am test inc.
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ATMOSPHERIC

EMISSION

EVALUATION

AUGUST 5, 1985

Prepared For:

LAKESIDE INDUSTRIES
MADSON ASPHALT PAVING PLANT
LACEY, WASHINGTON
JULY 18, 1985

Submitted by:

Kris A. Hansen

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INTRODUCTION

The purpose of this atmospheric emission evaluation performed at Lakeside Industries' Madson asphalt paving plant located in Lacey, Washington was to determine the particulate emission concentration of the baghouse exhaust gas. Three (3) particulate emission concentration compliance tests were performed on July 18, 1985 utilizing the Environmental Protection Agency's (EPA) Method 5 procedures. Mr. James A. Guenthoer of Am Test, Inc., Seattle, Washington performed the field sampling and laboratory analysis. Mr. Kris A. Hansen of Am Test performed data reduction. Mr. Harold Nickel of Lakeside Industries coordinated this project. Mr. Bob Smith, Lakeside Industries' Lacey plant foreman, coordinated plant operations. Mr. Jim Wilson of the Olympic Air Pollution Control Authority (OAPCA) observed the field testing.

SUMMARY OF RESULTS

The results of the three (3) Method 5 compliance tests for determining particulate emission concentration, collected July 18, 1985 at Lakeside Industries' Lacey, Washington facility, are summarized in Table 1 below:

Table 1. Summary of particulate emission concentration test results.

SAMPLE RUN #	AM TEST LAB #	PARTIC. CONC. gr/dscf	MASS EMISSION RATE lbs/hr	ST. OF WA. PARTIC. STD gr/dscf	AIR FLOW dscf/m
1	92151	0.056	15.49	0.10	32209
2	92152	0.058	17.35	0.10	34695
3	92153	0.056	16.44	0.10	34459
AVERAGE		0.056	16.43	0.10	33788

The average particulate mass emission rate of 0.056 grains per dry standard cubic foot (gr/dscf) was within the Olympic Air Pollution Control Authority (OAPCA) standard of 0.10 gr/dscf for this particular asphalt paving plant. Computer printouts which detail the complete results immediately follow the "Calculation of Results" section of this report. An acceptable leak check followed each run. The percentage isokinetics were within the acceptable limits of 100 ± 10% for each run. Run 1 was nearly completed when Lakeside personnel signaled that the holding silo was full and they were stopping the process. The test was stopped at 59.3 minutes into the run. During run 3 the probe-to-filter connecting glassware was broken when switching from port 3 to port 4 after 45 minutes of sampling time. The plant was near the end of its' production day when this breakage occurred, therefore, Mr. Guenthoer of Am Test and Mr. Wilson of OAPCA decided that it would be appropriate to discontinue sampling. The filter and condenser section of the Method 5 train were leak-checked and found to be within the acceptable EPA criteria.

DISCUSSION

SAMPLING PROCEDURES - OVERVIEW

Sampling procedures specified in the July 1, 1984 Title 40 Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Methods 1-5, were followed throughout this project. Methodology suggested in the Environmental Protection Agency's (EPA's) Air Pollution Training Institute "Course 450 - Source Sampling for Particulate Pollutants" and quality assurance procedures outlined in the EPA's reference manual titled Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-600/4-77-0276, along with current updates, were used for supplemental information with respect to quality assurance and testing protocol.

SAMPLING PROCEDURES - SPECIFIC

The 31 inch by 37 inch rectangular stack had four (4) sampling ports located at equal distances along the 37 inch side. The sampling ports were located 3 feet upstream and 15 feet downstream from the nearest flow disturbance. Four (4) traverses of six (6) points each were selected according to Method 1 criteria (40 CFR 60, July 1, 1984). Each point was sampled for 2.5 minutes, for a total sampling time for each Method 5 run of 60 minutes. Both the sample probe and the support plank were marked with felt pen to indicate the proper point location.

Stack condition measurements were performed prior to testing. A sample nozzle was chosen and isokinetic operating parameters were established utilizing a Hewlett-Packard 41CX programmable calculator. The sampling nozzle, probe and prefilter connective glassware were acetone cleaned prior to use. The sample train was assembled and determined to be leak free following the procedures outlined in

Method 5. Before each test a final check was made to assure that the plant was operating at the desired production rate and the desired operating parameters. A final check was made of the box and probe heat. Ice was added to the condenser section. The sample nozzle was positioned in the stack at the first sample point. The sample pump was then turned on and the sampling rate adjusted for isokinetic sampling. Sampling proceeded isokinetically at each of the 6 traverse points. The pump was then turned off and the sample train was moved to the second port. Care was taken to assure that the nozzle tip did not touch the port nipple. The nozzle was then positioned at the first point of the second traverse, the pump was again turned on and isokinetic sampling was performed at the 6 traverse points. Upon completion of the second traverse the probe was removed from the stack and the third and fourth sampling ports were traversed. A post-test leak check was performed according to Method 5 procedures.

SAMPLE TRAIN

The sample train used was an EPA Method 5 design with modifications as shown in Figure 1. The stainless steel button hook nozzle used had a diameter of 0.183 inches as measured on-site with inside calipers. A three (3) foot stainless steel probe with a heated liner was used for these tests. The probe was equipped with S-type pitot tubes and a thermocouple sensor. The pitot tubes have been recently calibrated at the State of Washington Department of Ecology (DOE) wind tunnel. A thermocouple probe was used to measure the stack gas temperature. The Fluke thermocouple indicator has been certified by the manufacturer to be accurate within 1 degree Fahrenheit. A field check with 32 degree icewater was performed. A glass filter assembly with a 125 millimeter glassfiber filter was enclosed in a temperature controlled heated box. The average box temperature was maintained at 248^{o} F $\pm$ 25^{o} F. The nozzle, probe liner, prefilter connective glassware and glassfiber filter is often referred to as the "fronthalf" of the sample train. Following the filter is a condenser section which, by convention, is referred to as the "backhalf". The condenser section consisted of a modified Smith-Greenburg bubbler containing 100 milliliters (ml) of deionized, distilled water, an impinger also containing 100 ml of deionized, distilled water, an empty bubbler, and a bubbler containing indicating silica gel desiccant. The backhalf was maintained at a temperature below 70^{o} F. The sample train was connected to a control box by means of an umbilical cord which contains a vacuum hose, pitot lines, thermocouple wires and a 4-wire electrical cord. The control box (meter box) was used to monitor stack conditions and to facilitate isokinetic sampling. The control box consists of a diaphragm pump used to pull the stack gas through the sample train, fine and course metering valves to control the sampling rate, a vacuum gauge which measures the pressure drop from the sampling nozzle to the metering valves, and a dry gas meter. The dry gas meter has been recently calibrated on a spirometer at the State of Washington Department of Ecology. At the outlet of the dry gas meter is a critical orifice which is used to isokinetically control the flow of gas through the metering system. The pressure drop across the orifice was monitored with both low and high range magnehelic gauges. The pitot tubes utilized to measure stack gas velocity are connected to the control box via the umbilical cord. The control box contains low and high range magnehelic gauges which are used for the velocity measurement.

Sample Clean-Up and Analysis

Following sample collection, the Method 5 sample box was transferred to a room free from air disturbances and airborne particulate. The glassfiber filter was transferred to a petri dish labeled with the sample date, client name and run number. This portion of the particulate catch is referred to as the "A" section.

Care was taken to assure that any loose particulate matter and filter mat were quantitatively transferred to the petri dish. The filters were then placed in an oven and baked at 103^{o} C for 2 hours, then they were transferred to a desiccator containing indicating silica gel for 24 hours of desiccation prior to obtaining final weights. The tare and final weights were made using a Mettler AE163 electronic balance set to a time integrating mode with a readibility of 0.1 milligrams. The filters containing particulate matter were weighed to a constant weight of $\pm$ 0.5 milligrams. The interval between weighings was at least 6 hours. These weights were recorded in a bound laboratory notebook.

The contents of the nozzle, probe liner and prefilter connective glassware were quantitatively transferred to the "B" section storage container labeled with sample date, client name, and run number. Several rinses of acetone, with simultaneous loosening of particulate matter using a clean nylon brush, were used for the fronthalf clean-up. An iodine flask with a female ball joint end was attached to the male ball joint end of the probe to assure that no particulate matter was lost during the cleaning of the probe. This contents of this "B" section acetone rinse were transferred to tared 150 milliliter beakers. The volume of acetone in the beaker was recorded and the beakers were placed on a hot plate with the temperature set on low. The acetone was evaporated under close supervision at a temperature lower than the boiling point of acetone. A tared beaker with 100 milliliters of acetone was handled in an identical fashion to the "B" section samples as a control. The tare and final weights of the beakers were obtained following 2 hours of heating to 103^{o} C and 24 hours of desiccation, as with the filters described above. The samples and acetone blanks were weighed to a constant weight of $\pm$ 0.5 milligrams at 6 hour or greater intervals.

The bubblers and impingers utilized for the condenser section, or "backhalf" of the sample train were weighed with an accuracy of ± 0.1 grams before and after sampling on a triple beam balance. The difference between the initial and final weights of the condenser section constitute the amount of moisture gain during the run. The percent moisture was calculated and did not exceed the theoretical psychrometric chart value. The particulate weights are included on the "Method 5-Particulate Emission Concentration Results" computer printouts which immediately follow the "Calculation of Results" section of this report.

QUALITY ASSURANCE

A strict quality assurance program was followed throughout preparation, sampling, analysis, and report preparation. This program includes recent equipment calibrations, careful chain-of-custody procedures, and use of ACS quality or better reagents.

The sample nozzle was calibrated on-site before sampling using inside calipers accurate to ± 0.001 inch. The dry gas meter was recently calibrated on a spirometer at the Washington State Department of Ecology (DOE). The "S" type pitot tubes have been recently calibrated at the DOE laboratory utilizing a wind tunnel and a standard "P" type pitot tube. The Fluke thermocouple indicator has an accuracy of ± 1 degree Fahrenheit.

In addition to quantitative clean-up and analysis procedures, acetone and filter blanks were carried throughout the laboratory procedures. The Method 5 filters and beakers were weighed to a constant weight of ± 0.5 milligrams. Additional information with respect to the Am Test, Inc. laboratory quality assurance and quality control protocol is included in the Appendix of this report.

CALCULATION OF RESULTS

The results of these tests were calculated using the equations found in the 40 CFR 60 Methods 1-5. These equations are included in the Appendix. Final result calculations were performed using Hewlett-Packard 110 and 150 computer systems. A by-hand sample calculation for the Method 5 runs was performed on a Hewlett-Packard 41CX calculator, and may be found in the Appendix of this report.

APPENDIX

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METHO... PARTICULATE EMISSION CONCENTRATION RESULTS
AM TEST, INC. - AIR QUALITY DEPARTMENT

FILE NAME:	LKSD_R1	LAB #:	92151
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	0749 O'CLOCK
LOCATION:	LACEY, WASHINGTON	STOP TIME:	0856 O'CLOCK
SAMPLE SITE:	BAGHOUSE OUTLET	SAMPLE TIME:	59.3 MINUTES
SAMPLE DATE:	JULY 18, 1985	PRODUCTION RATE:	250 TONS/HR
RUN #:	1-METHOD 5	MIXED REFUSE	
OPERATORS:	JIM GUENTHOER		
CONTACT:	BOB SMITH		
CONTACT:	HAROLD NICKEL		

FINAL WT. OF H2O G.	INIT.WT. OF H2O G	NET WT. OF H2O G.		
			PITOT Cp:	0.845
			NOZZLE DIA INCHES:	0.183
			NOZZLE AREA FT^2:	0.0002
679.1	577.4	101.7	STACK DIA. INCHES:	31"X37"
592.4	573.3	19.1	STACK AREA FT^2:	7.965
466.6	464.7	1.9	METER TEMP. DEG F:	72.0
838.0	829.0	9.0	BAROM. PRES. "HG:	29.96
TOTAL H2O GAIN:		131.7	STATIC PRES. "H2O:	3.00
TOTAL VOLUME (SCF)		6.20	STACK PRES. "HG:	30.18
PERCENT MOISTURE:		12.69	ORIFICE PRES "H2O:	0.98
Bws:		0.1269	METER PRES. "HG:	30.25

INIT. METER VOLUME	250.611		
FINAL METER VOLUME	293.003	AVERAGE % CO2:	8.2
VOLUME SAMPLED:	42.392	AVERAGE % O2:	10.3
STD VOLUME (DSCF):	42.652	AVERAGE % CO:	.0
STD VOLUME (DSCM):	1.507	STACK GAS MW. DRY:	29.72
Y FACTOR:	1.010	STACK GAS MW. WET:	28.23

FRONTHALF PARTICULATE MASS LOADING

FILTER NUMBER:	#125-008	
TARE WEIGHT OF FILTER IN GRAMS:		0.6082
FINAL WEIGHT OF FILTER IN GRAMS:		0.6796
NET WEIGHT OF PARTIC. MATTER IN GRAMS:		0.0714
BEAKER NUMBER:	#85-354	
TARE WEIGHT OF BEAKER IN GRAMS:		68.2786
FINAL WEIGHT OF BEAKER IN GRAMS:		68.3625
NET WEIGHT OF PARTIC. MATTER IN GRAMS:		0.0839
VOLUME OF ACETONE IN MILLILITERS:		110.0
TARE WEIGHT OF ACETONE IN GRAMS:		66.8075
FINAL WEIGHT OF ACETONE IN GRAMS:		66.8077
VOLUME OF ACETONE IN MILLILITERS:		100.0
NET CONTRIBUTION OF ACETONE IN MG/ML:		0.0020
TOTAL FRONTHALF PARTIC. MATTER IN GRAMS:		0.1551

JAW

$$C_{p\,gr/dscf\,@12\%CO_2} = \frac{12}{\%CO_2} * C_p\,(\text{uncorr.})$$

$$= \frac{12}{8.2} * .056 = 0.082$$

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SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
1	0.75	155	1	1.00	156
2	1.35	155	2	1.30	159
3	2.00	156	3	1.70	159
4	2.80	156	4	2.20	159
5	3.00	156	5	3.00	159
6	3.00	156	6	3.50	159
1	0.95	156	1	1.20	159
2	1.70	156	2	1.50	160
3	2.00	158	3	1.90	161
4	2.80	158	4	2.40	158
5	3.50	158	5	3.00	159
6	3.50	156	6	3.00	159

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PERCENT ISOKINETICS:	97 %	
STACK TEMPERATURE:	157.6 DEG. F.	617.6 DEG. R.
AVERAGE VELOCITY HEAD:	2.12 " OF H2O	
STACK GAS VELOCITY:	88.63 AFT/SEC	89.52 FT/SEC.
STACK GAS AIR FLOW:	42359.21 ACF/M	32209.3 DSCF/M
PARTICULATE CONCENTRATION:		0.056 GR/DSCF
POLLUTANT MASS RATE (CONCENTRATION METHOD):		15.49 LB/HR

0.082 gr/DSCF @ 12% CO_2

METHOD 5 - PARTICULATE EMISSION CONCENTRATION RESULTS
AM TEST, INC. - AIR QUALITY DEPARTMENT

FILE NAME:	LKSD_R2	LAB #:	92152
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	1055 O'CLOCK
LOCATION:	LACEY, WASHINGTON	STOP TIME:	1204 O'CLOCK
SAMPLE SITE:	BAGHOUSE OUTLET	SAMPLE TIME:	60.0 MINUTES
SAMPLE DATE:	JULY 18, 1985	PRODUCTION RATE:	250 TONS/HR
RUN #:	2-METHOD 5	MIXED REFUSE	
OPERATORS:	JIM GUENTHOER		
CONTACT:	BOB SMITH		
CONTACT:	HAROLD NICKEL		

FINAL WT. OF H2O G.	INIT.WT. OF H2O G	NET WT. OF H2O G.		
			PITOT Cp:	0.845
			NOZZLE DIA INCHES:	0.183
			NOZZLE AREA FT^2:	0.0002
713.4	600.5	112.9	STACK DIA. INCHES:	31"X37"
609.1	591.1	18.0	STACK AREA FT^2:	7.965
477.7	475.3	2.4	METER TEMP. DEG F:	81.0
849.1	836.7	12.4	BAROM. PRES. "HG:	29.96
TOTAL H2O GAIN:		145.7	STATIC PRES. "H2O:	3.00
TOTAL VOLUME (SCF)		6.86	STACK PRES. "HG:	30.18
PERCENT MOISTURE:		12.89	ORIFICE PRES "H2O:	1.11
Bws:		0.1289	METER PRES. "HG:	30.26

INIT. METER VOLUME	293.576		
FINAL METER VOLUME	340.420	AVERAGE % CO2:	2.3
VOLUME SAMPLED:	46.844	AVERAGE % O2:	17.9
STD VOLUME (DSCF):	46.363	AVERAGE % CO:	0.0
STD VOLUME (DSCM):	1.638	STACK GAS MW. DRY:	29.09
Y FACTOR:	1.010	STACK GAS MW. WET:	27.66

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SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
1	1.50	142	1	1.20	153
2	2.00	143	2	2.00	155
3	2.10	145	3	2.90	156
4	2.50	147	4	3.20	157
5	3.00	148	5	3.50	157
6	3.00	150	6	3.50	157
1	1.30	150	1	1.10	156
2	1.60	152	2	1.60	157
3	2.00	153	3	2.80	159
4	2.20	153	4	3.30	159
5	3.00	154	5	3.50	159
6	3.00	154	6	3.50	159

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PERCENT ISOKINETICS:	97 %	
STACK TEMPERATURE:	153.1 DEG. F.	613.1 DEG. R.
AVERAGE VELOCITY HEAD:	2.40 " OF H20	
STACK GAS VELOCITY:	94.02 AFT/SEC	95.94 FT/SEC.
STACK GAS AIR FLOW:	44934.23 ACF/M	34694.5 DSCF/M
PARTICULATE CONCENTRATION:		0.058 GR/DSCF
POLLUTANT MASS RATE (CONCENTRATION METHOD):		17.35 LB/HR

FRONTHALF PARTICULATE MASS LOADING

FILTER NUMBER:	#125-009	
TARE WEIGHT OF FILTER IN GRAMS:		0.6103
FINAL WEIGHT OF FILTER IN GRAMS:		0.7031
NET WEIGHT OF PARTIC. MATTER IN GRAMS:		0.0928
BEAKER NUMBER:	#85-355	
TARE WEIGHT OF BEAKER IN GRAMS:		65.0917
FINAL WEIGHT OF BEAKER IN GRAMS:		65.1744
NET WEIGHT OF PARTIC. MATTER IN GRAMS:		0.0827
VOLUME OF ACETONE IN MILLILITERS:		115.0
TARE WEIGHT OF ACETONE IN GRAMS:		66.8075
FINAL WEIGHT OF ACETONE IN GRAMS:		66.8077
VOLUME OF ACETONE IN MILLILITERS:		100.0
NET CONTRIBUTION OF ACETONE IN MG/ML:		0.0020
TOTAL FRONTHALF PARTIC. MATTER IN GRAMS:		0.1753

$.1753g \times \frac{1000\,mg}{g} = 175$ ... 2

$C_{p\,12\%CO_2} = .058 \times \frac{12}{2.3} = 0.30$

METHOD 5 - PARTICULATE EMISSION CONCENTRATION RESULTS
AM TEST, INC. - AIR QUALITY DEPARTMENT

FILE NAME:	LKSD_R3	LAB #:	92153
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	1338 O'CLOCK
LOCATION:	LACEY, WASHINGTON	STOP TIME:	1430 O'CLOCK
SAMPLE SITE:	BAGHOUSE OUTLET	SAMPLE TIME:	45.0 MINUTES
SAMPLE DATE:	JULY 18, 1985	PRODUCTION RATE:	250 TONS/HR
RUN #:	3-METHOD 5	MIXED REFUSE	
OPERATORS:	JIM GUENTHOER		
CONTACT:	BOB SMITH		
CONTACT:	HAROLD NICKEL		

FINAL WT. OF H2O G.	INIT.WT. OF H2O G	NET WT. OF H2O G.		
			PITOT Cp:	0.845
			NOZZLE DIA INCHES:	0.183
			NOZZLE AREA FT^2:	0.0002
669.3	575.0	94.3	STACK DIA. INCHES:	31"X37"
592.2	577.6	14.6	STACK AREA FT^2:	7.965
482.3	480.9	1.4	METER TEMP. DEG F:	89.1
754.4	745.6	8.8	BAROM. PRES. "HG:	29.92
TOTAL H2O GAIN:		119.1	STATIC PRES. "H2O:	3.00
TOTAL VOLUME (SCF)		5.61	STACK PRES. "HG:	30.14
PERCENT MOISTURE:		13.83	ORIFICE PRES "H2O:	1.14
Bws:		0.1383	METER PRES. "HG:	30.22

INIT. METER VOLUME	340.688		
FINAL METER VOLUME	376.571	AVERAGE % CO2:	2.3
VOLUME SAMPLED:	35.883	AVERAGE % O2:	17.9
STD VOLUME (DSCF):	34.946	AVERAGE % CO:	0.0
STD VOLUME (DSCM):	1.235	STACK GAS MW. DRY:	29.09
Y FACTOR:	1.010	STACK GAS MW. WET:	27.55

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SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
1	1.30	146	1	1.20	163
2	1.90	150	2	1.50	162
3	2.90	152	3	1.90	164
4	3.20	154	4	2.20	166
5	3.50	156	5	3.00	164
6	3.50	157	6	3.00	165
1	1.20	161	1		
2	1.80	162	2		
3	2.90	163	3		
4	3.00	163	4		
5	3.70	163	5		
6	3.70	162	6		

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PERCENT ISOKINETICS:	98 %	
STACK TEMPERATURE:	159.6 DEG. F.	619.6 DEG. R.
AVERAGE VELOCITY HEAD:	2.44 " OF H20	
STACK GAS VELOCITY:	95.28 AFT/SEC	97.47 FT/SEC.
STACK GAS AIR FLOW:	45537.04 ACF/M	34459.3 DSCF/M
PARTICULATE CONCENTRATION:		0.056 GR/DSCF
POLLUTANT MASS RATE (CONCENTRATION METHOD):		16.44 LB/HR

FRONTHALF PARTICULATE MASS LOADING

FILTER NUMBER:	#125-010
TARE WEIGHT OF FILTER IN GRAMS:	0.6084
FINAL WEIGHT OF FILTER IN GRAMS:	0.6632
NET WEIGHT OF PARTIC. MATTER IN GRAMS:	0.0548
BEAKER NUMBER:	#85-356
TARE WEIGHT OF BEAKER IN GRAMS:	65.6246
FINAL WEIGHT OF BEAKER IN GRAMS:	65.6961
NET WEIGHT OF PARTIC. MATTER IN GRAMS:	0.0715
VOLUME OF ACETONE IN MILLILITERS:	105.0
TARE WEIGHT OF ACETONE IN GRAMS:	66.8075
FINAL WEIGHT OF ACETONE IN GRAMS:	66.8077
VOLUME OF ACETONE IN MILLILITERS:	100.0
NET CONTRIBUTION OF ACETONE IN MG/ML:	0.0020
TOTAL FRONTHALF PARTIC. MATTER IN GRAMS:	0.1261

APPENDIX

METHOD 1 - LOCATION OF TRAVERSE POINTS

Circular Stacks

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

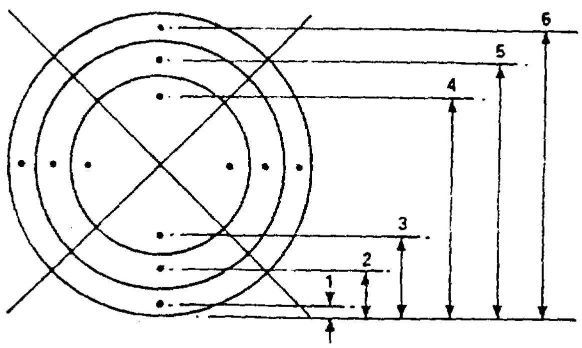


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

[Percent of stack diameter from inside wall to traverse point]

Traverse point number on a diameter	Number of traverse points on a diameter—											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

Rectangular Stacks

For a rectangular cross section, an equivalent diameter (D_e) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{(L+W)}$$

where L=length and W=width.

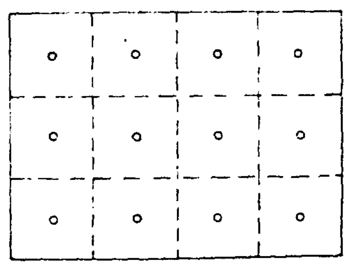
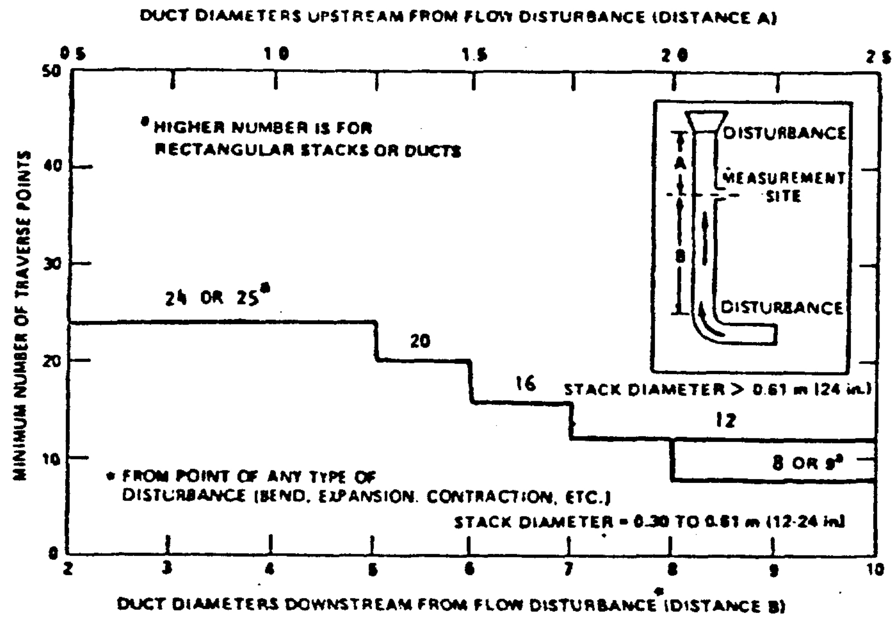
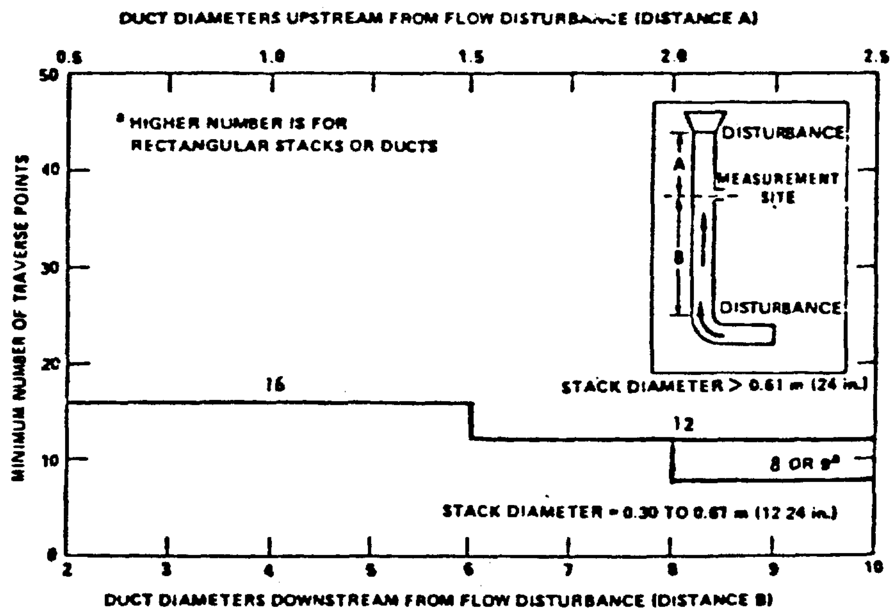


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

METHOD 1 - MINIMUM NUMBER OF TRAVERSE POINTS



Minimum number of traverse points for particulate traverses.



Minimum number of traverse points for velocity (nonparticulate) traverses.

METHOD 2 - STACK GAS VELOCITY AND VOLUMETRIC FLOW CALCULATIONS

Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).
B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.
C_p = Pitot tube coefficient, dimensionless.
K_p = Pitot tube constant,

$$34.97 \frac{m}{sec}\left[\frac{(g/g\text{-mole})(mm\ Hg)}{(°K)(mm\ H_2O)}\right]^{1/2}$$

for the metric system and

$$85.49 \frac{ft}{sec}\left[\frac{(lb/lb\text{-mole})(in.\ Hg)}{(°R)(in.\ H_2O)}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).
M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).
$= M_d\ (1 - B_{ws}) + 18.0\ B_{ws}$

Equation 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).
P_g = Stack static pressure, mm Hg (in. Hg).

P_s = Absolute stack gas pressure, mm Hg (in. Hg).
$= P_{bar} + P_g$

Equation 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).
t_s = Stack temperature, °C (°F).
T_s = Absolute stack temperature, °K, (°R).
$= 273 + t_s$ for metric

Equation 2-7

$= 460 + t_s$ for English

Equation 2-8

T_{std} = Standard absolute temperature, 293 °K (528° R)
v_s = Average stack gas velocity, m/sec (ft/sec).
Δ_p = Velocity head of stack gas, mm H_2O (in. H_2O).
3,600 = Conversion factor, sec/hr.
18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average stack gas velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

Equation 2-9

5.3 Average stack gas dry volumetric flow rate.

$$Q_{sd} = 3{,}600\ (1 - B_{ws}) v_s A \left(\frac{T_{std}}{T_{s(avg)}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Equation 2-10

METHOD 3 - MOLECULAR WEIGHT AND EXCESS AIR CALCULATIONS

Nomenclature.

M_d = Dry molecular weight, g/g-mole (lb/lb-mole).
%EA = Percent excess air.
$\%CO_2$ = Percent CO_2 by volume (dry basis).
$\%O_2$ = Percent O_2 by volume (dry basis).
%CO = Percent CO by volume (dry basis).
$\%N_2$ = Percent N_2 by volume (dry basis).
0.264 = Ratio of O_2 to N_2 in air, v/v.
0.280 = Molecular weight of N_2 or CO, divided by 100.
0.320 = Molecular weight of O_2 divided by 100.
0.440 = Molecular weight of CO_2 divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O_2, CO, and N_2 (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\%EA = \left[\frac{\%O_2 - 0.5\%CO}{0.264\ \%N_2 - (\%O_2 - 0.5\%CO)}\right]100$$

Equation 3-1

NOTE: The equation above assumes that ambient air is used as the source of O_2 and that the fuel does not contain appreciable amounts of N_2 (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternate methods, subject to approval of the Administrator, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

Equation 3-2

METHOD 4 - STACK GAS MOISTURE CALCULATIONS

Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m³)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft³)/(lb-mole) (°R) for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel or silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of water vapor condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w} = K_1 (V_f - V_i) \qquad \text{Equation 4-1}$$

where:
K_1 = 0.001333 m³/ml for metric units
= 0.04707 ft³/ml for English units

2.3.3 Volume of water vapor collected in silica gel.

$$V_{wsg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w} = K_2 (W_f - W_i) \qquad \text{Equation 4-2}$$

where:
K_2 = 0.001335 m³/g for metric units
= 0.04715 ft³/g for English units

2.3.4 Sample gas volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)} = K_3 Y \frac{V_m P_m}{T_m} \qquad \text{Equation 4-3}$$

where:
K_3 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: If the post-test lead rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}} \qquad \text{Equation 4-4}$$

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

METHOD 5 - PARTICULATE EMISSION CONCENTRATION CALCULATIONS - (1)

Nomenclature

A_n = Cross-sectional area of nozzle, m^2 (ft^2).
B_{ws} = Water vapor in the gas stream, proportion by volume.
C_a = Acetone blank residue concentration, mg/g.
c_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).
I = Percent of isokinetic sampling.
L_a = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.0057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.
L_i = Individual leakage rate observed during the leak check conducted prior to the "i^{th}" component change (i=1, 2, 3....n), m^3/min (cfm).
L_p = Leakage rate observed during the post-test leak check, m^3/min (cfm).
m_n = Total amount of particulate matter collected, mg.
M_w = Molecular weight of water, 18.0 g/g-mole (18.0lb/lb-mole).
m_a = Mass of residue of acteone after evaporation, mg.
P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).
P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
R = Ideal gas constant, 0.06236 mm Hg-m^3/°K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole).
T_m = Absolute average dry gas meter temperature (see Figure 5-2), °K (°R).
T_s = Absolute average stack gas temperature (see Figure 5-2), °K (°R).
T_{std} = Standard absolute temperature, 293° K (528° R).
V_a = Volume of acetone blank, ml.
V_{aw} = Volume of acetone used in wash, ml.
V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.
V_m = Volume of gas sample as measured by dry gas meter, dcm (dscf).
$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).
v_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).
W_a = Weight of residue in acetone wash, mg.
Y = Dry gas meter calibration factor.
ΔH = Average pressure differential across the orifice meter (see Figure 5-2), mm H_2O (in. H_2O).
ρ_a = Density of acetone, mg/ml (see label on bottle).
ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).
θ = Total sampling time, min.
θ_1 = Sampling time interval, from the beginning of a run until the first component change, min.
θ_i = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.
θ_p = Sampling time interval, from the final (n^{th}) component change until the end of the sampling run, min.
13.6 = Specific gravity of mercury.
60 = Sec/min.
100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20° C, 760 mm Hg or 68° F, 29.92 in. Hg) by using Equation 5-1.

$$V_{m(std)} = V_m Y\left(\frac{T_{std}}{T_m}\right)\left[\frac{P_{bar}+\frac{\Delta H}{13.6}}{P_{std}}\right] = K_1 V_m Y \frac{P_{bar}+(\Delta H/13.6)}{T_m}$$

Equation 5-1

where;
K_1 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds L_a. If L_p or $_i$ exceeds L_a, Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V_m in Equation 5-1 with the expression:

$$V_m-(L_p-L_a)\theta]$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace V_m in Equation 5-1 by the expression:

$$\left[V_m-(L_1-L_a)\theta_1 - \sum_{i=2}^{n}(L_i-L_a)\theta_i-(L_p-L_a)\theta_p\right]$$

METHOD 5 - PARTICULATE EMISSION CONCENTRATION CALCULATIONS - (2)

and substitute only for those leakage rates (L_i or L_p) which exceed L_a.

6.4 Volume of water vapor.

$$V_{w(std)} = V_{1c}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{1c}$$

Equation 5-2

where:
K_2=0.001333 m³/ml for metric units
=0.04707 ft³/ml for English units.

6.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Equation 5-3

NOTE: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of B_w shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ±1° C (2° F).

6.6 Acetone Blank Concentration.

$$C_a = \frac{m_a}{V_a \rho_a}$$

Equation 5-4

6.7 Acetone Wash Blank.

$$W_a = C_a V_{aw} \rho_a$$

Equation 5-5

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 5-3).

NOTE: Refer to Section 4.1.5 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

6.9 Particulate Concentration.

$$c_s = (0.001\ g/mg)\ (m_n/V_{m(std)})$$

Equation 5-6

6.10 Conversion Factors:

From	To	Multiply by
scf	m³	0.02832
g/ft³	gr/ft³	15.43
g/ft³	lb/ft³	2.205 × 10⁻³
g/ft³	g/m³	35.31

6.11 Isokinetic Varition.
6.11.1 Calculation From Raw Data.

$$I = \frac{100\ T_s[K_3 V_{lc} + (V_m/T_m)(P_{bar} + \Delta H/13.6)]}{60\ \theta v_s P_s A_n}$$

Equation 5-7

where:
K_3=0.003454 mm Hg−m³/ml−°K for metric units.
=0.002669-in. Hg−ft³/ml−°R for English units.

6.11.2 Calculation From Intermediate Values.

$$I = \frac{T_s V_{m(std)} P_{std} 100}{T_{std} v_s \theta A_n P_s 60(1-B_{ws})}$$

$$= K_4 \frac{T_s V_{m(std)}}{P_s V_s A_n \theta (1-B_{ws})}$$

Equation 5-8

where:
K_4=4.320 for metric units
=0.09450 for English units.

6.12 Acceptable Results. If 90 percent I <110< percent, the results are acceptable. If the results are low in comparison to the standard and I is beyond the acceptable range, or, if I is less than 90 percent, the Administrator may opt to accept the results.

OK RB

Client: Lakeside Industries Run #: - Date: 7-15-…

Particulate concentration

Vm = 17.647*42.392*1.010*(29.76 + (0.98/13.6))/532 Equation 5-1

Vm = 42.652 dscf

Wa = ma*vaw/va Substitution of Equation 5-4 into 5-5

Wa = .2 * 110 / 100

Wa = .22 mg

mn = (net weight filter catch) + (net weight "B" section) - Wa + (Backhalf)

mn = 155.1 mg = 71.4 + 83.9 - .22 + NA

cs = [(0.001g/mg)*(15.43gr/ft)*155.1 / 42.652 Equation 5-6

cs = .056 gr/dscf or NA gr/dscf@12% CO2 = cs * 12% / NA %

Moisture

Vw(std) = 0.04707*131.7 ml or grams of water condensed Equation 5-2

Vw(std) = 6.2 scf

Bws = (6.2)/(6.2 + 42.652) Equation 5-3

Bws = .1269 %H2O = 12.69 %

Molecular weight

Md = 0.440(8.2) + 0.320(10.3) + 0.280(81.5) Equation 3-2

Md = 29.72 g/g-mole

Ms = 29.72 * (1 - .1269) + 18.0 * .1269

Ms = 28.23 g/g-mole

Stack gas velocity and volumetric flow rate

vs = 85.49*.845*1.455*$\sqrt{617.6/28.23/30.18}$ Equation 2-9

vs = 89.52 ft/sec (std) or 88.63 afps = 2.9*1.455*.845*$\sqrt{617.6}$ (apx.)

Qsd = 3600*(1-.1269)*89.52*7.965*(528/617.6)*(30.18/29.92) Equation 2-1(

Qsd = 1932540 dscf/hr / 60 min/hr

Qsd = 32209 dscf/min or 42359 acfm = 88.63 afps*7.965 sf*60 (apx.)

Isokinetic variation

I = 0.09450*42.652*617.6/(30.18*89.52*59.3*.0001827*(1-.1269)) Equation 5-8

I = 97 %

* All of the above equations are from the 40CFR60 and assume English units.

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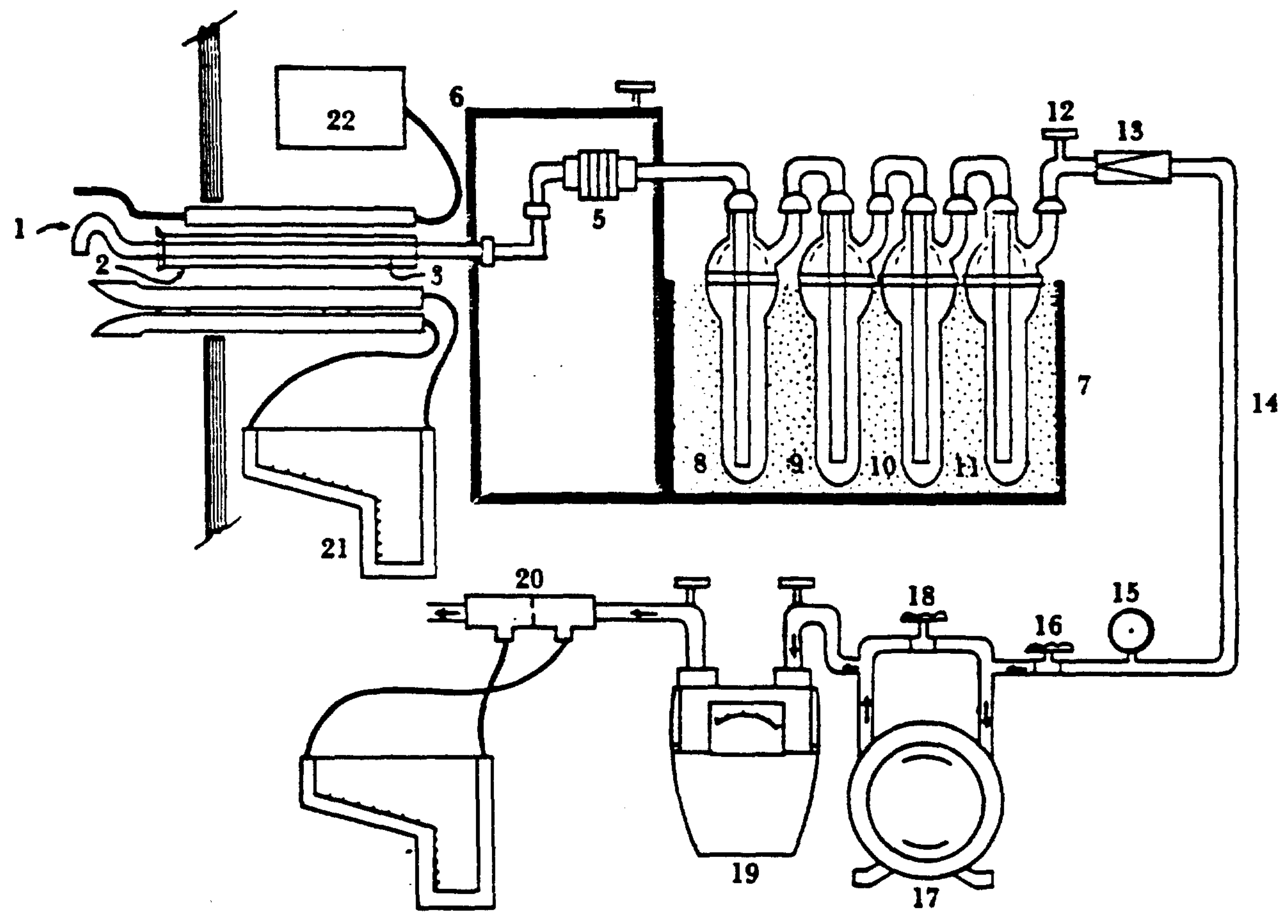

Figure 1. EPA Method 5 particulate sampling train

1. Sampling nozzle
2. Sampling probe sheath
3. Heated sample probe liner
4. Cyclone assembly (proposed regulations do not require this cyclone)
5. Out of stack filter assembly
6. Heated filter compartment maintained 120°C ± 14°C (248°F ± 25°F) (or temperature specified in 40CFR subpart)
7. Impinger case
8. First impinger filled with H_20 (100 ml)
9. Greenburg-Smith (or modified Greenburg-Smith) impinger filled with H_20 (100 ml)
10. Third impinger—dry
11. Fourth impinger—filled with H_20 absorption media (200-300 gm)
12. Impinger exit gas thermometer
13. Check valve to prevent back pressure
14. Umbilical cord—vacuum line
15. Pressure gage
16. Coarse adjustment valve
17. Leak free pump
18. By-pass valve
19. Dry gas meter with inlet and outlet dry gas meter thermometer
20. Orifice meter with manometer
21. Type S pitot tube with manometer
22. Stack temperature sensor

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Lab # 92151

TRAVERSE SAMPLING DATA

Client Lakeside (Lacey)
Date 7-18-85
Sample Location baghouse outlet stack
Operators JAG
Sample Box # 1
Run# 1

EQUIPMENT CHECKS

Initial/Final

Leak Rate Cfm <.02/<.01
Leak Test Vac 24/15

- ✓ Pitots, Pretest
- ✓ Pitots, Postest
- ✓ Orsat Sampling System
- ✓ Tedlar Bag
- ✓ Thermocouple @ _____ °F

SCHEMATIC TRAVERSE LAYOUT

Stack Diameter 31 x 37" (33.6") equiv.
Distance Upstream 15'
Distance Downstream 3'

Filter # 125008 tare _____ mgs

	Final Wt.	Initial Wt.	Net Wt.
#1 Bubbler	679.1	577.4	=
#2 Impinger	592.4	573.3	=
#3 Bubbler	466.6	464.7	=
#4 Silica Gel	838.0	829.0	=

TOTAL WATER VOLUME _____

Start Time 0749
Stop Time 0856
Barometric Pressure "Hg 29.96
Static Pres"H_2O +3"
Production Rate 250 tph

NOMOGRAPH SETUP

% Moisture 15
Meter Temp. 90
Stack Temp. 150
KMZ ΔH@ .944 Y 1.01
Pitot# 3' Side# A
Cp .845
Nozzle Diameter .183
C Factor
Reference ΔP 3.5

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu. Ft.	Pitot Reading (ΔP), In. H_2O		Orifice Setting (ΔH), In H_2O Ideal	Actual	Gas Meter Temp°F In	Out	Pump Vacuum In. Hg Guage	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	Opacity or Orsat Values O_2/CO
A 1	0	250.611	.75	.866	.33	.33	65	64	1	224	59	155	17.6/170
2	2½		1.35	1.162	.60	.60	66	64	1	232	53	155	17.7/171
3	5		2.0	1.414	.88	.88	68	64	2	235	[illegible]	156	17.9/93
4	7½		2.8	1.673	1.24	1.24	69	64	3	234	[illegible]	[illegible]	18.0/134
5	10		3.0	1.732	1.31	1.31	71	65	3	232	[illegible]	[illegible]	17.8/142
6	12½		3.0	1.732	1.31	1.31	73	65	3	232	[illegible]	[illegible]	17.8/141
B 1	15		.95	.975	.42	.42	70	66	1	227	54	156	17.4/163
2	17½		1.7	1.304	.74	.74	72	67	2	242	51	158	17.5/160
3	20		2.0	1.414	.88	.88	73	67	2	245	50	158	17.5/186
4	22½		2.8	1.673	1.23	1.23	75	68	3	247	49	158	17.7/194
5	25		3.5	1.871	1.53	1.53	77	68	4	248	48	158	17.7/197
6	27½		3.5	1.871	1.53	1.53	79	69	4	249	49	156	18.1/[illegible]
C 1	30		1.0	1.000	.45	.45	75	76	1	253	57	156	17.[illegible]/[illegible]
2	32½		1.3	1.140	.58	.58	75	70	1½	248	54	159	17.6/[illegible]
3	35		1.7	1.304	.76	.76	76	71	2	252	53	159	17.8/[illegible]
4	37½		2.2	1.483	.98	.98	77	71	3	256	53	159	17.8/180
5	40		3.0	1.732	1.33	1.33	79	72	3½	258	52	159	17.8/193
6	42½		3.5	1.871	1.55	1.55	80	72	4	258	52	159	17.9/191
D 1	45		1.2	1.095	.53	.53	77	73	1	266	59	159	17.8/159
2	47½		1.5	1.225	.67	.67	78	73	2	267	55	160	17.6/153
3	50		1.9	1.378	.84	.84	78	73	2	264	54	161	17.6/133
4	52½		2.4	1.549	1.06	1.06	79	74	3	262	55	158	17.7/[illegible]
5	55		3.0	1.732	1.33	1.33	81	75	3½	256	56	159	17.[illegible]
6	57½		3.0	1.732	1.33	1.33	82	75	3½	252	58	159	17.[illegible]
59.3	[illegible]	293.003		1.455		.975	72						17.7

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Lab # 92152

TRAVERSE SAMPLING DATA

Client Lakeside (Lacey)
Date 7-18-85
Sample Location
baghouse outlet stack
Operators JAG
Sample Box # 1
Run# 2

EQUIPMENT CHECKS

Initial/Final

Leak Rate Cfm <.01 / <.01
Leak Test Vac 15 / 17
✓ Pitots, Pretest
✓ Pitots, Postest
✓ Orsat Sampling System
✓ Tedlar Bag
✓ Thermocouple @ ___ °F

SCHEMATIC TRAVERSE LAYOUT

Stack Diameter 31 x 37
Distance Upstream 15'
Distance Downstream 31'

Filter # 125009 tare ___ mgs

	Final Wt.	Initial Wt.	Net Wt.
#1 Bubbler	~~608~~ 713.4	- 600.5	=
#2 Impinger	609.1	- 591.1	=
#3 Bubbler	477.7	- 475.7	=
#4 Silica Gel	849.1	- 836.7	=

TOTAL WATER VOLUME ___

Start Time 1055
Stop Time 1204
Barometric Pressure "Hg 29.96
Static Pres"H_2O +3"
Production Rate ___

NOMOGRAPH SETUP

% Moisture 15
Meter Temp. 80
Stack Temp. 150
Kmz
ΔH@ .944 Y 1.01
Pitot# 3 Side# A
Cp .845
Nozzle Diameter .183
C Factor ___
Reference ΔP 3.5

Sample Point		Elap Time Min.	Dry Gas Meter Reading Cu. Ft.	Pitot Reading (ΔP), In. H_2O	Orifice Setting (ΔH), In H_2O Ideal	Actual	Gas Meter Temp °F In	Out	Pump Vacuum In. Hg Guage	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	Opacity or Orsat Values O_2/C
D	1	0	293.576	1.5	.69	.69	76	76	4½	265	63	142	18.1/63
	2	2½		2.0	.91	.91	77	76	5	240	55	143	18.0/62
	3	5		2.1	.95	.95	78	76	6	256	54	145	17.9/88
	4	7½		2.5	1.13	1.13	80	76	7	255	54	147	17.9/89
	5	10		3.0	1.36	1.36	81	76	8	254	54	148	17.9/89
	6	12½		3.0	1.35	1.35	82	76	8	255	54	150	18.0/85
C	1	15		1.3	.59	.59	81	77	4	249	62	150	17.8/62
	2	17½		1.6	.72	.72	82	78	5	254	59	152	17.8/164
	3	20		2.0	.90	.90	82	78	6	254	59	153	17.9/199
	4	22½		2.2	.99	.99	83	78	7	254	59	153	17.9/201
	5	25		3.0	1.34	1.34	85	79	8	253	58	154	18.1/140
	6	27½		3.0	1.34	1.34	86	79	8	255	58	154	17.9/126
B	1	30		1.2	.54	.54	83	79	4	262	67	153	17.8/162
	2	32½		2.0	.90	.90	84	80	5½	245	62	155	17.7/156
	3	35		2.9	1.29	1.29	84	80	8	264	61	156	17.8/144
	4	37½		3.2	1.43	1.43	85	80	8½	263	61	157	17.9/142
	5	40		3.5	1.56	1.56	87	81	9	261	62	157	18.0/178
	6	42½		3.5	1.56	1.56	88	81	9	261	62	157	18.0/184
A	1	45		1.1	.49	.49	84	81	4	262	67	156	17.9/176
	2	47½		1.6	.71	.71	84	82	5	257	67	157	17.8/163
	3	50		2.8	1.25	1.25	85	82	8	252	67	159	18.0/132
	4	52½		3.3	1.47	1.47	86	82	9	249	66	159	18.1/119
	5	55		3.5	1.56	1.56	88	82	10	239	65	159	17.9/131
	6	57½		3.5	1.56	1.56	89	83	10	240	66	159	17.9/125
		60	340.420										

46.844   1.11   81   17.9   125

am test inc.

4900 9TH AVENUE N.W., • SEATTLE, WASHINGTON 98107-3697 • 206/783-4700

Lab# 92153

TRAVERSE SAMPLING DATA

Client Labinde (Lacey)
Date 7-16-85
Sample Location baghouse outlet stack
Operators DAG
Sample Box # 1
Run# 3

EQUIPMENT CHECKS

Initial/Final

Leak Rate Cfm <.01 / <.01

Leak Test Vac 15 / 15

✓ Pitots, Pretest

✓ Pitots, Postest

✓ Orsat Sampling System

✓ Tedlar Bag

✓ Thermocouple @ ____ °F

SCHEMATIC TRAVERSE LAYOUT

Stack Diameter 31" X 37"
Distance Upstream 15 ft
Distance Downstream 3 ft

Filter #625010 tare ____ mgs

	Final Wt.		Initial Wt.		Net Wt.
#1 Bubbler	669.3	-	575.0	=	
#2 Impinger	592.2	-	577.6	=	
#3 Bubbler	482.3	-	480.9	=	
#4 Silica Gel	754.4	-	745.6	=	

TOTAL WATER VOLUME ____

Start Time 1338
Stop Time 1430
Barometric Pressure "Hg 29.92
Static Pres"H_2O +3.0
Production Rate 250 tph

NOMOGRAPH SETUP

% Moisture 15
Meter Temp. 90
Stack Temp. 155
Km 2 ΔH@ .944 Y 1.01
Pitot# 3' Side# A
Cp .845
Nozzle Diameter .183
C Factor ____
Reference ΔP 3.5

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu. Ft.	Pitot Reading (ΔP), In. H_2O	Orifice Setting (ΔH), In H_2O Ideal	Orifice Setting (ΔH), In H_2O Actual	Gas Meter Temp°F In	Gas Meter Temp°F Out	Pump Vacuum In. Hg Guage	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	Opacity or Orsat O2/CO Values
A 1	0	340.688	1.3	.55	.55	84	84	2	204	54	146	16.7/283
2	2½		1.9	.86	.86	85	84	3	234	47	150	17.1/229
3	5		2.9	1.32	1.32	86	84	4	240	45	152	18.0/257
4	7½		3.2	1.45	1.45	88	84	4	241	46	154	18.1/294
5	10		3.5	1.59	1.59	90	85	4½	245	48	156	18.1/292
6	12½		3.5	1.59	1.59	91	85	4½	246	50	157	18.1/267
B 1	15		1.2	.54	.54	90	86	2	259	56	161	17.9/298
2	17½		1.8	.82	.82	90	86	3	264	53	162	17.9/297
3	20		2.9	1.30	1.30	91	86	5	264	53	163	18.0/293
4	22½		3.0	1.35	1.35	93	87	5	263	55	163	18.0/293
5	25		3.7	1.66	1.66	95	88	7	250	59	163	18.3/350
6	27½		3.7	1.66	1.66	96	88	7	255	58	162	18.1/337
C 1	30		1.2	.54	.54	92	89	2	246	60	163	17.8/106
2	32½		1.5	.67	.67	93	89	3	247	60	162	17.7/126
3	35		1.9	.85	.85	93	89	3	245	58	164	17.9/118
4	37½		2.2	.99	.99	94	90	4	265	60	166	17.8/315
5	40		3.0	1.35	1.35	93	90	5	248	61	164	18.1/227
6	42½		3.0	1.35	1.35	94	90	5	245	61	165	18.2/251
STOP		376.571										

* 45 | 1.135 | 89.1 | 17.9 | 26

Lakeside
LACEY - PLANT-

Source Test Observation Checklist
Asphalt Batch Plants

Process

Asphalt Paving Plant Madson Lakeside (Lacey)

Drum Mix Description 9' x 32'
Madson NR 642

Identification No. NR 642 5056008-72 Installed June 1985

Process Rate 250 + Tons/hr Firing Rate 275 Gal/hr

Type of Fuel Diesel Smoke Point optional

Injection Location Front of Dryer

Asphalt Discharge Temp. 325 °F Gravel Moisture 4 %

Fines In Gravel (<200 mesh) 6%

Operation Personnel Foreman — oiler — Loader op.

Asphalt Supplier U.S. Oil

Density optional #/gal Flash Point optional °F

Class B -

Control Equipment

Description or Name Wag Baghouse

Water Press N/A PSI Rate N/A Gal/min

Water: Reused, Clean? N/A

Venturi Press ΔP = N/A Inch

Static = N/A Inch

Air Flow Method 5 test

Saturated Stack

Form No. 63-172 1/84

State of Washington Department of Ecology

Summary & Description Pages 1-5

SOURCE TEST

SUMMARY OF EMISSIONS TO ATMOSPHERE

Report No. 87-10

Report Date 8-21-87

Test Date 7-7-87

Name of plant Lakeside Industries

Location of plant Lacey

Person contacted Morris Johnston

Type of operation Asphalt Plant

Source tested Dryer Stack

Requesting Agency Olympic Air Pollution Control Authority

Purpose Measure Particulate Emissions

Applicable Standard OAPCA Regulation 1

SUMMARY OF MEASUREMENTS

Pollutant	Measured Emission	Allowable Emission	Emission/Process Factor	Methods
Particulate	.009 gr/DSCF	.04 gr/DSCF		Ecology Eco Method 5

TEST ENGINEER John Drabek *John Drabek*

FIELD PERSONNEL

John Drabek

Tom Harris

LAB ANALYSIS

Susan Davis

Test Witnessed by:

Gregory Conner (OAPCA)

ECY 020-1-62
Rev. 1/79

I. Purpose

The purpose of the test was to measure particulate emissions from the dryer stack at the Lakeside Industries asphalt plant in Lacey. Results will be used by the Olympic Air Pollution Control Authority in determining compliance.

II. Description of Unit Tested

This plant is located off Hagum Bay Road and is visible from the I-5 freeway in Lacey. The hot mix asphalt paving batch plant consisted of a rotary dryer, screening and classifying systems, weigh boxes for asphalt cement and aggregate, a pug mill mixer, and the necessary conveying equipment of bucket elevators and belt conveyors. The dryer was fired by diesel oil from U.S. Oil, Tacoma, and heated the aggregate to 325^{o}F. The dried aggregate is conveyed by a bucket elevator to the screening equipment where it is classified and dumped into elevated storage bins. Selected amounts of the proper size aggregate are dropped from the storage bins to the weigh hopper. The weighed aggregate is then dropped into the mixer along with hot asphalt cement, forming a final class B mix of 5.0 percent asphalt and 5/8 inch minus aggregate. The batch is then dumped into waiting trucks for transportation to the paving site. Production was 260 tons per hour.

Drier emissions are controlled by a multiclone and a baghouse containing 1120 bags. Dust collection from secondary sources, that is, the elevator, vibrating screens, hot aggregate bins, weigh hopper and mixer are controlled by connection through branch ducting to the main exhaust system. The pressure drop across the pulse jet baghouse was 4 inches water gauge as measured by Ecology at the wall surface and baghouse temperature was 230^{o}F. The pulse jet air pressure was 110 psi. Collected solids are recycled. Gases pass through a 250 amp, 900 rpm fan and then to the atmosphere through a rectangular stack.

III. Test Procedure

Two Ecology Method 5 particulate samples were collected using a heated probe and filter as shown in Figure 1. A third sample could not be collected due to lack of plant operating time. A 64 minute 16 point traverse was made for each sample to representative points in the stack. An integrated bag sample was taken concurrently with particulate sampling and was subsequently analyzed for carbon dioxide and oxygen using an orsat analyzer according to Ecology Method 3. Moisture condensed in the impingers was used to determine the water vapor content.

IV. Results

Results are shown on Page 4. The average measured particulate concentrations was .009 grains per dry standard cubic foot.

V. Comments

Problems in the particulate control equipment were observed during an Ecology inspection in September, 1984. The problems and current status are listed below.

1. 1984: An oil water removal system was bypassed

   1987: A new commercial compressor system has been installed with an integral oil-water removal arrangement.

2. 1984: Moisture may have been condensing on the bags.

   1987: The baghouse temperature is monitored and was 230°F during testing.

3. 1984: Fugitive emissions were observed from the solids discharge pit hopper and elevator.

   1987: All solids discharged are recycled while the dryer is operating. Visible emissions were not observed from the secondary sources.

TABLE 1
METHOD 5 RESULTS SUMMARY

Plant Name LAKESIDE INDUSTRIES, LACEY   NEDS
Address   City *LACEY*
County *THURSTON*   State *WASH*   Zip code

Industry Type *ASPHALT PLANT*
Process Tested *DRYER STACK*   SCC
Unit Capacity   Fuel Type *OIL*
Type of Control Equipment *MULI/BAGH* Tested at Inlet   Outlet *X*

Reason Tested: Spec. Study____Compliance w/ Fed. _ State & Local_ Other _
Personnel Present *JOHN DRABEK, TOM HARRIS*

Pollutant Measured *PARTICULATE*   Method 5
Stack Height, ft 35.00   Area, sq ft *8.44*
Diameters Downstream *8.0*   Upstream *3+*

Test No. *87-10*

Run Number	1	2	Average
Date: Mo-Day-Yr.	07-Jul-87	07-Jul-87	
Operating Rate TONS/HR	260	260	260
Gas Composition % CO_2	2.30	1.70	2.00
% O_2	18.50	16.80	17.65
% N_2	79.20	81.50	80.35
% Other	0.00	0.00	
% H_2O	19.41	20.64	20.02
Estimated Mole Wt., Wet	27.08	26.81	26.95
Execess Air, %	768.02	356.23	562.13
Gas Flow Data			
Gas Pressure, in. Hg.	29.91	30.08	30.00
Gas Temperature, F	200.06	209.88	204.97
Ave. Stack Vel. FPS	101.38	97.46	99.42
Flow Rate, SCFM Dry	32,582	31,518	32,050
Sample Information			
Volume Sampled, SDCF	47.18	45.57	
Sample Duration, Min.	64.0	64.0	
Nozzle Dia., in.	0.188	0.188	
Isokinetic Rate, %	99.6	101.0	
Results PARTICULATE Front Half			
Conc., Gr/SDCF	0.007	0.010	0.009
Conc., Gr/SDCF 7% O2	0.043	0.034	0.039
Conc., Gr/SDCF 12% CO2	0.039	0.071	0.055
Emission Rate, lb/Hr	2.1	2.7	2.4
Emission Factor, lb/Ton	0.008	0.010	0.009

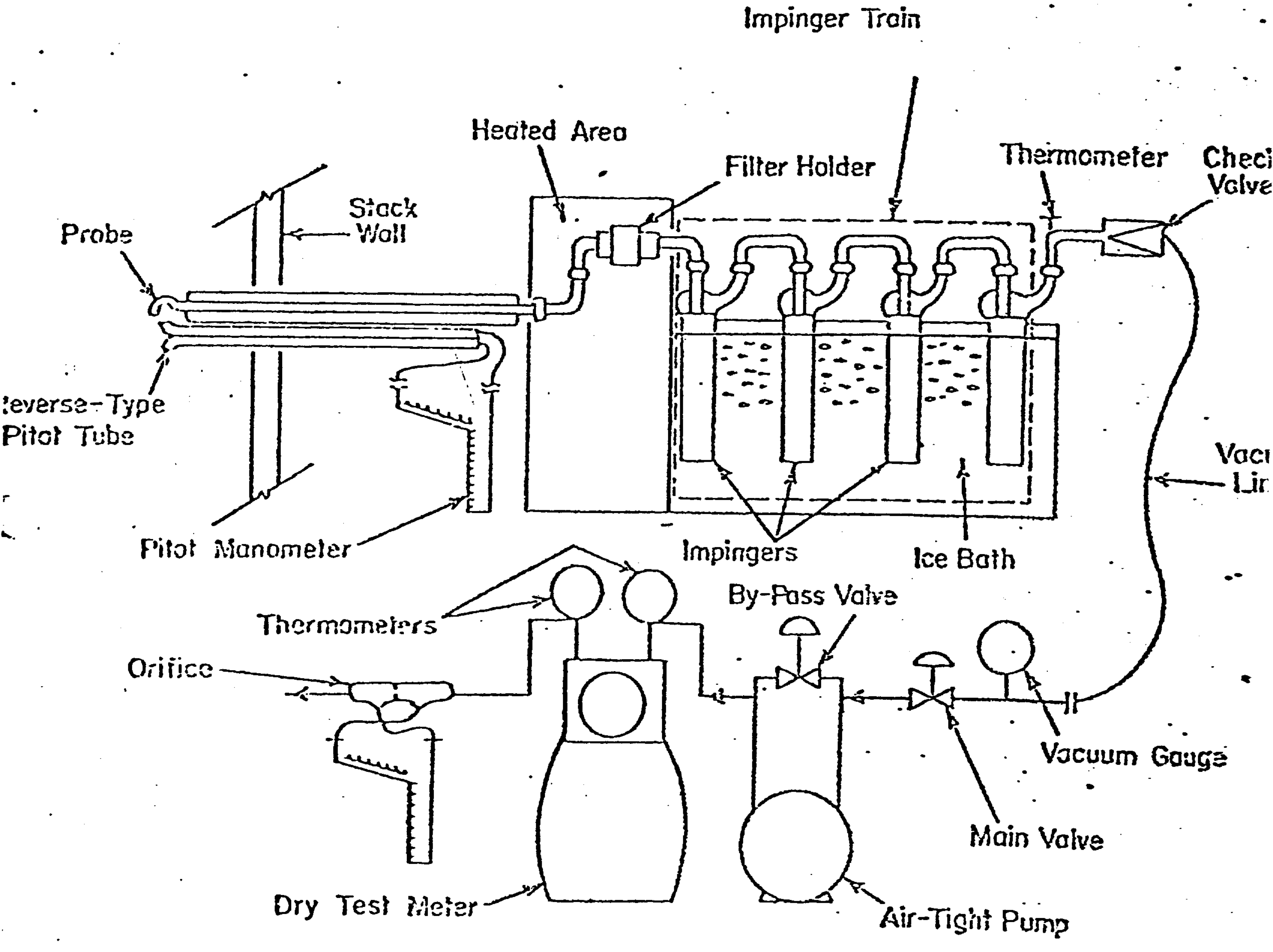


FIGURE 1. PARTICULATE SAMPLING TRAIN

State of Washington
Department of Ecology

TEST NO. ______

DATE 7-7-87

METHOD 5—
PARTICULATE SAMPLING WITH A HEATED FILTER WITH IMPINGER

PLANT Lakeside Industries

SAMPLING LOCATION Lacey

SAMPLE TYPE part.

RUN NUMBER 1 OPERATOR J.D.

AMBIENT TEMPERATURE ______

BAROMETRIC PRESSURE 29.91

STATIC PRESSURE ______

STACK DIAMETER 32 x 38 Area ______ ft^2

PROBE LENGTH, TYPE, FACTOR 6' SS, .797

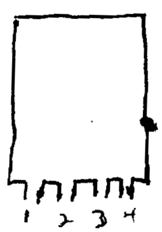
NOZZLE I.D. .1875

ASSUMED MOISTURE, % 20

SAMPLE BOX NUMBER 1 METER 2

WATER VOLUME COLLECTED 226.0 (Impingers) + 15.3 (Silica Gel) = 241.3 ml

ORSAT CO_2 2.3% O_2 18.5 CO ______



PARTICULATE WEIGHT

	WASH	FILTER	IMPINGERS
I.D. NO.		D-20A	
FINAL		.7775	
TARE		.7665	
GAIN	.0116	.0110	

total weight = .0226

	TRAVERSE POINT NUMBER	SAMPLING TIME, min. / CLOCK TIME (24 hr. clock)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (P_s) ~~in.~~ H_2O mm	ORIFICE PRESSURE DIFFERENTIAL (H) H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACTUAL	STACK TEMP (T_s), °F	PROBE TEMP °F	SAMPLE BOX TEMP °F	IMPINGER TEMP °F OUT	IMPINGER TEMP °F IN	DRY GAS METER TEMPERATURE OUTLET ($T_{m_{out}}$), °F	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$), °F	PUMP VACUUM in. Hg
	1	0 \ 6:15	532.97	130		45	175	277	254	54	121	61	62	5
	2	4	537.5	75		27	174	322	281	48	127	61	65	3
1	3	8	540.3	44		16	182	275	291	47	169	63	68	2
	4	12	542.7	36		13	189	256	290	46	184	65	71	
	5	16	544.95	118		41	189	248	246	46	167	66	67	5
	6	20	548.7	86		30	200	260	231	44	160	66	70	4
2	7	24	552.2	55		19	203	266	237	45	189	67	74	3
	8	28	555.1	42		14	201	261	248	45	192	69	75	2
	9	32	557.18	120		42	205	250	248	46	186	70	76	5
	10	36	561	92		32	206	244	286	44	211	71	79	
3	11	40	564.9	52		18	206	243	290	45	217	73	80	2
	12	44	567	38		13	205	241	281	48	207	74	81	
	13	48	569.8	76		26	212	237	247	50	191	75	77	3
4	14	52	572.8	80		28	217	286	234	47	193	75	81	4
	15	56	576.6	60		21	218	254	227	47	187	75	81	3
	16	60	578.8	48		16	219	236	225	48	187	76	82	2

ECL-943- 64 add 2 581.35 [illegible] = 8.21 [illegible] Ave Ts 200 Ave(Tm) 74

METHOD 5 CALCULATIONS
Data Input

Plant LAKESIDE INDUSTRIES, LACEY
Sampling Location DRYER STACK
Sample Type PARTICULATE
Run Number 1
Bar Pressure 29.91
Static Pressure 0.0
Stack I.D. Area 8.44
Length 32.00 Width 38.00

Operating Rate 260.00 Tons/hr
Sample Time 64.00 Min

Pitot Fact 0.7970
Nozzle ID 0.1875 inches
H2O Weight 141.30
Orsat CO2 2.30 O2 18.50

Particulate Weight

	Wash	Filter	Impingers
I.D. NO.		D-20A	
Final		0.7775	
Tare		0.7665	
Gain	0.0116	0.0110	

Start Vol 532.97
Final Vol 581.35

Moisture Fraction 0.1941
Mole Weight 29.2664
Fo 1.34
Stack Flow est, acfm 51,337

Point	Del P	Del H	Temperature Stack	Temperature Meter	sqrt[dp]	Vel
1	130.0	45.0	175	62	2.27	136.47
2	75.0	27.0	174	65	1.73	103.57
3	44.0	16.0	182	68	1.32	79.83
4	36.0	13.0	189	71	1.20	72.60
5	118.0	41.0	189	67	2.16	131.44
6	86.0	30.0	200	70	1.85	113.16
7	55.0	19.0	203	74	1.48	90.70
8	42.0	14.0	201	75	1.29	79.14
9	120.0	42.0	205	76	2.18	134.18
10	92.0	32.0	206	79	1.91	117.57
11	52.0	18.0	206	80	1.44	88.39
12	38.0	13.0	205	81	1.23	75.51
13	76.0	26.0	212	77	1.74	107.34
14	80.0	28.0	217	81	1.8	110.5
15	60.0	21.0	218	81	1.54	95.80
16	48.0	16.0	219	82	1.38	85.75
Average		25.1	200.1	74.31	1.66	101.38

State of Washington Department of Ecology

TEST NO. ____
DATE 7-7-87

METHOD 5— PARTICULATE SAMPLING WITH A HEATED FILTER WITH IMPINGER

PLANT Lakeside Industries
SAMPLING LOCATION Lacey
SAMPLE TYPE part.
RUN NUMBER 2 OPERATOR ____
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 29.91
STATIC PRESSURE ____
STACK DIAMETER 32x38 Area ____ ft²

PROBE LENGTH, TYPE, FACTOR 6' SS .797
NOZZLE I.D. .1875
ASSUMED MOISTURE, % 20
SAMPLE BOX NUMBER 2 METER 2
WATER VOLUME COLLECTED 236.0 (Impingers) + 15.6 (Silica Gel) = 251.6 ml
ORSAT CO_2 1.7 O_2 16.8 CO ____

PARTICULATE WEIGHT

	WASH	FILTER	IMPINGERS
I.D. NO.		D-103	
FINAL		.7908	
TARE		.7789	
GAIN	.0176	.0119	

total weight = .0295 gm.

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24 hr. clock)	GAS METER READING (V_m), ft³	VELOCITY HEAD (P_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (H), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL ACTUAL	STACK TEMP (T_s), °F	PROBE TEMP °F	SAMPLE BOX TEMP °F	IMPINGER TEMP °F OUT	IMPINGER TEMP °F IN	DRY GAS METER TEMPERATURE OUTLET ($T_{m_{out}}$), °F	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$), °F	PUMP VACUUM in. Hg
1	0	7:57	581.55	110		38	221	260	301	57	214	73	72	5
2	4		585.5	65		22	222	295	280	53	256	73	75	4
3	8			38		13	224	245	274	51	230	73	77	2
4	12		591.3	40		14	226	225	277	52	236	74	74	
5	16		593.18	135		46	227	248	274	55	181	75	78	7
6	20		597.5	80		27	229	261	274	55	244	76	82	4
7	24		600.7	40		14	229	263	272	56	237	76	82	3
8	28		603.1	72		11	228	274	264	58	231	77	83	
9	32		605.4	105		35	218	273	261	60	186	78	81	5
10	36		609.3	85		29	174	224	236	54	167	68	65	4
11	40		611.9	50		17	175	218	229	50	195	68	68	3
12	44		614.8	25		8	181	262	224	50	195	68	70	
13	48		616.6	78		26	186	280	239	53	180	69	73	4
14	52		629.8	85		29	196	263	255	49	218	70	77	4
15	56		623.4	60		20	209	239	275	50	232	72	82	
16	60		626.1	3?		12	211	213	271	52	214	74	81	2
	Tot		628.21											

[illegible] about one hour

METHOD 5 CALCULATIONS
Data Input

Plant	LAKESIDE INDUSTRIES, LACEY		Pitot Fact	0.7970	
Sampling Location	DRYER STACK		Nozzle ID	0.1875	inches
Sample Type	PARTICULATE		H2O Weight	251.60	
Run Number	[illegible]		Orsat CO2	1.70	O2 [illegible]
Bar Pressure	30.[illegible]				
Static Pressure					
Stack Dia	Area	8.44			
Length	32.00 Width	38.00			
Operating Rate	260	Tons/hr			
Sample Time	64.[illegible] min				

Particulate Weight

	Wash	Filter	Impingers
I.D. NO.		D-103	
Final		0.7908	
Tare		0.7789	
Gain	0.0176	0.0119	

Start Vol	581.55
Final Vol	628.21
Moisture Fraction	0.2064
Mole Weight	29.1070
Fo	2.41
Stack Flow Wet, acfm	49,354

Point	Del P	Del H	Temperature Stack	Temperature Meter	sqrt[dp]	Vel
1	110.0	38.[illegible]	221	72	2.09	130.00
2	65.0	22.[illegible]	222	75	1.61	100.01
3	38.0	13.[illegible]	224	77	1.23	76.58
4	40.0	14.[illegible]	226	79	1.26	78.68
5	135.0	46.[illegible]	227	78	2.31	144.65
6	80.0	27.[illegible]	229	82	1.78	111.51
7	40.0	14.[illegible]	229	82	1.26	78.85
8	32.0	11.[illegible]	228	83	1.13	70.48
9	105.0	35.[illegible]	218	81	2.04	126.73
10	85.0	29.[illegible]	174	65	1.84	110.26
11	50.0	17.[illegible]	175	68	1.41	84.64
12	25.0	8.[illegible]	181	70	1.00	60.13
13	78.0	26.[illegible]	186	73	1.76	106.62
14	85.0	29.[illegible]	196	77	1.84	112.16
15	60.0	20.[illegible]	209	80	1.54	95.16
16	35.0	12.[illegible]	213	81	1.18	72.90
Average		22.[illegible]	209.9	76.44	1.58	97.46

STATE OF WASHINGTON DEPARTMENT OF ECOLOGY May 1, 1977

SOURCE TEST CALCULATIONS

APPENDIX-B CALCULATIONS

SAMPLE CALCULATION RUN 1

Volume Sampled

The volume sampled is normally expressed in standard dry cubic feet (sometimes in standard dry liters), and is determined by correction of the meter volume to standard conditions.

$$Vs = \overset{48.38}{\cancel{Vm}} \frac{520}{460 + \underset{74}{\cancel{Tm}}} \frac{\overset{29.91}{\cancel{Pm}}}{29.92} = 47.10 \text{ DSCF}$$

Particulate Concentration

The concentration of particulate is determined by dividing the weight of particulate collected by the volume sample and expressed in grains per standard cubic foot.

$$C_p = \frac{(.01543 \text{ gr/mg}) (\overset{22.6 \text{ mg}}{\cancel{M_p}})}{\underset{47.10}{\cancel{Vs}}} = .0074 \frac{gr}{ft^3}$$

Gas Pollutant

To determine the volumetric concentration of gaseous pollutants, find the number of moles of pollutants per 10^6 moles of gas. The result is expressed in parts per million, ppm.

$$Cgas = \frac{Mp}{MWp} \frac{MV}{Vs} \times 10^6$$

Excess Air

The excess air is determined by the concentration of O_2 in the gas stream at the sample point, divided by the concentration of O_2 used for combustion, with adjustments for carbon monoxide.

$$EA = \frac{\%O_2 - 0.5\% \, CO}{0.264 \, (\%N_2) - \%O_2 + 0.5 \, (\%CO)} \times 100$$

O_2 Correction

To adjust the pollutant concentration to a 7% O_2 standard, the concentration is multiplied by the O_2 in the air, minus 7% O_2, and divided by the O_2 in the air minus the O_2 in the gas stream.

$$C_7 = \frac{(21.0 - 7.0)}{(21.0 - \%O_2)} C = \frac{14.0 \, C}{21.0 - \%O_2}$$

Moisture Mole Fraction

Condensation Method -

The moisture mole fraction is determined by dividing the volume of the water vapor collected by the total volume of the sample, including water vapor.

241.3

$$Fm = \frac{0.0465\ Ww}{0.0465\ Ww + Vs} = .192$$

241.3 47.10

Saturation Method -

By the saturation assumption method, the moisture mole fraction is dividing the vapor pressure of water at the stack temperature by the absolute pressure of the stack gas.

$$Fm = \frac{Pwv}{Ps}$$

Molecular Weight

The molecular weight of the stack gas is determined by summing the mole fraction and the molecular weight of each constituent.

Dry Gas Basis - .023 .155

$$MWd = 44.0\ (FCO_2) + 32.0\ (FO_2) + 28.0\ (FCO) +$$

$$+\ 28.2\ (1.00 - FCO_2 - FO_2 - FCO) = 29.27$$

.023 .155

Wet Basis -

29.27 .192

$$MW = MWd\ (1.00 - Fm) + 18.0\ (Fm) = 27.11$$

.192

Average Stack Gas Velocity

The average stack gas velocity expressed in actual feet per second is determined by:

.797 200 1.65

$$Vave = 85.48\ Fv \sqrt{\frac{460 + Ts}{PS\ MW}}\ \sqrt{\Delta ha} = 101\ ft/sec$$

29.91 27.11

Stack Gas Flow Rate, Actual

The average stack gas flow rate is expressed in actual cubic feet per minute and found by multiplying the average stack gas velocity by the stack area and 60.0.

101

$$Qd = Vave(Ad)60 = 51{,}200\ ft^3/min$$

8.44 ft²

Stack Gas Flow Rate, Standard

The stack gas flow rate under standard conditions is expressed as standard dry cubic feet per minute, and obtained by adjusting the stack gas flow rate to standard temperature and pressure and subtracting the volume of the water vapor.

$$Qs = \frac{520}{460 + \overset{206}{Ts}} \frac{\overset{29.91}{(Ps)}}{(29.92)} (1 - \overset{.192}{Fm}) \overset{51,200}{Qd} = 32,600 \text{ SDCFM}$$

Emission Rate

Emission rate is calculated from the product of the concentration and the flow rate, and normally expressed in pounds per hour.

Particulate -

$$Rp = \frac{\overset{.0074}{CP}\ (\overset{32,600}{Qstd.})(60\ Min/Hr)}{7000\ Gr./Lb.} = 2.0$$

$$Rgas = Cgas \frac{(Qstd)(MWp)}{(MVe)} \frac{(60\ Min.)}{(Hr.)}$$

Isokinetic Rate

The isokinetic rate ratio of the velocity of gas through the nozzle to the velocity of gas passed the nozzle and normally expressed as percent.

$$I = \frac{0.\overset{.138}{\cancel{230}}\ Vs\ (460 + Ts)}{AnPs\ (1 - Fm)\ Vave}$$

$$I = \frac{\text{Velocity of Nozzle}}{\text{Velocity of Stack}}$$

$$= \frac{V_s\ (460 + T_s)\ 29.92}{60\ \theta\ (A_n)\ 520°R\ V_{ave}\ P_s\ (1 - F_s)}$$

$$= \frac{47.10\ (460 + 206)\ 29.92}{60\ (64\ min)\ .00019\ ft^2\ (520°R)\ 101\ \frac{ft}{sec}\ 29.91\ (1 - .19)}$$

$$= 1.00$$

USER: John Drabek

DATE: Postweighed 7-14-87 by Susan Davis

Identification of Sample	Post Weight	Pre-Weight	Difference
D9	0.9017	0.7772	0.1245
D101	.8804	.7656	.1148
D136	.8383	.7452	.0931
D20A	.7775	.7665	.0110
D103	.7908	.7789	.0119

*** Lab Analysis Report ***

John Drabek

Transaction #: 08031148 Seq #: 01 (15) Solids - Specified
(WE) DOE, Manchester Was
Prj: LAKESIDE ASPHALT (DOE-582A) 212 JWD
Par: Solids Total mg (Par# 500 S)

Instrument: GRAV Gravimetric Measurement
Method: EP1-160.3 Residue, Total, Gravimetric, Dried at 103-105 Deg-C
Chemist: (DKS) Solberg, Keith DOE Hours Worked:
Lab Prep:( ) Unspecifed Date Preprd: Date Anlyzd: 870714

Matrix: (10) Water-Total Units: (52) mg

Line	Sample #	Result	Sample Location/Description	Volume-ml	#Days to Anl
1	87 287044	11.6	RUN 1 , LACEY	575	870707 (7)
2	87 287045	17.9	RUN 2, LACEY	480	870707 (7)
3	87 287046	58.6	RUN 1, ABERDEEN	550	870708 (6)
4	87 287047	47.6	RUN 2, ABERDEEN	500	870708 (6)
5	87 287048	31.6	RUN 3, ABERDEEN	350	870708 (6)

Record Type: TRNIN2 Date Verified: 8/4/87 By: W Kniff
Transaction Status: New Transaction...First Printing...Unverified.
Processed: 3-AUG-87 11:53:21 Status: N Batch: (In CUR DB)

State of Washington
Department of Ecology

VISIBLE EMISSION OBSERVATION FORM

OBSERVATION DATE	START TIME	STOP TIME
7-8-87	1525 DST	1529

SEC / M	0	15	30	45	SEC / M	0	15	30	45
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25	0	0	0	0	55				
26	0	0	0	0	56				
27	0	0	0	0	57				
28	0	0			58				
29					59				
30					60				

AVERAGE OPACITY DURING THE PERIOD OF

1525 THROUGH 1529 WAS 0 %

OBSERVER'S NAME (PRINT) James H. [illegible]

OBSERVER'S SIGNATURE [illegible]

DATE 7-8-87

COMPANY [illegible]

ADDRESS [illegible]

LOCATION [illegible]

WIND DIRECTION [illegible]

CLOUD COVER [illegible]

DIAGRAM:

EMISSION POINT

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE [illegible]

TITLE [illegible]

DATE [illegible]

ECY 020-79

AMTEST
AIR QUALITY, INC.

AmTest-Air Quality, Inc.
30545 S.E. 84th St., #5
Preston, WA 98050
Office: (206) 222-7746
FAX: (206) 222-7849

SOURCE

EMISSION

EVALUATION

September 8, 1994

Prepared For:

LAKESIDE INDUSTRIES
HOT MIX ASPHALT BATCH PLANT
BAGHOUSE STACK
METHOD 5 TESTING
LACEY, WASHINGTON
AUGUST 24, 1994

Submitted by:

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Project Manager

E. Ray Lawrence
E. Ray Lawrence
Sr. Air Quality Specialist

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Angela F. Blaisdell
Sr. Technical Writer

Am Test-Air Quality, Inc.
Preston, Washington

We certify that the information contained herein is accurate and complete to the best of our knowledge.

[amb\c:\w\r\lklacem5]

TABLE OF CONTENTS

1.0

INTRODUCTION

The purpose of this source emission evaluation was to quantify particulate and condensible matter emissions from a hot mix asphalt batch plant located at Lakeside Industries' facility in Lacey, Washington. The asphalt plant was manufactured by Madson and is equipped with a WAG baghouse to control particulate matter emissions prior to exhausting to the atmosphere. Lakeside Industries contracted Am Test-Air Quality Inc. based in Preston, Washington to conduct these source tests. These tests were performed to demonstrate compliance with a regulatory order from the Olympic Air Pollution Control Authority (OAPCA).

Testing and analysis procedures used for this project are presented in the July 1, 1993 edition of the Environmental Protection Agency (EPA) document Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Methods 1, 2, 3A, 4, 5 and the OAPCA back-half method. Methods 1 and 2 were performed to measure the stack gas temperature and velocity for calculating volumetric flow rate. Method 3A was performed to determine the molecular weight of the stack gas based on measurements of the oxygen (O_2), carbon dioxide (CO_2) and carbon monoxide (CO) concentration in the stack gas. Method 4 was performed to measure the moisture content of the stack gas. Method 5 was performed to quantify particulate and condensible matter emissions. OAPCA requires that the condensible particulate matter present in the gas stream be quantified by performing an extraction of the back-half portion of the Method 5 sample train. Three (3) Method 1, 2, 3A, 4 and 5 tests were performed at the baghouse stack on August 24, 1994.

Mr. E. Ray Lawrence and Mr. Aaron Porter of Am Test-Air Quality, Inc. performed the field sampling. Sample recovery and gravimetric laboratory analysis of the Method 5 samples were performed by Ms. Stacy Akin and Ms. Annika M. Woehr of Am Test-Air Quality, Inc. Data reduction, quality assurance review and final report preparation were performed by Mr. Kris A. Hansen, Ms. Angela F. Blaisdell and Ms. Amy M. Brotherton of Am Test. This testing program was coordinated by Mr. Forest Lane of Lakeside Industries. Mr. Robert Moody of OAPCA observed the testing.

2.0

SUMMARY OF RESULTS

The following section of this report presents results from the particulate and condensible matter emissions testing performed at the hot mix asphalt batch plant baghouse stack. Refer to the Table of Contents to locate specific information for each type of test. The summary table in this section contains information obtained from computer printouts of results for each individual run which are included in Appendix A of this report. Appendix B of this report contains example calculations of results and copies of the original field data sheets. Appendix C of this report contains miscellaneous supporting information.

The results of the three (3) Method 5 tests for quantifying particulate and condensible matter emissions at the hot mix asphalt batch plant baghouse exhaust are summarized in Table 2.0 below, and on the following computer printout titled "Summary of Results - Methods 1, 2, 3A, 4 and 5".

Table 2.0. Summary of particulate and condensible matter emissions test results from samples collected on August 24, 1994 at the hot mix asphalt batch plant stack at Lakeside Industries' facility in Lacey, Washington.

Sample Run #	Front-half P.M. Emission Conc. (gr/dscf)	Back-half P.M. Emission Conc. (gr/dscf)	Total P.M. Emission Conc. (gr/dscf)	Total P.M. Emission Conc. (mg/dscm)	Total P.M. Emission Rate (lb/hr)
1	0.045	0.003	0.049	111.4	11.0
2	0.046	0.004	0.050	114.7	11.4
3	0.042	0.007	0.049	113.2	11.0
Average	0.044	0.005	0.049	113.1	11.1

The front-half, back-half and total particulate matter emission concentration is presented in units of grains per dry standard cubic foot (gr/dscf) and milligrams per dry standard cubic meter (mg/dscm) of gas sampled. The particulate matter emission standard for this source is 0.04 gr/dscf. The particulate matter emission rate is presented in units of pounds per hour (lb/hr).

AMTEST AIR QUALITY, INC.

SUMMARY OF RESULTS - METHODS 1, 2, 3A, 4 AND 5
AM TEST - AIR QUALITY, INC.

FILE NAME: R311\LKLCSUM
CLIENT: LAKESIDE INDUSTRIES, INC.
LOCATION: LACEY, WASHINGTON

	HOT MIX ASPHALT BATCH PLANT STACK			
	RUN #1	RUN #2	RUN #3	AVERAGE
LAB #:	6506	6507	6508	
DATE:	8/24/94	8/24/94	8/24/94	
START TIME:	10:15	12:33	14:43	
STOP TIME:	11:35	13:45	15:54	
SAMPLE LENGTH (minutes):	60.0	60.0	60.0	
VOLUME SAMPLED (cubic feet):	58.496	58.678	60.990	59.388
VOLUME SAMPLED (dry std. cubic feet):	58.576	57.668	59.478	58.574
VOLUME SAMPLED (dry std. cubic meters):	1.659	1.633	1.684	1.659
STACK GAS MOISTURE (percent):	26.40	27.37	28.80	27.52
BAROMETRIC PRESSURE (inches of Hg):	29.95	29.95	29.95	29.95
STATIC PRESSURE (inches of H2O):	0.26	0.26	0.26	0.260
STACK PRESSURE (inches of Hg):	29.97	29.97	29.97	29.97
STACK TEMPERATURE (degrees F.):	228.5	231.0	233.7	231.1
STACK TEMPERATURE (degrees R.):	688.5	691.0	693.7	691.1
CARBON DIOXIDE (percent):	5.5	5.8	5.8	5.7
OXYGEN (percent):	13.0	12.8	12.5	12.8
MOLECULAR WEIGHT (dry, lb/lb-mole):	29.40	29.44	29.43	29.42
MOLECULAR WEIGHT (wet, lb/lb-mole):	26.39	26.31	26.14	26.28
AVERAGE VELOCITY HEAD (inches of H2O):	2.08	2.15	2.16	2.13
PITOT TUBE Cp:	0.84	0.84	0.84	
STACK GAS VELOCITY (feet per second):	96.7	98.7	99.3	98.2
STACK DIAMETER (inches):	37.375x31	37.375x31	37.375x31	
STACK AREA (square feet):	8.05	8.05	8.05	
STACK GAS AIRFLOW (dry std. cubic feet per min.):	26402.8	26479.4	26025.4	26302.5
STACK GAS AIRFLOW (actual cubic feet per min.):	46703.7	47637.5	47944.0	47428.4
NOZZLE DIAMETER (inches):	0.238	0.238	0.238	
ISOKINETICS (percent):	96	95	99	
FRONT-HALF PARTICULATE EMISSION CONC. (gr/dscf):	0.045	0.046	0.042	0.044
BACK-HALF PARTICULATE EMISSION CONC. (gr/dscf):	0.003	0.004	0.007	0.005
TOTAL PARTICULATE EMISSION CONC. (gr/dscf):	0.049	0.050	0.049	0.049
TOTAL PARTICULATE EMISSION CONC. (mg/dscm):	111.4	114.7	113.2	113.1
TOTAL PARTICULATE MATTER EMISSION RATE (lb/hr):	11.0	11.4	11.0	11.1

3.0
PROJECT OVERVIEW/EXCEPTIONS

An acceptable leak check of less than 0.02 cfm at the highest vacuum rate (or greater) used during the test preceded and followed each run. The average percentage isokinetics for each run were within the acceptable limits of 100 $\pm$ 10%. Process and production conditions were considered to be representative, according to plant personnel.

4.0

SOURCE OPERATION

Lakeside Industries operates a Madsen hot mix asphalt batch plant in Lacey, Washington. Emissions are controlled by a WAG Model 8 reverse pulse baghouse prior to exhausting to the atmosphere. The baghouse contains 1180 14-ounce Nomex bags. The pressure drop across the baghouse averaged 5.5 inches of water column ("H_2O) on the day of testing. According to plant personnel, the plant operated at an average asphalt production rate of 270 tons per hour (tph), with a gravel moisture content of 4-6% and gravel containing 5-7% fines. The plant was fired with diesel at a rate of 590 gallons per hour (gph). Process information sheets, completed by Mr. Forest Lane of Lakeside Industries, are included in Appendix C of this report.

5.0

SAMPLING AND ANALYSIS PROCEDURES

5.1 EPA Methods 1 and 2 - Velocity, Temperature and Airflow

EPA Method 1 procedures were used to assure that representative measurements of volumetric flow rate were obtained by dividing the cross-section of the stack or duct into a number of equal areas, and then locating a traverse point within each of the equal areas. Refer to the "Stack Schematic and Location of Sample Points" data sheet and/or the figure titled, "Location of Sampling Ports and Traverse Points", located in the appendices of this report for a schematic of the stack and the point locations selected for testing. Method 2 was performed to measure the stack gas velocity using a type S or a standard pitot tube, and the gas temperature using a calibrated thermocouple probe connected to a digital thermocouple indicator. The type S pitot tubes were connected with tubing to an oil-filled inclined manometer, a hook gauge manometer or magnehelic gauges to obtain velocity measurements. The pitot tube lines were leak-checked and the pressure measurement device was leveled and zeroed prior to use. Calibration information for each pressure and temperature measurement device used are included in the appendices of this report.

5.2 EPA Method 3A - Molecular Weight

The stack gas composition was evaluated during each Method 5 test by collecting integrated samples of the stack gas in multilayer bags. The integrated bag samples were analyzed using a paramagnetic analyzer to measure the percent (%) O_2, a non-dispersive infrared (NDIR) analyzer to measure the % carbon dioxide (CO_2), and an NDIR or a gas filter correlation NDIR analyzer to measure the parts per million (ppm) carbon monoxide (CO) in the gas stream. The manufacturer and model number of each of the analyzers used is included in the appendices of this report on the "Continuous Analyzer Checklist" and/or the "Gas Bag Sample Data Sheet". The average measured O_2 concentration and CO_2 concentration were used to calculate the molecular weight of the stack gas.

5.3 EPA Method 4 - Moisture

The percent moisture in the gas stream was quantified by weighing the impingers to 0.1 grams before and after each Method 5 run on a digital top-loading balance. The net weight (final minus initial) was used to calculate the amount of moisture condensed from the known volume of stack gas collected.

5.4 EPA Method 5 - Particulate Matter

The sample train used for particulate matter sampling was an EPA Method 5 design as illustrated in the figure titled "Method 5 Sample Train" in the appendices of this report. The "Sample Train Information Sheet" (also in the appendices) details the type of nozzle, probe, probe liner and filter used along with the contents of the sample train impingers. The probe was equipped with S-type pitot tubes for measuring gas velocity and a thermocouple sensor for measuring stack gas temperature. The thermocouple sensor was connected to a digital thermocouple indicator which was used to measure the stack gas temperature at each sample point. A glass filter assembly was enclosed in a temperature-controlled heated sample box. The average box temperature was maintained at 248° F $\pm$ 25° F. The nozzle, probe liner, prefilter connective glassware and filter are referred to as the "front-half" of the sample train. Following the filter is a condenser section which, by convention, is referred to as the "back-half". The back-half was maintained at a temperature below 68° F by adding ice to the condenser section during sampling. Note: Some subparts or methods specify alternate temperatures for the probe liner, filter holder box and impinger ice bath. The "Sample Train Information Sheet" details any exceptions.

The Method 5 sample train was connected to a control box by means of an umbilical cord which contained a vacuum hose, pitot lines, thermocouple wires and a 4-wire electrical cord. The control box (meter box) was used to monitor stack conditions and to facilitate isokinetic sampling. The control box consisted of a diaphragm pump used to pull the stack gas through the sample train, fine and coarse metering valves to control the sampling rate, a vacuum gauge to measure the pressure drop from the sample nozzle to the metering valves, and a calibrated dry gas meter readable to 0.001 cubic feet. At the outlet of the dry gas meter was a calibrated orifice which was used to isokinetically control the flow of gas through the metering system. The pitot tubes utilized to measure stack gas velocity were connected to the control box via the umbilical cord. The control box contained a manometer or magnehelic gauges which were used for the velocity measurement and for monitoring orifice pressure.

Stack condition measurements were made prior to collecting a sample, including measurements of velocity, temperature and a check for cyclonic flow in the stack. A sample nozzle was chosen and isokinetic operating parameters were established utilizing a Hewlett-Packard programmable calculator. The sampling nozzle, probe and prefilter connective glassware were cleaned and rinsed prior to use. The sample train was assembled and determined to be leak free following the procedures outlined in Method 5. Before each test, a final check was made to assure that the process was operating at the desired production rate and operating parameters. A final check was made of the sample box and probe heat temperatures. Crushed ice was added to the condenser section. The sample nozzle was positioned in the stack at the first sample point. The sample pump was then turned on and the gas sampling rate was adjusted for isokinetic sampling. Isokinetic sampling proceeded at each of the traverse points. Upon completion of the test, the sample probe was removed from the stack and a post-test leak check was performed according to Method 5 procedures. Care was taken to assure that the nozzle tip did not touch the port nipple.

Following sample collection, the Method 5 sample trains were transferred to an area free from air disturbances and airborne particulate matter. The filters were transferred to petri dishes labeled with the sample date, client name and run number. Am Test refers to the front-half filter portion of the particulate catch as the "A" section. Care was taken to assure that any loose particulate matter and filter mat were quantitatively transferred to the petri dish. In the laboratory, the filters were placed in an oven and baked at 105° C for two (2) hours, then transferred to a constant humidity desiccator containing silicon-dioxide (SiO_2) for at least 24 hours of desiccation prior to obtaining weights. The same weighing procedures were followed to obtain the tare weights for the filters. The tare and final weights were made using an electronic balance set to a time integrating mode with a readability of 0.1 milligrams. The filters were weighed to a constant weight of $\pm$0.5 milligrams. The interval between weighings was at least 6 hours. These weights were recorded in a bound laboratory notebook.

Following each run, the contents of the nozzle, probe liner and prefilter connective glassware were quantitatively transferred to the "B" section storage container labeled with sample date, client name and run number. Several rinses of acetone, with simultaneous loosening of particulate matter using a clean nylon brush, were used for the front-half clean-up. An iodine flask with a female ball joint end was attached to the male ball joint end of the probe to assure that no particulate matter was lost during the rinsing and brushing of the probe. The contents of the iodine flask were quantitatively transferred to the "B" section storage container. In the laboratory, the "B" section acetone rinse was transferred to a tared, graduated 150 milliliter (mL) beaker. The volume of acetone was recorded and the beakers were placed in an evaporation chamber at a temperature of approximately 75-80° F until dry. Note: Some subparts or methods specify alternate "B" section cleanup solvents. The "Sample Train Information Sheet" details any exceptions.

The bubblers and impingers utilized for the condenser section, or "back-half" of the sample train were weighed with a readability of 0.1 grams before and after sampling using an electronic top loading balance. The difference between the initial and final weights of the condenser section constitute the amount of moisture gain during the run. The contents of the bubblers and impingers were transferred to a 1000 mL graduated cylinder. The bubblers and impingers were rinsed with deionized water into the graduated cylinder and the liquid level was recorded. A 20 milliliter aliquot of each impinger catch was archived for potential future analysis. The remaining impinger catch was extracted and the C and Cx section net weights were factored to represent the total impinger catch. This liquid was transferred to a separatory funnel and the contents were extracted with three (3) 50 mL portions of dichloromethane (CH_2Cl_2). The organic layer was transferred to a tared 150 mL beaker labeled the "C_x" section and was allowed to evaporate to dryness in an evaporation chamber at a temperature of 75-80° F. The water layer was transferred to a tared 150 mL beaker with glass boiling beads labeled the "C" section, and was heated on a drum plate to boiling until approximately 20 mL remained in the beaker. The remaining 20 mL in the beaker was evaporated to dryness in an evaporation chamber set at 105° C. The bubblers, impingers and graduated cylinder were given a final rinse with acetone into another tared, graduated beaker ("D" Section) and was allowed to evaporate to dryness in an evaporation chamber at 75-80° F. Sample blanks containing deionized water, dichloromethane, and acetone were analyzed in an identical fashion as the representative "section". All beakers were desiccated for at least 24 hours and weighed to constant weights of $\pm$0.5 milligrams at 6 hour or greater intervals. This is the same procedure used to obtain tare weights for each beaker. The total particulate matter weight is the sum of the net weights of the particulate matter found on the filter, plus the net weights found in the B, C, Cx and D section beakers, minus the acetone, water, and dichloromethane blank contributions. The particulate matter weights are included on the Method 5 computer printouts and in copies of the laboratory analysis forms in the appendices of this report. Note: Some subparts or methods specify alternate back-half section cleanup solvents. The "Sample Train Information Sheet" details any exceptions.

6.0

QUALITY ASSURANCE PLAN

The purpose of the quality assurance plan is to provide guidelines for achieving quality control in air pollution measurements. The detailed procedures which are utilized are included in the Environmental Protection Agency's (EPA's) reference manual titled Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-600/4-77-027b. These procedures are followed throughout equipment preparation, field sampling, sample recovery, analysis and data reduction. Am Test-Air Quality, Inc.'s quality assurance procedures are discussed below.

6.1 Calibration Procedures and Frequency

Field equipment utilized for on-site measurements is calibrated at a frequency recommended by the equipment manufacturer or industry practice. Prior to field use, each instrument is calibrated and the calibration value is recorded. If any measuring or test device requiring calibration cannot immediately be removed from service, the Project Manager may extend the calibration cycle providing a review of the equipment's history warrants the issuance of an extension. No equipment will be extended more than twice a calibration cycle, nor will the extension exceed one-half the prescribed calibration cycle. Test equipment consistently found to be out of calibration will be repaired or replaced.

The sample nozzles used to collect isokinetic samples are calibrated on-site before sampling using digital inside calipers readable to 0.001 inch. Three (3) measurements were taken at varying points around the inside of the nozzle tip and averaged. The dry gas meters used to accurately measure sample volumes are calibrated using a standard laboratory dry gas meter. The type S pitot tubes utilized for velocity determination are calibrated using Method 2, Section 4.1, and are inspected regularly for wear. The magnehelic gauges used for pressure measurements are checked against an oil-filled manometer. The digital thermocouple indicator used for temperature measurement has a readability of 1 degree Fahrenheit and is periodically re-certified by the manufacturer. Each thermocouple probe used to monitor temperature is checked periodically at three (3) temperature settings. Copies of calibration information for each measurement device used are included in the appendices of this report. A barometer readable to 0.01 inches of mercury is used in the field to obtain barometric pressure readings.

In the laboratory reagent blanks are carried throughout the gravimetric analysis procedures. The samples were weighed to constant weights of $\pm$0.5 milligrams following desiccation in a cabinet desiccator. This desiccator is an electronic dehumidifier which automatically maintains the humidity inside the desiccator. The dehumidifier automatically recharges the internal desiccant every 5.5 hours. An Airguide humidity indicator accurate to $\pm$1% is used to check the humidity inside the desiccator when obtaining tare and final weights. A small container of indicating silica gel is placed in the desiccators to maintain the desired humidity. The Mettler AE163 electronic balance used to obtain weights is set to a time integrating mode (100,000 readings per minute) with a readability of 0.01 milligrams. The balance is calibrated prior to every weighing session and an audit is performed with class S weights once a week. The calibration of Am Test's Mettler balances is checked by the manufacturer on a yearly basis.

Support equipment is defined as all equipment, not previously discussed, that is required for completing an environmental monitoring or measurement task. This equipment may include storage and transportation containers, sample recovery glassware, and communications gear. Support equipment is periodically inspected to maintain the performance standards necessary for proper and efficient execution of all tasks and responsibilities.

During a project, a systems audit is performed, consisting of an on-site qualitative inspection and review of the total measurement system. This inspection is conducted on a daily basis by the Project Leader. During the systems audit, the auditor observes the procedures and techniques of the field team in the following general areas:

- Setting up and leak testing the sample train
- Isokinetic sampling check
- Final leak check of the sample train
- Sample recovery

Visual inspections of pitot tubes, glassware, and other equipment are also made. The main purpose of a systems audit is to ensure that the measurement system will generate valid data, if operated properly.

6.2 Sample Recovery and Field Documentation

Data collected during each test, are immediately inspected for completeness and placed under the custody of the Project Leader until custody is transferred when the samples were returned to the Air Quality laboratory. Sample recovery is carried out in a suitable area free from particulate matter contamination. Each sample is assigned an identifying lab number to assist the chemists in tracking the sample.

6.3 Data Reduction, Validation and Reporting

Raw data are handled according to strict guidelines when being transposed into computer files or to other logs. The guidelines include document receipt control procedures, file review, and sign-off by a project assistant. Raw data are entered into the appropriate computer spreadsheet by a "processor", then the entered figures are checked for accuracy by a "checker", different from the "processor". Any mistakes are corrected, and figures are rechecked and signed off by the "checker". In addition, a by-hand calculation check of each spreadsheet is made using a hand-held calculator to validate the computer output. All data generated by each phase of a laboratory or field sampling program are reviewed by the senior reviewer. The data package is signed off by the senior reviewer prior to releasing the data for report preparation.

The test results are calculated in accordance with current EPA 40 CFR 60 criteria. Copies of the pertinent equations used to derive the results for this test are included in the appendices of this report. Standard conditions are 29.92 inches of mercury and 68° F.

7.0

METHODOLOGY REFERENCES

EPA. Title 40 Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A, Reference Methods 1, 2, 3A, 4 and 5. July 1, 1993.

EPA. EPA 450/2-79-006, APTI Course, "Course 450 - Source Sampling For Particulate Pollutants", December 1979.

EPA. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-60/4-77-027b.

Attachment 1, Olympic Air Pollution Control Authority Particulate Test Procedure (OAPCA method).

APPENDIX A

Computer Printouts of Results

METHODS 1, 2, 3A, 4 AND 5
AM TEST-AIR QUALITY, INC.

FILE NAME:	R311\LKLACE51
CLIENT:	LAKESIDE INDUSTRIES
LOCATION:	LACEY, WASHINGTON
SAMPLE SITE:	HOT MIX ASPHALT BATCH PLANT STACK
SAMPLE DATE:	AUGUST 24, 1994
RUN #:	1 - METHOD 5
OPERATORS:	R. LAWRENCE

LAB #:	6506
START TIME:	10:15 o'clock
STOP TIME:	11:35 o'clock
SAMPLE LENGTH:	60.0 minutes

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
971.1	661.4	309.7
744.6	643.5	101.1
571.3	558.7	12.6
870.4	848.2	22.2

TOTAL H2O GAIN:	445.6
TOTAL VOLUME (scf):	21.01
PERCENT MOISTURE:	26.40
Bws:	0.2640
INIT. METER VOLUME:	139.262
FINAL METER VOLUME:	197.758
VOLUME SAMPLED:	58.496
STD VOLUME (dscf):	58.576
STD VOLUME (dscm):	1.659
Y FACTOR:	1.002

PITOT TUBE Cp:	0.84
NOZZLE DIAMETER:	0.238 inches
NOZZLE AREA:	0.0003 sq. feet
STACK DIAMETER:	37.375x31 inches
STACK AREA:	8.05 sq. feet
METER TEMPERATURE:	70.9 degrees F
BAROMETRIC PRES.:	29.95 inches Hg
STATIC PRESSURE:	0.26 inches H2O
STACK PRESSURE:	29.97 inches Hg
ORIFICE PRESSURE:	1.568 inches H2O
METER PRESSURE:	30.07 inches Hg
AVERAGE CONC. CO2:	5.5 percent
AVERAGE CONC. O2:	13.0 percent
AVERAGE CONC. CO:	NA ppm
MOLECULAR WEIGHT:	29.40 g/g-mole-dry
MOLECULAR WEIGHT:	26.39 g/g-mole-wet
Fo FACTOR:	1.436

SAMPLE POINT	VELOCITY " OF H20	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H20	TEMPERATURE °F
A 1	0.90	223	C 1	0.84	228
2	1.09	224	2	1.08	230
3	1.54	225	3	1.77	229
4	2.18	227	4	2.68	228
5	4.10	229	5	3.48	230
6	4.80	230	6	3.49	229
B 1	0.94	228	D 1	1.02	228
2	0.96	228	2	1.40	228
3	1.45	229	3	2.05	229
4	2.35	229	4	2.62	230
5	3.90	231	5	2.39	231
6	4.35	232	6	2.35	230

PERCENT ISOKINETICS:	96 %	
STACK TEMPERATURE:	228.5 degrees F	688.5 degrees R
AVERAGE VELOCITY HEAD:	2.08 " of H20	
STACK GAS VELOCITY:		96.7 ft/second
STACK GAS AIR FLOW:	46703.7 acf/min	26402.8 dscf/min
PARTICULATE EMISSION CONCENTRATION (front-half):		0.045 gr/dscf
PARTICULATE EMISSION CONCENTRATION (back-half):		0.003 gr/dscf
TOTAL PARTICULATE EMISSION CONC. (front & back-half):		0.049 gr/dscf
TOTAL PARTICULATE EMISSION CONCENTRATION:		111.4 mg/dscm
TOTAL PARTICULATE MATTER EMISSION RATE:		11.0 lb/hr

FRONT-HALF PARTICULATE MATTER MASS LOADING

FILTER NUMBER:	#110-582
TARE WEIGHT OF FILTER (grams):	0.8136
FINAL WEIGHT OF FILTER (grams):	0.9294
NET WEIGHT OF PARTICULATE MATTER (grams):	0.1158
BEAKER NUMBER:	#150-1608
TARE WEIGHT OF BEAKER (grams):	65.4787
FINAL WEIGHT OF BEAKER (grams):	65.5349
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0562
VOLUME OF ACETONE (milliliters):	140.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.0029
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0004
TOTAL FRONT-HALF PARTICULATE MATTER (grams):	0.1716

BACK-HALF PARTICULATE MATTER MASS LOADING

"C" SECTION - CONDENSER PARTICULATE	#150-1623
TARE WEIGHT OF BEAKER (grams):	65.2250
FINAL WEIGHT OF BEAKER (grams):	65.2392
NET WEIGHT OF PARTIC. MATTER (grams):	0.0142
TOTAL VOLUME OF WATER (milliliters):	760.0
VOLUME OF WATER CONDENSED (milliliters):	423.4
NET VOLUME OF WATER FOR BLANK (milliliters):	336.6
WT./VOL. OF WATER BLANK (milligrams/ml):	0.0024
NET WEIGHT OF PARTIC. DUE TO WATER (grams):	0.0008
"Cx" SECTION - HYDROCARBON EXTRACTION	#150-1610
TARE WEIGHT OF BEAKER (grams):	65.6427
FINAL WEIGHT OF BEAKER (grams):	65.6427
NET WEIGHT OF PARTIC. MATTER (grams):	0.0000
TOTAL VOLUME OF CH2Cl2 (milliliters):	150.0
WT./VOL. OF CH2Cl2 BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO CH2Cl2 (grams):	0.0000
"D" SECTION - ACETONE RINSE OF CONDENSER	#150-1609
TARE WEIGHT OF BEAKER (grams):	65.5389
FINAL WEIGHT OF BEAKER (grams):	65.5389
NET WEIGHT OF PARTIC. MATTER (grams):	0.0000
TOTAL VOLUME OF ACETONE (milliliters):	70.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.0029
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0002
TOTAL BACK-HALF PARTICULATE MATTER (grams):	0.0132
TOTAL WEIGHT OF PARTICULATE MATTER (grams):	0.1848

[redacted]

METHODS 1, 2, 3A, 4 AND 5
AM TEST-AIR QUALITY, INC.

FILE NAME:	R311\LKLACE52	LAB #:	6507
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	12:33 o'clock
LOCATION:	LACEY, WASHINGTON	STOP TIME:	13:45 o'clock
SAMPLE SITE:	HOT MIX ASPHALT BATCH PLANT STACK	SAMPLE LENGTH:	60.0 minutes
SAMPLE DATE:	AUGUST 24, 1994		
RUN #:	2 - METHOD 5		
OPERATORS:	R. LAWRENCE		

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
950.8	645.8	305.0
759.1	638.0	121.1
546.1	534.5	11.6
872.2	848.9	23.3

TOTAL H2O GAIN:	461.0
TOTAL VOLUME (scf):	21.74
PERCENT MOISTURE:	27.37
Bws:	0.2737
INIT. METER VOLUME:	198.162
FINAL METER VOLUME:	256.840
VOLUME SAMPLED:	58.678
STD VOLUME (dscf):	57.668
STD VOLUME (dscm):	1.633
Y FACTOR:	1.002

PITOT TUBE Cp:	0.84
NOZZLE DIAMETER:	0.238 inches
NOZZLE AREA:	0.0003 sq. feet
STACK DIAMETER:	37.375x31 inches
STACK AREA:	8.05 sq. feet
METER TEMPERATURE:	81.0 degrees F
BAROMETRIC PRES.:	29.95 inches Hg
STATIC PRESSURE:	0.26 inches H2O
STACK PRESSURE:	29.97 inches Hg
ORIFICE PRESSURE:	1.615 inches H2O
METER PRESSURE:	30.07 inches Hg
AVERAGE CONC. CO2:	5.8 percent
AVERAGE CONC. O2:	12.8 percent
AVERAGE CONC. CO:	NA ppm
MOLECULAR WEIGHT:	29.44 g/g-mole-dry
MOLECULAR WEIGHT:	26.31 g/g-mole-wet
Fo FACTOR:	1.397

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
A 1	1.01	230	C 1	0.97	229
2	1.15	229	2	1.25	231
3	1.49	229	3	1.62	231
4	2.35	230	4	2.55	233
5	3.80	232	5	3.78	233
6	4.50	231	6	3.85	234
B 1	0.85	230	D 1	1.28	232
2	1.05	230	2	1.58	231
3	1.50	230	3	2.19	232
4	2.45	230	4	2.55	232
5	3.90	230	5	2.49	232
6	4.62	231	6	2.38	232

PERCENT ISOKINETICS:	95 %	
STACK TEMPERATURE:	231.0 degrees F	691.0 degrees R
AVERAGE VELOCITY HEAD:	2.15 " of H20	
STACK GAS VELOCITY:		98.7 ft/second
STACK GAS AIR FLOW:	47637.5 acf/min	26479.4 dscf/min
PARTICULATE EMISSION CONCENTRATION (front-half):		0.046 gr/dscf
PARTICULATE EMISSION CONCENTRATION (back-half):		0.004 gr/dscf
TOTAL PARTICULATE EMISSION CONC. (front & back-half):		0.050 gr/dscf
TOTAL PARTICULATE EMISSION CONCENTRATION:		114.7 mg/dscm
TOTAL PARTICULATE MATTER EMISSION RATE:		11.4 lb/hr

FRONT-HALF PARTICULATE MATTER MASS LOADING

FILTER NUMBER:	#110-589
TARE WEIGHT OF FILTER (grams):	0.8177
FINAL WEIGHT OF FILTER (grams):	0.9345
NET WEIGHT OF PARTICULATE MATTER (grams):	0.1168
BEAKER NUMBER:	#150-1611
TARE WEIGHT OF BEAKER (grams):	66.7606
FINAL WEIGHT OF BEAKER (grams):	66.8159
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0553
VOLUME OF ACETONE (milliliters):	170.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.0029
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0005
TOTAL FRONT-HALF PARTICULATE MATTER (grams):	0.1716

BACK-HALF PARTICULATE MATTER MASS LOADING

"C" SECTION - CONDENSER PARTICULATE	#150-1624
TARE WEIGHT OF BEAKER (grams):	65.1514
FINAL WEIGHT OF BEAKER (grams):	65.1680
NET WEIGHT OF PARTIC. MATTER (grams):	0.0166
TOTAL VOLUME OF WATER (milliliters):	740.0
VOLUME OF WATER CONDENSED (milliliters):	437.7
NET VOLUME OF WATER FOR BLANK (milliliters):	302.3
WT./VOL. OF WATER BLANK (milligrams/ml):	0.0024
NET WEIGHT OF PARTIC. DUE TO WATER (grams):	0.0007
"Cx" SECTION - HYDROCARBON EXTRACTION	#150-1613
TARE WEIGHT OF BEAKER (grams):	66.9948
FINAL WEIGHT OF BEAKER (grams):	66.9948
NET WEIGHT OF PARTIC. MATTER (grams):	0.0000
TOTAL VOLUME OF CH2Cl2 (milliliters):	150.0
WT./VOL. OF CH2Cl2 BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO CH2Cl2 (grams):	0.0000
"D" SECTION - ACETONE RINSE OF CONDENSER	#150-1612
TARE WEIGHT OF BEAKER (grams):	67.3012
FINAL WEIGHT OF BEAKER (grams):	67.3012
NET WEIGHT OF PARTIC. MATTER (grams):	0.0000
TOTAL VOLUME OF ACETONE (milliliters):	75.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.0029
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0002
TOTAL BACK-HALF PARTICULATE MATTER (grams):	0.0157
TOTAL WEIGHT OF PARTICULATE MATTER (grams):	0.1873

ok

METHODS 1, 2, 3A, 4 AND 5
AM TEST-AIR QUALITY, INC.

FILE NAME:	R311\LKLACE53	LAB #:	6508
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	14:43 o'clock
LOCATION:	LACEY, WASHINGTON	STOP TIME:	15:54 o'clock
SAMPLE SITE:	HOT MIX ASPHALT BATCH PLANT STACK	SAMPLE LENGTH:	60.0 minutes
SAMPLE DATE:	AUGUST 24, 1994		
RUN #:	3 - METHOD 5		
OPERATORS:	R. LAWRENCE		

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
785.7	593.8	191.9
888.6	640.3	248.3
589.5	541.7	47.8
791.4	769.2	22.2

TOTAL H2O GAIN:	510.2
TOTAL VOLUME (scf):	24.06
PERCENT MOISTURE:	28.80
Bws:	0.2880
INIT. METER VOLUME:	257.697
FINAL METER VOLUME:	318.687
VOLUME SAMPLED:	60.990
STD VOLUME (dscf):	59.478
STD VOLUME (dscm):	1.684
Y FACTOR:	1.002

PITOT TUBE Cp:	0.84
NOZZLE DIAMETER:	0.238 inches
NOZZLE AREA:	0.0003 sq. feet
STACK DIAMETER:	37.375x31 inches
STACK AREA:	8.05 sq. feet
METER TEMPERATURE:	85.2 degrees F
BAROMETRIC PRES.:	29.95 inches Hg
STATIC PRESSURE:	0.26 inches H2O
STACK PRESSURE:	29.97 inches Hg
ORIFICE PRESSURE:	1.618 inches H2O
METER PRESSURE:	30.07 inches Hg
AVERAGE CONC. CO2:	5.8 percent
AVERAGE CONC. O2:	12.5 percent
AVERAGE CONC. CO:	NA ppm
MOLECULAR WEIGHT:	29.43 g/g-mole-dry
MOLECULAR WEIGHT:	26.14 g/g-mole-wet
Fo FACTOR:	1.448

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
A 1	0.97	232	C 1	0.96	235
2	1.05	233	2	1.19	232
3	1.52	233	3	1.79	233
4	2.29	234	4	2.65	233
5	4.15	236	5	3.61	234
6	4.71	236	6	3.60	234
B 1	0.83	232	D 1	1.10	230
2	1.05	233	2	1.65	230
3	1.55	235	3	2.15	232
4	2.49	235	4	2.55	232
5	4.19	237	5	2.73	236
6	4.20	236	6	2.46	236

PERCENT ISOKINETICS:	99 %	
STACK TEMPERATURE:	233.7 degrees F	693.7 degrees R
AVERAGE VELOCITY HEAD:	2.16 " of H2O	
STACK GAS VELOCITY:		99.3 ft/second
STACK GAS AIR FLOW:	47944.0 acf/min	26025.4 dscf/min
PARTICULATE EMISSION CONCENTRATION (front-half):		0.042 gr/dscf
PARTICULATE EMISSION CONCENTRATION (back-half):		0.007 gr/dscf
TOTAL PARTICULATE EMISSION CONC. (front & back-half):		0.049 gr/dscf
TOTAL PARTICULATE EMISSION CONCENTRATION:		113.2 mg/dscm
TOTAL PARTICULATE MATTER EMISSION RATE:		11.0 lb/hr

FRONT-HALF PARTICULATE MATTER MASS LOADING

FILTER NUMBER:	#110-583
TARE WEIGHT OF FILTER (grams):	0.8202
FINAL WEIGHT OF FILTER (grams):	0.9156
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0954
BEAKER NUMBER:	#150-1614
TARE WEIGHT OF BEAKER (grams):	66.9630
FINAL WEIGHT OF BEAKER (grams):	67.0306
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0676
VOLUME OF ACETONE (milliliters):	230.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.0029
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0007
TOTAL FRONT-HALF PARTICULATE MATTER (grams):	0.1623

BACK-HALF PARTICULATE MATTER MASS LOADING

"C" SECTION - CONDENSER PARTICULATE	#150-1625
TARE WEIGHT OF BEAKER (grams):	65.1549
FINAL WEIGHT OF BEAKER (grams):	65.1843
NET WEIGHT OF PARTIC. MATTER (grams):	0.0294
TOTAL VOLUME OF WATER (milliliters):	840.0
VOLUME OF WATER CONDENSED (milliliters):	488.0
NET VOLUME OF WATER FOR BLANK (milliliters):	352.0
WT./VOL. OF WATER BLANK (milligrams/ml):	0.0024
NET WEIGHT OF PARTIC. DUE TO WATER (grams):	0.0008
"Cx" SECTION - HYDROCARBON EXTRACTION	#150-1616
TARE WEIGHT OF BEAKER (grams):	65.7992
FINAL WEIGHT OF BEAKER (grams):	65.7992
NET WEIGHT OF PARTIC. MATTER (grams):	0.0000
TOTAL VOLUME OF CH2Cl2 (milliliters):	150.0
WT./VOL. OF CH2Cl2 BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO CH2Cl2 (grams):	0.0000
"D" SECTION - ACETONE RINSE OF CONDENSER	#150-1615
TARE WEIGHT OF BEAKER (grams):	65.8874
FINAL WEIGHT OF BEAKER (grams):	65.8874
NET WEIGHT OF PARTIC. MATTER (grams):	0.0000
TOTAL VOLUME OF ACETONE (milliliters):	95.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.0029
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0003
TOTAL BACK-HALF PARTICULATE MATTER (grams):	0.0283
TOTAL WEIGHT OF PARTICULATE MATTER (grams):	0.1906

APPENDIX B

Example Calculations and Field Data Sheets

EXAMPLE CALCULATION SHEET
EPA METHODS 1, 2, 3A, 4 AND 5

CLIENT: Lakeside Industries LOCATION: Lacey, Washington DATE: 8/24/94

RUN #: 3 LAB #: 6508 SITE LOCATION: Hot Mix Asphalt Batch Plant Stack

Particulate Matter Emission Concentration - Equation 5-1

Vm_{std} = 17.647°R/"$Hg_{(constant)}$*volume sampled*Y_{factor}*(P_B + ΔH/13.6)/(460 + T_m)

= 17.647°R/"Hg* 60.990 ft³* 1.002 *(29.95"Hg + (1.618 "H_2O/13.6))/(460 + 85.2° F)

= 59.478 dscf

dscm = 59.478 dscf/35.31 ft³/m³

= 1.684 dscm

Substitution of Equation 5-4 into 5-5

W_a = mg/ml blank * ml sample = mg sample due to acetone blank

W_a = 0.7 mg = 0.0029 mg/ml * 230 ml

M_n = (net weight filter catch) + (net weight "B" section) - Wa + Back-half

= 190.6 mg = 95.4 mg + 67.6 mg - 0.7 mg + 28.3 mg

C_s = (0.001 g/mg) * (15.43 grains/gram) * M_n / Vm_{std}

C_s = (0.001 g/mg) * (15.43 grains/gram) * 190.6 mg / 59.478 dscf

= 0.049 gr/dscf (Equation 5-6)

gr/dscf @____% O_2 = ______gr/dscf * (20.9% - ______%O_2)/(20.9% - ______%O_2)

% correction % measured

= N/A gr/dscf @ ____% O_2

gr/dscf @___%CO_2 = _______gr/dscf * ______% / ______%CO_2

% correction % measured

= N/A gr/dscf @ ____% CO_2

mg/dscm = 190.6 mg/ 1.684 dscm

= 113.2 mg/dscm

Particulate Matter Emission Rate

pounds/hour = C_s * dscf/min * 60 min/hr * 1 lb/7000 grains

pounds/hour = 0.049 gr/dscf * 26025.4 dscf/min * 60 min/hr * 1 lb/7000 grains

= 11.0 lb/hr

EXAMPLE CALCULATION SHEET (continued)
EPA METHODS 1, 2, 3A, 4 and 5

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft^3/g * 510.2 grams of H_2O collected in impingers

= 24.1 scf

B_{ws} = (24.1 scf)/(24.1 scf + 59.478 dscf)

= 0.2880

% Moisture = 28.80 % = B_{ws} * 100

Molecular weight - Equation 3-2

M_d = 0.440*(5.8 %CO_2)+0.320*(12.5 %O_2)+0.280*(100%- 5.8 %CO_2- 12.5 %O_2(%CO+%N_2))

= 29.43 g/g-mole (dry)

M_s = M_d * (1-B_{ws}) + 18.0 * B_{ws} = 29.43 g/g-mole * (1 - 0.2880) + 18.0 g/g-mole * 0.2880

= 26.14 g/g-mole (wet)

F_o = 1.448 = (20.9- 12.5)%O_2/ 5.8 %CO_2

Stack gas velocity and volumetric flow rate - Equation 2-9 and 2-10

$V_s = 85.49 * Cp * \sqrt{\Delta P * T_s / (M_s * P_s)}$

V_s = 85.49 * 0.84 * $\sqrt{2.16 * 693.7\ °R / (26.14\ g/g\text{-mole} * 29.97\ "Hg)}$

(233.7° F + 460)° R (29.95 P_B + 0.26 P_s/13.6)

V_s = 99.3 ft/sec (std)

Q_{sd} = 3600 * (1 - B_{ws}) * V_s * A_s * (T_{std}/T_s) * (P_s / P_{std}) / 60 min/hr

Q_{sd} = 3600 * (1 - 0.2880) * 99.3 ft/sec * 8.05 ft^2 * (528° R/ 693.7 ° R) * (29.97"Hg / 29.92"Hg) / 60

37.375×31/144

= 26025.4 dscf/min (dry standard cubic feet per minute)

acfm = 99.3 ft/sec * 8.05 ft^2 * 60 sec/min

= 47944.0 acfm (actual cubic feet per minute)

Isokinetic variation - Equation 5-8

I = 0.09450 * Vm_{std} * T_s ÷ [P_s * V_s * sample time * A_n *(1 -B_{ws})]

I = 0.09450 * 59.478 dscf * 693.7 ° R/[29.97"Hg * 99.3 ft/sec * 60 min * 0.0003 ft^2 *(1 - 0.2880)]

(.238 N_{dia}/12/2)^2*Pi

I = 99 %

All of the above numbered equations are from the 40 CFR 60 and assume English units.

EXAMPLE CALCULATION SHEET (continued)
EPA METHODS 1, 2, 3A, 4 and 5

BACKHALF PARTICULATE

Final Wt	Initial Wt	Net Wt
785.7 -	593.8 =	191.9
888.6 -	640.3 =	248.3
589.5 -	541.7 =	47.8
		488.0

"C" Section

a 29.4 mg particulate in "C" Section Beaker

b 840 ml of water in condensers, including rinses

c 488 ml condensation in 1st, 2nd and 3rd bubblers (final wt - initial wt, assumes 1g/1ml water density)

d 352 ml DI water used in bubblers including rinses = *b* - *c*

e 0.0024 mg/ml blank particulate = 0.6 mg blank / 250 ml blank

f 0.8 mg blank particulate = *e* * *d*

28.6 **mg of "C" particulate** = *a* - *f* = 29.4 mg - 0.8 mg

"Cx" Section

a 0.0 mg particulate in "Cx" Section Beaker

b 150 ml CH_2Cl_2 used for sample

c 0.0 mg/ml blank particulate = 0.0 mg blank / 150 ml blank

d 0.0 mg blank particulate = *b* * *c*

0.0 **mg of "Cx" particulate** = *a* - *d* = 0.0 mg - 0.0 mg

"D" Section

a 0.0 mg particulate in "D" Section Beaker

b 95 ml Acetone used for sample

c 0.0029 mg/ml blank particulate (Same as "B" Section)

d 0.3 mg blank particulate = *b* * *c*

-0.3 **mg of "D" particulate** = *a* - *d* = 0.0 mg - 0.3 mg

TOTAL BACK-HALF PARTICULATE

+ 28.6 mg "C" Section Particulate
+ 0.0 mg "Cx" Section Particulate
+ -0.3 mg "D" Section Particulate
+ N/A mg Back-half Filter Particulate (If applicable)

= 28.3 **mg Back-half Particulate**

STACK SCHEMATIC AND LOCATION OF SAMPLE POINTS

Client [illegible]

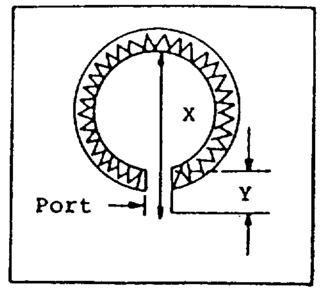
Location [illegible]

Sampling Location [illegible]

Inside of far wall to outside of port (distance, X) [illegible]

Inside of near wall to outside of port (distance, Y) 4"

Stack I.D. (distance X - distance Y) 37.375"

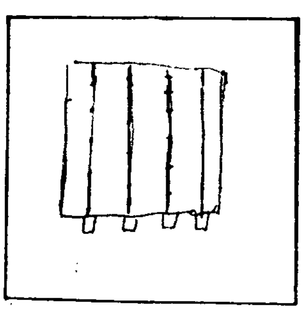


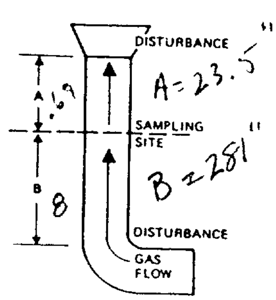
Schematic of Sampling Location

RECTANGULAR STACK
37.375" X 31"

1 Traverse Point #	2 ~~Fractional Percent of Stack I.D.~~	3 Stack I.D. inches	4 ~~Column 2 x 3~~	5 Distance Y	6 Traverse Point Location from Outside of Port columns 4 + 5
1		37.375	3.12	4"	7.12
2			9.36		13.36
3			15.60		19.60
4			21.84		25.84
5			28.08		32.08
6			34.32		38.32
7					
8					
9					
10					
11					
12					

CROSS SECTION

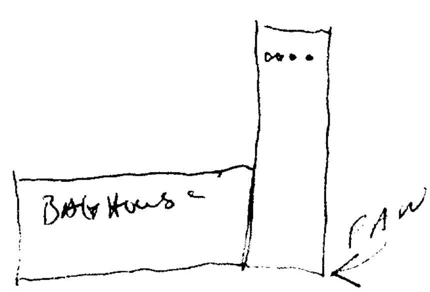




EQ DIA = 33.84

Distance A = 23.5" *downstream*
Distance B = 281" *upstream*

STACK, CONTROL DEVICE AND PROCESS FLOW DIAGRAM



TRAVERSE SAMPLING DATA SHEET

6506

Client Lakeside
Location LACEY WA
Sample Site BAG House outlet

Stack Diameter 37.375 X 31
Date 8-24-94
Operators BRL
Run I.D. R-1 M5 BH

EQUIPMENT CHECKS

Initial/Final
Leak Rate cfm .005 / .004
Leak Test Vacuum 11" / 9"
✓ Pitots, Pre Leak Ck
✓ Pitots, Post Leak Ck
___ Gas Sampling System
✓ Integrated Bag
M5 Rinse Acetone/H_2O/Other

QA FORMS COMPLETED
Stack Schematic ✓
Sample Train ✓
Pitot Tube Insp. ✓
Magnehelic Cal. ✓
Temp. Probe Cal. TUDJ
Gas Meter Calib. ✓

Filter # ___ Box # S-1

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	971.1	661.4	309.7
#2 Imp.	744.6	643.5	101.1
#3 Imp.	571.3	558.7	12.6
#4 Imp.			423.4
#5 Imp.			
#6 S.G.	870.4	848.2	22.2 ok

Total H_2O Volume 445.6 ✓

Start Time 1015
Stop Time 1135
Barometric Pressure "Hg 29.95
Static Pres "H_2O +.2
Production Rate

SAMPLING PARAMETERS

% Moisture 26%
Meter Temp. 65 78
Stack Temp. 215 225
Δ H@ .805 Y 1.002
Pitot # P5W Side #
Cp .84
Nozzle Diameter .238 inch
D_1 .238 D_2 .239 D_3 .237
K Factor 1.88

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Pitot Reading Δ P " H_2O	Orifice Setting (Δ H) " H_2O Ideal	Orifice Setting (Δ H) " H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump Vac. Gauge " Hg	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	O_2 %	
A1	0	139.262	.90	.62	.62	61	62	3	253	67	223		
2	2½	140.85	1.09	.75	.75	61	64	3	253	63	224		
3	5	142.58	1.54	1.06	1.06	65	61	4½	247	61	225		
4	7½	144.57	2.48	1.70	1.71	68	62	5	248	58	227		
5	10	148.10	4.10	2.82	2.82	72	63	5	249	57	229		
6	12½	151.50	4.80	3.33	3.33	76	64	7	247	63	230	CO_2	5.5%
B1	15	155. —	.94	.65	.65	70	65	3	247	67	228	O_2	13.0%
2	17½	156.76	.96	.67	.67	71	65	3	249	65	228	CO	NA
3	20	158.36	1.45	1.00	1.00	72	68	4	250	61	229		
4	22½	160.31	2.35	1.63	1.67	74	66	4½	243	56	229		
5	25	162.77	3.90	2.71	2.71	78	67	6	250	53	231		
6	27½	165.92	4.35	3.04	3.04	80	68	8	244	53	232		
C1	30	169.484	.84	.59	.59	73	69	2½	249	60	228		
2	32½	171.02	1.08	.76	.76	74	70	3	244	54	230		
3	35	172.76	1.77	1.24	1.24	74	70	4	247	53	229		
4	37½	174.94	2.68	1.88	1.88	76	70	5	248	51	228		
5	40	177.67	3.48	2.44	2.43	79	71	6	251	51	230		
6	42½	180.69	3.49	2.44	2.44	81	71	6	251	52	229		
D1	45	183.813	1.02	.71	.71	75	71	3	247	58	228		
2	47½	185.51	1.40	.98	.98	76	72	3½	252	55	228		
3	50	187.47	2.05	1.43	1.43	78	72	4	248	53	229		
4	52½	189.87	2.62	1.83	1.83	80	72	5	249	53	230		
5	55	192.55	2.39	1.67	1.67	81	73	5	249	53	231		
6	57½	195.18	2.35	1.64	1.64	82	73	5	250	54	230		
END	60	197.758 ✓			ok			ok			ok		
		58.496 ✓	2.097 $(\Delta p)^2$	ok	1.568 ✓ Δ H	70.9 ✓ T_m	Tmg ok				228.5 ✓ T		

METHOD 5
LABORATORY ANALYSIS

Client: Lakeside Industries-lacey Run Number: 1

Sample Location: Baghouse outlet

Date: 8-24-94

"A" Section (Filter)

Filter #: 110-582

Tare Weight: 0.8136 grams
Final Weight: 0.9294 grams
Net Weight: 0.1158 grams

"B" Section (Probe Wash)

Beaker #: 150-1608

Volume Acetone: 140 mls

Tare Weight: 65.4787 grams
Final Weight: 65.5349 grams
Net Weight: 0.0562 grams

$140 \times 0.0029/1000 = 0.0004g$

$$\begin{array}{r} 0.0562 \\ -0.0004 \\ \hline 0.0558 \end{array}$$

0.1716g front

"C" Section (Condenser Particulate - Inorganic Catch)

[illegible]

Beaker #: 150-1623

Volume Water: 740/760 mls

1000 = 0.0008

$760/740 = 1.027$

Tare Weight: 65.2250 grams
Final Weight: ~~65.2392~~ 65.2388 grams
Net Weight: 0.0138 grams $\times 1.027$

0.0142 − .0008 = 0.0134

$$\begin{array}{r} 0.1858g \\ -.0002 \\ \hline 0.1856 \end{array}$$

"Cx" Section (Condenser Particulate - Organic Catch)

Beaker #: 150-1610

Volume CH_2Cl_2: 150 mls

Tare Weight: 65.6427 grams
Final Weight: 65.6424 grams
Net Weight: Ø grams $\times 1.027$

"D" Section (Final Acetone Rinse of Impingers)

Beaker #: 150-1609

Volume Acetone: 70 mls

Tare Weight: 65.5389 grams
Final Weight: 65.5381 grams
Net Weight: Ø grams

$70 \times 0.0029/1000 = 0.0002$

$$\begin{array}{r} .0134 \\ -.0002 \\ \hline 0.0132 \\ 0.1716 \\ \hline [illegible] \end{array}$$

Back
Front
[illegible]

6506

6507

TRAVERSE SAMPLING DATA SHEET

Page ___ of 30

Client Lakeside
Location Lacey WA
Sample Site Baghouse outlet

Stack Diameter 37.375 X 31
Date 8-24
Operators BRL
Run I.D. R-2 M5/8H

QA FORMS COMPLETED
Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic/Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Start Time 1233
Stop Time 1345
Barometric Pressure "Hg 29.95
Static Pres "H_2O +.26
Production Rate ___

Filter # ___ Box # S-2

EQUIPMENT CHECKS

Initial/Final
Leak Rate cfm .002 / .008
Leak Test Vacuum 9" / 14"
✓ Pitots, Pre Leak Ck
✓ Pitots, Post Leak Ck
___ Gas Sampling System
✓ Integrated Bag
M5 Rinse Acetone/H_2O/Other

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	950.8	645.8	
#2 Imp.	759.1	638.0	
#3 Imp.	546.1	534.5	
#4 Imp.			
#5 Imp.			
#6 S.G.	872.2	848.9	

Total H_2O Volume 461 ✓ g

SAMPLING PARAMETERS

% Moisture 26%
Meter Temp. 78
Stack Temp. 225
Δ H@ 1.805 Y 1.002
Pitot # ___ Side # ___
Cp .84
Nozzle Diameter .238 inch
D_1 .238 D_2 .239 D_3 .237
K Factor ___

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Pitot Reading Δ P " H_2O	Orifice Setting (Δ H) " H_2O Ideal	Orifice Setting (Δ H) " H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump Vac. Gauge " Hg	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	O_2 %	
A 1	0	198.162	1.01	.71	.71	73	73	3	256	67	230		
2	2½	199.99	1.15	.80	.80	75	73	3	242	60	229		
3	5	201.7	1.49	1.04	1.04	76	73	4	242	58	229		
4	7½	203.74	2.35	1.64	1.64	79	73	5	252	54	230		
5	10	206.17	3.80	2.65	2.65	82	74	7	247	52	232		
6	12½	209.34	4.50	3.14	3.14	83	74	8	246	52	231	CO_2	5.8%
B 1	15	212.78	.85	.59	.59	80	75	3	240	60	230	O_2	12.8%
2	17½	214.41	1.05	.73	.73	81	76	3	230	57	230	CO	NA
3	20	216.11	1.50	1.05	1.05	81	76	4	244	56	230		
4	22½	218.16	2.45	1.71	1.71	83	76	4	239	56	230		
5	25	219.99	3.90	2.74	2.74	86	77	7½	234	54	230		
6	27½	223.98	4.62	3.26	3.26	89	78	9	231	55	231		
C 1	30	227.485	.97	.69	.69	84	78	3	231	57	229		
2	32½	229.14	1.25	.88	.88	85	78	4	232	56	231		
3	35	231.02	1.62	1.14	1.14	85	79	4	234	57	231		
4	37½	233. —	2.55	1.80	1.80	87	79	6	233	57	233		
5	40	235.97	3.78	2.67	2.67	90	79	8	240	59	233		
6	42½	238.98	3.85	2.72	2.72	92	80	8	236	63	234		
D 1	45	242.91	1.28	.90	.90	87	80	4	232	65	232		
2	47½	244.18	1.58	1.12	1.12	88	81	4½	232	67	231		
3	50	246.32	2.19	1.55	1.55	89	82	5½	232	64	232		
4	52½	248.79	2.55	1.80	1.80	90	82	6	230	63	232		
5	55	251.50	2.49	1.76	1.76	91	82	6	245	62	232		
6	57½		2.38	1.68	1.68	91	82	6	235	61	232		
End	60	256.840											
		58.678 ✓	2.154 $(\Delta p)^2$		1.615 ✓ ΔH	81 ✓ T_m					231 ✓ T_s		

METHOD 5
LABORATORY ANALYSIS

Client Lakeside Industries - Lacey Run Number 2

Sample Location Baghouse Outlet

Date 8-24-94

"A" Section (Filter)

Filter # 110-589

Tare Weight 0.8177 grams
Final Weight 0.9345 grams
Net Weight 0.1168 grams

"B" Section (Probe Wash)

Beaker # 150-1611

Volume Acetone 170 mls

Tare Weight 66.7606 grams
Final Weight 66.8159 grams
Net Weight 0.0553 grams
-0.0005
0.0548 -0.0548 0.1716g front

190 x 0.0029/1000 = 0.0005g

"C" Section (Condenser Particulate - Inorganic Catch)

Beaker # 150-1624

Volume Water 720/740 mls

740
-437.7
302.3 x 0.0024/1000
0.0007

740/720 = 1.028

Tare Weight 65.1514 grams
Final Weight 65.1675 grams
Net Weight 0.0161 grams * 1.028
0.0166

"Cx" Section (Condenser Particulate - Organic Catch)

Beaker # 150-1613

Volume CH_2Cl_2 150 mls

Tare Weight 66.9948 grams
Final Weight 66.9939 grams
Net Weight Ø grams * 1.028

"D" Section (Final Acetone Rinse of Impingers)

Beaker # 150-1612

Volume Acetone 75 mls

Tare Weight 67.3012 grams
Final Weight 67.3004 grams
Net Weight Ø grams

75 x .0029/1000 = 0.0002g

.1168
+.0548
+.0166
-.
-.0007

.0166
-.0007
-.0002
0.0157g Back

6507

6508

TRAVERSE SAMPLING DATA SHEET

Client LAKESIDE
Location LACEY
Sample Site BAG House outlet
Stack Diameter 37.375 x 31
Date 8-24-94
Operators ERL
Run I.D. ~~R-1~~ M5 / BH R-3

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.015 / .007
Leak Test Vacuum	9" / 12"

✓ Pitots, Pre Leak Ck
✓ Pitots, Post Leak Ck
___ Gas Sampling System
✓ Integrated Bag
M5 Rinse Acetone/H_2O/Other

QA FORMS COMPLETED
Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Filter # ______ Box # W-4

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	785.7	593.8	[illegible]
#2 Imp.	888.6	640.3	[illegible]
#3 Imp.	589.5	541.7	[illegible]
#4 Imp.			~~480~~
#5 Imp.	791.4	769.2	[illegible]
#6 S.G.	~~792.0~~	~~769.2~~	[illegible]

Total H_2O Volume 510.20 g

Start Time 14:43
Stop Time 15:54
Barometric Pressure "Hg 29.95
Static Pres "H_2O -.25
Production Rate ______

SAMPLING PARAMETERS

% Moisture 26%
Meter Temp. 78
Stack Temp. 225
Δ H@ .805   Y 1.002
Pitot # ____ Side # ____
Cp .84
Nozzle Diameter .238 inch
D_1 .238 D_2 .237 D_3 .239
K Factor ______

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Pitot Reading Δ P " H_2O	Orifice Setting (Δ H) " H_2O Ideal	Orifice Setting Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump Vac. Gauge " Hg	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	O_2 %	
A 1	0	257.697	.97	.68	.68	79	79	5	235	62	232		
2	2½	260.29	1.05	.73	.73	81	80	7	234	55	233		
3	5	—	1.52	1.06	1.06	84	80	4	241	53	233		
4	7½	—	2.29	1.61	1.61	85	80	5	234	53	234		
5	10	267.75	4.15	2.92	2.92	88	80	11	233	53	236		
6	12½	270.91	4.71	3.31	3.31	91	81	11	234	54	236	CO_2	5.8%
B 1	15	274.411	.83	.58	.58	86	81	3	239	57	232	O_2	12.5%
2	17½	275.92	1.05	.74	.74	86	86	3	238	56	233	CO	NA
3	20	277.63	1.55	1.09	1.09	86	82	4	234	57	235		
4	22½	279.70	2.49	1.76	1.76	88	82	6½	241	55	235		
5	25	282.—	4.19	2.97	2.97	91	83	11½	237	53	237		
6	27½	—	4.20	2.97	2.97	93	83	11½	231	55	235		
C 1	30	289.134	.96	.68	.68	88	83	3½	234	61	235		
2	32½	290.69	1.19	.84	.84	88	84	4	230	59	232		
3	35	292.55	1.79	1.27	1.27	88	84	4	233	59	233		
4	37½	294.82	2.65	1.88	1.88	89	84	7	232	58	233		
5	40	297.51	3.61	2.56	2.56	91	84	10	232	58	234		
6	42½	300.45	3.60	2.55	2.55	93	84	10	232	60	234		
D 1	45	303.922	1.10	.78	.78	87	83	4	236	61	230		
2	47½	305.69	1.65	1.17	1.17	88	84	5	232	62	230		
3	50	307.88	2.15	1.52	1.52	88	84	6½	234	61	232		
4	52½	310.6—	2.55	1.81	1.81	89	84	7	234	57	233		
5	55	313.07	2.73	1.93	1.93	90	84	8	234	56	236		
6	57½	315.	2.46	1.74	1.74	91	83	8	236	54	236		
End	60	318.687			.95								
		60.990	2.16 (Δ P)½		1.018 Δ H	85.2					233.7		

METHOD 5
LABORATORY ANALYSIS

Client Lakeside Industries - Lacey Run Number 3

Sample Location Baghouse Outlet

Date 8-24-94

"A" Section (Filter)

Filter # 110-583

Tare Weight 0.8202 grams
Final Weight 0.9156 grams
Net Weight 0.0954 grams

"B" Section (Probe Wash)

Beaker # 150-1614

Volume Acetone 230 mls

Tare Weight 66.9630 grams
Final Weight 67.0306 grams
Net Weight 0.0676 grams
-.0007
0.0669 g + 0.0954 = 0.1623 g front half

230 ml x 0.0029 mg/ml /1000 = 0.0007 g due to blank

"C" Section (Condenser Particulate - Inorganic Catch)

Beaker # 150-1625

Volume Water 820/840 mls

840/820 = 1.024

Tare Weight 65.1549 grams
Final Weight 65.1836 grams
Net Weight 0.0287 grams * 1.024
0.0294 ✓

.0294
H_2O -.0008
Acetone -.0003
.0283

"Cx" Section (Condenser Particulate - Organic Catch)

Beaker # 150-1616

Volume CH_2Cl_2 150 mls

Tare Weight 65.7992 grams
Final Weight 65.7990 grams
Net Weight Ø grams * 1.024

"D" Section (Final Acetone Rinse of Impingers)

Beaker # 150-1615

Volume Acetone 95 mls

Tare Weight 65.8874 grams
Final Weight 65.8872 grams
Net Weight -0.0002 grams

95 x 0.0029 /1000 = 0.0003

.1623 g F
+ .0283 g B
total = .1906 g

6508

LAKESIDE
LACEY

AT

METHOD 5
LABORATORY ANALYSIS

Acetone Blank

Beaker # 150 - 1617	Tare Weight 66.4545 grams
Volume Acetone 140 mls	Final Weight 66.4549 grams
	Net Weight 0.0004 grams

0.4mg/140ml = 0.0029 mg/ml

Distilled, Deionized Water Blank

Beaker # 150 - 1626	Tare Weight 65.1471 grams
Volume Water 250 mls	Final Weight 65.1477 grams
	Net Weight 0.0006 grams

0.6mg/250ml = 0.0024 mg/ml

Methylene Chloride (CH2Cl2) Blank

Beaker # 150 - 1618	Tare Weight 66.9341 grams
Volume CH_2Cl_2 150 mls	Final Weight 66.9331 grams
	Net Weight -0.0010 grams

0.0

AMTEST AIR QUALITY, INC. 35

SAMPLE TRAIN INFORMATION

Fill out one sheet per site and per test type.

CLIENT: LAKESIDE INDUSTRIES

LOCATION: LACEY, WA

SITE: [illegible]

TEST TEAM: [illegible] DATE(S): M5 w/ BH

RUN #'S: [illegible] TYPE: [illegible]

Probe/Filter Temperature: ✓ 248+25 F ___ 320 F ___ Other

Impinger Temperature: ✓ <68 F ___ Other

THIMBLE: ___ yes ✓ no NOZZLE TYPE: ___ quartz ✓ steel ___ none

PROBE LINER: ___ quartz ___ glass ✓ steel ___ teflon

PROBE TYPE: ✓ regular ___ water-cooled

FRONT-HALF FILTER: ✓ yes ___ no SIZE (mm): ___ 90 ✓ 110 ___ 125 ___ other___

FRONT-HALF FILTER MEDIA: ✓ quartz fiber ___ glass fiber ___ teflon

SUPPORT: ___ steel ___ glass frit ✓ teflon GASKET: ✓ silicon ___ teflon

BACK-HALF FILTER: ___ yes ✓ no

BACK-HALF FILTER MEDIA: ___ quartz fiber ___ glass fiber ___ telfon ___ tared ___ untared

NOTE: Show the back-half filter location with an arrow on the table below.

CONTENTS	Initial Volume (mL)	Clean-up Solution Used	Bottle Type	Comments
Nozzle/Probe Rinse		ACETONE	500mL W.M.	
Filter				
#1 H_2O	100	H_2O/ACE	1L/250mL	
#2 H_2O	100	↓	↓	
#3 M.T.	-	↓	↓	
#4 S.G.	-			
#5				
#6				
#7				

IF THIS INFORMATION IS NOT ACCURATE FOR ALL RUNS, NOTE ALL EXCEPTIONS.

AMTEST
AIR QUALITY, INC.

GAS BAG SAMPLE DATA SHEET

CLIENT: LAKESIDE
LOCATION: LACEY
SAMPLE SITE: BAGHOUSE Outlet
DATE: 8-24

NUMBER/TYPE OF TESTS: 1, 2, 3 NUMBER OF BAGS: 3
SAMPLED BY: ERL
SUBMITTED BY: ERL
ANALYZED BY: ERL DATE: 8/23

BAG NUMBER/IDENTIFICATION	CO_2 %	O_2 %	CO ppm	F_o	NOTES
R-1	5.5	13.0		1.44	
R-2	5.8	12.8		1.40	
R-3	5.8	12.5		1.45	

CO_2 ANALYZER: SERVOMEX CALIBRATION GAS: 5.98 - 12.01
O_2 ANALYZER: SERVOMEX CALIBRATION GAS: 14.28 - 10.03
CO ANALYZER: CALIBRATION GAS:

APPENDIX C

Supporting Information

10... START 38

AMTEST AIR QUALITY, INC.

SOURCE AND PROCESS INFORMATION

CLIENT: Lakeside Industries

LOCATION: Lacey

SAMPLE SITE: stack

TEST DATE: 24 Aug 94

CLIENT CONTACT: Forest Lane

OPERATION PERSONNEL: "Smokey"

AGENCY REPRESENTATIVE: Ray Lawrence

AM TEST-AIR QUALITY PERSONNEL: Robert Moody

TYPE OF PROCESS: Hot-mix Asphalt

EQUIPMENT MANUFACTURER: Madson

MODEL: ______ CONSTRUCTED/INSTALLED: 1977?

IDENTIFICATION NO.: ______ DATE LAST TESTED: 1989

PROCESS RATE: 270 TPH

FUEL FIRING RATE: 590 gal/hour TYPE OF FUEL: Diesel

TYPE OF EMISSION CONTROL DEVICE: Baghouse

EQUIPMENT MANUFACTURER: W.A.G

PURPOSE OF TESTING: Routine 5-yr test.

EMISSION STANDARD (in units): .04 gr/DSCM

PROCESS DESCRIPTION:
① aggregate dried in drum dryer ② elevated to batch tower ③ sorted and mixed with asphalt. ④ asphalt elevated to silo. ⑤ ~~fines~~ exhaust from ~~baghouse~~ dryer to baghouse ⑥ fines from baghouse routed back to mix or to collection bin.

PROCESS SHUTDOWNS/PROBLEMS: ______

Forest Lane

AUTHORIZED SIGNATURE

SOURCE TEST OBSERVATION CHECKLIST
ASPHALT PLANTS WITH BAGHOUSE

AMTEST AIR QUALITY, INC

CLIENT: Lakeside Industries

LOCATION: Lacey

SAMPLE SITE: stack

TEST DATE: 24 Aug 94

TYPE OF PLANT: Hot-Mix Batch Plant

EQUIPMENT MANUFACTURER: Madson

MODEL: ______ CONSTRUCTED/INSTALLED: 1977?

IDENTIFICATION NO.: ______ DATE LAST TESTED: ______

PROCESS RATE: 270 TPH DISCHARGE TEMP °F: ______

FUEL FIRING RATE: 590 gal/hr TYPE OF FUEL: diesel

A/C INJECTION LOCATION: pug mill

FINES IN GRAVEL (-200 mesh): 5-7%

GRAVEL MOISTURE: 4-6 % ASPHALT TYPE: AR 4000

DENSITY ______ lb/gal FLASHPOINT °F 450°

TYPE OF EMISSION CONTROL DEVICE: Baghouse

EQUIPMENT MANUFACTURER: W.A.G. MODEL: Model 8

IDENTIFICATION NO.: ______

BAG MATERIAL: Nomex 14 oz. NO. OF BAGS: 1180

BAG SIZE: 8' DATE BAGS LAST CHANGED: 1990

TYPE OF BAG CLEANING: Reverse Pulse

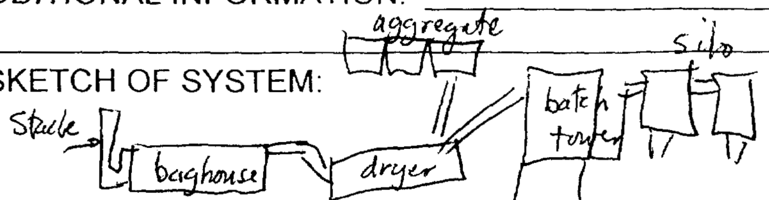
BAGHOUSE PRESSURE ΔP = 5.5 " H_2O (OR PRESSURE DROP ACROSS BAGHOUSE)

CLEANING CYCLE DURATION: ______

DISPOSITION OF COLLECTED DUST: Return to mix / collection bin

ADDITIONAL INFORMATION: ______

SKETCH OF SYSTEM:

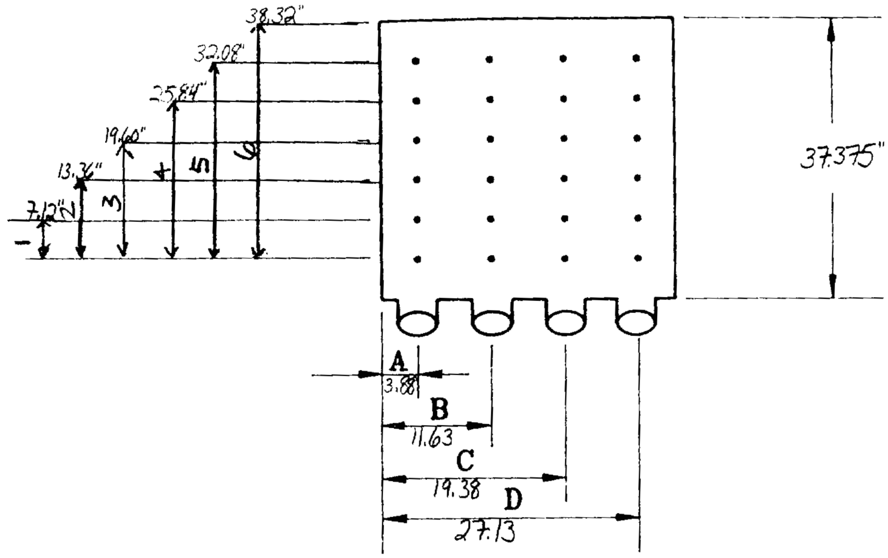


AUTHORIZED SIGNATURE

CROSS SECTIONAL AREA

Traverse Point	Distance (inches)
1	7.12
2	13.36
3	19.60
4	25.84
5	32.08
6	38.32

Port	Distance (inches)
A	3.88
B	11.63
C	19.38
D	27.13



STACK DIMENSIONS

37.375 inch x 31 inch rectangular vent

4 ports located along the 31 inch side

A = 23.5 inches downstream

B = 281 inches upstream

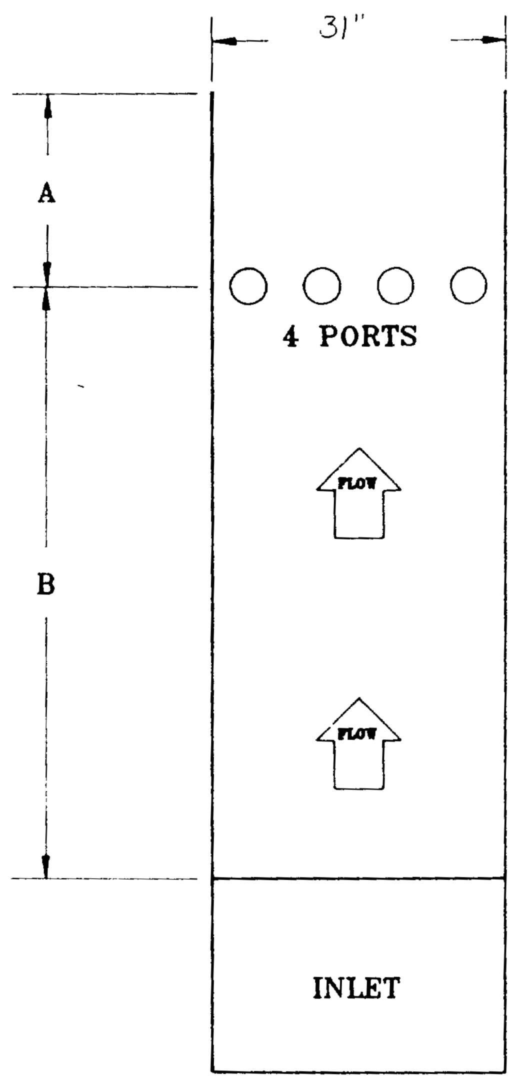


Figure 1. Location of sampling ports and traverse points.

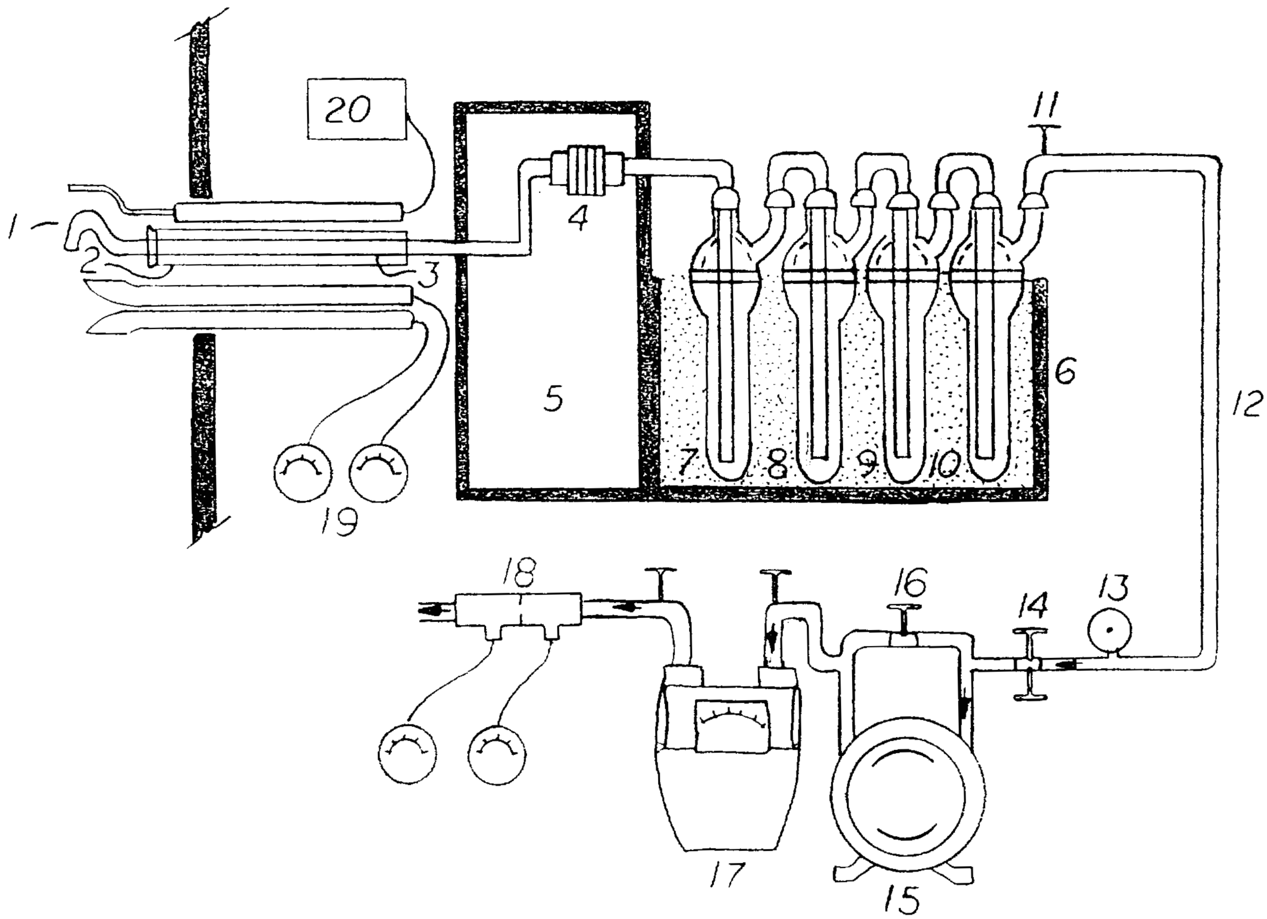


Figure 2 . Method 5 Sample Train.

1. Sampling nozzle
2. Sampling probe sheath
3. Heated sample probe liner
4. Out of stack filter assembly
5. Heated filter compartment maintained at 248°F ± 25°F (or temperature specified in 40 CFR subpart)
6. Impinger case - contains ice during sampling
7. First impinger containing 100 ml H_2O
8. Modified Greenburg-Smith impinger containing 100 ml H_2O
9. Third impinger - empty
10. Fourth impinger containing indicating silica gel desiccant
11. Impinger exit gas temperature sensor
12. Umbilical cord - vacuum line
13. Vacuum gauge
14. Fine and coarse adjustment valves
15. Leak free pump
16. By-pass valve
17. Dry gas meter with inlet and outlet temperature sensors
18. Orifice meter with magnehelic gauges
19. S-type pitot tube with magnehelic gauges
20. Fluke multi-channel digital thermocouple indicator

METHOD 1 - LOCATION OF TRAVERSE POINTS

Circular Stacks

TRAVERSE POINT	DISTANCE % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

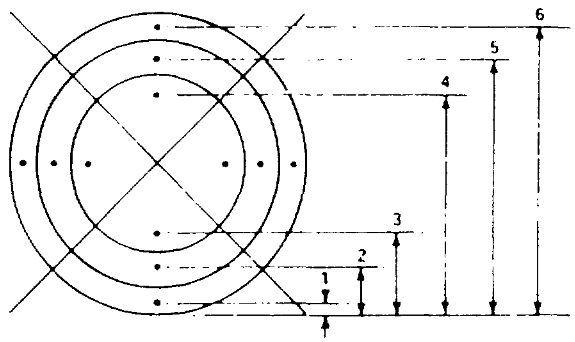


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

[Percent of stack diameter from inside wall to traverse point]

Traverse point number on a diameter	Number of traverse points on a diameter—											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	65.4	80.6
18									98.6	93.3	88.4	83.9

Rectangular Stacks

For a rectangular cross section, an equivalent diameter (D_e) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{(L+W)}$$

where L=length and W=width.

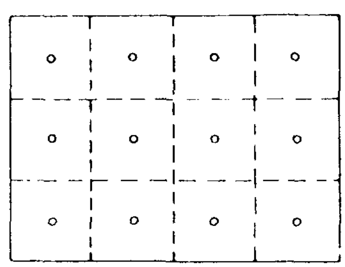


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

METHOD 1 - MINIMUM NUMBER OF TRAVERSE POINTS

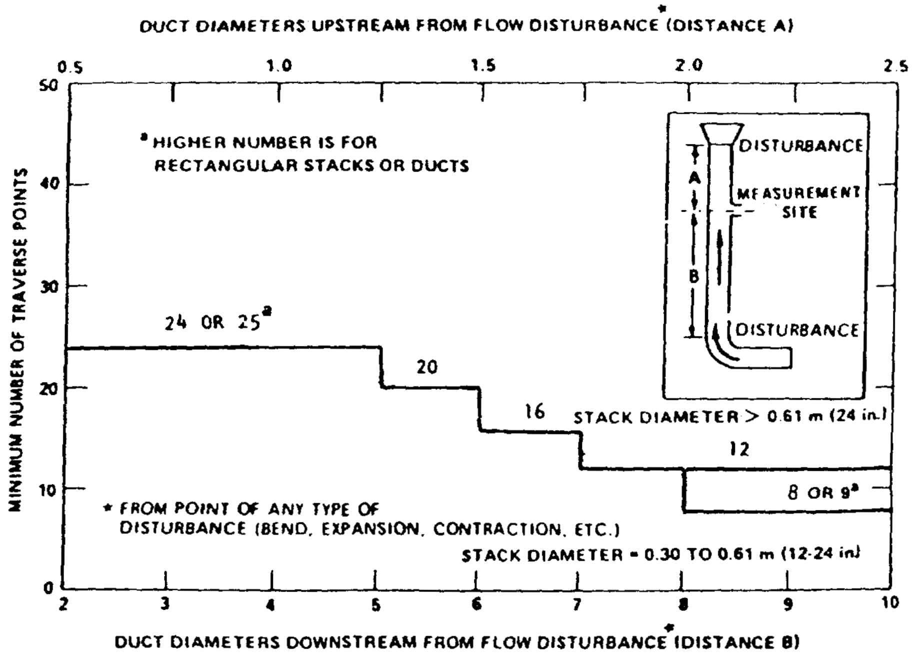


Figure 1-1. Minimum number of traverse points for particulate traverses.

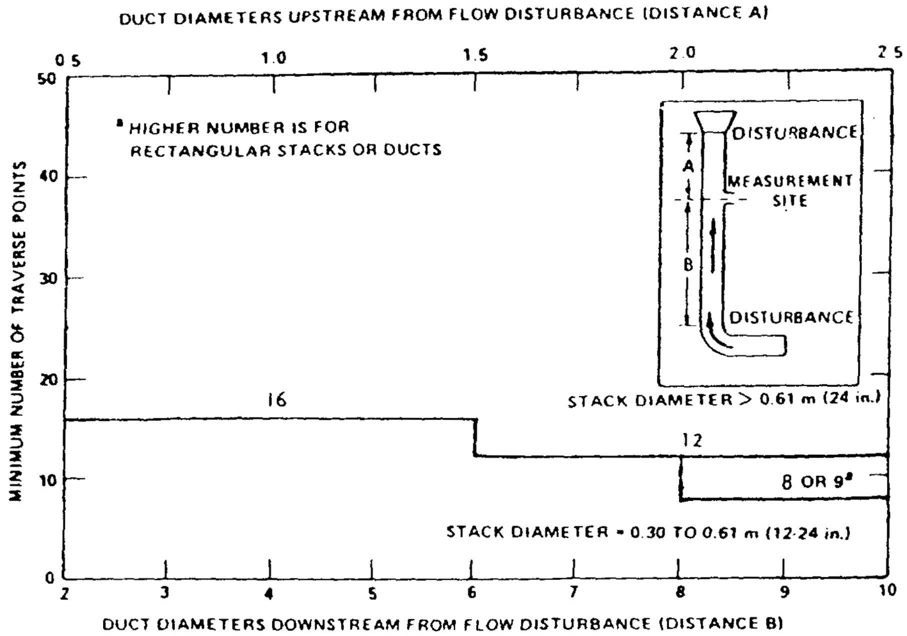


Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

METHOD 2 - STACK GAS VELOCITY AND VOLUMETRIC FLOW CALCULATIONS

5.1 Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).
B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.
C_p = Pitot tube coefficient, dimensionless.
K_p = Pitot tube constant,

$$34.97 \frac{\text{m}}{\text{sec}} \left[\frac{(g/g\text{-mole})(\text{mm Hg})}{(°\text{K})(\text{mm H}_2\text{O})}\right]^{1/2}$$

for the metric system and

$$85.49 \frac{\text{ft}}{\text{sec}} \left[\frac{(\text{lb/lb-mole})(\text{in. Hg})}{(°\text{R})(\text{in. H}_2\text{O})}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).
M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).
$= M_d (1 - B_{ws}) + 18.0 B_{ws}$

Eq. 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).
P_g = Stack static pressure, mm Hg (in. Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).
$= P_{bar} + P_g$ Eq. 2-6

Eq. 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).
t_s = Stack temperature, °C (°F).
T_s = Absolute stack temperature, °K, (°R).
$= 273 + t_s$ for metric.

Eq. 2-7

$= 460 + t_s$ for English.

Eq. 2-8

T_{std} = Standard absolute temperature, 293 °K (528° R).
v_s = Average stack gas velocity, m/sec (ft/sec).
Δ_p = Velocity head of stack gas, mm H_2O (in. H_2O).
3,600 = Conversion factor, sec/hr.
18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average Stack Gas Velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

Equation 2–9

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3{,}600(1 - B_{ws}) v_s A \left(\frac{T_{std}}{T_{s\,(avg)}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Eq. 2-10

METHOD 3 - MOLECULAR WEIGHT AND EXCESS AIR CALCULATIONS

6.1 Nomenclature.

M_d = Dry molecular weight, g/g-mole (lb/lb-mole).
%EA = Percent excess air.
$\%CO_2$ = Percent CO_2 by volume (dry basis).
$\%O_2$ = Percent O_2 by volume (dry basis).
%CO = Percent CO by volume (dry basis).
$\%N_2$ = Percent N_2 by volume (dry basis).
0.264 = Ratio of O_2 to N_2 in air, v/v.
0.280 = Molecular weight of N_2 or CO, divided by 100.
0.320 = Molecular weight of O_2 divided by 100.
0.440 = Molecular weight of CO_2 divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O_2, CO, and N_2 (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\%\,EA = \frac{\%O_2 - 0.5\%\,CO}{0.264\%\,N_2 - (\%O_2 - 0.5\%\,CO)} \times 100$$

Eq. 3-1

NOTE: The equation above assumes that ambient air is used as the source of O_2 and that the fuel does not contain appreciable amounts of N_2 (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternate methods, subject to approval of the Administrator, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

Eq. 3-2

METHOD 4 - STACK GAS MOISTURE CALCULATIONS

2.3.1 Nomenclature.

B_{ws} = Proportion of water vapor, by volume, in the gas stream.

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m³)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft³)/(lb-mole) (°R) for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel or silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of Water Vapor Condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w}$$

$$= K_1 (V_f - V_i)$$

Eq. 4-1

K_1 = 0.001333 m³/ml for metric units
= 0.04707 ft³/ml for English units

2.3.3 Volume of Water Vapor Collected in Silica Gel.

$$V_{wsg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w}$$

$$= K_2 (W_f - W_i)$$

Eq. 4-2

Where:
K_2 = 0.001335 m³/g for metric units
= 0.04715 ft³/g for English units

2.3.4 Sample Gas Volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)}$$

$$= K_3 Y \frac{V_m P_m}{T_m}$$

Eq. 4-3

Where:
K_3 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Eq. 4-4

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

METHOD 5 - PARTICULATE EMISSION CALCULATIONS - (1)

6.1 Nomenclature.

A_n = Cross-sectional area of nozzle, m^2 (ft^2).
B_{ws} = Water vapor in the gas stream, proportion by volume.
C_a = Acetone blank residue concentration, mg/g.
c_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).
I = Percent of isokinetic sampling.
L_a = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.0057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.
L_i = Individual leakage rate observed during the leak check conducted prior to the "i^{th}" component change (i = 1, 2, 3....n), m^3/min (cfm).
L_p = Leakage rate observed during the post-test leak check, m^3/min (cfm).
m_a = Mass of residue of acetone after evaporation, mg.
m_n = Total amount of particulate matter collected, mg.
M_w = Molecular weight of water, 18.0 g/g-mole (18.0lb/lb-mole).
P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).
P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
R = Ideal gas constant, 0.06236 mm Hg-m^3/°K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole).
T_m = Absolute average dry gas meter temperature (see Figure 5-2), °K (°R).
T_s = Absolute average stack gas temperature (see Figure 5-2), °K (°R).
T_{std} = Standard absolute temperature, 293° K (528° R).
V_a = Volume of acetone blank, ml.
V_{aw} = Volume of acetone used in wash, ml.
V_{lc} = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.
V_m = Volume of gas sample as measured by dry gas meter, dcm (dscf).
$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).
v_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).
W_a = Weight of residue in acetone wash, mg.
Y = Dry gas meter calibration factor.
ΔH = Average pressure differential across the orifice meter (see Figure 5-2), mm H_2O (in. H_2O).
ρ_a = Density of acetone, mg/ml (see label on bottle).
ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).
θ = Total sampling time, min.
θ_1 = Sampling time interval, from the beginning of a run until the first component change, min.
θ_i = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.
θ_p = Sampling time interval, from the final (n^{th}) component change until the end of the sampling run, min.
13.6 = Specific gravity of mercury.
60 = Sec/min.
100 = Conversion to percent.

6.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop. See data sheet (Figure 5-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20° C, 760 mm Hg or 68° F, 29.92 in. Hg) by using Equation 5-1.

$$V_{m(std)} = V_m Y\left(\frac{T_{std}}{T_m}\right)\left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right]$$

$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 5-1

Where;
K_1 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds L_a. If L_p or $_i$ exceeds L_a, Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V_m in Equation 5-1 with the expression:

$$[V_m - (L_p - L_a)\theta]$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace V_m in Equation 5-1 by the expression:

$$\left[V_m - (L_1 - L_a)\theta_1 - \sum_{i=2}^{n} (L_i - L_a)\theta_i - (L_p - L_a)\theta_p\right]$$

and substitute only for those leakage rates (L_i or L_p) which exceed L_a.

6.4 Volume of Water Vapor.

METHOD 5 - PARTICULATE EMISSION CALCULATIONS - (2)

Equation 5-2

$$V_{w(std)} = V_{1c}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{1c}$$

Where:
K_2=0.001333 m³/ml for metric units
=0.04707 ft³/ml for English units.

6.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Eq. 5-3

NOTE: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of B_w shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ±1° C (2° F).

6.6 Acetone Blank Concentration.

$$C_a = \frac{m_a}{V_a \rho_a} \qquad \text{Eq. 5-4}$$

6.7 Acetone Wash Blank.

$$W_a = C_a V_{aw} \rho_a \qquad \text{Eq. 5-5}$$

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from Containers 1 and 2 less the acetone blank (see Figure 5-3).

NOTE: Refer to Section 4.1.5 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

6.9 Particulate Concentration.

$$c_s = (0.001\ g/mg)\ (m_n / V_{m(std)})$$

Eq. 5-6

6.10 Conversion Factors:

From	To	Multiply by
scf	m³	0.02832
g/ft³	gr/ft³	15.43
g/ft³	lb/ft³	2.205 × 10⁻³
g/ft³	g/m³	35.31

6.11 Isokinetic Variation.

6.11.1 Calculation From Raw Data.

$$I = \frac{100\ T_s[K_3 V_{1c} + (V_m/T_m)(P_{bar} + \Delta H/13.6)]}{60\theta v_s P_s A_n}$$

Eq. 5-7

Where:
K_3=0.003454 mm Hg−m³/ml−°K for metric units.
=0.002669 in. Hg−ft³/ml−°R for English units.

6.11.2 Calculation From Intermediate Values.

$$I = \frac{T_s V_{m(std)} P_{std}\ 100}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})}$$

$$= K_4 \frac{T_s V_{m(std)}}{P_s V_s A_n \theta (1 - B_{ws})}$$

Equation 5-8

where:
K_4=4.320 for metric units
=0.09450 for English units.

6.12 Acceptable Results. If 90 percent < I < 110 percent, the results are acceptable. If the particulate results are low in comparison to the standard, and I is over 110 percent or less than 90 percent, the Administrator may accept the results.

NOMENCLATURE
METHOD 5 CALCULATIONS

Vm_{std} = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

Y = Dry gas meter calibration factor

P_b = Barometric pressure at the sampling site, mm Hg (in. Hg)

H = Average pressure differential across the orifice meter, mm H_2O (in. H_2O)

T_m = Absolute average dry gas meter temperature, $^{\circ}$ K ($^{\circ}$ R)

dscm = Dry standard cubic meters

dscf = Dry standard cubic feet

W_a = Weight of residue in acetone wash

M_a = Mass of residue of acetone after evaporation, mg

C_a = Acetone blank residue concentration, mg/g

V_a = Volume of acetone blank

V_{aw} = Volume of acetone used in wash, ml

M_n = Total amount of particulate matter collected, mg

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, mg/dscm (gr/dscf)

gr/dscf = grains per dry standard cubic foot

Vw_{std} = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf)

B_{ws} = Water vapor in the gas stream, proportion by volume

M_d = Molecular weight of stack gas, g/g-mole on dry basis

M_s = Molecular weight of stack gas, g/g-mole on wet basis

V_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec)

C_p = Pitot tube coefficient, dimensionless

Δp = Velocity head of stack gas, mm H_2O (in. H_2O)

P_s = Absolute stack gas pressure, mm Hg (in. Hg)

NOMENCLATURE (continued)
METHOD 5 CALCULATIONS

Q_{std} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr)

dscf/min = dry standard cubic feet per minute (also identified as dcfm or scfm)

acfm = actual cubic feet per minute

I = Percent of isokinetic sampling

A_n = Cross-sectional area of nozzle, m^2 (ft^2)

AMTEST
AIR QUALITY, INC.

DRY GAS METER CALIBRATION
AM TEST - AIR QUALITY, INC.

FILE NAME: RDMAG894.WK1
METER BOX #: RED MAG (JAG)
CALIBRATION DATE: 8-22-94
METHOD OF CALIB.: STANDARD DRY GAS METER (Method 5 Section 7.1)

TOTAL TIME min	DELTA H "H2O	METER VOL V1 cf	METER VOL V2 cf	TEMP IN deg F	TEMP OUT deg F	BARO. PRES. "Hg	STD DGM V1	STD DGM V2	ST.DGM TEMP IN deg F	ST.DGM TEMP OUT deg F	ST.DGM Yds FACTOR	Y FACTOR	DELTA H@
23.5	0.50	853.674	866.938	72.0	70.0	29.57	686.912	700.037	74.0	69.0	1.001	0.9883	0.914
15.0	1.00	867.393	880.679	76.0	73.0	29.57	700.488	713.616	70.0	69.0	1.001	0.9960	0.735
12.0	1.50	881.254	893.230	80.0	75.0	29.57	714.186	726.032	70.0	69.0	1.001	1.0014	0.863
13.5	2.00	900.566	917.371	82.0	77.0	29.57	733.300	749.951	69.0	69.0	1.001	1.0065	0.733
9.0	2.50	930.060	942.199	86.0	77.0	29.57	762.595	774.652	69.0	69.0	1.001	1.0114	0.777
10.0	3.00	968.304	982.810	85.0	78.0	29.57	800.708	815.117	70.0	69.0	1.001	1.0093	0.806
AVERAGE												1.002	0.805

PRESSURE SENSOR CALIBRATION DATA FORM

Date 9-21-93 Control Box # Red Mag (JAG Red)

Ambient Temperature 65 °F Barometric Pressure 29.8 in Hg

MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	%
0 - 3"				
High	0.61	0.62	0.01	1.6%
	1.23	1.28	0.05	4.1%
	1.80	1.85	0.05	2.8%
	2.40	2.44	0.04	1.7%
Low	0.65	0.67	0.02	3.1%
	1.20	1.25	0.05	4.2%
	1.80	1.84	0.04	2.2%
	2.45	2.50	0.05	2.0%
0 - 4"	~~0.82~~	~~0.82~~		
High	0.82	0.82	0.0	0.0
	1.60	1.59	0.01	0.63%
	2.35	2.36	0.01	~~0.3%~~ .4%
	3.20	3.19	0.01	0.31%
Low	0.82	0.86	0.04	0.49%
	1.62	1.65	0.03	1.9%
	2.38	2.41	0.03	1.3%
	3.13	3.14	0.01	.3%

$$\frac{(\text{ref pres. " } H_2O - \text{test pres. " } H_2O))}{(\text{ref pres. " } H_2O)} * 100 \leq 5\%$$

PRESSURE SENSOR CALIBRATION DATA FORM

Date 9-21-93 Control Box # Red Mag (JAG Red)

Ambient Temperature 65 °F Barometric Pressure 29.8 in Hg

	MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	PRESSURE DIFFERENCE %
	0 - .25"				
High		0.06	0.06	0.0	0%
		0.11	0.11	0.0	0%
		0.15	0.15	0.0	0%
		0.21	0.21	0.0	0%
~~Low~~					
Low		0.06	0.06	0.0	0%
		0.11	0.11	0.0	0%
		0.16	0.16	0.0	0%
		0.19	0.19	0.0	0%

$$\frac{(\text{ref pres. " } H_2O - \text{test pres. " } H_2O)}{(\text{ref pres. " } H_2O)} * 100 \leq 5\%$$

PRESSURE SENSOR CALIBRATION DATA FORM

Date 9-21-93 Control Box # Red Mag (JAG Red)

Ambient Temperature 65 °F Barometric Pressure 29.8 in Hg

	MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	%
	0 - 1"				
high		0.23	0.23	0.00	0.0%
		0.42	0.42	0.00	0.0%
		0.60	0.61	0.01	1.7%
		0.82	0.84	0.02	2.5%
Low		0.21	0.22	0.01	4.8%
		0.44	0.44	0.00	0.0%
		0.63	0.66	0.02	3.2%
		0.82	0.84	0.02	2.4%
	0 - 2"				
High		0.43	0.43	0.00	0.0%
		0.82	0.83	0.01	1.2%
		1.20	1.24	0.04	3.23
		1.63	1.66	0.03	1.8%
Low		0.39	0.39	0.00	0.0%
		0.82	0.82	0.00	0.0%
		1.21	1.24	0.03	2.5%
		1.63	1.65	0.02	1.2%

$\frac{\text{(ref pres. " H}_2\text{O - test pres. " H}_2\text{O))}}{\text{(ref pres. "H}_2\text{O)}} * 100 \leq 5\%$

AMTEST
AIR QUALITY, INC.

STANDARD DRY GAS METER CALIBRATION DATA SUMMARY
AMTEST AIR QUALITY, INC.

PERFROMED BY HOMER R. DULIN CO.

Cal. DGM Ind, SCFH	Primary Standard SCFH	Yds
13.5	13.8	1.022
25.7	25.8	1.004
35.9	35.7	0.994
46.5	46.2	0.994
55.9	55.9	1.000
66.8	66.6	0.997
85.5	84.8	0.992
88.8	88.5	0.997
99.9	100.1	1.002
108.6	108.9	1.003
113.3	113.5	1.002
	AVG. Yds =	1.001

54

55

HOMER R. DULIN CO.

729 EAST WILLOW STREET
LONG BEACH, CALIFORNIA 90806

(310) 424-8533 (213) 636-4096 FAX (310) 426-7707

CERT. NO. 4-304-4

CALIBRATION CERTIFICATION

SUBMITTED BY: KRIS A. HANSEN CO.

FLOWMETER SERIAL No. 0302

MANUFACTURER EQUIMETER MFG. SERIAL No. 27688

TUBE No. ____ FLOAT No. ____

MODEL NO.: T-110

REMARKS: CALIBRATED IN CFH AIR @ 14.7 PSIA & 70 DEG F.

ACCURACY: SEE DATA

INDICATED		ACTUAL	
CFH		CFH	
113.3		113.5	
108.6		108.9	
99.9		100.1	
88.8		88.5	
85.5		84.8	
66.8		66.6	
55.9		55.9	
46.5		46.2	
35.9		35.7	
25.7		25.8	
13.5		13.8	

Flowmeter Certified with HOMER R. DULIN CO.

Equipment No. 12400 Accuracy 0.2% Calib. Due 5-28-94

Procedure No. 101G

NIST Cert. No. 821/249576-92

Our standards are certified by or are traceable to the National Institute of Standards and Technology and comply with MIL-STD-45662A

P.O. No. 06330 Shipper No. ____

4-18-94	4-18-95	B. Richardson
CALIBRATION DATE	RECALIBRATION DATE	CALIBRATION TECHNICIAN B. RICHARDSON

TYPE S PITOT TUBE INSPECTION DATA FORM

Date 12-28-93 Pitot Tube # P5CJ

Client Lakeside Industries

Location Lacey, Washington

Site(s) Hot Mix Asphalt Batch Plant Baghouse Stack

Test Date(s) August 24, 1994

Pitot tube assembly level? ✓ yes ___ no

Pitot tube openings damaged? ___ yes (explain below) ✓ no

α_1 = 4.0 ° (<10°), α_2 = 2.0 ° (<10°), β_1 = 3.5 ° (<5°),

β_2 = 1.5 ° (<5°)

γ = 0.5 °, θ = 0.5 °, A = 1.113 cm (in.)

z = A sin γ = .00971 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = .00971 cm (in.); <.08 cm (<1/32 in.)

P_A 0.557 cm (in.) P_b 0.556 cm (in.)

D_t = 0.375 cm (in.)

Comments:

Calibration required? ___ yes* ✓ no

*If yes, tag and take out of service until repaired.

VP

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 12-29-93 Thermocouple Indicator # Red L/F

Ambient Temperature 71 °F Barometric Pressure 29.85 in Hg

THERMOCOUPLE # OR REFERENCE	REFERENCE THERMOMETER TEMPERATURE °F	THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F	TEMPERATURE DIFFERENCE %
T6DJ				
	33	33	0	0.00%
	211	214	3	0.45%
	364	364	0	0.00%

$$\frac{(\text{ref temp, °F} + 460) - (\text{test therm. temp, °F} + 460)}{(\text{ref temp, °F} + 460)} * 100 \leq 1.5\%$$

VP