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SOURCE

EMISSION

EVALUATION

JUNE 30, 1992

Prepared For:

LAKESIDE INDUSTRIES
BOEING 400 DRUM MIX ASPHALT PLANT
SCRUBBER STACK
SHELTON, WASHINGTON
JUNE 3, 1992

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

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1.0
INTRODUCTION

The purpose of this source emission evaluation was to quantify particulate matter emissions from an asphalt plant owned and operated by Lakeside Industries. The drum mix asphalt plant is located in Shelton, Washington. The asphalt plant was manufactured by Boeing Construction Company and is equipped with a Boeing venturi wet scrubber system to control particulate matter emissions. 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 the Olympic Air Pollution Control Authority (OAPCA) requirements.

The methodology which was used to collect the emission samples is discussed in the July 1, 1991 edition of the Environmental Protection Agency (EPA) document Title 40, Code of Federal Regulations, Parts 53-60 (40 CFR 60), Appendix A, Methods 1, 2, 3A, 4 and 5. Methods 1 and 2 were performed to measure the stack gas temperature and velocity and for calculating the volumetric flow rate. Method 3A was performed to measure the oxygen (O_2), carbon dioxide (CO_2) and carbon monoxide (CO) concentration in order to determine the molecular weight of the stack gas. Method 4 was performed to measure the moisture content of the stack gas. Method 5 was performed to quantify the particulate matter and condensible matter emissions. Olympic Air Pollution Control Authority (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. Condensible particulate matter was quantified by performing an extraction of the back-half portion of the Method 5 sample train using Puget Sound Air Pollution

Control Agency (PSAPCA) Regulation I procedures. Three (3) Method 1, 2, 3A, 4 and 5 samples were collected at the scrubber exhaust on June 3, 1992.

Mr. James A. Guenthoer and Mr. E. Ray Lawrence of Am Test-Air Quality, Inc. conducted the field sampling and in-field sample recovery. Ms. Cassie B. Heaton and Ms. Kristi L. Bischofberger performed the laboratory analysis. Mr. Kris A. Hansen, Ms. Angela F. Blaisdell, Ms. Jan M. Widmeyer, Ms. Amy M. Brotherton and Ms. Bischofberger of Am Test-Air Quality, Inc. performed data reduction and final report preparation. Mr. Harold Nickel of Lakeside Industries coordinated this project. Mr. Jack Faye of Asphalt Equipment Services Company (AESCO) was present during the testing. Mr. James Werner of the Olympic Air Pollution Control Authority (OAPCA) observed the testing.

2.0

SUMMARY OF RESULTS

The results of the three (3) Method 5 tests for quantifying particulate matter emissions from the drum mix asphalt plant scrubber stack at Lakeside Industries' Shelton plant are summarized in Table 2.0 below, and on page 5 in a computer printout titled "Summary of Results - Methods 1, 2, 3A, 4, and 5".

Table 2.0 Summary of particulate matter emission test results from samples collected June 3, 1992 at the scrubber stack at Lakeside Industries' Shelton Plant.

Sample Run #	Am Test Lab #	Front-half Partic. Matter Emission Conc. gr/dscf	Back-half Partic. Matter Emission Conc. gr/dscf	Total Partic. Matter Emission Conc. gr/dscf	Total Partic. Matter Emission Rate lb/hr
1	01913	0.014	0.021	0.035	6.99
2	01914	0.015	0.024	0.039	8.02
3	01915	0.017	0.024	0.040	8.25
Average		0.015	0.023	0.038	7.75

The front-half, back-half and total particulate matter emission concentrations in the table above are presented in units of grains of particulate matter collected per dry standard cubic foot (gr/dscf) of gas sampled. The particulate matter emission rate is presented in units of pounds per hour (lb/hr). An acceptable leak check of less than 0.02 cubic feet per minute (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%. Results for each Method 5 run are included in the individual computer printouts for each run, which are included in Appendix A of this report. Example calculations of the Method 5

results were performed for run 2 and are included in Appendix B of this report along with copies of the field data sheets.

AMTEST
AIR QUALITY, INC.

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

FILE NAME: 163\LAKEM5SM
CLIENT: LAKESIDE INDUSTRIES
LOCATION: SHELTON, WASHINGTON
SAMPLE SITE: BOECON PLANT EXHAUST STACK

	RUN #1	RUN #2	RUN #3	AVERAGE
LAB #:	01913	01914	01915	
DATE:	06/03/92	06/03/92	06/03/92	
START TIME:	07:25	09:19	11:18	
STOP TIME:	08:37	10:28	12:29	
SAMPLE LENGTH (minutes):	60.0	60.0	60.0	
VOLUME SAMPLED (cubic feet):	36.716	37.608	37.348	37.224
VOLUME SAMPLED (dry std. cubic feet):	36.564	36.907	36.261	36.577
VOLUME SAMPLED (dry std. cubic meters):	1.036	1.045	1.027	1.036
STACK GAS MOISTURE (percent):	36.38	35.78	35.13	35.76
BAROMETRIC PRESSURE (inches of Hg):	29.94	30.15	30.24	30.11
STATIC PRESSURE (inches of H2O):	-0.23	-0.24	-0.23	-0.23
STACK PRESSURE (inches of Hg):	29.92	30.13	30.22	30.09
STACK TEMPERATURE (degrees F.):	168.8	168.9	169.6	169.1
STACK TEMPERATURE (degrees R.):	628.8	628.9	629.6	629.1
CARBON DIOXIDE (percent):	7.4	7.3	7.1	7.3
OXYGEN (percent):	10.3	10.6	10.9	10.6
CARBON MONOXIDE (ppm):	30	45	85	53
MOLECULAR WEIGHT (dry, g/g-mole):	29.60	29.59	29.57	29.59
MOLECULAR WEIGHT (wet, g/g-mole):	25.38	25.44	25.51	25.44
AVERAGE VELOCITY HEAD (inches of H2O):	0.154	0.156	0.156	0.155
PITOT TUBE Cp:	0.84	0.84	0.84	
STACK GAS VELOCITY (feet/second):	25.6	25.7	25.7	25.7
STACK DIAMETER (inches):	72.0	72.0	72.0	
STACK AREA (square feet):	28.27	28.27	28.27	
STACK GAS AIRFLOW (dry std. cubic feet per min.):	23206.2	23695.7	23913.3	23605.1
STACK GAS AIRFLOW (actual cubic feet per min.):	43436.8	43640.5	43518.7	43532.0
NOZZLE DIAMETER (inches):	0.373	0.373	0.373	
ISOKINETICS (percent):	98	97	94	
FRONT-HALF PARTICULATE MATTER EMISSION CONC. (gr/dscf):	0.014	0.015	0.017	0.015
BACK-HALF PARTICULATE MATTER EMISSION CONC. (gr/dscf):	0.021	0.024	0.024	0.023
TOTAL PARTICULATE MATTER EMISSION CONC. (gr/dscf):	0.035	0.039	0.040	0.038
PARTICULATE MATTER EMISSION CONC. (mg/dscm):	80.4	90.3	92.1	87.6
PARTICULATE MATTER MASS EMISSION RATE (lb/hr):	6.99	8.02	8.25	7.75

3.0
SOURCE OPERATION

The Boeing Construction Company Model 400, (I.D. #2862-S) drum mix asphalt plant located at Lakeside Industries' facility in Shelton, Washington was constructed in 1976. Emissions from the asphalt plant are controlled by a Boeing Model 400 venturi scrubber prior to exhausting to the atmosphere. The venturi scrubber system was operated on the test day with a water pressure of 80 pounds per square inch (psi) and utilized 130 gallons per minute (gal/min) of water (non-recycled). The water inlet temperature was 109° F, and the water outlet temperature was 101° F. The pressure drop across the scrubber system was 20 inches of water column during these tests. During the tests, asphalt was being produced at a rate of 335 tons per hour (tph). The asphalt discharge temperature was 300° F, with approximately 5% fines in the gravel. A process information sheet, completed in the field by Mr. John Wakefield of Lakeside Industries, is included in Appendix C of this report.

4.0

METHODOLOGY REFERENCES

Sampling procedures specified in the July 1, 1991 edition of the Environmental Protection Agency (EPA) document Title 40 Code of Federal Regulations, Parts 53-60 (40 CFR 60), Appendix A, Methods 1, 2, 3A, 4 and 5 were used for these tests. Sampling and analysis procedures specified in the Puget Sound Air Pollution Control Agency (PSAPCA) "Particulate Source Test Procedures" adopted by the PSAPCA Board of Directors, August 11, 1983, in accordance with section 9.09 of Regulation I, PSAPCA, were utilized in conjunction with the EPA Method 5 procedures for "back-half" analysis for extracting condensible matter. Methodology suggested in the EPA 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-600/4-77-027b, along with current updates, were used with respect to quality assurance and testing protocol.

5.0
SAMPLING AND ANALYSIS PROCEDURES

The following sections discuss the Environmental Protection Agency (EPA) methodology which was used to collect the samples for this project. The objective of the testing was to determine the particulate matter emission concentration in the gas stream, temperature, airflow, and composition of the gases. Airflow data which was collected concurrent with each test was used to calculate the emission rate of particulate matter. A description of each sample procedure used follows.

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 baghouse exhaust stack into a number of equal areas, and then locating a traverse point within each of the equal areas. Method 2 was performed to measure the stack gas velocity using a pitot tube, and the gas temperature using a thermocouple. The S-type pitot tubes were connected with tubing to magnehelic gauges to obtain velocity measurements. The pitot tube lines were leak-checked and the magnehelic gauges were zeroed prior to use. Temperatures were measured using calibrated thermocouple probes connected to a Fluke^{R} digital thermocouple indicator.

The scrubber stack exhausts to the atmosphere through a 72 inch circular stack. The stack is fitted with two (2) ports located at the same elevation, and circumferentially 90 degrees apart. The sample ports are located greater than two diameters from the nearest upstream flow disturbance, and greater than one-half a diameter from the nearest downstream flow disturbance. Two (2) velocity and

temperature traverses of twelve (12) points each were performed during each Method 5 test. Figure 1 located in Appendix C of this report is a schematic of the stack and the point locations selected. Each point was sampled for 2.5 minutes, for a total sampling time for each Method 5 run of 60 minutes. The sample probe was marked with a felt pen and heat resistant tape to indicate the proper point location.

5.2 EPA Method 3A - Gas Composition

The stack gas composition was evaluated during each Method 5 test by collecting integrated samples of the stack gas in multilayer bags. The samples were analyzed in the Am Test-Air Quality, Inc laboratory. An Infrared Industries Model 2200 oxygen (O_2) analyzer was utilized to measure the percent oxygen in the stack gas. An Automated Custom Systems (ACS) Model 3300 NDIR analyzer was utilized to measure the percent carbon dioxide (CO_2). A Thermo Environmental Instruments Model 48 gas filter correlation non-dispersive infrared (NDIR) analyzer was used to measure the parts per million (ppm) carbon monoxide (CO). These instruments meet 40 CFR 60, Appendix A, Method 3A and 10 criteria. Appropriate certified calibration gases were utilized to check the calibration of the analyzers. The gas composition measurements during each test period 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 using 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 which was 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 Figure 2 in Appendix C of this report. The stainless steel button hook nozzle used for these tests was measured on-site with inside calipers. A stainless steel probe sheath with a heated stainless steel liner was used to draw gas from the stack. 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 Fluke thermocouple indicator which was used to measure the stack gas temperature at each sample point. A glass filter assembly containing a 125 millimeter Whatman 934-AH glass fiber filter was enclosed in a temperature-controlled heated sample box. The filter was pretreated by baking, desiccating and weighing. The average box temperature was maintained at 248° F $\pm$ 25° F. The nozzle, probe liner, prefilter connective glassware and filter is often 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 condenser section of the Method 5 sample train consisted of a modified Greenburg-Smith bubbler containing 100 milliliters (ml) of deionized water, an impinger also containing 100 ml of deionized water, an empty bubbler, and a bubbler containing indicating silica gel desiccant. The back-half was maintained at a temperature below 68° F by adding ice to the condenser section during sampling.

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 which is used to pull the stack gas through the sample train, fine and coarse 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 calibrated dry gas meter readable to 0.001 cubic feet. At the outlet of the dry gas meter is a calibrated orifice which is used to isokinetically control the flow of gas through the metering system. The pressure drop across the orifice was monitored with an inclined manometer. The pitot tubes utilized to measure stack gas velocity are connected to the control box via the umbilical cord. The control box contains magnehelic gauges which were used for the velocity measurement as well as 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 all 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 the desired 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 was 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 103° C for two (2) hours, then they were transferred to a Labconco Auto-Dry 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 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 following each run. 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. The contents of this "B" section acetone rinse were transferred to a tared, graduated 150 milliliter beaker. The volume of acetone was recorded and the beakers were placed in an evaporation chamber at elevated ambient temperature. 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 at least 24 hours of desiccation. 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 "back-half" of the sample train were weighed with a readability of 0.1 grams before and after sampling on 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. 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 this beaker's contents were allowed to evaporate in an evaporation chamber at elevated ambient temperature to dryness. The water layer was transferred to a tared 150 ml beaker labeled the "C" section and this beaker's contents were heated at 103^o C until dry. The bubblers, impingers, connecting glassware and graduated cylinder were given a final rinse with acetone into another tared, graduated beaker ("D" section) and it's contents were allowed to evaporate in the evaporation chamber until dry. 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 after their contents had evaporated. 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 concentrations. The particulate weights are included on the Method 5 computer printouts which are included in Appendix A of this report.

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 were utilized are included in the Environmental Protection Agency's (EPA's) reference manual titled Quality Assurance Handbook for Air Pollution Measurements Systems, Volume 3, EPA-600/4-77-027b. Procedures were 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 as 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 were 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 have been calibrated using a calibrated dry gas meter or a wet test meter. Calibration data for the dry gas meter used for this project is included in Appendix C of this report. The S-type pitot tubes utilized for velocity determination have been calibrated using Method 2, Section 4.1, and are inspected regularly for wear. A pitot tube inspection form is included in Appendix C of this report. The magnehelic gauges used for pressure measurements are periodically calibrated against an oil-filled manometer. The Fluke^{R} digital thermocouple indicator used for temperature measurement has a readability of 1 degree Fahrenheit and has been re-certified by the manufacturer. Each thermocouple probe used to monitor temperature is checked quarterly at three (3) temperature settings.

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

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

Visual inspections of pitot tubes, glassware, and other equipment were 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 relative to samples, 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 are returned to the Air Quality laboratory. Sample recovery was carried out in a suitable area free from particulate matter contamination.

In the laboratory, acetone, dichloromethane, water and filter blanks were carried throughout the gravimetric analysis procedures. The samples were weighed to constant weights of ± 0.5 milligrams following desiccation in a Labconco "Autodry 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 was set to a time integrating mode (100,000 readings per minute) with a readability of 0.01 milligrams. The balance was calibrated prior to every weighing session. The calibration of Am Test's Mettler balances is checked by the manufacturer on a yearly basis.

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 checker. Raw data were entered into the appropriate software package by a "processor", then the entered figures were checked for accuracy by a "checker," different from the "processor". Any mistakes were corrected, and figures were rechecked and signed off by the "checker". In addition, by-hand calculation checks were made to validate the computer output. All data generated by each phase of a laboratory or field sampling program were reviewed by the senior reviewer. The data package was signed off by the senior reviewer prior to releasing the data for report preparation.

7.0

CALCULATION OF RESULTS

The Method 1, 2, 3A, 4 and 5 test results were calculated in accordance with current EPA 40 CFR 60, OAPCA and PSAPCA criteria. Copies of the pertinent equations used to derive these results are included in Appendix C of this report. Final result calculations were performed using custom-written spreadsheet programs run on Hewlett-Packard Vectra computer systems. A sample "by-hand" calculation was performed to check the integrity of the computer programs which were used to reduce the data. A sample "by-hand" calculation was completed for run 2 using a Hewlett Packard 11C calculator, and may be found in Appendix B of this report.

APPENDIX A

Computer Printouts of Results

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

FILE NAME:	163\LAKEM5R1	LAB #:	01913
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	07:25 o'clock
LOCATION:	SHELTON, WASHINGTON	STOP TIME:	08:37 o'clock
SAMPLE SITE:	BOECON PLANT EXHAUST STACK	SAMPLE TIME:	60.0 minutes
SAMPLE DATE:	JUNE 3, 1992		
RUN #:	1 - METHOD 5/BH		
OPERATORS:	J. GUENTHOER/R. LAWRENCE		

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
817.9	613.8	204.1
804.2	618.8	185.4
563.9	541.4	22.5
831.1	799.6	31.5

TOTAL H2O GAIN:	443.5		
TOTAL VOLUME (SCF):	20.91		
PERCENT MOISTURE:	36.38		
Bws:	0.3638		
PITOT TUBE Cp:	0.84		
NOZZLE DIAMETER:	0.373	inches	
NOZZLE AREA:	0.0008	sq. feet	
STACK DIAMETER:	72.0	inches	
STACK AREA:	28.27	sq. feet	
METER TEMPERATURE:	56.8	degrees F	
BAROMETRIC PRES.:	29.94	inches Hg	
STATIC PRESSURE:	-0.23	inches H2O	
STACK PRESSURE:	29.92	inches Hg	
ORIFICE PRESSURE:	0.871	inches H2O	
METER PRESSURE:	30.00	inches Hg	
INIT. METER VOLUME:	276.466		
FINAL METER VOLUME:	313.182		
VOLUME SAMPLED:	36.716		
STD VOLUME (DSCF):	36.564		
STD VOLUME (DSCM):	1.036		
Y FACTOR:	0.972		
AVERAGE CONC. CO2:	7.4	percent	
AVERAGE CONC. O2:	10.3	percent	
AVERAGE CONC. CO:	30	ppm	
MOLECULAR WEIGHT:	29.60	g/g-mole-dry	
MOLECULAR WEIGHT:	25.38	g/g-mole-wet	

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
S 1	0.26	165	E 1	0.350	164
2	0.28	166	2	0.320	167
3	0.20	171	3	0.220	169
4	0.15	170	4	0.135	170
5	0.12	170	5	0.060	170
6	0.06	170	6	0.020	169
7	0.02	169	7	0.020	169
8	0.01	169	8	0.070	170
9	0.02	169	9	0.190	170
10	0.07	169	10	0.340	171
11	0.20	168	11	0.600	170
12	0.24	168	12	0.600	168

PERCENT ISOKINETICS:	98 %		
STACK GAS TEMPERATURE:	168.8	degrees F	628.8 degrees R
AVERAGE VELOCITY HEAD:	0.154	" of H2O	
STACK GAS VELOCITY:			25.6 ft/second
STACK GAS AIR FLOW:	43436.8	acf/min	23206.2 dscf/min
PARTICULATE EMISSION CONCENTRATION (FRONT-HALF):			0.014 gr/dscf
PARTICULATE EMISSION CONCENTRATION (BACK-HALF):			0.021 gr/dscf
TOTAL PARTICULATE EMISSION CONC. (FRONT & BACK-HALF):			0.035 gr/dscf
TOTAL PARTICULATE MATTER EMISSION CONCENTRATION:			80.4 mg/dscm
PARTICULATE MATTER MASS EMISSION RATE:			6.99 lb/hr

FRONT-HALF PARTICULATE MATTER MASS LOADING

FILTER NUMBER:	#125-1483
TARE WEIGHT OF FILTER (grams):	0.8155
FINAL WEIGHT OF FILTER (grams):	0.8346
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0191
BEAKER NUMBER:	#150-211
TARE WEIGHT OF BEAKER (grams):	65.9756
FINAL WEIGHT OF BEAKER (grams):	65.9891
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0135
VOLUME OF ACETONE (milliliters):	280.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0000
TOTAL FRONT-HALF PARTICULATE MATTER (grams):	0.0326

BACK-HALF PARTICULATE MATTER MASS LOADING

"C" SECTION - CONDENSER PARTICULATE	#150-229
TARE WEIGHT OF BEAKER (grams):	66.9567
FINAL WEIGHT OF BEAKER (grams):	66.9965
NET WEIGHT OF PARTIC. MATTER (grams):	0.0398
TOTAL VOLUME OF WATER (milliliters):	670.0
VOLUME OF WATER CONDENSED (milliliters):	412.0
NET VOLUME OF WATER FOR BLANK (milliliters):	258.0
WT./VOL. OF WATER BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO WATER (grams):	0.0000
"Cx" SECTION - HYDROCARBON EXTRACTION	#150-221
TARE WEIGHT OF BEAKER (grams):	65.1756
FINAL WEIGHT OF BEAKER (grams):	65.1840
NET WEIGHT OF PARTIC. MATTER (grams):	0.0084
TOTAL VOLUME OF CH2Cl2 (milliliters):	150.0
WT./VOL. OF CH2Cl2 (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO CH2Cl2 (grams):	0.0000
"D" SECTION - ACETONE RINSE OF CONDENSER	#150-214
TARE WEIGHT OF BEAKER (grams):	66.5988
FINAL WEIGHT OF BEAKER (grams):	66.6013
NET WEIGHT OF PARTIC. MATTER (grams):	0.0025
TOTAL VOLUME OF ACETONE (milliliters):	40.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0000
TOTAL BACK-HALF PARTICULATE MATTER (grams):	0.0507
TOTAL WEIGHT OF PARTICULATE MATTER (grams):	0.0833

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

FILE NAME:	163\LAKEM5R2	LAB #:	01914
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	09:19 o'clock
LOCATION:	SHELTON, WASHINGTON	STOP TIME:	10:28 o'clock
SAMPLE SITE:	BOECON PLANT EXHAUST STACK	SAMPLE TIME:	60.0 minutes
SAMPLE DATE:	JUNE 3, 1992		
RUN #:	2 - METHOD 5/BH		
OPERATORS:	J. GUENTHOER/R. LAWRENCE		

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
825.7	599.7	226.0
828.0	647.0	181.0
526.0	521.8	4.2
836.3	811.3	25.0

TOTAL H2O GAIN:	436.2	PITOT TUBE Cp:	0.84
TOTAL VOLUME (SCF):	20.57	NOZZLE DIAMETER:	0.373 inches
PERCENT MOISTURE:	35.78	NOZZLE AREA:	0.0008 sq. feet
Bws:	0.3578	STACK DIAMETER:	72.0 inches
		STACK AREA:	28.27 sq. feet
		METER TEMPERATURE:	68.1 degrees F
		BAROMETRIC PRES.:	30.15 inches Hg
		STATIC PRESSURE:	-0.24 inches H2O
		STACK PRESSURE:	30.13 inches Hg
		ORIFICE PRESSURE:	0.870 inches H2O
		METER PRESSURE:	30.21 inches Hg
INIT. METER VOLUME:	315.072		
FINAL METER VOLUME:	352.680		
VOLUME SAMPLED:	37.608	AVERAGE CONC. CO2:	7.3 percent
STD VOLUME (DSCF):	36.907	AVERAGE CONC. O2:	10.6 percent
STD VOLUME (DSCM):	1.045	AVERAGE CONC. CO:	45 ppm
Y FACTOR:	0.972	MOLECULAR WEIGHT:	29.59 g/g-mole-dry
		MOLECULAR WEIGHT:	25.44 g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
S 1	0.280	165	E 1	0.30	163
2	0.280	167	2	0.28	165
3	0.200	172	3	0.18	169
4	0.115	170	4	0.10	169
5	0.070	170	5	0.07	170
6	0.030	170	6	0.02	170
7	0.010	170	7	0.01	171
8	0.030	170	8	0.06	171
9	0.080	170	9	0.19	170
10	0.210	169	10	0.28	170
11	0.300	169	11	0.60	167
12	0.320	169	12	0.60	167

PERCENT ISOKINETICS:	97 %	
STACK GAS TEMPERATURE:	168.9 degrees F	628.9 degrees R
AVERAGE VELOCITY HEAD:	0.156 " of H20	
STACK GAS VELOCITY:		25.7 ft/second
STACK GAS AIR FLOW:	43640.5 acf/min	23695.7 dscf/min
PARTICULATE EMISSION CONCENTRATION (FRONT-HALF):		0.015 gr/dscf
PARTICULATE EMISSION CONCENTRATION (BACK-HALF):		0.024 gr/dscf
TOTAL PARTICULATE EMISSION CONC. (FRONT & BACK-HALF):		0.039 gr/dscf
TOTAL PARTICULATE MATTER EMISSION CONCENTRATION:		90.3 mg/dscm
PARTICULATE MATTER MASS EMISSION RATE:		8.02 lb/hr

FRONT-HALF PARTICULATE MATTER MASS LOADING

FILTER NUMBER:	#125-1392
TARE WEIGHT OF FILTER (grams):	0.8080
FINAL WEIGHT OF FILTER (grams):	0.8292
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0212
BEAKER NUMBER:	#150-212
TARE WEIGHT OF BEAKER (grams):	65.4116
FINAL WEIGHT OF BEAKER (grams):	65.4273
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0157
VOLUME OF ACETONE (milliliters):	280.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0000
TOTAL FRONT-HALF PARTICULATE MATTER (grams):	0.0369

BACK-HALF PARTICULATE MATTER MASS LOADING

"C" SECTION - CONDENSER PARTICULATE	#150-230
TARE WEIGHT OF BEAKER (grams):	66.5654
FINAL WEIGHT OF BEAKER (grams):	66.6008
NET WEIGHT OF PARTIC. MATTER (grams):	0.0354
TOTAL VOLUME OF WATER (milliliters):	605.0
VOLUME OF WATER CONDENSED (milliliters):	411.2
NET VOLUME OF WATER FOR BLANK (milliliters):	193.8
WT./VOL. OF WATER BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO WATER (grams):	0.0000
"Cx" SECTION - HYDROCARBON EXTRACTION	#150-222
TARE WEIGHT OF BEAKER (grams):	66.2019
FINAL WEIGHT OF BEAKER (grams):	66.2218
NET WEIGHT OF PARTIC. MATTER (grams):	0.0199
TOTAL VOLUME OF CH2Cl2 (milliliters):	150.0
WT./VOL. OF CH2Cl2 (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO CH2Cl2 (grams):	0.0000
"D" SECTION - ACETONE RINSE OF CONDENSER	#150-215
TARE WEIGHT OF BEAKER (grams):	66.1142
FINAL WEIGHT OF BEAKER (grams):	66.1164
NET WEIGHT OF PARTIC. MATTER (grams):	0.0022
TOTAL VOLUME OF ACETONE (milliliters):	55.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0000
TOTAL BACK-HALF PARTICULATE MATTER (grams):	0.0575
TOTAL WEIGHT OF PARTICULATE MATTER (grams):	0.0944

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

FILE NAME:	163\LAKEM5R3	LAB #:	01915	
CLIENT:	LAKESIDE INDUSTRIES	START TIME:	11:18	o'clock
LOCATION:	SHELTON, WASHINGTON	STOP TIME:	12:29	o'clock
SAMPLE SITE:	BOECON PLANT EXHAUST STACK	SAMPLE TIME:	60.0	minutes
SAMPLE DATE:	JUNE 3, 1992			
RUN #:	3 - METHOD 5/BH			
OPERATORS:	J. GUENTHOER/R. LAWRENCE			

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
789.3	586.8	202.5
757.6	574.6	183.0
479.7	472.1	7.6
794.8	771.4	23.4

TOTAL H2O GAIN:	416.5		
TOTAL VOLUME (SCF):	19.64		
PERCENT MOISTURE:	35.13		
Bws:	0.3513		
PITOT TUBE Cp:	0.84		
NOZZLE DIAMETER:	0.373	inches	
NOZZLE AREA:	0.0008	sq. feet	
STACK DIAMETER:	72.0	inches	
STACK AREA:	28.27	sq. feet	
METER TEMPERATURE:	75.4	degrees F	
BAROMETRIC PRES.:	30.24	inches Hg	
STATIC PRESSURE:	-0.23	inches H2O	
STACK PRESSURE:	30.22	inches Hg	
ORIFICE PRESSURE:	0.881	inches H2O	
METER PRESSURE:	30.30	inches Hg	
INIT. METER VOLUME:	355.177		
FINAL METER VOLUME:	392.525		
VOLUME SAMPLED:	37.348		
STD VOLUME (DSCF):	36.261		
STD VOLUME (DSCM):	1.027		
Y FACTOR:	0.972		
AVERAGE CONC. CO2:	7.1	percent	
AVERAGE CONC. O2:	10.9	percent	
AVERAGE CONC. CO:	85	ppm	
MOLECULAR WEIGHT:	29.57	g/g-mole-dry	
MOLECULAR WEIGHT:	25.51	g/g-mole-wet	

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
S 1	0.28	170	E 1	0.300	164
2	0.27	171	2	0.300	169
3	0.18	171	3	0.180	170
4	0.13	171	4	0.130	170
5	0.06	170	5	0.070	169
6	0.02	170	6	0.015	171
7	0.02	170	7	0.010	171
8	0.02	171	8	0.040	171
9	0.09	170	9	0.200	170
10	0.20	170	10	0.330	168
11	0.31	170	11	0.600	167
12	0.33	170	12	0.550	167

PERCENT ISOKINETICS:	94 %		
STACK GAS TEMPERATURE:	169.6	degrees F	629.6 degrees R
AVERAGE VELOCITY HEAD:	0.156	" of H20	
STACK GAS VELOCITY:			25.7 ft/second
STACK GAS AIR FLOW:	43518.7	acf/min	23913.3 dscf/min
PARTICULATE EMISSION CONCENTRATION (FRONT-HALF):			0.017 gr/dscf
PARTICULATE EMISSION CONCENTRATION (BACK-HALF):			0.024 gr/dscf
TOTAL PARTICULATE EMISSION CONC. (FRONT & BACK-HALF):			0.040 gr/dscf
TOTAL PARTICULATE MATTER EMISSION CONCENTRATION:			92.1 mg/dscm
PARTICULATE MATTER MASS EMISSION RATE:			8.25 lb/hr

FRONT-HALF PARTICULATE MATTER MASS LOADING

FILTER NUMBER:	#125-1484
TARE WEIGHT OF FILTER (grams):	0.8158
FINAL WEIGHT OF FILTER (grams):	0.8394
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0236
BEAKER NUMBER:	#150-213
TARE WEIGHT OF BEAKER (grams):	65.3845
FINAL WEIGHT OF BEAKER (grams):	65.4001
NET WEIGHT OF PARTICULATE MATTER (grams):	0.0156
VOLUME OF ACETONE (milliliters):	370.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0000
TOTAL FRONT-HALF PARTICULATE MATTER (grams):	0.0392

BACK-HALF PARTICULATE MATTER MASS LOADING

"C" SECTION - CONDENSER PARTICULATE	#150-231
TARE WEIGHT OF BEAKER (grams):	67.3224
FINAL WEIGHT OF BEAKER (grams):	67.3457
NET WEIGHT OF PARTIC. MATTER (grams):	0.0233
TOTAL VOLUME OF WATER (milliliters):	565.0
VOLUME OF WATER CONDENSED (milliliters):	393.1
NET VOLUME OF WATER FOR BLANK (milliliters):	171.9
WT./VOL. OF WATER BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO WATER (grams):	0.0000
"Cx" SECTION - HYDROCARBON EXTRACTION	#150-224
TARE WEIGHT OF BEAKER (grams):	65.1190
FINAL WEIGHT OF BEAKER (grams):	65.1441
NET WEIGHT OF PARTIC. MATTER (grams):	0.0251
TOTAL VOLUME OF CH2Cl2 (milliliters):	150.0
WT./VOL. OF CH2Cl2 (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO CH2Cl2 (grams):	0.0000
"D" SECTION - ACETONE RINSE OF CONDENSER	#150-216
TARE WEIGHT OF BEAKER (grams):	65.3668
FINAL WEIGHT OF BEAKER (grams):	65.3738
NET WEIGHT OF PARTIC. MATTER (grams):	0.0070
TOTAL VOLUME OF ACETONE (milliliters):	85.0
WT./VOL. OF ACETONE BLANK (milligrams/ml):	0.000
NET WEIGHT OF PARTIC. DUE TO ACETONE (grams):	0.0000
TOTAL BACK-HALF PARTICULATE MATTER (grams):	0.0554
TOTAL WEIGHT OF PARTICULATE MATTER (grams):	0.0946

APPENDIX B

Example Calculations and Field Data Sheets

SAMPLE CALCULATION SHEET
METHODS 1, 2, 3A, 4 AND 5

CLIENT: Lakeside Industries DATE OF TEST: 6/3/92

LOCATION: Shelton, WA Boecon Plant Exhaust stack RUN #: 2- M5w/BH

Particulate Matter Emission Concentration - Equation 5-1

Vm_{std} =
17.647°R/"Hg * 37.608 ft^3 * .972 * (30.15 "Hg + (0.870 "H_2O/13.6))/(460 + 68.1 °F)

= 36.907 dscf

dscm = 36.907 dscf/35.31 ft^3/m^3

= 1.045 dscm

Substitution of Equation 5-4 into 5-5

W_a = 0.0 mg * 280 ml / 100 ml

= 0.0 mg

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

= 94.4 mg = 21.2 mg + 15.7 mg - 0.0 mg + 57.5 mg

C_s= (0.001 g/mg) * (15.43 grains/gram) * 94.4 mg / 36.907 dscf (1)

= .039 gr/dscf (Equation 5-6)

gr/dscf @7% O_2 = _____ gr/dscf * (20.9% - 7%O_2)/(20.9% - _____ %O_2)

= NA gr/dscf @ 7% O_2

gr/dscf @ 12% CO_2 = _____ gr/dscf * 12% / _____ %CO_2

= NA gr/dscf @ 12% CO_2

mg/dscm = 94.4 mg/1.045 dscm

= 90.3 mg/dscm

Particulate Matter Emission Rate

pounds/hour = 0.039 gr/dscf * 23695.7 dscf/min * 60 min/hr * 1 lb/7000 grains

= 8.02 lb/hr

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft^3/g * 436.2 grams of H_2O collected in impingers

= 20.57 scf

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

B_{ws} = (20.57 scf)/(20.57 scf + 36.907 dscf)

= 0.3578

%Moisture = 0.3578 * 100

= 35.78 %

Molecular weight - Equation 3-2

M_d = 0.440 * (7.3 $\%CO_2$) + 0.320 * (10.6 $\%O_2$) + 0.280 * (82.1 % CO + $\%N_2$)

M_d = 29.59 g/g-mole (dry)

M_s = 29.59 g/g-mole * (1 - .3578) + 18.0g/g-mole * .3578

M_s = 25.44 g/g-mole (wet)

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

V_s = 85.49 * .84 * $\sqrt{0.156 * 628.9\,^\circ R / 25.44 \text{ g/g-mole} / 30.13 \text{ "Hg}}$

V_s = 25.7 ft/sec

Q_{sd} = 3600 * (1 - 0.3578) * 25.7 ft/sec * 28.27 ft^2 * (528 ° R/628.9 ° R) * (30.13 "Hg/29.92 "Hg)

=1,421,741.3 dscf/hr / 60 min/hr

= 23695.7 dscf/min (dry standard cubic feet per minute)

acfm = 25.7 ft/sec * 28.27 ft^2 * 60 sec/min

= 43640.5 acfm (actual cubic feet per minute)

Isokinetic variation - Equation 5-8

I = 0.09450 * 36.907 dscf * 628.9 ° R/(30.13 "Hg * 25.7 ft/sec * 60 min * 0.000788 ft^2 * (1 - .3578))

I = 97 %

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

SAMPLE CALCULATION SHEET (2)

Backhalf particulate

"C" Section

35.4 mg particulate in "C" Section beaker

605.0 ml of water in condensers, including rinses

411.2 ml of condensation in 1st, 2nd and 3rd bubblers (final weight - initial weight, assumes 1g/1ml water density)

193.8 ml of deionized, distilled water used in bubblers including rinses

0.0 mg/ml blank partic. = (0.0 mg H2O blank / 100 ml H2O)

0.0 mg of blank particulate

= 35.4 mg of "C" partic. = 35.4 mg of partic. in "C" - 0.0 mg of blank

"Cx" Section

19.9 mg of particulate in "Cx" Section beaker

0.0 mg/ml of blank partic. = (0.0 mg CH2Cl2 blank / 100 ml CH2Cl2)

0.0 mg of blank particulate = (150 ml * 0.0 mg/ml)

= 19.9 mg of "Cx" partic = 19.9 mg of partic in "Cx" - 0.0 mg of blank

"D" Section

2.2 mg of particulate in "D" Section beaker

0.0 mg/ml of blank particulate (same as "B" Section)

0.0 mg of blank particulate = (55 ml * 0.0 mg/ml)

= 2.2 mg of "D" partic. = 2.2 mg of partic. in "D" - 0.0 mg of blank

Total Backhalf Particulate

+ 35.4 mg of "C" Section particulate

+ 19.9 mg of "Cx" Section particulate

+ 2.2 mg of "D" Section particulate

+ NA mg of Backhalf filter (if applicable)

= 57.5 mg of Backhalf particulate

TRAVERSE SAMPLING DATA SHEET

1912 28

Client LAKESIDE IND.
Location Shelton, WA
Sample Site BOECON PLANT. Exhaust Stack
Stack Diameter 72" ø
Date 6-3-92
Operators SAG - ERL
Run I.D. 1 - M5/Bit

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	2.02 / .009
Leak Test Vacuum	15"/ 15
Pitots, Pre Leak Ck	✓
Pitots, Post Leak Ck	✓
Gas Sampling System	✓
Integrated Bag	✓
Thermocouples @ ___ °F	

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

Filter # 1463 Box # R-1

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	817.9	- 613.8	=
#2 Imp.	804.2	- 618.8	=
#3 Imp.	563.9	- 541.4	=
#4 Imp.		-	=
#5 Imp.		-	=
#6 S.G.	831.1	- 799.6	=
Total H_2O Volume	443.5 g		

Start Time 0725
Stop Time 0837
Barometric Pressure "Hg 29.94
Static Pres "H_2O -.23
Production Rate

SAMPLING PARAMETERS

% Moisture 9.2
Meter Temp. 57
Stack Temp. 164
ΔH@ .959 Y .972
Pitot # P6B Side # A
Cp .84
Nozzle Diameter .373 inch
D_1 .372 D_2 .373 D_3 .375
K Factor 4.83

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 %
S 1	0	276.466	.26	1.26	1.26	53	52	4½	260	67	165	
2			.28	1.35	1.35	53	52	5½	261	49	166	
3	5		.20	.97	.97	58	52	5	260	56	171	
4			.15	.72	.72	54	53	4½	259	60	170	
5	10		.12	.58	.58	54	53	3½	260	54	170	
6			.06	.29	.29	54	53	3	261	55	170	
7	15		.02	.10	.10	55	54	1½	245	55	169	
8			.01	.05	.05	55	54	1½	270	60	169	
9	20		.02	.10	.10	55	54	1½	263	68	169	
10			.07	.34	.34	56	55	2½	261	62	169	
11	25		.20	.97	.97	54	55	5	260	59	168	
12			.24	1.16	1.16	57	55	5½	257	57	168	
5 1	30	292.937	.35	1.55	1.55	58	57	5½	261	57	164	
2			.32	1.42	1.42	59	57	5½	258	52	167	
3	35		.22	.98	.98	57	57	5	254	52	169	
4			.135	.60	.60	59	58	3½	257	54	170	
5	40		.06	.27	.27	59	58	2½	247	55	170	
6			.02	.09	.09	60	59	1½	249	55	169	
7	45		.02	.09	.09	60	59	1½	249	57	169	
8			.07	.31	.31	60	59	2½	257	55	170	
9	50		.19	.84	.84	61	60	4	253	52	170	
10			.34	1.55	1.55	61	60	6	255	52	171	
11	55		.60	2.66	2.66	62	61	10	253	53	170	
12			.60	2.66	2.66	63	61	10	250	55	168	
	60	313.182										
		30.716	$\sqrt{(\Delta P)^2}$		0.871 / ΔH		510.8 / T_m				168.8 / T_s	

1914

TRAVERSE SAMPLING DATA SHEET

Page ___ of 29

Client Lakeside
Location Shelton, WA
Sample Site Boiler Plant #2 Coal Stack
Stack Diameter 72"ø
Date 6-3-92
Operators JMG - BW
Run I.D. 2-M5/M4

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

Start Time 0919
Stop Time 1018
Barometric Pressure "Hg 30.15
Static Pres "H_2O -.24
Production Rate ___

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.02 / .010
Leak Test Vacuum	15 / 15
✓ Pitots, Pre Leak Ck	
✓ Pitots, Post Leak Ck	
___ Gas Sampling System	
✓ Integrated Bag	
___ Thermocouples @ ___ °F	

Filter # 1392 Box # M2

Find net

	Final Wt. gram	Initial Wt. gram	Wt. gram
#1 Imp.	___	-599.7	= 825.7
#2 Imp.	___	-647.0	= 828.0
#3 Imp.	___	-521.8	= 526.0
#4 Imp.	___	- ___	= ___
#5 Imp.	___	- ___	= ___
#6 S.G.	___	-811.3	= 836.3
Total H_2O Volume		436.2	g

SAMPLING PARAMETERS
% Moisture ___
Meter Temp. ___
Stack Temp. ___
ΔH@ .957 Y .972
Pitot # ___ Side # ___
Cp .84
Nozzle Diameter .373 inch
D_1 ___ D_2 ___ D_3 ___
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 %
S 1	0	315.072	.28	1.27	1.27	65	64	4	240	61	165	
2			.28	1.27	1.27	65	64	4	265	53	167	
3	5		.20	.90	.90	65	65	3½	245	53	172	
4			.115	.52	.52	65	65	2½	252	53	170	
5	10		.07	.32	.32	66	65	2	257	59	170	
6			.03	.14	.14	66	66	1½	265	62	170	
7	15		.01	.045	.045	66	66	1½	262	65	170	
8			.03	.14	.14	66	66	1½	261	65	170	
9	20		.08	.36	.36	67	67	2	264	60	170	
10			.21	.95	.95	67	67	4	260	55	169	
11	25		.30	1.36	1.36	68	68	4	258	52	169	
12			.32	1.45	1.45	69	68	5	248	53	169	
E 1	30	332.384	.30	1.36	1.36	70	68	4½	264	56	163	
2			.28	1.27	1.27	70	68	4	267	52	165	
3	35		.18	.81	.81	70	68	3½	258	53	169	
4			.10	.045	.045	71	69	2	265	57	169	
5	40		.07	.32	.32	71	69	2	264	58	170	
6			.02	.09	.09	71	69	1½	250	61	170	
7	45		.01	.045	.045	71	69	1½	254	64	171	
8			.06	.27	.27	71	69	2	254	61	171	
9	50		.19	.86	.86	71	70	4	253	54	170	
10			.28	1.27	1.27	72	70	5	248	52	170	
11	55		.60	2.71	2.71	72	70	9	247	52	167	
12			.60	2.71	2.71	73	71	9	241	53	167	
	60	352.680										
	✓	37.608	$\sqrt{(\Delta P)^2}$	✓	0.870 ΔH	68.1 Tm	✓				168.9 Ts ✓	

TRAVERSE SAMPLING DATA SHEET

Page ___ of 30

1915

Client LAKESIDE
Location SHELTON, WA
Sample Site BOISEN PLANT Exhaust STACK
Stack Diameter 72" Ø
Date 6-3-92
Operators JMG - ERC
Run I.D. 3-MS/BIF

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.02 / .018
Leak Test Vacuum	15 / 16
✓ Pitots, Pre Leak Ck	
✓ Pitots, Post Leak Ck	
___ Gas Sampling System	
✓ Integrated Bag	
___ Thermocouples @ ___ °F	

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

Filter # 1484 Box # A-3

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	789.3	- 586.8	= ~~789.3~~
#2 Imp.	757.6	- 674.6	=
#3 Imp.	479.7	- 472.1	=
#4 Imp.		-	=
#5 Imp.		-	=
#6 S.G.	794.8	- 711.4	=
Total H_2O Volume	416.5		= √g

Start Time 1110
Stop Time 1229
Barometric Pressure "Hg 30.24
Static Pres "H_2O -.23
Production Rate

SAMPLING PARAMETERS
% Moisture
Meter Temp.
Stack Temp.
ΔH@ .959 Y .972
Pitot # ___ Side # ___
Cp .84
Nozzle Diameter .373 inch
D_1 ___ D_2 ___ D_3 ___
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 %	
S 1	0	355.177	.20	1.28	1.20	72	71	5½	258	59	170		
2			.27	1.23	1.23	73	71	5½	255	55	171		
3	5		.18	.82	.82	73	71	4½	253	56	171		
4			.13	.59	.59	73	71	3½	252	59	171		
5	10		.06	.27	.27	73	71	2½	253	63	170		
6			.02	.09	.09	73	72	1½	254	65	170		
7	15		.02	.09	.09	73	72	1½	257	66	170		
8			.02	.09	.09	73	73	1½	260	67	171		
9	20		.09	.41	.41	73	74	3	262	65	170		
10			.20	.91	.91	74	74	5	260	61	170		
11	25		.31	1.42	1.42	74	74	6½	258	60	170		
12			.33	1.51	1.51	75	74	7	257	60	170		
E 1	30	372.700	.30	1.37	1.37	76	76	6½	261	63	164		
2			.30	1.37	1.37	77	76	6½	260	58	169		
3	35		.18	.82	.82	78	77	5	255	58	170		
4			.13	.59	.59	78	77	4	252	60	170		
5	40		.07	.32	.32	78	77	3	251	61	169		
6			.015	.07	.07	78	77	1½	252	65	171		
7	45		.01	.046	.046	79	78	1½	253	67	171		
8			.04	.18	.18	79	78	2	251	67	171		
9	50		.20	.91	.91	79	78	5	252	61	170		
10			.33	1.51	1.51	80	79	7½	251	59	168		
11	55		.60	2.74	2.74	80	79	13	251	60	167		
N			.55	2.51	2.51	81	79	13	256	65	167		
	60	382.525			0.881		75.4				169.6		
	V	37.348	$\sqrt{(\Delta P)^2}$		ΔH		T_m √				T_s √		

SAMPLE TRAIN INFORMATION

Fill Out One Sheet Per Site and Per Test Type

Client: LAKESIDE INDUSTRIES

Location: SHELTON, WA

Site: BOILER PLANT — STACK

Date(s): 6/3/92

Test Team: JAG / EKL

Number of Runs: 3 — M5/BH

If this information is not accurate for all runs, note all exceptions:

Thimble: ___yes ✓no **Nozzle type:** ___quartz ✓steel

Probe liner: ___quartz ___glass ✓steel ___teflon

Probe type: ✓regular ___water-cooled

Front-half filter: ✓yes ___no **Size (mm):** ___90 ___110 ✓125

Support: ___steel ✓glass frit ___teflon

Gasket: ✓silicon ✓teflon

Filter media: ___quartz fiber ✓glass fiber ___teflon

Impinger Train Solutions/Quantity of Solution Charged
#1 100ml D.I.
#2 100ml D.I.
#3 M.T.
#4 S.G.
#5
#6

Note: Show the back-half filter location with an arrow

Back-half filter type: ___quartz fiber ___glass fiber ___teflon
___tared ___untared

APPENDIX B

Example Calculations and Field Data Sheets

SAMPLE CALCULATION SHEET
METHODS 1, 2, 3A, 4 AND 5

CLIENT: Lakeside Industries DATE OF TEST: 6/3/92

LOCATION: Shelton, WA Boecon Plant Exhaust stack RUN #: 2- M5w/BH

Particulate Matter Emission Concentration - Equation 5-1

Vm_{std} =
17.647°R/"Hg * 37.608 ft³ * .972 * (30.15 "Hg + (0.870 "H_2O/13.6))/(460 + 68.1 °F)

= 36.907 dscf

dscm = 36.907 dscf/35.31 ft³/m³

= 1.045 dscm

Substitution of Equation 5-4 into 5-5

W_a = 0.0 mg * 280 ml / 100 ml

= 0.0 mg

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

= 94.4 mg = 21.2 mg + 15.7 mg - 0.0 mg + 57.5 mg (1)

C_s= (0.001 g/mg) * (15.43 grains/gram) * 94.4 mg / 36.907 dscf

= .039 gr/dscf (Equation 5-6)

gr/dscf @7% O_2 = _____ gr/dscf * (20.9% - 7%O_2)/(20.9% - _____ %O_2)

= NA gr/dscf @ 7% O_2

gr/dscf @ 12% CO_2 = _____ gr/dscf * 12% / _____ %CO_2

= NA gr/dscf @ 12% CO_2

mg/dscm = 94.4 mg/1.045 dscm

= 90.3 mg/dscm

Particulate Matter Emission Rate

pounds/hour = 0.039 gr/dscf * 23695.7 dscf/min * 60 min/hr * 1 lb/7000 grains

= 8.02 lb/hr

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft³/g * 436.2 grams of H_2O collected in impingers

= 20.57 scf

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

B_{ws} = (20.57 scf)/(20.57 scf + 36.907 dscf)

= 0.3578

%Moisture = 0.3578 * 100

= 35.78 %

Molecular weight - Equation 3-2

M_d = 0.440 * (7.3 $\%CO_2$) + 0.320 * (10.6 $\%O_2$) + 0.280 * (82.1 % CO + $\%N_2$)

M_d = 29.59 g/g-mole (dry)

M_s = 29.59 g/g-mole * (1 - .3578) + 18.0g/g-mole * .3578

M_s = 25.44 g/g-mole (wet)

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

V_s = 85.49 * .84 * $\sqrt{0.156 * 628.9}$ ° R / 25.44 g/g-mole / 30.13 "Hg

V_s = 25.7 ft/sec

Q_{sd} = 3600 * (1 - 0.3578 * 25.7 ft/sec * 28.27 ft^2 * (528 ° R/628.9 ° R) * (30.13 "Hg/ 29.92 "Hg)

=1,421,741.3dscf/hr / 60 min/hr

= 23695.7dscf/min (dry standard cubic feet per minute)

acfm = 25.7 ft/sec * 28.27 ft^2* 60 sec/min

=43640.5acfm (actual cubic feet per minute)

Isokinetic variation - Equation 5-8

I = 0.09450 * 36.907dscf * 628.9° R/(30.13 "Hg * 25.7 ft/sec * 60 min * 0.000758ft^2 *(1 -.3578))

I = 97 %

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

SAMPLE CALCULATION SHEET (2)

Backhalf particulate

"C" Section

35.4 mg particulate in "C" Section beaker

605.0 ml of water in condensers, including rinses

411.2 ml of condensation in 1st, 2nd and 3rd bubblers (final weight - initial weight, assumes 1g/1ml water density)

193.8 ml of deionized, distilled water used in bubblers including rinses

0.0 mg/ml blank partic. = (0.0 mg H2O blank / 100 ml H2O)

0.0 mg of blank particulate

= 35.4 mg of "C" partic. = 35.4 mg of partic. in "C" - 0.0 mg of blank

"Cx" Section

19.9 mg of particulate in "Cx" Section beaker

0.0 mg/ml of blank partic. = (0.0 mg CH2Cl2 blank / 100 ml CH2Cl2)

0.0 mg of blank particulate = (150 ml * 0.0 mg/ml)

= 19.9 mg of "Cx" partic = 19.9 mg of partic in "Cx" - 0.0 mg of blank

"D" Section

2.2 mg of particulate in "D" Section beaker

0.0 mg/ml of blank particulate (same as "B" Section)

0.0 mg of blank particulate = (55 ml * 0.0 mg/ml)

= 2.2 mg of "D" partic. = 2.2 mg of partic. in "D" - 0.0 mg of blank

Total Backhalf Particulate

+ 35.4 mg of "C" Section particulate

+ 19.9 mg of "Cx" Section particulate

+ 2.2 mg of "D" Section particulate

+ NA mg of Backhalf filter (if applicable)

= 57.5 mg of Backhalf particulate

TRAVERSE SAMPLING DATA SHEET

1913 28

Client LAKESIDE IND.
Location Shelton, WA
Sample Site BOILER PLANT. Exhaust Stack
Stack Diameter 72" ø
Date 6-3-92
Operators SAG - ERL
Run I.D. 1 - M5/Bit

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	2.02 / .009
Leak Test Vacuum	15 / 15
Pitots, Pre Leak Ck	
Pitots, Post Leak Ck	
Gas Sampling System	
Integrated Bag	
Thermocouples @ °F	

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

Filter # 1463 Box # R-1

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	817.9	- 613.8	=
#2 Imp.	804.2	- 618.8	=
#3 Imp.	763.9	- 541.4	=
#4 Imp.		-	=
#5 Imp.		-	=
#6 S.G.	831.1	- 749.6	=

Total H_2O Volume 443.5 g

Start Time 0725
Stop Time 0837
Barometric Pressure "Hg 29.94
Static Pres "H_2O -0.23
Production Rate

SAMPLING PARAMETERS

% Moisture 9.2
Meter Temp. 57
Stack Temp. 164
ΔH@ .957 Y .972
Pitot # P6B Side # A
Cp .84
Nozzle Diameter .373 inch
D_1 .372 D_2 .373 D_3 .375
K Factor 4.83

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 %
S 1	0	276.466	.26	1.26	1.26	53	52	4½	260	67	165	
2			.28	1.35	1.35	53	52	5½	261	49	166	
3	5		.20	.97	.97	54	52	5	260	56	171	
4			.15	.72	.72	54	53	4½	259	60	170	
5	10		.12	.58	.58	54	53	3½	260	54	170	
6			.06	.29	.29	54	53	3	261	55	170	
7	15		.02	.10	.10	55	54	1½	265	55	169	
8			.01	.05	.05	55	54	1½	270	60	169	
9	20		.02	.10	.10	55	54	1½	263	68	169	
10			.07	.34	.34	56	55	2½	261	62	169	
11	25		.20	.97	.97	56	55	5	260	59	168	
12			.24	1.16	1.16	57	55	5½	257	57	168	
S 1	30	292.937	.35	1.55	1.55	58	57	5½	261	52	164	
2			.32	1.42	1.42	59	57	5½	258	52	167	
3	35		.22	.98	.98	59	57	5	254	52	169	
4			.135	.60	.60	59	58	3½	251	54	170	
5	40		.06	.27	.27	59	58	2½	247	55	170	
6			.02	.09	.09	60	59	1½	249	55	169	
7	45		.02	.09	.09	60	59	1½	249	57	169	
8			.07	.31	.31	60	59	2½	251	55	170	
9	50		.19	.84	.84	61	60	4	253	52	170	
10			.34	1.55	1.55	61	60	6	255	52	171	
11	55		.60	2.66	2.66	62	61	10	253	53	170	
12			.60	2.66	2.66	63	61	10	250	55	168	
	60	313.182										
		36.716	$\sqrt{(\Delta P)^2}$		0.871 / ΔH		516.8 / Tm				168.8 / Ts	

TRAVERSE SAMPLING DATA SHEET

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1914

Client Lakeside
Location Shelton, WA
Sample Site Boiler Plant 2 Exhaust Stack
Stack Diameter 72"ø
Date 6-3-92
Operators JMG - BDW
Run I.D. 2-MS/BH

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

Start Time 0919
Stop Time 1028
Barometric Pressure "Hg 30.15
Static Pres "H_2O -.24
Production Rate ___

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.02 / .010
Leak Test Vacuum	15 / 15
✓ Pitots, Pre Leak Ck	
✓ Pitots, Post Leak Ck	
___ Gas Sampling System	
✓ Integrated Bag	
___ Thermocouples @ ___ °F	

Filter # 1392 Box # 12

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	___	-599.7 =	825.7
#2 Imp.	___	-647.0 =	828.0
#3 Imp.	___	-521.8 =	526.0
#4 Imp.	___	- ___ =	___
#5 Imp.	___	- ___ =	___
#6 S.G.	___	-811.3 =	836.3

Total H_2O Volume 4362 g

SAMPLING PARAMETERS
% Moisture ___
Meter Temp. ___
Stack Temp. ___
ΔH@ .957 Y .972
Pitot # ___ Side # ___
Cp .84
Nozzle Diameter .373 inch
D_1 ___ D_2 ___ D_3 ___
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 %
S 1	0	315.072	.28	1.27	1.27	65	64	4	240	61	165	
2			.28	1.27	1.27	65	64	4	265	53	167	
3	5		.20	.90	.90	65	65	3½	245	53	172	
4			.115	.52	.52	65	65	2½	252	55	170	
5	10		.07	.32	.32	66	65	2	257	59	170	
6			.03	.14	.14	66	66	1½	265	62	170	
7	15		.01	.045	.045	66	66	1½	262	65	170	
8			.03	.14	.14	66	66	1½	261	65	170	
9	20		.08	.36	.36	67	67	2	264	60	170	
10			.21	.95	.95	67	67	4	260	55	169	
11	25		.30	1.36	1.36	68	68	4	258	52	169	
12			.32	1.45	1.45	69	68	5	248	53	169	
E 1	30	332.384	.30	1.36	1.36	70	68	4½	264	52	163	
2			.28	1.27	1.27	70	68	4	267	52	165	
3	35		.18	.81	.81	70	68	3½	258	53	169	
4			.10	.045	.045	71	69	3	245	57	169	
5	40		.07	.32	.32	71	69	2	264	58	170	
6			.02	.09	.09	71	69	1½	250	61	170	
7	45		.01	.045	.045	71	69	1½	254	64	171	
8			.06	.27	.27	71	69	2	254	61	171	
9	50		.19	.86	.86	71	70	4	253	54	170	
10			.28	1.27	1.27	72	70	5	248	52	170	
11	55		.60	2.71	2.71	72	70	9	247	52	167	
E			.60	2.71	2.71	73	71	9	241	53	167	
	60	352.680										
	✓	37.608	$\sqrt{(\Delta P)^2}$		✓ $\frac{0.870}{\Delta H}$	$\frac{68.1}{T_m}$ ✓					$\frac{168.9}{T_s}$ ✓	

TRAVERSE SAMPLING DATA SHEET

Page ___ of 30

1915

Client LAKESIDE
Location SHELTON, WA
Sample Site BOILER ROOM Exhaust STACK
Stack Diameter 72"Ø
Date 6-3-92
Operators JAG - ERIC
Run I.D. 3-M5/13H

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.02 / .018
Leak Test Vacuum	15 / 16
___ Pitots, Pre Leak Ck	
___ Pitots, Post Leak Ck	
___ Gas Sampling System	
___ Integrated Bag	
___ Thermocouples @ ___ °F	

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

Filter # 1484 Box # A-3

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	789.3	- 586.8	= ~~789.3~~
#2 Imp.	757.1	- 574.6	=
#3 Imp.	479.7	- 472.1	=
#4 Imp.		-	=
#5 Imp.		-	=
#6 S.G.	794.8	- 777.4	=

Total H_2O Volume 416.5 ✓ g

Start Time 1118
Stop Time 1229
Barometric Pressure "Hg 30.24
Static Pres "H_2O -.23
Production Rate

SAMPLING PARAMETERS

% Moisture
Meter Temp.
Stack Temp.
ΔH@ .959 Y .972
Pitot # ___ Side # ___
Cp .84
Nozzle Diameter .373 inch
D_1 ___ D_2 ___ D_3 ___
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 %	
S 1	0	355.177	.28	1.28	1.20	72	71	5½	258	59	170		
2			.27	1.23	1.23	73	71	5½	255	55	171		
3	5		.18	.82	.82	73	71	4½	253	56	171		
4			.13	.59	.59	73	71	3½	252	59	171		
5	10		.06	.27	.27	73	71	2½	253	63	170		
6			.02	.09	.09	73	72	1½	256	65	170		
7	15		.02	.09	.09	73	72	1½	257	66	170		
8			.02	.09	.09	73	73	1½	260	67	171		
9	20		.09	.41	.41	73	74	3	262	65	170		
10			.20	.91	.91	74	74	5	260	61	170		
11	25		.31	1.42	1.42	74	74	6½	258	60	170		
12			.33	1.51	1.51	75	74	7	257	60	170		
E 1	30	372.700	.30	1.37	1.37	76	76	6½	261	63	164		
2			.30	1.37	1.37	77	76	6½	260	58	169		
3	35		.18	.82	.82	78	77	5	255	58	170		
4			.13	.59	.59	78	77	4	252	60	170		
5	40		.07	.32	.32	78	77	3	251	61	169		
6			.015	.07	.07	78	77	1½	252	65	171		
7	45		.01	.046	.046	79	78	1½	253	67	171		
8			.04	.18	.18	79	78	2	251	67	171		
9	50		.20	.91	.91	79	78	5	252	61	170		
10			.33	1.51	1.51	80	79	7½	257	59	168		
11	55		.60	2.74	2.74	80	79	13	257	60	167		
N			.55	2.51	2.51	81	79	13	256	65	167		
	60	382.525			0.881	75.4					169.6		
	V	37.348	$\sqrt{(\Delta P)^2}$		ΔH	T_m ✓					T_s ✓		

SAMPLE TRAIN INFORMATION

Fill Out One Sheet Per Site and Per Test Type

Client: LAKESIDE INDUSTRIES

Location: SHELTON, WA

Site: BOILER PLANT — STACK

Date(s): 6/3/92

Test Team: JAG / ERL

Number of Runs: 3 — M5/BH

If this information is not accurate for all runs, note all exceptions:

Thimble: ___yes ✓no **Nozzle type:** ___quartz ✓steel

Probe liner: ___quartz ___glass ✓steel ___teflon

Probe type: ✓regular ___water-cooled

Front-half filter: ✓yes ___no **Size (mm):** ___90 ___110 ✓125

Support: ___steel ✓glass frit ___teflon

Gasket: ✓silicon ✓teflon

Filter media: ___quartz fiber ✓glass fiber ___teflon

Impinger Train Solutions/Quantity of Solution Charged
#1 100ml D.I.
#2 100ml D.I.
#3 M.T.
#4 S.G.
#5
#6

Note: Show the back-half filter location with an arrow

Back-half filter type: ___quartz fiber ___glass fiber ___teflon
___tared ___untared

APPENDIX C

Supporting Information

SOURCE TEST OBSERVATION CHECKLIST
ASPHALT PLANTS WITH WET SCRUBBERS

Client Lakeside Industries Date 06-01-92

Location Shelton

Process Information

Type of Plant Boing 400 Drum Mix

Manufacturer Boing

Model 400 Constructed/Installed ~~10-04-90~~ 1976

Identification No. 2862-5 Date Last Tested 10-04-90

Operation Personnel John Wakefield

Process Rate 335 Tons/Hr Discharge Temp 300 °F

Type of Fuel #2 heating oil Firing Rate 1.52 = 5/2 Gal/Hr

A/C Injection Location 26' From burner end

Fines In Gravel (-200 mesh) 5.0%

Gravel Moisture 5.3 % Asphalt Type AR 4000 & 1% Anti strip

Density 7.75 #/Gal Flash Point 530 °F

Control Equipment

Manufacturer Boeing Model 400

Water Press 80 PSI Rate 130 Gal/Min

% Recycled Water 0 Saturated Stack See mtls data

Venturi Press ΔP = 20 "H_2O Influent Pond Temp 109 °F
Static Pressure = _____ "H_2O Effluent Pond Temp 101 °F

Venturi Damper Position 20% # Ponds One

Size of Ponds 12x16x8 Type Liner none

Additional Information

Sketch of Pond System

Jeff Wakefield
James D. Wenne — OAPCA

Authorized Signature

CROSS SECTIONAL AREA

Traverse Point	Distance (inches)
1	1.32
2	4.82
3	8.50
4	12.74
5	18.00
6	25.63
7	46.37
8	54.00
9	59.26
10	63.50
11	67.18
12	70.49

STACK DIMENSIONS

72 inch diameter circular stack

2 ports

A = > 1/2 diameter downstream

B = > 2 diameters upstream

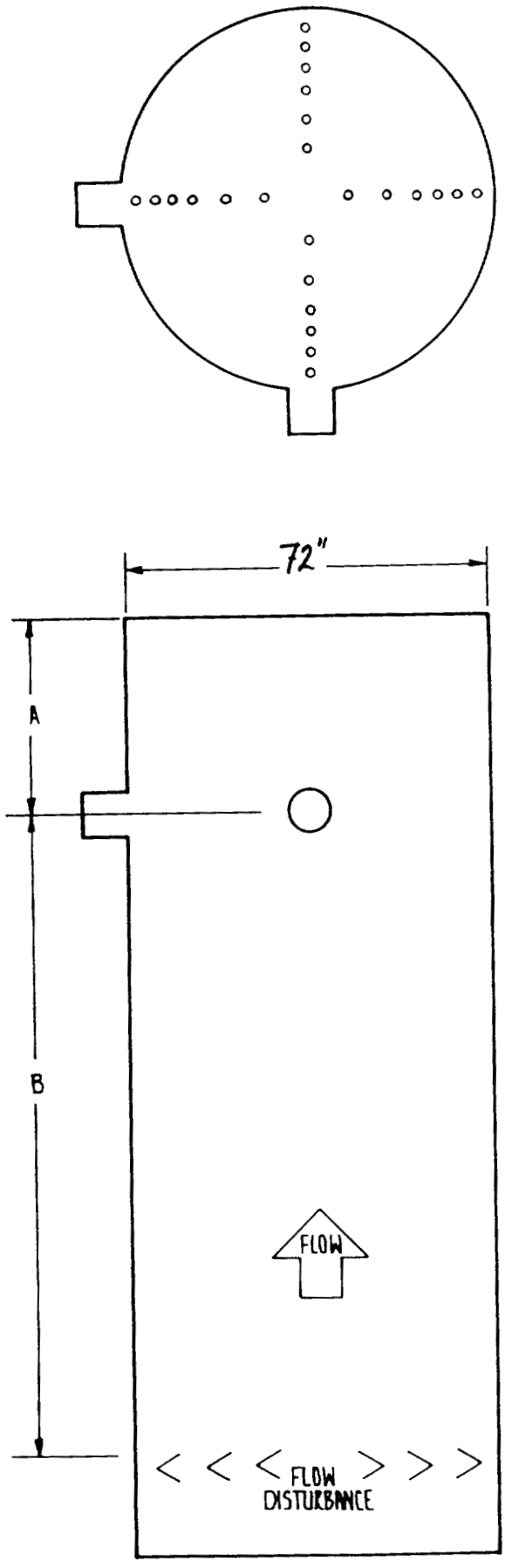

Figure 1. Location of sampling ports and traverse points.

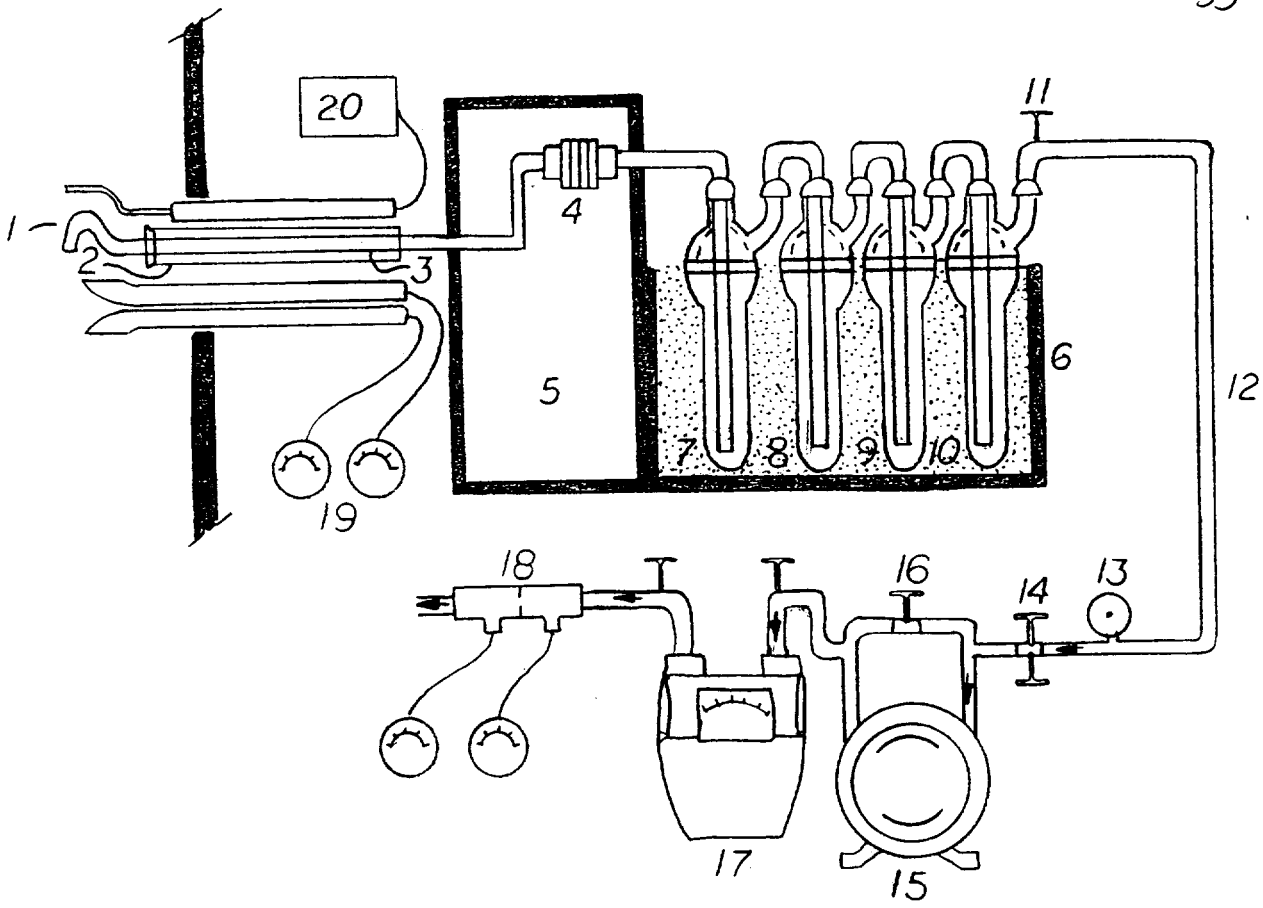

Figure 2. Method 5 Sample Train.

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

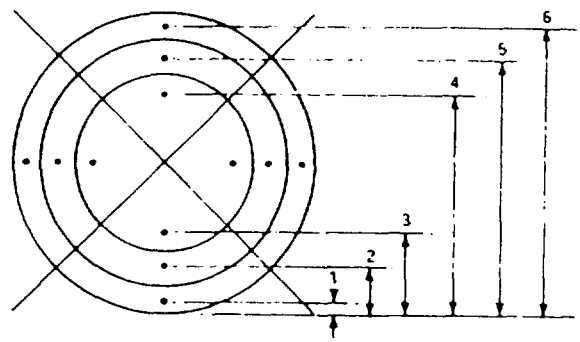

Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

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	85.4	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.

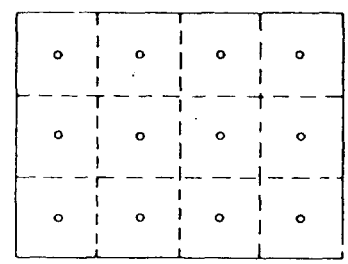

Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

METHOD 1 - MINIMUM NUMBER OF TRAVERSE POINTS

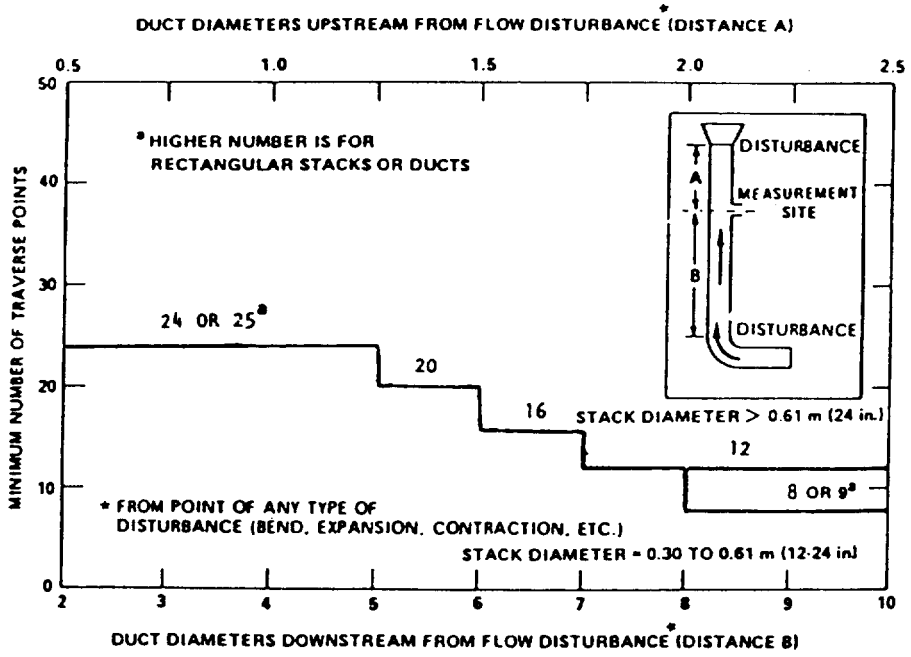

Figure 1-1. Minimum number of traverse points for particulate traverses.

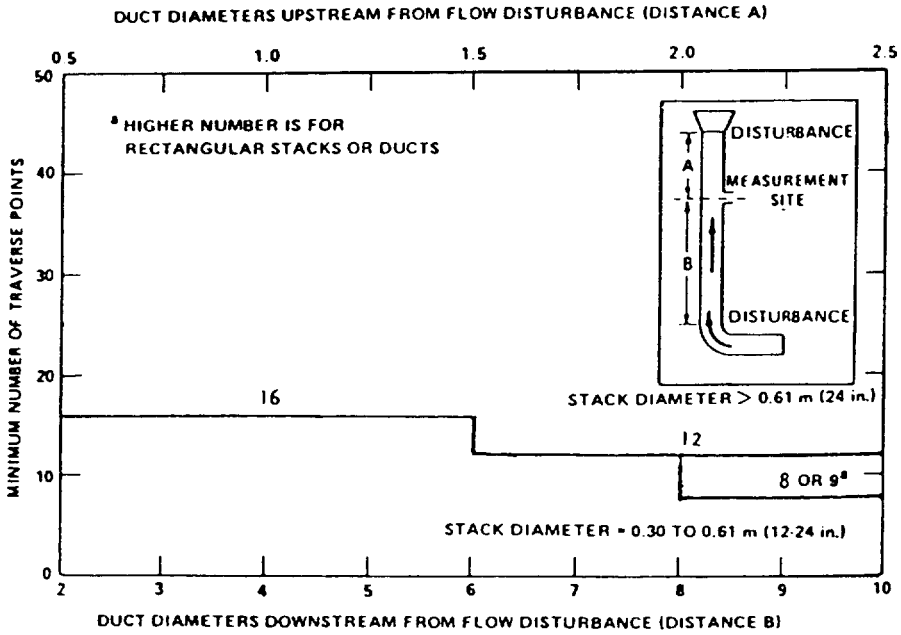

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

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,

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

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).

$$= M_d(1-B_{ws}) + 18.0\ B_{ws} \qquad \text{Eq. 2-5}$$

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).

$$= P_{bar} + P_g \qquad \text{Eq. 2-6}$$

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).

$$= 273 + t_s \text{ for metric.} \qquad \text{Eq. 2-7}$$

$$= 460 + t_s \text{ for English.} \qquad \text{Eq. 2-8}$$

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.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}} \qquad \text{Equation 2-9}$$

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3{,}600(1-B_{ws})v_s A \left(\frac{T_{std}}{T_{s\ (avg)}}\right)\left(\frac{P_s}{P_{std}}\right) \qquad \text{Eq. 2-10}$$

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.

$$\%EA = \frac{\%O_2 - 0.5\%\ CO}{0.264\%\ N_2 - (\%O_2 - 0.5\%\ CO)} \times 100 \qquad \text{Eq. 3-1}$$

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

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO) \qquad \text{Eq. 3-2}$$

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) (m^3)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft^3)/(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 m^3/ml for metric units
= 0.04707 ft^3/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 m^3/g for metric units
= 0.04715 ft^3/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 L_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

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

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.

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

6.7 Acetone Wash Blank.

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

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

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, ° K (° 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

Δ_p = 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)

DRY GAS METER CALIBRATION
AMTEST AIR QUALITY INC.

FILE NAME: RED0492
METER BOX #: RED JAG
CALIBRATION DATE: APRIL 15, 1992
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@
11.230	0.25	501.342	505.665	79.5	73.0	29.50	560.400	564.500	70.5	70.0	1.014	0.9720	1.034
12.780	0.50	481.330	488.490	80.5	73.0	29.50	541.400	548.200	70.0	70.0	1.014	0.9741	0.973
10.430	1.00	282.230	290.530	78.0	71.0	29.50	351.700	359.600	68.5	68.0	1.014	0.9741	0.957
9.920	1.50	322.290	332.140	72.0	71.0	29.50	390.000	399.300	69.0	69.0	1.014	0.9583	0.940
18.080	2.00	362.560	383.070	81.5	73.0	29.50	428.300	447.900	69.0	69.0	1.014	0.9792	0.934
13.880	2.50	417.585	435.450	83.0	72.5	29.50	480.800	497.800	69.5	69.0	1.014	0.9743	0.916
AVERAGE												0.972	0.959

PRESSURE SENSOR CALIBRATION DATA FORM

Date 4-16-92 Control Box # RED METER Box ALC (JAG)

Ambient Temperature _____ °F Barometric Pressure _____ in Hg

MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	%
0-3	.5	5	0	0
	1.5	1.5	0	0
	3.0	3.0	0	0
	-1.5	-1.5	0	0
	-.5	-.5	0	0
	-3.0	-3.0	0	0
0-.25	.2	.2	0	0
	.25	.25	0	0
	-.2	-.2	0	0
	-.25	-.25	0	0
1.0 0-4	1.0	1.0	0	0
2.5	2.5	2.5	0	0
4.0	4.0	4.0	0	0
-1.0	-1.0	-1.0	0	0
-2.5	-2.5	-2.5	0	0
-4.0	-4.0	-4.0	0	0
0-2	.5	.5	0	0
	1.0	1.0	0	0
	2.0	2.0	0	0
	-.5	-.5	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 4-16-92 Control Box # RED METER Box ALL (JAG,

Ambient Temperature _____ °F Barometric Pressure _____ in Hg

MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	%
0-2	-1.0	-1.0	0	0
2	-2.0	-2.0	0	0
0-1	.2	.2	0	0
1	.6	.6	0	0
1	1.0	1.0	0	0
1	-.2	-.2	0	0
1	-.6	-.6	0	0
1	-1.0	-1.0	0	0

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

TYPE S PITOT TUBE INSPECTION DATA FORM

Date 1/24/92 Pitot Tube # 6B

Client Lakeside Industries

Location Shelton, WA

Site(s) Boeing Plant

Test Date(s) 6/3/92

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 0 ° (<10°), α_2 = 1 ° (<10°), β_1 = 0 ° (<5°),

β_2 = 0 ° (<5°)

γ = .5 °, θ = 1.5 °, A = 0.968" cm (in.)

z = A sin γ = .0085 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 0.0254" cm (in.); <.08 cm (<1/32 in.)

P_A 0.484" cm (in.) P_b 0.484" cm (in.)

D_t = 0.375 cm (in.)

Comments:

_____

_____

_____

Calibration required? _____ yes* ✓ no

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

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 1/24/92 Thermocouple Indicator # Fluke from Blue RAM meter Box

Ambient Temperature 66 °F Barometric Pressure _____ in Hg

THERMOCOUPLE # OR REFERENCE	REFERENCE THERMOMETER TEMPERATURE °F	THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F	TEMPERATURE DIFFERENCE %
T6B Thermometer A	34	33	1	0.20%
T6B Therm. A	59	59	0	0
T6B Therm. A	214	215	1	0.15%

(ref temp, °F + 460) - (test therm. temp, °F + 460) * 100 ≤ 1.5%
(ref temp, °F + 460)