57	2.811
2,6-Dimethylnaphthalene	27.82	31.58	25.02	21.52	3.694
Add'l Dimethylnaphthalenes	25.62	25.85	17.05	7.37	2.695
Acenaphthylene	1.52				0.057
Acenaphthene					
Fluorene	15.52	1.04			0.626
1-Methylfluorene	31.15				1.175
Add'l Methylfluorene - Peak 1	29.75				1.122
Add'l Methylfluorene - Peak 2	5.61				0.212
Phenanthrene	38.26	0.18	0.13	0.26	1.456
Add'l Dimethylphenanthrenes	3.16				0.113

Table P-7. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Anthracene	39.97	0.20			1.515
Methylanthracene - Peak 1	43.25				1.631
Methylanthracene - Peak 2	52.91				1.996
Methylanthracene - Peak 3	25.62				0.966
Methylanthracene - Peak 4	22.28				0.840
Octylcyclohexane				0.76	0.025
Norpristane		30.11	24.72	14.48	2.344
Decylcyclohexane	2.61		4.28		0.216
Pristane	24.48	40.43	20.21	3.50	3.165
Phytane	41.00	16.35	0.51		2.201
Tridecylcyclohexane					
Dibutyl phthalate	1.45	0.97	1.43	7.89	0.347
Butyl benzyl phthalate			0.99	3.64	0.047
bis(2-Ethylhexyl) phthalate	3.03	2.00	0.57	1.56	0.168
Dioctyl phthalate					
Fluoranthene					
Pyrene	0.56				0.021
Chrysene	0.17				0.006
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane		0.38	0.20		0.020
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					

Table P-7. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Cholestane 3					
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)		0.24	0.20		0.015
n-Dodecane (*n*-C12)	1.32	6.39	3.42	2.44	0.167
n-Tridecane (*n*-C13)	1.71	2.09	2.05	2.14	0.268
9H-Fluoren-9-one					
n-Tetradecane (*n*-C14)	6.24	6.84	6.65	8.15	0.909
n-Pentadecane (*n*-C15)	16.39	21.52	21.66	29.79	3.010
n-Hexadecane (*n*-C16)	34.00	56.75	51.24	53.33	6.604
n-Heptadecane (*n*-C17)	75.79	78.83	30.41	2.35	6.795
1-Octadecene					
n-Octadecane (*n*-C18)	113.85	24.19	0.43	0.27	5.174
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	89.86	0.65	0.19	0.27	3.303
n-Eicosane (*n*-C20)	93.19	0.30	0.27	0.28	3.382
n-Heneicosane (*n*-C21)	76.44	0.79	0.80	1.03	2.834
n-Docosane (*n*-C22)	64.39	0.87	0.72	1.13	2.413
n-Tricosane (*n*-C23)	65.89	2.26	2.11	3.21	2.515
iso-Docosane (C22)					
anteiso-Docosane (C22)					

Table P-7. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pyrene	2.05				0.077
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	23.45	2.38	1.76	2.81	0.776
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	13.68	3.77	2.19		0.287
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	10.61	4.80	2.45	4.93	0.360
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	10.37	5.14	2.44	5.63	0.443
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	8.60	4.23	2.32	4.81	0.399
Nonacosane (*n*-C29)	7.70	3.75	2.26	4.72	0.447
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	1.32	1.46	2.06	2.09	-0.787

Table P-7. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	15.64	8.16	6.12	10.66	0.808
n-Hentriacontane (*n*-C31)	14.75	7.64	6.17	10.21	0.826
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	5.49	4.08	4.00	4.89	0.342
Tritriacontane (C33)	2.96	1.72	1.81	2.57	0.189
Tetratriacontane (C34)	1.44	1.72	2.12	2.36	0.119
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)		3.18	3.87	3.68	0.354
Tetracontane (C40)			1.43		0.039
Hexanoic acid	2.59	1.59	0.95	0.50	0.091
Succinic acid	0.79	0.31	0.20	0.15	0.052
Octanoic acid	12.48	0.66	0.58	0.23	0.468
Glutaric acid			0.14	0.00	0.004
Nonanoic Acid	16.00	2.11	2.05	1.88	0.641
Adipic acid					
Decanoic acid	8.16	0.59	0.58	0.75	0.331
Undecanoic acid	9.69	1.40	1.38	1.84	0.342
Pimelic acid					
Suberic acid					
Dodecanoic acid	5.36	0.69	0.68	0.91	0.187

Table P-7. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Azelaic acid					
Tridecanoic acid					
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	5.51	0.80	0.98	1.26	-0.157
Pentadecanoic acid	4.36	0.90	1.05	1.34	-0.200
Palmitoleic acid		0.58	0.74	1.08	-0.719
Hexadecanoic acid	20.24	5.94	7.48	12.78	-0.756
Heptadecanoic acid		0.26	0.30	0.48	-0.048
Linoleic acid		0.54	0.44	0.43	0.016
Oleic acid	0.74	0.55	0.65	0.64	-0.313
Linolenic acid					
Octadecanoic acid	6.46	3.68	5.76	13.33	0.379
Nonoadecanoic acid					
Eicosanoic aicd		0.10	0.13	0.16	-0.005
Docosanoic acid			0.11	0.14	-0.004
Tricosanoic acid					
Tetracosanoic acid		0.18	0.18	0.18	-0.010

Table P-7. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	1369.0	514.16	358.76	337.08	80.23

Table P-8. Campaign #2 Gas-Phase Semivolatiles, July 9, 2002

Sampling Date		**July 9, 2002**			
Substrate		**PUF**			
Sample ID	**P012202E**	**P012202F**	**P012202G**	**P012302A**	
Port and Array	**10A**	**10A**	**10A**	**10A**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (Lpm)	**8.215**				
Sampling Time (min)	**600.6**				
Dilution Ratio	**44.30**				
Flue Gas Flow (Lpm)	**111439**				
Fuel (kg/min)	**7.40**				
Volume (µL)	**260**	**280**	**260**	**250**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate					
Diethyl phthalate	3.97	0.23		0.82	0.148
Naphthalene	2.87	3.35	3.41	3.30	0.417
2-Methylnaphthalene	14.35	15.47	16.29	15.45	2.324
1-Methylnaphthalene	9.85	10.78	11.32	10.91	1.630
2,7-Dimethylnaphthalene	24.92	25.31	26.33	16.13	3.546
1,3-Dimethylnaphthalene	24.34	18.65	18.56	10.46	2.755
2,6-Dimethylnaphthalene	25.86	24.51	25.43	16.97	3.546
Add'l Dimethylnaphthalenes	24.17	20.63	17.75	6.97	2.672
Acenaphthylene	1.44				0.054
Acenaphthene					
Fluorene	17.39	1.20			0.705
1-Methylfluorene	39.78				1.500
Add'l Methylfluorene - Peak 1	32.78				1.236
Add'l Methylfluorene - Peak 2	8.26				0.312
Phenanthrene	40.75			0.18	1.537
Add'l Dimethylphenanthrenes	5.53				0.202
Anthracene					0.000
Methylanthracene - Peak 1	55.24				2.084

Table P-8. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 4	30.18				1.138
Octylcyclohexane					
Norpristane	18.37	24.32	27.82	16.40	3.325
Decylcyclohexane	3.03	4.83	4.25	1.91	0.540
Pristane	30.65	35.12	26.14	6.99	3.806
Phytane	50.75	13.23	1.63		2.513
Tridecylcyclohexane					
Dibutyl phthalate	1.79	0.75	0.87	6.50	0.318
Butyl benzyl phthalate	3.80	1.10	1.62	9.08	0.476
bis(2-Ethylhexyl) phthalate	2.28	0.69	0.95	2.77	0.158
Dioctyl phthalate					
Fluoranthene					
Pyrene	5.53				0.209
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					

Table P-8. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)	3.98	1.71	2.89	15.30	0.575
n-Tridecane (*n*-C13)	2.52	1.71	1.88	1.89	0.298
9H-Fluoren-9-one					
n-Tetradecane (*n*-C14)	5.32	5.51	5.94	6.13	0.821
n-Pentadecane (*n*-C15)	15.54	17.38	20.35	26.14	2.965
n-Hexadecane (*n*-C16)	36.41	48.22	67.61	60.78	7.993
n-Heptadecane (*n*-C17)	82.67	67.22	46.41	5.59	7.734
1-Octadecene					
n-Octadecane (*n*-C18)	102.49	24.38	1.20	0.17	4.819
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	95.71	0.80	0.17	0.12	3.527
n-Eicosane (*n*-C20)	96.52	0.33	0.33	0.35	3.518
n-Heneicosane (*n*-C21)	76.19	0.63	0.68	0.66	2.812
n-Docosane (*n*-C22)	72.76	0.69	0.75	0.41	2.709
n-Tricosane (*n*-C23)	59.08	2.14	3.44	3.33	2.342
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	2.27				0.086
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					

Table P-8. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	26.16	1.72	2.91	23.76	1.684
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	14.99	2.70	4.17	3.20	0.512
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	12.48	3.48	5.26	5.03	0.532
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	12.41	3.72	5.74	3.15	0.545
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	10.32	5.17	5.44	2.67	0.586
Nonacosane (*n*-C29)	9.65	3.26	5.31	2.60	0.581
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	4.69	3.26	0.99	1.12	-0.633
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	21.05	7.51	11.81	7.32	1.184
n-Hentriacontane (*n*-C31)	18.83	6.62	10.72	6.02	1.061

Table P-8. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	6.79	3.26	5.22	4.70	0.457
Tritriacontane (C33)	3.35	1.06	2.31	1.92	0.200
Tetratriacontane (C34)	2.92	1.30	2.19	2.66	0.202
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	3.25	1.95	3.33	4.30	0.483
Tetracontane (C40)			0.85	1.32	0.080
Hexanoic acid	3.74	4.91	2.49	1.31	0.370
Succinic acid	0.53	0.41			0.037
Octanoic acid	11.19	0.74	0.49	0.36	0.431
Glutaric acid					
Nonanoic Acid	13.75	1.21	1.69	1.14	0.509
Adipic acid					
Decanoic acid	7.60	0.45	0.55	0.49	0.303
Undecanoic acid	9.05	0.86	1.10	0.85	0.271
Pimelic acid					
Suberic acid					
Dodecanoic acid	4.95	0.43	0.54	0.41	0.148
Azelaic acid					
Tridecanoic acid					
Pinonic acid					
Phthalic acid					

Table P-8. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	5.59	0.79	0.69	0.60	-0.174
Pentadecanoic acid	5.05	1.18	0.79	0.88	-0.174
Palmitoleic acid		1.41	0.74	0.56	-0.692
Hexadecanoic acid	23.64	6.45	4.90	5.63	-0.842
Heptadecanoic acid		0.31	0.28	0.30	-0.049
Linoleic acid		0.43	0.36		-0.001
Oleic acid		0.78	0.43	0.20	-0.346
Linolenic acid					
Octadecanoic acid	4.75	3.64	2.63	2.80	-0.085
Nonoadecanoic acid					
Eicosanoic aicd	0.25	0.11	0.10		0.000
Docosanoic acid	0.16	0.11			-0.001
Tricosanoic acid					
Tetracosanoic acid	0.44	0.21	0.16	0.10	0.007
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					

Table P-8. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Nonacosanoic acid					
Triacontanoic acid					
Total	1462.7	440.33	418.18	331.11	88.15

Table P-9. Campaign #2 Gas-Phase Semivolatiles, July 9, 2002

Test Date				**July 9, 2002**				
Substrate				**PUF**				
Sample ID	**P012302B**	**P012302C**	**P012302D**	**P012302E**		**P012302F**	**P012302G**	
Port and Array	**10B**	**10B**	**10B**	**10B**		**DA**	**DA**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**		**First**	**Second**	
Sampling Flow (Lpm)	**8.215**					**8.215**		
Sampling Time (min)	**600.6**					**600.6**		
Dilution Ratio	**44.30**					**44.30**		
Flue Gas Flow (Lpm)	**111439**					**119569.9**		
Fuel (kg/min)	**7.40**					**7.40**		
Volume (µL)	**250**	**220**	**220**	**220**		**260**	**260**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate								
Diethyl phthalate	5.92		0.79	1.72	0.254	0.00	1.07	0.040
Naphthalene	3.19	3.46	3.54	4.63	0.411	1.61	0.39	0.075
2-Methylnaphthalene	14.28	15.77	17.92	19.36	2.191	0.41	0.12	0.020
1-Methylnaphthalene	9.08	9.72	12.45	13.04	1.451	0.00	0.05	0.002
2,7-Dimethylnaphthalene	23.40	28.66	26.55	15.62	3.109			
1,3-Dimethylnaphthalene	23.57	27.17	18.21	10.86	2.650			
2,6-Dimethylnaphthalene	25.48	27.95	17.01	17.46	2.916			
Add'l Dimethylnaphthalenes	25.28	27.17	25.36	6.59	2.804			
Acenaphthylene	1.66	0.51			0.076			
Acenaphthene	9.78				0.355			
Fluorene	27.15				0.985			
1-Methylfluorene	44.91				1.629			
Add'l Methylfluorene - Peak 1	48.25				1.750			
Add'l Methylfluorene - Peak 2	10.92				0.396			
Phenanthrene	55.50	0.27	0.22	0.28	2.031	0.00	0.17	0.006
Add'l Dimethylphenanthrenes	4.56	0.32			0.169	0.17	0.00	0.006
Anthracene								
Methylanthracene - Peak 1	72.56				2.632			

Table P-9. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 2	80.06				2.904			
Methylanthracene - Peak 3	45.15				1.638			
Methylanthracene - Peak 4	34.72				1.259			
Octylcyclohexane								
Norpristane	20.46	30.26	25.44	12.48	2.918			
Decylcyclohexane		6.31	3.34	1.34	0.351			
Pristane	34.39	41.53	15.13	3.02	3.136	0.00	0.42	0.016
Phytane	58.36	8.21			2.379			
Tridecylcyclohexane								
Dibutyl phthalate	1.95	0.74		0.71	0.069	0.00	1.28	0.048
Butyl benzyl phthalate	2.62			1.06	0.027	1.15	1.56	0.102
bis(2-Ethylhexyl) phthalate	2.19	1.11		0.79	0.048	0.84	1.61	0.092
Dioctyl phthalate						1.70		0.064
Fluoranthene								
Pyrene								
Chrysene	0.17				0.006			
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								
Cholestane 4								

Table P-9. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)	13.12	9.51	4.97	10.18	0.954	5.39	2.80	0.309
n-Tridecane (*n*-C13)	1.71	1.88	1.83	1.93	0.236		0.16	0.006
9H-Fluoren-9-one								
n-Tetradecane (*n*-C14)	3.97	5.18	6.42	7.08	0.691	0.62	0.69	0.049
n-Pentadecane (*n*-C15)	13.04	16.73	23.67	26.65	2.570	0.48	0.65	0.043
n-Hexadecane (*n*-C16)	33.08	52.30	69.34	43.79	6.386	1.23	1.25	0.094
n-Heptadecane (*n*-C17)	97.90	77.55	18.29	1.84	6.600	0.88	0.93	0.068
1-Octadecene								
n-Octadecane (*n*-C18)	109.31	4.09	0.31	0.35	4.027	1.89	0.47	0.089
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	87.28	0.53	0.27	0.22	3.072	2.99	0.36	0.126
n-Eicosane (*n*-C20)	89.63	0.59	0.44	0.35	3.133	3.93	0.35	0.161
n-Heneicosane (*n*-C21)	69.53	0.73	0.74	0.65	2.453	2.87	0.75	0.137
n-Docosane (*n*-C22)	57.57	0.77	0.69	0.55	2.045	1.86	0.98	0.107
n-Tricosane (*n*-C23)	55.64	2.71	2.66	2.86	2.057	4.11	1.82	0.224
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene	1.86				0.067			
Anthraquinone								

Table P-9. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Naphthalic anhydride								
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	21.89	2.99	2.00	3.55	0.722	6.00	3.12	0.344
iso-Tricosane (C23)								
anteiso-Tricosane (C23)								
n-Pentacosane (*n*-C25)	12.61	4.54	2.62	4.77	0.401	7.52	4.06	0.437
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C26)	8.71	5.57	2.81	4.61	0.270	8.12	4.09	0.461
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)								
Heptacosane (*n*-C27)	7.37	6.13	2.22	4.12	0.261	7.25	3.48	0.405
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (*n*-C28)	5.31	6.71	1.41	2.72	0.223	6.18	2.18	0.315
Nonacosane (*n*-C29)	4.64	4.67	1.14	2.50	0.223	3.83	1.75	0.210
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	2.77	17.57	2.37	2.12	-0.216	11.73	15.32	1.020
Indeno[1,2,3-c,d]fluoranthene								
Dibenzo[a,e]pyrene								

Table P-9. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
n-Triacontane (*n*-C30)		10.22	2.07	6.71	-0.019	11.27	5.32	0.626
n-Hentriacontane (*n*-C31)		8.88	1.81	6.27	0.001	9.29	5.04	0.541
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (*n*-C32)	4.62	5.29	1.26	4.98	0.237	5.45	2.47	0.299
Tritriacontane (C33)	1.85	2.53	0.29	2.29	0.104	2.35	0.99	0.126
Tetratriacontane (C34)	1.83	3.02		3.10	0.121	2.99	0.73	0.140
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)								
Hexatriacontane (*n*-C36)	3.14	5.85		4.74	0.452	4.93		
Tetracontane (C40)		2.19			0.070			
Hexanoic acid	4.54	4.75	7.75	2.24	0.523		2.96	0.112
Succinic acid	0.49		0.79	0.26	0.051			
Octanoic acid	9.48	0.36	2.41	0.36	0.391		1.39	0.052
Glutaric acid			0.35		0.011			
Nonanoic Acid	12.93	1.36	4.38	1.36	0.531		4.35	0.164
Adipic acid								
Decanoic acid	7.88	0.70	1.08	0.83	0.328		1.08	0.041
Undecanoic acid	10.20	1.60	1.50	1.08	0.325		4.71	0.178
Pimelic acid								
Suberic acid								
Dodecanoic acid	5.70	0.85	0.74	0.53	0.183		2.43	0.091
Azelaic acid								
Tridecanoic acid								

Table P-9. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Pinonic acid								
Phthalic acid								
1,4-Benzenedicarboxylic acid								
1,3-Benzenedicarboxylic acid								
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid								
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid	6.31	2.50	1.05	0.94	-0.093		12.33	0.465
Pentadecanoic acid	5.85	3.44	1.24	1.29	-0.071		12.55	0.473
Palmitoleic acid	6.58	2.90	0.83	0.86	-0.413		21.15	0.798
Hexadecanoic acid	24.99	14.71	6.49	5.86	-0.614		63.21	2.384
Heptadecanoic acid		0.66	0.31	0.30	-0.042		2.19	0.083
Linoleic acid		0.61	0.44	0.40	0.015		0.84	0.032
Oleic acid		2.55	0.68	0.61	-0.279		10.64	0.401
Linolenic acid							1.14	0.043
Octadecanoic acid	5.13	2.63	2.24	1.40	-0.227		16.24	0.612
Nonoadecanoic acid								
Eicosanoic aicd	0.24	0.21	0.11	0.11	0.005		0.46	0.017
Docosanoic acid	0.19	0.18		0.11	0.004		0.31	0.012
Tricosanoic acid								
Tetracosanoic acid	0.38	0.46	0.23	0.16	0.013		0.74	0.028
Pentacosanoic acid								
Hexacosanoic acid								

Table P-9. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Heptacosanoic acid								
Octacosanoic acid							0.19	0.007
Nonacosanoic acid								
Triacontanoic acid								
Total	1494.8	528.37	348.18	276.59	78.33		225.32	12.80

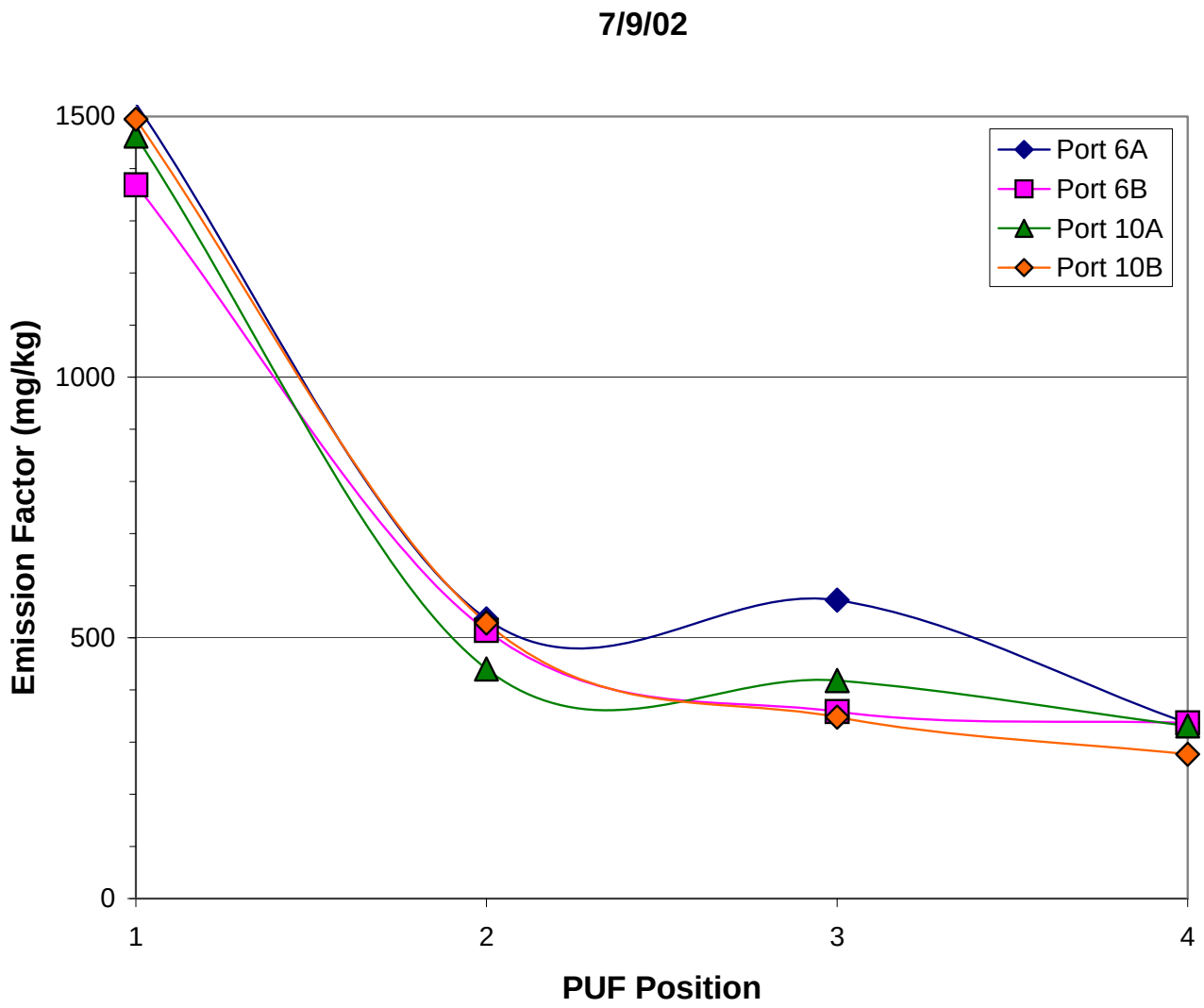

Figure P-1. Campaign #2 Gas Phase Semivolatiles, July 9, 2002: PUF Position

Table P-10. Campaign #2 Gas-Phase Semivolatiles, July 9, 2002

Test Date			**July 10, 2002**		
Substrate			**PUF**		
Sample ID	**P020102J**	**P020102K**	**P020102L**		**P020102M**
Port and Array	**6A**	**6A**	**6A**	**6A**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (lpm)	**8.219**				
Sampling Time (min)	**600.67**				
Dilution Ratio	**44.34**				
Flue gas flow (lpm)	**115149**				
Fuel (kg/min)	**7.43**				
Volume (uL)	**290**	**260**	**260**	**260**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate					
Diethyl phthalate			0.51	0.24	
Naphthalene	3.13	3.35	3.69	3.86	0.542
2-Methylnaphthalene	13.52	15.38	16.01	16.22	2.431
1-Methylnaphthalene	9.13	10.59	10.74	10.70	1.638
2,7-Dimethylnaphthalene	22.18	27.64	23.30	7.96	3.246
1,3-Dimethylnaphthalene	17.19	20.05	15.40	5.31	2.326
2,6-Dimethylnaphthalene	21.26	25.15	22.87	9.41	3.149
Add'l Dimethylnaphthalenes	19.58	22.67	12.10	2.74	2.304
Acenaphthylene	1.25	0.74			0.083
Acenaphthene					
Fluorene	14.84				0.642
1-Methylfluorene	27.13		0.14	0.17	1.187
Add'l Methylfluorene - Peak 1	33.52				1.451
Add'l Methylfluorene - Peak 2	8.15				0.353
Phenanthrene	40.90	0.24	0.23		1.782
Add'l Dimethylphenanthrenes	3.32				0.144

Table P-10. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Anthracene					
Methylanthracene - Peak 1	44.64				1.933
Methylanthracene - Peak 2	51.42				2.226
Methylanthracene - Peak 3	27.77				1.202
Methylanthracene - Peak 4	23.42				1.014
Octylcyclohexane					
Norpristane	16.41	23.07	16.45	4.35	2.413
Decylcyclohexane		5.01	2.54	0.45	0.311
Pristane	32.31	37.36	9.41	1.07	3.240
Phytane	58.00	7.48			2.780
Tridecylcyclohexane					
Dibutyl phthalate		0.79	0.86	0.52	0.028
Butyl benzyl phthalate			0.57	0.45	
bis(2-Ethylhexyl) phthalate	1.84		1.25	0.92	0.034
Dioctyl phthalate					
Fluoranthene	1.44				0.062
Pyrene	3.32				0.144
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					

Table P-10. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)	2.13	5.81	1.56	0.91	0.289
n-Tridecane (*n*-C13)	1.63	1.63	1.14	1.58	0.232
9H-Fluoren-9-one	10.41				0.451
n-Tetradecane (*n*-C14)	6.70	5.45	6.17	6.71	0.959
n-Pentadecane (*n*-C15)	17.23	16.81	18.93	23.85	3.025
n-Hexadecane (*n*-C16)	41.17	50.42	56.95	30.80	7.069
n-Heptadecane (*n*-C17)	96.09	73.21	8.75	1.05	7.338
1-Octadecene					
n-Octadecane (*n*-C18)	104.51	9.31	0.48	0.74	4.877
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	97.55	0.39	0.39	0.54	4.194

Table P-10. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
n-Eicosane (*n*-C20)	80.54		0.51	0.52	3.433
n-Heneicosane (*n*-C21)	79.47	1.04	1.46	1.29	3.474
n-Docosane (*n*-C22)	69.99	1.93	2.77	2.32	3.257
n-Tricosane (*n*-C23)	60.44	3.31	4.70	4.24	2.979
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	1.85				0.080
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	25.03	2.98	4.82	3.48	1.376
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	10.15	3.89	5.83	3.81	0.798
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	5.87	3.89	5.61	4.30	0.567
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	4.15	3.05	5.00	4.34	0.434
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					

Table P-10. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	5.84	5.96	4.35	3.73	0.598
Nonacosane (*n*-C29)	6.38	2.76	3.96	4.74	0.528
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	3.60	6.98	5.24	8.71	-1.893
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	36.46	11.81	13.31	22.49	2.909
n-Hentriacontane (*n*-C31)		10.90	12.96	21.36	1.239
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	13.38	7.63	7.90	10.78	1.370
Tritriacontane (C33)	8.44	3.74	4.55	6.43	0.837
Tetratriacontane (C34)	10.41	4.78	5.69	7.61	1.127
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	9.84	5.70	6.68	7.38	1.193
Tetracontane (C40)					

Table P-10. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Hexanoic acid	4.73	5.68	1.16	0.56	0.472
Succinic acid	0.58	0.21			-0.031
Octanoic acid	9.91	0.55	0.19		0.433
Glutaric acid	0.54	0.30			0.022
Nonanoic Acid	11.80	1.06	1.26	0.64	0.528
Adipic acid	0.00		0.00		-0.009
Decanoic acid	7.69	0.61	0.78	0.41	0.350
Undecanoic acid	9.79	0.88	1.44	1.41	0.372
Pimelic acid					
Suberic acid					
Dodecanoic acid	5.43	0.44	1.24	1.21	0.249
Azelaic acid			8.34		0.324
Tridecanoic acid					
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	11.71	1.06	1.11	2.88	-0.892

Table P-10. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pentadecanoic acid	7.55	2.06	2.01	5.89	-0.662
Palmitoleic acid	5.69	2.80	2.99	7.48	-2.252
Hexadecanoic acid	30.03	7.73	8.13	20.54	-3.411
Heptadecanoic acid	1.99	0.40	0.38	0.89	-0.142
Linoleic acid		0.46	0.48	0.63	-0.025
Oleic acid		1.20	1.31	3.76	-1.364
Linolenic acid					
Octadecanoic acid	4.44	2.49	2.40	4.43	-0.857
Nonoadecanoic acid					
Eicosanoic aicd	0.14	0.13	0.11	0.19	-0.044
Docosanoic acid	0.11	0.13		0.16	-0.036
Tricosanoic acid					
Tetracosanoic acid	0.30	0.30	0.23	0.39	-0.066
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	1417.3	471.38	359.32	299.53	82.37

Table P-11. Campaign #2 Gas-Phase Semivolatiles, July 10, 2002

Test Date		July 10, 2002			
Substrate		PUF			
Sample ID	P020102N	P020102O	P020102P	P020102Q	
Port and Array	6B	6B	6B	6B	
Sampling Position	First	Second	Third	Fourth	
Sampling Flow (lpm)	8.219				
Sampling Time (min)	600.67				
Dilution Ratio	44.34				
Flue gas flow (lpm)	115149				
Fuel (kg/min)	7.43				
Volume (uL)	230	230	230	250	
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dimethyl phthalate					
Diethyl phthalate	1.44		0.25	0.47	0.055
Naphthalene	3.61	3.51	4.50	3.88	0.527
2-Methylnaphthalene	15.76	15.08	18.92	16.81	2.334
1-Methylnaphthalene	10.86	9.86	12.11	10.87	1.533
2,7-Dimethylnaphthalene	23.54	26.58	24.31	7.68	2.842
1,3-Dimethylnaphthalene	22.99	19.89	17.51	4.29	2.234
2,6-Dimethylnaphthalene	26.30	25.51	25.82	9.19	3.008
Add'l Dimethylnaphthalenes	23.94	23.16	12.60	1.34	2.100
Acenaphthylene	1.49	0.70			0.075
Acenaphthene					
Fluorene	17.64				0.606
1-Methylfluorene	25.46				0.874
Add'l Methylfluorene - Peak 1	30.19				1.037
Add'l Methylfluorene - Peak 2	6.64				0.228
Phenanthrene	39.53	0.06	0.08	0.20	1.363
Add'l Dimethylphenanthrenes	3.64				0.125
Anthracene					
Methylanthracene - Peak 1	45.46				1.561

Table P-11. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 2	51.76				1.777
Methylanthracene - Peak 3	28.31				0.972
Methylanthracene - Peak 4	23.08				0.792
Octylcyclohexane					
Norpristane	14.47	20.45	18.31		1.828
Decylcyclohexane	2.28	4.03	2.13		0.290
Pristane	26.23	36.16	5.88	0.66	2.353
Phytane	46.25	3.35			1.682
Tridecylcyclohexane					
Dibutyl phthalate		0.86	0.89	2.76	0.107
Butyl benzyl phthalate				2.06	0.077
bis(2-Ethylhexyl) phthalate	1.26				-0.086
Dioctyl phthalate					
Fluoranthene	1.23				0.042
Pyrene	3.64				0.125
Chrysene	0.23				0.008
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					

Table P-11. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)			0.15		0.005
n-Dodecane (*n*-C12)	4.37	3.36	1.55	1.38	0.246
n-Tridecane (*n*-C13)	1.87	1.80	1.72	1.43	0.231
9H-Fluoren-9-one	11.40				0.391
n-Tetradecane (*n*-C14)	6.10	5.59	6.57	6.20	0.816
n-Pentadecane (*n*-C15)	17.64	15.41	18.91	20.72	2.524
n-Hexadecane (*n*-C16)	36.76	42.57	59.34	35.27	6.001
n-Heptadecane (*n*-C17)	79.53	63.38	2.56	1.26	4.998
1-Octadecene					
n-Octadecane (*n*-C18)	100.74	2.61	0.26	0.93	3.537
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	77.47	0.18	0.14	0.73	2.618
n-Eicosane (*n*-C20)	74.74	0.42	0.41	0.69	2.526
n-Heneicosane (*n*-C21)	71.66	0.90	0.96	1.20	2.456
n-Docosane (*n*-C22)	60.40	1.29	1.34	1.40	2.171
n-Tricosane (*n*-C23)	62.51	2.88	2.76	3.17	2.345
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	1.94				0.067
Anthraquinone					

Table P-11. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	25.41	2.87	2.24	2.19	0.985
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	9.64	3.67	2.95	2.45	0.484
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	4.92	4.48	3.36	3.34	0.340
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	3.22	4.57	3.22	2.80	0.256
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	2.88	5.65	3.00	2.99	0.307
Nonacosane (*n*-C29)	2.59	3.98	2.78	2.68	0.229
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	4.97	6.47	3.92	3.50	-2.203
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					

Table P-11. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
n-Triacontane (*n*-C30)	9.44	15.79	10.80	11.99	1.167
n-Hentriacontane (*n*-C31)	9.08	13.96	10.44	11.60	1.066
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	5.11	6.40	5.25	5.68	0.557
Tritriacontane (C33)	2.40	3.84	2.67	3.03	0.320
Tetratriacontane (C34)	3.36	3.71	3.00	3.30	0.444
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	4.71	4.99	4.06	4.75	0.650
Tetracontane (C40)					
Hexanoic acid	4.46	3.25	0.68		0.268
Succinic acid	0.59			0.18	-0.037
Octanoic acid	10.60	0.23	0.23		0.355
Glutaric acid					
Nonanoic Acid	12.90	0.74	0.95	1.25	0.450
Adipic acid					-0.009
Decanoic acid	8.18	0.41	0.39	0.76	0.284
Undecanoic acid	10.13	0.81	0.63	0.23	0.209
Pimelic acid					
Suberic acid					
Dodecanoic acid	5.65	0.40	0.30	0.73	0.147
Azelaic acid					0.000
Tridecanoic acid					

Table P-11. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	8.48	1.64	0.76	1.54	-1.164
Pentadecanoic acid	7.83	3.14	1.63	2.43	-0.853
Palmitoleic acid		4.40	2.04	3.60	-2.658
Hexadecanoic acid	29.64	12.41	6.73	11.50	-4.020
Heptadecanoic acid		0.64	0.31	0.45	-0.243
Linoleic acid		0.45			-0.070
Oleic acid		2.08	0.79	1.50	-1.453
Linolenic acid					
Octadecanoic acid	4.64	3.94	2.71	4.58	-0.852
Nonoadecanoic acid					
Eicosanoic aicd	0.21	0.20	0.11	0.11	-0.044
Docosanoic acid	0.18	0.20	0.13		-0.035
Tricosanoic acid					
Tetracosanoic acid	0.44	0.55	0.26	0.21	-0.064
Pentacosanoic acid					
Hexacosanoic acid					

Table P-11. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	1296.0	445.45	316.30	223.94	56.21

Table P-12. Campaign #2 Gas-Phase Semivolatiles, July 10, 2002

Test Date			July 10, 2002		
Substrate			PUF		
Sample ID	P012902B	P012902C	P012902D	P012902E	
Port and Array	10A	10A	10A	10A	
Sampling Position	First	Second	Third	Fourth	
Sampling Flow (lpm)	8.183				
Sampling Time (min)	600.67				
Dilution Ratio	44.34				
Flue gas flow (lpm)	115149				
Fuel (kg/min)	7.43				
Volume (uL)					
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dimethyl phthalate					
Diethyl phthalate					
Naphthalene					
2-Methylnaphthalene					
1-Methylnaphthalene					
2,7-Dimethylnaphthalene					
1,3-Dimethylnaphthalene					
2,6-Dimethylnaphthalene					
Add'l Dimethylnaphthalenes					
Acenaphthylene					
Acenaphthene					
Fluorene					
1-Methylfluorene					
Add'l Methylfluorene - Peak 1					
Add'l Methylfluorene - Peak 2					
Phenanthrene					
Add'l Dimethylphenanthrenes					
Anthracene					

Table P-12. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 1					
Methylanthracene - Peak 2					
Methylanthracene - Peak 3					
Methylanthracene - Peak 4					
Octylcyclohexane					
Norpristane					
Decylcyclohexane					
Pristane					
Phytane					
Tridecylcyclohexane					
Dibutyl phthalate					
Butyl benzyl phthalate					
bis(2-Ethylhexyl) phthalate					
Dioctyl phthalate					
Fluoranthene					
Pyrene					
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					

Table P-12. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)					
n-Tridecane (*n*-C13)					
9H-Fluoren-9-one					
n-Tetradecane (*n*-C14)					
n-Pentadecane (*n*-C15)					
n-Hexadecane (*n*-C16)					
n-Heptadecane (*n*-C17)					
1-Octadecene					
n-Octadecane (*n*-C18)					
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)					
n-Eicosane (*n*-C20)					
n-Heneicosane (*n*-C21)					
n-Docosane (*n*-C22)					
n-Tricosane (*n*-C23)					
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene					

Table P-12. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)					
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)					
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)					
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)					
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)					
Nonacosane (*n*-C29)					
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene					
Indeno[1,2,3-c,d]fluoranthene					

Table P-12. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)					
n-Hentriacontane (*n*-C31)					
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)					
Tritriacontane (C33)					
Tetratriacontane (C34)					
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)					
Tetracontane (C40)					
Hexanoic acid	1.99	4.49	4.80	0.76	-0.020
Succinic acid				0.20	-0.064
Octanoic acid	2.68			0.31	-0.024
Glutaric acid				0.21	-0.013
Nonanoic Acid	8.95	0.49	0.19	1.39	-0.097
Adipic acid					
Decanoic acid	8.99			0.69	-0.052
Undecanoic acid	24.70	4.54	3.05	0.20	-0.196
Pimelic acid					
Suberic acid					
Dodecanoic acid	21.30	3.91	2.63	0.71	-0.098
Azelaic acid					

Table P-12. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Tridecanoic acid					
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	4.66	3.86	0.81	7.63	-1.595
Pentadecanoic acid	4.79	5.24	1.40	9.45	-1.375
Palmitoleic acid	2.35	6.53	1.48	12.50	-3.013
Hexadecanoic acid	22.20	34.10	12.65	32.53	-6.124
Heptadecanoic acid	1.33	0.69	0.40	1.59	-0.292
Linoleic acid		0.59	0.54	0.85	-0.085
Oleic acid		2.14	0.83	5.14	-1.607
Linolenic acid					
Octadecanoic acid	12.53	14.21	3.25	6.11	-1.410
Nonoadecanoic acid					
Eicosanoic aicd	0.23	0.19	0.16	0.41	-0.066
Docosanoic acid	0.09			0.36	-0.052
Tricosanoic acid					
Tetracosanoic acid	0.15	0.26		1.00	-0.115
Pentacosanoic acid					

Table P-12. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	116.9	81.23	32.18	82.04	-16.30

Table P-13. Campaign #2 Gas-Phase Semivolatiles, July 10, 2002

Test Date			July 10, 2002		
Substrate			PUF		
Sample ID	P012902F	P012902G	P012902H	P020102A	
Port and Array	10B	10B	10B	10B	
Sampling Position	First	Second	Third	Fourth	
Sampling Flow (lpm)	8.183				
Sampling Time (min)	600.67				
Dilution Ratio	44.34				
Flue gas flow (lpm)	115149				
Fuel (kg/min)	7.43				
Volume (uL)	250	230	250	250	
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dimethyl phthalate					
Diethyl phthalate				0.53	0.000
Naphthalene	2.52	2.83	2.91	3.11	0.401
2-Methylnaphthalene	11.02	12.73	12.74	13.57	1.836
1-Methylnaphthalene	7.63	8.75	8.71	8.88	1.247
2,7-Dimethylnaphthalene	16.94	23.66	20.62	7.17	2.493
1,3-Dimethylnaphthalene	14.96	17.31	14.89	4.39	1.880
2,6-Dimethylnaphthalene	17.32	22.47	21.30	9.07	2.563
Add'l Dimethylnaphthalenes	16.40	20.41	11.29	1.52	1.799
Acenaphthylene	0.70				0.026
Acenaphthene					
Fluorene	15.65				0.587
1-Methylfluorene	4.38				0.164
Add'l Methylfluorene - Peak 1	19.57				0.734
Add'l Methylfluorene - Peak 2	18.77				0.704
Phenanthrene	27.27	0.11	0.11	0.23	1.032
Add'l Dimethylphenanthrenes	3.65				0.137
Anthracene					
Methylanthracene - Peak 1	30.22				1.133

Table P-13. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 2	36.56				1.370
Methylanthracene - Peak 3	19.43				0.728
Methylanthracene - Peak 4	15.29				0.573
Octylcyclohexane					
Norpristane	10.60	18.98	15.82	0.47	1.663
Decylcyclohexane		4.27	2.04	3.17	0.343
Pristane	16.55	28.84	5.65		1.811
Phytane	29.53	4.48		0.56	1.262
Tridecylcyclohexane					
Dibutyl phthalate	1.24	0.73	0.92		0.050
Butyl benzyl phthalate	2.16		0.44	2.05	0.174
bis(2-Ethylhexyl) phthalate	1.69	0.56	0.53	0.88	0.006
Dioctyl phthalate				1.97	0.074
Fluoranthene	3.65				0.137
Pyrene					
Chrysene	0.12				0.004
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4		0.13	0.13		0.009

Table P-13. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)	2.69	3.01	1.57	1.35	0.190
n-Tridecane (*n*-C13)	1.29	1.82	1.58	1.58	0.222
9H-Fluoren-9-one	7.59				0.285
n-Tetradecane (*n*-C14)	5.50	5.07	4.72	5.16	0.709
n-Pentadecane (*n*-C15)	12.46	13.52	14.27	17.17	2.078
n-Hexadecane (*n*-C16)	24.33	34.23	48.87	29.24	4.944
n-Heptadecane (*n*-C17)	54.73	51.71	2.76	0.65	3.919
1-Octadecene					
n-Octadecane (*n*-C18)	84.42	4.68	0.25	0.52	3.299
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	77.19	0.19	0.21	0.47	2.846
n-Eicosane (*n*-C20)	66.22	0.23	0.26	0.39	2.421
n-Heneicosane (*n*-C21)	57.33	0.84	0.84	0.93	2.131
n-Docosane (*n*-C22)	55.94	1.14	0.89	1.07	2.165
n-Tricosane (*n*-C23)	50.18	1.85	1.51	2.39	1.978
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	1.73				0.065
Anthraquinone					

Table P-13. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	20.70	2.12	1.61	3.15	0.882
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	12.07	2.30	1.73	4.30	0.592
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)	8.91	2.28	1.84	4.22	0.417
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	8.59	1.97	1.52	3.99	0.370
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	7.53	1.82	1.71	2.97	0.320
Nonacosane (*n*-C29)	6.93	1.75	1.65	2.47	0.282
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	5.09	3.49	1.37	6.39	-2.259
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					

Table P-13. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
n-Triacontane (*n*-C30)	21.15	7.32	9.58	9.05	1.226
n-Hentriacontane (*n*-C31)	19.66	7.38	8.12	8.53	1.100
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	7.34	4.66	5.41	4.37	0.572
Tritriacontane (C33)	4.14	2.24	2.51	1.97	0.301
Tetratriacontane (C34)	3.45	2.51	3.25	2.40	0.402
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	3.90	4.47	5.75	4.03	0.667
Tetracontane (C40)					
Hexanoic acid	1.08	1.66	1.38		0.129
Succinic acid					
Octanoic acid	3.49				0.106
Glutaric acid					
Nonanoic Acid	7.93	0.78	0.84	1.28	0.306
Adipic acid					
Decanoic acid	7.29	0.49	0.50	1.11	0.298
Undecanoic acid	15.98	1.71	1.83	2.98	0.642
Pimelic acid					
Suberic acid					
Dodecanoic acid	13.78	1.48	1.58	2.56	0.624
Azelaic acid					
Tridecanoic acid					

Table P-13. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	8.76	1.06	0.68	3.94	-1.057
Pentadecanoic acid	7.05	1.50	0.80	5.94	-0.807
Palmitoleic acid	4.43	1.41	0.78	6.53	-2.525
Hexadecanoic acid	30.16	9.20	7.95	51.14	-2.461
Heptadecanoic acid	2.41	0.28	0.21	1.08	-0.144
Linoleic acid		0.40		0.63	-0.048
Oleic acid		0.59		2.55	-1.491
Linolenic acid					
Octadecanoic acid	17.74	8.38	9.38	24.58	0.816
Nonoadecanoic acid					
Eicosanoic aicd	0.30			0.23	-0.046
Docosanoic acid	0.21			0.13	-0.040
Tricosanoic acid					
Tetracosanoic acid	0.36	0.14		0.51	-0.077
Pentacosanoic acid					
Hexacosanoic acid					

Table P-13. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	1095.8	357.92	267.78	281.48	51.29

Table P-14. Campaign #2 Gas-Phase Semivolatiles, July 10, 2002

Test Date				July 10, 2002				
Substrate				PUF				
Sample ID	P012902F	P012902G	P012902H	P020102A		P020102R	P020102S	
Port and Array	10B	10B	10B	10B		DA	DA	
Sampling Position	First	Second	Third	Fourth		First	Second	
Sampling Flow (lpm)	8.183					8.219		
Sampling Time (min)	600.67					600.67		
Dilution Ratio	44.34					44.34		
Flue gas flow (lpm)	115149					123537.5		
Fuel (kg/min)	7.43					7.43		
Volume (uL)	250	230	250	250		230	250	
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Dimethyl phthalate								
Diethyl phthalate				0.53	0.000	0.37	0.20	0.020
Naphthalene	2.52	2.83	2.91	3.11	0.401	0.26	0.21	0.017
2-Methylnaphthalene	11.02	12.73	12.74	13.57	1.836		0.06	0.002
1-Methylnaphthalene	7.63	8.75	8.71	8.88	1.247			
2,7-Dimethylnaphthalene	16.94	23.66	20.62	7.17	2.493			
1,3-Dimethylnaphthalene	14.96	17.31	14.89	4.39	1.880			
2,6-Dimethylnaphthalene	17.32	22.47	21.30	9.07	2.563			
Add'l Dimethylnaphthalenes	16.40	20.41	11.29	1.52	1.799			
Acenaphthylene	0.70				0.026			
Acenaphthene								
Fluorene	15.65				0.587			
1-Methylfluorene	4.38				0.164			
Add'l Methylfluorene - Peak 1	19.57				0.734			
Add'l Methylfluorene - Peak 2	18.77				0.704			
Phenanthrene	27.27	0.11	0.11	0.23	1.032	0.13	0.06	0.007
Add'l Dimethylphenanthrenes	3.65				0.137			
Anthracene								

Table P-14. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 1	30.22				1.133			
Methylanthracene - Peak 2	36.56				1.370			
Methylanthracene - Peak 3	19.43				0.728			
Methylanthracene - Peak 4	15.29				0.573			
Octylcyclohexane								
Norpristane	10.60	18.98	15.82	0.47	1.663			
Decylcyclohexane		4.27	2.04	3.17	0.343			
Pristane	16.55	28.84	5.65		1.811	0.23	0.21	0.016
Phytane	29.53	4.48		0.56	1.262	0.61		0.021
Tridecylcyclohexane								
Dibutyl phthalate	1.24	0.73	0.92		0.050	0.86	0.71	0.056
Butyl benzyl phthalate	2.16		0.44	2.05	0.174			
bis(2-Ethylhexyl) phthalate	1.69	0.56	0.53	0.88	0.006	1.72	1.89	0.130
Dioctyl phthalate				1.97	0.074			
Fluoranthene	3.65				0.137			
Pyrene								
Chrysene	0.12				0.004			
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								

Table P-14. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Cholestane 4		0.13	0.13		0.009			
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)	2.69	3.01	1.57	1.35	0.190	1.86	1.62	0.124
n-Tridecane (*n*-C13)	1.29	1.82	1.58	1.58	0.222	0.23		0.008
9H-Fluoren-9-one	7.59				0.285			
n-Tetradecane (*n*-C14)	5.50	5.07	4.72	5.16	0.709	0.68	0.51	0.042
n-Pentadecane (*n*-C15)	12.46	13.52	14.27	17.17	2.078	0.57	0.38	0.034
n-Hexadecane (*n*-C16)	24.33	34.23	48.87	29.24	4.944	1.23	0.92	0.077
n-Heptadecane (*n*-C17)	54.73	51.71	2.76	0.65	3.919	0.81	0.43	0.044
1-Octadecene								
n-Octadecane (*n*-C18)	84.42	4.68	0.25	0.52	3.299	1.36	0.24	0.056
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	77.19	0.19	0.21	0.47	2.846	2.11	0.20	0.080
n-Eicosane (*n*-C20)	66.22	0.23	0.26	0.39	2.421	2.74		0.094
n-Heneicosane (*n*-C21)	57.33	0.84	0.84	0.93	2.131	2.52	0.72	0.113
n-Docosane (*n*-C22)	55.94	1.14	0.89	1.07	2.165		1.21	0.045
n-Tricosane (*n*-C23)	50.18	1.85	1.51	2.39	1.978	1.35	1.79	0.113
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene	1.73				0.065			

Table P-14. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Anthraquinone								
Naphthalic anhydride								
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	20.70	2.12	1.61	3.15	0.882	1.53	2.48	0.145
iso-Tricosane (C23)								
anteiso-Tricosane (C23)								
n-Pentacosane (*n*-C25)	12.07	2.30	1.73	4.30	0.592	1.49	3.08	0.166
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C26)	8.91	2.28	1.84	4.22	0.417	2.17	3.97	0.223
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)								
Heptacosane (*n*-C27)	8.59	1.97	1.52	3.99	0.370	2.12	4.13	0.227
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (*n*-C28)	7.53	1.82	1.71	2.97	0.320	1.85	3.66	0.200
Nonacosane (*n*-C29)	6.93	1.75	1.65	2.47	0.282	1.77	3.53	0.193
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	5.09	3.49	1.37	6.39	-2.259	38.98	40.81	2.861
Indeno[1,2,3-c,d]fluoranthene								

Table P-14. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Dibenzo[a,e]pyrene								
n-Triacontane (*n*-C30)	21.15	7.32	9.58	9.05	1.226	5.07	9.20	0.517
n-Hentriacontane (*n*-C31)	19.66	7.38	8.12	8.53	1.100	5.06	9.17	0.516
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (*n*-C32)	7.34	4.66	5.41	4.37	0.572	2.45	3.92	0.230
Tritriacontane (C33)	4.14	2.24	2.51	1.97	0.301	1.00	1.74	0.099
Tetratriacontane (C34)	3.45	2.51	3.25	2.40	0.402	0.74		0.025
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)								
Hexatriacontane (*n*-C36)	3.90	4.47	5.75	4.03	0.667			
Tetracontane (C40)								
Hexanoic acid	1.08	1.66	1.38		0.129	0.58		0.020
Succinic acid						1.06	0.74	0.064
Octanoic acid	3.49				0.106	0.43	0.26	0.024
Glutaric acid							0.34	0.013
Nonanoic Acid	7.93	0.78	0.84	1.28	0.306	1.60	1.14	0.097
Adipic acid							0.24	0.009
Decanoic acid	7.29	0.49	0.50	1.11	0.298	0.86	0.61	0.052
Undecanoic acid	15.98	1.71	1.83	2.98	0.642	2.85	2.64	0.196
Pimelic acid								
Suberic acid								
Dodecanoic acid	13.78	1.48	1.58	2.56	0.624	1.43	1.33	0.098
Azelaic acid								

Table P-14. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Tridecanoic acid								
Pinonic acid								
Phthalic acid								
1,4-Benzenedicarboxylic acid								
1,3-Benzenedicarboxylic acid								
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid								
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid	8.76	1.06	0.68	3.94	-1.057	20.59	23.80	1.595
Pentadecanoic acid	7.05	1.50	0.80	5.94	-0.807	17.01	21.20	1.375
Palmitoleic acid	4.43	1.41	0.78	6.53	-2.525	36.66	47.01	3.013
Hexadecanoic acid	30.16	9.20	7.95	51.14	-2.461	76.34	93.85	6.124
Heptadecanoic acid	2.41	0.28	0.21	1.08	-0.144	3.49	4.63	0.292
Linoleic acid		0.40		0.63	-0.048	1.11	1.26	0.085
Oleic acid		0.59		2.55	-1.491	19.19	25.41	1.607
Linolenic acid								
Octadecanoic acid	17.74	8.38	9.38	24.58	0.816	16.88	22.26	1.410
Nonoadecanoic acid							0.28	0.010
Eicosanoic aicd	0.30			0.23	-0.046	0.71	1.11	0.066
Docosanoic acid	0.21			0.13	-0.040	0.50	0.94	0.052
Tricosanoic acid								
Tetracosanoic acid	0.36	0.14		0.51	-0.077	1.01	2.14	0.115
Pentacosanoic acid								

Table P-14. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid								
Triacontanoic acid								
Total	1095.8	357.92	267.78	281.48	51.29	286.16	348.23	22.82

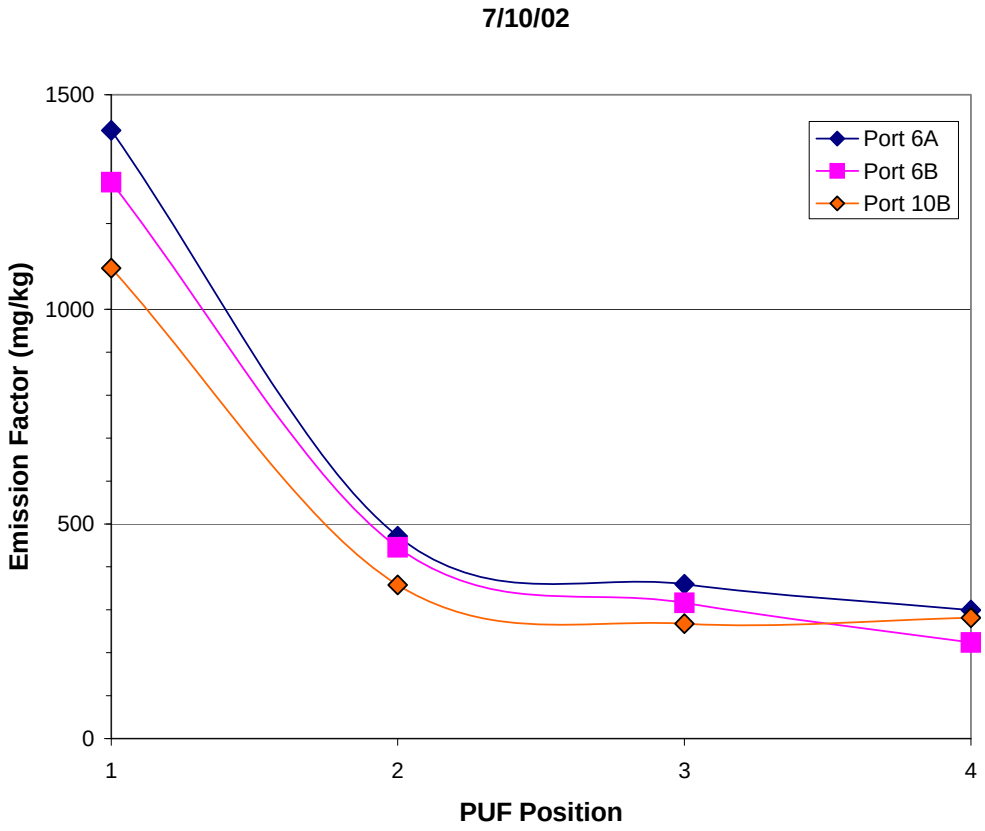

Figure P-2. Campaign #2 Gas-Phase Semivolatiles, July 10, 2002: PUF Position

Table P-15. Campaign #2 Gas-Phase Semivolatiles, July 11, 2002

Test Date			**July 11, 2002**		
Substrate			**PUF**		
Sample ID	**P062502K**	**P062502L**	**P062502M**	**P062502N**	
Port and Array	**6A**	**6A**	**6A**	**6A**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (lpm)	**8.276**				
Sampling Time (min)	**600.0**				
Dilution Ratio	**44.91**				
Flue gas flow (lpm)	**120926**				
Fuel (kg/min)	**7.43**				
Volume (uL)	**200**	**230**	**240**	**240**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate	0.07				-0.003
Diethyl phthalate			1.87	2.78	0.066
Naphthalene	10.06	7.54	10.14	11.07	1.369
2-Methylnaphthalene	65.25	53.41	62.05	46.74	8.123
1-Methylnaphthalene	44.72	37.82	43.47	27.40	5.471
2,7-Dimethylnaphthalene	66.00	71.06	8.15		4.974
1,3-Dimethylnaphthalene		46.14	4.58		1.849
2,6-Dimethylnaphthalene	75.08	73.38	11.97		5.489
Add'l Dimethylnaphthalenes	70.00	36.21	1.30		3.575
Acenaphthylene	0.48				0.015
Acenaphthene	10.33				0.326
Fluorene	2.96				0.093
1-Methylfluorene					
Add'l Methylfluorene - Peak 1					
Add'l Methylfluorene - Peak 2					
Phenanthrene	36.72	0.49	0.36		1.167
Add'l Dimethylphenanthrenes					
Anthracene	0.28				0.009
Methylanthracene - Peak 1					

Table P-15. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 2					
Methylanthracene - Peak 3					
Methylanthracene - Peak 4					
Octylcyclohexane		5.44		0.206	
Norpristane	59.35			2.155	
Decylcyclohexane	9.58			0.348	
Pristane	33.60			1.220	
Phytane	0.96			0.035	
Tridecylcyclohexane11.48				0.363	
Dibutyl phthalate	2.38		2.74	0.085	
Butyl benzyl phthalate					
bis(2-Ethylhexyl) phthalate					
Dioctyl phthalate					
Fluoranthene7.20				0.227	
Pyrene					
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					

Table P-15. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)					
n-Dodecane (*n*-C12)	13.08	16.34	12.07	11.52	1.749
n-Tridecane (*n*-C13)	8.97	9.53	10.34	13.04	1.515
9H-Fluoren-9-one			0.12	0.10	0.008
n-Tetradecane (*n*-C14)		32.24	41.19	48.49	4.531
n-Pentadecane (*n*-C15)		96.55	105.96		7.417
n-Hexadecane (*n*-C16)		140.64	34.12	1.20	6.328
n-Heptadecane (*n*-C17)		37.48	0.58	0.97	1.357
1-Octadecene			0.37		0.014
n-Octadecane (*n*-C18)		0.35	0.32	0.56	0.015
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)					
n-Eicosane (*n*-C20)					
n-Heneicosane (*n*-C21)		1.41	1.50		0.021
n-Docosane (*n*-C22)		2.02			-0.015
n-Tricosane (*n*-C23)		3.15	4.95		0.162
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	2.44				0.077
Anthraquinone					

Table P-15. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	6.79	2.51		1.82	0.242
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)					
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)					
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	1.58	2.21	5.15		0.120
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	1.88	2.45	6.12	2.24	0.297
Nonacosane (*n*-C29)	1.80	2.51			-0.037
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	17.16	7.67	11.13	14.44	-0.001
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					

Table P-15. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
n-Triacontane (*n*-C30)	7.25	9.85	18.14	12.29	0.714
n-Hentriacontane (*n*-C31)	7.58	10.94			-0.345
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	5.06	6.23	7.80	6.76	0.413
Tritriacontane (C33)	2.58	3.12	4.42	3.33	0.188
Tetratriacontane (C34)	2.75	3.28	4.12	4.38	0.168
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	4.46	5.00		6.04	0.047
Tetracontane (C40)					
Hexanoic acid	18.18	1.70	1.08	1.20	0.686
Succinic acid	1.19	0.50	0.48	0.44	0.078
Octanoic acid	17.59	0.95	1.24	1.34	0.655
Glutaric acid	0.54		0.19		0.024
Nonanoic Acid	21.15	6.11	7.93	9.00	1.401
Adipic acid				0.49	0.018
Decanoic acid	12.08	1.35	1.20	1.50	0.475
Undecanoic acid	15.15	3.69	3.39	4.78	0.709
Pimelic acid					
Suberic acid					
Dodecanoic acid	9.36	1.88	1.71	2.45	0.414
Azelaic acid					
Tridecanoic acid					

Table P-15. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid16.61	6.01	8.31	15.61	0.686	
Pentadecanoic acid10.53	5.48	7.63	12.71	0.400	
Palmitoleic acid	11.14	14.81	22.23	0.024	
Hexadecanoic acid47.23	27.81	36.89	58.08	2.259	
Heptadecanoic acid3.50	1.34	1.68	2.81	0.144	
Linoleic acid1.05	1.39	2.31	2.23	0.133	
Oleic acid	5.46	8.80	11.40	0.068	
Linolenic acid					
Octadecanoic acid16.36	12.99	14.31	21.05	1.359	
Nonoadecanoic acid					
Eicosanoic aicd0.85	0.46	0.64	1.00	0.055	
Docosanoic acid0.81	0.44	0.64	0.88	0.054	
Tricosanoic acid					
Tetracosanoic acid1.91	0.94	1.45	2.25	0.126	
Pentacosanoic acid					
Hexacosanoic acid					

Table P-15. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	678.1	917.03	532.39	389.34	71.92

Table P-16. Campaign #2 Gas-Phase Semivolatiles, July 11, 2002

Test Date		July 11, 2002			
Substrate		PUF			
Sample ID	P062502O	P062102A	P062102B	P062102C	
Port and Array	6B	6B	6B	6B	
Sampling Position	First	Second	Third	Fourth	
Sampling Flow (lpm)	8.276				
Sampling Time (min)	600.0				
Dilution Ratio	44.91				
Flue gas flow (lpm)	120926				
Fuel (kg/min)	7.43				
Volume (uL)	230	200	210	230	
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dimethyl phthalate					
Diethyl phthalate			0.71		-0.087
Naphthalene		7.30	8.40		0.483
2-Methylnaphthalene		53.35	54.23		3.483
1-Methylnaphthalene		40.22	40.30		2.606
2,7-Dimethylnaphthalene		68.43	10.43		2.507
1,3-Dimethylnaphthalene		41.89	6.12		1.526
2,6-Dimethylnaphthalene		70.87	16.99		2.801
Add'l Dimethylnaphthalenes		36.09	1.88		1.202
Acenaphthylene					
Acenaphthene					
Fluorene					
1-Methylfluorene					
Add'l Methylfluorene - Peak 1					
Add'l Methylfluorene - Peak 2					
Phenanthrene		0.30	0.23		-0.007
Add'l Dimethylphenanthrenes					
Anthracene					
Methylanthracene - Peak 1					

Table P-16. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 2					
Methylanthracene - Peak 3					
Methylanthracene - Peak 4					
Octylcyclohexane					
Norpristane		50.87	2.20		1.679
Decylcyclohexane		8.38			0.265
Pristane		22.97	0.26		0.734
Phytane		0.32			0.010
Tridecylcyclohexane					
Dibutyl phthalate		2.24	1.42		0.013
Butyl benzyl phthalate					
bis(2-Ethylhexyl) phthalate		2.25	1.51		0.121
Dioctyl phthalate					
Fluoranthene					
Pyrene					
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					

Table P-16. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)		0.38	0.52	0.54	0.049
n-Dodecane (*n*-C12)	43.43	4.83	4.57	5.67	1.936
n-Tridecane (*n*-C13)	12.02	7.79	8.48	12.33	1.411
9H-Fluoren-9-one			0.05	0.06	0.004
n-Tetradecane (*n*-C14)	20.52	34.10	35.01	48.54	4.707
n-Pentadecane (*n*-C15)	61.87	92.71	94.31	98.81	11.786
n-Hexadecane (*n*-C16)	277.07	124.93	38.17	2.41	15.242
n-Heptadecane (*n*-C17)	351.06	21.44	0.59	1.32	13.431
1-Octadecene					
n-Octadecane (*n*-C18)		0.47	0.42	0.94	0.031
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)		0.38	0.32	0.67	0.000
n-Eicosane (*n*-C20)					
n-Heneicosane (*n*-C21)		1.08	1.18	1.19	0.029
n-Docosane (*n*-C22)		1.38	1.21	1.56	0.052
n-Tricosane (*n*-C23)		2.99	2.32	3.12	0.144
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	2.24				0.081
Anthraquinone					

Table P-16. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	6.47	3.16	2.34	3.46	0.405
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)		4.50	2.97	4.39	0.211
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)		5.79	3.73		0.168
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	2.86	5.90	3.13	5.22	0.378
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	3.50	5.29	3.58	4.97	0.425
Nonacosane (*n*-C29)	2.97	5.61	3.36	4.61	0.379
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	8.72	4.36	21.40	19.28	0.074
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					

Table P-16. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
n-Triacontane (*n*-C30)	11.10	20.06	14.91	15.11	1.054
n-Hentriacontane (*n*-C31)	12.70	18.47	13.84	14.31	1.042
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	7.82	8.59	8.14	6.78	0.547
Tritriacontane (C33)	3.98	5.60	5.08	4.05	0.336
Tetratriacontane (C34)	5.30	6.21	7.00	3.99	0.406
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	7.21	8.03	9.86	5.20	0.527
Tetracontane (C40)	4.42	4.37	6.30		0.507
Hexanoic acid	17.04	3.51	0.81	0.84	0.751
Succinic acid	1.53	0.44	0.28	0.36	0.079
Octanoic acid	17.78	0.56	0.48	0.55	0.667
Glutaric acid	0.46	0.45	0.28	0.20	0.047
Nonanoic Acid	24.54	2.24	1.44	1.93	0.949
Adipic acid					
Decanoic acid	12.71	0.90	0.75	0.93	0.491
Undecanoic acid	16.46	2.08	2.55	3.00	0.644
Pimelic acid					
Suberic acid					
Dodecanoic acid	10.54	1.06	1.28	1.50	0.406
Azelaic acid					
Tridecanoic acid					

Table P-16. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	16.36	3.45	11.81	14.13	0.644
Pentadecanoic acid	8.90	4.20	12.68	13.06	0.449
Palmitoleic acid		7.88	22.58	23.26	0.058
Hexadecanoic acid	37.64	20.61	45.38	49.90	1.493
Heptadecanoic acid	3.45	0.94	2.44	2.61	0.145
Linoleic acid		1.19	1.93	1.35	0.028
Oleic acid		4.24	11.06	10.73	-0.006
Linolenic acid					
Octadecanoic acid	15.01	8.30	11.86	12.98	0.703
Nonoadecanoic acid					
Eicosanoic aicd	0.65	0.36	0.75	0.78	0.037
Docosanoic acid	0.51	0.36	0.65	0.75	0.034
Tricosanoic acid					
Tetracosanoic acid	1.14	0.86	1.74	2.03	0.092
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					

Table P-16. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total		867.53	568.18	409.39	

Table P-17. Campaign #2 Gas-Phase Semivolatiles, July 11, 2002

Test Date			**July 11, 2002**		
Substrate			PUF		
Sample ID	**P062502C**	**P062502D**	**P062502E**	**P062502F**	
Port and Array	**8A**	**8A**	**8A**	**8A**	
Sampling Position	**First**	**Second**	**Third**	**Fourth**	
Sampling Flow (lpm)	**8.239**				
Sampling Time (min)	**600.0**				
Dilution Ratio	**44.91**				
Flue gas flow (lpm)	**120926**				
Fuel (kg/min)	**7.43**				
Volume (uL)	**290**	**250**	**220**	**260**	
Compound	**ng/µL**	**ng/µL**	**ng/µL**	**ng/µL**	**mg/kg**
Dimethyl phthalate					
Diethyl phthalate			1.95	3.59	0.106
Naphthalene	3.39	9.29	9.35	10.88	1.273
2-Methylnaphthalene	21.18	60.27	54.90	51.45	7.401
1-Methylnaphthalene	14.85	41.28	39.22	34.41	5.107
2,7-Dimethylnaphthalene	37.73	66.74	21.52		5.132
1,3-Dimethylnaphthalene	45.91	52.14	12.72		4.623
2,6-Dimethylnaphthalene	42.88	70.02	28.59		5.746
Add'l Dimethylnaphthalenes	40.99	37.10	4.48		3.512
Acenaphthylene	1.02				0.047
Acenaphthene					
Fluorene	11.77				0.541
1-Methylfluorene	23.92				1.092
Add'l Methylfluorene - Peak 1	32.38				1.489
Add'l Methylfluorene - Peak 2	4.85				0.223
Phenanthrene	21.30	1.57	0.30	0.46	1.047
Add'l Dimethylphenanthrenes	6.58				0.303
Anthracene					
Methylanthracene - Peak 1	28.34				1.303

Table P-17. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 2	34.00				1.564
Methylanthracene - Peak 3	20.80				0.957
Methylanthracene - Peak 4	13.31				0.612
Octylcyclohexane			4.66		0.163
Norpristane	170.11	51.13	7.25		10.104
Decylcyclohexane		9.71			0.385
Pristane	132.06	24.00	0.91		7.057
Phytane	143.99	1.59	0.67		6.709
Tridecylcyclohexane					
Dibutyl phthalate	3.26		2.71	4.24	0.314
Butyl benzyl phthalate				2.21	
bis(2-Ethylhexyl) phthalate					
Dioctyl phthalate					
Fluoranthene	2.36	0.12			0.113
Pyrene					
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					

Table P-17. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)	0.42	0.58	0.47		0.059
n-Dodecane (*n*-C12)	11.68	9.25	9.33	10.71	1.520
n-Tridecane (*n*-C13)	7.75	9.84	9.63	15.43	1.719
9H-Fluoren-9-one					
n-Tetradecane (*n*-C14)	56.43	37.84	36.54	50.17	7.401
n-Pentadecane (*n*-C15)	151.06	105.55	94.26	114.02	19.018
n-Hexadecane (*n*-C16)	241.57	139.05	62.28	3.35	18.816
n-Heptadecane (*n*-C17)	360.68	21.26	0.66	0.44	17.409
1-Octadecene					
n-Octadecane (*n*-C18)	266.33	0.86	0.77	0.37	12.294
2-Methylnonadecane					
3-Methylnonadecane					
n-Nonadecane (*n*-C19)	221.68	6.33	0.25	1.05	10.452
n-Eicosane (*n*-C20)	179.84				8.271
n-Heneicosane (*n*-C21)	116.84	2.75	2.22	1.10	5.518
n-Docosane (*n*-C22)	67.74	3.87	4.41	1.62	3.402
n-Tricosane (*n*-C23)	40.75	7.66	9.16	3.32	2.494
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	2.81				0.129

Table P-17. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	13.40	5.35	9.62	1.51	1.094
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	9.13		13.27		0.694
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)			16.26		0.429
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	12.16		13.35	6.12	1.072
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	21.02	6.74	12.21	5.35	1.712
Nonacosane (*n*-C29)	11.29	5.14	11.42	4.72	1.131
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	27.20		15.87	18.78	0.789
Indeno[1,2,3-c,d]fluoranthene					

Table P-17. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	47.34	21.18	43.92	20.46	4.367
n-Hentriacontane (*n*-C31)	43.63	25.22	40.90	19.40	4.252
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	15.28	8.66	12.30	10.51	1.384
Tritriacontane (C33)	13.50	5.50	9.54	6.52	1.140
Tetratriacontane (C34)	17.75	4.99	8.14	10.33	1.364
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)	14.37	6.64	7.95	10.57	1.133
Tetracontane (C40)	10.31				0.474
Hexanoic acid	15.88	3.83	1.84	0.73	0.940
Succinic acid	0.76	0.31	0.24	0.14	0.049
Octanoic acid	17.83	2.49	1.16	1.09	0.971
Glutaric acid					
Nonanoic Acid	24.38	21.74	8.63	8.48	2.503
Adipic acid					
Decanoic acid	12.34	4.01	1.21	1.78	0.784
Undecanoic acid	17.71	10.93	2.88	4.91	1.338
Pimelic acid					
Suberic acid					
Dodecanoic acid	11.79	6.19	1.45	4.24	0.906
Azelaic acid					
Tridecanoic acid					

Table P-17. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	25.05	25.98	8.13	11.30	1.968
Pentadecanoic acid	16.73	16.76	7.73	12.10	1.301
Palmitoleic acid		38.70	18.15	21.63	1.276
Hexadecanoic acid	61.88	71.11	36.36	49.05	5.115
Heptadecanoic acid	4.73	3.39	1.76	2.35	0.325
Linoleic acid		2.34	1.91	1.30	0.090
Oleic acid		18.00	8.99	10.50	0.564
Linolenic acid					
Octadecanoic acid	16.65	20.63	12.35	12.63	1.566
Nonoadecanoic acid					
Eicosanoic aicd	0.91	1.11	0.63	0.70	0.086
Docosanoic acid	1.00	1.13	0.61	0.70	0.096
Tricosanoic acid					
Tetracosanoic acid	2.45	2.73	1.66	1.83	0.246
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					

Table P-17. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	3069.0	1110.57	749.64	568.52	216.58

Table P-18. Campaign #2 Gas-Phase Semivolatiles, July 11, 2002

Test Date		July 11, 2002			
Substrate		PUF			
Sample ID	P041202G	P041202H	P041202I	P041202J	
Port and Array	10A	10A	10A	10A	
Sampling Position	First	Second	Third	Fourth	
Sampling Flow (lpm)	8.239				
Sampling Time (min)	600.0				
Dilution Ratio	44.91				
Flue gas flow (lpm)	120926				
Fuel (kg/min)	7.43				
Volume (uL)	250	230	210	220	
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Dimethyl phthalate					
Diethyl phthalate			0.74		
Naphthalene	6.02	4.15	7.14		
2-Methylnaphthalene	41.96	64.99	47.84		
1-Methylnaphthalene	30.79	48.80	36.42		
2,7-Dimethylnaphthalene	66.19	84.06	19.14		
1,3-Dimethylnaphthalene		51.26	11.59		
2,6-Dimethylnaphthalene	71.96	89.00	25.68		
Add'l Dimethylnaphthalenes	70.00	55.55	5.13		
Acenaphthylene					
Acenaphthene					
Fluorene					
1-Methylfluorene					
Add'l Methylfluorene - Peak 1					
Add'l Methylfluorene - Peak 2					
Phenanthrene	44.15	0.30	0.49		
Add'l Dimethylphenanthrenes					
Anthracene					
Methylanthracene - Peak 1	73.81				
Methylanthracene - Peak 2	52.67				

Table P-18. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 3	32.86				
Methylanthracene - Peak 4	28.53				
Octylcyclohexane			4.83		
Norpristane		60.53	8.00		
Decylcyclohexane		12.69	0.70		
Pristane		42.95	0.67		
Phytane		3.10			
Tridecylcyclohexane					
Dibutyl phthalate		7.48	3.18		
Butyl benzyl phthalate	3.78	6.93	7.04		
bis(2-Ethylhexyl) phthalate	2.49	2.36	4.89		
Dioctyl phthalate			0.58		
Fluoranthene					
Pyrene	5.41				
Chrysene					
Benzo[a]anthracene					
Benzo[k]fluoranthene					
Benzo[b]fluoranthene					
Benzo[a]pyrene					
Nonadecylcyclohexane					
Squalane					
Indeno[1,2,3-cd]pyrene					
Dibenzo[a,h]anthracene					
Benzo[ghi]perylene					
Coronene					
Cholestane 1					
Cholestane 2					
Cholestane 3					
Cholestane 4					
ABB-20R-24S-Methylcholestane					
ABB-20R-Ethylcholestane					

Table P-18. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
17A(H)-22,29,30-Trisnorhopane					
17B(H)-21A(H)-Norhopane					
17B(H)-21B(H)-Hopane					
17B(H)-21A(H)-Hopane					
17A(H)-21B(H)-Hopane					
n-Decane (*n*-C10)					
n-Undecane (*n*-C11)	0.36	0.42			
n-Dodecane (*n*-C12)	5.23	9.11	3.51		
n-Tridecane (*n*-C13)	9.95	9.98	13.33		
9H-Fluoren-9-one			0.12		
n-Tetradecane (*n*-C14)	60.14	39.15	30.12		
n-Pentadecane (*n*-C15)	141.38	94.41	79.90		
n-Hexadecane (*n*-C16)	247.27	136.88	55.68		
n-Heptadecane (*n*-C17)	627.27	69.32	0.72		
1-Octadecene					
n-Octadecane (*n*-C18)	284.83	2.80	0.37		
2-Methylnonadecane		4.94			
3-Methylnonadecane		1.45			
n-Nonadecane (*n*-C19)	252.99	0.36	0.44		
n-Eicosane (*n*-C20)	175.82		1.71		
n-Heneicosane (*n*-C21)	121.70	1.00	6.48		
n-Docosane (*n*-C22)	67.92	1.15	13.45		
n-Tricosane (*n*-C23)	35.70	1.66	24.65		
iso-Docosane (C22)					
anteiso-Docosane (C22)					
Pyrene	2.37				
Anthraquinone					
Naphthalic anhydride					
Methylfluoranthene					
Retene					

Table P-18. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
Cyclopenta[c,d]acepyrene					
Benzanthraquinone					
1-Methylchrysene					
Benzo[a]pyrene					
n-Tetracosane (*n*-C24)	6.21	1.66	21.62		
iso-Tricosane (C23)					
anteiso-Tricosane (C23)					
n-Pentacosane (*n*-C25)	2.45	1.73	26.33		
iso-Tetracosane (C24)					
anteiso-Tetracosane (C24)					
n-Hexacosane (*n*-C26)		2.07	28.43		
iso-Pentacosane (C25)					
anteiso-Pentacosane (C25)					
Heptacosane (*n*-C27)	1.54	2.01	31.44		
iso-Hexacosane (C26)					
anteiso-Hexacosane (C26)					
iso-Heptacosane (C27)					
anteiso-Heptacosane (C27)					
iso-Octacosane (C28)					
anteiso-Octacosane (C28)					
Octacosane (*n*-C28)	1.33	3.01	28.55		
Nonacosane (*n*-C29)	1.57		25.20		
iso-Nonacosane (C29)					
anteiso-Nonacosane (C29)					
Squalene	16.19	14.78	25.22		
Indeno[1,2,3-c,d]fluoranthene					
Dibenzo[a,e]pyrene					
n-Triacontane (*n*-C30)	4.40	7.78	64.78		
n-Hentriacontane (*n*-C31)	5.35	8.15	60.11		
iso-Triacontane (C30)					
anteiso-Triacontane (C30)					

Table P-18. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
iso-Hentriacontane (C31)					
anteiso-Hentriacontane (C31)					
iso-Dotriacontane (C32)					
anteiso-Dotriacontane (C32)					
Dotriacontane (*n*-C32)	2.49	4.91	13.25		
Tritriacontane (C33)	1.16	2.39	10.40		
Tetratriacontane (C34)		2.89	6.90		
iso-Tritriacontane (C33)					
anteiso-Tritriacontane (C33)					
Pentatriacontane (C35)					
Hexatriacontane (*n*-C36)		4.93	5.28		
Tetracontane (C40)		2.68			
Hexanoic acid	7.21	2.19	0.36		
Succinic acid	1.04	0.33	0.36		
Octanoic acid	13.53	0.76	0.78		
Glutaric acid	0.51	0.18	0.23		
Nonanoic Acid	16.01	2.78	4.11		
Adipic acid			0.86		
Decanoic acid	11.08	1.41	2.13		
Undecanoic acid	14.09	2.69	6.16		
Pimelic acid					
Suberic acid					
Dodecanoic acid	8.49	1.35	3.23		
Azelaic acid					
Tridecanoic acid					
Pinonic acid					
Phthalic acid					
1,4-Benzenedicarboxylic acid					
1,3-Benzenedicarboxylic acid					

Table P-18. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg
1,2-Benzenedicarboxylic acid, 4-methyl					
1,2,4-Benzenetricarboxylic acid					
Benzenetetracarboxylic acid					
Abietic acid					
Pimaric acid					
Sandaracopimaric acid					
Isopimaric acid					
Dehydroabietic acid					
Sebacic acid					
Tetradecanoic acid	15.36	8.49	23.29		
Pentadecanoic acid	11.56	9.48	19.81		
Palmitoleic acid	11.34	15.28	38.13		
Hexadecanoic acid	45.50	37.96	79.68		
Heptadecanoic acid	3.04	1.81	3.96		
Linoleic acid		2.29	3.24		
Oleic acid	10.85	8.28	21.65		
Linolenic acid					
Octadecanoic acid	17.20	12.16	23.51		
Nonoadecanoic acid					
Eicosanoic aicd	0.70	0.59	1.38		
Docosanoic acid	0.50	0.53	1.25		
Tricosanoic acid			0.00		
Tetracosanoic acid	1.16	1.43	3.28		
Pentacosanoic acid					
Hexacosanoic acid					
Heptacosanoic acid					
Octacosanoic acid					
Nonacosanoic acid					
Triacontanoic acid					
Total	2795.4	1075.72	999.43		

Table P-19. Campaign #2 Gas-Phase Semivolatiles, July 11, 2002

Test Date				July 11, 2002				
Substrate				PUF				
Sample ID						P062102D	P062102E	
Port and Array	10B	10B	10B	10B		DA	DA	
Sampling Position	First	Second	Third	Fourth		First	Second	
Sampling Flow (lpm)	8.239					8.203		
Sampling Time (min)	600.0					600.0		
Dilution Ratio	44.91					44.91		
Flue gas flow (lpm)	120926					129745.2		
Fuel (kg/min)	7.43					7.43		
Volume (uL)	240	240	260	240		220	250	
Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Dimethyl phthalate						0.15		0.005
Diethyl phthalate			3.23	3.97		1.87	1.12	0.110
Naphthalene	3.06	6.18	8.74	8.98		0.34	0.35	0.026
2-Methylnaphthalene	20.90	46.17	56.58	48.09				
1-Methylnaphthalene	16.03	35.29	41.57	30.08				
2,7-Dimethylnaphthalene	50.86	73.58	15.97					
1,3-Dimethylnaphthalene	49.01	56.12	9.56					
2,6-Dimethylnaphthalene	47.84	72.85	23.23					
Add'l Dimethylnaphthalenes	46.03	41.10	3.02					
Acenaphthylene								
Acenaphthene								
Fluorene	18.17							
1-Methylfluorene	6.98					0.22		0.008
Add'l Methylfluorene - Peak 1	37.22							
Add'l Methylfluorene - Peak 2	39.93							
Phenanthrene	30.84	0.63	0.49	0.63		0.38	0.28	0.024
Add'l Dimethylphenanthrenes								
Anthracene								
Methylanthracene - Peak 1	49.79							
Methylanthracene - Peak 2	55.90							

Table P-19. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Methylanthracene - Peak 3	33.90							
Methylanthracene - Peak 4	25.98							
Octylcyclohexane		4.04	5.05					
Norpristane	126.37	58.18						
Decylcyclohexane	24.02	10.39						
Pristane	113.16	31.60						
Phytane								
Tridecylcyclohexane								
Dibutyl phthalate	5.17	7.70	3.81	3.24		1.44	1.37	0.105
Butyl benzyl phthalate	4.08	6.39	1.60	1.44			1.92	0.076
bis(2-Ethylhexyl) phthalate	2.36	2.55		2.84				
Dioctyl phthalate								
Fluoranthene								
Pyrene	0.90							
Chrysene								
Benzo[a]anthracene								
Benzo[k]fluoranthene								
Benzo[b]fluoranthene								
Benzo[a]pyrene								
Nonadecylcyclohexane								
Squalane								
Indeno[1,2,3-cd]pyrene								
Dibenzo[a,h]anthracene								
Benzo[ghi]perylene								
Coronene								
Cholestane 1								
Cholestane 2								
Cholestane 3								
Cholestane 4								
ABB-20R-24S-Methylcholestane								
ABB-20R-Ethylcholestane								

Table P-19. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
17A(H)-22,29,30-Trisnorhopane								
17B(H)-21A(H)-Norhopane								
17B(H)-21B(H)-Hopane								
17B(H)-21A(H)-Hopane								
17A(H)-21B(H)-Hopane								
n-Decane (*n*-C10)								
n-Undecane (*n*-C11)								
n-Dodecane (*n*-C12)	5.440	6.110	9.74	15.89		2.42	1.66	0.151
n-Tridecane (*n*-C13)	10.020	8.320	10.99	12.14				
9H-Fluoren-9-one								
n-Tetradecane (*n*-C14)	34.320	32.730	39.73	47.04		0.60	0.44	0.039
n-Pentadecane (*n*-C15)	104.570	107.920	116.75	128.19		1.62	1.20	0.105
n-Hexadecane (*n*-C16)	189.780	163.300	60.22	3.76		1.82	1.37	0.118
n-Heptadecane (*n*-C17)	270.790	34.260	0.70	0.60		1.03	0.68	0.063
1-Octadecene								
n-Octadecane (*n*-C18)	237.460	0.390	0.30	0.26		0.34	0.49	0.031
2-Methylnonadecane								
3-Methylnonadecane								
n-Nonadecane (*n*-C19)	207.050		1.85			0.93	0.35	0.047
n-Eicosane (*n*-C20)	162.000							
n-Heneicosane (*n*-C21)	103.680	0.830	1.22	1.12		1.45	0.92	0.087
n-Docosane (*n*-C22)	59.760	1.220	2.18	1.38		1.25	1.11	0.088
n-Tricosane (*n*-C23)	26.270	3.770	4.09	3.34		1.94	1.82	0.140
iso-Docosane (C22)								
anteiso-Docosane (C22)								
Pyrene	2.500							
Anthraquinone								
Naphthalic anhydride								

Table P-19. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
Methylfluoranthene								
Retene								
Cyclopenta[c,d]acepyrene								
Benzanthraquinone								
1-Methylchrysene								
Benzo[a]pyrene								
n-Tetracosane (*n*-C24)	7.080	1.410	3.14	1.41		1.58	1.94	0.133
iso-Tricosane (C23)								
anteiso-Tricosane (C23)								
n-Pentacosane (*n*-C25)	4.150					2.42	2.61	0.189
iso-Tetracosane (C24)								
anteiso-Tetracosane (C24)								
n-Hexacosane (*n*-C26)	3.950						3.47	0.138
iso-Pentacosane (C25)								
anteiso-Pentacosane (C25)								
Heptacosane (*n*-C27)	2.770	2.180	2.59			2.49	2.96	0.205
iso-Hexacosane (C26)								
anteiso-Hexacosane (C26)								
iso-Heptacosane (C27)								
anteiso-Heptacosane (C27)								
iso-Octacosane (C28)								
anteiso-Octacosane (C28)								
Octacosane (*n*-C28)	2.480	3.750	3.10	1.81		1.90	2.56	0.169
Nonacosane (*n*-C29)	2.200	2.690	2.95	2.56		1.99	2.90	0.185
iso-Nonacosane (C29)								
anteiso-Nonacosane (C29)								
Squalene	17.930	9.750	35.08	40.24		24.02	23.81	1.790
Indeno[1,2,3-c,d]fluoranthene								
Dibenzo[a,e]pyrene								
n-Triacontane (*n*-C30)	6.690	19.290	10.74	13.25		10.76	16.30	1.026
n-Hentriacontane (*n*-C31)	6.050	16.570	11.23	13.12		10.58	15.33	0.981

Table P-19. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
iso-Triacontane (C30)								
anteiso-Triacontane (C30)								
iso-Hentriacontane (C31)								
anteiso-Hentriacontane (C31)								
iso-Dotriacontane (C32)								
anteiso-Dotriacontane (C32)								
Dotriacontane (*n*-C32)	3.480	10.810	6.84	8.41		5.87	8.01	0.525
Tritriacontane (C33)	0.980	6.890	3.38	5.02		2.98	4.93	0.301
Tetratriacontane (C34)	1.600	10.050	4.44	7.51		3.35	6.09	0.360
iso-Tritriacontane (C33)								
anteiso-Tritriacontane (C33)								
Pentatriacontane (C35)								
Hexatriacontane (*n*-C36)	2.720	9.250	6.12	8.55		5.45	7.87	0.504
Tetracontane (C40)								
Hexanoic acid						0.48	0.49	0.036
Succinic acid						0.20	0.14	0.012
Octanoic acid						0.51	0.36	0.032
Glutaric acid								
Nonanoic Acid						2.01	1.50	0.130
Adipic acid							0.00	0.000
Decanoic acid						0.84	0.71	0.058
Undecanoic acid						2.91	2.79	0.213
Pimelic acid								
Suberic acid								
Dodecanoic acid						1.46	1.40	0.107
Azelaic acid								
Tridecanoic acid								
Pinonic acid								
Phthalic acid								
1,4-Benzenedicarboxylic acid								

Table P-19. (Continued)

Compound	ng/µL	ng/µL	ng/µL	ng/µL	mg/kg	ng/µL	ng/µL	mg/kg
1,3-Benzenedicarboxylic acid								
1,2-Benzenedicarboxylic acid, 4-methyl								
1,2,4-Benzenetricarboxylic acid								
Benzenetetracarboxylic acid								
Abietic acid								
Pimaric acid								
Sandaracopimaric acid								
Isopimaric acid								
Dehydroabietic acid								
Sebacic acid								
Tetradecanoic acid						11.05	14.48	0.964
Pentadecanoic acid						10.18	13.69	0.902
Palmitoleic acid						20.60	26.66	1.784
Hexadecanoic acid						44.48	57.31	3.841
Heptadecanoic acid						2.06	2.84	0.185
Linoleic acid						2.00	1.33	0.123
Oleic acid						10.68	13.10	0.896
Linolenic acid								
Octadecanoic acid						11.20	14.48	0.969
Nonoadecanoic acid								
Eicosanoic aicd						0.55	0.79	0.051
Docosanoic acid						0.45	0.74	0.045
Tricosanoic acid								
Tetracosanoic acid						1.01	1.83	0.108
Pentacosanoic acid								
Hexacosanoic acid								
Heptacosanoic acid								
Octacosanoic acid								
Nonacosanoic acid								
Triacontanoic acid								
Total						213.85	268.47	18.19

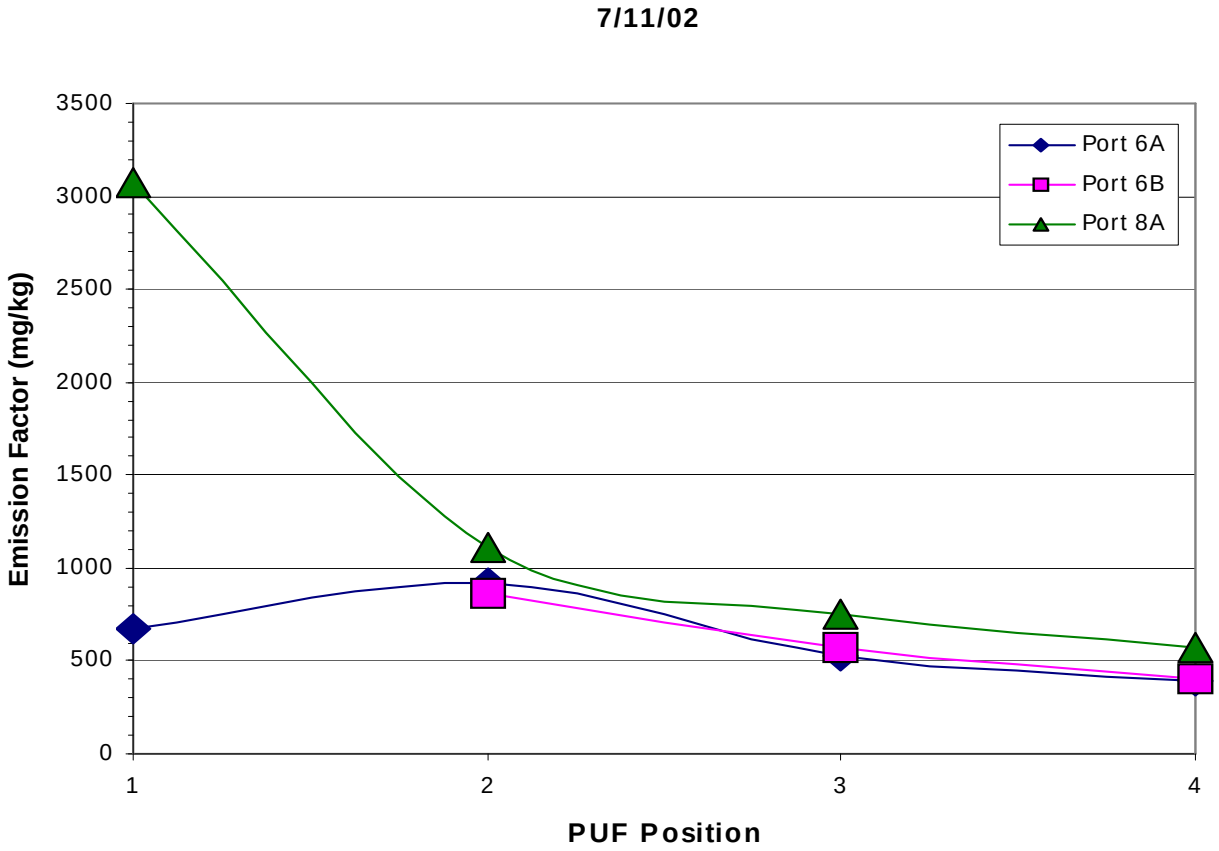

Figure P-3. Gas-Phase Semivolatiles, July 11, 2002: PUF Position