EPA-450/3-76-010

November 1975

SOURCE SAMPLING RESIDENTIAL FIREPLACES FOR EMISSION FACTOR DEVELOPMENT

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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by

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Contract No. 68-02-1992

EPA Project Officer: Thomas Lahre

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
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I. INTRODUCTION

This Atmospheric Emission Evaluation was conducted on an "Average Fireplace" located in the Seattle area for use in the development of an Emission Factor for residential fireplaces, EPA Contract No. 68-02-1992. This Project was funded by the United States Environmental Protection Agency's National Air Data Branch, Technical Development Section, with Messrs. James A. Southerland and Tom Lahre serving as advisors during the entire evaluation. Messrs. David A. Alguard, Gregory A. Swanson and William E. Stolberg, of Valentine, Fisher & Tomlinson, served as project leader and colleagues respectively. The field sampling was performed during the period of July 29 through August 20, 1975.

Area wide emissions can be projected from the enclosed point source emissions factors by establishing the number and use frequency for residential fireplaces.

II. SUMMARY

The average pollutant mass rate was found to be 76.1 grams/hour and the grams of particulate per kilogram of wood burned was found to be 10.4 grams/kilogram. The average particle size was 3.0 microns. 66.3% of the particulate was condensables caught in the back half or impinger section of the Method 5 sampling trains. A back-up filter was used in anticipation of this high back half catch. All atmospheric emissions reported are calculated using front half plus back half particulate including the back-up filter. Poor combustion conditions of considerable excess air was indicated by CO_2 concentrations of consistently less than 1.0%.

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III. DISCUSSION OF EMISSION FACTORS

The representative fireplace in the Seattle area was prepared for sampling as shown on Figure 1. The selection of the representative fireplace is discussed in Appendix A. A total of 24 samples consisting of 18 EPA Method 5 samples, 3 polycyclic organic material (POM) samples and 3 particle sizing runs were collected from the selected fireplace. Sampling was performed using alder, pine, douglas fir, locust and coal as fuels. Coal was not included in computing final average emission parameters because of its current low frequency of use.

A summary of emissions and burning conditions is presented in Table I. Sampling was conducted under three burning conditions of start-up, stable, and smolder. Start-up conditions were present just after building the fire. The flue gas temperatures were rising during this condition. Stable conditions were present when the fire had reached a constant combustion rate. The flue gas temperatures were at a constant level during this burning condition. Smolder conditions were present when the fire was no longer stoked. Since no fuel was being added during smoldering, burning rate was decreasing. Flue gas temperatures dropped throughout the smolder condition.

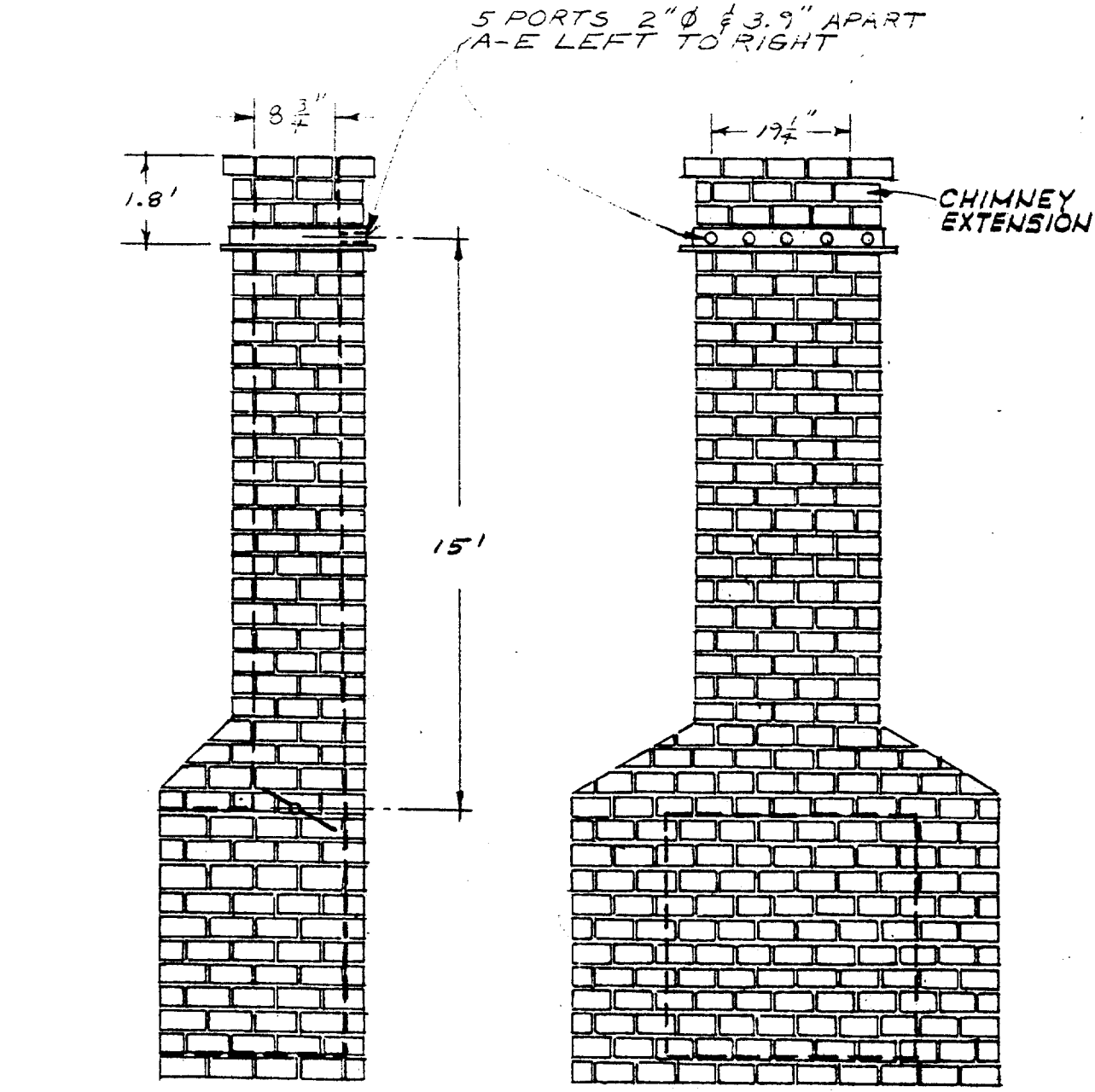
Emissions reported in Table I are calculated using the EPA Method 5 front half section plus the back half section which includes a back-up filter. In addition to the standard EPA-designed particulate sampling train (referred to generally as Method 5) a back-up filter was added between the dry bubbler and the bubbler containing silica gel. The sampling train with the back-up filter is shown in Figure 2. The average back-up filter catch for the 18 particulate runs was found to be 61% as heavy as the front half filter catch (see Tabulation of the Ratio of Back Half to Front Half Catch, Appendix B). In four cases the back-up filter catch was more than the front half filter catch.

Concentrations of CO_2 reported in Table I were measured by an Orsat analyzer. Subsequent particulate concentrations corrected to 12% CO_2 are susceptible to errors due to the magnitude of correction and the accuracy of the CO_2 analysis. More accurate determinations of CO_2 were made by infrared analysis as shown in Table II.

The data given in Table I shows how three factors affecting atmospheric emissions were developed during this project. The factors are 7.4 kilograms per hour wood burning rate (BR), 76.1 grams per hour pollutant mass rate (PMR) and 11.7 grams emissions per kilogram of wood burned (PMR/BR). The BR and the PMR were calculated from the average of fifteen modified EPA Method 5 sampling runs. From these fifteen runs a 95 percent confidence interval was found for the BR, PMR, and PMR/BR to be $\pm$ 1.15, $\pm$ 11.6 and $\pm$ 2.3 respectively.

All samples utilized for emission parameters reported in Table I were collected within 100 $\pm$ 10% of isokinetic conditions. Stack sampling utilized 3-foot heated glass probes within S type pitobes. A 1/2-inch diameter nozzle was used to collect all particulate and POM samples. Section IV, Procedures, describes in more detail the sampling procedure used for this evaluation.

An important emission parameter which allows comparison of the emissions of various types of wood being burned, is gm particulate/kg wood burned. A plot of this parameter versus burning condition, Figure 3, reveals that emissions



AVERAGE FIREPLACE SAMPLING PORT LOCATIONS

FIGURE 1

E.P.A. FIREPLACE EMISSION EVALUATION

DRAWN: W.B.	Prepared by: VALENTINE, FISHER & TOMLINSON Consulting Engineers 520 LLOYD BUILDING SEATTLE, WASHINGTON
CHECKED: G.A.S.	
DATE: '75	ES-1

TABLE I

Summary of Emissions and Burning Conditions

Fuel Type	Run	*Burning Conditions	Burning Rate Kg/hr (BR)	Stack Temp °C	Stack Gas Flow Rate Std.[a] m3/min	**Pollutant Mass Rate gm/hr (PMR)	**Concentration gm/std.m3	% CO2	**Concentration gm/std.m3 @12%CO2	Pollutant Mass Rate / Burning Rate (PMR/BR) gm/Kg
Alder	1	Start Up	4.8	83	11.538	76.6	.111	0.1	13.279	16.0
Alder	2	Stable	7.8	108	10.513	46.0	.073	0.6	1.389	5.9
Alder	3	Smolder	1.9	67	8.262	42.2	.085	0.1	10.211	22.2
Alder	4	Start Up	10.8	114	9.242	135.4	.244	0.6	4.690	12.5
Alder	5b	Stable	9.1	92	---b	---b	---b	---	---b	----b
Alder	6c	Stable	6.2	99	12.771	---c	---c	0.5	---c	----c
Alder Average		Start Up	7.8	98	10.39	106	.178	0.4	8.984	14.2
Alder Average		Stable e	7.8e	108e	10.513e	46.0e	.073e	0.6e	1.389e	5.9e
Alder Average		All Conditions e	6.3e	93e	9.889e	75.0e	0.128e	0.4e	7.392e	14.15e
Douglas Fir	7	Stable	5.7	79	12.139	65.7	.090	0.2	5.414	11.5
Douglas Fir	8	Stable	4.1	88	11.715	58.9	.084	0.4	2.322	14.4
Douglas Fir	9	Start Up	8.3	83	8.787	72.7	.138	0.6	2.759	8.8
Douglas Fir	10	Stable	6.7	110	11.814	90.2	.127	0.4	3.817	13.5
Douglas Fir	11c	Stable	4.3	88	11.737	---c	---c	0.5	---c	----c
Douglas Fir Average		Start Up	8.3	83	8.787	72.7	.138	0.6	2.759	8.8
Douglas Fir Average		Stable	5.5e	92e	11.889e	71.6e	.104e	0.3e	3.851e	13.1e
Douglas Fir Average		All Conditions	6.2e	90e	11.114e	71.9e	.110e	0.4e	3.578e	12.05e
Locust	14	Start Up	9.0	86	10.046	85.2	.141	0.4	.430	9.5
Locust	15	Stable	6.2	92	11.414	78.7	.115	0.4	.397	12.7
Locust	16	Start Up	5.2	82	9.918	60.4	.102	0.6	2.150	11.6
Locust	17b	Stable	4.5	91	----b	---b	---b	---	---b	---b
Locust	18	Stable	5.5	91	12.709	84.2	.110	0.4	3.312	15.3
Locust Average		Start Up	7.1	84	9.982	72.8	.112	0.5	1.290	10.6
Locust Average		Stable	5.8d	92d	12.062d	81.4d	.112d	0.4d	1.854d	14.0d
Locust Average		All Conditions	6.5d	88d	11.022d	77.1d	.117d	0.4d	1.572d	12.3d

Table I, Continued

Summary of Emissions and Burning Conditions

Fuel Type	Run	Burning Conditions	Burning Rate (BR) Kg/hr	Stack Temp °C	Stack Gas Flow Rate Std. a m3/min	Pollutant Mass Rate gm/hr (PMR)	Concentration gm/std.m3	% CO2	Concentration gm/std.m3 @12%CO2	Pollutant Mass Rate Burning Rate(PMR/BR) gm/Kg
Pine	19	Start Up	11.2	125	11.857	80.5	.113	0.2	6.792	7.2
Pine	20	Stable	14.0	109	10.986	91.4	.139	0.2	8.323	6.5
Pine	21c	Stable	10.0	104	10.539	----c	----c	---c	----c	---
Pine	22f	Start Up	11.1	136	8.484	151.5	0.298	1.0f	3.572	13.6
Pine	23	Stable	9.1	105	10.727	73.9	.115	0.5	2.755	8.1
Pine	24b	Stable	13.6	97	----	----	----	---	----	---
Pine Average		Start Up	11.2e	125e	11.857e	80.5e	.113e	0.2e	6.792e	7.2e
Pine Average		Stable	11.6e	107e	10.856e	82.6e	.127e	0.4e	5.539e	7.3e
Pine Average		All Conditions	11.4e	113e	11.190e	81.9e	.122e	.3e	5.957e	7.3e
Coal	12	Start Up	2.3	80	11.290	69.8	.103	0.2	6.186	30.3
Coal	13	Stable	2.7	74	11.597	38.8	.056	0.3	2.231	14.4
Coal Average		All Conditions	2.5	77	11.444	54.3	.080	0.2	4.208	22.4
All Types h	Aver.	All Conditions	7.4	95	10.778	76.1	.119	0.4	4.536	***11.7

a) Standard - 76 cm Mercury 21.1°C and dry
b) Particle sizing - see particle sizing results
c) Sampling for polycyclic organic materials (POM) - See Table II
d) Particle sizing runs not included in average
e) POM; particle sizing, smolder and glass front, (if run) are not included in average
f) Glass fireplace screen was used for this run - note higher % CO2
g) POM runs are not included in average
h) Coal, POM, particle sizing and glass front runs are not included in average

* Start Up - Initial ignition of fire or fuel addition, increasing combustion rate.
Stable - Constant combustion rate.
Smolder - Tail end of combustion, decreasing combustion rate.

** All values reported from results of modified EPA Method 5; front half, back half impinger catch, and back-up filter.

***Statistically determined mean from individual values or PMR/BR. Division of mean PMR by mean BR is not equal to the mean of the individual PMR/BR values due to statistical procedure for obtaining mean values

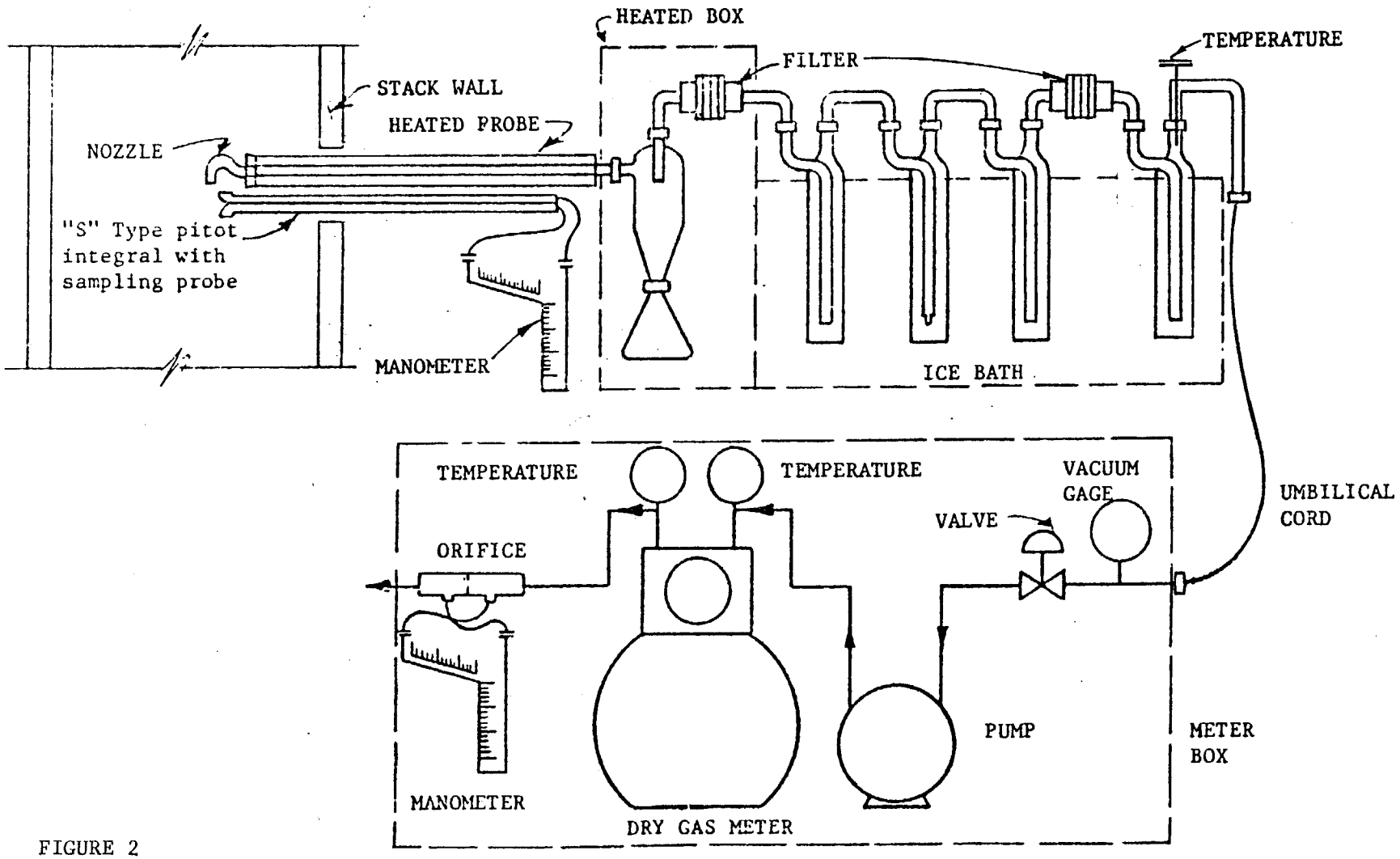


FIGURE 2

VALENTINE, FISHER & TOMLINSON STACK GAS SAMPLING TRAIN WITH BACK-UP FILTER

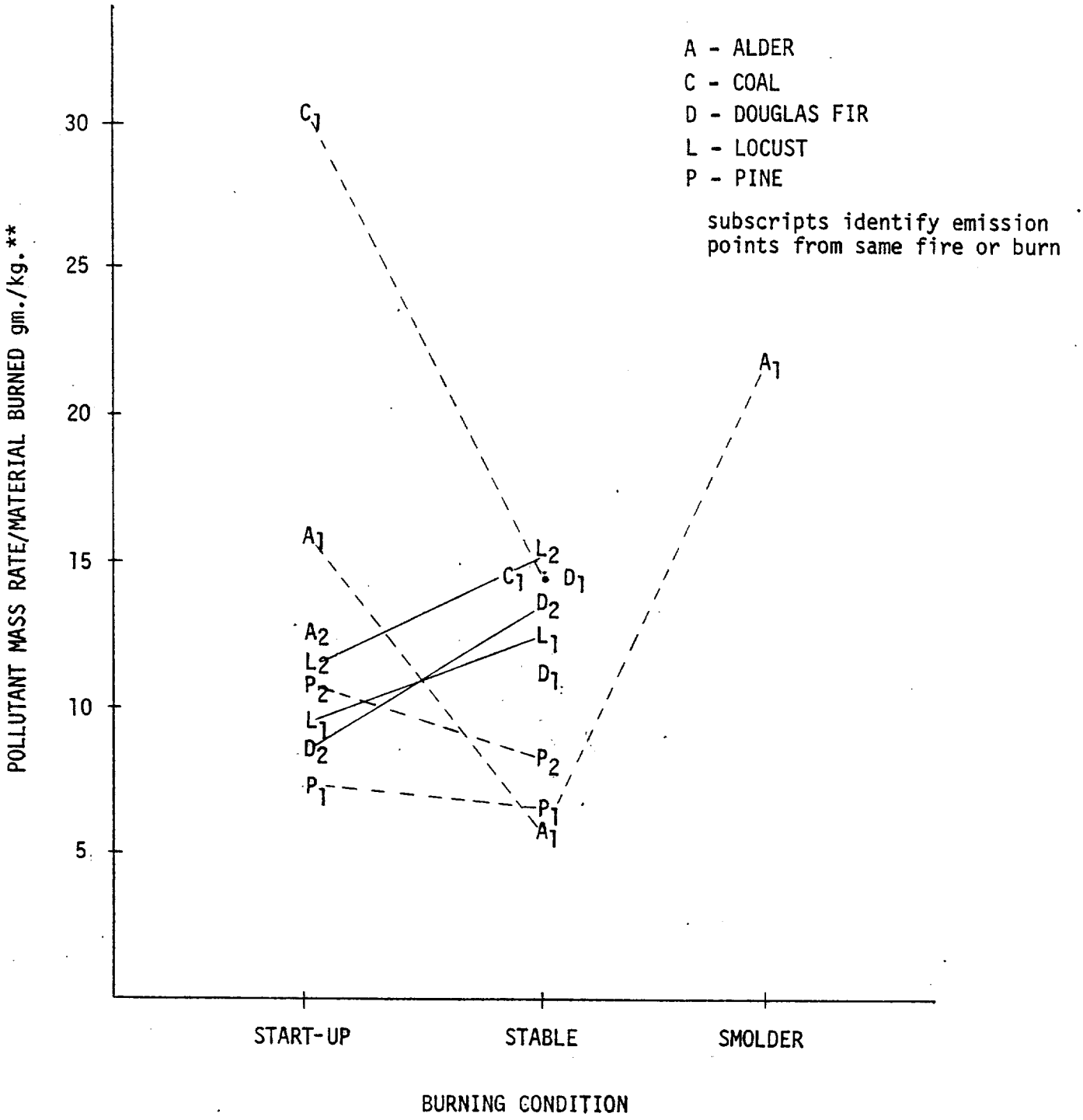


FIGURE 3

ATMOSPHERIC EMISSION VARIATION
WITH BURNING CONDITIONS

**Emissions were calculated using front half and back half particulate collected in the EPA Method 5 type sampling train.

are mainly grouped within a range of from 5.9 to 16 grams of particulate per kg wood burned. No general trend of emissions at the various burning conditions for all species can be observed from this plot. Emissions from pine wood and alder burning decrease from start up to stable burning while douglas fir and locust increase. Only one sample was obtained during smoldering as it was observed during testing that the stack gas opacity was so low and little fuel was being consumed. In retrospect, more samples should have been taken during this burning mode. These erratic results would indicate that emission trends cannot be projected simply from factors such as wood species and burning conditions. Other factors which might be included in the final emission factor development might be moisture content and density of the fuel and temperature of combustion. Also, nebulous factors such as fire stoking technique and fuel configuration (e.g., split or unsplit) could cause some variability.

The back half of the EPA Method 5 sampling train (impingers and back-up filter) caught more particulate than the front half (filter and probe). The back half particulate catch was an average of twice the front half catch, indicating that fireplace burning is a partial combustion process releasing a significant portion of vaporized hydrocarbons (See Appendix B). The back half particulate catch appeared as a golden coloration of the condenser water and as a similar color on the back-up filter.

During the field sampling phase of this project, we expected to use particulate collected in the front half (i.e. probe and filter) of POM sampling to project a total particulate catch. When analysis was completed, it became obvious that no general relation between front half and back half particulate developed as projected (see Appendix B). Consequently, POM samples are not used in the determination of average particulate parameters.

The flue gas was analyzed to quantitatively determine various components. These components are nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO). Gas analysis and determinations of N_2, O_2, CO, CO_2 and dry molecular weight of the stack gas were performed according to EPA Method 3, Federal Register, December 23, 1971, Sections 3.2, 3.3 and 4.3 (see Section IV for procedures).

In addition to in-the-field Orsat determinations of N_2, O_2, CO and CO_2, more accurate determinations were made in the laboratory using gas chromatography (GC) and infrared spectrophotometry (IR). Three runs, 6, 8 and 15, were selected for the analysis of these parameters. GC methods were used to quantitatively determine the N_2 and O_2 values for these runs. CO and CO_2 quantities were determined using IR. The values of these emission constituents can be found in Table III. Non-methane volatile hydrocarbons, (NMVH), were also quantified (see Table III), using infrared spectophotometry. Hexane was used as a standard and all results are read as Hexane. The average NMVH was found to be 4.8 ppm. (See Appendix C for GC graph and Appendix D for IR graph.)

A good indicator of the accuracy of Orsat analysis is to compare the quantites of CO_2 obtained by Infrared (IR) analysis, with those obtained by Orsat analysis. It can be seen in Table II that the difference in % CO_2 is significant.

TABLE II

COMPARISON OF CO_2 RESULTS

Run No.	% CO_2 Infrared (IR)	% CO_2 Orsat	Difference
6	0.63	0.5	0.13
8	0.79	0.4	0.39
15	0.65	0.4	0.25

The lower Orsat measured carbon dioxide concentrations at 0.4% indicates that combustion of wood in a fireplace is taking place with 4900% excess air (See Appendix F for % excess air calculation). Carbon dioxide was calculated at 1% theoretically which yields 1900% excess air. In either calculation, the high excess air quantities indicate that fireplace burning of wood is at best a partial combustion process.

One sample was taken with a glass front fitted on the fireplace to determine the effect of reduced air supply to the fireplace. Carbon dioxide was increased indicating more efficient combustion but atmospheric emissions were not significantly reduced.

Three POM samples were collected, one each, on alder, douglas fir and pine fires. POM concentrations in the stack gas averaged 6,946 ng per cubic meter (76 cmHg and 21.1°C dry). The complete results showing each constituent analyzed is shown in Appendix E. The procedure of POM sampling and analysis is discussed in Section IV. The total concentration of POM in runs 6, 11 and 21 are shown in Table III.

Three cascade impactor particle sizings were made, (one each), on alder, locust, and pine wood using a Brinks particle sizer built into the Method 5 type sampling train (see Figure 5 in Section IV). The mean particle sizes are 3.5 microns, 2.2 microns, and 3.4 microns respectively. The average particle size for the three runs (Nos. 5, 17 and 24) is 3.0 microns. The particle size samples were collected at 358, 385 and 269% of isokinetic conditions for runs 5, 17 and 24 respectively. These high % of isokinetic values are due to under sizing of the sampling nozzle. The stack gas velocity was 7.8 feet/sec. at the point of sampling. The nozzle was sized by previous sampling experience where approximately 25 feet/sec. is normally encountered. (Procedures of particle sizing runs are found in Section IV. Calculations and distribution graphs are found in Appendix G.)

Precautions were taken to maintain uniform burning conditions during sampling. Stack gas temperatures were revealed during sampling to provide a good indication of the state of combustion conditions. As stack gas temperatures dropped, more fuel was added which maintained the stack gas temperature within a relatively constant range. A "P" type pitot at a single reference point was utilized to attempt to monitor flue gas flow changes during sampling. The reference pitot also would have allowed corrections to be made in the flue gas

TABLE III

Summary of Emission Constituents

Fuel Type	Run	Burning Condition	Polycyclic Organic Materials a (ng)	Concentration Polycyclic Organic Materials ng/std. m3 b	Parameters Obtained by Gas Chormatography and Mass Spectophotometry % O2	% N2	PPM CO	PPM CO2	PPM NMVHc
Alder	6	Stable	166,000	5,746	20.2	79	280	6,300	4.5
Douglas Fir	8	Stable	---	---	20.0	79	405	7,900	4.7
Douglas Fir	11	Stable	220,000	7,444	---	--	---	---	---
Locust	15	Stable	---	---	20.2	79	440	6,500	5.3
Pine	21		162,000	7,647	---	--	---	---	---
All Average			183,000	6,946	20.1	79	375	6,900	4.8

a) See table V for quantification of specific materials
b) Standard - 76 cm. Mercury 21.1°C and dry
c) NMVH - Non Methane Volatile Hydrocarbons

flow recorded during traverse sampling if the flow fluctuations would have been significant. The procedures used in sampling and calculations involving the reference pitot are found in Section IV. Example calculations of a velocity correction coefficient (See Appendix H) indicate that three of the most variable samples required an average air flow adjusted increase of 2.2%. Therefore, the resulting correction in total air flow from the flue gases for all runs would be less than 2.2%. With this correction so slight, a correction was not made in reported flows.

A special expanded inclined manometer (24 inches long) was utilized to obtain precise stack pitot readings. The velocities of the stack gas averaged 2.15 meters per/sec. on 20 runs, with such low velocities the expanded manometer was most useful.

Wood burning rates, (tabulated in Appendix I), were determined from data collected during sampling runs. The wood burning rate for all types of wood in the particulate samples excluding one smolder run and the glass fireplace screen run was 7.4 kg per hour. Procedures for determining fuel consumption rates are found in Section IV.

The ultimate heating efficiency of the reference fireplace was determined in an energy balance found in Appendix F. The efficiency at 70°F outside temperatures was determined to be 30%. With lower outside temperatures, this efficiency will decrease.

The moisture content and density of the fuel consumed during this project are found in Table IV. The average moisture content of the wood fuel was 12.5%. The wood fuel density averaged 0.52 grams per cubic centimeter. The fuel analysis procedures are found in Section IV.

Two projects separate from this report were previously performed by Valentine, Fisher & Tomlinson. The atmospheric emission parameters of these projects are found in Appendix J.

TABLE IV

FUEL CHARACTERISTICS

Fuel Type	Percent Moisture	Dry Density grams/cc	Wet Density grams/cc
Alder	12.2	0.43	0.49
Fir	10.6	0.39	0.44
Locust	11.7	0.64	0.73
Pine	15.4	0.36	0.43
Coal	----	1.18	----

IV. PROCEDURES

PARTICULATE SAMPLING TRAIN

Stack gas sampling equipment designed by the United States Environmental Protection Agency, (EPA), Office of Air Quality Planning and Standards was used on this evaluation. A schematic of the sampling equipment is shown in Figure 2.

Sampling was performed according to the following:
The number of sampling points were determined by considering the number of duct diameters between obstructions in the duct upstream and downstream of the sampling ports. The rectangular chimney 8.75 in. x 19.25 in. had an area of 1.17 ft^2 and was equivalent in area to a round duct 1.22 ft. in diameter or by equation 1-1 of Method 1 Standards of Performance for New Stationary Sources, i.e. $\frac{2 \text{ (length) (width)}}{\text{(length + width)}}$ or the chimney was equivalent to a round duct 1.0 ft. in diameter. Thus the number of stack diameters downstream from the damper was 15, and the number of diameters upstream from the chimney top was 1.8. The minimum number of points required would be 10. The actual number of points selected was 20 to improve air flow measurement and sampling accuracy. A drawing of the fireplace port locations is shown on Figure 1. The five ports A, B, C, D and E are spaced 3.85 inches apart and ports A and E are 1.92 inches from the inside wall of the chimney.

Five ports with 4 sampling points each giving 20 points total were required in order to meet criteria from the Federal Register Method 1 Section 2.2.2. The ratio of the length to width of each elemental area was 1.76 meeting the 1 to 2 ratio requirements.

Stack pressure, temperature moisture content and maximum velocity head readings were measured. An EPA designed nomograph was set up using this data and the correct nozzle diameter was selected using the nomograph.

The sampling train was prepared as follows:
A filter (MSA 1106-BH) was labeled and desiccated for at least 24 hours to a constant weight and weighed to the nearest 0.5 mg. The filter was placed in a glass holder and was supported by a glass frit. The outlet side of the filter holder was connected to the condenser section. 100 miligrams of water was placed in the first bubbler and second impinger. The third bubbler was left dry. The fourth bubbler was filled with approximately 500 gram of silica gel. All four sections of the condenser were then weighed individually to the nearest 0.1 gram and recorded. A back-up filter (MSA 1106-BH) was desiccated for more than 24 hours to a constant weight and weighed to the nearest 0.5 mg. The back-up filter was placed between the third and fourth bubblers.

Just prior to sampling, a leak test was performed on the assembled sampling train. The leak rate did not exceed 0.02 cfm at a vaccum of approximately 24 inches Hg. The probe was heated so that the gas temperature at the probe outlet was approximately 250°F. The filter was heated to approximately 250°F to avoid condensation of moisture on the filter. Crushed ice was placed in the condenser section at the beginning of the test with new ice being added as required to keep the gases leaving the sampling train below 70°F.

The train was operated as follows:
The probe was inserted into the stack to the first traverse point with the nozzle tip pointing directly into the gas stream. The pump was started and immediately adjusted to sample at isokinetic velocities. Equal time was spent at selected points of equal elemental areas of the duct with the pertinent data being recorded from each time interval. The EPA nomograph was used to maintain isokinetic sampling throughout the sampling period. At the conclusion of the run the pump was turned off, the probe was removed, and the final readings were recorded.

Clean up of the sample train and analysis of the samples were performed according to the Clean-Up and Analysis procedure found on page 18.

POLYCYCLIC ORGANIC MATERIALS

The Polycyclic Organic Materials (POM) determined by the consulting laboratories of Batelle Columbus Laboratories, Columbus, Ohio, were sampled as follows:

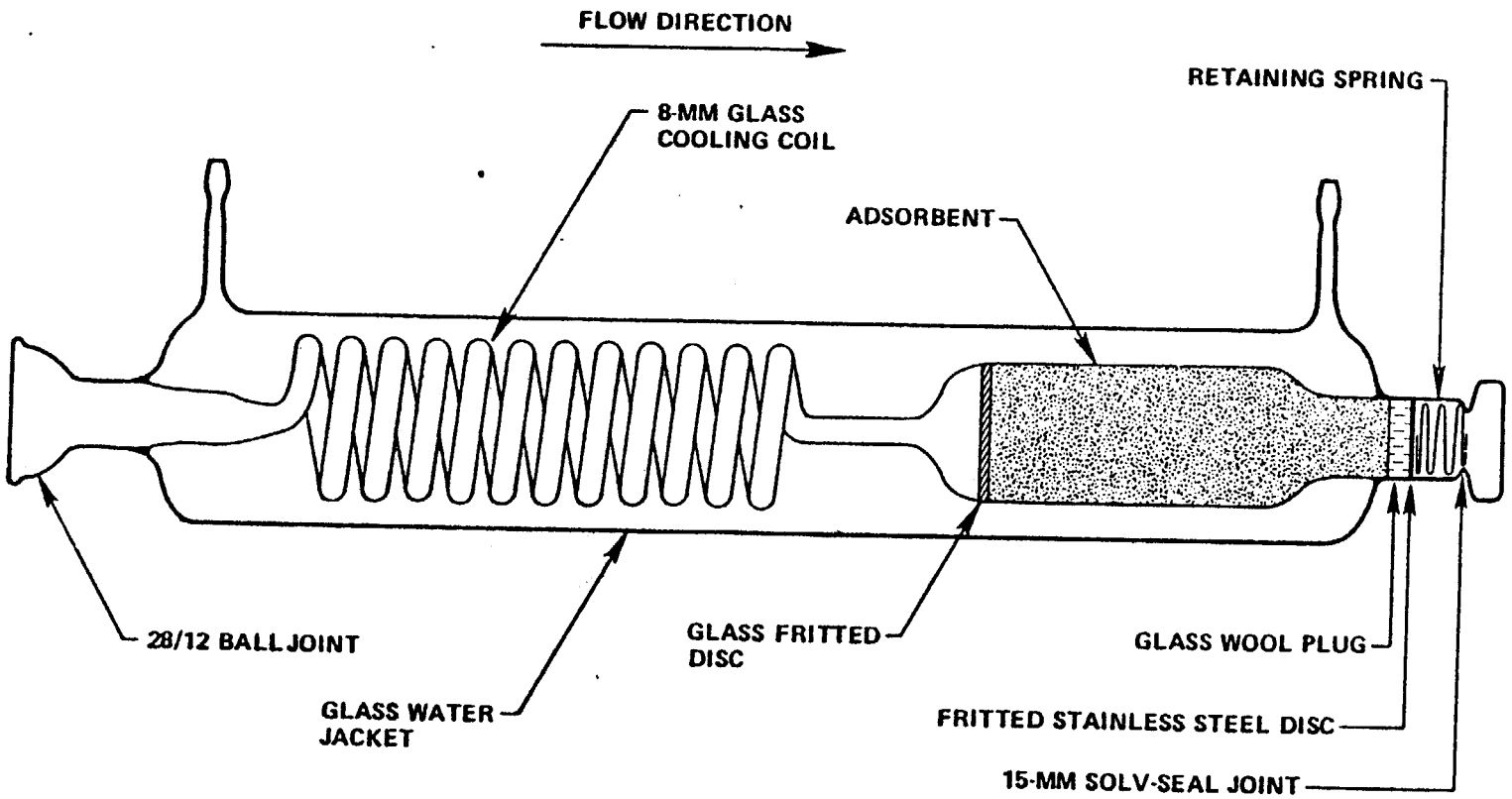
Sampling was conducted by Valentine, Fisher & Tomlinson's Environmental Services Team. Sample collection was made at isokinetic conditions at all preselected traverse points. The sampling system was a modified EPA Method 5 sampling train using a special POM adsorbent column of Tenax (see Figure 4). The column was located directly after the heated filter. Prior to passing through the adsorbent, the gas was cooled to 55°C in a thermostatically controlled circulating water bath. From here the gas entered the regular EPA condenser section.

Aluminum foil was wrapped around the Tenax column to prevent light exposure. After sampling, the Tenax column and cooling jacket were removed from the POM train and sealed with a Solv-Seal cap and a ball-joint stopper. This section was stored out of light prior to shipment to Batelle Laboratories for analysis. The tared acid treated glass filter was removed and desiccated until a constant weight was obtained. The filter was weighed to the nearest 0.1 mg. The impinger section was weighed and the amount of water collected was determined. The probe and prefilter connections were cleaned up with brushes and reagent grade acetone. The washings were transferred to a tared beaker and after evaporation and desiccation the net weight gain was determined. The filter and Tenax column section were shipped in padded containers to Batelle for analysis. Gas chromatographic separation was utilized to quantify the POM constituents.

More detailed sampling and analysis procedures can be found in "Efficient Collection of Polycyclic Organic Compounds From Combustion Effluents," by Peter W. Jones et. al, Paper No. 75-33.3, Batelle Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201, presented at Annual Meeting of Air Pollution Control Association in Boston, Mass., June 1975.

"P" TYPE REFERENCE PITOT

The "P" type reference pitot was positioned 9" below point C-3 during each particulate and POM sampling runs to correct for total air flow but sampling revealed the correction to be unnecessary. Reference pitot readings



ADSORBENT SAMPLING SYSTEM

From the Paper: Efficient Collection of Polycyclic Organic Compounds from Combustion Effluents, by Peter W. Jones et.al.

FIGURE 4

were made during each sampling point time interval. The method by which the velocity could have been corrected for a particular run is as follows:

The average square root of all reference pitot readings ratioed over the square root of each particular reference reading yielded the pitot correction coefficient for each point on the stack traverse. Each traverse pitot reading was corrected by calculating the product of the pitot correction coefficient times the traverse pitot reading. The ratio of the average of all corrected traverse pitot readings over the average of all traverse pitot readings yielded the stack velocity correction coefficient. The velocity calculated from the actual data can then be corrected by this coefficient. (See three examples in the Appendix).

INTEGRATED GRAB BAG GAS SAMPLING

An integrated sample of stack gas was taken for each run during the evaluation according to the following method. A probe was inserted into the stack. In line with the probe was a drying tube which contained glass wool and silica gel to remove particulate and moisture. This assembly was connected to a sampling pump inlet. All connections were checked for leaks and the sampling line was purged. An evacuated flexible aluminized scotchpak (polyvinyl chloride) bag was then connected to the pump outlet and an integrated sample was taken at a rate proportional to the stack flow rate.

PARTICLE SIZING

Particle sizing was accomplished using a cascade impactor as set up in the sampling train shown in Figure 5.

The Brinks Cascade Impactor consisted of five stages, each of which contained a collection cup and a nozzle jet. Particles suspended in the sample gas passed through the jet and were impacted on the disk. The amount of particles collected on each disk was a function of the gas velocity through the jet, the particle characteristics, and the amount of sample drawn.

The sampling train is set up as in the drawing. The nozzle tip diameter was essentially the only means of providing for isokinetic sampling. A 0.125 in diameter nozzle was utilized in sampling. The sample flow rate was fixed by the pressure drop across the impactor (pressure drop is determined by the 3rd impactor stage, and its requirements for maximum collection). With the normally small flow rates, a 0.125 inch nozzle tip was necessary to prevent under isokinetic sampling (unrepresentative large particle capture).

The sample train was leak tested under 24 inch mercury vacuum. A leak test of 0.02 cubic feet per minute was obtained. The probe and the sample box were heated to 250°F. The sample probe was inserted in the process stream and gas flow through the impactor was started and held near constant until the end of the test. The vacuum was held constant at 5.0 inches of mercury. Sampling time was 20, 30 and 30 minutes on runs 5, 17 and 24 respectively.

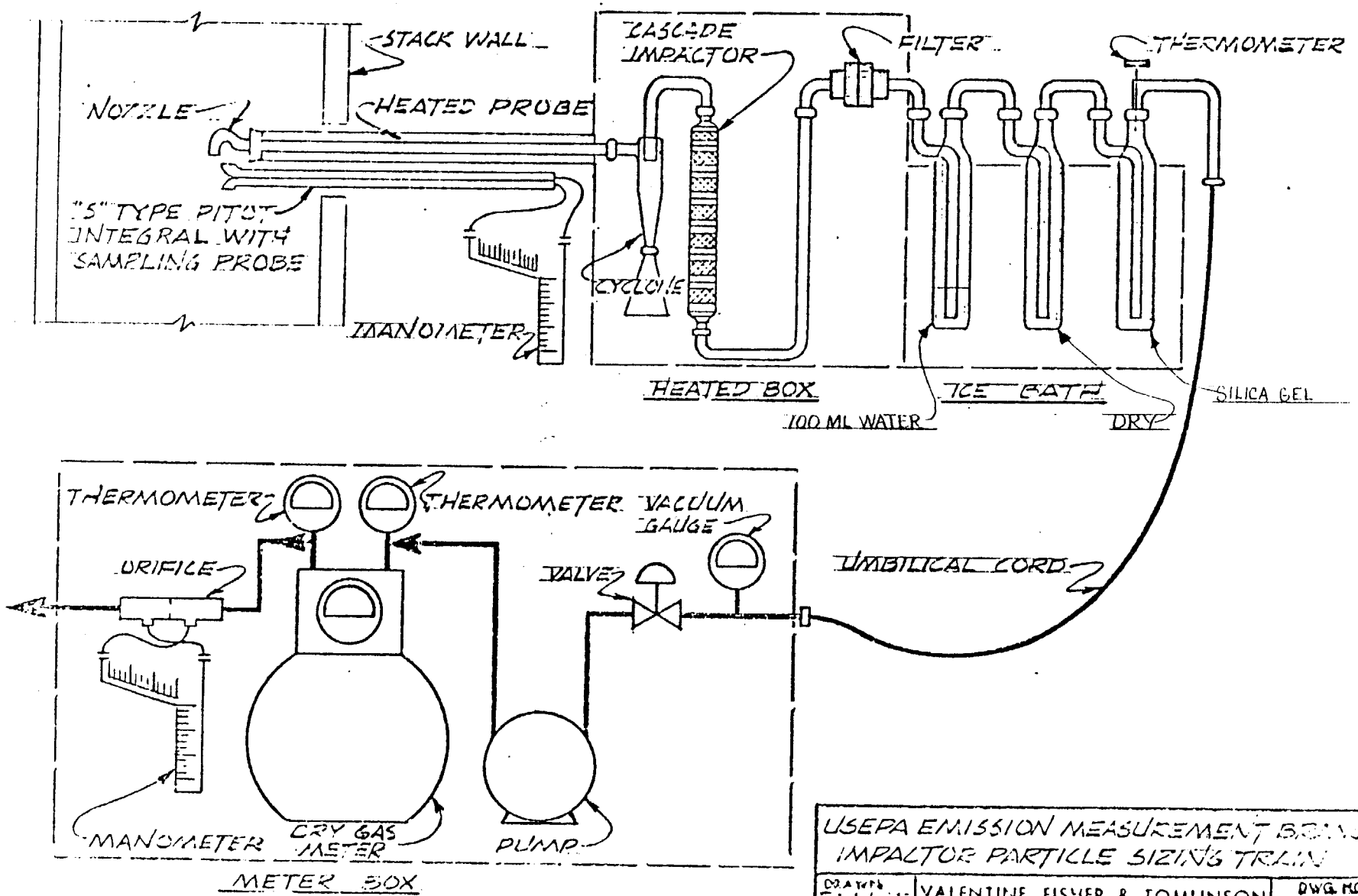

STACK WALL
NOZZLE
HEATED PROBE
"S" TYPE PITOT INTEGRAL WITH SAMPLING PROBE
MANOMETER
CASCADE IMPACTOR
CYCLONE
FILTER
THERMOMETER
HEATED BOX
ICE BATH
100 ML WATER
DRY
SILICA GEL
UMBILICAL CORD
THERMOMETER
THERMOMETER
VACUUM GAUGE
ORIFICE
VALVE
MANOMETER
DRY GAS METER
PUMP
METER BOX
USEPA EMISSION MEASUREMENT BRANCH
IMPACTOR PARTICLE SIZING TRAIN
DRAWN
CHECKED
DATE 5-11-72
VALENTINE, FISHER & TOMLINSON
CONSULTING ENGINEERS
520 LLOYD BLDG., SEATTLE
DWG NO.
ES-1

FIGURE 5

After each test, the sample cups were removed from the impactor with tweezers. The quantity collected on each cup was determined by weighing to the nearest 0.1 mg after desiccation. Similarly, the quantity of material collected on the filter was determined. The nozzle, probe and pre-filter connections were rinsed with reagent grade acetone. The nozzle and probe washers were evaporated to dryness in a 150 ml tared beaker. The prefilter connections wash was also evaporated to dryness in a tared beaker. The weight of residue in both beakers were determined. A blank value for the acetone used was also determined.

CLEAN-UP AND ANALYSIS

Clean-up of the EPA train was performed by carefully removing the filter and placing it in a container marked Sample #___ A. Reagent grade acetone and brushes were used to clean the nozzle, glass probe and pre-filter connections. The acetone wash was placed in a container marked Sample #___ B. The impinger and bubblers were weighed in their respective containers to the nearest 0.1 gram. The original weights which included approximately 100 ml water in one bubbler and 100 ml water in the impinger were then subtracted and the differences added with the water weight gain of the silica gel. This constituted the amount of water collected during the run. The silica gel was weighed in a bubbler before and after the run. The water from the glassware and a water rinse of the glassware were placed in a container marked Sample #___ C. An acetone rinse of the glassware and all post-filter glassware (not including the silica gel container) was performed and placed in a container marked Sample #___ D. The back-up filter was carefully removed and placed in a container marked Sample #___ E.

Analysis of the samples in each container was performed according to the following:

Sample #___ A - Transfer the filter and any loose particulate from the sample container to a tared glass weighing dish and desiccate for 24 hours in a desiccator containing "drierite." Weigh and redesiccate repeating until a constant weight is obtained and report the results to the nearest 0.1 milligram.

Sample #___ B - Measure the volume to the nearest 0.1 milliliter. Transfer acetone washings from container into a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh. redesiccate and weigh repeating until a constant weight is obtained. Report the result to the nearest 0.1 milligram.

Sample #___ C - Measure the volume to the nearest 0.1 milliliter. Extract organic particulate from the water solution with three 25 milliliter portions of chloroform and three 25 milliliter portions of ethyl ether. Combine the ether and chloroform extracts and transfer to a tared beaker. Evaporate until no solvent remains at about 70°F. This can be accomplished by blowing air that has been filtered through activated charcoal over the sample. Desiccate for 24 hours and weigh and redesiccate to a constant weight. Report the results to the nearest 0.1 milligram. After the extraction, evaporate the remaining water to dryness and report the results to the nearest 0.1 milligram.

Sample #___ D - Measure the volume to the nearest 0.1 milliliter. Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 milligram.

Sample #___ E - Transfer the filter and any loose particulate from the sample container to a tared glass weighing dish and desiccate for 24 hours in a desiccator. Weigh to a constant weight and report the results to the nearest 0.1 milligram.

Blanks were taken on the acetone, ether, chloroform, and deionized water and subtracted from the respective sample volumes. The filter paper used with the EPA train was a Mine Safety Appliance 1106 BH, heat treated glass fiber filter mat.

FUEL DENSITY AND MOISTURE CONTENT

Samples of each type of wood fuel were determined for moisture by weighing samples of each and drying these at 105°C. for several days. After cooling in a desiccator the samples were weighed. This process continued until constant weights were found. The % moisture was calculated by dividing the weight lost by the original weight times 100.

The densities of all fuels including coal were determined by weighing samples of each and then measuring the liquid displacement of each sample. Density was calculated by dividing the weight by the displaced volume.

WOOD WEIGHT AND FIRE STOKING

Prior to sampling, the fire was built with a weighed quantity of fuel. The wood was weighed with a spring balance. With this data the fire stoker would estimate the quantity of wood in the fire at the start of sampling and record the estimate on the data sheet. As wood was required for the fire, it was weighed and placed on the fire. The time and weights of the wood added were recorded on the data sheet. At the end of sampling the stoker would estimate the quantity of wood left in the fire and would record this data. Each day of sampling was begun with the fireplace swept out. A hearth of ribbed cast iron was used throughout the evaluation.

GAS ANALYSIS

On runs 6, 8 and 15, nitrogen and oxygen were analyzed utilizing thermal conductivity gas chromatography techniques. A 20-foot long 1/4-inch diameter 45/60 molecular sieve column at 100°C and an attenuation of 16 X was used for this determination. The carrier gas was Helium at 50cc/minute. A 0.25 milliliter sample was injected into the G.C. Three representative G.C. peaks per parameter for each run analyzed substantiated the reported values as measured against standard N_2 and O_2 peaks.

Carbon monoxide, carbon dioxide, and non-methane volatile hydrocarbon were analyzed by means of an infrared spectrophotometer with a 10 meter cell. Standard curves for CO, CO_2, hexane and methane were run. The value for methane was determined for each run analyzed, then subtracted from the total volatile hydrocarbon value measured as hexane, resulting in the reported quantity of total volatile non-methane hydrocarbons.

All runs except particle size runs and POM run #21, utilized the hand-operated Orsat for quantifying oxygen, carbon dioxide, carbon monoxide and nitrogen concentrations in the stack gas. The samples were collected as described in the preceding procedure in integrated grab bag. In analysis CO_2 was absorbed in the first column of the analyzer. The gas sample was passed through the column several times to insure complete collection. The volume of displaced gas was recorded. Oxygen and then carbon monoxide were measured similarily. In all cases of quantifying the gas constituents of the grab bag sample at least three separate samples were pumped into the Orsat for separate analysis. Nitrogen was quantified by subtracting the total percent of the measured gases from 100.

SECTION IV

APPENDIX

APPENDIX A

SELECTION OF THE REPRESENTATIVE FIREPLACE WITH STATISTICAL CALCULATIONS

The representative fireplace was selected from a sample distribution of 34 fireplaces. The 34 fireplaces were selected from employees, friends and relatives of Valentine, Fisher & Tomlinson, Inc. Wider and more statistically random selection of the fireplaces was limited due to U.S. Government, Office of Management and Budget solicitation form approval procedures and contract funding limitations. Valentine, Fisher & Tomlinson is confident that the fireplace selected is of a representative nature.

The fireplace dimension parameters included in the sample were those considered to have an effect on the quality of burning in a fireplace. The parameters included were: (a) area of the fire box opening, (b) cross sectional area of the chimney opening and (c) chimney height. These dimensional parameters are illustrated in Figure 6.

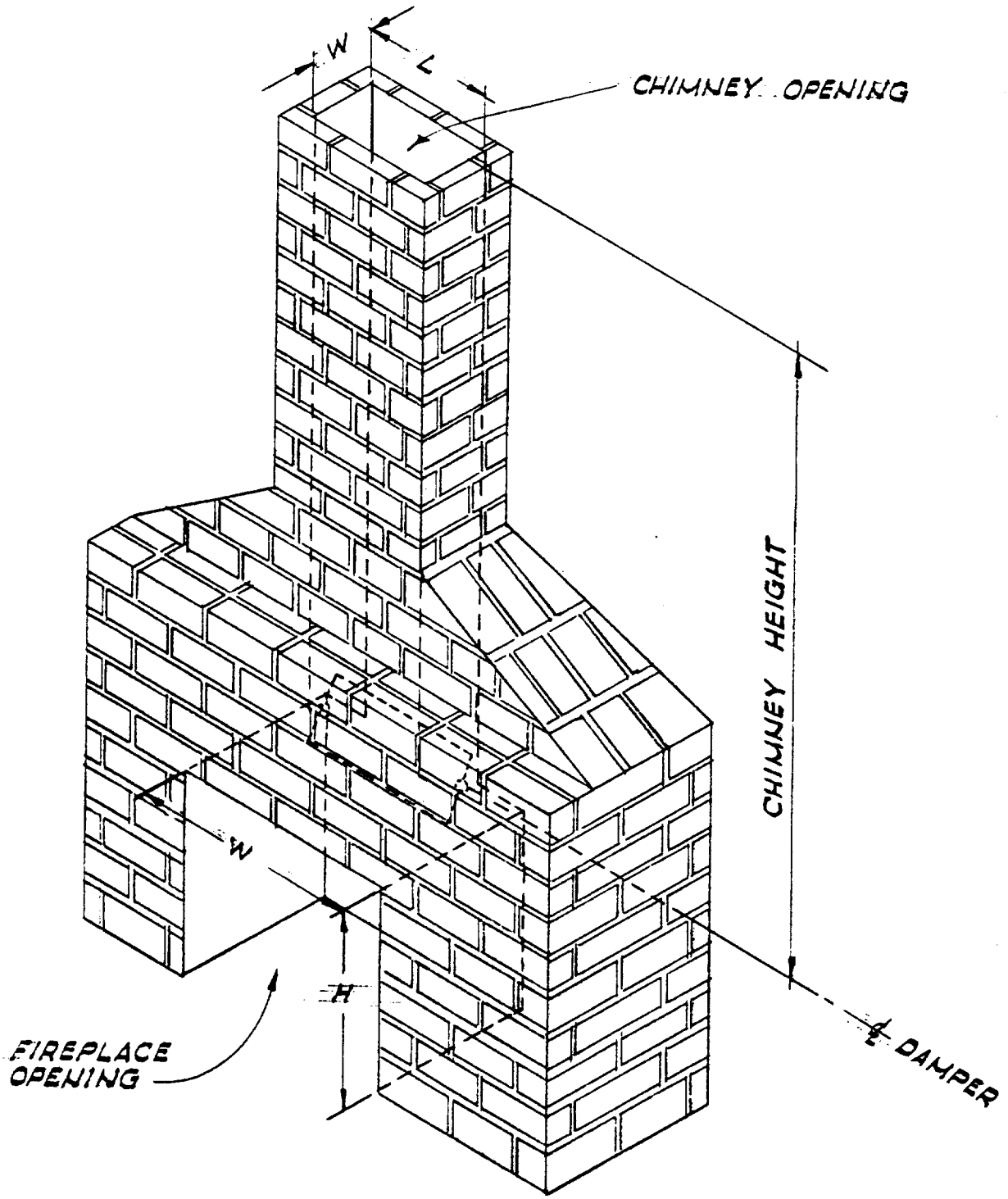
From the compilation of the 34 sets of parameters, a population mean was computed for each parameter. A standard deviation was then computed which was used to determine a 95 percent confidence interval for each mean dimension. No fireplace fit within a 99 percent confidence interval.

Fireplaces were picked which had dimensions which were within the 95 percent confidence intervals. Three fireplaces were examined more closely and a final selection was made based on accuracy of dimension, accessibility for sampling and consent of the owner. The fireplace selected has an opening of 6187 sq. cm, a chimney cross sectional area of 1087 sq. cm^2 and a chimney height of 4.66 m. Note that the chimney height was selected so that a 0.46 m extension could be added and still remain within the 95 percent confidence interval of chimney height.

Table V

Representative Fireplace Mean Dimensions and 95% Confidence Interval

Parameter	Mean Dimension	Confidence Interval
Fireplace Opening	6336 cm^2	5865 to 6807 cm
Chimney Opening	961 cm^2	832 to 1,090 cm
Chimney Height	4.4 meters	3.87 to 4.97 meters



FIREPLACE DIMENSIONS

NO SCALE

FIGURE 6

E.P.A. FIREPLACE REPORT EMISSION TESTS	
DRAWN: W.B.	Prepared by: VALENTINE, FISHER & TOMLINSON Consulting Engineers 520 LLOYD BUILDING SEATTLE, WASHINGTON
CHECKED: G.A.S.	
DATE: SEPT. 19, 78	

APPENDIX B

Tabulation of Front Half to Back Half Ratios

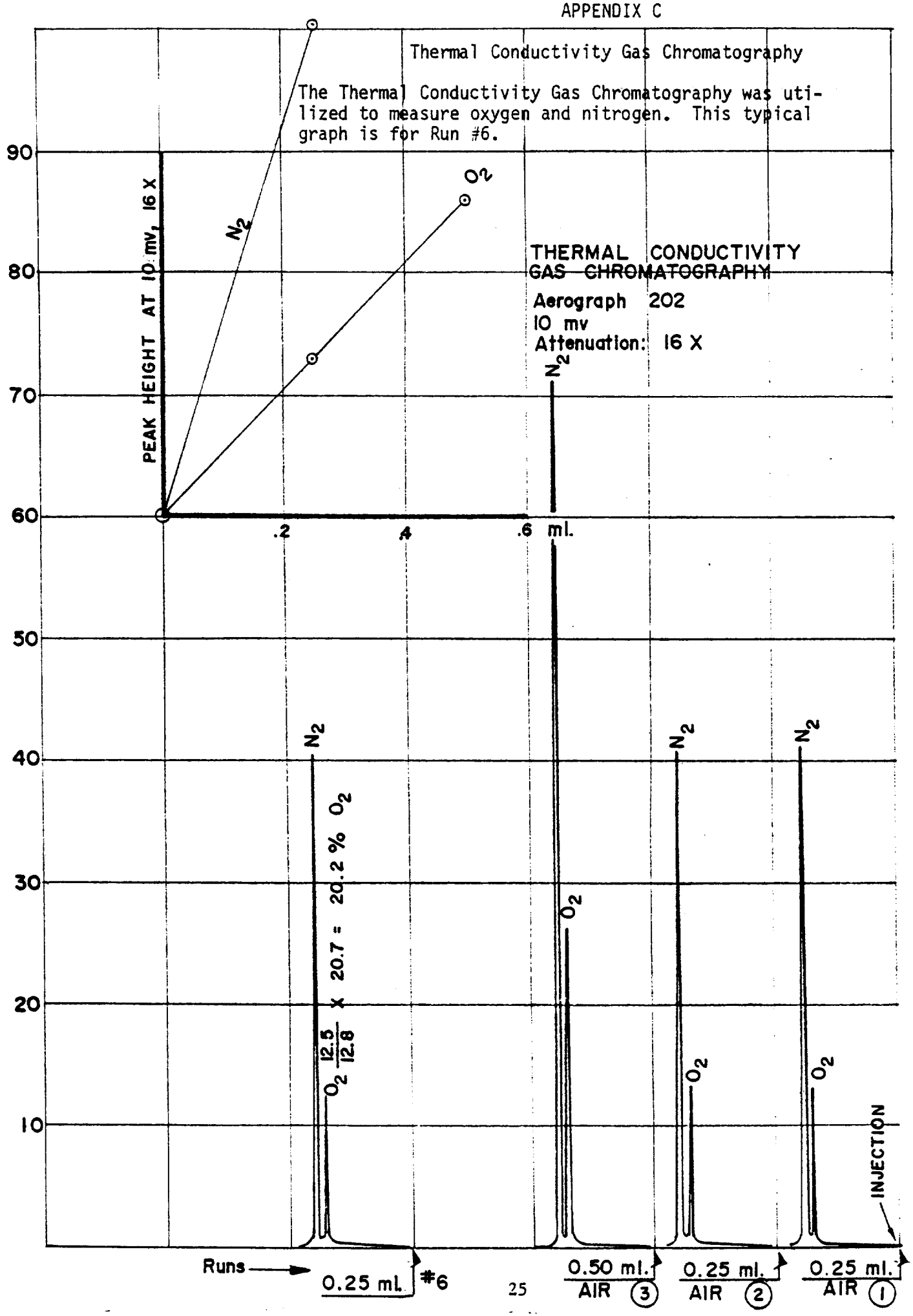
This tabulation of the front half to the back half ratios in 18 runs show the significance of the back half particulate. Also, the back-up filter shows to be important in this type of sampling.

Run #	Ratio: $\frac{BH\ particulate}{FH\ particulate}$	Ratio: $\frac{BU\ Filter\ particulate}{F\ Filter\ particulate}$
1	2.07	0.463
2	1.93	0.542
3	0.688	0.289
4	7.36	1.030
5	—	—
6	—	—
7	2.18	0.540
8	3.35	1.32
9	2.99	1.37
10	3.93	1.79
11	—	—
12	0.509	.064
13	1.05	0.143
14	2.08	0.525
15	2.90	0.761
16	—	—
17	—	—
18	1.44	0.200
19	0.537	.028
20	1.82	1.07
21	—	—
22	0.528	.027
23	1.10	0.239
ave.	1.968	0.612

APPENDIX C

Thermal Conductivity Gas Chromatography

The Thermal Conductivity Gas Chromatography was utilized to measure oxygen and nitrogen. This typical graph is for Run #6.



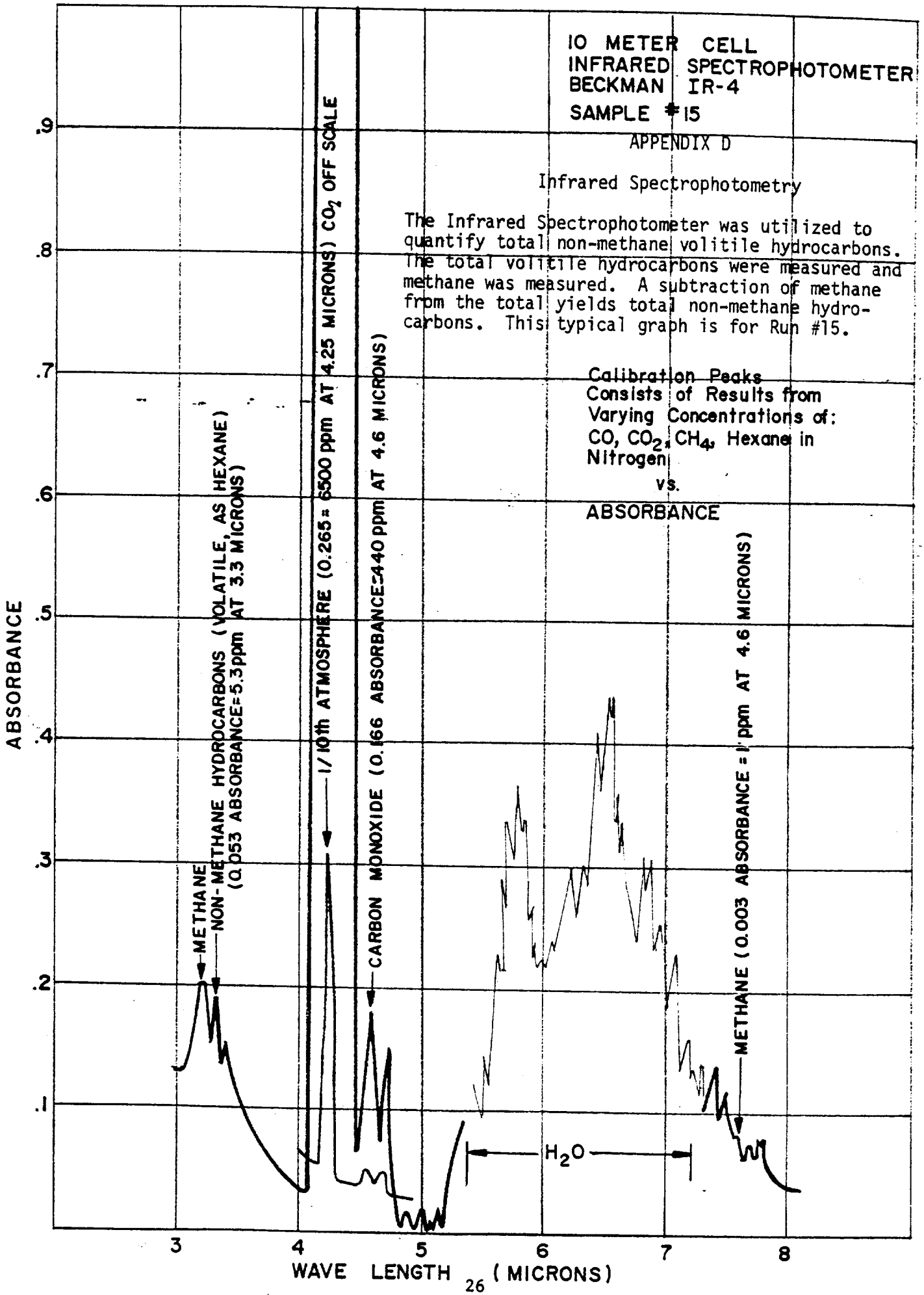

10 METER CELL
INFRARED SPECTROPHOTOMETER
BECKMAN IR-4
SAMPLE #15
APPENDIX D
Infrared Spectrophotometry
The Infrared Spectrophotometer was utilized to quantify total non-methane volitile hydrocarbons. The total volitile hydrocarbons were measured and methane was measured. A subtraction of methane from the total yields total non-methane hydrocarbons. This typical graph is for Run #15.
Calibration Peaks Consists of Results from Varying Concentrations of: CO, CO_2, CH_4, Hexane in Nitrogen
vs.
ABSORBANCE
ABSORBANCE
.9
.8
.7
.6
.5
.4
.3
.2
.1
METHANE
NON-METHANE HYDROCARBONS (VOLATILE, AS HEXANE) (0.053 ABSORBANCE=5.3ppm AT 3.3 MICRONS)
1/10th ATMOSPHERE (0.265 = 6500 ppm AT 4.25 MICRONS) CO_2 OFF SCALE
CARBON MONOXIDE (0.166 ABSORBANCE=440 ppm AT 4.6 MICRONS)
METHANE (0.003 ABSORBANCE = 1 ppm AT 4.6 MICRONS)
H_2O
3
4
5
6
7
8
WAVE LENGTH (MICRONS)

Table V

APPENDIX E

Fireplace Atmospheric Emissions

POM Quantification

POM QUANTIFICATION (ng)

POM quantification is reported in nanograms. The samples were collected by the methods described in the Procedure section, Page 13.

Component	NAS Notation	SAMPLE Alder 69-5	D. Fir 76-5	Pine 8605
Anthracene/Phenanthrene		52,450	59,600	52,100
Methyl anthracenes		21,300	32,900	---
Fluoranthene		16,100	27,200	21,400
Pyrene		18,900	24,700	21,750
Methyl Pyrene/Fluoranthene		17,800	13,400	450
Benzo(c)phenanthrene	***	4,300	3,800	2,450
Chrysene/Benz(a)anthracene	*	11,900	17,800	7,950
Methyl chrysenes	*	5,300	9,200	28,300
Benzo fluoranthenes	**	5,400	7,300	3,000
Benz(a)pyrene	***	5,200	8,900	12,400
Benz(e)pyrene				
Perylene		---	---	---
-Mehtylcholanthrenes	****	3,300	9,600	5,650
Indene(1,2,3-cd)pyrene	*	1,300	2,600	3,050
Benzo(ghi)perylene		2,800	3,200	3,000
Dibenxo(a,h)anthracene	***	---	---	---
Diebenzo(c,g)carbazole	***	---	---	---
Dibenz(ai and ah)pyrenes	***	---	---	---
Coronene		---	---	---
TOTAL		166,000	220,000	162,000

APPENDIX F

ENERGY BALANCE, % EXCESS AIR

In order to evaluate the combustion characteristics and heating efficiency of the fireplace during testing, calculations were done to determine air requirements for burning, % CO_2, theoretical heat available, and heat losses from the fireplace. These calculations are contained in this section.

Combustion calculations were based mainly on stoichiometric equations of combustion and the ultimate analysis of wood. The heat available for combustion was also calculated with data from ultimate analysis.

Heat losses from the fireplace were divided into four components. These components include: heat lost in exhaust gases, heat lost due to air infiltration, heat lost from the fire box, and heat lost from the chimney. Each of these components were then calculated using approximate thermodynamic and heat transfer equations and techniques.

① Ultimate analysis of wood

Ref. - Air Pollution Handbook (p-1-16)
Magill, P.C., McGraw Hill 1956

Dry basis	@ 15% H_2O
C = 52%	C = 44%
H = 6%	H = 5.1%
S = < 0.1%	S = 0
N = 0.1%	N = 0
O = 40%	O = 34%
ash = 2%	ash = 1.7%
	H_2O = 15%
Btu/lb. = 8700	Btu/lb. = 7400

② Theoretical air needed for combustion of 1 lb. of wood with h. 15% moisture:

Basic Equation for combustion

$$C + \tfrac{3}{2} O_2 + 2H \longrightarrow CO_2 + H_2O$$

To determine air required for combustion seperate reation and calculate air required

a) $C + O_2 \longrightarrow CO_2$

$$\frac{0.441b\ C}{1b.\ wood} \times \frac{32\ lb.\ O_2}{12\ lb.\ C} \times \frac{56.4\ SCF\ air}{1\ lb.\ O_2} \approx 66.2\ \frac{SCF\ air}{lb.\ wood}$$

b) $2H + \frac{1}{2} O_2 \longrightarrow H_2O$

$$\frac{0.051\ lb.H}{lb.\ wood} \times \frac{16\ lb.O_2}{2\ lb.H} \times \frac{56.4\ SCF\ air}{lb.\ O_2} \approx 23.0\ \frac{SCF\ air}{lb.\ wood}$$

c) O_2 available from fuel:

$$\frac{0.34\ lb\ O}{lb.\ wood} \times \frac{32\ lb.O_2}{32\ lb.O} \times \frac{56.4\ SCF\ air}{lb.\ O_2} \approx -19.2\ \frac{SCF\ air}{lb.\ wood}$$

d) Total Air Needed @ 0% Excess Air

$$Q_{air} = 66.2 + 23 - 19.2 = 70\ \frac{SCF\ air}{lb.\ wood}$$

③ Products of combustion from 1 lb. wood wet

a) CO_2 : $C + O_2 \longrightarrow CO_2$

$$\frac{44\ lb.CO_2}{12\ lb.C} \times \frac{0.44\ lb\ C}{lb.\ wood} \times \frac{1\ lb\ mole\ CO_2}{44\ lb.\ CO_2} \times \frac{379\ SCF\ CO_2}{lb\text{-}mole\ CO_2} = \frac{14\ SCF\ CO_2}{lb.\ wood}$$

b) H_2O : $2H + \frac{1}{2} O_2 \longrightarrow H_2O$

$$\frac{18\ lb.H_2O}{2\ lb.H} \times \frac{0.05\ lb\ H}{lb.\ wood} \times \frac{1\ lb\text{-}mole\ H_2O}{18\ lb.\ H_2O} \times \frac{379\ SCF\ H_2O}{lb\text{-}mole\ H_2O} = \frac{9.7\ SCF\ H_2O}{lb.\ wood}$$

c) H_2O (from fuel)

$$\frac{0.15\ lb\ H_2O}{lb.\ wood} \times \frac{1\ lb\text{-}mole\ H_2O}{18\ lb\ H_2O} \times \frac{379\ SCF\ H_2O}{lb\text{-}mole\ H_2O} = \frac{3.2\ SCF\ H_2O}{lb.\ wood}$$

d) N_2 carried through combustion

$$70\ \frac{SCF\ air}{lb\text{-}wood} \times \frac{79\ SCF\ N_2}{100\ SCF\ air} = \frac{55.3\ SCF\ N_2}{lb.\ wood}$$

@ 0% excess air

e) Total combustion products at 0% excess air

$$Q_{comb.} = 14 + 9.7 + 3.2 + 55 \approx 81.9 \ \frac{SCF\ products\ (wet)}{lb.\ wood}$$

$$Q_{comb\text{-}dry} = 14 + 55 = \frac{69\ SCF\ CO_2}{lb.\ wood}\ (dry)$$

f) % CO_2 at 0% E.A. and dry

$$\%\ CO_2 = \frac{14\ SCF\ CO_2}{69\ SCF\ products} \approx 20\ \%\ CO_2$$

④ Excess air during combustion

average CO_2: 0.4% (orsat), 0.7% (by I.R.)

average wood consumption: $7.4\ \frac{kg}{hr} \approx 16.3\ \frac{lb}{hr.}$

average stack gas flow rate: $10.8\ \frac{scm}{min} = 382\ \frac{SCF}{min}$

a) % CO_2 (calculated):

$$\%\ CO_2 = \frac{14\ SCF\ CO_2}{lb.\ wood} \times \frac{16.3\ lb\ wood}{hr.} \times \frac{1\ hr}{60\ min.} \times \frac{1\ min}{382\ SCF_{air}} \times 100$$

$$\%\ CO_2 \approx 1.0\ \%$$

Note: best agreement between calculated CO_2 and that measured with I.R.

b) % Excess air:

$$E_a = \frac{382\ SCF/min. - 16.3\ lb\ wood/hr. \times 69\ SCF/lb.\ wood \times 1\ hr/60\ min.}{\frac{16.3 \times 69}{60}}$$

$$= 19.43 \times 100 = 1,943\%\ E.A.$$

Note: $\left(\frac{20\%\ CO_2 - 1\%\ CO_2}{1\%\ CO_2}\right) \times 100 = 1,900\%\ E.A.$

(5) Energy balance

a) Heat released by wood:

$$\frac{7400\ Btu}{lb.} \times \frac{16.3\ lb.}{hr.} \approx 120,620\ \frac{Btu}{hr.}$$

b) Heat lost in exhaust

$$382\ SCF/min. \times 0.24\ Btu/lb.{}^\circ F \times (203^\circ F - 70^\circ F)(.075\ lb/SCF) \times 60\ min/hr. \approx 54,870\ Btu/hr.$$

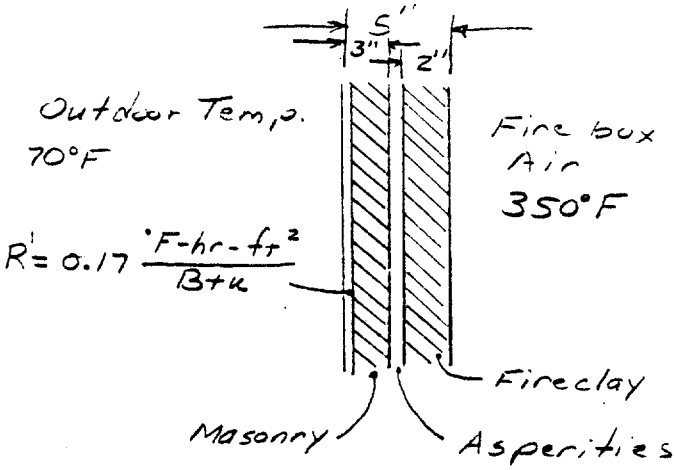
c) Heat lost to infiltrating air:

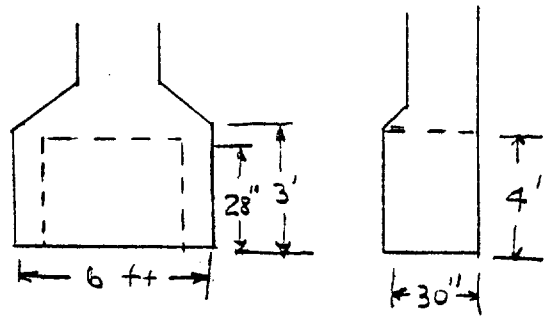
Assume infiltration rate ≈ 382 SCF/min.

If outside temp. ≈ inside temp (as was the case during testing)

heat lost in warming incoming air = $0\ \frac{Btu}{hr.}$

(D) Heat lost through fire box





Total area of fire box

$A_{total} = (4' \times 6') + 2(4' \times 2.5') = 44 ft^2$

Thermal Conductivities

Perry's Chemical Engineering Handbook page 3-211 and Kreith's Principles of Heat Transfer page 595

Material	K Btu-ft/Hr-ft²-°F	R' °F-hr-ft²/Btu
Masonry	0.4	
Fireclay	0.6	
Air @ 200°F	0.02	
Air @ w/ wind		0.17

Assume wall temperature of fire box is 400°F

Calculation of thermal resistances

$R'_{fireclay}$: 0.17 ft. thick = L

$$R'_{fc} = \frac{L}{K} = \frac{0.17}{0.6} = .0278 \quad \frac{°F-hr-ft^2}{Btu}$$

$R'_{Asperities\ in\ brick}$: Asperities in brick = 1/32 in.
Solid to solid contact 3% of area

$$R'_{As} = \frac{(R_{as})(R_{air})}{R_{as} + R_{air}}$$

$$R_{as} = \frac{L}{0.3K} = \frac{.0026}{(0.3)(0.6)} = 0.014 \quad \frac{^\circ F - hr - ft^2}{Btu}$$

$$R_{air} = \frac{L}{0.7K} = \frac{.0026}{(0.7)(.02)} = 0.186 \quad \frac{^\circ F - hr - ft^2}{Btu}$$

$$R'_{As} = \frac{(0.014)(0.186)}{0.014 + 0.186} = 0.013 \quad \frac{^\circ F - hr - ft^2}{Btu}$$

R'_{Brick} : 0.25 ft. = L

$$R'_b = \frac{L}{K} = \frac{0.25}{0.4} = 0.625 \quad \frac{^\circ F - hr - ft^2}{Btu}$$

$R'_{Outside\ air}$: From ASHRAE GUIDE

$$R'_{Air} = 0.25 \quad \frac{^\circ F - hr - ft^2}{Btu}$$

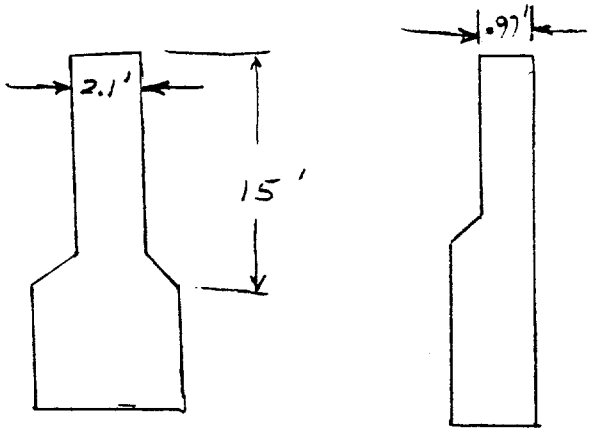
$$R'_{TOTAL} = \Sigma R' = 0.9158 \quad \frac{^\circ F - hr - ft^2}{Btu}$$

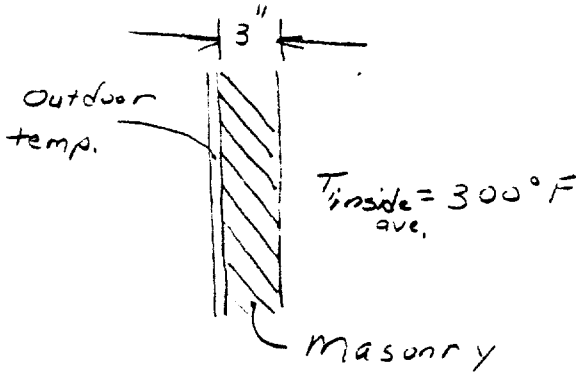
Heat loss through fire box, Q_{Fb} :

Use 44 ft^2 Area

$$Q_{Fb} = \frac{\Delta T}{R'_T} A = \frac{(350 - 70)}{(0.9158)} (44) \approx 13,453 \quad \frac{Btu}{hr.}$$

(E) Heat lost through chimney:





Total Chimney Area: Neglect wall facing house since heat is transfered to house and is therefore not lost

$$A_T = (15')(2.1') + 2(.97')(15')$$

$$= 60.6\ ft^2$$

Assume average wall temp. = 300°F

$$R'_{outside} = 0.25\ °F\text{-}hr\text{-}ft^2/Btu$$

$$K_{brick} = 0.4\ Btu\text{-}ft/hr.\ ft^2\,°F$$

$$R'_{brick} = \frac{L}{K} = \frac{0.25}{0.4} = 0.625\ °F\text{-}hr\text{-}ft^2/Btu$$

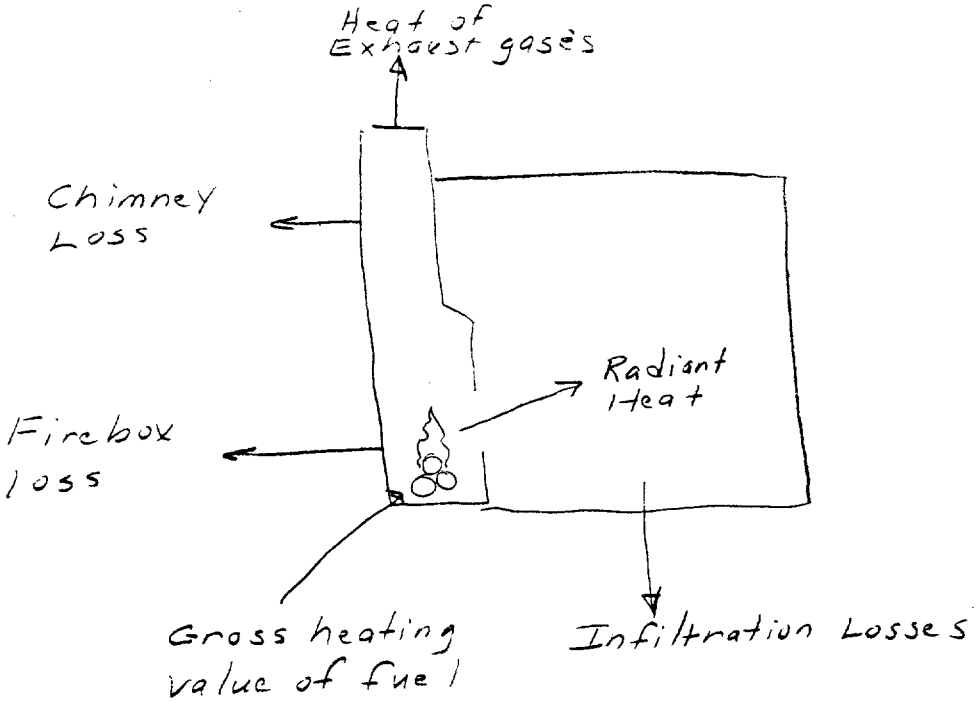
$$R_{total} = \Sigma R = 0.875\ °F\text{-}hr\text{-}ft^2/Btu$$

Heat loss through chimney, Q_{Ch}

Use 60.6 ft^2 area

$$Q_{Ch} = \frac{\Delta T A}{R_T} = \frac{(300-70)(60.6)}{0.875} \approx 15{,}929\ Btu/hr.$$

(F) Efficiency of fire place



$$\%\,Eff. = \frac{\text{Radiant heat}}{\text{Total heat available}} = \frac{\text{Total} - \text{heat losses}}{\text{Total}}$$

$$\text{heat losses} = 54{,}870 + 0 + 13{,}453 + 15{,}929 = 84{,}252 \ \frac{Btu}{hr.}$$

$$\%\,Eff. = \frac{120{,}620 \ Btu/hr. - 84{,}252 \ Btu/hr.}{120{,}620 \ Btu/hr.}$$

$$\approx 0.30 \text{ or } 30\,\% \text{ efficiency}$$

G) Note: at lower outside temperatures with higher winds the efficiency is lowered

- Infiltration heat losses are increased
- Firebox losses are increased

Chimney losses increase but this increase is offset by decreased heat losses in exhaust gases.

APPENDIX G

Particle Sizing

Particle sizing was performed by a Brinks Cascade Impactor. The samples were collected and determined by the methods found in the Procedure section, Page 15. This appendix contains Particle Sizing Calculations, Secondary Data and Size Distribution Graphs. Field Data and Moisture Determination is found in Appendix L.

CASCADE IMPACTOR CALCULATIONS

V_o = $(8465.41)(VOL_m)\ (P_m) / (T_m)\ (TIME) + (22.6417)(VOL_w) / (TIME)$

a = $(234.0)\ (\mu^2) / (\rho)\ (P_2)$

b = $(2.05 \times 10^8)\ (\mu)\ (P_2) / (\rho_p)\ (V_o)\ (P_o)$

D_{pc} = $\sqrt{a + bD_c^3} - \sqrt{a}$

V_o = Gas flow at inlet to impactor at 25° C. and 14.7 psia, cc per second.

VOL_m = Dry gas meter volume at meter temperature and pressure, dry acf

P_m = Dry gas meter pressure, "Hg

T_m = Dry gas meter temperature, °R

TIME = Sampling time, minutes

VOL_w = Volume of water collected, ml

μ = Viscosity of gas in impactor, gm / (cm) (sec)

ρ = Density of gas in impactor, gm per cc

P_2 = Average pressure in impactor, atm.

ρ_p = Density of aerosal particle, gm per cc

P_o = Pressure at inlet to impactor, atm.

D_{pc} = Characteristic diameter of aerosol particle for impactor stage, microns

D_c = Diameter of impactor jet, cm.

VALENTINE, FISHER & TOMLINSON
CONSULTING ENGINEERS

COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME EPA. FIREPLACE DATE AUG. 21, 1975

PREPARED BY SWANSON APPROVED PAGE 1 OF 1

SUBJECT Particle Sizing Run's 5, 17 and 24 67-5, 82-5, 89-5

	RUN NO. 5	RUN NO. 17	RUN NO. 24
VOL_m	2·28	2·797	2·416
P_m	29·813	29·72	29·79
T_m	533	539	548
TIME	20	30	30
VOL_w	0·6	26·1	1·6
V_o	54·659056	63·217313	38·268256
ρ_p	0·6087	0·6087	0·6087
P_o	0·9963	0·9933	0·9956
μ	0·000275	0·000275	0·00021
ρ	0·0008587	0·000861	0·0008471
P_2	0·9146	0·9131	0·9142
a	0·021645	0·021623	0·012911
b	1555·472020	1346·744274	1697·022253
D_c	0·249	0·249	0·249
D_{pc}	4·755430	4·415042	5·006094
D_c	0·1775	0·1775	0·1775
D_{pc}	2·805816	2·601155	2·969012
D_c	0·1396	0·1396	0·1396
D_{pc}	1·915043	1·772527	2·037841
D_c	0·0946	0·0946	0·0946
D_{pc}	1·009413	0·930435	1·089948
D_c	0·0731	0·0731	0·0731
D_{pc}	0·645510	0·592448	0·707805

CASCADE IMPACTOR DATA

Client E.P.A. FIREPLACE

Sampling Location AVERAGE FIREPLACE

Date July 30, 1975

Run Number 5 67-5

Comments

PARTICULATE

	FINAL (gm)		TARE (gm)		NET PARTICULATE (gm)	
Cyclone	78.4436	-	78.4406	=	.0024	-.0006 BLAN
Stage #1	3.2883	-	3.2878	=	.0005	
Stage #2	3.4524	-	3.4220	=	.0004	
Stage #3	3.5337	-	3.5334	=	.0003	
Stage #4	3.3191	-	3.3190	=	.0001	
Stage #5	3.5137	-	3.5129	=	.0004	
Filter (#16-5)	182.1	-	181.1	=	.0011	
Filter holder front	79.4720		79.4709		.0008	
TOTALS		-		=	.0060	-.0003 BLA

MOISTURE

	FINAL (gm)		TARE (gm)		NET WATER (ml = gm)
Bubbler (#1)		-		=	
Impinger (#2)		-		=	
Bubbler (#3)		-		=	
Bubbler (#4)		-		=	
TOTALS		-		=	

CASCADE IMPACTOR RESULTS

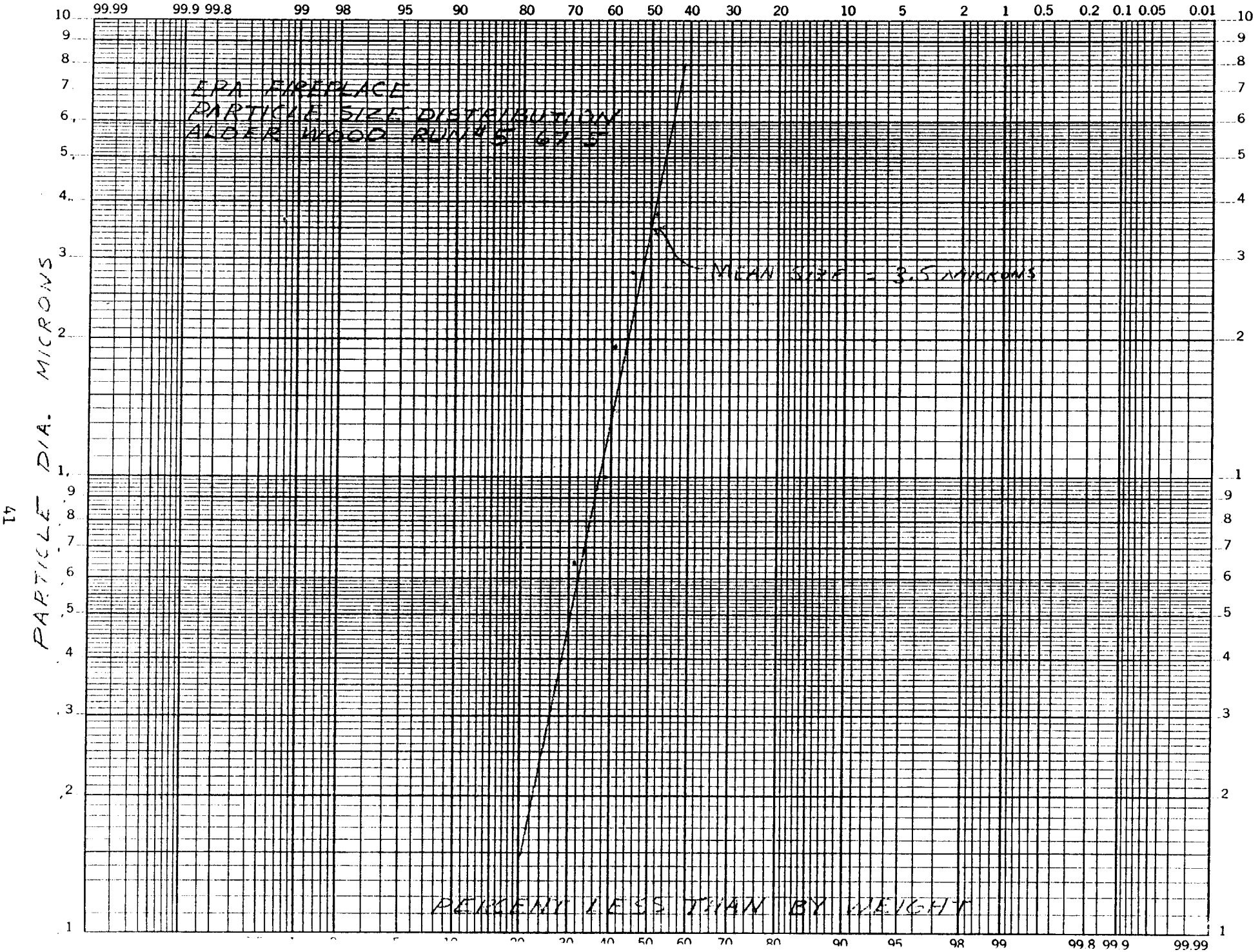
Client: EPA FIREPLACE

Sampling Location: AVERAGE FIREPLACE

Date: July 30, 1975

Run No: 5

ITEM	Dp (=Dpc), microns	Particulate collected, mg	Weight % collected	Cumulative % less than Dp
Cyclone		2.4	40.0	
Stage #1	4.755	0.5	8.3	51.8
Stage #2	2.806	0.4	6.7	45.1
Stage #3	1.915	0.3	5.0	40.1
Stage #4	1.009	0.1	1.7	38.4
Stage #5	0.646	0.4	6.7	31.7
Filter		1.9	31.7	


K&E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 8043
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
10 9 8 7 6 5 4 3 2 1 .9 .8 .7 .6 .5 .4 .3 .2
EPA FIREPLACE
PARTICLE SIZE DISTRIBUTION
ALDER WOOD RUN #5 6-7-5
MEAN SIZE = 3.5 MICRONS
PARTICLE DIA. MICRONS
PERCENT LESS THAN BY WEIGHT

CASCADE IMPACTOR DATA

Client E.P.A. FIREPLACE

Sampling Location AVERAGE FIREPLACE

Date 8/13/75

Run Number 17 82-5

Comments

PARTICULATE

	FINAL (gm)		TARE (gm)		NET PARTICULATE (gm)	
Cyclone	76.7264	-	76.7242	=	.0016	- .0006 BLANK
Stage #1	3.2883	-	3.2882	=	.0001	
Stage #2	3.4522	-	3.4521	=	.0001	
Stage #3	3.5339	-	3.5335	=	.0004	
Stage #4	3.3193	-	3.3190	=	.0003	
Stage #5	3.5135	-	3.5129	=	.0006	
Filter (#27-5)	181.2	-	180.1	=	.0011	
TOTALS		-		=	.0042	

MOISTURE

	FINAL (gm)		TARE (gm)		NET WATER (ml = gm)
Bubbler (#1)		-		=	
Impinger (#2)		-		=	
Bubbler (#3)		-		=	
Bubbler (#4)		-		=	
TOTALS		-		=	

CASCADE IMPACTOR RESULTS

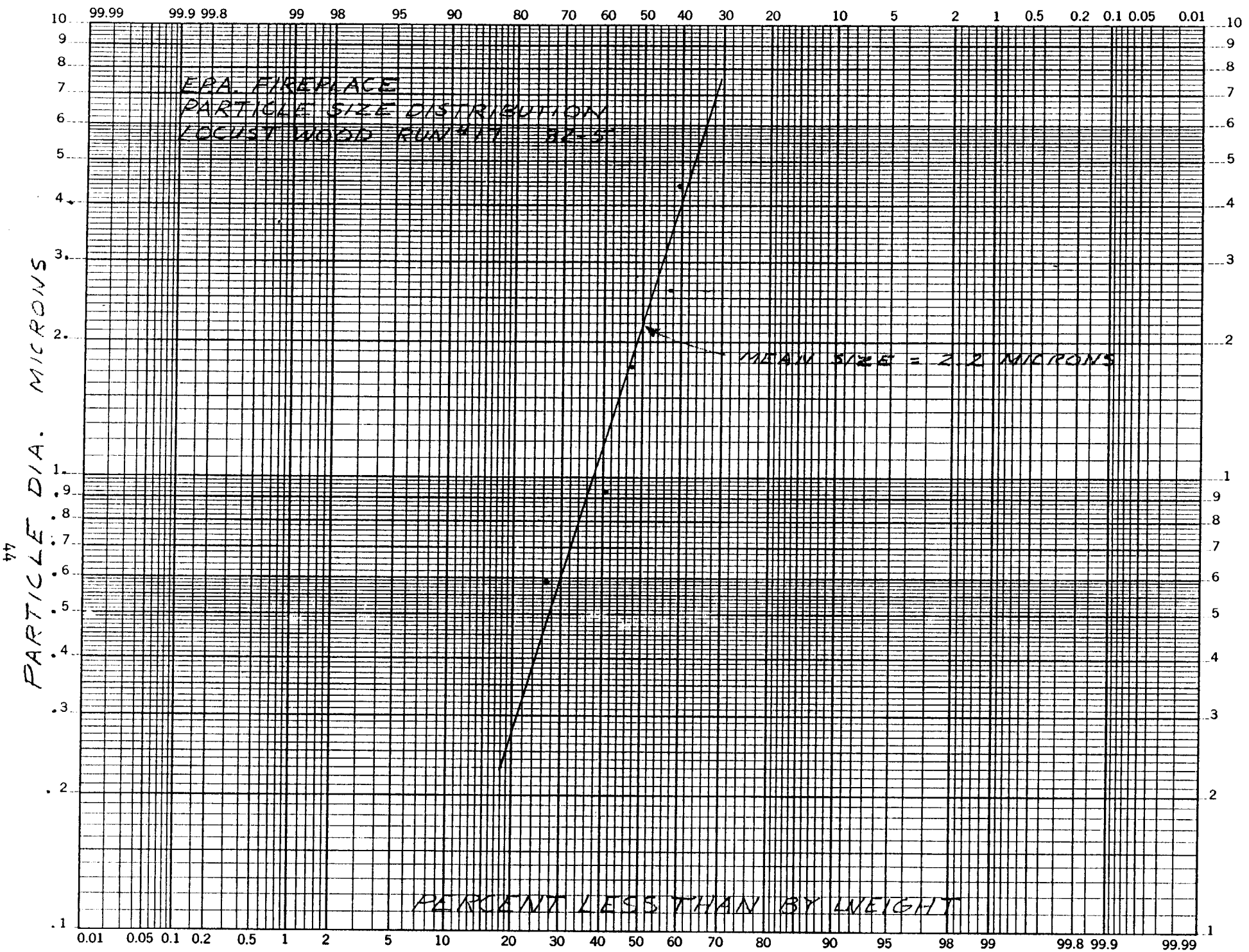
Client: EPA FIREPLACE

Sampling Location: AVERAGE FIREPLACE

Date: 13 AUGUST 1975

Run No: 17 - 82-5

ITEM	Dp (=Dpc), microns	Particulate collected, mg	Weight % collected	Cumulative % less than Dp
Cyclone		1.6	38.1	
Stage #1	4.415	0.1	2.4	59.5
Stage #2	2.601	0.1	2.4	57.1
Stage #3	1.772	0.4	9.5	47.6
Stage #4	0.930	0.3	7.1	40.5
Stage #5	0.592	0.6	14.3	26.2
Filter		1.1	26.2	



CASCADE IMPACTOR DATA

Client EPA. FIREPLACE

Sampling Location AVERAGE FIREPLACE

Date 20 AUGUST 1975

Run Number 24 89-5

Comments

PARTICULATE

	FINAL (gm)		TARE (gm)		NET PARTICULATE (gm)
Cyclone	78.4917	-	78.4902	=	.0012
Stage #1	3.7738	-	3.7736	=	.0002
Stage #2	3.2596	-	3.2295	=	.0001
Stage #3	3.5293	-	3.5290	=	.0003
Stage #4	3.4134	-	3.4133	=	.0001
Stage #5	3.6565	-	3.6564	=	.0001
Filter (# 32-5)	182.1	-	181.2	=	.0009
TOTALS		-		=	.0029

MOISTURE

	FINAL (gm)		TARE (gm)		NET WATER (ml = gm)
Bubbler (#1)		-		=	
Impinger (#2)		-		=	
Bubbler (#3)		-		=	
Bubbler (#4)		-		=	
TOTALS		-		=	

CASCADE IMPACTOR RESULTS

Client: EPA FIREPLACE

Sampling Location: AVERAGE FIREPLACE

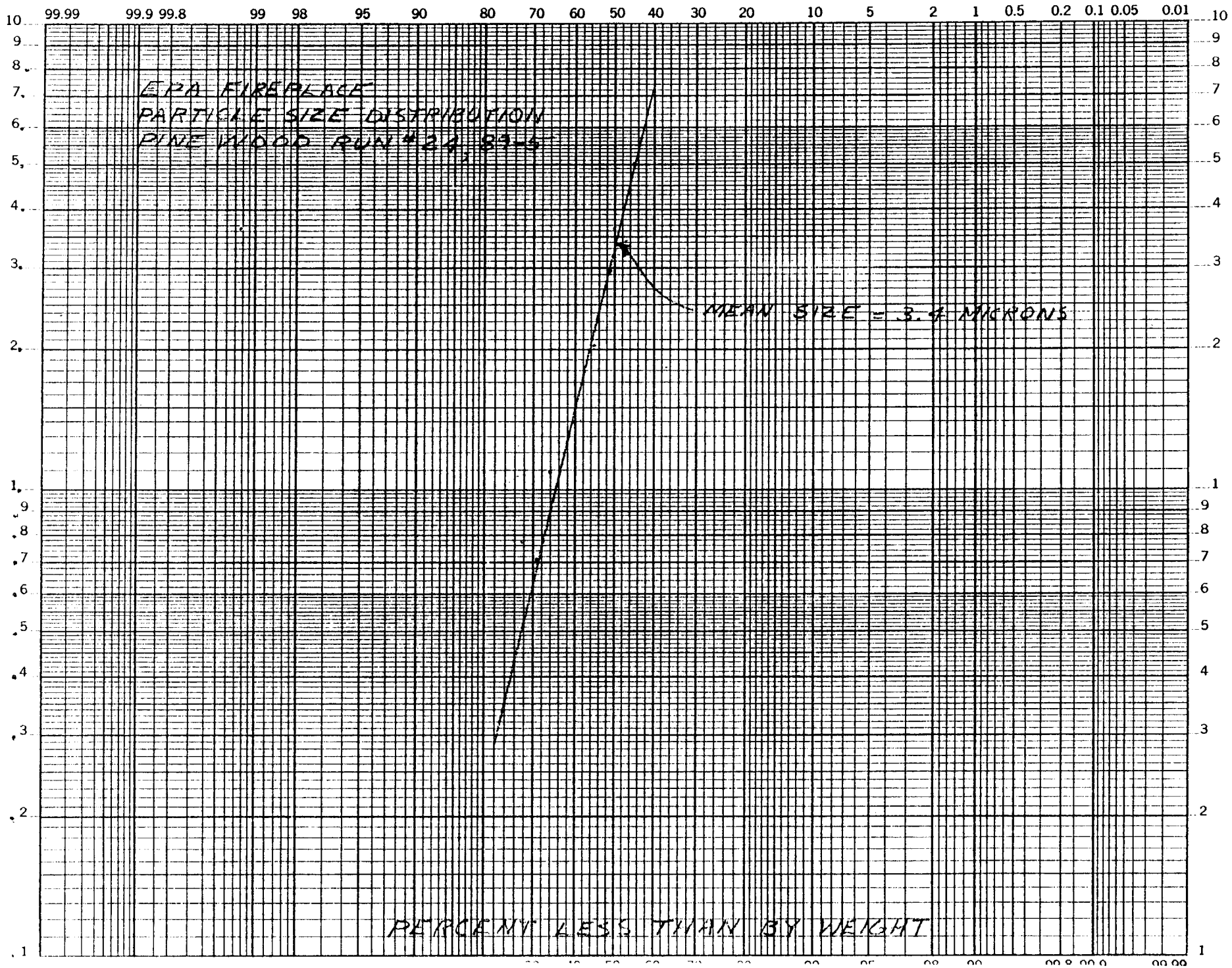
Date: 20 AUGUST 1975

Run No: 24 — 89-5

ITEM	Dp (=Dpc), microns	Particulate collected, mg	Weight % collected	Cumulative % less than Dp
Cyclone		1.2	41.4	
Stage #1	5.006	.2	6.9	55.2
Stage #2	2.969	.1	3.5	48.3
Stage #3	2.038	.3	10.3	44.8
Stage #4	1.090	.1	3.5	34.5
Stage #5	0.708	.1	3.5	31
Filter		.9	31	

K·E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 8043



APPENDIX H

Velocity Correction Coefficient

The reference point velocity correction calculation was performed on 3 of the most variable samples. Findings are discussed on Page 8. The procedures for measuring and calculating are found in the Procedure section, Page 13.

SUBJECT REFERENCE POINT VELOCITY CORRECTION, RUN 8

TRAV PT.	$\sqrt{Tr\ V_H}$	$\sqrt{Ref\ V_H}$	$\frac{Av\sqrt{Ref\ V_H}}{\sqrt{Ref\ V_H}}$	$\sqrt{Tr\ V_H} \times \frac{Av\sqrt{Ref\ V_H}}{\sqrt{Ref\ V_H}}$
1	.110	.1	1.08	.119
2	.1	.1	1.08	.108
3	.1	.07	1.543	.154
4	.122	.1	1.08	.132
5	.1	.1	1.08	.108
6	.122	.1	1.08	.132
7	.132	.1	1.08	.143
8	.141	.1	1.08	.152
9	.110	.1	1.08	.119
10	.122	.1	1.08	.132
11	.141	.1	1.08	.152
12	.122	.122	.885	.108
13	.122	.122	.885	.108
14	.132	.122	.885	.117
15	.132	.122	.885	.117
16	.148	.122	.885	.131
17	.1	.122	.885	.088
18	.112	.122	.885	.099
19	.132	.122	.885	.117
20	.122	.122	.885	.108
TOTAL 20	Av. .121	Av. .108	1111	Av. .122

TRUE AVERAGE VELOCITY =

$$= \left[1 - \left(\frac{.121 - .122}{.121}\right)\right] \text{AVERAGE TRAVERSE VELOCITY}$$

$(1.0083)(7.475\ \text{feet/sec}) = 7.535\ \text{feet/sec}$

SHOWING THAT THE AVERAGE TRAVERSE VELOCITY IS

$$\frac{7.475 - 7.535}{7.535} \times 100 = -.8\%$$ OR IS .8% BELOW TRUE AVERAGE VELOCITY

VALENTINE, FISHER & TOMLINSON ● CONSULTING ENGINEERS

COMPUTATION & DESIGNING SHEET

JOB NAME E.P.A. FIREPLACE DATE 9-25-75

PREPARED BY D. A. ALGUARD PAGE 1 OF 1

SUBJECT REFERENCE PITOT VELOCITY CORRECTIONS, RUN 10

TRAV. PT.	$\sqrt{P_{TR} V_H}$	$\sqrt{P_{REF} V_H}$	$\frac{Av.\sqrt{P_{REF} V_H}}{\sqrt{P_{REF} V_H}}$	$\sqrt{P_{TR} V_H} \times \frac{Av.\sqrt{P_{REF} V_H}}{\sqrt{P_{TR} V_H}}$
1	.100	.122	1.02	.102
2	.110	.122	1.02	.112
3	.122	.122	1.02	.124
4	.141	.122	1.02	.143
5	.132	.141	.886	.115
6	.110	.122	1.02	.112
7	.132	.122	1.02	.133
8	.132	.122	1.02	.133
9	.100	.141	.886	.089
10	.122	.122	1.02	.124
11	.122	.122	1.02	.124
12	.141	.122	1.02	.143
13	.100	.122	1.02	.102
14	.110	.1	1.25	.125
15	.141	.12	1.02	.143
16	.148	.122	1.02	.153
17	.122	.141	.886	.108
18	.148	.141	.886	.106
19	.141	.122	1.02	.143
20	.141	.122	1.02	.143
TOTAL 20	Av .126	Av .125	1.11	Av .124

TRUE AVERAGE VELOCITY =

$= \left[1 - \left(\frac{.126 - .124}{.126}\right)\right]$ AVERAGE TRAVERSE VELOCITY

$= (.984)(7.97 \text{ feet/sec}) = 7.84 \text{ feet/sec}$

SHOWING THAT AVERAGE TRAVERSE VELOCITY IS

$\frac{7.97 - 7.84}{7.84} \times 100 = 1.7\%$ ABOVE TRUE VELOCITY

VALENTINE, FISHER & TOMLINSON ● CONSULTING ENGINEERS

COMPUTATION & DESIGNING SHEET

JOB NAME EPA FIREPLACE DATE 9-26-75

PREPARED BY D.A. ALGUARD PAGE ____ OF ____

SUBJECT REFERENCE PITOT VELOCITY CORRECTIONS, RUN 23

TRAV. PT.		$\sqrt{Tr.V_H}$	$\sqrt{Ref V_H}$	$\frac{\sqrt{Av.Ref V_H}}{\sqrt{Ref V_H}}$	$\sqrt{Tr.V_H} \times \frac{Av.\sqrt{Ref V_H}}{\sqrt{Tr V_H}}$
	1	0.100	0.1	1.055	.105
	2	0.110	0.095	0.959	.105
	3	0.114	0.095	0.925	.105
	4	0.118	0.095	0.894	.105
	5	0.095	0.089	1.111	.106
	6	0.105	0.084	1.005	.106
	7	0.126	0.095	.837	.105
	8	0.130	0.1	.812	.106
	9	0.105	0.095	1.005	.106
	10	0.105	0.089	1.005	.106
	11	0.126	0.105	.837	.105
	12	0.122	0.110	.865	.106
	13	0.105	0.126	1.005	.106
	14	0.126	0.122	.837	.105
	15	0.126	0.126	.837	.105
	16	0.122	0.134	.865	.106
	17	0.095	0.126	1.111	.106
	18	0.100	0.114	1.055	.106
	19	0.100	0.105	1.055	.106
	20	0.100	0.105	1.055	.106
TOTAL	20	$Av = 0.1115$	$Av = .1055$		$Av = .1056$

TRUE AVERAGE VELOCITY =

$= \left[1 - \frac{(.1115 - .1056)}{.1115}\right]$ AVERAGE TRAVERSE VELOCITY

$= [.947] \quad [7.16] = 6.78$ feet/sec

SHOWING THAT THE AVERAGE TRAVERSE VELOCITY IS $\frac{7.16 - 6.78}{6.78} \times 100 = 5.6\%$ ABOVE THE TRUE AVERAGE

APPENDIX I

Wood Burning Rates

The wood burning rate data was collected during each POM and particulate emission evaluation. The data was collected by the methods described in the Procedure section, Page 16.

Run No.	WOOD ADDED LB.	WOOD REMAINING LB.	WOOD BURNT LB.	TIME START	TIME END	BURNING TIME HR	BURNING RATE LB/HR
1	21	9	12	11.43	12.57	1.14	10.5
2	47	8.5	38.5	2.5	4.75	2.25	17.1
3	8	4	4.0	17.05	18.00	0.95	4.2
4	31.5	12.0	19.5	10.25	11.07	0.82	23.8
5	22	7	15	1.08	1.83	0.75	20.0
6	25.25	4	21.25	14.58	16.13	1.55	13.7
7	22.5	3.0	19.5	12.42	13.98	1.56	12.5
8	21.5	3.0	18.5	14.33	16.37	2.04	9.1
9	31.5	9	22.5	9.83	11.05	1.22	18.4
10	28	4	24	12.38	1400	1.62	14.8
11	23	2	21	1400	16.20	2.2	9.5
* 12	14 *	8 *	6 *	9.63	10.83	1.2	5.0 *
* 13	16 *	9 *	7 *	11.4	12.57	1.17	6.0 *
14	42	15	27	11.37	12.73	1.36	19.8
15	28	9	17	13.35	14.6	1.25	13.6
16	31	17	14	10.45	11.65	1.2	11.7
17	16	9	5	13.72	14.22	0.5	10.00
18	28	12	16	2.97	1428	1.31	12.21
19	42	14	28	11.75	12.88	1.13	24.8
20	33.5	11	22.5	14.75	15.48	0.73	30.8
21	31	[illegible]	21	16.32	17.27	0.95	22.1
22	31.5 23	18 14	13.5 13	11.3 12.33	11.83 12.88	0.53 0.55	25.47 23.4 > 24.5
23	28	10	18	14.77	15.67	0.9	20.0
24	22	7	15	16.48	16.98	0.5	30.0

* COAL WAS BEING BURNED INSTEAD OF WOOD

APPENDIX J

Auxiliary Atmospheric Emission Data

Two projects separate to this study were performed by Valentine, Fisher & Tomlinson wherein atmospheric emissions were measured from combustion of fuels in residential fireplaces. The first project was evaluating emissions from a compacted-waste-wood formed into a log and burned under simulated fireplace conditions. The results of the emissions are shown in Table VI. The second project was sampling atmospheric emissions from burning alder wood in a residential fireplace and were reported in a paper by W. D. Snowden and I. J. Primlani titled "Atmospheric Emissions from Residential Space Heating," presented at the Pacific Northwest International Section of the Air Pollution Control Association annual meeting in Boise, Idaho, in November, 1974. Emissions from the second project are also shown in Table VI.

Table VI

Auxiliary Fireplace Atmospheric Emission Data

Project No.	Burning Rate (BR)	Stack Temp.	Stack Gas Flow Rate	Pollutant Mass Rate (PMR)	$\%CO_2$	(PMR/BR)
1	8 kg/hr	54° C	14.2 m^3/min	18.8 gm/hr	0.2%	2.4 gm/kg
2	19.8 kg/hr	107° C	11.7 m^3/min	129 gm/hr	0.25%	6.5 gm/kg
3*	7258 kg/hr	363° C	3881 m^3/min	34500 gm/hr	3.5%	4.8 gm/kg

*Air Curtain Wood Waste Combustion System

APPENDIX K, COMPUTER PRINT-OUTS OF PARTICULATE EMISSION DATA WITH CALCULATIONS AND TERMINOLOGY

PARTICULATE CONCENTRATION AND PMR CALCULATION TERMINOLOGY

VOL_m = Dry gas meter volume @ meter temperature and pressure, dry - acf

P_m = Dry gas meter pressure (recorded as inlet deflection accross orifice meter) - "Hg

T_m = Dry gas meter temperature (average of inlet and outlet)

P_{STD} = Standard atmospheric pressure (29.92" Hg)

T_{STD} = Standard Temperature (520 or 530° R)

VOL_w = Volume of water collected (expressed as vapor at standard temperature and pressure) - scf

M = % water, calculated from amount the train collected in impinger, bubblers, and on silica gel

MF = Mole fraction of dry gas

W_D = Molecular weight of dry stack gas - lb/lb mole

W_W = Molecular weight of wet stack gas - lb/lb mole

W_a = Molecular weight of air - lb/lb mole

C_D = Velocity correction coefficient for gas density

P_{SN} = Stack pressure (static + barometric) - "Hg

C_S = Velocity correction coefficient for stack pressure

VH_n = Pitot tube pressure differential - "H_2O

V_o = Stack velocity @ stack conditions - fps

Q_o = Stack flow rate at stack conditions - acfm

T_s = Average stack temperature - °R

Q_{OS} = Stack flow rate at standard conditions - scfm

T = Time over which sample was collected - minutes

V_n = Velocity of gases inside nozzle during sampling - fps

I = % isokinetic ($\pm$ 10% desirable)

C_O = Particulate concentration - grains/scf

N = % CO_2 by volume in stack (12 indicates no % CO_2 correction is to be made)

PARTICULATE CONCENTRATION AND PMR CALCULATION TERMINOLOGY

C = Particulate concentration corrected to 12% CO_2

PMR_P = Pollutant mass rate - "concentration method" - lb/hr

PMR_{AR} = Pollutant mass rate - "area ratio method" - lb/hr

PMR_{AVG} = Average pollutant mass rate - lb/hr

C' = Particulate concentration corrected for non-isokinetic sampling condition -grains/scf

P_T = Total Particulate collected by sampling train - mg

A_s = Area of Stack - FT^2

A_n = Area of Nozzle - FT^2

VH = Velocity head readings for pitot tube - inches water

VOL_{STD} = Standardized gas that passed through the sampling train - cubic feet, 70° F., 1 atmosphere pressure, and dry.

C_p = Velocity correction coefficient for type pitot tube - dimensionless 0.83 to 0.87 for "S" type pitot tube normally and 1.0 for "P" type pitot tube.

PARTICULATE CONCENTRATION & PMR CALCULATIONS

1. $VOL_{STD} = \dfrac{(VOL_m)\ (P_m)\ (T_{STD})}{(P_{STD}*)\ (T_m)}$

2. $M = \dfrac{(100)\ (VOL_w)}{VOL_{STD} + VOL_w}$

3. $MF = \dfrac{100 - M}{100}$

4. $W_w = (W_D)\ (MF) + 18\ (1\text{-}MF)$

5. $C_D = \sqrt{\dfrac{W_a*}{W_w}}$

6. $C_S = \sqrt{\dfrac{P_{STD}}{P_{SN}}}$

7. $K = \dfrac{\sum\sqrt{VH_n \times T_{S_n}}}{n}$

8. $V_o = 2.9\ (K_a)\ (C_p)\ (C_D)\ (C_S)$

9. $Q_o = (V_o)\ (A_S)\ (60)$

10. $Q_{OS} = \dfrac{Q_o\ (T_{STD})\ (P_{SN})\ (MF)}{(T_S)\ (P_{STD})}$

11. $V_n = \dfrac{(VOL_{STD})\ (P_{STD})(T_S)}{(MF)\ (T_{STD})\ (P_{SN})\ (T)\ (A_N)\ (60)}$

12. $I = (100)\ \dfrac{V_n}{V_o}$

13. $C_O = \dfrac{P_T}{VOL_{STD}}\ (0.0154)$

14. $C = \dfrac{C_O\ (12\%)}{N}$

15. $PMR_p = (C_O)\ (Q_{OS})\ (0.008571)$

16. $PMR_{AR} = \dfrac{P_T}{T}\dfrac{A_s}{A_n}\ (0.000132)$

17. $PMR_{AVG} = \dfrac{PMR_p + PMR_{AR}}{2}$

18. $C' = \dfrac{PMR_{AVG}}{Q_{OS}N}\ (1400)$

* $P_{STD} = 29.92$" Hg.

* $W_a = 28.95$ LB/LB MOLE

CALCULATIONS (Continued)

The weight of the dust per volume and weight of dust per time were calculated using two procedures:

1. The Concentration Method:

   The concentration of dust entering the sampling nozzle is calculated and then multiplied by the volumetric flow rate of the stack gases to obtain the Pollutant Mass Rate (PMR).

   Concentration in Nozzle x Volumetric Flow Rate = Pollutant Mass Rate On Concentration Basis.

   $$(P_T/VOL_{STD}) \times Q_{os} = PMR_p$$

Assuming the nozzle velocity is greater than the average stack gas velocity (V_n greater than V_o), the calculated Pollutant Mass Rate will be less than the true Pollutant Mass Rate because the heavier dust particles will leave their streamline and not enter the nozzle. If V_n is less than V_o then the calculated PMR will be greater than the true PMR.

2. The Area Ratio Method:

   The weight of dust collected is divided by the sampling time and multiplied by the ratio of the Stack Area to the nozzle area to obtain the calculated Pollutant Mass Rate (PMR_{AR}).

   $$\frac{\text{Weight Collected}}{\text{Sample Time}} \times \frac{\text{Area of Stack}}{\text{Area of Nozzle}} = \text{Pollutant Mass Rate on Area Ratio Basis.}$$

   $$(P_T/T) \times A_s/A_n = PMR_{AR}$$

Assuming the nozzle velocity is greater than the average stack gas velocity (V_n greater than V_o), the calculated Pollutant Mass Rate will be greater than the true Pollutant Mass Rate because the lighter particles in the dust laden stream follow their streamlines and enter the sampling nozzle resulting in P_T/T being greater than true. If V_n is less than V_o, the calculated PMR_{AR} will be greater than the true PMR.

To obtain a more true Pollutant Mass Rate, the two calculated pollutant mass rates are averaged. This allows some of the bias introduced because of non-isokinetic sampling calculated by one method to offset the bias of the other method.

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COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

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SUBJECT FIREPLACE EMISSIONS RUN NO. 1 64-5

20.319	VOLm	0.011	VH	0.02	VH		
30.30	Pm	640	Ts	635	Ts	2.977091	Ka
530	Tstd	2.653299		3.563705			
541	Tm					0.023	Cp
		0.02	VH	0.01	VH	7.126595	Vo
20.158674	VOLstd	645	Ts	630	Ts	1.170	As
		3.591656		2.509900			
0.40348	VOLw					499.865760	Qo
		0.02		0.01			
		640		625			
3.542100	M	3.577700		2.500000		530	Tstd
						642	Ts
0.976579	MF	0.02		0.015		30.25	Psn
28.78	Wd	665		620			
		3.646916		3.049590		407.441630	Qos
28.597521	Ww						
		0.015		0.015		642	Ts
1.007377	Cd	665		620		530	Tstd
30.25	Psn	3.158322		3.049590		30.25	Psn
						40	T
0.994530	Cs	0.015		0.01		0.00136	An
		665		640			
		3.158322		2.529022		7.577034	Vn
						106.410124	I
		0.02		0.01			
		650		625		63.3	Pt
		3.605551		2.500000		0.048357	Co
		0.02		0.0015			
		635		650		0.1	N
		3.563705		0.987420		5.802840	C
		0.01		0.015			
		660		640		0.168871	PMRp
		2.569046		3.098306		63.3	Pt
						1.170	As
		0.015				40	T
		660				0.00136	An
		3.146426					
						0.170922	PMRar
		0.015					
		640				0.174306	PMRavg
		3.098306					
						0.1	N
						5.992370	C'

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT E.P.A. FIREPLACE DATE OF ANALYSIS 8-9-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 13

EVALUATION DATE 8-8-75 CLEAN-UP SET NO. 78-5

I. EVAPORATION OF 117 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 80146.7 (mg) - TARE 80138.9 (mg)

-BLANK ((.0057 mg/ml) (117 ml) = .7 mg) = 7.1 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 378.2 (mg) - TARE 362.9 (mg) = 15.3 mg.

BACK UP 185.3 (MG) 183.1 (mg)

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS. = 2.2 mg.

FINAL 76573.4 (mg) - TARE 76571.0 (mg)

-BLANK (1.8 mg) = 0.6 mg.

IV. PARTICULATE FROM EVAPORATION OF 215 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77845.2 (mg) - TARE 77829.6 (mg)

-BLANK ((.0086 mg/ml) (215 ml initial

- 9.5 ml CONDENSED = 205.5 ml) = .6 mg) = 15 mg.

V. PARTICULATE FROM 120 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77392.9 (mg) - TARE 77386.4 (mg)

-BLANK ((.0057 mg/ml) (120 ml) = .7 mg) = 5.8 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 46 mg.

BLANKS Run #: 1.

ACETONE = ___ mg/___ml = ___mg/ml FINAL ___mg. TARE ___mg.

ETHER-CHLOROFORM = ___ mg.(FINAL ___ mg - TARE ___ mg)

WATER = ___mg/___ml = ___mg/ml. FINAL ___mg. TARE ___mg.

VFT/AP9 A

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SUBJECT FIREPLACE EMISSIONS RUN NO. 3 66-5

14.428	VOLm
30.27	Pm
530	Tstd
556	Tm
10.914193	VOLstd
0.37446	VOLw
2.620600	M
0.973794	MF
28.83	Wd
28.546189	Ww
1.007047	Cd
30.25	Psn
0.994530	Cs

0.005	VH
643	Ts
1.726820	
0.005	VH
635	Ts
1.701052	
0.0075	
645	
2.199431	
0.0075	
640	
2.190090	
0.005	
630	
1.774823	
0.0075	
625	
2.165063	
0.01	
620	
2.489979	
0.01	
625	
2.500000	
0.005	
622	
1.763519	
0.0075	
615	
2.147673	
0.0075	
615	
2.147673	

0.0075	VH
610	Ts
2.138924	
0.005	VH
611	Ts
1.747855	
0.005	
611	
1.747855	
0.005	
596	
1.726267	
0.0075	
594	
2.110607	
0.005	
586	
1.711724	
0.005	
585	
1.710263	
0.0075	
583	
2.091052	
0.0075	
580	
2.085665	

0.001351	K_a
0.04	C_p
4.882708	V_o
1.170	A_s
342.771660	Q_o
530	T_{std}
613	T_s
30.25	P_{sn}
291.777087	Q_{os}
613	T_s
530	T_{std}
30.25	P_{sn}
40	T
0.00136	A_n
5.007965	V_n
102.563637	I
33.6	P_t
0.037107	C_o
0.1	N
4.462440	C
0.092998	PMRp
33.6	P_t
1.170	A_s
40	T
0.00136	A_n
0.095504	PMR_{ar}
0.094251	PMR_{avg}
0.1	N
4.502336	C'

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COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME EPA FIREPLACE DATE 30 JULY 1975

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SUBJECT FIREPLACE EMISSIONS RUN #4 68-5

15.421	VOLm	0.005	VH	0.015	VH		
29.84	Pm	660	Ts	695	Ts	2.567168	K_a
530	Tstd	1.816590		3.228776			
532	Tm					0.84	C_p
		0.0075	VH	0.0075	VH	6.301775	V_o
15.321948	VOLstd	690	Ts	670	Ts	1.170	A_s
		2.274862		2.241651			
0.41238	VOLw					442.384560	Q_o
		0.0075		0.005			
2.620800	M	700		710		530	T_{std}
		2.291287		1.884144		697	T_s
0.973792	MF					29.81	P_{sn}
28.90	Wd	0.015		0.012			
		710		695		326.369556	Q_{os}
28.614332	Ww	3.263433		2.887905			
				0.0075			
1.005847	Cd	0.01		675		697	T_s
29.81	Psn	660		2.250000		530	T_{std}
		2.569046				29.81	P_{sn}
1.001843	Cs			0.005		40	T
		0.01		710		0.00136	A_n
		745		1.884144			
		2.729468				6.362879	V_n
				0.0075		100.969631	I
		0.02		690			
		754		2.274862		106.2	P_t
		3.883297				0.106740	C_o
				0.0075			
		0.02		675			
		735		2.250000		0.625	N
		3.834057				2.049400	C
				0.0075			
		0.0075		670			
		705		2.241651		0.298585	PMR_p
		2.299456				106.2	P_t
						1.170	A_s
		0.0075				40	T
		700				0.00136	A_n
		2.291287					
						0.301860	PMR_{ar}
		0.0125					
		695				0.300222	PMR_{avg}
		2.947456					
						0.625	N
						2.060539	C'

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JOB NAME E.P.A FIREPLACE DATE 2-28-75

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SUBJECT RUN #5 IMPACTOR

0.00	VOLm	0.013	VH	0.013	VH		
		630	Ts	675	Ts	3.193745	Ka
29.81	Pm	0.061817		3.405605			
530	Tstd						
933	Tm					0.042	Cp
		0.013	VH	0.013	VH	7.007022	Vo
0.253831	VOLstd	635	Ts	670	Ts	1.17	As
		3.061862		0.951273			
0.022004	VOLw	0.013		0.018		540.050000	Qo
		636		660			
1.260600	M	0.875413		3.446737		530	Tstd
						657	Ts
0.287594						29.81	Psn
29.96	MF	0.02		0.015			
	Wd	687		650			
29.811964		3.706756		3.122498		434.034491	Qos
	Ww						
1.002320		0.015		0.015		657	Ts
29.81	Cd	687		647		530	Tstd
						29.81	Psn
	Psn	3.210140		3.115284		20	T
1.001043						0.000085	An
	Cs						
						27.004901	Vn
						357.433359	I
							Pt
							Co
							N
							C
							PMRp
							Pt
							As
							T
							An
							PMRar
							PMRavg
							N
							C'

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COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME EPA FIREPLACE DATE JULY 30, 1975

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SUBJECT FIREPLACE EMISSIONS RUN NO. 6 69-5

29.307	VOLm
30.66	Pm
530	Tstd
551	Tm
28.887249	VOLstd
0.58776	VOLw
1.994000	M
0.980060	MF
28.89	Wd
28.672853	Ww
1.004820	Cd
30.62	Psn
0.988503	Cs

0.015	VH
705	Ts
3.251922	
0.015	VH
660	Ts
3.146426	
0.0175	
665	
3.411378	
0.015	
655	
3.134485	
0.01	
667	
2.582634	
0.015	
667	
3.163068	
0.0125	
660	
2.872281	
0.015	
660	
3.146426	
0.01	
640	
2.529822	
0.015	
690	
3.217141	
0.027	
695	
4.331850	

0.02	VH
700	Ts
3.741657	
0.075	VH
660	Ts
7.035623	
0.012	
650	
2.792846	
0.015	
680	
3.193743	
0.02	
670	
3.660601	
0.01	
690	
2.626785	
0.012	
667	
2.829134	
0.015	
655	
3.134485	
0.015	
652	
3.127299	

3.346480	Ka
0.84	Cp
8.097142	Vo
1.17	As
568.419360	Qo
530	Tstd
670	Ts
30.62	Psn
450.989249	Qos
670	Ts
530	Tstd
30.62	Psn
60	T
0.00136	An
7.436470	Vn
91.840676	I
11.71	Pt
0.006242	Co
0.5	N
0.149808	C
0.024127	PMRp
11.71	Pt
1.17	As
60	T
0.00136	An
0.022189	PMRar
0.023156	PMRavg
0.5	N
0.143778	C'

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COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME EPA FIREPLACE DATE 4 AUGUST 1975

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SUBJECT FIREPLACE EMISSIONS RUN # 7 72-5

29.636	VOLm	0.075	VH	0.020	VH		
29.66	Pm	625	Ts	665	Ts	3.111103	Ka
530	Tstd	6.846831		3.024910			
543	Tm					0.03	Cp
		0.01	VH	0.01	VH	7.574072	Vo
28.3166438	VOLstd	630	Ts	635	Ts	1.170	As
		2.509900		2.519520			
0.69670	VOLw					931.756000	Qo
		0.012		0.012			
		625		620			
2.401500	M	2.738610		2.749545		530	Tstd
						635	Ts
0.975085	MF	0.0125		0.015		29.61	Psn
29.85	Wd	620		625			
		2.783082		3.061862		428.601264	Qos
28.509437	Ww						
		0.01		0.015		635	Ts
1.006285	Cd	630		620		530	Tstd
29.61	Psn	2.509900		3.049590		29.61	Psn
						60	T
1.005220	Cs	0.0125		0.012		0.00136	An
		630		625			
		2.806243		2.738612		7.174276	Vn
						24.711514	I
		0.015		0.012			
		620		625		72.5	Pt
		3.049590		2.738612		0.039429	Co
		0.012		0.015			
		611		620		0.2	N
		2.707766		3.049590		2.365740	C
		0.01		0.015			
		635		610		0.144871	PMRp
		2.617250		3.024896		72.5	Pt
						1.170	As
		0.015				60	T
		680				0.00136	An
		3.193743					
						0.137301	PMRar
		0.02					
		605				0.141126	PMRavg
		3.701381					
						0.2	N
						2.304465	C'

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SUBJECT FIREPLACE EMISSIONS RUN #8 73-5

32.059	VOLm
29.61	Pm
530	Tstd
567	Tm
29.656479	VOLstd
0.59	VOLw
1.950600	M
0.980494	MF
28.88	Wd
28.667774	Ww
1.004909	Cd
29.55	Psn
1.006241	Cs

0.012	VH
635	Ts
2.760434	
0.01	VH
620	Ts
2.489979	
0.01	
620	
2.489979	
0.015	
650	
3.122498	
0.01	
620	
2.489979	
0.015	
670	
3.170173	
0.0175	
650	
3.372684	
0.020	
650	
3.605551	
0.012	
700	
2.898275	
0.015	
690	
3.217141	
0.020	
645	
3.591656	

0.015	VH
630	Ts
3.074085	
0.015	VH
695	Ts
3.228776	
0.0175	
670	
3.424178	
0.0175	
670	
3.424178	
0.022	
685	
3.882009	
0.01	
660	
2.569046	
0.0125	
635	
2.817356	
0.0175	
620	
3.293933	
0.015	
610	
3.024896	

3.097340	K_a
0.823	C_p
7.475070	V_o
1.170	A_s
524.749860	Q_o
530	T_{std}
651	T_s
29.55	P_{sn}
413.702407	Q_{os}
651	T_s
530	T_{std}
29.55	P_{sn}
60	T
0.00136	A_n
7.683198	V_n
102.784294	I
70.5	P_t
0.036609	C_o
0.433	N
1.014568	C
0.129809	PMRp
70.5	P_t
1.170	A_s
60	T
0.00136	A_n
0.133591	PMR_{ar}
0.131700	PMR_{avg}
0.433	N
1.029208	C'

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COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME EPA FIREPLACE DATE 6 AUGUST 1975

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SUBJECT FIREPLACE EMISSIONS RUN #9 74-5

22.657	VOLm	0.0005	VH	0.0125	VH		
29.76	Pm	645	Ts	640	Ts	2.246009	Ka
530	Tstd	0.567890		2.820427			
535	Tm					0.04	Cp
		0.0075	VH	0.005	VH	5.518616	Vo
22.325224	VOLstd	710	Ts	675	Ts	1.170	As
		2.307596		1.837117			
0.53008	VOLw					387.406800	Qo
		0.012		0.0075			
		670		655			
2.322700	M	2.835489		2.216416		530	Tstd
						642	Ts
0.976773	MF	0.012		0.012		29.72	Psn
28.90	Wd	620		645			
		2.727636		2.782085		310.305120	Qos
28.646825	Ww						
		0.0075		0.01		642	Ts
1.005277	Cd	590		635		530	Tstd
29.72	Psn	2.103568		2.519920		29.72	Psn
						60	T
1.003358	Cs	0.005		0.005		0.00136	An
		590		.630			
		1.717556		1.774823		5.692879	Vn
						103.157730	I
		0.012		0.005			
		625		625			
		2.738612		1.767766		87.4	Pt
						0.060288	Co
		0.016		0.005			
		670		605			
		3.274141		1.739252		0.6	N
						1.205760	C
		0.0075		0.0075			
		670		615		0.160343	PMRp
		2.241651		2.147673		87.4	Pt
						1.170	As
		0.0075				60	T
		665				0.00136	An
		2.233271					
						0.163616	PMRar
		0.01					
		655				0.162979	PMRavg
		2.559296					
						0.6	N
						1.205516	C'

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SUBJECT FIREPLACE EMISSIONS RUN # 10 75-5

32.641	VOLm
29.76	Pm
530	Tstd
546	Tm
31.515051	VOLstd
0.72048	VOLw
2.235000	M
0.977650	MF
28.88	Wd
28.636832	Ww
1.005452	Cd
29.7	Psn
1.003696	Cs

0.01	VH
670	Ts
2.588435	
0.012	VH
665	Ts
2.824889	
0.015	
670	
3.170173	
0.02	
690	
3.714835	
0.0175	
710	
3.524911	
0.0125	
695	
2.947456	
0.0175	
670	
3.424178	
0.0175	
650	
3.372684	
0.01	
675	
2.598076	
0.015	
690	
3.217141	
0.015	
720	
3.286335	

0.02	VH
665	Ts
3.646916	
0.01	VH
635	Ts
2.519920	
0.012	
630	
2.749545	
0.02	
680	
3.687817	
0.022	
665	
3.824918	
0.015	
800	
3.464101	
0.022	
770	
4.115823	
0.02	
740	
3.847076	
0.02	
705	
3.754996	

3.314011	K_a
0.822	C_p
7.972363	V_o
1.17	A_s
559.659840	Q_o
530	T_{std}
690	T_s
29.7	P_{sn}
417.185481	Q_{os}
690	T_s
530	T_{std}
29.7	P_{sn}
60	T
0.00136	A_n
8.635171	V_n
108.313821	I
113.8	P_t
0.055608	C_o
0.4	N
1.668240	C
0.198837	PMRp
113.8	P_t
1.17	A_s
60	T
0.00136	A_n
0.215642	PMR_{ar}
0.207239	PMRavg
0.4	N
1.738642	C'

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SUBJECT FIREPLACE EMISSIONS RUN # 11 76-5

31.295	VOLm
29.75	Pm
530	Tstd
558	Tm
29.555751	VOLstd
0.531	VOLw
1.764800	M
0.982352	MF
29.6	Wd
28.412931	Ww
1.009406	Cd
29.7	Psn
1.003696	Cs

0.01	VH
665	Ts
2.578759	
0.012	VH
660	Ts
2.814249	
0.015	
650	
3.122498	
0.015	
640	
3.098386	
0.01	
675	
2.598076	
0.0125	
650	
2.850438	
0.0175	
640	
3.346640	
0.02	
635	
3.563705	
0.0125	
650	
2.850430	
0.015	
640	
3.098306	
0.0175	
640	
3.346640	

0.0175	VH
635	Ts
3.333541	
0.015	VH
600	Ts
3.193743	
0.015	
665	
3.158322	
0.015	
660	
3.146426	
0.015	
665	
3.158322	
0.01	
665	
2.578759	
0.01	
650	
2.549509	
0.015	
635	
3.086259	
0.0125	
625	
2.795084	

3.013409	Ka
0.84	Cp
7.437095	Vo
1.17	As
522.084060	Qo
530	Tstd
651	Ts
29.7	Psn
414.474014	Qos
651	Ts
530	Tstd
29.7	Psn
60	T
0.00136	An
7.604019	Vn
102.244478	I
10.1	Pt
0.005262	Co
0.5	N
0.126280	C
0.018693	PMRp
10.1	Pt
1.17	As
60	T
0.00136	An
0.019130	PMRar
0.018915	PMRavg
0.5	N
0.127780	C'

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SUBJECT FIREPLACE EMISSIONS RUN #12 77-5

27.027	VOLm	0.01	VH	0.014	VH				
30.265	Pm	632	Ts	630	Ts	2.822736	K_a		
530	Tstd	2.513961		2.969848					
538	Tm					0.84	C_p		
		0.012	VH	0.01	VH	6.881424	V_o		
26.932118	VOLstd	630	Ts	644	Ts	1.170	A_s		
		2.749545		2.537715					
0.53562	VOLw					483.075960	Q_o		
		0.014		0.01					
1.949900	M	625		643					
		2.958039		2.535744		530	T_{std}		
0.980501	MF					636	T_s		
28.83	Wd	0.013		0.014		30.22	P_{sn}		
		625		642					
28.618825	Ww	2.850438		2.997999		398.671408	Q_{os}		
		0.01		0.016					
1.005768	Cd	635		645		636	T_s		
30.22	Psn	2.519920		3.212475		530	T_{std}		
						30.22	P_{sn}		
0.995023	Cs	0.011		0.013		60	T		
		640		645		0.00136	A_n		
		2.653299		2.895686					
						6.665441	V_n		
		0.015		0.013		96.861361	I		
		640		645					
		3.098386		2.895686		78.8	P_t		
						0.045058	C_o		
		0.015		0.014					
		637		642					
		3.091116		2.997999		0.2	N		
						2.703480	C		
		0.01		0.015					
		630		637		0.153963	PMRp		
		2.509980		3.091116		78.8	P_t		
						1.17	A_s		
		0.01				60	T		
		632				0.00136	A_n		
		2.513961							
						0.149319	PMR_{ar}		
		0.013							
		630				0.151641	PMR_{avg}		
		2.861817							
						0.2	N		
						2.662560	C'		

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SUBJECT FIREPLACE EMISSIONS RUN #13 78-5

29.029	VOLm	0.01	VH	0.016	VH		
30.22	Pm	625	Ts	627	Ts	0.040149	K_a
530	Tstd	2.500000		3.167333			
592	Tm					0.038	Cp
		0.01	VH	0.015	VH	6.016520	V_o
29.062725	VOLstd	625	Ts	620	Ts	1.170	A_s
		2.500000		3.049590			
0.450	VOLw					485.540220	Q_o
		0.01		0.013			
1.524700	M	620		620		530	T_{std}
		2.489979		2.839013		625	T_s
0.984753	MF					30.22	P_{sn}
28.07	Wd	0.012		0.013			
		615		620			
28.704265	Ww	2.716615		2.839013		409.525779	Q_{os}
		0.01		0.015		625	T_s
1.004270	Cd	622		620		530	T_{std}
30.22	Psn	2.493992		3.049590		30.22	P_{sn}
0.995023	Cs					60	T
		0.014		0.014		0.00136	A_n
		635		620			
		2.981610		2.946183		7.037830	V_n
						101.753799	I
		0.016		0.01			
		637		620		46	P_t
		3.122491		2.489979		0.024374	C_o
		0.014		0.014			
		640		625			
		2.993325		2.958039		0.3	N
						0.974960	C
		0.014		0.014			
		630		627		0.005553	PMRp
		2.969848		2.962768		46	P_t
						1.17	A_s
		0.012				60	T
		630				0.00136	A_n
		2.749545					
						0.087166	PMR_{ar}
		0.015					
		630				0.086359	PMR_{avg}
		3.074385					
						0.3	N
						0.904083	C'

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SUBJECT FIREPLACE EMISSIONS RUN # 14 79-5

25.503	VOLm
29.69	Pm
530	Tstd
541	Tm
24.792395	VOLstd
0.69678	VOLw
2.733600	M
0.972664	MF
28.88	Wd
28.582584	Ww
1.006406	Cd
29.65	Psn
1.004542	Cs

0.005	VH
605	Ts
1.739252	
0.005	VH
625	Ts
1.767766	
0.008	
630	
2.244994	
0.006	
610	
1.913112	
0.01	
645	
2.539685	
0.012	
635	
2.760434	
0.013	
625	
2.850438	
0.016	
670	
3.274141	
0.008	
675	
2.323790	
0.014	
665	
3.051229	
0.014	
660	
3.039736	

0.015	VH
660	Ts
3.146426	
0.01	VH
680	Ts
2.607680	
0.011	
640	
2.653299	
0.013	
645	
2.895686	
0.011	
640	
2.653299	
0.01	
645	
2.539685	
0.011	
655	
2.684213	
0.011	
650	
2.673948	
0.01	
645	
2.539685	

2.594924	Ka
0.84	Cp
6.390621	Vo
1.17	As
448.621560	Qo
530	Tstd
646	Ts
29.65	Psn
354.772086	Qos
646	Ts
530	Tstd
29.65	Psn
60	T
0.00136	An
6.403345	Vn
100.199104	I
99.5	Pt
0.061805	Co
0.4	N
1.854150	C
0.187933	PMRp
99.5	Pt
1.17	As
60	T
0.00136	An
0.188544	PMRar
0.188238	PMRavg
0.4	N
1.857057	C'

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SUBJECT FIREPLACE EMISSIONS RUN #15 80-5

30.331	VOLm	0.01	VH	0.017	VH		
29.74	Pm	710	Ts	660	Ts	3.000070	K_a
530	Tstd	2.664502		3.349626			
556	Tm					0.838	C_p
		0.012	VH	0.015	VH	7.356127	V_o
28.736704	VOLstd	690	Ts	630	Ts	1.17	A_s
		2.877498		3.074005			
0.6797	VOLw					516.400000	Q_o
		0.01		0.015			
2.310400	M	700		655		530	T_{std}
		2.645751		3.134485		653	T_s
0.976896	MF					29.68	P_{sn}
28.92	Wd	0.01		0.015			
		670		640		403.075976	Q_{os}
28.667704	Ww	2.588435		3.098386			
		0.011		0.015		658	T_s
1.004911	Cd	655		638		530	T_{std}
29.68	Psn	2.684213		3.093541		29.68	P_{sn}
						60	T
1.004034	Cs	0.013		0.015		0.00136	A_n
		660		645			
		2.929163		3.110466		7.520122	V_n
						102.229366	I
		0.014		0.015			
		655		650		93.7	P_t
		3.028200		3.122498		0.050210	C_o
		0.016		0.016			
		635		655		0.4	N
		3.187475		3.237282		1.506300	C
		0.013		0.015			
		640		665		0.173463	PMRp
		2.884441		3.150322		93.7	P_t
						1.17	A_s
		0.013				60	T
		645				0.00136	A_n
		2.895606					
						0.177554	PMR_{ar}
		0.016					
		655				0.175503	PMR_{avg}
		3.237282					
						0.4	N
						1.000975	C'

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SUBJECT FIREPLACE EMISSIONS RUN #16 81-5

24.538	VOLm
29.74	Pm
530	Tstd
537	Tm
24.072440	VOLstd
0.694	VOLw
2.802100	M
0.971979	MF
28.90	Wd
28.594571	Ww
1.006195	Cd
29.70	Psn
1.003696	Cs

0.008	VH
634	Ts
2.252110	
0.01	VH
648	Ts
2.545584	
0.012	
638	
2.766947	
0.011	
629	
2.630399	
0.007	
615	
2.074849	
0.013	
650	
2.906886	
0.015	
640	
3.098386	
0.014	
638	
2.988645	
0.008	
638	
2.259203	
0.011	
638	
2.649150	
0.013	
638	
2.879930	

0.014	VH
640	Ts
2.993325	
0.006	VH
650	Ts
1.974841	
0.01	
649	
2.547547	
0.012	
647	
2.786395	
0.012	
650	
2.792848	
0.007	
645	
2.124852	
0.009	
640	
2.400000	
0.009	
630	
2.381176	
0.012	
633	
2.756084	

2.590457	K_a
0.823	C_p
6.243933	V_o
1.170	A_s
438.324060	Q_o
530	T_{std}
640	T_s
29.70	P_{sn}
350.221615	Q_{os}
640	T_s
530	T_{std}
29.70	P_{sn}
60	T
0.00136	A_n
6.153615	V_n
98.553507	I
69.4	P_t
0.044397	C_o
0.567	N
0.939619	C
0.133268	PMRp
69.4	P_t
1.170	A_s
.60	T
0.00136	A_n
0.131507	PMR_{ar}
0.132387	PMR_{avg}
0.567	N
0.933354	C'

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SUBJECT IMPACTOR RUN #17

2.797	VOLm
29.72	Pm
530	Tstd
539	Tm
2.731918	VOLstd
0.035	VOLw
1.264900	M
0.987351	MF
28.95	Wd
28.011493	Ww
1.002400	Cd
29.72	Psn
1.003358	Cs

0.02	VH
685	Ts
3.701351	
0.018	VH
685	Ts
3.511409	
0.016	
680	
3.298484	
0.018	
670	
3.472751	
0.016	
660	
3.049615	
0.015	
655	
3.134485	
0.015	VH
650	Ts
3.102400	
0.013	VH
640	
2.864441	Ts
0.015	
641	
3.100006	
0.014	
640	
2.993325	
0.015	
635	
3.086259	
0.015	
637	
3.091116	

3.000545	K_a
0.042	C_p
7.000266	V_o
1.17	A_s
555.830586	Q_o
530	T_{std}
656	T_s
29.72	P_{sn}
439.950682	Q_{os}
656	T_s
530	T_{std}
29.72	P_{sn}
30	T
0.000085	A_n
22.534313	V_n
284.910221	I
	P_t
	C_o
	N
	C
	PMRp
	P_t
	A_s
	T
	A_n
	PMR_{ar}
	PMR_{avg}
	N
	C'

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SUBJECT FIREPLACE EMISSIONS RUN NO. 18 83-5

33.73	VOLm
29.77	Pm
530	Tstd
560	Tm
31.762993	VOLstd
0.78684	VOLw
2.417300	M
0.975827	MF
28.87	Wd
28.607239	Ww
1.005972	Cd
29.70	Psn
1.003696	Cs

0.005	VH
640	Ts
1.788854	
0.014	VH
650	Ts
3.016620	
0.015	
650	
3.122498	
0.015	
660	
3.146426	
0.013	
630	
2.861817	
0.014	
635	
2.981610	
0.017	
660	
3.349626	
0.019	
662	
3.546547	
0.014	
662	
3.044339	
0.015	
660	
3.146426	
0.018	
660	
3.446737	

0.020	VH
665	Ts
3.646916	
0.02	VH
660	Ts
3.633130	
0.019	
660	
3.541186	
0.021	
658	
3.717257	
0.021	
645	
3.680353	
0.015	
655	
3.134485	
0.017	
665	
3.362290	
0.015	
658	
3.141655	
0.016	
660	
3.249615	

3.227921	K_a
0.863	C_p
8.156797	V_o
1.17	A_s
572.607120	Q_o
530	T_{std}
655	T_s
29.7	P_{sn}
448.806360	Q_{os}
655	T_s
530	T_{std}
29.70	P_{sn}
60	T
0.00136	A_n
8.277083	V_n
101.474671	I
99.5	P_t
0.048241	C_o
0.4	N
1.447230	C
0.185569	PMRp
99.5	P_t
1.17	A_s
60	T
0.00136	A_n
0.188544	PMR_{ar}
0.187056	PMRavg
0.4	N
1.458747	C'

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SUBJECT FIREPLACE EMISSIONS RUN # 19 84-5

26.706	VOLm	0.006	VH	0.021	VH		
29.08	Pm	705	Ts	709	Ts	3.304418	K_a
530	Tstd	2.056696		4.047221			
538	Tm					0.063	C_p
		0.006	VH	0.016	VH	0.346924	V_o
26.273712	VOLstd	677	Ts	720	Ts	1.17	A_s
		2.015440		3.394112			
0.815	VOLw					505.954060	Q_o
		0.02		0.016			
		750		705		530	T_{std}
3.008600	M	3.872983		3.350571		717	T_s
0.969914	MF					29.82	P_{sn}
28.84	Wd	0.02		0.017			
		735		605			
28.513867	Ww	3.834057		3.412477		418.696719	Q_{os}
		0.011		0.016		717	T_s
1.007618	Cd	685		675		530	T_{std}
29.32	Psn	2.744995		3.286335		29.82	P_{sn}
						57	T
1.001675	Cs	0.021		0.008		0.00136	A_n
		740		695			
		3.942080		2.357965		7.005330	V_n
						94.709500	I
		0.025		0.011			
		745		705		64.4	P_t
		4.315669		2.784700		0.049469	C_o
		0.025		0.01			
		730		695		0.2	N
		4.272001		2.636085		2.960140	C
		0.013					
		717				0.177526	PMRp
		3.053031				64.4	P_t
						1.17	A_s
		0.015				57	T
		690				0.00136	A_n
		3.217141					
						0.168348	PMR_{ar}
		0.022					
		795				0.172937	PMR_{avg}
		4.182104					
						0.2	N
						0.991255	C'

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SUBJECT FIREPLACE EMISSIONS RUN # 20 85-5

18.337	VOLm
29.9	Pm
530	Tstd
540	Tm
17.985395	VOLstd
0.559	VOLw
3.014300	M
0.969857	MF
28.33	Wd
28.018622	Ww
1.016484	Cd
29.85	Psn
1.001171	Cs

0.01	VH
680	Ts
2.607680	
0.014	VH
680	Ts
3.085449	
0.015	
685	
3.205464	
0.016	
680	
3.298484	
0.011	
667	
2.708689	
0.015	
680	
3.193743	
0.023	
695	
3.998124	
0.021	
710	
3.861346	
0.01	
677	
2.601922	
0.011	
677	
2.728919	
0.015	
680	
3.193743	

0.015	VH
672	Ts
3.174901	
0.01	VH
705	Ts
2.655183	
0.013	
720	
3.059411	
0.016	
720	
3.394112	
0.016	
710	
3.370459	
0.009	
685	
2.482941	
0.011	
670	
2.714774	
0.013	
695	
3.005827	
0.011	
669	
2.712747	

3.052695	K_a
0.823	C_p
7.414636	V_o
1.17	A_s
520.507440	Q_o
530	T_{std}
688	T_s
29.85	P_{sn}
387.975966	Q_{os}
688	T_s
530	T_{std}
29.85	P_{sn}
40	T
0.00136	A_n
7.392500	V_n
99.701455	I
70.8	P_t
0.060622	C_o
0.2	N
3.637320	C
0.201588	PMRp
70.8	P_t
1.17	A_s
40	T
0.00136	A_n
0.201240	PMR_{ar}
0.201414	PMR_{avg}
0.2	N
3.633980	C'

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JOB NAME EPA FIREPLACE DATE 19 AUGUST 1975

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SUBJECT FIREPLACE EMISSIONS RUN # 21 86-5

21.9	VOLm	0.007	VH	0.015	VH		
89.87	Pm	690	Ts	670	Ts	0.844832	Ka
530	Tstd	2.197726		3.109043			
547	Tm					0.838	Cp
		0.01	VH	0.011	VH	7.005101	Vo
21.163918	VOLstd	670	Ts	665	Ts	1.17	As
		2.538435		2.704625			
0.592	VOLw					491.750000	Qo
		0.011		0.011			
2.716509	M	660		650		530	Tstd
		2.694433		2.673048		679	Ts
0.972815	MF					29.82	Psn
28.58	Wd	0.015		0.014			
		665		670			
20.292302	Ww	3.158322		3.062678		372.163611	Qos
1.011554	Cd	0.01		0.015		679	Ts
29.82	Psn	690		685		530	Tstd
		2.626785		3.205464		29.82	Psn
1.001675	Cs					50	T
		0.014		0.008		0.00136	An
		695		665			
		3.119294		2.306512		6.660625	Vn
						97.337560	I
		0.014		0.012			
		680		695			Pt
		3.085449		2.887905			Co
		0.014		0.012			
		675		710			N
		3.074005		2.910903			C
		0.01		0.013			PMRp
		665		710			Pt
		2.570759		3.030021			As
							T
		0.01					An
		660					
		2.560046					PMRar
		0.015					
		690					PMRavg
		3.817141					N
							C'

VALENTINE, FISHER & TOMLINSON
CONSULTING ENGINEERS

COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME E.P.A. FIREPLACE DATE 20 AUGUST 1975

PREPARED BY SWANSON APPROVED PAGE 1 OF 1

SUBJECT FIREPLACE EMISSIONS RUN #22 87-5

20·301	VOLm
30·23	Pm
530	Tstd
536	Tm
20·281733	VOLstd
0·692	VOLw
3·299300	M
0·967007	MF
28·95	Wd
28·588726	Ww
1·006298	Cd
30·2	Psn
0·995353	Cs

0·005	VH
640	Ts
1·788854	
0·008	VH
665	Ts
2·306512	
0·01	
645	
2·539685	
0·008	
770	
2·481934	
0·008	
760	
2·465765	
0·008	
755	
2·457641	
0·009	
745	
2·589401	
0·011	
735	
2·843413	
0·006	
730	
2·416609	
0·009	
707	
2·522498	
0·01	
745	
2·729468	

0·011	VH
740	Ts
2·853068	
0·008	VH
772	Ts
2·485155	
0·011	
750	
2·872281	
0·01	
745	
2·729468	
0·009	
750	
2·598076	
0·006	
730	
2·092844	
0·006	
710	
2·063976	
0·007	
820	
2·395829	
0·009	
825	
2·724885	

2·497868	Ka
0·838	Cp
6·080160	Vo
1·17	As
426·827220	Qo
530	Tstd
737	Ts
30·20	Psn
299·595619	Qos
737	Ts
530	Tstd
30·2	Psn
60	T
0·00136	An
5·901740	Vn
97·065537	I
171·3	Pt
0·130068	Co
1·0	N
1·560816	C
0·333993	PMRp
171·3	Pt
1·17	As
60	T
0·00136	An
0·324599	PMRar
0·329296	PMRavg
1·0	N
1·538788	C'

VALENTINE, FISHER & TOMLINSON
CONSULTING ENGINEERS

COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME E.P.A. FIREPLACE DATE 20 AUGUST, 1975

PREPARED BY SWANSON APPROVED PAGE 1 OF 1

SUBJECT FIREPLACE EMISSIONS RUN #23 88-5

22.278	VOLm
29.86	Pm
530	Tstd
546	Tm
21.581798	VOLstd
0.616	VOLw
2.775000	M
0.972250	MF
28.89	Wd
28.587802	Ww
1.006314	Cd
29.81	Psn
1.001843	Cs

0.01	VH
670	Ts
2.588435	
0.012	VH
665	Ts
2.824089	
0.013	
660	
2.929163	
0.014	
657	
3.032820	
0.009	
645	
2.409356	
0.011	
630	
2.632489	
0.016	
695	
3.334666	
0.017	
685	
3.412477	
0.011	
680	
2.734958	
0.011	
665	
2.704625	
0.016	
660	
3.249615	

0.015	VH
662	Ts
3.151190	
0.011	VH
710	Ts
2.794637	
0.016	
730	
3.417601	
0.016	
735	
3.429285	
0.015	
720	
3.286335	
0.009	
695	
2.500999	
0.01	
695	
2.636285	
0.01	
685	
2.617250	
0.01	
677	
2.601922	

2.914449	K_a
0.84	C_p
7.157500	V_o
1.17	A_s
500.462620	Q_o
530	T_{std}
681	T_s
29.81	P_{sn}
378.800770	Q_{os}
681	T_s
530	T_{std}
29.81	P_{sn}
50	T
0.00136	A_n
7.016495	V_n
98.028763	I
70.3	P_t
0.050163	C_o
0.5	N
1.203912	C
0.162864	PMRp
70.3	P_t
1.17	A_s
50	T
0.00136	A_n
0.159855	PMR_{ar}
0.161359	PMRavg
0.5	N
1.192724	C'

VALENTINE, FISHER & TOMLINSON
CONSULTING ENGINEERS

COMPUTER PRINT-OUT OF ATMOSPHERIC EMISSION DATA

JOB NAME EPA FIREPLACE DATE

PREPARED BY D. ALGUARD APPROVED PAGE OF

SUBJECT IMPACTOR PARTICLE SIZE RUN #24

2.416	VOLm	0.014	VH	0.014	VH		
29.792	Pm	695	Ts	665	Ts	3.001042	K_a
530	Tstd	3.119294		3.051229			
548	Tm					0.838	C_p
		0.015	VH	0.014	VH	7.353021	V_o
2.326646	VOLstd	697	Ts	657	Ts	1.17	A_s
		3.233419		3.032820			
0.0758	VOLw					516.182040	Q_o
		0.015		0.013			
3.155100	M	688		655			
		3.212475		2.918047		530	T_{std}
0.968449	MF					667	T_s
28.95	Wd	0.014		0.012		29.79	P_{sn}
		688		647			
28.604516	Ww	3.103546		2.786395		395.492810	Q_{os}
1.006020	Cd	0.014		0.012		667	T_s
29.79	Psn	675		642		530	T_{std}
		3.074085		2.775608		29.79	P_{sn}
1.002179	Cs					30	T
		0.014		0.011		0.0000852	A_n
		670		635			
		3.062678		2.642915		19.800665	V_n
						269.286120	I
							P_t
							C_o
							N
							C
							PMRp
							P_t
							A_s
							T
							A_n
							PMR_{ar}
							PMR_{avg}
							N
							C′

APPENDIX L

Data Sheets

This appendix contains Field Data Sheets with corresponding Moisture Determination Sheet, Laboratory Analysis and Total Particulate Sheet, and Oreat Data and Calculation Sheet for all particulate and POM samples. Field Data and Moisture Determination Sheets for the particle sizing runs are included also.

Pages are ordered by run number.

Start Up + Stable

64-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA- FIREPLACE
PORT LOCATION Stack Extension
DATE 29 JULY
OPERATOR/S SWANSON/ALGUARD
RUN NO. 1 ALDER
SAMPLE & METER BOX NUMBERS VEC &
METER BOX ΔH 1.7897
FILTER NO. 22-5 @ TARE 423.9 mg
CLEAN-UP NO. 15 ; BLANKS ___ & ___
BOX & PROBE HEATER SETTING 300 & 50

LEAK CHECK 0.016 cfm @ 23.5" Hg Vac @ 11:25
WOOD -
8 lb. 11:25
2 lb. 11:35
5 lb. 11:50
B-0 10-5 12:00
3 lb - 12:00
3 lb - 12:20 → 9 lb. remaining @ 12:34

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 30.25 "Hg
AMBIENT CONDITIONS Overcast
PORT PRESSURE (P_S) 0.0 "H_2O = ___ "Hg
$P_{SN} = P_B + P_S$ 30.25 "Hg
ASSUMED MOISTURE 2.0 %
C FACTOR .84
REF. ΔP .045 .043 (B-4) .098
STACK DIMENSIONS 8¾ x 19¼" AREA 1.170 F2
PROBE NOZZLE DIA. 1/2 IN; A_N .00136 F2
PROBE LENGTH Probe B Side 2 FT. ___ IN.

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F)		BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O)		PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
			INLET	OUTLET					DESIRED	ACTUAL				
11:45	0	596.157	73	72	210	60	A-1	.011	.45	.45	1.5	180	Opac, CO_2	.005
11:47	2	597.07	76	73	225	50	A-2	.02	.82	.80	2.0	185		.005
11:49	4	598.15	78	73	225	50	A-3	.02	.82	.82	2.0	190		.005
11:51	6	599.31	79	73	240	50	A-4	.02	.82	.82	2.0	205		.005
11:53	8	600.41	80	74	250	50	B-1	.015	.67	.70	1.9	205	/	.075
11:55	10	601.46	80	74	250	50	B-2	.015	.62	.62	2.0	205		.075
11:57	12	602.45	81	74	290	48	B-3	.02	.82	.82	2.0	190		.075
11:59	14	603.59	85	75	275	50	B-4	.02	.82	.82	2.0	175		.005
12:03	16	604.69	85	75	230	50	C-1	.01	.43	.40	2.0	200		.005
12:05	18	605.75	85	77	260	51	C-2	.015	.625	.60	2.0	200	15	.005
12:07	20	606.65	86	77	215	50	C-3	.015	.625	.62	2.0	180	1	.005
12:09	22	607.77	87	78	240	52	C-4	.02	.86	.80	2.1	175	1, .25	.005
12:15	24	608.88	87	79	250	58	D-1	.01	.43	.47	1.5	170		.005
12:17	26	609.725	89	80	230	55	D-2	.01	.43	.43	1.5	165		.005
12:19	28	610.56	89	80	215	54	D-3	.015	.65	.57	2.0	160	.25	.005
12:21	30	611.55	90	81	225	55	D-4	.015	.65	.65	2.0	160		.005
12:23	32	612.580	91	82	275	56	E-1	.01	.45	.48	1.5	180		.005
12:28	34	613.41	90	83	250	55	E-2	.01	.45	.45	1.5	165	22, .01	.005
12:30	36	614.37	91	84	250	55	E-3	.015	.69	.60	2.0	190		.015
12:32	38	615.27	92	84	265	55	E-4	.015	.69	.69	2.0	180	2, .25	.015
12:34	40	616.476	92	84	270	55								
TOTAL	40	20.319	1788	1632			20			12.6 "H_2O		3650		
AVERAGE			81 °F = 541 °R						.63 "H_2O = .046 "Hg			182		

$P_m = P_B + ΔH$ = 30.30 "Hg

642 °R

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

64-5

CLIENT EPA FIREPLACE

LOCATION AVERAGE FIREPLACE

OPERATOR SCHANKEN / ALGUARD

SAMPLE BOX YEL

RUN NO. 1

Clean up NO. -

DATE 7/29/75

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)		395.7	2.5
IMPINGER (#2 W/APPROX. 100 ml WATER)		432.4	1.0
BUBBLER (#3 DRY)		341.4	.6
H_2O ABSORBED BY SILICA GEL, ml		610.9	6.1
TOTAL H_2O COLLECTED, ml			10.2
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.48348
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 7-29-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 1

EVALUATION DATE 7-29-75 CLEAN-UP SET NO. 64-5

I. EVAPORATION OF 90 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77406.1 (mg) - TARE 77398.8 (mg)

-BLANK ((.0057 mg/ml) (90 ml) = .5 mg) = 6.8 mg.

II. FILTER CATCH MSA 1106 BH (Media Type)

FINAL 437.7 (mg) - TARE 423.9 (mg) = 13.8 mg.

BACK-UP 183.4 mg - 177.0 mg = 6.4 mg

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 662835 (mg) - TARE 66273.2 (mg)

-BLANK (1.8 mg) = 8.5 mg.

IV. PARTICULATE FROM EVAPORATION OF 210 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 78345.7 (mg) - TARE 78331.8 (mg)

-BLANK ((.4 mg/ml) (210 ml initial

- 10.2 ml CONDENSED = 199.8 ml) = .6 mg) = 13.3 mg.

V. PARTICULATE FROM 155 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77401.1 (mg) - TARE 77385.7 (mg)

-BLANK ((.0057 mg/ml) (155 ml) = .9 mg) = 14.5 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 63.3 mg.

BLANKS

ACETONE = .8 mg/140 ml = .0057 mg/ml FINAL 78536.6 mg. TARE 78535.8 mg.

ETHER-CHLOROFORM = 1.8 mg.(FINAL 79280.7 mg - TARE 79278.9 mg)

WATER = .4 mg/140 ml = .00286 mg/ml. FINAL 76973.4 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE EVAL

SAMPLING POINT LOCATION CHIMNEY OUTLET DURING VELOCITY TRAVERSE

DATE 7/28/75 RUN NO. ONE HOW COLLECTED GREEN BAG

TIME OF SAMPLE COLLECTION 2:30-3307/29 TIME OF ANALYSIS 7:30 7/29/75

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.1	0.0	0.1	
$CO_2 + O_2$	21.0	21.0	21.0	
$CO_2 + O_2 + CO$	21.0	21.0	21.0	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.1	0	.1		.067	44/100	.029
O_2	20.9	21.0	20.9		20.67	32/100	6.614
CO	0	0	0			28/100	0
N_2 (100-Above)	79.1	79.0	79.1		79.067	28/100	22.139
						AVG. MOLECULAR WT. DRY STACK GAS	28.78

VFT/AP4B

Leak rate = .02/min

CRAB BAG #2

65-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION OUTSIDE EXTENSION
DATE 29 July 1975
OPERATOR/S STJANSON / AAGAARD
RUN NO. 2 ALDER
SAMPLE & METER BOX NUMBERS 4
METER BOX ΔH 1.1897
FILTER NO. 23-5 GLASS @ TARE 417.0 mg BU 12-5 176.2mg
CLEAN-UP NO. 13 ; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 300 & 50

approx. 5 lb. remaining from lunch
Wood – 2^{25} – 7 lb.
2^{55} – 8 lb.
15^{12} – 3 lb.
15^{20} – 7 lb. — Remaining
15^{32} – 3 lb. — Added
15^{40} – 6 lb. — "
4 lb. @ 16^{11}
4.5 @ 16^{22}
6.5 @ 16^{32}
8.5 lb. remaining @ 16^{45}

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 30.25 "Hg
AMBIENT CONDITIONS OVERCAST
PORT PRESSURE (P_S) .00 "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 30.25 "Hg
ASSUMED MOISTURE 2.0 %
C FACTOR .85
REF. ΔP .12 .45 (A-2) .9131 .45
STACK DIMENSIONS 3⅝" x 14⅝"; AREA 1.170 F²
PROBE NOZZLE DIA. ½" IN; A_N .00136 F²
PROBE LENGTH 3 FT. ____ IN.

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL						
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
1530	0	618.507	78	77	230	49	A-1	.021	.44	.45	1.1	230	
1533	3	620.02	80	77	275	43	A-2	.015	.66	.6[illegible]	2.0	210	
1536	6	621.59	82	78	275	43	A-3	.015	.62	.63	2.0	230	
1539	9	623.007	84	78	260	44	A-4	.0125	.515	.52	1.5	210	
1542/44	12	624.445	84	79	260	44	B-1	.015	.66	.60	2.0	250	
1547	15	625.92	87	80	250	46	B-2	.015	.66	.66	2.0	250	
1551	18	627.47	89	80	260	43	B-3	.0175	.70	.70	2.0	250	
1553	21	629.09	91	82	280	50	B-4	.02	.83	.84	2.2	[illegible]	
1557/59	24	630.315	94	83	240	52	C-1	.01	.42	.45	1.5	215	
1602	27	632.48	93	84	215	50	C-2	.01	.42	.42	1.5	215	
1605	30	633.69	94	86	245	50	C-3	.015	.62	.61	2.0	207	
1608	33	635.21	96	87	225	51	C-4	.015	.62	.62	2.0	190	
1611/17	36	636.745	97	87	305	50	D-1	.01	.42	.42	1.5	255	
1617	39	637.59	96	89	295	51	D-2	.015	.62	.69	2.0	217	
1620	42	639.05	97	90	250	48	D-3	.015	.62	.62	2.0	215	
1623	45	640.51	100	90	216	44	D-4	.02	.84	.84	2.5	245	
1626/30	48	642.24	99	92	250	49	E-1	.005	.20	.20	1.0	217	
1633	51	643.16	99	92	230	44	E-2	.005	.20	.20	1.0	210	
1636	54	644.02	99	93	230	42	E-3	.005	.20	.20	1.0	210	
1639	57	644.92	100	94	240	43	E-4	.01	.41	.42	2.0	260	
1642	60	646.079	100	94	250	43							
TOTAL	60	27.542	1941	1792			20			10.67 "H_2O		4526	
AVERAGE			89 °F = 549 °R						.53 "H_2O = .039 "Hg			226	

$P_m = P_B + \Delta H$ = 30.29 "Hg

686 °R

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIBERGLAS — RUN NO. 2

LOCATION AVERAGE FIBERAGE — NO. 65-5

OPERATOR SWANSON / ALGUARD — DATE 7/29/75

SAMPLE BOX GRN

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	451.0	447.5	3.5
IMPINGER (#2 W/APPROX. 100 ml WATER)	446.6	445.2	1.4
BUBBLER (#3 DRY)	327.4	~~320~~ 326.6	0.8
H_2O ABSORBED BY SILICA GEL, ml	650.2	642.5	7.7
TOTAL H_2O COLLECTED, ml			13.4
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.63516
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT E.P.A. FIREPLACE DATE OF ANALYSIS 7-29-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 2

EVALUATION DATE 7-29-75 CLEAN-UP SET NO. 65-5

I. EVAPORATION OF 145 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 788432 (mg) - TARE 78825.8 (mg)

-BLANK ((.0057 mg/ml) (145 ml) = 0.8 mg) = 16.6 mg.

II. FILTER CATCH 1106 MSA (Media Type)

FINAL 419.4 (mg) - TARE 417.0 (mg) = 2.4 mg.

BACK UP - 177.5 mg - 176.2 mg

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS. = 1.3 mg.

FINAL 794549 (mg) - TARE 79445.9 (mg)

-BLANK (1.8 mg) = 7.2 mg.

IV. PARTICULATE FROM EVAPORATION OF 290 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77418.3 (mg) - TARE 77400.6 (mg)

-BLANK ((.00286 mg/ml) (290 ml initial

- 13.4 ml CONDENSED = 276.6 ml) = 0.8 mg) = 16.9 mg.

V. PARTICULATE FROM 155 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 76732.6 (mg) - TARE 76720.4 (mg)

-BLANK ((.0057 mg/ml) (155 ml) = 0.9 mg) = 11.3 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 55.7 mg.

BLANKS

ACETONE = .8 mg/140 ml = .0057 mg/ml FINAL 78536.6 mg. TARE 78825.8 mg.

ETHER-CHLOROFORM = 1.8 mg. (FINAL 79280.7 mg - TARE 79278.9 mg)

WATER = .4 mg/140 ml = .00286 mg/ml. FINAL 76973.4 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACES

SAMPLING POINT LOCATION STACK - AVERAGE FIREPLACE

DATE 7-29-75 RUN NO. TWO HOW COLLECTED GRAB BAG

TIME OF SAMPLE COLLECTION 1530 - 1642 TIME OF ANALYSIS 7/30/75 16:00

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.7	0.6	0.6	
$CO_2 + O_2$	20.8	20.7	20.7	
$CO_2 + O_2 + CO$	20.8	20.8	20.7	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.7	0.6	0.6		.633	44/100	.279
O_2	20.1	20.1	20.1		20.1	32/100	6.432
CO	0	.1	0		.033	28/100	.009
N_2 (100-Above)	79.2	79.2	79.3		79.233	28/100	22.185
						AVG. MOLECULAR WT. DRY STACK GAS	28.90

VFT/AP4B

Leak rate .01 / min

GRAB BAG # 3

66-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

816. left @ 17 03

416. remaining @ 18 00

BU 11-5 TARE 1785 mg

CLIENT EPA FIREPLACE
PORT LOCATION OUTSIDE EXTENSION
DATE 29 JULY 1975
OPERATOR/S SWANSON / ALGUARD
RUN NO. 3 — SMOKE — ALDER
SAMPLE & METER BOX NUMBERS RED & _____
METER BOX ΔH 1.4897
FILTER NO. 20-5 GA/AS TARE 433.0 mg
CLEAN-UP NO. 14 ; BLANKS _____ & _____
BOX & PROBE HEATER SETTING 300 & 350

BAROMETRIC PRESSURE (P_B) 30.25 "Hg
AMBIENT CONDITIONS CLOUDY
PORT PRESSURE (P_S) -0.0 "H_2O = _____ "Hg
$P_{SN} = P_B + P_S$ 30.25 "Hg
ASSUMED MOISTURE 2.0 %
C FACTOR .85
REF. ΔP .210 .033 (1-1)
STACK DIMENSIONS 8 3/4" x 11 1/2" AREA 1.170 F^2
PROBE NOZZLE DIA. 1/2" Ø IN; A_N .00136 F^2
PROBE LENGTH _____ FT. _____ IN.

SCHEMATIC OF TRAVERSE POINT LAYOUT

Probe #2 side 2+

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL						
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
1703	0 0	646.704	96	94	245	56	E-1	.005	.225	.30	2.5	185	0, 0
1705	2 2	647.49	96	94	260	56	E-2	.005	.225	.20	2.0	175	
1707	4 4	648.11	96	94	275	56	E-3	.0075	.35	.35	2.0	185	
1709	6 6	648.87	96	94	235	48	E-4	.0075	.35	.35	2.0	180	0, 0
1711/14	8 8	649.765	96	94	215	48	D-1	.005	.225	.25	1.0	170	
1716	10 10	650.31	96	94	210	48	D-2	.0075	.35	.35	1.5	165	
1718	12 12	651.07	96	94	275	48	D-3	.01	.46	.46	1.5	160	0, 0
1720	14 14	651.96	97	94	300	48	D-4	.01	.46	.46	1.5	165	
1722/24	16 16	652.815	97	94	220	47	C-1	.005	.225	.225	1.0	162	
1725	18 18	653.91	98	94	240	46	C-2	.0075	.345	.33	1.0	155	
1727	20 20	654.73	98	94	265	46	C-3	.0075	.345	.345	1.0	155	
1729	22 22	654.89	98	94	275	47	C-4	.0075	.345	.345	1.0	150	
1731/34	24 24	655.69	97	94	280	51	B-1	.005	.225	.225	1.0	141	2, 0
1735	26 26	656.29	97	95	272	49	B-2	.005	.225	.225	1.0	141	
1740	28 28	656.91	97	95	300	50	B-3	.005	.225	.225	1.0	136	3, 0
1742	30 30	657.53	97	95	245	47	B-4	.0075	.345	.33	1.0	134	
1744/48	32 32	658.30	97	95	220	55	A-1	.005	.24	.24	1.0	126	3, 0
1750	34 34	658.91	97	95	270	50	A-2	.005	.24	.24	1.0	125	
1752	36 36	659.56	97	95	295	50	A-3	.0075	.36	.36	1.0	123	
1754	38 38	660.33	98	95	256	48	A-4	.0075	.36	.36	1.0	120	
1756	40 40	661.132	98	95	260	48							
TOTAL	40	14.428	2035	1982						6.17 "H_2O		3053	
AVERAGE			96 °F = 556 °R						-.31 "H_2O = .023 "Hg			153	
								Pm = P_B + ΔH = 30.27 "Hg				613 °R	

61
70
9

VFT/APIE

91

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE

RUN NO. 3

LOCATION AVOCADO FIREPLACE

NO. 66-5

OPERATOR SCHANSON / ALLCARD

DATE 7/29/75

SAMPLE BOX EED

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	431.9	435.2	-3.3
IMPINGER (#2 W/APPROX. 100 ml WATER)	448.9	443.2	5.7
BUBBLER (#3 DRY)	365.8	364.3	1.5
H_2O ABSORBED BY SILICA GEL, ml	665.3	661.3	4.0
TOTAL H_2O COLLECTED, ml			0.37446
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 7-29-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 3

EVALUATION DATE 7-29-75 CLEAN-UP SET NO. 66-5

I. EVAPORATION OF 80 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77431.4 (mg) - TARE 77426.3 (mg)

-BLANK ((.0057 mg/ml) (80 ml) = 0.4 mg) = 4.7 mg.

II. FILTER CATCH 1106 MSA (Media Type)

FINAL 448.2 (mg) - TARE 433.0 (mg) = 15.2 mg.

BACK UP - 182.9 mg. - 178.5 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS. = 4.4 mg.

FINAL 77497.4 (mg) - TARE 77494.3 (mg)

-BLANK (1.8 mg) = 1.3 mg.

IV. PARTICULATE FROM EVAPORATION OF 240 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77423.6 (mg) - TARE 77420.9 (mg)

-BLANK ((.00286 mg/ml) (240 ml initial

- 4.0 ml CONDENSED = 236 ml) = 0.7 mg) = 2.0 mg.

V. PARTICULATE FROM 90 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 80279.7 (mg) - TARE 80273.2 (mg)

-BLANK ((.0057 mg/ml) (90 ml) = .5 mg) = 6.0 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 33.6 mg.

BLANKS

ACETONE = .8 mg/140 ml = .0057 mg/ml FINAL 78536.6 mg. TARE 78535.8 mg.

ETHER-CHLOROFORM = 1.8 mg.(FINAL 79280.7 mg - TARE 79279.9 mg)

WATER = .4 mg/140 ml = .00286 mg/ml. FINAL 76973.4 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION METER DISCHARGE

DATE 29 July 1975 RUN NO. THREE HOW COLLECTED GRAB BAG

TIME OF SAMPLE COLLECTION 1703 - 1756 TIME OF ANALYSIS 30 July 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.1	0.0	0.1	
$CO_2 + O_2$	20.7	20.7	20.6	
$CO_2 + O_2 + CO$	20.7	20.7	20.6	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.1	0.0	0.1		.067	44/100	.029
O_2	20.6	20.7	20.5		20.6	32/100	6.592
CO	0.0	0.0	0.0		0.0	28/100	0
N_2 (100-Above)	79.3	79.3	79.4		79.333	28/100	22.213
						AVG. MOLECULAR WT. DRY STACK GAS	28.83

VFT/AP4B

START UP OF FIRE — GRAB BAG NO. 4

LEAK RATE .02 @ 24"

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

68-5

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIRE RACE
PORT LOCATION Stack extension
DATE July 30, 1975
OPERATOR/S Swanson / Alguard
RUN NO. 4 ALDER START UP
SAMPLE & METER BOX NUMBERS GRN & 1
METER BOX ΔH 1.4897
FILTER NO. 29-5 @ TARE 426.6 B.U. #14-5 mg 100.2 mg
CLEAN-UP NO. ____; BLANKS ____ & ____
BOX & PROBE HEATER SETTING ____ & ____

1005
11.5 lb. @ 10 15
7.0 @ 10 27
5.0 @ 10 36
3.0 @ 10 48
5.0 @ 11 03
12.0 remaining @ completion of run

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 29.81 "Hg
AMBIENT CONDITIONS Cloudy 65°
PORT PRESSURE (P_S) 0 "H_2O = 0 "Hg
$P_{SN} = P_B + P_S$ 29.81 "Hg
ASSUMED MOISTURE 1½ %
C FACTOR .82
REF. ΔP .07 .072 .046
STACK DIMENSIONS 8¾ x 11½" AREA 1.170 F^2 Probe 2
PROBE NOZZLE DIA. ½ IN; A_N .00136 F^2 Side 1
PROBE LENGTH 3 FT. ____ IN.

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL							REF "P" PITOT C2
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
1015	0	661.621	67	64	215	45								.01
1017	2	662.23	67	64	250	43	A-1	.005	.225	.225	1.0	200	.5	.01
1019	4	662.88	68	64	265	42	A-2	.0075	.32	.30	1.0	230		.015
1021	6	663.75	69	65	275	42	A-3	.0075	.32	.32	1.0	240		.01
1021/25	8	664.51	70	65	240	43	A-4	.015	.61	.58	1.5	250	.5	.01
1027	10	665.29	71	65	210	43	B-1	.01	.41	.41	1.2	200		.01
1029	12	661.12	72	65	210	42	B-2	.01	.41	.41	1.2	235	.6	.02
1031	14	667.30	74	66	235	42	B-3	.02	.82	.80	2.0	294	.5	.02
1033/35	16	668.325	75	67	300	43	B-4	.02	.82	.82	2.1	275		.015
1037	18	668.85	25	68	290	43	C-1	.0075	.3	.3	1.0	245		.015
1039	20	669.89	76	69	265	43	C-2	.0075	.3	.3	1.5	240	.1	.015
1041	22	670.61	27	70	232	45	C-3	.0125	.5	.5	1.5	235		.01
1043/47	24	671.61	28	71	200	50	C-4	.015	.62	.60	2.0	235	.1	.01
1049	26	672.23	79	72	205	48	D-1	.0075	.3	.3	1.2	210		.01
1051	28	672.91	79	73	250	43	D-2	.005	.2	.22	1.0	250		.01
1053	30	673.68	80	73	280	46	D-3	.012	.485	.480	1.5	235		.01
1055/59	33	674.42	80	75	300	49	D-4	.0075	.3	.31	1.2	215	.5	.01
1058	34	674.98	81	75	290	46	E-1	.005	.2	.2	1.0	250	.6	.01
1100	36	675.64	82	76	265	47	E-2	.0075	.31	.30	1.3	230	.4	.01
1102	38	676.34	83	77	240	47	E-3	.0075	.31	.31	1.2	215		.01
1104	40	677.042	83	77	250	47	E-4	.0075	.31	.31	1.2	210	.5	.01
TOTAL	40	15.421	1586	1461			20			8.0 "H_2O		4744		
AVERAGE			72 °F = 532 °R						0.4 "H_2O = .03 "Hg			237		
								$P_m = P_B + \Delta H$ = 29.84 "Hg				697 °R		

VFT/APIE

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VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREMARKS — RUN NO. 4

LOCATION BUECHER FOREMAN — NO. 685

OPERATOR SWANSON / ALGUARD — DATE 7/30/75

SAMPLE BOX GREEN

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	431.2	428.1	3.1
IMPINGER (#2 W/APPROX. 100 ml WATER)	452.6	451.6	1.0
BUBBLER (#3 DRY)	350.2	~~351.4~~ 350.1	0.1
H_2O ABSORBED BY SILICA GEL, ml	654.7	650.2	4.5
TOTAL H_2O COLLECTED, ml			8.7
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.41238
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 7-30-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 4

EVALUATION DATE 7-30-75 CLEAN-UP SET NO. 68-5

I. EVAPORATION OF 45 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77124.4 (mg) - TARE 77117.6 (mg)

-BLANK ((.0057 mg/ml) (45 ml) = 0.2 mg) = 6.6 mg.

II. FILTER CATCH MSA 1106 BH (Media Type)

FINAL 439.8 (mg) - TARE 426.6 (mg) = 13.2 mg.

BACK UP 193.8 mg - 180.2 mg = 13.6 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 65461.6 (mg) - TARE 65440.1 (mg)

-BLANK (1.8 mg) = 19.7 mg.

IV. PARTICULATE FROM EVAPORATION OF 210 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 76796.2 (mg) - TARE 76784.4 (mg)

-BLANK ((.00286 mg/ml) (210 ml initial

- 8.7 ml CONDENSED = 201.3 ml) = .6 mg) = 11.2 mg.

V. PARTICULATE FROM 80 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 78286.2 (mg) - TARE 78243.9 (mg)

-BLANK ((.0057 mg/ml) (80 ml) = .4 mg) = 41.9 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 106.2 mg.

BLANKS

ACETONE = .8 mg/ 140 ml = .0057 mg/ml FINAL 78536.6 mg. TARE 78535.8 mg.

ETHER-CHLOROFORM = 1.8 mg.(FINAL 79287 mg - TARE 79278.9 mg)

WATER = .4 mg/ 140 ml = .00286 mg/ml. FINAL 76973.4 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION METER DISCHARGE

DATE July 30, 1975 RUN NO. 4 HOW COLLECTED GRAB BAG

TIME OF SAMPLE COLLECTION 10^15 - 11^01 TIME OF ANALYSIS July 31, AM

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.7	0.5	0.6	0.7
$CO_2 + O_2$	20.6	20.6	20.6	20.6
$CO_2 + O_2 + CO$	20.6	20.6	20.6	20.6

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.7	.5	.6	.7	.625	44/100	.275
O_2	19.9	20.1	20.0	19.9	19.975	32/100	6.392
CO	0.0	0.0	0.0	0.0	0.0	28/100	0.0
N_2 (100-Above)	79.4	79.4	79.4	79.4	79.4	28/100	22.232
						AVG. MOLECULAR WT. DRY STACK GAS	28.90

IMPACTOR

67-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON
TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION AVERAGE FIREPLACE @ HAMILTON RESIDENCE
DATE 7/30/75
OPERATOR/S SWANSON, ALGORD
RUN NO. 4 PART SIZE 5 ALDER
SAMPLE & METER BOX NUMBERS ORIG & 1
METER BOX ΔH 1.4897
FILTER NO. 13-5 & 66 TARE 16-C mg BW 3-5
CLEAN-UP NO 67-5; BLANKS — & —
BOX & PROBE HEATER SETTING 300 & 60

START WOOD 10# @ 1:05
TEST START @ 1:30
+4# 1:35
STOP 7# REMAIN 6

BAROMETRIC PRESSURE (P_B) 29.81 "Hg
AMBIENT CONDITIONS CLOUDY 70°
PORT PRESSURE (P_S) 0 "H_2O = 0 "Hg
$P_{SN} = P_B + P_S$ — "Hg
ASSUMED MOISTURE 14 %
C FACTOR — Not Req'd
REF. ΔP —
STACK DIMENSIONS 8¾ DIA; AREA 1.170 F2
PROBE NOZZLE DIA. ¼ IN; A_N .000852 F2
PROBE LENGTH 3 FT. — IN.

SCHEMATIC OF TRAVERSE POINT LAYOUT

#14 5-1
Ref Pitot
C-B
.015
.02
.02

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL						
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
1330	0	677.402	74	72	235								
1332	2	677.67	74	72	236	56	B.3	.08	TO	.03	5.0	170	.02
1334	4	677.9	74	72	235	56	"	.025		.04	5.0	165	.02
1336	6	678.13	73	72	250	56	"	.04		.04	5.0	176	
1338	8	678.37	75	73	259	55	"	.04		.04	5.0	227	.02
1340	10	678.6	74	72	255	55	"	.065		.04	5.0	227	.02
1342	12	678.82	74	73	260	54	"	.06		.04	5.0	215	.02
1344	14	679.03	74	73	250	54	"	.03		.04	5.0	210	.015
1346	16	679.25	74	74	250	54	"	.06		.04	5.0	200	.015
1348	18	679.48	74	74	250	54	"	.05		.03	5.0	190	.015
1350	20	679.70	74	74	255	54	"	.05		.04	5.0	187	.015
												196	
TOTAL	20	2.28	812	801			1			.38 "H_2O		196.7	
AVERAGE			73 °F = 533 °R						.04 "H_2O = .0023 "Hg			197	
								$P_M = P_B + \Delta H$ = 29.813 "Hg				657 °R	

66

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

IMPACTOR

CLIENT EPA FIREPLACE

RUN NO. 5

LOCATION ARCOLA FIREPLACE

NO. 67-5

OPERATOR JOHNSON-ARCOLA

DATE 7/30/75

SAMPLE BOX ORANGE

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	415.0	415.3	-.3
IMPINGER (#2 W/APPROX. 100 ml WATER)	435.4	435.7	-.3
BUBBLER (#3 DRY)	334.8	334.7	0.1
H_2O ABSORBED BY SILICA GEL, ml	636.4	635.3	1.1
TOTAL H_2O COLLECTED, ml			0.9
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.0426
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

POM - outlet 130°F

Grab Bags: G - stack; GB - outlet of meter

69-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION OUTSIDE EXTENSION
DATE July 30, 1975
OPERATOR/S SWANSON
RUN NO. 6 ALDER
SAMPLE & METER BOX NUMBERS ___ & No. 1
METER BOX ΔH 1.4897
FILTER NO. 57-5 @ TARE 395.5 mg
CLEAN-UP NO. 695; BLANKS ___ & ___
BOX & PROBE HEATER SETTING 300 & 60

WOOD
2.5 lb. remaining @ 14:35 — 4 lb remaining @ 16:03
7.0 lb. @ 14:35
5.25 lb. @ 14:55
2.5 lb. @ 15:11 — Probe-1
6.0 lb. @ 15:30 — Side-2
2.0 lb. @ 15:56

BAROMETRIC PRESSURE (P_B) 30.62 "Hg
AMBIENT CONDITIONS Partly Cloudy
PORT PRESSURE (P_S) 0 "H_2O = ___ "Hg
$P_{SN} = P_B + P_S$ 30.62 "Hg
ASSUMED MOISTURE 1.5 %
C FACTOR .83
REF. ΔP .47, .44 (D-3), .43 (B-1), 4/5 (A
STACK DIMENSIONS 8¾x14; AREA .670 F2
PROBE NOZZLE DIA. ½" Ø IN; A_N .00136 F2
PROBE LENGTH ___ FT. ___ IN.

SCHEMATIC OF TRAVERSE POINT LAYOUT

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
1500	0	679.81	79	78	310	70	E-1	.015	.59	.58	3.0	245		.01
1503	3	681.25	80	78	270	65	E-2	.015	.59	.59	8.5	220		.01
1506	6	682.69	82	79	235	60	E-3	.0175	.68	.68	9.5	205		.01
1508	9	684.19	84	79	260	58	E-4	.015	.59	.60	9.0	190		.01
1510/14	12	685.725	85	80	292	60	D-1	.01	.39	.39	6.2	207		.01
1517	15	686.92	85	80	240	60	D-2	.015	.59	.59	8.5	207		.015
1520	18	688.39	87	81	275	60	D-3	.0125	.53	.52	3.0	200		.01
1523	21	689.74	89	82	290	60	D-4	.015	.64	.64	9.0	200		.01
1524/28	24	691.28	91	84	230	63	C-1	.01	.425	.43	7.0	180		.01
1531	27	692.51	92	85	265	62	C-2	.015	.64	.64	9.0	230		.01
1534	30	693.97	95	86	300	60	C-3	.027	1.12	1.0	14.0	235		.01
1537	33	695.77	91	88	300	60	C-4	.02	.35	.85	12.0	240		.01
1540/44	36	697.599	101	90	240	62	B-1	.075	.32	.35	5.5	200		.01
1547	39	698.76	100	92	265	62	B-2	.012	.53	.52	8.0	190		.01
1549	42	700.09	102	94	270	62	B-3	.015	.66	.65	10.0	220		.01
1552	45	701.62	103	94	235	60	B-4	.02	.85	.84	11.0	210		.01
1555/56	48	703.485	103	95	265	62	A-1	.01	.435	.44	7.0	230		.01
1559	51	704.62	105	97	261	61	A-2	.012	.52	.50	7.0	207		.01
1602	54	706.54	106	98	265	61	A-3	.015	.650	.64	3.0	195		.01
1605	57	707.51	107	100	278	61	A-4	.015	.65	.65	10.0	192		.01
1608	60	709.117	109	101	278	61								
TOTAL	60	29.307	1978	1841			20			12.08 "H_2O		4209		
AVERAGE			91 °F = 551 °R						0.6 "H_2O = .044 "Hg			210		

$P_m = P_B + \Delta H$ = 30.66 "Hg

670 °R

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA Fireplace — Dow RUN NO. 6

LOCATION Average Fireplace in Sampling Extension NO. 69-5

OPERATOR Swanson-Alcorado DATE Dec 30 1975

SAMPLE BOX Yellow

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)		ABSORBER	
IMPINGER (#2 W/APPROX. 100 ml WATER)	735.2		1.7
BUBBLER (#3 DRY)	342.6		.6
H_2O ABSORBED BY SILICA GEL, ml	626.6		10.1
TOTAL H_2O COLLECTED, ml			12.4
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.58776 ~~0.0776~~
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION AT STACK EXTENSION

DATE July 30, 1975 RUN NO. 6-a HOW COLLECTED GRAB BAG FROM STACK

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS July 31, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	.4	.5	.6	.5
$CO_2 + O_2$	20.8	20.8	20.8	20.8
$CO_2 + O_2 + CO$	20.8	20.8	20.8	20.8

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.4	.5	.6	.5	.5	44/100	.22
O_2	20.4	20.3	20.2	20.3	20.3	32/100	6.496
CO	0.0	0.0	0.0	0.0	0.0	28/100	0
N_2 (100-Above)	79.2	79.2	79.2	79.2	79.2	28/100	22.176
						AVG. MOLECULAR WT. DRY STACK GAS	28.89

VFT/AP4B

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT E.P.A. FIREPLACE

SAMPLING POINT LOCATION METER DISCHARGE

DATE 7/30/75 RUN NO. 6 6 HOW COLLECTED GRAB BAG @ Meter Outlet

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS 7/31/75

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.0	0.0	0.0	
$CO_2 + O_2$	21.0	21.0	20.8	
$CO_2 + O_2 + CO$	21.0	21.0	20.8	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0	0	0			44/100	0.0
O_2	21.0	21.0	20.8		20.933	32/100	6.699
CO	0.0	0.0	0.0		0.0	28/100	0.0
N_2 (100-Above)	79.0	79.0	79.2		79.067	28/100	22.139
						AVG. MOLECULAR WT. DRY STACK GAS	28.84

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 7-30-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 6

EVALUATION DATE 7-30-75 CLEAN-UP SET NO. 69-5

I. EVAPORATION OF 70 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 776721 (mg) - TARE 776640 (mg)

-BLANK ((.0057 mg/ml) (70 ml) = .4 mg) = 7.7 mg.

II. FILTER CATCH _____ # ___ (Media Type & #)

FINAL 399.51 (mg) - TARE 395.5 (mg) = 4.01 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL _____ (mg) - TARE _____ (mg)

-BLANK (_____mg) = — mg.

IV. PARTICULATE FROM EVAPORATION OF _____(ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL _____ (mg) - TARE _____ (mg)

-BLANK ((_____ mg/ml) (_____ ml initial

- _____ml CONDENSED = _____ ml) = _____ mg) = — mg.

V. PARTICULATE FROM _____ (ml) OF _____ RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL _____ (mg) - TARE _____ (mg)

-BLANK ((_____ mg/ml) (_____ml) = _____ mg) = — mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 11.71 mg.

BLANKS

ACETONE = _____ mg/_____ml = _____mg/ml FINAL _____mg. TARE _____ mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____mg/_____ml = _____mg/ml. FINAL _____ mg. TARE _____ mg.

VFT/AP9 A

72-5

Stable Burning

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIRE PLACE
PORT LOCATION OUTSIDE EXTENSION
DATE Aug 4 1975
OPERATOR/S Swanson Valentine
RUN NO. 7 Doug Fir
SAMPLE & METER BOX NUMBERS BLK & No. 3
METER BOX ΔH 1.842
FILTER NO. 28-5 @ TARE 4274 mg → Back up 17-5
CLEAN-UP NO. 72-5; BLANKS ______ & ______
BOX & PROBE HEATER SETTING ______ & ______

Wood:
6½ lb @ 12 23
8 lb @ 12 39
8 lb @ 13 11

3 lb remaining @ 13 59

Probe 1 Side 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 29.61 "Hg
AMBIENT CONDITIONS Clear
PORT PRESSURE (P_S) 0 "H_2O = ______ "Hg
$P_{SN} = P_B + P_S$ 29.61 "Hg
ASSUMED MOISTURE 2.5 %
C FACTOR 1.03
REF. ΔP .035 (A-4), .033, .035 (C-4), .033 E-4
STACK DIMENSIONS [illegible]; AREA 1.170 F²
PROBE NOZZLE DIA. 1/2 IN; A_N .00136 F²
PROBE LENGTH 3 FT. 0 IN.

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)
1240	0	633.189	74	71	225	50
1243	3	634.23	76	71	230	49
1246	6	635.49	79	71	220	42
1249	9	636.79	82	72	280	40
1252/55	12	638.41	81/82	72/73	235	44
1258	15	639.51	95	74	230	44
1301	18	640.95	89	75	255	44
1304	21	642.48	92	76	250	44
1307/11	24	643.64	93/91	77/79	215	50
1314	27	645.28	94	80	290	46
1317	30	646.86	97	80	215	46
1321	33	648.79	101	82	280	46
1324/30	36	650.74	104/98	83/84	240	50
1333	39	652.23	100	85	260	48
1336	42	653.39	101	86	250	48
1339	45	655.01	102	87	220	48
1342/47	48	656.64	106/103	88/89	275	50
1350	51	658.08	104	90	245	50
1353	54	659.49	106	91	260	50
1356	57	661.12	109	91	245	50
1359	60	662.724	111	92	225	50
TOTAL	60	29.535	2359	[illegible]		
AVERAGE			88 °F = 548 °R			

AVERAGE VALUES READ WITHIN THE TIME INTERVAL

POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	Rel pt. C-3 vel
A-1	.0075	.39	.39	1.2	165		.01
A 2	.01	.53	.52	1.5	170		.01
A 3	.012	.64	.62	2.0	165		.01
A 4	.0125	.70	.70	2.0	160		.01
B-1	.01	.56	.57	1.5	170		.015
B 2	.0125	.70	.69	2.0	170		.015
B 3	.015	.85	.83	2.0	160		.01
B 4	.012	.63	.68	2.0	150		.01
C 1	.01	.57	.57	1.5	225		.015
C-2	.015	.85	.83	2.0	220		.015
C-3	.02	1.15	1.10	2.0	225		.015
C-4	.022	1.17	1.15	2.5	205		.015
D-1	.01	.53	.54	1.5	175		.01
D-2	.012	.64	.64	2.0	170		.01
D-3	.015	.81	.81	2.0	165		.01
D-4	.015	.81	.81	2.0	160		.01
E-1	.012	.64	.64	2.0	165		.01
E-2	.012	.64	.64	2.0	165		.01
E-3	.015	.79	.78	2.1	160		.01
E-4	.015	.84	.84	2.1	150		.01
TOTAL [illegible]			[illegible] "H_2O		[illegible]		
AVERAGE		.72 "H_2O = [illegible] "Hg			175		

$P_m = P_B + \Delta H$ = 29.66 "Hg

[illegible] °R

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE — RUN NO. 7

LOCATION OUTSIDE EXTENSION — NO. 72-5

OPERATOR SWANSON — DATE AUG 4 1975

SAMPLE BOX BCK

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (#1 W/APPROX. 100 ml WATER)	418.8	416.6	2.2
IMPINGER (#2 W/APPROX. 100 ml WATER)	438.2	435.8	2.4
BUBBLER (#3 DRY)	335.6	334.5	1.1
H_2O ABSORBED BY SILICA GEL, ml	675.3	666.3	9.0
TOTAL H_2O COLLECTED, ml			14.7
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.69678
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\%\ \text{MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \%\ \text{MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-4-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 7

EVALUATION DATE 8-3-75 CLEAN-UP SET NO. 72-5

I. EVAPORATION OF 90 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 76957.6 (mg) - TARE 76949.6 (mg)

-BLANK ((.0057 mg/ml) (90 ml) = 0.5 mg) = 6.5 mg.

II. FILTER CATCH MSA 1106BH (Media Type)

FINAL 443.7 (mg) - TARE 427.4 (mg) = 16.3 mg.

BACK UP 188.3 mg - 179.5 mg = 8.8 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 77569.6 (mg) - TARE 77557.3 (mg)

-BLANK (1.8 mg) = 10.5 mg.

IV. PARTICULATE FROM EVAPORATION OF 210 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77908.4 (mg) - TARE 77897.2 (mg)

-BLANK ((.00236 mg/ml) (210 ml initial

- 9.0 ml CONDENSED = 201 ml) = 0.6 mg) = 10.6 mg.

V. PARTICULATE FROM 80 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 78786.4 (mg) - TARE 79766.1 (mg)

-BLANK ((.0057 mg/ml) (80 ml) = .4 mg) = 19.8 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 72.5 mg.

BLANKS

ACETONE = .8 mg/140 ml = .0057 mg/ml FINAL 78536.0 mg. TARE 78515.5 mg.

ETHER-CHLOROFORM = 1.8 mg.(FINAL 79280.7 mg - TARE 79270.9 mg)

WATER = .4 mg/140 ml = .0029 mg/ml. FINAL 76973.4 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

72-5

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION EXTENSION ON STACK

DATE Aug 4, 1975 RUN NO. 7 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION $12^{28} - 13^{30}$ TIME OF ANALYSIS Aug 5, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.2	0.2	0.2	
$CO_2 + O_2$	20.6	20.6	20.7	
$CO_2 + O_2 + CO$	20.6	20.6	20.7	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.2	0.2	0.2		.2	44/100	.088
O_2	20.4	20.4	20.5		20.433	32/100	6.539
CO	0.0	0.0	0.0		0.0	28/100	0.0
N_2 (100-Above)	79.4	79.4	79.3		79.367	28/100	22.222
						AVG. MOLECULAR WT. DRY STACK GAS	28.85

373

Leak Rate: .02 ft³/min. @ 24" Hg.

Stable Burning Doug Fir Grab Bag from stack

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

Wood: 516. @ 14²⁰ — 416. @ 14⁴⁰ — 616. @ 15¹⁸ — 6.516. @ 15⁵²

315. remaining @ completion

Feb. 4-14 Stk. 12

CLIENT EPA FIREPLACE
PORT LOCATION OUTSIDE EXTENSION
DATE 4 AUG 1975
OPERATOR/S SWANSON / VALENTINE
RUN NO. 8 Doug Fir
SAMPLE & METER BOX NUMBERS BLU & 3
METER BOX ΔH 1.842
FILTER NO. 29-5 (29-5 BLNP) @ TARE 422.4 mg
CLEAN-UP NO. 73-5; BLANKS ____ & ____
BOX & PROBE HEATER SETTING ____ & ____

BAROMETRIC PRESSURE (P_B) 29.55 "Hg
AMBIENT CONDITIONS Clear
PORT PRESSURE (P_S) 0 "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 29.55 "Hg
ASSUMED MOISTURE 2.5 %
C FACTOR 1.075
REF. ΔP .39
STACK DIMENSIONS 83/4 x 19¾ AREA 1.179 F²
PROBE NOZZLE DIA. 1/2 IN; An .0136 F²
PROBE LENGTH 3 FT. 0 IN.

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	Rel. Pr C-3 VH
1500	0	663.025	95	90	230	60	E-1	.012	.65	.65	1.75	175		.01
1503	3	664.49	98	93	235	55	E-2	.01	.55	.55	1.5	160		.01
1506	6	665.73	99	90	245	50	E-3	.01	.55	.53	1.5	160		.005
1509	9	667.06	101	91	260	55	E-4	.015	.83	.82	2.0	190		.01
1512/15	12	668.697	104/103	92/91	260	55	D-1	.01	.55	.56	1.5	160		
1519	15	669.99	105	93	275	55	D-2	.015	.83	.82	2.1	210		.01
1521	18	671.58	103	94	275	50	D-3	.0175	.94	.92	2.1	190		.01
1523	21	673.32	112	95	280	50	D-4	.020	1.1	1.1	2.5	190		.01
1526/35	24	675.22	115/111	97/99	260	65	C-1	.012	.66	.66	2.0	240		.01
1538	27	676.68	113	100	240	55	C-2	.015	.83	.83	2.0	230		.01
1541	30	678.28	115	100	250	50	C-3	.020	1.1	1.0	2.5	135		.01
1544	33	680.13	119	101	260	50	C-4	.015	.83	.84	2.0	170		.01
1547/55	36	681.84	120/115	102/103	280	60	B-1	.015	.83	.82	2.0	235		.015
1558	39	683.43	118	104	245	55	B-2	.0175	.94	.93	2.2	210		.015
1601	42	685.22	121	105	225	55	B-3	.0175	.94	.94	2.1	210		.015
1604	45	686.88	123	105	245	50	B-4	.022	1.2	1.1	3.0	225		.015
1607/10	48	688.94	124/123	106/107	260	60	A-1	.01	.54	.54	1.5	200		.015
1613	51	690.23	123	107	270	55	A-2	.0125	.68	.68	2.0	175		.015
1616	54	691.71	124	108	270	55	A-3	.0125	.94	.93	2.2	160		.015
1619	57	693.38	126	109	275	55	A-4	.015	.82	.82	2.0	150		.015
1622	60	695.084	127	109	273	55								
TOTAL	60	31.059	2895	2488			20			16.06 "H_2O		3825		
AVERAGE			107 °F = 567 °R						.80 "H_2O = .059 "Hg			191		
								Pm = P_B + ΔH = 29.61 "Hg				651 °R		

VFT/APTE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE

RUN NO. 8 ~~73~~-5

LOCATION OUTSIDE EXTENSION

NO. _____

OPERATOR SWANSON

DATE 4 AUG 75

SAMPLE BOX BLUE

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	430.7	427.1	3.6
IMPINGER (#2 W/APPROX. 100 ml WATER)	446.6	445.8	0.8
BUBBLER (#3 DRY)	337.9	337.7	0.2
H_2O ABSORBED BY SILICA GEL, ml	618.6	610.8	7.8
TOTAL H_2O COLLECTED, ml			12.4
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.59
MOISTURE IN STACK GAS, %			1.8
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-4-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 8

EVALUATION DATE 8-3-75 CLEAN-UP SET NO. 73-5

I. EVAPORATION OF 90 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77266.7 (mg) - TARE 77260.9 (mg)

-BLANK ((.0057 mg/ml) (90 ml) =0.5 mg) = 5.8 mg.

II. FILTER CATCH MSA 1106 BH (Media Type)

FINAL 432.8 (mg) - TARE 422.4 (mg) = 10.4 mg.

BACK UP 193.9 (mg) - 180.2 (mg) = 13.7 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 76912.1 (mg) - TARE 76900.7 (mg)

-BLANK (1.8 mg) = 9.6 mg.

IV. PARTICULATE FROM EVAPORATION OF 240 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 79201.2 (mg) - TARE 79190.2 (mg)

-BLANK ((.00296 mg/ml) (240 ml initial

- 12.4 ml CONDENSED = 227.6 ml) =0.7 mg) = 10.3 mg.

V. PARTICULATE FROM 70 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 79665.9 (mg) - TARE 79644.8 (mg)

-BLANK ((.0057 mg/ml) (70 ml) =0.4 mg) = 20.7 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 70.5 mg.

BLANKS

ACETONE = 0.8 mg/140 ml = .0057 mg/ml FINAL 78530.6 mg. TARE 78535.8 mg.

ETHER-CHLOROFORM = 1.8 mg.(FINAL 79280.7 mg - TARE 79278.9 mg)

WATER = .4 mg/140 ml = .00286 mg/ml. FINAL 76973.4 mg. TARE 76972.6 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

73-5

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION EXTENSION ON STACK

DATE AUG 4, 1975 RUN NO. 8 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION $14^{00} - 16^{09}$ TIME OF ANALYSIS AUG 5, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.4	0.5	0.4	
$CO_2 + O_2$	20.8	20.8	20.8	
$CO_2 + O_2 + CO$	20.8	20.8	20.8	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.4	0.5	0.4		0.433	44/100	.191
O_2	20.4	20.3	20.4		20.367	32/100	6.517
CO	0.0	0.0	0.0		0.0	28/100	
N_2 (100-Above)	79.2	79.2	79.2		79.2	28/100	22.176
						AVG. MOLECULAR WT. DRY STACK GAS	28.88

VFT/AP4B

START UP CONDITIONS WITH DOUGLAS FIR

74-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIRECRAFT
PORT LOCATION OUTSIDE EXTENSION
DATE 6 AUG 75 AMBIENT CONDITIONS 2 VERY COOL
OPERATOR/S SWANSON/VALENTINE
RUN NO. 9
SAMPLE & METER BOX NUMBERS BCK & 3
METER BOX ΔH 1.8-1.2
FILTER NO. 32-5 & TARE 359.0 mg (Blk-23-5)
CLEAN-UP NO. 24-5; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 300 & 50

Wood
5½ lb. Kindling (Alder) @ 950
13 5/16. Doug Fir @ 950
2½ lb. @ 1011
21b. @ 1020
10 lb. @ 1027
Approx. 9 lb. remaining @ end 1103

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 29.72 "Hg
LEAK RATE .02 CFM @ 25 "HG
PORT PRESSURE (P_S) -2 "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 29.72 "Hg
ASSUMED MOISTURE 2.2 % MAX VH ____ "H_2O
C FACTOR 1.04
REF. ΔP .33
STACK DIMENSIONS 33 x 44½ AREA 1.170 F2
PROBE NOZZLE DIA ½" ϕ IN; AN .00136 F2
PROBE LENGTH 3' NUMBER 1 SIDE 2

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)
952	0	695.609	61	58	225	34
955	3	696.430	62	58	265	32
958	6	697.48	64	58	270	30
1001	9	698.79	68	59	240	30
1004/26	12	700.208	71/70	60/60	275	32
1021	15	701.26	72	61	280	30
1012	18	702.14	73	62	230	32
1015	21	703.49	77	63	265	32
1018/21	24	705.108	8/79	65/66	265	36
1024	27	706.19	80	67	245	34
1027	30	707.25	82	68	240	34
1030	33	708.48	85	70	265	34
1033/37	36	709.91	89/85	71/72	225	40
1040	39	710.78	85	73	220	40
1043	42	711.82	87	74	290	40
1046	45	713.21	90	75	225	40
1049/51	48	714.52	92/92	77/77	240	44
1054	51	715.41	90	78	280	42
1057	54	716.25	91	79	245	44
1100	57	717.14	92	80	260	46
1103	60	718.266	94	81	275	46
TOTAL	60	22.657	2009	1722		
AVERAGE			75 °F = 535 °R			

AVERAGE VALUES: READ WITHIN THE TIME INTERVAL

POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	Ref. ΔH Ga Pa. C-3
A-1	.305	.28	.28	1.0	135		.01
A-2	.0275	.42	.42	1.5	250		.035
A-3	.012	.68	.68	2.2	210		.01
A-4	.012	.68	.68	2.0	160		.005
B-1	.2775	.42	.43	1.5	230		.035
B-2	.225	.28	.30	1.0	130		.005
B-3	.012	.68	.67	2.2	165		.01
B-4	.216	.91	.90	2.2	210		.01
C-1	.0272	.42	.43	1.5	210		.01
C-2	.0275	.42	.42	1.5	225		.01
C-3	.21	.56	.55	1.75	195		.01
C-4	.1125	.71	.70	2.2	180		.01
D-1	.005	.28	.28	1.0	215		.01
D-2	.0275	.42	.41	1.2	195		.01
D-3	.012	.68	.68	2.0	195		.01
D-4	.01	.57	.57	2.0	175		.01
E-1	.005	.28	.28	1.2	170		.01
E-2	.005	.28	.28	1.2	165		.01
E-3	.005	.28	.28	1.0	145		.01
E-4	.0275	.42	.42	1.5	155		.01
20	1.[illegible] "H_2O				3[illegible]		
		.48 "H_2O = .0[illegible] "Hg			192		
		$P_m = P_B + \Delta H$ = 29.76 "Hg			642 °R		

* Added Kindling to improve starting

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VFT/APTE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE

RUN NO. 9

LOCATION OUTSIDE EXTENTION

NO. 74-5

OPERATOR SWANSON

DATE 6AUG75

SAMPLE BOX BLK

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	429.1	425.8	3.3
IMPINGER (#2 W/APPROX. 100 ml WATER)	449.6	447.6	2.0
BUBBLER (#3 DRY)	335.5	334.4	1.1
H_2O ABSORBED BY SILICA GEL, ml	670.6	665.8	4.8
TOTAL H_2O COLLECTED, ml			11.2
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.53088
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-7-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 9

EVALUATION DATE 8-6-75 CLEAN-UP SET NO. 74-5

I. EVAPORATION OF 100 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 78780.3 (mg) - TARE 78770.8 (mg)

-BLANK ((.0057 mg/ml) (100 ml) = .6 mg) = 8.9 mg.

II. FILTER CATCH MSH 1106 QH (Media Type)

FINAL 372.0 (mg) - TARE 359.0 (mg) = 13 mg.

BACKUP - 193.5 (mg) - 175.7 (mg) = 17.8 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 79567.5 (mg) - TARE 79557.5 (mg)

-BLANK (1.8 mg) = 8.2 mg.

IV. PARTICULATE FROM EVAPORATION OF 251 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77068.3 (mg) - TARE 77050.4 (mg)

-BLANK ((.00286 mg/ml) (251 ml initial

- 11.2 ml CONDENSED = 239.8 ml) = .7 mg) = 17.2 mg.

V. PARTICULATE FROM 105 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 78119.7 (mg) - TARE 78096.8 (mg)

-BLANK ((.0057 mg/ml) (105 ml) = .6 mg) = 22.3 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 87.4 mg.

BLANKS

ACETONE = 0.8 mg/140 ml = 0.0057 mg/ml FINAL 78536.6 mg. TARE 78535.8 mg.

ETHER-CHLOROFORM = 1.8 mg. (FINAL 79280.7 mg - TARE 79278.9 mg)

WATER = .4 mg/140 ml = .00286 mg/ml. FINAL 76973.4 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

74-5

CLIENT E.P.A. FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG. 6, 1975 RUN NO. 9 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION 952-1103 TIME OF ANALYSIS AUG. 7, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.5	0.6	0.6	
$CO_2 + O_2$	20.9	20.8	20.8	
$CO_2 + O_2 + CO$	21.0	21.0	21.0	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.5	0.6	0.6		0.567	44/100	.249
O_2	20.4	20.2	20.2		20.267	32/100	6.485
CO	.1	.2	.2		.167	28/100	.047
N_2 (100-Above)	79.0	79.0	79.0		79.0	28/100	22.12
						AVG. MOLECULAR WT. DRY STACK GAS	28.90

VFT/AP43

STABLE BURNING DOUG-FIR

75-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION EXTENSION
DATE 6 Aug 75 AMBIENT CONDITIONS Partly Cloudy
OPERATOR/S SWANSON, VALENTINE
RUN NO. 10
SAMPLE & METER BOX NUMBERS PCOE & 3
METER BOX ΔH 1.842
FILTER NO. 31-5 @ TARE 5621 mg
CLEAN-UP NO. 75-5; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 200 & 250

Loads:
6 lb remaining @ 1223
8 lb Doug Fir @ 1225
7 lb. " @ 1317
7 lb. " @ 1345
4 lb remaining @ 1400

BAROMETRIC PRESSURE (P_B) 29.70 "Hg
LEAK RATE .02 CFM @ 25 "HG
PORT PRESSURE (P_S) 0 "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 29.70 "Hg
ASSUMED MOISTURE 6.0 % MAX VH ____ "H_2O
C FACTOR .825
REF. ΔP .037 .037 .037 .037 .037
STACK DIMENSIONS 33"x92" AREA 1.770 F^2
PROBE NOZZLE DIA. 1/2" IN; A_N .00136 F^2
PROBE LENGTH 3' NUMBER 14 SIDE 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES: READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	Ref. # ⊙ C-3
1243	0	719.034	74	70	210	55								
1251	3	719.79	75	70	215	50	E-1	.01	.55	.55	1.5	210		.015
1254	6	721.17	78	70	220	50	E-2	.012	.66	.65	1.5	205		.015
1257	9	722.72	81	71	230	45	E-3	.015	.84	.84	2.0	210		.015
1300/1304	12	724.58	82/82	71/71	250	50	E-4	.020	1.1	1.1	2.2	230		.015
1307	15	726.18	84	73	250	45	D-1	.0175	.94	.92	2.0	250		.020
1310	18	727.63	88	73	255	45	D-2	.0122	.69	.70	1.5	235		.015
1313	21	729.31	91	74	260	45	D-3	.0172	.94	.94	2.0	240		.015
1315/17	24	731.03	91/91	75/75	250	55	D-4	.0175	.95	.95	2.0	170		.015
1320	27	732.22	92	76	260	50	C-1	.01	.55	.55	1.5	215		.020
1323	30	733.83	95	77	250	50	C-2	.015	.84	.84	2.0	230		.015
1326	33	735.46	93	78	260	50	C-3	.015	.84	.84	2.0	260		.015
1329/32	36	737.23	100/96	90/80	260	55	C-4	.02	1.0	1.0	2.2	205		.015
1336	39	738.54	97	81	260	50	B-1	.01	.55	.55	1.5	175		.015
1339	42	739.93	99	82	265	50	B-2	.012	.66	.66	2.0	170		.01
1342	45	741.32	102	83	260	50	B-3	.011	1.1	1.0	2.5	220		.015
1345/47	48	743.84	104/101	84/85	265	60	B-4	.022	1.3	1.2	2.5	205		.015
1351	51	745.72	103	85	265	55	A-1	.015	.82	.82	2.0	340		.02
1354	54	747.23	105	86	275	55	A-2	.022	1.02	1.0	2.1	310		.02
1357	57	749.06	107	87	270	55	A-3	.020	.94	.96	3.5	230		.015
1400	60	750.735	108	88	265	55	A-4	.020	.94	.94	2.5	245		.015
TOTAL	60	32.041	[illegible]	[illegible]			20			1.01 "H_2O		4595		
AVERAGE			86 °F = 546 °R						.85 "H_2O = .062 "Hg			[illegible]		

Pm = P_B + ΔH = 29.76 "Hg

690 °R

VFT/APIE

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VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE

RUN NO. 10

LOCATION EXTENSION

NO. 75-5

OPERATOR SWANSON

DATE 6 AUG 75

SAMPLE BOX BLUE

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	448.	444.0	4.0
IMPINGER (#2 W/APPROX. 100 ml WATER)	447.8	445.1	2.7
BUBBLER (#3 DRY)	349.8	348.9	.9
H_2O ABSORBED BY SILICA GEL, ml	635.5	627.9	7.6
TOTAL H_2O COLLECTED, ml			15.2
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.72048
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\%\ \text{MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \%\ \text{MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-7-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 10

EVALUATION DATE 8-6-75 CLEAN-UP SET NO. 75-5

I. EVAPORATION OF 107 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 79840.4 (mg) - TARE 79832.8 (mg)

-BLANK ((.0057 mg/ml) (107 ml) = .6 mg) = 7.6 mg.

II. FILTER CATCH MSA 1106 BH (Media Type)

FINAL 382.6 (mg) - TARE 367.1 (mg) = 15.5 mg.

BACKUP 208.7 (mg) - 181.0 (mg) = 27.7 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 77538.3 (mg) - TARE 77523.9 (mg)

-BLANK (1.8 mg) = 12.6 mg.

IV. PARTICULATE FROM EVAPORATION OF 260 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 78606.9 (mg) - TARE 78583.8 (mg)

-BLANK ((.00286 mg/ml) (260 ml initial

- 7.6 ml CONDENSED = 252.4 ml) = .7 mg) = 22.4 mg.

V. PARTICULATE FROM 129 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77897.6 (mg) - TARE 77868.9 (mg)

-BLANK ((.0057 mg/ml) (129 ml) = .7 mg) = 28 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 113.8 mg.

BLANKS

ACETONE = 0.8 mg/140 ml = 0.0057 mg/ml FINAL 78536.6 mg. TARE 58535.8 mg.

ETHER-CHLOROFORM = 1.8 mg.(FINAL 79280.7 mg - TARE 79278.9 mg)

WATER = 0.4 mg/140 ml = .00286 mg/ml. FINAL 76278.9 mg. TARE 76973.0 mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

75-5

CLIENT E.P.A. FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG 6, 1975 RUN NO. 10 HOW COLLECTED INTEGRATED GAMB BAG

TIME OF SAMPLE COLLECTION 12^48 - 14^00 TIME OF ANALYSIS AUG. 7

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.4	0.3	0.4	
$CO_2 + O_2$	20.8	20.8	20.8	
$CO_2 + O_2 + CO$	21.0	21.0	21.0	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.4	0.3	0.4		0.4	44/100	.176
O_2	20.4	20.5	20.4		20.4	32/100	6.528
CO	0.2	0.2	0.2		0.2	28/100	.056
A					0.93	39.5	.367
N_2 (100-Above)	79.0	79	79.0		79.0	28/100	22.12
						AVG. MOLECULAR WT. DRY STACK GAS	28.33

VFT/AP43

PO M STABLE BURN DOUG FIR

PUM COOLANT Temp. 130° F

76-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION EXTENSION
DATE 8/6/75 AMBIENT CONDITIONS
OPERATOR/S SWANSON/VALENTINE
RUN NO. 11
SAMPLE & METER BOX NUMBERS #6 & 3
METER BOX ΔH 1.842
FILTER NO. 60-5 @ TARE 370.5 mg
CLEAN-UP NO. ____; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 300 & 50

416. remaining @ 1405
916. Fir @ 1430
416. " @ 1448
616. " @ 1525
216 remaining @ 1612

BAROMETRIC PRESSURE (P_B) 29.69 "Hg
LEAK RATE .015 CFM @ 25 "HG
PORT PRESSURE (P_S) 0 "H_2O = ____ "Hg
P_{SN} = P_B + P_S 29.70 "Hg
ASSUMED MOISTURE 2.0 % MAX VH ____ "H_2O
C FACTOR 1.1
REF. ΔP .33
STACK DIMENSIONS 33¾" x 19½" AREA 1.170 F^2
PROBE NOZZLE DIA. ½" ϕ IN; A_N ____ F^2
PROBE LENGTH 3 NUMBER 1 SIDE 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES: READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	Ref. ΔH @ Pt. C-3
1457	0	750.966	87	82	190	50								
1500	3	752.21	88	82	225	48	A-1	.01	.56	.53	6.0	205		.015
1503	6	753.63	91	82	255	38	A-2	.012	.68	.68	6.1	200		.015
1506	9	755.26	94	82	270	40	A-3	.015	.85	.85	7.5	190		.015
1509/13	12	756.89	97/95	83/83	285	42	A-4	.015	.85	.85	7.5	180		.010
1516	15	758.19	96	84	225	36	B-1	.01	.56	.56	5.5	215		.015
1519	18	759.64	99	85	260	36	B-2	.0125	.71	.70	6.5	190		.010
1522	21	761.35	104	86	215	36	B-3	.0175	.97	.97	8.0	180		.010
1525/28	24	763.25	106/103	86/88	250	42	B-4	.02	1.12	1.10	9.5	175		.010
1531	27	764.75	105	88	210	40	C-1	.0125	.71	.71	6.5	190		.010
1534	30	766.34	108	89	215	38	C-2	.015	.85	.80	7.5	180		.015
1537	33	768.09	110	90	250	38	C-3	.0175	.97	.97	8.0	180		.015
1540/43	36	769.875	112/110	92/92	255	46	C-4	.0175	.97	.97	8.0	175		.010
1546	39	771.49	112	94	240	40	D-1	.015	.86	.86	7.2	220		.010
1549	42	773.13	114	95	270	40	D-2	.015	.86	.82	7.5	205		.010
1552	45	774.74	115	96	295	40	D-3	.015	.86	.86	7.5	200		.010
1555/1600	48	776.48	117/113	97/98	290	50	D-4	.015	.86	.86	7.5	205		.010
1603	51	777.79	114	99	285	44	E-1	.010	.56	.56	5.5	205		.010
1606	54	779.08	115	100	240	42	E-2	.010	.56	.56	5.5	190		.010
1609	57	780.69	117	100	250	40	E-3	.015	.86	.86	7.5	175		.010
1612	60	782.261	119	101	245	42	E-4	.0125	.71	.71	6.5	165		.010
TOTAL	60	31.295	2641	2254						15.78 "H_2O		3825		
AVERAGE			98 °F = 558°R						.79 "H_2O = .06 "Hg			191		
								Pm = P_B + ΔH = 29.75 "Hg				651°R		

VFT/APTE

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VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIRE PLACE

LOCATION EXTENSION

OPERATOR SWANSON

SAMPLE BOX YELLOW

RUN NO. 11

NO. 76-5

DATE 8-6-75

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)		Pan	
IMPINGER (#2 W/APPROX. 100 ml WATER)	434.2	433.8	.4
BUBBLER (#3 DRY)	342.6	341.4	1.2
H_2O ABSORBED BY SILICA GEL, ml	656.4	646.8	9.6
TOTAL H_2O COLLECTED, ml			11.2
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.531
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-7-75

EVALUATION LOCATION AVERAGE FIRE PLACE RUN NO. 11

EVALUATION DATE 8-6-75 CLEAN-UP SET NO. 76-5

I. EVAPORATION OF 106 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 78 719.0 (mg) - TARE 78 713.1 (mg)

-BLANK ((0.0057 mg/ml) (106 ml) = 0.6 mg) = 5.3 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 375.3 (mg) - TARE 370.5 (mg) = 4.8 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL _____ (mg) - TARE _____ (mg)

-BLANK (_____ mg) = _____ mg.

IV. PARTICULATE FROM EVAPORATION OF _____ (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL _____ (mg) - TARE _____ (mg)

-BLANK ((_____ mg/ml) (_____ ml initial

- _____ ml CONDENSED = _____ ml) = _____ mg) = _____ mg.

V. PARTICULATE FROM _____ (ml) OF _____ RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL _____ (mg) - TARE _____ (mg)

-BLANK ((_____ mg/ml) (_____ ml) = _____ mg) = _____ mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 10.1 mg.

BLANKS

ACETONE = .8 mg/140 ml = .0057 mg/ml FINAL 78536.6 mg. TARE 78533.8 mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____ mg/_____ ml = _____ mg/ml. FINAL _____ mg. TARE _____ mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

76-5

CLIENT E.P.A. FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG. 6, 1975 RUN NO. 11 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION 1457 - 1612 TIME OF ANALYSIS AUG. 7

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.6	0.5	0.5	
$CO_2 + O_2$	20.6	20.6	20.6	
$CO_2 + O_2 + CO$	20.8	20.8	20.7	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.6	0.5	0.5		0.5	44/100	.22
O_2	20.0	20.1	20.1		20.1	32/100	6.432
CO	0.2	0.2	0.1		0.2	28/100	.056
N_2 (100-Above)	78.2	78.2	78.3		78.2	28/100	21.89
						AVG. MOLECULAR WT. DRY STACK GAS	28.60

VFT/AP4B

77-5 START-UP

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA Fire Coke
PORT LOCATION EXTENSION
DATE 8/6/75 AMBIENT CONDITIONS
OPERATOR/S ALGUARD/SWANSON
RUN NO. 12
SAMPLE & METER BOX NUMBERS BLUE & 3
METER BOX ΔH 1.892
FILTER NO. 3-5 @ TARE 356.7 mg
CLEAN-UP NO. 5; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 250° & 300

START 9# COAL
Add 2# @ 9:53
1# @ 10:09
2# @ 10:20
STOP 8# LEFT @ 10:50

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 30.215 "Hg
LEAK RATE .01 CFM @ 25 "HG
PORT PRESSURE (P_S) 0 "H_2O = 0 "Hg
$P_{SN} = P_B + P_S$ 30.215 "Hg
ASSUMED MOISTURE 12 % MAX VH ____ "H_2O
C FACTOR 1.01
REF. ΔP .036
STACK DIMENSIONS 33.4" ID AREA 7.85 F2
PROBE NOZZLE DIA. ½ IN; AN .136 F2
PROBE LENGTH 3' NUMBER 1 SIDE 2

Type C-3

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES: READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
9:38	0	782.435	62	59	250		A1	.01	.5	.5	2.0	172		
	3	789.86	65	59	255	40	2	.013	0.6	0.6	2.0	170		.011
	6	789.8	66	60	240	40	3	.014	0.7	0.7	3.0	165		.01
	9	786.3	70	60	255	40	4	.013	0.66	0.66	2.5	165		.01
9:54	12	787.65	70/71	60/60	262	45	B1	.01	0.5	0.5	2.0	175		.01
9:57	15	788.69	79	62	262	45	2	.011	0.55	0.55	2.0	180		.01
	18	790.0	76	62	255	40	3	.015	0.8	0.8	3.0	160		.01
	21	791.45	80	64	265	40	4	.015	0.8	0.8	3.0	177		.012
10:01	24	792.8	82/82	65/65	270	45	C1	.01	0.5	0.5	2.0	170		.01
10:10	27	794.12	83	67	270	45	2	.01	0.5	0.5	2.2	172		
	30	795.29	84	68	267	45	3	0.013	0.7	0.7	3.0	170		
	33	796.67	86	70	270	45	4	0.014	0.74	0.74	3.0	170		
10:20	36	798.14	90/88	71/72	270	52	D1	0.01	0.5	0.5	2.2	169		.01
10:24	39	799.35	90	73	275	45	2	0.01	0.5	0.5	2.5	183		.01
27	42	800.55	92	75	275	45	3	0.014	0.74	0.74	3.1	184		.01
30	45	802.0	94/94	76/77	275	45	4	0.016	0.85	0.85	4.0	185		.01
36	48	803.8	94/94	77/77	272	50	E1	0.013	0.7	0.7	3.2	185		.011
10:31	51	805.C	96	79	270	52	2	0.03	0.7	0.7		185		.012
10:42	54	806.4	98	80	267	45	3	0.014	0.75	0.75	3.6	182		.011
10:43	57	807.9	99	80	265	45	4	0.015	0.8	0.8	4.0	177		.01
10:48	60	809.462	101	81	250	48								
TOTAL	60	27.027	2183	1722						14.85 "H_2O		3529		
AVERAGE			78 °F = 538°R						.74 "H_2O = .05 "Hg			176		
									Pm = P_B + ΔH = 30.265 "Hg			636 °R		

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VFT/AP1E

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACES RUN NO. 12

LOCATION EXTENSION NO. 77-5

OPERATOR ALGUARD DATE 8-8-75

SAMPLE BOX BLUE

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (#1 W/APPROX. 100 ml WATER)	431.4	429.4	2.0
IMPINGER (#2 W/APPROX. 100 ml WATER)	451.0	447.6	3.4
BUBBLER (#3 DRY)	336.9	336.3	0.6
H_2O ABSORBED BY SILICA GEL, ml	632.2	626.9	5.3
TOTAL H_2O COLLECTED, ml			11.3
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.53562
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-9-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 12

EVALUATION DATE 8-8-75 CLEAN-UP SET NO. 77-5

I. EVAPORATION OF 98 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77043.6(mg) - TARE 77038.8 (mg)

-BLANK ((.0057mg/ml) (98 ml) = .6 mg) = 4.2 mg.

II. FILTER CATCH MSA 1106 BH (Media Type)

FINAL 404.7 (mg) - TARE 356.7 (mg) = 48 mg.

BACK-UP 182.4 (mg) 179.3 (mg) = 3.1 mg

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 77947.1 (mg) - TARE 77945 (mg)

-BLANK (1.8 mg) = 0.8 mg.

IV. PARTICULATE FROM EVAPORATION OF 215 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77256.7 (mg) - TARE 77239.6 (mg)

-BLANK ((.00286 mg/ml) (215 ml initial

- 11.3 ml CONDENSED = 203.7 ml) = .6 mg) = 16.5 mg.

V. PARTICULATE FROM 130 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77080.2 (mg) - TARE 77073.3 (mg)

-BLANK ((.0057 mg/ml) (130 ml) = .7 mg) = 6.2 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 78.8 mg.

BLANKS RUN #1

ACETONE = .8 mg/ 140 ml = 0.0057 mg/ml

FINAL 79536.6 mg.
TARE 79535.8 mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____ mg/_____ ml = _____ mg/ml.

FINAL _____ mg.
TARE _____ mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACES 77-5

SAMPLING POINT LOCATION CHIMNEY OUTLET

DATE 8/6/75 RUN NO. 12-COAL HOW COLLECTED INTEGRATED IN BAG

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS 8/11 '75

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.3	0.2	0.2	
$CO_2 + O_2$	20.9	20.8	20.8	
$CO_2 + O_2 + CO$	20.9	20.9	20.9	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.3	0.2	0.2		0.2	44/100	.088
O_2	20.7	20.6	20.6		20.6	32/100	6.592
CO	0	0	0.1		0	28/100	0
N_2 (100-Above)	79.1	79.2	79.1		79.1	28/100	22.148
						AVG. MOLECULAR WT. DRY STACK GAS	28.83

VFT/AP4B

Stable burning

78-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

START 10# COAL
Add 2# 11:49
2½# 12:07
1½# 12:26
FINISH 9# LEFT

CLIENT EPA FIRE RAKE
PORT LOCATION Honeychuck Residence
DATE 12/2/75 AMBIENT CONDITIONS Cloudy 65°
OPERATOR/S Aljoard / Swanson
RUN NO. 13
SAMPLE & METER BOX NUMBERS RK & 3
METER BOX ΔH 1.84.2
FILTER NO. 34-5 & 33-5 BS TARE 362.9 mg
CLEAN-UP NO. 78-5; BLANKS — & —
BOX & PROBE HEATER SETTING 250 & 30%

BAROMETRIC PRESSURE (P_B) 30.215 "Hg
LEAK RATE .02 CFM @ 25 "HG
PORT PRESSURE (P_S) .00 "H_2O = .00 "Hg
P_{SN} = P_B + P_S 30.215 "Hg
ASSUMED MOISTURE 1.5 % MAX VH — "H_2O
C FACTOR 1.1 — —
REF. ΔP .30 .32 — —
STACK DIMENSIONS 8½ x 9½ AREA 1.17.1 F^2
PROBE NOZZLE DIA. ½ IN; AN .1136 F^2
PROBE LENGTH 3 NUMBER 14 SIDE 1

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES: READ WITHIN THE TIME INTERVAL							"ΔP" REF C-3
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
11:24	0	807.662	85	80	200	50	E1	.01	0.6	0.6	2.0	165		
11:27	3	811.1	88	80	230	50	2	.01	0.56	0.56	2.0	165		.01
11:30	6	812.45	90	80	260	50	3	.01	0.56	0.56	2.0	160		
11:33	9	813.73	91	80	250	50	4	.012	0.62	0.62	2.1	155		.01
11:36/11:38	12	815.12	93/92	80/80	235	50	D1	.01	0.56	0.56	2.0	162		
11:41	17	816.37	93	81	250	50	2	.014	0.8	0.8	2.5	175		
11:44	18	817.93	96	82	195	50	3	.016	0.92	0.92	3.0	177		.01
11:47	21		99	82	280	50	4	.014	0.8	0.8	2.7	180		
11:50/11:53	24	821.17	100/99	85/83	205	50	C1	.014	0.8	0.8	2.8	170		
11:56	27	822.75	101	84	255	48	2	.012	0.7	0.7	2.2	170		
11:59	30	824.2	102	85	222	50	3	.015	0.84	0.84	3.0	170		
12:02	33	825.77	104	85	250	50	4	.016	0.92	0.92	3.0	167		
12:05/12:08	36	827.45	105/104	86/86	250	50	B1	.015	0.85	0.85	3.0	160		
12:11	39	829.0	105	87	270	50	2	.013	0.75	0.75	2.5	160		.01
12:14	42	830.6	106	88	220	50	3	.013	0.75	0.75	2.6	160		
12:17	45	832.1	106	88	275	50	4	.015	0.85	0.85	3.0	160		
12:20/12:23	48	833.72	108/106	89/89	235	52	A1	.014	0.8	0.8	3.0	160		.01
12:26	51	835.26	107	89	260	52	2	.01	0.58	0.58	2.1	160		
12:29	54	836.7	108	89	250	52	3	.014	0.8	0.8	3.0	165		
12:32	57	838.1	109	90	255	53	4	.014	0.8	0.8	3.0	167		.01
12:35	60	839.751	110	90	255	53								
TOTAL	60	29.929	2505	2116						4.86 "H_2O		3308		
AVERAGE			92 °F = 552 °R						.243 "H_2O = .05 "Hg			165		
								Pm = P_B + ΔH = 30.26 "Hg				627 °R		

130

VFT/AP12

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CCHL

CLIENT EPA FIREPLACES RUN NO. 13

LOCATION HENKELMANN RESIDENCE - AVERAGE FIREPLACE NO. 78-5

OPERATOR ALFRED SWANSON DATE 8/5/75

SAMPLE BOX BLACK

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (#1 W/APPROX. 100 ml WATER)	435.1	433.4	1.7
IMPINGER (#2 W/APPROX. 100 ml WATER)	447.8	445.4	2.4
BUBBLER (#3 DRY)	327.0	326.7	.3
H_2O ABSORBED BY SILICA GEL, ml	607.1	602.0	5.1
TOTAL H_2O COLLECTED, ml			9.5
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.450
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT E.P.A. FIREPLACE DATE OF ANALYSIS 8-9-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 13

EVALUATION DATE 8-8-75 CLEAN-UP SET NO. 78-5

I. EVAPORATION OF 117 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 80146.7 (mg) - TARE 80138.9 (mg)

-BLANK ((.0057 mg/ml) (117 ml) = .7 mg) = 7.1 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 378.2 (mg) - TARE 362.9 (mg) = 15.3 mg.

BACK UP 185.3 (MG) 183.1 (mg)

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS. = 2.2 mg.

FINAL 76573.4 (mg) - TARE 76571.0 (mg)

-BLANK (1.8 mg) = 0.6 mg.

IV. PARTICULATE FROM EVAPORATION OF 215 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77845.2 (mg) - TARE 77829.6 (mg)

-BLANK ((.0086 mg/ml) (215 ml initial

- 9.5 ml CONDENSED = 205.5 ml) = .6 mg) = 15 mg.

V. PARTICULATE FROM 120 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77392.9 (mg) - TARE 77386.4 (mg)

-BLANK ((.0057 mg/ml) (120 ml) = .7 mg) = 5.8 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 46 mg.

BLANKS Run #: 1.

ACETONE = ___ mg/___ml = ___mg/ml FINAL ___mg. TARE ___mg.

ETHER-CHLOROFORM = ___ mg.(FINAL ___ mg - TARE ___ mg)

WATER = ___mg/___ml = ___mg/ml. FINAL ___mg. TARE ___mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREBRICKS

SAMPLING POINT LOCATION CHIMNEY OUTLET

DATE 8/8/75 RUN NO. 13-COM HOW COLLECTED INTEGRATED W BAG

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS 8/11/75

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.3	0.3	0.3	
$CO_2 + O_2$	20.9	20.9	20.9	
$CO_2 + O_2 + CO$	20.9	20.9	20.9	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.3	0.3	0.3		0.3	44/100	.132
O_2	20.6	20.6	20.6		20.6	32/100	6.592
CO	0	0	0		0	28/100	0
N_2 (100-Above)	79.1	79.1	79.1		79.1	28/100	22.148
						AVG. MOLECULAR WT. DRY STACK GAS	28.87

VFT/AP4B

79-5

START-UP

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION HENEFACHUCH RESIDENCE OUTSIDE EXTEN
DATE 8/12/75 AMBIENT CONDITIONS M. JAR 70°
OPERATOR/S ALLCARD & STANTON
RUN NO. 14
SAMPLE & METER BOX NUMBERS 3 & BLACK
METER BOX ΔH 1.6-72
FILTER NO. 36-5 @ TARE 3659 mg
CLEAN-UP NO. 29-5; BLANKS — & —
BOX & PROBE HEATER SETTING 250 & —

START 17# LOAD
ADD 11# @ 11:30
3# @ 11:50
2# @ 12:05
9# @ 12:20
FINISH 15# LEFT

SMALL FL. 24-5

SCHEMATIC OF TRAVERSE POINT LAYOUT

'BAROMETRIC PRESSURE (P_B) [illegible] "Hg
LEAK RATE .01 CFM @ 25 "HG
PORT PRESSURE (P_S) 0 "H_2O = 0 "Hg
$P_{SN} = P_B + P_S$ [illegible] "Hg
ASSUMED MOISTURE 1½ % MAX VII ___ "H_2O
C FACTOR 1.1 ___ ___ ___
REF. ΔP .032 ___ ___ ___
STACK DIMENSIONS 24"ϕ AREA [illegible] F2
PROBE NOZZLE DIA. ½ IN; AN [illegible] F2
PROBE LENGTH 3' NUMBER 1 SIDE 2

REF P TYPE C-3 C

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)
11.22	0	840052	70	65	210	58
	3		71	66		
	6	841.74	71	66	210	61
	9	842.7	73	66	240	54
11:35	12	843.6	74/76	67/68	255	60
	15	844.8	78	69	240	52
	18	846.45	81	70	270	56
	21	847.7	86	71	280	66
11:58	24	849.2	87/86	72/72	285	61
	27	850.4	87	73	255	59
	30	851.8	91	75	280	60
	33	853.4	93	76	250	60
12:21	36	854.95	95/91	77/78	250	62
	39	856.2	93	80	270	60
	42	857.5	96	80	245	58
	45	858.95	98	81	275	57
12:42	48	860.3	94/95	81/83	255	59
	51	861.7	98	84	265	59
	54	862.96	100	85	280	58
	57	864.3	101	85	250	58
	60	865.555	102	86		
TOTAL	60	25.503	2189	1876		
AVERAGE			81.3 °F = 541 °R			

AVERAGE VALUES; READ WITHIN THE TIME INTERVAL

POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
A 1	.005	.28	.28	1.0	155	.01
2	.005	.22	.28	1.0	160	.008
3	.008	.45	.45	1.5	170	.008
4	.006	.39	.39	1.2	155	.01
B 1	.01	.56	.56	2.0	185	.01
2	.012	.69	.69	2.0	175	.012
3	.013	.75	.73	2.0	165	.015
4	.016	.92	.92	2.1	210	
C 1	.008	.45	.45	2.0	215	
2	.014	.8	.8	2.2	205	
3	.014	.8	.8	2.2	200	
4	.015	.85	.85	2.5	200	
D 1	.01	.56	.56	1.8	220	.01
2	.011	.62	.62	2.0	180	.01
3	.013	.72	.72	2.2	185	.01
4	.011	.56	.56	2.0	180	.01
E 1	.01	.56	.56	2.0	175	.01
2	.011	.62	.62	2.0	195	.01
3	.011	.62	.62	2.0	190	.01
4	.01	.56	.56	2.0	185	.01
20	11.99 "H_2O				3720	
		0.60 "H_2O = .07 "Hg			186	
	Pm = P_B + ΔH = [illegible] "Hg				[illegible] °R	

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE

LOCATION AVOCADO FIREPLACE

OPERATOR ALVARO-STANTON

SAMPLE BOX Black Box

RUN NO. 79-5

CLEAN-UP NO. 79-5

DATE 8-12-75

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	450.9	446.1	4.8
IMPINGER (#2 W/APPROX. 100 ml WATER)	449.0	447.1	1.9
BUBBLER (#3 DRY)	349.5	348.0	1.5
H_2O ABSORBED BY SILICA GEL, ml	649.3	642.8	6.5
TOTAL H_2O COLLECTED, ml			14.7
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.69678
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-12-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 14

EVALUATION DATE 8-12-75 CLEAN-UP SET NO. 79-5

I. EVAPORATION OF 118 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77103.7 (mg) - TARE 77094.3 (mg)

-BLANK ((.0057 mg/ml) (118 ml) = .7 mg) = 8.7 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 389.5 (mg) - TARE 365.9 (mg) = 23.6 mg.

BACK UP 196.3 (mg) - 183.9 mg = 12.4 mg

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 7792233 (mg) - TARE 7792080 (mg)

-BLANK (1.8 mg) = 13.5 mg.

IV. PARTICULATE FROM EVAPORATION OF 253 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 78803.4 (mg) - TARE 78783.0 (mg)

-BLANK ((.00286 mg/ml) (253 ml initial

- 14.7 ml CONDENSED = 238.3 ml) = .7 mg) = 19.7 mg.

V. PARTICULATE FROM 117 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77789.0 (mg) - TARE 77761.7 (mg)

-BLANK ((.0057 mg/ml) (117 ml) = .7 mg) = 21.6 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 99.5 mg.

BLANKS Run No 1

ACETONE = ____ mg/____ml = ____mg/ml FINAL ____mg. TARE ____mg.

ETHER-CHLOROFORM = ____ mg.(FINAL ____ mg - TARE ____ mg)

WATER = ____mg/____ml = ____mg/ml. FINAL ____mg. TARE ____mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT E.P.A. FIREPLACE - LOCUST WOOD

SAMPLING POINT LOCATION HONEYCHURCH RES.

DATE 8/12/75 RUN NO. 14 HOW COLLECTED [illegible]

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS 8/13/75 - 9:30 AM

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.4	0.3	0.4	
$CO_2 + O_2$	20.8	20.8	20.9	
$CO_2 + O_2 + CO$	20.8	20.8	21.0	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.4	0.3	0.4		0.4	44/100	.176
O_2	20.4	20.5	20.5		20.5	32/100	6.56
CO	0	0	0.1		0	28/100	0
N_2 (100-Above)	79.2	79.2	79.0		79.1	28/100	22.148
						AVG. MOLECULAR WT. DRY STACK GAS	28.88

VFT/AP4B

STABLE

80-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION HONEYCHURCH RES.
DATE 8/12 75 AMBIENT CONDITIONS CLEAR 75°
OPERATOR/S ACCORD & STANTON
RUN NO. 15
SAMPLE & METER BOX NUMBERS Blue & 3
METER BOX ΔH 1.842
FILTER NO. 3555 @ TARE BK-2355 352.1 mg
CLEAN-UP NO. ____; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 250° & 30?

Locust
START 15#
Add 11# @9:51
Add 4# @ 10:05
FINISH 9# LEFT

BAROMETRIC PRESSURE (P_B) [illegible] "Hg
LEAK RATE .01 CFM @ 25 "HG
PORT PRESSURE (P_S) 0 "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 29.68 "Hg
ASSUMED MOISTURE 1½ % MAX VH ____ "H_2O
C FACTOR 1.11
REF. ΔP .031 .034
STACK DIMENSIONS 5.5/4 AREA .170 F2
PROBE NOZZLE DIA. ½ IN; A_N .00136 F2
PROBE LENGTH 3' NUMBER 14 SIDE 1

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)
9:28	0	865.737	90	85	207	
[illegible]	3	867.1	92	85	220	45
[illegible]	6	868.5	94	84	235	45
[illegible]	9	869.73	95	84	245	45
[illegible]	12	871.75	96/85	85/85	255	55
[illegible]	15	872.4	98	85	260	54
[illegible]	18	873.8	100	86	270	50
[illegible]	21	875.3	101	86	270	50
[illegible]	24	876.915	104/[illegible]	88/87	278	50
[illegible]	27	878.37	103	88	285	50
[illegible]	30	880.1	105	89	285	50
[illegible]	33	881.5	107	89	287	49
[illegible]	36	883.2	109/107	90/90	295	51
[illegible]	39	884.9	108	91	290	59
[illegible]	42	886.5	107	92	295	52
[illegible]	45	888.1	109	92	295	53
[illegible]	48	889.69	110/108	92/93	295	60
[illegible]	51	891.25	110	93	297	54
[illegible]	54	892.3	111	94	293	55
[illegible]	57	893.9	112	95	295	54
[illegible]	60	896.068	114	95		
TOTAL	60	30.331	2258	[illegible]		
AVERAGE			96 °F = 556 °R			

AVERAGE VALUES: READ WITHIN THE TIME INTERVAL

POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
E1	.01	.6	.6	3.1	250	.5	.02
2	.012	.66	.66	2.1	230		
3	.01	.54	.54	2.0	240		.014
4	.01	.54	.54	2.0	210		.015
D1	.011	.6	.6	2.0	195	.25	.012
2	.013	.7	.7	2.2	200		.01
3	.014	.75	.75	2.5	185		.01
4	.016	.85	.85	2.8	175	.5	.01
C1	.013	.7	.7	2.4	180		[illegible]
2	.013	.7	.7	2.5	185	.5	[illegible]
3	.016	.87	.87	2.8	195		[illegible]
4	.017	.92	.92	3.0	200		[illegible]
B1	.015	.81	.81	3.0	170		.01
2	.015	.81	.81	3.0	195		.01
3	.015	.81	.81	2.8	180		.011
4	.015	.81	.81	2.8	178		.012
A1	.015	.81	.81	2.5	185		.013
2	.015	.81	.81	3.0	190		.012
3	.016	.85	.85	3.0	195		.013
4	.015	.81	.81	3.0	205		.012
TOTAL			[illegible] "H_2O		39[illegible]		
AVERAGE		.75 "H_2O = .06 "Hg			198		

"P" REF.
C-3

$P_m = P_B + ΔH$ = 29.74 "Hg

658 °R

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA Fieldcrew

LOCATION Honeywell Residence

OPERATOR Richard Sorrin

SAMPLE BOX Blue

RUN NO. 15

NO. 80-5

DATE 8/12/75

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	437.1	432.9	4.2
IMPINGER (#2 W/APPROX. 100 ml WATER)	451.9	450.06	1.84
BUBBLER (#3 DRY)	336.9	336.8	.1
H_2O ABSORBED BY SILICA GEL, ml	641.4	632.2	8.2
TOTAL H_2O COLLECTED, ml			14.34
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.6797
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-12-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 15

EVALUATION DATE 8-12-75 CLEAN-UP SET NO. 20-5

I. EVAPORATION OF 116 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77282.2 (mg) - TARE 77278.0 (mg)

-BLANK ((.0057 mg/ml) (116 ml) = .7 mg) = 3.5 mg.

II. FILTER CATCH 125A 110% 3 H # ___ (Media Type & #)

FINAL 376.6 (mg) - TARE 356.1 (mg) = 20.5 mg.

BACK-UP 198.2 (mg) 182.6 (mg) = 15.6 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 790329 (mg) - TARE 79012.8 (mg)

-BLANK (1.8 mg) = 18.3 mg.

IV. PARTICULATE FROM EVAPORATION OF 250 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 76800.7 (mg) - TARE 76780.7 (mg)

-BLANK ((.00286 mg/ml) (250 ml initial

- 14.34 ml CONDENSED = 235.66 ml) = 0.7 mg) = 19.3 mg.

V. PARTICULATE FROM 115 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 78765.2 (mg) - TARE 78748.1 (mg)

-BLANK ((.0057 mg/ml) (115 ml) = 0.6 mg) = 16.5 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 93.7 mg.

BLANKS Run No 1.

ACETONE = ____ mg/____ml = ____mg/ml FINAL ____mg. TARE ____mg.

ETHER-CHLOROFORM = ____ mg.(FINAL ____ mg - TARE ____ mg)

WATER = ____mg/____ml = ____mg/ml. FINAL ____ mg. TARE ____ mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA Fireplace - Locust - Wood

SAMPLING POINT LOCATION Chimney [illegible] Residence

DATE 3/12/75 RUN NO. 15 HOW COLLECTED Integrating Grab Bag

TIME OF SAMPLE COLLECTION ______ TIME OF ANALYSIS 3/13/75 [illegible]

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.2	0.3	0.4	0.4
$CO_2 + O_2$	20.3	20.9	21.0	20.9
$CO_2 + O_2 + CO$	20.8	20.9	21.0	20.9
	Void			

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2		0.3	0.4	0.4	0.4	44/100	.176
O_2		20.6	20.6	20.5	20.6	32/100	6.592
CO		0	0	0	0	28/100	
N_2 (100-Above)		79.1	79	79.1	79.1	28/100	22.148

AVG. MOLECULAR WT. DRY STACK GAS 28.92

VFT/AP4B

81-5

START-UP - STABLE

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

CLIENT E.P.A.
PORT LOCATION HONEYWELL #65
DATE 8/13/75 AMBIENT CONDITIONS CLEAR 70°
OPERATOR/S ALGUARD & STANTON
RUN NO. 16
SAMPLE & METER BOX NUMBERS BLUE & 3
METER BOX ΔH 1.892
FILTER NO. 39-5 @ TARE _____ mg
CLEAN-UP NO. 81-5; BLANKS _____ & _____
BOX & PROBE HEATER SETTING 250° & 300°

START 10:00 18#
ADD @ 10:40 5#
ADD @ 11:02 8#

BO 926-5

FINISH 174 LEFT

BAROMETRIC PRESSURE (P_B) 29.70 "Hg
LEAK RATE .02 CFM @ 25 "HG
PORT PRESSURE (P_S) _____ "H_2O = _____ "Hg
$P_{SN} = P_B + P_S$ _____ "Hg
ASSUMED MOISTURE 1 % MAX VH _____ "H_2O
C FACTOR 1.1
REF. ΔP .034 .032
STACK DIMENSIONS _____ AREA _____ F^2
PROBE NOZZLE DIA. 1/2 IN; AN _____ F^2
PROBE LENGTH 3' NUMBER 14 SIDE 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES: READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	REF M. "P" TYPE PITOT C=.8
1027	0	896.312	69	62	192	66	A 1	.008	.42	.42	1.2	174		.011
	3	897.35	66	62	218	53	2	.01	.54	.54	2.0	188		.01
	6	898.5	69	62	224	50	3	.012	.65	.65	2.0	178		.012
	9	899.8	72	63	235	49	4	.011	.6	.6	2.0	169		.011
1042	12	901.1	74/78	63/64	240	54	B 1	.007	.38	.38	1.5	155		.011
	15	901.8	75	65	245	51	2	.013	.7	.7	2.0	190		.011
	18	903.15	78	65	240	50	3	.015	.83	.83	2.0	180		.011
	21	904.55	82	67	240	50	4	.014	.78	.78	2.2	178		
1056	24	906.07	84/86	68/69	246	58	C 1	.008	.45	.45	1.4	178		
	27	907.2	83	70	250	52	2	.011	.61	.61	2.0	178		
	30		85	71	249	51	3	.013	.72	.72	2.0	178		
	33	909.9	89	72	248	50	4	.014	.8	.8	2.1	180		
	36	911.9	91/88	64/74	250	61	D 1	.006	.33	.33	1.2	170		.011
	39	912.3	90	75	255	55	2	.01	.55	.55	1.5	189		.01
	42	913.5	91	76	250	53	3	.012	.66	.66	2.0	187		.01
	45	914.9	93	78	257	53	4	012	.66	.66	2.0	190		.01
1134/1102	48	916.25	96/92	71/80	260	64	E 1	.007	.39	.39	1.2	185		.01
	51	917.3	93	80	260	58	2	.009	.5	.5	1.8	180		.01
	54	918.4	97	81	260	57	3	.009	.5	.5	1.7	170		.011
	57	919.6	96	82	261	57	4	.012	.67	.67	2.0	173		
	60	920.850	97	80										
TOTAL	60	24.538	2014	1724			20			11.7 "H_2O				
AVERAGE			77 °F = 537 °R						.54 "H_2O = .07 "Hg			180		
								$P_m = P_B + \Delta H$ = 29.74 "Hg				640 °R		

142

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT E.P.A.

LOCATION HONEYCHURCH RES

OPERATOR ALGUARD / STANTON

SAMPLE BOX BLUE

RUN NO. 16

NO. 81-5

DATE 8-13-75

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	436.5	430.9	5.6
IMPINGER (#2 W/APPROX. 100 ml WATER)	448.5	447.1	1.4
BUBBLER (#3 DRY)	336.8	335.9	0.9
H_2O ABSORBED BY SILICA GEL, ml	576.9	571.1	5.8
TOTAL H_2O COLLECTED, ml			13.7
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.649
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

122

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 9-14-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 16

EVALUATION DATE 8-13-75 CLEAN-UP SET NO. 81-5

I. EVAPORATION OF 112 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77702.3 (mg) - TARE 77695.4 (mg)

-BLANK ((.0057 mg/ml) (112 ml) = .6 mg) = 6.3 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 358.6 (mg) - TARE 351.8 (mg) = 6.8 * mg.

BACK UP 201.7 mg — 176.6 mg = 25.1 * mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 79878.9 (mg) - TARE 79868.6 (mg)

-BLANK (1.8 mg) = 8.5 mg.

IV. PARTICULATE FROM EVAPORATION OF 290 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 79103.6 (mg) - TARE 79090.7 (mg)

-BLANK ((.00286 mg/ml) (290 ml initial

- 13.7 ml CONDENSED = 276.3 ml) = .8 mg) = 12.1 mg.

V. PARTICULATE FROM 126 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77161.2 (mg) - TARE 77149.9 (mg)

-BLANK ((.0057 mg/ml) (126 ml) = .7 mg) = 10.6 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 69.4 mg.

BLANKS - Run No 1

ACETONE = ____ mg/____ml = ____mg/ml FINAL ____mg. TARE ____mg.

ETHER-CHLOROFORM = ____ mg.(FINAL ____ mg - TARE ____ mg)

WATER = ____mg/____ml = ____mg/ml. FINAL ____mg. TARE ____mg.

VFT/AP9 A

* FRONT FILTER LEAKED
BACK-UP FILTER CAUGHT THE LEAKAGE

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT E.P.A. FIRE PLACE

SAMPLING POINT LOCATION CHIMNEY EXTENSION

DATE 8/13/75 RUN NO. 16 HOW COLLECTED GRAB BAG

TIME OF SAMPLE COLLECTION 10:27-11:39 TIME OF ANALYSIS 8/14/75

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	.6	.6	0.5	
$CO_2 + O_2$	20.8	21.0	20.9	
$CO_2 + O_2 + CO$	20.8	21.0	20.9	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.6	.6	.5		.567	44/100	.249
O_2	20.2	20.4	20.4		20.33	32/100	6.506
CO	0	0	0		0	28/100	0
N_2 (100-Above)	79.2	79	79.1		79.1	28/100	22148
						AVG. MOLECULAR WT. DRY STACK GAS	28.90

VFT/AP43

IMPACTOR

82-9

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS

CLIENT E.P.A. FIRERACE
PORT LOCATION HONEYCHURCH RES @ TIRE EXTENSION
DATE 4-13-75 AMBIENT CONDITIONS CLEAR 75°
OPERATOR/S ALGUARD & STANTON
RUN NO. 17
SAMPLE & METER BOX NUMBERS CKG &
METER BOX ΔH 1.812
FILTER NO. 275 SMALL @ TARE 180.1 mg
CLEAN-UP NO. ___ ; BLANKS ___ & ___
BOX & PROBE HEATER SETTING 250° & 30%

START 16"

FINS 9" LEFT

BAROMETRIC PRESSURE (P_B) 29.72 "Hg
LEAK RATE .02 CFM @ 24.5 "HG
PORT PRESSURE (P_S) 0 "H_2O = ___ "Hg
$P_{SN} = P_B + P_S$ 29.72 "Hg
ASSUMED MOISTURE 1 % MAX VH ___ "H_2O
C FACTOR —
REF. ΔP —
STACK DIMENSIONS 5¾"x19¾" AREA 1.170 F2
PROBE NOZZLE DIA. 1/8 IN; A_N [illegible] F2
PROBE LENGTH 3' NUMBER 1 SIDE 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)
13:43	0	921.526	78	75	255	
	2½		78	76	261	72
	5	922.05	78	75	255	60
	7½	922.27	79	76	230	71
	10	922.501	80	76	230	60
	12½	922.74	80	76	235	58
	15	922.98	81	77	245	60
	17½	923.185	81	78	250	61
	20	923.425	82	79	260	60
	22½	923.66	83	80	270	59
	25	923.881	84	80	260	58
	27½	924.105	84	82	265	57
14:13	30	924.323	85	82	265	58
TOTAL	30	2.797	1053	1012		
AVERAGE			79 °F = 539 °R			

AVERAGE VALUES: READ WITHIN THE TIME INTERVAL

POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO2
C-3	.02		.05	5.0	225	
"	.018		.05	5.0	225	
"	.016		.05	5.0	220	
"	.018		.05	5.0	210	
"	.016		.045	5.0	200	
"	.015		.045	5.0	195	
"	.015		.05	5.0	190	
"	.013		.05	5.0	180	
"	.015		.05	5.0	181	
"	.014		.04	5.0	180	
"	.015		.045	5.0	175	
"	.015		.04	5.0	177	
TOTAL 1			.565 "H_2O		2358	
AVERAGE		.05 "H_2O = .003 "Hg			196	

$P_m = P_B + \Delta H$ = 29.723 "Hg

656 °R

VFT/APTE

VALENTINE, FISHER & TOMLINSON

STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT E.P.A.

RUN NO. 17

LOCATION HONEYCHURCH CES

NO. 89-5

OPERATOR ALGUARD / STANTON

DATE 8-13-75

SAMPLE BOX ORANGE

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (#1 W/APPROX. 100 ml WATER)	412.9	413.1	−0.2
IMPINGER (#2 W/APPROX. 100 ml WATER)	442.8	442.4	−0.1
BUBBLER (#3 DRY)	341.5	341.1	0.4
H_2O ABSORBED BY SILICA GEL, ml	619.8	593.8	26
TOTAL H_2O COLLECTED, ml			26.1
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			1.237
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\%\ \text{MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \%\ \text{MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

83-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

CLIENT EPA FIREPLACE
PORT LOCATION HONEYCHURCH RES.
DATE 8/13/74 AMBIENT CONDITIONS 80°
OPERATOR/S ALGUARD & STANION
RUN NO. 18
SAMPLE & METER BOX NUMBERS BLK & 3 MIS
METER BOX ΔH 1.842
FILTER NO. 385 @ TARE 854.6 mg
CLEAN-UP NO. ____; BLANKS ____ & ____
BOX & PROBE HEATER SETTING 250° & 300°

B.U. #25-5 175.6 mg

IMPORTANT: FILL IN ALL BLANKS

START LOCUST 16"
AΔΔ @ 11"
AΔΔ @ 1"
LEFT 12"

A B C D E

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 29.70 "Hg
LEAK RATE .02 CFM @ 26 "HG
PORT PRESSURE (P_S) ____ "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ ____ "Hg
ASSUMED MOISTURE 1 % MAX VII ____ "H_2O
C FACTOR [redacted] 1.1
REF. ΔP .032
STACK DIMENSIONS ____ AREA ____ F^2
PROBE NOZZLE DIA. ____ IN; A_N ____ F^2
PROBE LENGTH 3' NUMBER 1 SIDE 1

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES: READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	
2:58	0	924.50	86	82	240	63	A 1	.005	.32	.32	1.5	180		.001
3:01	3	925.59	88	87	220	60	2	.004	.80	.80	3.0	190		.016
3:04	6	926.94	92	82	240	60	3	.015	.87	.87	3.2	190		.017
3:07	9	928.53	94	83	210	60	4	.015	.87	.87	3.2	200		.012
3:10/3:15	12/17	930.13	94/96	83/84	230	60	B 1	.013	.76	.76	3.0	170		
3:18	15	931.65	99	85	220	60	2	.014	.82	.82	3.5	175		
3:21	18	933.25	102	86	200	60	3	.017	.95	.95	3.5	200		
3:24	21	934.85	106	89	260	60	4	.019	1.1	1.1	3.9	202		
3:27/3:28	24/27	936.44	107	88/89	260	60	C 1	.014	.80	.80	3.1	202		
3:31	27	938.15	105	89	270	58	2	.015	.87	.87	3.3	200		
3:34	30	939.78	112	91	250	58	3	.018	1.02	1.02	4.1	200		
3:37	33	941.63	114	92	215	59	4	.020	1.17	1.17	4.5	205		
3:42/3:45	36/39	943.61/945.60	114/112/118	92/94/95	230	59	D 1	.02	1.17	1.17	4.5	200		.01
3:48	42	947.54	121	96	240	58	2	.019	1.1	1.1	4.1	200		.009
3:51	45	949.53	122	98	255	59	3	.021	1.21	1.21	4.2	198		.010
3:54/4:05	48/58	951.57	116/122	101/98	265	60	4	.021	1.21	1.21	4.2	185		.010
4:08	51	953.18	118	102	240	60	E 1	.0175	.870	.870	4.3	195		.011
4:11	54	954.99	119	102	220	60	2	.017	.95	.95	4.5	205		.010
4:14	57	956.58	121	103	250	60	3	.015	.87	.87	4.2	198		
4:17	60	958.290	122	103	280	60	4	.016	.93	.93	4.4	200		
TOTAL	60	33.73	2709	2289			20			18.66 "H_2O				
AVERAGE			100 °F = 560 °R						.93 "H_2O = .07 "Hg			195		
								Pm = P_B + ΔH = 29.77 "Hg				655 °R		

93 & 105
93 & 31.45
1.60

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VFT/APIE

STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT GPP

RUN NO. 18

LOCATION HONEY CHURCH RES.

NO. 83-5

OPERATOR ALBERT STANTON

DATE Aug. 13, 1975

SAMPLE BOX BLK

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	449.2	445.2	4.0
IMPINGER (#2 W/APPROX. 100 ml WATER)	451.7	449.4	2.3
BUBBLER (#3 DRY)	350.0	348.9	1.1
H_2O ABSORBED BY SILICA GEL, ml	643.2	634.0	9.2
TOTAL H_2O COLLECTED, ml			16.6
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.78684
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-18-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 18

EVALUATION DATE 8-13-75 CLEAN-UP SET NO. 83-5

I. EVAPORATION OF 77 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 79781.1 (mg) - TARE 79775.3 (mg)

-BLANK ((.0057 mg/ml) (77 ml) = .4 mg) = 5.4 mg.

II. FILTER CATCH WSA 110% 3H # ___ (Media Type & #)

FINAL 387.0 (mg) - TARE 351.6 (mg) = 35.4 mg.
BACK UP 182.7 mg - 175.6 mg = 7.1 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 79398.6 (mg) - TARE 79372.2 (mg)

-BLANK (1.8 mg) = 13.6 mg.

IV. PARTICULATE FROM EVAPORATION OF 325 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 76730.5 (mg) - TARE 7671.7 (mg)

-BLANK ((.00286 mg/ml) (325 ml initial

- 16.6 ml CONDENSED = 308.4 ml) = .9 mg) = 17.9 mg.

V. PARTICULATE FROM 140 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 79223.2 (mg) - TARE 79202.3 (mg)

-BLANK ((.0057 mg/ml) (140 ml) = .8 mg) = 20.1 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 99.5 mg.

BLANKS Run #1

ACETONE = _____ mg/_____ml = _____mg/ml FINAL _____mg. TARE _____mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____mg/_____ml = _____mg/ml. FINAL _____mg. TARE _____mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT E.P.A. FIREPLACE

SAMPLING POINT LOCATION AVERAGE FIREPLACE

DATE 8/13/75 RUN NO. 18 HOW COLLECTED GRAB BAG

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS 8/14/75

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	.4	.4	0.8	
$CO_2 + O_2$	20.6	20.6	20.6	
$CO_2 + O_2 + CO$	20.6	20.7	20.7	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.4	0.4	0.3		0.4	44/100	0.176
O_2	20.2	20.2	20.3		20.2	32/100	6.464
CO	0	0.1	0.1		0.1	28/100	0.028
N_2 (100-Above)	79.4	79.3	79.3		79.3	28/100	22.204
						AVG. MOLECULAR WT. DRY STACK GAS	28.87

VFT/AP43

84-5

START UP & STABLE

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION HONEYCHURCH RES.
DATE 8-19-75 AMBIENT CONDITIONS 65° CLOUDY
OPERATOR/S ALLGUARD / SWANSON
RUN NO. 19
SAMPLE & METER BOX NUMBERS BLK & 3
METER BOX ΔH 1.842
FILTER NO. 40-5 @ TARE 368.1 mg B.U. # 28-5 176.4 mg
CLEAN-UP NO. ____ ; BLANKS ____ & ____
BOX & PROBE HEATER SETTING ____ & ____

START	28#	PINE
ADD	4 1/2#	11:52
	6 1/2#	12:03
	5#	12:19
	4#	12:41
FINISH	14#	

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 29.82 "Hg
LEAK RATE 1.6 CFM @ 25 "HG
PORT PRESSURE (P_S) ? "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 29.82 "Hg
ASSUMED MOISTURE 3 % MAX VH ____ "H_2O
C FACTOR 1.01
REF. ΔP .38 .41 .39 .30
STACK DIMENSIONS 24"x19" AREA [illegible] F2
PROBE NOZZLE DIA. 1/2 IN; A_N .0136 F2
PROBE LENGTH 3' NUMBER 1 SIDE 1

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL / AVERAGE VALUES: READ WITHIN THE TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO2
1145	0	958.722	64	62	290	45							
1148	3	959.63	66	62	260	42	A1	.006	.28	.28	1.6	245	
1151	6		69	62	220	42	2	.006	.28	.28	1.7	217	
1154	9	962.0	72	62	217	40	3	~~.0~~ .02	.98	.98	4.2	290	
1157/1200	12	963.61	75/[illegible]	63/[illegible]	255	42	4	.02	.98	.98	4.2	275	
1203/~~1203~~	15	964.77	75	64	230	42	B1	.011	.52	.52	2.2	225	
1206	18	966.31	81	65	260	40	2	.021	1.1	1.1	4.0	260	
1209	21	968.27	85/86	66/66	245	40	3	.025	1.3	1.3	5.0	255	
[illegible]/1211	21		87/86	67/68	270	40	4	.025	1.3	1.3	5.0	270	
1217	27	971.52	88	68	240	40	C1	.013	.64	.64	3.0	257	
1220	30	972.90	90	70	270	40	2	.015	.7	.7	3.0	230	
1223	33	974.61	94	71	240	40	3	.022	1.01	1.01	4.2	335	
1226/1227	36	976.207	94/93	73/73	230	40	4	.021	1.0	1.0	4.0	320	
1230	39	977.72	95	75	275	40	D1	.016	.76	.76	3.8	260	
1233	42	979.2	96	76	260	40	2	.016	.76	.76	3.7	245	
1236	45	980.65	98	77	255	40	3	.017	.8	.8	4.0	225	
1239/1240	48	982.172	99/96	78/79	280	40	4	.016	.8	.8	5.1	215	
1246	51		97	81	290	40	E1	.008	.39	.39	8.[illegible]	235	
1249	54	984.31	96	81	310	40	2	.011	.52	.52	13.	245	
1252	57	985.428	97	82	310	40	3	.01	.48	.41	17.0	235	
1253	60						4				20.0		
TOTAL	57	26.706	2056	1688			20			41.53 "H_2O		4889	
AVERAGE			78 °F = 538 °R						.76 "H_2O = .06 "Hg			257	

$P_m = P_B + \Delta H$ = 29.88 "Hg

717 °R

P" Type: .02, .02, .02, .02, .018, .02, .02, .018, .016, .015, .021, .02, .018, .017, .017, .016, .016, .012, .014

VFT/APIE

152

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA

RUN NO. 19

LOCATION AVERAGE FIREBRICK

NO. 84-5

OPERATOR ALGUARD SWANSON

DATE 8-15-75

SAMPLE BOX BLACK

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	459.3	451.5	7.8
IMPINGER (#2 W/APPROX. 100 ml WATER)	470.8	467.9	2.9
BUBBLER (#3 DRY)	318.3	318.1	.2
H_2O ABSORBED BY SILICA GEL, ml	649.5	643.2	6.3
TOTAL H_2O COLLECTED, ml			17.2
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.815
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-20-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 19

EVALUATION DATE 8-19-75 CLEAN-UP SET NO. 84-5

I. EVAPORATION OF 160 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77952.0 (mg) - TARE 77935.1 (mg)

-BLANK ((.0057 mg/ml) (160 ml) = .9 mg) = 16 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 407.0 (mg) - TARE 368.1 (mg) = 38.9 mg.

BACKUP 177.5 mg - 176.4 mg

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS. = 1.1 mg.

FINAL 76609.8 (mg) - TARE 76601.1 (mg)

-BLANK (1.8 mg) = 6.9 mg.

IV. PARTICULATE FROM EVAPORATION OF 230 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 76863.1 (mg) - TARE 76851.2 (mg)

-BLANK ((.00236 mg/ml) (230 ml initial

- 17.2 ml CONDENSED = 212.8 ml) = .6 mg) = 11.3 mg.

V. PARTICULATE FROM 139 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 79034.9 (mg) - TARE 79023.9 (mg)

-BLANK ((.0057 mg/ml) (139 ml) = .8 mg) = 10.2 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 84.4 mg.

BLANKS Run #1

ACETONE = _____ mg/_____ml = _____mg/ml FINAL _____ mg. TARE _____ mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____mg/_____ml = _____mg/ml. FINAL _____ mg. TARE _____ mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG. 19, 1975 RUN NO. 19 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS AUG. 20, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	.22	0.2	0.3	
$CO_2 + O_2$	20.4	20.4	20.4	
$CO_2 + O_2 + CO$	20.4	20.4	20.4	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	0.2	0.2	0.3		0.233	44/100	.103
O_2	20.2	20.2	20.1		20.167	32/100	6.453
CO	0	0	0		0	28/100	0
N_2 (100-Above)	79.6	79.6	79.6		79.6	28/100	22.288
						AVG. MOLECULAR WT. DRY STACK GAS	28.84

VFT/AP42

85

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA Fireplace

PORT LOCATION Honeycreek Res

DATE [illegible] AMBIENT CONDITIONS 69° cloudy

OPERATOR/S Allard / Swanson

RUN NO. 20

SAMPLE & METER BOX NUMBERS Blue & 3

METER BOX ΔH 4842

FILTER NO. 42-5 @ TARE 350.6 mg (84-29-5 @ 196.8)

CLEAN-UP NO. 85-5; BLANKS ____ & ____

BOX & PROBE HEATER SETTING 250 & 30%

START 22# Pine

ADD 5# 14:55

ADD 6½# 15:10

FINISH 11# LEFT

BAROMETRIC PRESSURE (P_B) 29.85 "Hg

LEAK RATE .01 CFM @ 25 "HG

PORT PRESSURE (P_S) 0 "H_2O = ____ "Hg

$P_{SN} = P_B + P_S$ 29.85 "Hg

ASSUMED MOISTURE 2 % MAX VH ____ "H_2O

C FACTOR 1.05

REF. ΔP .036

STACK DIMENSIONS 33" x 14" AREA [illegible] F^2

PROBE NOZZLE DIA. ½ IN; A_N [illegible] F^2

PROBE LENGTH 3' NUMBER 14 SIDE 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL						
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
14:45	0	985.603	72	69	220	54	A1	.01	.5	.5	2.3	220	
1447	2	986.39	74	69	225	45	2	.014	.7	.7	3.1	220	
1449	4	987.30	76	69	230	45	3	.015	.77	.77	3.2	225	
1451	6	988.28	78	69	235	42	4	.016	.8	.8	3.2	220	
1453/1453	8	989.27	79/79	69/69	240	45	B1	.011	.55	.55	2.2	207	
1455	10	990.09	80	70	245	45	2	.015	.77	.77	3.0	222	
1457	12	991.05	83	70	250	45	3	.023	1.2	1.2	3.0	235	
1500	14	992.20	85/	70/	250	45	4	.021	1.1	1.1	3.0	250	
1502/1502	16	993.387	87/87	71/71	252	45	C1	.01	.5	.5	2.2	217	
1504	18	994.12	87	72	250	47	2	.011	.55	.55	2.0	217	
1506	20	994.98	88	72	250	47	3	.015	.77	.77	2.0	220	
1508	22	995.97	90	73	255	47	4	.015	.77	.77	2.0	212	
1510/15:12	24	996.736	91/90	74/74	255	50	D1	.01	.5	.5	1.5	245	
15:14	26	997.70	92	75	255	50	2	.013	.66	.66	1.6	260	
15:16	28	998.6	93	75	255	50	3	.016	.8	.8	2.0	260	
15:18	30	999.61	95	77	257	50	4	.016	.8	.8	2.0	250	
20/1521	32	000.622	96/95	77/78	255	52	E1	.009	.45	.45	1.5	225	
1523	34	1.37	95	79	260	50	2	.011	.55	.55	1.5	210	
1525	36	2.16	96	80	260	50	3	.013	.66	.66	2.0	235	
1527	38	3.1	97	80	250	45	4	.011	.55	.55	1.6	209	
1529	40	3.940	98	80									
TOTAL	40	18.337	2183	1482			20			13.95 "H_2O		4551	
AVERAGE			80 °F = 540 °R							.70 "H_2O = .05 "Hg		228	

$P_m = P_B + ΔH$ = 29.90 "Hg

688 °R

VFT/APIE

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE — RUN NO. 20

LOCATION AVERAGE FIREPLACE — NO. 85-5

OPERATOR ALGUARD SWANSON — DATE 8/19/75

SAMPLE BOX Blue

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)	445.6	440.0	5.6
IMPINGER (#2 W/APPROX. 100 ml WATER)	444.9	443.4	1.5
BUBBLER (#3 DRY)	326.9	326.8	0.1
H_2O ABSORBED BY SILICA GEL, ml	577.5	572.9	4.6
TOTAL H_2O COLLECTED, ml			11.8
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.559
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\%\ \text{MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \%\ \text{MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VET/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-20-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 20

EVALUATION DATE 8-19-75 CLEAN-UP SET NO. 85-5

I. EVAPORATION OF 155 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 76884.4 (mg) - TARE 76869.6 (mg)

-BLANK ((.0057 mg/ml) (155 ml) = .9 mg) = 13.9 mg.

II. FILTER CATCH MSA 1106 B.H # ___ (Media Type & #)

FINAL 361.8 (mg) - TARE 350.6 (mg) = 11.2 mg.

BACK-UP 188.4 - 176.4 = 12 mg

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 77225 (mg) - TARE 77718.8 (mg)

-BLANK (1.8 mg) = 6.9 mg.

IV. PARTICULATE FROM EVAPORATION OF 230 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 792886 (mg) - TARE 79279.1 (mg)

-BLANK ((.00286 mg/ml) (230 ml initial

- 11.8 ml CONDENSED = 218.2 ml) = .6 mg) = 8.9 mg.

V. PARTICULATE FROM 139 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 766072 (mg) - TARE 76588.5 (mg)

-BLANK ((.0057 mg/ml) (139 ml) = .8 mg) = 17.9 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 70.8 mg.

BLANKS Run #1

ACETONE = ____ mg/____ml = ____mg/ml FINAL ____mg. TARE ____mg.

ETHER-CHLOROFORM = ____ mg.(FINAL ____ mg - TARE ____ mg)

WATER = ____mg/____ml = ____mg/ml. FINAL ____mg. TARE ____mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG. 19, 1975 RUN NO. 20 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION _____ TIME OF ANALYSIS AUG, 20, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.2	0.2	0.2	
$CO_2 + O_2$	20.3	20.3	20.3	
$CO_2 + O_2 + CO$	20.3	20.3	20.3	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.2	.2	.2		.2	44/100	.088
O_2	20.1	20.1	20.1		20.1	32/100	6.432
CO	0.0	0.0	0.0		0.0	28/100	0.0
N_2 (100-Above)	77.9				77.9	28/100	21.812
						AVG. MOLECULAR WT. DRY STACK GAS	28.33

VFT/AP43

80-5

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

28,538

CLIENT EPA Firetake
PORT LOCATION Honeychuck Pos - Outside Extension
DATE 8-19-75 AMBIENT CONDITIONS Cloudy 65°
OPERATOR/S Acquaed / Swanson
RUN NO. 21
SAMPLE & METER BOX NUMBERS YEL & 3
METER BOX ΔH 1.841
FILTER NO. 41-5 @ TARE 353.4 mg
CLEAN-UP NO. ____; BLANKS ____ & ____
BOX & PROBE HEATER SETTING ____ & ____

TRAVERSE SAMPLING DATA SHEET
IMPORTANT: FILL IN ALL BLANKS
WATER TEMP 130° F

Pom

START 16" PINE
6" @ 16:28
2" @ 16:45
2" 16:54
3" 17:03
10" LEFT @ FINISH

SCHEMATIC OF TRAVERSE POINT LAYOUT

BAROMETRIC PRESSURE (P_B) 29.68 "Hg
LEAK RATE .02 CFM @ 25.2 "HG
PORT PRESSURE (P_S) ? "H_2O = ____ "Hg
$P_{SN} = P_B + P_S$ 29.87 "Hg
ASSUMED MOISTURE 2 % MAX VH ____ "H_2O
C FACTOR 1.01
REF. Δ P .038 .034 .050
STACK DIMENSIONS 24" x 24" AREA 3.14 F^2
PROBE NOZZLE DIA. 1/2 IN; A_N .0030 F^2
PROBE LENGTH 3' NUMBER 14 SIDE 1

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE Δ H ("H_2O) DESIRED	ORIFICE Δ H ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
16:19	0	0 c41.070	83	80	270	42	A1	.057	.35	.35	5.5	230	
	2½	4.85	83	77	240	40	2	.01	.5	.5	7.8	210	
	5	5.8	84	77	205	40	3	.01	.58	.58	8.1	200	
	7½	6.82	86	77	295	40	4	.015	.8	.8	11.0	225	
16:30	10	8.049	88/8	77/77	280	40	B1	.01	.51	.51	8.0	230	
	12½	9.05	88	78	295	40	2	.014	.71	.71	10.5	235	
	15	10.20	90	78	260	40	3	.014	.73	.73	10.6	220	
	17½	11.42	92	78	230	40	4	.014	.73	.73	11.0	215	
16:41	20	12.605	94/92	78/79	270	40	C1	.01	.51	.51	8.1	200	
16:43½	22½	13 56	93	79	285	40	2	.01	.51	.51	8.0	200	
	25	14.56	94	80	235	40	3	.015	.8	.8	10.5	250	
	27½	15.85	97	80	295	40	4	.015	.8	.8	10.0	218	
16:53	30	17.15	98/96	80/81	285	40	D1	.011	.55	.55	8.2	205	
	32½	18.05	97	81	275	40	2	.011	.65	.65	9.0	190	
	35	19.23	99	82	235	40	3	.014	.74	.74	10.5	210	
	37½	20.44	100	83	240	40	4	.015	.80	.80	11.0	225	
17:00	40	21.722	101/99	83/83	290	40	E1	.008	.42	.42	6.5	205	
17:07	42½	22.6	100	83	240	40	2	.012	.63	.63	9.8	235	
17:10	45	23.11	101	85	250	40	3	.012	.62	.62	9.5	250	
17:13	47½		103	86	230	40	4	.013	.66	.66	10.0	250	
17:16	50	25 970	103	86									
TOTAL	50	21.9	2348	2010			20			12.66 "H_2O		4388	
AVERAGE			87 °F = 547 °R						.63 "H_2O = .05 "Hg			219	
								$P_m = P_B + \Delta H$ = 29.87 "Hg				679 °R	

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VFT/AP1E

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE RUN NO. 21

LOCATION HUNTER FIREPLACE NO. 86-5

OPERATOR ALCARAZ - SWANSON DATE 9/19/85

SAMPLE BOX YELLOW

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm) BUBBLER (#1 W/APPROX. 100 ml WATER)		POM	
IMPINGER (#2 W/APPROX. 100 ml WATER)	438.8	433.9	4.9
BUBBLER (#3 DRY)	333.2	332.0	1.2
H_2O ABSORBED BY SILICA GEL, ml	647.8	641.4	6.4
TOTAL H_2O COLLECTED, ml			12.5
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.592
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS + VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VFT/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-20-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 21

EVALUATION DATE 8-19-75 CLEAN-UP SET NO. 86-5

I. EVAPORATION OF _____(ml) OF _____

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL _____(mg) - TARE 76518.0 (mg)

-BLANK ((_____mg/ml) (_____ ml) = _____ mg) = _____ mg.

II. FILTER CATCH _____ # ___ (Media Type & #)
FILTER COST IN ANALYSIS — PETRI DISH BROKEN & CONTAMINATED SAMPLE
FINAL _____ (mg) - TARE 353.4 (mg) = _____ mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL _____ (mg) - TARE _____ (mg)

-BLANK (_____mg) = _____ mg.

IV. PARTICULATE FROM EVAPORATION OF _____(ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL _____ (mg) - TARE _____ (mg)

-BLANK ((_____ mg/ml) (_____ ml initial

- _____ml CONDENSED = _____ ml) = _____ mg) = _____ mg.

V. PARTICULATE FROM _____ (ml) OF _____ RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL _____ (mg) - TARE _____ (mg)

-BLANK ((_____ mg/ml) (_____ml) = _____ mg) = _____ mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = LOST mg.

BLANKS Run #1

ACETONE = _____ mg/_____ml = _____mg/ml FINAL _____mg.
TARE _____ mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____mg/_____ml = _____mg/ml. FINAL _____ mg.
TARE _____ mg.

VFT/AP9 A

START UP — STAKE

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

87-5

START 16# PINE
7½ @ 11:30
8" @ 11:50

FINISH 18# LEFT @ 11:54
START 33 MIN ELAPSED TIME 18# @ 12:20
ADD 5# 12:42
FINISH 10# LEFT

BUT 50-5

CLIENT EPA FIELD PLACE
PORT LOCATION HONEYCHURCH RES.
DATE 9-20-75 AMBIENT CONDITIONS CLEAR 65°
OPERATOR/S ALGUARD / SWANSON
RUN NO. 22 GLASS FRONT
SAMPLE & METER BOX NUMBERS RED & 3
METER BOX ΔH 1.892
FILTER NO. 43-5 & 44-5 TARE 359.9 mg
CLEAN-UP NO. 87-5; BLANKS _____ & _____
BOX & PROBE HEATER SETTING 250° & 30%

BAROMETRIC PRESSURE (P_B) 30.20 "Hg
LEAK RATE .01 / .01 CFM @ 25 "HG
PORT PRESSURE (P_S) 0 "H_2O = 25 / 0 "Hg
$P_{SN} = P_B + P_S$ 30.20 "Hg
ASSUMED MOISTURE 5 % MAX VH _____ "H_2O
C FACTOR .98
REF. ΔP .038 (230) .036 .042 (200) .04 (170) .044 (150)
STACK DIMENSIONS 83" x 94" AREA 1.170 F2
PROBE NOZZLE DIA. ½ IN; A_N .00136 F2
PROBE LENGTH 3' NUMBER 14 SIDE A

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL

CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)
11:18	0	26.143	69	62	250	64
11:21	3	26.99	66	62	200	55
1124	6	27.95	67	62	240	54
1127	9	29.05	70	63	230	50
1130/1135	12	30.99	72	63	220	52
1138	15	31.20	74	64	230	52
1241	18	32.26	76	65	235	57
1144	21	33.24	78	66	240	52
1149	24	34.352	81	68	220	58
1153	27	35.36	82	70	210	56
1243	30	36.55	EX1	71	240	55
1248/12:20	33	* 37405/37552	86/82	72/71	270	62
1223/26	36	38.715	84	77	300	54
1229	39	39.70	86	77	280	54
1232	42	40.80	88	77	250	52
1235	45	41.91	89	78	280	50
1238/1241	48	42.982	90	79	250	55
1244	51	43.85	90	80	180	54
1247	54	44.68	91	80	220	55
1250	57	45.57	92	82	255	54
1253	60	46.591	93	82	250	54
TOTAL	60	20.301	1785	1577		
AVERAGE			76 °F	536 °R		

AVERAGE VALUES READ WITHIN THE TIME INTERVAL

POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
A1	.005	.25	.25	1.2	180	
2	.008	.4	.4	1.5	205	
3	.01	.51	.51	1.6	185	
4	.008	.35	.45	1.5	210	
B1	.008	.35	.45	2.0	300	
2	.008	.35	.45	1.9	295	
3	.009	.39	.39	1.9	285	
4	.011	.49	.49	2.0	275	
C1	.008	.35	.35	1.6	270	
2	.009	.41	.41	2.0	297	
3	.01	.45	.45	15.0	285	
4	.011	.49	.49	1.5	280	
D1	.008	.36	.36	1.2	312	
2	.011	.48	.48	2.0	290	
3	.01	.44	.44	1.5	285	
4	.009	.4	.4	1.6	290	
E1	.006	.26	.26	1.2	270	
2	.006	.26	.26	1.2	250	
3	.007	.31	.31	1.2	360	
4	.009	.36	.36	1.5	365	
TOTAL	20		7.94 "H_2O		5539	
AVERAGE		.397 "H_2O = .03 "Hg			277	
		$P_m = P_B + \Delta H$ = 30.23 "Hg			737 °R	

* LEAK CHECK - NEW DRY GAS METER START

VFT/AP1E

87-5

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VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACE — RUN NO. 22

LOCATION AVERAGE FIREPLACE — NO. 87-5

OPERATOR ALGUARD SWANSON — DATE 8/20/75

SAMPLE BOX RED

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (#1 W/APPROX. 100 ml WATER)	444.6	436.3	8.3
IMPINGER (#2 W/APPROX. 100 ml WATER)	446.1	445.0	1.1
BUBBLER (#3 DRY)	316.4	315.6	0.8
H_2O ABSORBED BY SILICA GEL, ml	642.3	637.9	4.4
TOTAL H_2O COLLECTED, ml			14.6
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.692
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

T/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8-21-75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 22

EVALUATION DATE 8-20-75 CLEAN-UP SET NO. 87-5

I. EVAPORATION OF 150 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 76658.8 (mg) - TARE 76626.2 (mg)

-BLANK ((.0057 mg/ml) (150 ml) = .9 mg) = 31.7 mg.

II. FILTER CATCH MSA 1106 B H # ___ (Media Type & #)

FINAL 400.9 (mg) - TARE 365.5 (mg) = 35.4 mg.

BACK UP 182.9 mg - 180.7 mg = 45.0 mg.

= 2.2 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 67268.7 (mg) - TARE 67256.1 (mg)

-BLANK (1.8 mg) = 10.8 mg.

IV. PARTICULATE FROM EVAPORATION OF 205 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 77108.9 (mg) - TARE 77088.9 (mg)

-BLANK ((.00286 mg/ml) (205 ml initial

- 14.6 ml CONDENSED = 190.4 ml) = .5 mg) = 19.5 mg.

V. PARTICULATE FROM 100 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 78906.4 (mg) - TARE 78876.9 (mg)

-BLANK ((.0057 mg/ml) (100 ml) = .6 mg) = 28.9 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 171.3 mg.

BLANKS Run #1

ACETONE = _____ mg/_____ml = _____mg/ml FINAL _____mg. TARE _____mg.

ETHER-CHLOROFORM = _____ mg.(FINAL _____ mg - TARE _____ mg)

WATER = _____mg/_____ml = _____mg/ml. FINAL _____ mg. TARE _____ mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG. 20, 1975 RUN NO. 22 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION 11⁰⁰-12⁰⁰ TIME OF ANALYSIS AUG 21, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	1.0	1.0	1.0	
$CO_2 + O_2$	20.8	20.8	20.8	
$CO_2 + O_2 + CO$	21.0	21.0	21.0	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	1.0	1.0	1.0		1.0	44/100	.44
O_2	19.8	19.8	19.8		19.8	32/100	6.336
CO	0.2	0.2	0.2		0.2	28/100	.056
N_2 (100-Above)	79.0	79.0	79.0		79.0	28/100	22.120
						AVG. MOLECULAR WT. DRY STACK GAS	28.95

VFT/AP43

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

CLIENT EPA FIREPLACE
PORT LOCATION HONEYCHURCH WES
DATE 8/20/75 AMBIENT CONDITIONS Clear
OPERATOR/S ALGUARD / SWANSON
RUN NO. 23 88-5
SAMPLE & METER BOX NUMBERS GEM & 3
METER BOX ΔH 1.842
FILTER NO. 45-5 @ TARE 367.5 mg BOX 31-5 @ 180.1mg
CLEAN-UP NO. ____; BLANKS ____ & ____
BOX & PROBE HEATER SETTING ____ & ____

START 18" PINE
ADD 4" @ 15:01
6" @ 15:22
10" LEFT & FINISH

BAROMETRIC PRESSURE (P_B) 29.81 "Hg
LEAK RATE .022 CFM @ 25" "Hg
PORT PRESSURE (P_S) 0 "H_2O = 0 "Hg
$P_{SN} = P_B + P_S$ 29.81 "Hg
ASSUMED MOISTURE 5 % MAX VH ____ "H_2O
C FACTOR 1.05
REF. ΔP .036 .039 .035 .035
STACK DIMENSIONS 23 3/4 x 19 1/4 AREA 1.772 F^2
PROBE NOZZLE DIA. 1/2 IN; AN .0136 F^2
PROBE LENGTH 3 NUMBER 12 SIDE 2

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL							
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2	REF OPACITY
14:46	0	46.783	76	73	200	70	A 1	.01	.5	.5	1.5	210	~~910~~	.01
	2½	47.9	78	73	220	66	2	.012	.6	.6	2.0	205		.009
	5	48.89	80	73	240	60	3	.013	.66	.66	2.0	200		
	7½	49.99	82	73	250	60	4	.019	.75	.75	2.0	197		.009
1451	10	51.194	84/—	73/—	270	60	B 1	.009	.48	.48	1.5	185		.008
	12½	52.12	85	74	280	58	2	.011	.58	.58	2.0	170		.008
	15	53.15	87	75	290	56	3	.016	.85	.85	2.1	235		.00
	17½	54.40	90	75	270	56	4	.017	.86	.86	2.1	225		.01
1508	20	55.71	91	76			C 1	.011	.58	.58	2.0	220		.00
	22½	56.76	92	77	210	56	2	.011	.58	.58	2.0	205		.008
	25	57.85	94	78	240	56	3	.016	.86	.86	2.1	200		.01
	27½	58.98	97	79	270	56	4	.015	.83	.83	2.2	202		.01
1514	30	60.3	97	80	260	60	D 1	.011	.55	.55	2.0	250		.01
	32½	61.44	99	81	230	60	2	.016	.77	.77	2.0	270		.01
	35	62.67	100	81			3	.016	.77	.77	2.0	275		.01
	37½	63.90	103	83	195	56	4	.015	.73	.73	2.0	260		.01
1528	40	65.14	104/103	83/84	235	60	E 1	.009	.45	.45	1.5	235		.01
	42½	66.05	103	85	260	60	2	.01	.52	.52	1.6	235		.01
	45	67.02	104	86	250	58	3	.01	.52	.52	1.8	225		.01
	47½	68.09	105	87	220	56	4	.01	.52	.52	1.8	217		.01
1540	50	69.201	106	87	230	56								
TOTAL	50	22.278	2060	1736			20			12.9 "H_2O		4421		
AVERAGE			86 °F = 546 °R						.648 "H_2O = .05 "Hg			221		
								$P_m = P_B + \Delta H$ = 29.86 "Hg				681 °R		

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VFT/APIE

VALENTE E, FISHER & TOMPKINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA FIREPLACES — RUN NO. 23

LOCATION AVERAGE FIREPLACE — NO. 88-5

OPERATOR ALFONSO SWANSON — DATE 8/20/75

SAMPLE BOX GREEN

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (#1 W/APPROX. 100 ml WATER)	446.2	440.0	6.2
IMPINGER (#2 W/APPROX. 100 ml WATER)	434.2	433.3	.9
BUBBLER (#3 DRY)	337.3	336.2	1.1
H_2O ABSORBED BY SILICA GEL, ml	686.1	631.3	4.8
TOTAL H_2O COLLECTED, ml			13
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			0.616
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\text{MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. } H_2O \text{ VAPOR}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{100 - \%\ \text{MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

VET/AP3C

VALENTINE, FISHER & TOMLINSON
LABORATORY ANALYSIS AND TOTAL PARTICULATE SHEET

CLIENT EPA FIREPLACE DATE OF ANALYSIS 8/21/75

EVALUATION LOCATION AVERAGE FIREPLACE RUN NO. 23

EVALUATION DATE 8/20/75 CLEAN-UP SET NO. 88-5

I. EVAPORATION OF 70 (ml) OF ACETONE

RINSE & BRUSHING OF NOZZLE, PROBE AND GLASSWARE BEFORE FILTER.

FINAL 77226.0 (mg) - TARE 77217.3 (mg)

-BLANK ((.0057 mg/ml) (70 ml) = .4 mg) = 8.3 mg.

II. FILTER CATCH MSA 1106 BH # ___ (Media Type & #)

FINAL 392.6 (mg) - TARE 367.5 (mg) = 25.1 mg.

BACK UP 186.1 mg - 180.1 mg * 6 mg.

III. HYDROCARBON OBTAINED BY ETHER-CHLOROFORM EXTRACTION ON WATER IN IMPINGER AND BUBBLERS.

FINAL 77368.7 (mg) - TARE 77363.3 (mg)

-BLANK (1.8 mg) = 3.6 mg.

IV. PARTICULATE FROM EVAPORATION OF 205 (ml) WATER IN IMPINGER AND BUBBLERS FOLLOWING EXTRACTION -

FINAL 78979.2 (mg) - TARE 78968.5 (mg)

-BLANK ((.00286 mg/ml) (205 ml initial

- 13 ml CONDENSED = 192 ml) = .5 mg) = 10.2 mg.

V. PARTICULATE FROM 125 (ml) OF ACETONE RINSE OF IMPINGER, BUBBLERS, AND CONNECTORS AFTER FILTER:

FINAL 77065.0 (mg) - TARE 77047.2 (mg)

-BLANK ((.0057 mg/ml) (125 ml) = .7 mg) = 17.1 mg.

VI. TOTAL PARTICULATE = I + II + III + IV + V = 70.3 mg.

BLANKS RUN #1

ACETONE = ___ mg/___ml = ___mg/ml FINAL ___mg. TARE ___mg.

ETHER-CHLOROFORM = ___ mg.(FINAL ___ mg - TARE ___ mg)

WATER = ___mg/___ml = ___mg/ml. FINAL ___mg. TARE ___mg.

VFT/AP9 A

VALENTINE, FISHER & TOMLINSON
ORSAT DATA AND CALCULATION SHEET

CLIENT EPA FIREPLACE

SAMPLING POINT LOCATION OUTSIDE EXTENSION

DATE AUG 20, 1975 RUN NO. 23 HOW COLLECTED INTEGRATED GRAB BAG

TIME OF SAMPLE COLLECTION 1:30 - 2:30 TIME OF ANALYSIS AUG. 21, 1975

CUMULATIVE % BY VOL.(DRY)	ANALYSIS #1	ANALYSIS #2	ANALYSIS #3	ANALYSIS #4
CO_2	0.5	0.4	0.5	
$CO_2 + O_2$	20.8	20.7	20.8	
$CO_2 + O_2 + CO$	20.9	20.8	20.9	

COMPONENT % BY VOL.(DRY)	#1	#2	#3	#4	AVG.	RATIO MOLE WT	WT./MOLE (DRY)
CO_2	.5	.4	.5		.467	44/100	.205
O_2	20.3	20.3	20.3		20.3	32/100	6.496
CO	0.1	0.1	0.1		0.1	28/100	.028
N_2 (100-Above)	79.1	79.2	79.1		79.133	28/100	22.157
						AVG. MOLECULAR WT. DRY STACK GAS	28.39

VFT/AP43

IMPACTOR

VALENTINE FISHER & TOMLINSON
SEATTLE, WASHINGTON

TRAVERSE SAMPLING DATA SHEET

IMPORTANT: FILL IN ALL BLANKS

89-5

CLIENT EPA FINANCE

PORT LOCATION HONEYCHURCH RES.-OUTSIDE EXTENSION

DATE 8/20/75 AMBIENT CONDITIONS Clear

OPERATOR/S ALGIARD/SWANSON

RUN NO. 24

SAMPLE & METER BOX NUMBERS 06 & 3

METER BOX ΔH 1.842

FILTER NO. 32-5 SMALL @ TARE 181.2 mg

CLEAN-UP NO. 89-5 ; BLANKS _____ & _____

BOX & PROBE HEATER SETTING 250 & 60

START 22# PINE

FINISH 7# LEFT

BAROMETRIC PRESSURE (P_B) 29.79 "Hg

LEAK RATE .02 CFM @ 24.9 "HG

PORT PRESSURE (P_S) 0 "H_2O = 0 "Hg

$P_{SN} = P_B + P_S$ 29.79 "Hg

ASSUMED MOISTURE ____ % MAX VH ____ "H_2O

C FACTOR ____

REF. ΔP ____

STACK DIMENSIONS 53" x 119" AREA 6.170 F^2

PROBE NOZZLE DIA. 1/8 IN; A_N .000852 F^2

PROBE LENGTH 3' NUMBER 14 SIDE 1+

SCHEMATIC OF TRAVERSE POINT LAYOUT

INSTANTANEOUS READINGS: RECORDED @ BEGINNING OF TIME INTERVAL							AVERAGE VALUES READ WITHIN THE TIME INTERVAL						
CLOCK TIME (24 HRS)	ELAP. TIME (MIN)	DRY GAS METER (CUBIC FEET)	DRY GAS TEMP. (°F) INLET	DRY GAS TEMP. (°F) OUTLET	BOX TEMP. (°F)	IMPINGER TEMP. (°F)	POINT	PITOT VH ("H_2O)	ORIFICE ΔH ("H_2O) DESIRED	ORIFICE ΔH ("H_2O) ACTUAL	PUMP VACUUM ("Hg GA)	STACK TEMP. (°F)	OPACITY OR %CO_2
16:29	0	69.387	90	85	235		C-3	.019		.04	5.0	235	
	2½	69.63	89	85	240			.015		.045	5.0	237	
	5	69.834	89	83	250			.015		.04	5.0	222	
	7½		89	89	245	55		.014		.04	5.0	222	
	10	70.25	89	84	245	55		.014		.04	5.0	215	
	12½	70.414	89	89	250	50		.014		.04	5.0	210	
	15	70.64	89	85	240	55		.014		.04	5.0	205	
	17½	70.84	90	85	245	55		.014		.04	5.0	197	
	20	71.03	90	86	240	55		.013		.04	5.0	195	
	22½	71.225	90	86	240	55		.012		.04	5.0	187	
	25	71.415	90	87	240	55		.012		.04	5.0	182	
	27½	71.610	91	87	240	55		.011		.04	5.0	175	
16:59	30	71.800	91	88	245								
TOTAL	30	2.416	1166	1109			1			.485 "H_2O		2482	
AVERAGE			88 °F = 548 °R						.04 "H_2O = .002 "Hg			207	
								$P_m = P_B + \Delta H$ = 29.792 "Hg				667 °R	

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VFT/AP1E

VALENTINE, FISHER & TOMLINSON
STACK MOISTURE CONTENT DATA AND CALCULATIONS

CLIENT EPA Fireback Evaluation — RUN NO. 2A

LOCATION Alcoa Fireback — NO. 89-5

OPERATOR Richard Swanson — DATE 8/24/75

SAMPLE BOX Orange

	CONTAINER WEIGHTS (gm)		
	FINAL	INITIAL	NET
H_2O CONDENSED, ml (1 ml = 1 gm)			
BUBBLER (1st W/APPROX. 100 ml WATER)	448.8	448.2	0.6
IMPINGER (2nd W/APPROX. 100 ml WATER)	433.6	433.7	-0.1
BUBBLER (3rd DRY)	364.5	364.2	0.3
H_2O ABSORBED BY SILICA GEL, ml	569.4	568.6	0.8
TOTAL H_2O COLLECTED, ml			1.6
VOL. OF H_2O VAPOR @ 70°F. AND 1 ATM. = 0.0474 x TOTAL H_2O			.0758
MOISTURE IN STACK GAS, %			
MOLE FRACTION OF DRY GAS			
MOLECULAR WT. OF STACK GAS			

$$\% \text{ MOISTURE IN STACK GAS} = \frac{100 \times \text{VOL. } H_2O \text{ VAPOR}}{\text{VOL. DRY GAS} + \text{VOL. WET GAS}}$$

$$\text{MOLE FRACTION OF DRY GAS} = \frac{1 - \% \text{ MOISTURE IN STACK GAS}}{100}$$

MOLECULAR WT. OF STACK GAS = AVG. DRY MOL. WT. OF GAS X MOLE FRACTION + 18 X (1-MOLE FRACTION)

EPA/APSC

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7. AUTHOR(S)
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16. ABSTRACT

One typical residential fireplace was source sampled for particulate (both filterable and condensible), polycyclic organic materials (POM), volatile hydrocarbons, and carbon monoxide emissions. Testing was conducted using alder, Douglas Fir, Locust, pine, and coal. Particulate was sampled and analyzed utilizing EPA Method 5. POM was collected on a TENAX adsorbent and analyzed by GC-MS methods. A rough energy balance on wood combustion in fireplaces was performed.

17. KEY WORDS AND DOCUMENT ANALYSIS

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TENAX Emissions Particulates POM Fireplace		

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