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ATMOSPHERIC
EMISSION
EVALUATION

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PUGET SOUND AIR POLLUTION
CONTROL AGENCY

Prepared For:

HI-LINE ASPHALT PAVING COMPANY, INC.
STANSTEEL ASPHALT PAVING PLANT
SEATTLE, WASHINGTON
AUGUST 9, 1985

Submitted by:

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✓ checked FJA 9-17-85

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INTRODUCTION

The purpose of this atmospheric emission evaluation performed at Hi-Line Asphalt Paving Company, Inc.'s Stansteel asphalt paving plant located in Seattle, Washington was to determine the particulate emission concentration of the baghouse exhaust gas. On August 9, 1985, three (3) Method 5 compliance runs were performed utilizing the Environmental Protection Agency's (EPA) Method 5 procedures. Mr. James A. Guenthoer of Am Test, Inc., Seattle, Washington performed the field sampling. Mr. Kris A. Hansen and Ms. Angela F. Blaisdell of Am Test performed the laboratory analysis and data reduction. Mr. Martin Romano of Hi-Line Asphalt coordinated this project. Mr. Ray Monette, the plant foreman, coordinated plant operations. Mr. Fred Austin of the Puget Sound Air Pollution Control Authority (PSAPCA) observed the field testing.

SUMMARY OF RESULTS

The results of Hi-Line Asphalt's three (3) Method 5 compliance tests for determining particulate emission concentration are summarized in Table 1 below:

Table 1. Summary of particulate emission concentration test results.

SAMPLE RUN # =====	AM TEST LAB # =====	PARTIC. CONC. FRONTHALF gr/dscf =====	PARTIC. CONC. BACKHALF gr/dscf =====	PARTIC. CONC. TOTAL gr/dscf =====	AIR FLOW dscf/m =====
1	92839	0.022	0.022	0.045	31392
2	92840	0.024	0.014	0.037	33578
3	92841	0.015	0.009	0.024	36500
AVERAGE		0.020	0.015	0.035	33823

The average particulate mass emission rate of 0.035 grains per dry standard cubic foot (gr/dscf) was within the PSAPCA standard of 0.05 gr/dscf for this asphalt paving plant. Computer printouts which detail the complete results immediately follow the "Calculation of Results" section of this report. No difficulties were encountered during sampling and an acceptable leak check followed each run. The percentage isokinetics were within the acceptable limits of $100 \pm 10\%$ for each run.

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 36.5 inch by 42.5 inch rectangular stack had four (4) sampling ports located at equal distances along the 42.5 inch side. The sampling ports were located 0.75 diameters upstream and approximately 3 diameters 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 run 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 condensor 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 then 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 4 foot stainless steel probe with a heated stainless steel 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 Reeve Angel 934AH filter was enclosed in a temperature controlled heated box. The average box temperature was

maintained at $248^{\circ} \text{ F} \pm 25^{\circ} \text{ F}$. 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° 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 103⁰ 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 readability of 0.1 milligrams. The filters containing particulate matter were weighed to a constant weight of ± 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. The 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 103⁰ C and 24 hours desiccation, as with the filters described above. The samples and acetone blanks were weighed to a constant weight of ± 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 contents and deionized, distilled water rinses of the 1st, 2nd and 3rd impingers were transferred to a 1000 ml graduated cylinder and the liquid level was recorded. This liquid was then transferred to a 1000 milliliter separatory funnel and the contents were extracted with three (3) 25 milliliter portions of dichloromethane (CH_2Cl_2). The organic layer was transferred to a tared 150 ml beaker, labeled the "Cx" section. The water layer was transferred to a tared 150 ml beaker labeled the "C" section. The "C" section beaker and contents were heated at a moderate boil until close to dryness, then were placed in a desiccator for 24 hours prior to weighing. The "Cx" section beaker contents were allowed to evaporate at room temperature until dry and were then placed in a desiccator for 24 hours prior to weighing. The bubblers and impinger were rinsed again with acetone into a tared 150 ml beaker, labeled the "D" section. The "D" section beaker contents were allowed to evaporate at room temperature and were then placed in a desiccator for 24 hours prior to weighing. Sample blanks containing deionized, distilled water, dichloromethane, and acetone were analyzed in an identical fashion as the respective "section". The beakers were weighed to constant weights of ± 0.5 milligrams at 6 hour or greater intervals. 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. The total particulate weight is the sum of the net weight of the particulate found on the filter plus the net weight of particulate found in the

B, C, Cx, and D section beakers, minus the acetone, water and dichloromethane blank concentrations.

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, deionized, distilled water, filter, and reagent 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 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 fronthalf and backhalf were performed on a Hewlett Packard 41CX calculator, and may be found in the Appendix of this report.

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

FILE NAME: HLN_PIC LAB #: 92839
CLIENT: HI-LINE ASPHALT START TIME: 0648 0'CLOCK
LOCATION: SEATTLE, WA STOP TIME: 0755 0'CLOCK
SAMPLE SITE: BAGHOUSE OUTLET STACK SAMPLE TIME: 60.0 MINUTES
SAMPLE DATE: AUGUST 9, 1985
RUN #: 1-COMPLIANCE
OPERATORS: JIM GUENTHER
CONTACT: MARTY ROMANO

FRONTHALF PARTICULATE MASS LOADING

FILTER NUMBER: #125-018
TARE WEIGHT OF FILTER IN GMS.: 0.8277
FINAL WEIGHT OF FILTER IN GMS.: 0.8523
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0246

BEAKER NUMBER: #85-319
TARE WEIGHT OF BEAKER IN GMS.: 80.2444
FINAL WEIGHT OF BEAKER IN GMS.: 80.2648
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0204
VOLUME OF ACETONE IN MLS.: 100.0

TARE WEIGHT OF ACETONE IN GMS.: 66.8075
FINAL WEIGHT OF ACETONE IN GMS.: 66.8077
VOLUME OF ACETONE IN MLS.: 100.0
NET CONTRIBUTION OF ACETONE IN MG/ML: 0.0020

TOTAL FRONTHALF PARTIC. MATTER IN GMS.: 0.0448

FINAL WT. INIT. WT. NET WT. PITOT Co: 0.845
OF H2O G. OF H2O G. OF H2O G. NOZZLE DIA INCHES: 0.183
NOZZLE AREA FT^2: 0.0002
STACK DIP. INCHES: 36.5x42.5
STACK AREA FT^2: 10.773
METER TEMP. DEG F: 65.6
BAROM. PRES. "HG: 30.28
STATIC PRES. "H2O: 0.25
STACK PRES. "HG: 30.30
ORIFICE PRES "H2O: 0.57
METER PRES. "HG: 30.34

INIT. METER VOLUME 490.073 O2 CORR. FACTOR: NA
FINAL METER VOLUME 520.007 AVERAGE % CO2: 1.7
VOLUME SAMPLED: 29.934 AVERAGE % O2: 16.3
STD VOLUME (DSCF): 30.779 AVERAGE % CO: 0
STD VOLUME (DSCM): 1.088 STACK GAS MW. DRY: 28.92
Y FACTOR: 1.010 STACK GAS MW. WET: 27.32

BACKHALF PARTICULATE MASS LOADING

"C" SECTION - CONDENSER PARTICULATE
TARE WEIGHT OF BEAKER IN GMS.: 67.7058
FINAL WEIGHT OF BEAKER IN GMS.: 67.7450
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0392
TOTAL VOLUME OF WATER IN MLS.: 365.0
VOLUME OF WATER CONDENSED IN MLS.: 112.6
NET VOLUME OF WATER FOR BLANK IN MLS.: 252.4
WT./VOL. OF WATER BLANK (NOT SHOWN) GMS/ML: 0.002
NET WEIGHT OF PARTIC. DUE TO WATER IN GMS.: 0.0005

"Cx" SECTION - HYDROCARBON EXTRACTION
TARE WEIGHT OF BEAKER IN GMS.: 67.0791
FINAL WEIGHT OF BEAKER IN GMS.: 67.0820
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0029
TOTAL VOLUME OF CH2C12 IN MLS.: 75.0
WT./VOL. OF CH2C12 BLANK (NOT SHOWN) GMS/ML: 0.001
NET WEIGHT OF PARTIC. DUE TO CH2C12 IN GMS.: 0.0001

"D" SECTION - ACETONE RINSE OF CONDENSER
TARE WEIGHT OF BEAKER IN GMS.: 78.8479
FINAL WEIGHT OF BEAKER IN GMS.: 78.8514
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0035
TOTAL VOLUME OF ACETONE IN MLS.: 75.0
WT./VOL. OF ACETONE BLANK (NOT SHOWN) GMS/ML: 0.002
NET WEIGHT OF PARTIC. DUE TO ACETONE IN GMS.: 0.0001

TOTAL BACKHALF PARTIC. MATTER IN GMS.: 0.0449
TOTAL WEIGHT OF PARTICULATE IN GMS.: 0.0897

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
1	3.40	181	1	0.85	216
2	3.70	181	2	0.85	218
3	3.80	182	3	0.65	220
4	3.80	182	4	0.35	224
5	3.60	182	5	0.50	226
6	3.40	193	6	0.80	227
1	1.30	192	1	0.30	196
2	1.20	198	2	0.20	216
3	1.20	196	3	0.08	222
4	1.70	202	4	0.08	223
5	1.70	201	5	0.20	211
6	2.00	212	6	0.40	217

PERCENT ISOKINETICS: 96 %
STACK TEMPERATURE: 204.9 DEG F. 664.9 DEG. R.
AVERAGE VELOCITY HEAD: 1.20 " OF H2O
STACK GAS VELOCITY: 69.10 AFPS 70.80 FT/SEC.
STACK GAS AIR FLOW: 44660.86 ACFM 31391.9 DSCF/M
PARTICULATE CONCENTRATION: 0.022 GR/DSCF
POLLUTANT MASS RATE (CONCENTRATION METHOD): 6.04 LB/HR
PARTICULATE CONCENTRATION (BACKHALF): 0.022 GR/DSCF
PARTICULATE CONCENTRATION (FRONT & BACKHALF): 0.045 GR/DSCF

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

FILE NAME: HJLN_R2C LAB #: 92840
 CLIENT: HI-LINE ASPHALT START TIME: 0846 0'CLOCK
 LOCATION: SEATTLE, WA STOP TIME: 0952 0'CLOCK
 SAMPLE SITE: BAGHOUSE OUTLET STACK SAMPLE TIME: 60.0 MINUTES
 SAMPLE DATE: AUGUST 9, 1985
 RUN #: 2-COMPLIANCE
 OPERATORS: JIM GUENTHER
 CONTACT: MARTY ROMANO

FRONTHALF PARTICULATE MASS LOADING

FILTER NUMBER: #125-019
 TARE WEIGHT OF FILTER IN GMS.: 0.8261
 FINAL WEIGHT OF FILTER IN GMS.: 0.8635
 NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0374

BEAKER NUMBER: #85-317
 TARE WEIGHT OF BEAKER IN GMS.: 79.2750
 FINAL WEIGHT OF BEAKER IN GMS.: 79.2987
 NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0137
 VOLUME OF ACETONE IN MLS.: 125.0

TARE WEIGHT OF ACETONE IN GMS.: 66.8075
 FINAL WEIGHT OF ACETONE IN GMS.: 66.8077
 VOLUME OF ACETONE IN MLS.: 100.0
 NET CONTRIBUTION OF ACETONE IN MG/ML: 0.0020

TOTAL FRONTHALF PARTIC. MATTER IN GMS.: 0.0509

FINAL WT. OF H2O G. INIT. WT. OF H2O G. NET WT. OF H2O G.
 679.3 576.0 103.3
 577.6 562.6 15.0
 465.9 464.1 1.8
 756.8 742.9 13.9
 TOTAL H2O GAIN: 134.0
 TOTAL VOLUME (SCF): 6.31
 PERCENT MOISTURE: 15.98
 Bws: 0.1598

PITOT Cp: 0.845
 NOZZLE DIA INCHES: 0.183
 NOZZLE AREA FT^2: 0.0002
 STACK DIA. INCHES: 36.5x42.5
 STACK AREA FT^2: 10.773
 METER TEMP. DEG F: 72.1
 BAROM. PRES. "HG: 30.28
 STATIC PRES. "H2O: 0.25
 STACK PRES. "HG: 30.30
 DRIFICE PRES "H2O: 0.68
 METER PRES. "HG: 30.35

INIT. METER VOLUME 522.485 O2 CORP. FACTOR: NA
 FINAL METER VOLUME 555.122 AVERAGE % CO2: 1.5
 VOLUME SAMPLED: 32.637 AVERAGE % O2: 16.5
 STD VOLUME (DSCF): 33.157 AVERAGE % CO: 0
 STD VOLUME (DSEM): 1.172 STACK GAS MW. DRY: 28.90
 Y FACTOR: 1.010 STACK GAS MW. WET: 27.16

BACKHALF PARTICULATE MASS LOADING

"C" SECTION - CONDENSER PARTICULATE
 TARE WEIGHT OF BEAKER IN GMS.: 68.3897
 FINAL WEIGHT OF BEAKER IN GMS.: 68.4147
 NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0250
 TOTAL VOLUME OF WATER IN MLS.: 400.0
 VOLUME OF WATER CONDENSED IN MLS.: 134.0
 NET VOLUME OF WATER FOR BLANK IN MLS.: 266.0
 WT./VOL. OF WATER BLANK (NOT SHOWN) GMS/ML: 0.002
 NET WEIGHT OF PARTIC. DUE TO WATER IN GMS.: 0.0005

"Cx" SECTION - HYDROCARBON EXTRACTION
 TARE WEIGHT OF BEAKER IN GMS.: 79.1420
 FINAL WEIGHT OF BEAKER IN GMS.: 79.1452
 NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0032
 TOTAL VOLUME OF CH2Cl2 IN MLS.: 75.0
 WT./VOL. OF CH2Cl2 BLANK (NOT SHOWN) GMS/ML: 0.001
 NET WEIGHT OF PARTIC. DUE TO CH2Cl2 IN GMS.: 0.0001

"D" SECTION - ACETONE RINSE OF CONDENSER
 TARE WEIGHT OF BEAKER IN GMS.: 65.6560
 FINAL WEIGHT OF BEAKER IN GMS.: 65.6579
 NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0019
 TOTAL VOLUME OF ACETONE IN MLS.: 15.0
 WT./VOL. OF ACETONE BLANK (NOT SHOWN) GMS/ML: 0.002
 NET WEIGHT OF PARTIC. DUE TO ACETONE IN GMS.: .0000

TOTAL BACKHALF PARTIC. MATTER IN GMS.: 0.0295
 TOTAL WEIGHT OF PARTICULATE IN GMS.: 0.0803

 SAMPLE VELOCITY TEMPERATURE SAMPLE VELOCITY TEMPERATURE
 POINT " OF H2O DEGREES F. POINT " OF H2O DEGREES F.

1	3.50	225	1	0.95	215
2	4.60	220	2	0.80	226
3	4.60	224	3	0.50	229
4	4.60	228	4	0.37	213
5	5.00	233	5	0.70	205
6	5.00	229	6	1.00	215
1	2.40	213	1	0.30	200
2	2.40	223	2	0.20	229
3	2.00	229	3	0.06	232
4	1.60	232	4	0.06	231
5	1.60	234	5	0.16	214
6	1.75	229	6	0.50	219

PERCENT ISOKINETICS: 97 %
 STACK TEMPERATURE: 222.8 DEG F. 682.8 DEG. R.
 AVERAGE VELOCITY HEAD: 1.44 " OF H2O
 STACK GAS VELOCITY: 76.72 FPS 78.84 FT/SEC.
 STACK GAS AIR FLOW: 49588.52 ACFM 33527.6 DSCF/M
 PARTICULATE CONCENTRATION: 0.024 GR/DSCF
 POLLUTANT MASS RATE (CONCENTRATION METHOD): 6.80 LB/HR
 PARTICULATE CONCENTRATION (BACKHALF): 0.014 GR/DSCF
 PARTICULATE CONCENTRATION (FRONT & BACKHALF): 0.037 GR/DSCF

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

FILE NAME: HILN_R3C LAB #: 92841
CLIENT: HI-LINE ASPHALT START TIME: 1054 O'CLOCK
LOCATION: SEATTLE, WA STOP TIME: 1326 O'CLOCK
SAMPLE SITE: BAGHOUSE OUTLET STACK SAMPLE TIME: 60.0 MINUTES
SAMPLE DATE: AUGUST 9, 1985
RUN #: 3-COMPLIANCE
OPERATORS: JIM GUENTHER
CONTACT: MARTY ROMANO

FRONTHALF PARTICULATE MASS LOADING
FILTER NUMBER: #125-020
TARE WEIGHT OF FILTER IN GMS.: 0.8279
FINAL WEIGHT OF FILTER IN GMS.: 0.8473
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0194

BEAKER NUMBER: #85-316
TARE WEIGHT OF BEAKER IN GMS.: 78.3709
FINAL WEIGHT OF BEAKER IN GMS.: 78.3851
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0142
VOLUME OF ACETONE IN MLS.: 155.0
TARE WEIGHT OF ACETONE IN GMS.: 66.8075
FINAL WEIGHT OF ACETONE IN GMS.: 66.8077
VOLUME OF ACETONE IN MLS.: 100.0
NET CONTRIBUTION OF ACETONE IN MG/ML: 0.0020

FINAL WT. INIT. WT. NET WT. PLOT Cp: 0.845
OF H2O G. OF H2O G. OF H2O G. NOZZLE DIA INCHES: 0.183
NOZZLE AREA FT^2: 0.0002
STACK DIA. INCHES: 36.5x42.5
STACK AREA FT^2: 10.773
METER TEMP. DEG F: 80.6
BAROM. PRES. "HG: 30.27
STATIC PRES. "H2O: 0.25
STACK PRES. "HG: 30.29
ORIFICE PRES "H2O: 0.80
METER PRES. "HG: 30.35

TOTAL FRONTHALF PARTIC. MATTER IN GMS.: 0.0333

INIT. METER VOLUME 595.540 O2 CORR. FACTOR: NA
FINAL METER VOLUME 590.329 AVERAGE % CO2: 1.6
VOLUME SAMPLED: 34.789 AVERAGE % O2: 16.5
STD VOLUME (DSCF): 34.787 AVERAGE % CO: 0
STD VOLUME (DSCM): 1.229 STACK GAS MW. DRY: 28.92
Y FACTOR: 1.010 STACK GAS MW. WET: 27.20

BACKHALF PARTICULATE MASS LOADING
"C" SECTION - CONDENSER PARTICULATE
TARE WEIGHT OF BEAKER IN GMS.: 63.8798
FINAL WEIGHT OF BEAKER IN GMS.: 63.8946
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0148
TOTAL VOLUME OF WATER IN MLS.: 400.0
VOLUME OF WATER CONDENSED IN MLS.: 137.5
NET VOLUME OF WATER FOR BLANK IN MLS.: 262.5
WT./VOL. OF WATER BLANK (NOT SHOWN) GMS/ML: 0.002
NET WEIGHT OF PARTIC. DUE TO WATER IN GMS.: 0.0005

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE DEGREES F.
1	3.50	226	1	1.20	176
2	5.00	220	2	1.00	198
3	5.50	211	3	0.70	194
4	5.50	217	4	0.50	186
5	5.50	223	5	0.60	197
6	5.50	212	6	1.00	206
1	2.25	196	1	0.30	175
2	2.60	211	2	0.20	202
3	2.30	206	3	0.08	205
4	2.05	217	4	0.08	210
5	2.50	199	5	0.15	211
6	2.90	190	6	0.35	200

"Cx" SECTION - HYDROCARBON EXTRACTION
TARE WEIGHT OF BEAKER IN GMS.: 68.4845
FINAL WEIGHT OF BEAKER IN GMS.: 68.4880
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0035
TOTAL VOLUME OF CH2C12 IN MLS.: 75.0
WT./VOL. OF CH2C12 BLANK (NOT SHOWN) GMS/ML: 0.001
NET WEIGHT OF PARTIC. DUE TO CH2C12 IN GMS.: 0.0001

PERCENT ISOKINETICS: 94 %
STACK TEMPERATURE: 203.7 DEG F. 663.7 DEG. R.
AVERAGE VELOCITY HEAD: 1.65 " OF H2O
STACK GAS VELOCITY: 80.98 AFPS 83.16 FT/SEC.
STACK GAS AIR FLOW: 52340.95 ACFM 36499.9 DSCF/M
PARTICULATE CONCENTRATION: 0.015 GR/DSCF
POLLUTANT MASS RATE (CONCENTRATION METHOD): 4.62 LB/HR
PARTICULATE CONCENTRATION (BACKHALF): 0.009 GR/DSCF
PARTICULATE CONCENTRATION (FRONT & BACKHALF): 0.024 GR/DSCF

"D" SECTION - ACETONE RINSE OF CONDENSER
TARE WEIGHT OF BEAKER IN GMS.: 65.3403
FINAL WEIGHT OF BEAKER IN GMS.: 65.3434
NET WEIGHT OF PARTIC. MATTER IN GMS.: 0.0031
TOTAL VOLUME OF ACETONE IN MLS.: 20.0
WT./VOL. OF ACETONE BLANK (NOT SHOWN) GMS/ML: 0.002
NET WEIGHT OF PARTIC. DUE TO ACETONE IN GMS.: .0000
TOTAL BACKHALF PARTIC. MATTER IN GMS.: 0.0208
TOTAL WEIGHT OF PARTICULATE IN GMS.: 0.0541

APPENDIX

METHOD 1 - LOCATION OF TRAVERSE POINTS

Circular Stacks

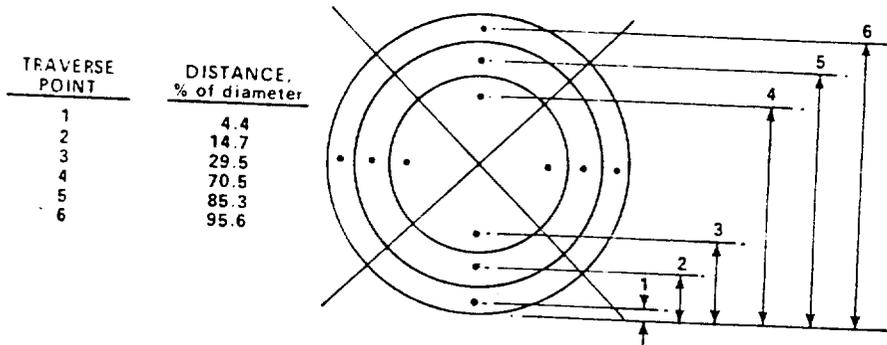


Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

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												
2	14.6											
3	85.4	6.7	4.4									
4		25.0	14.6	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
5		75.0	29.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
6			93.3	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
7				32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
8				67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
9				80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
10				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
11				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
12					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
13					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
14						93.3	85.4	78.0	70.4	61.2	39.3	32.5
15						97.9	90.1	83.1	76.4	69.4	60.7	39.8
16							94.3	87.5	81.2	75.0	68.5	60.2
17							98.2	91.5	85.4	79.6	73.8	67.7
18								95.1	89.1	83.5	78.2	72.8
19								98.4	92.5	87.1	82.0	77.0
20									95.6	90.3	85.4	80.6
21									98.6	93.3	88.4	83.9
22										96.1	91.3	86.8
23										98.7	94.0	89.5
24											96.5	92.1
											98.9	94.5
												96.8
												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.

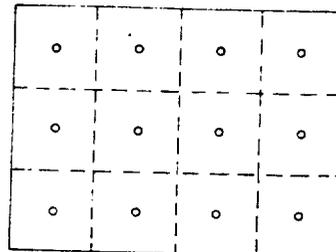
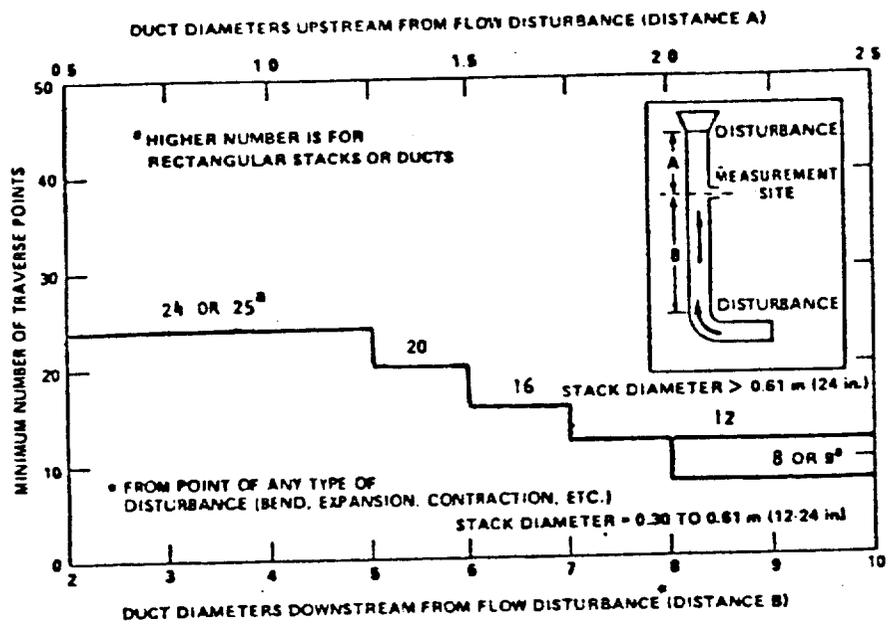
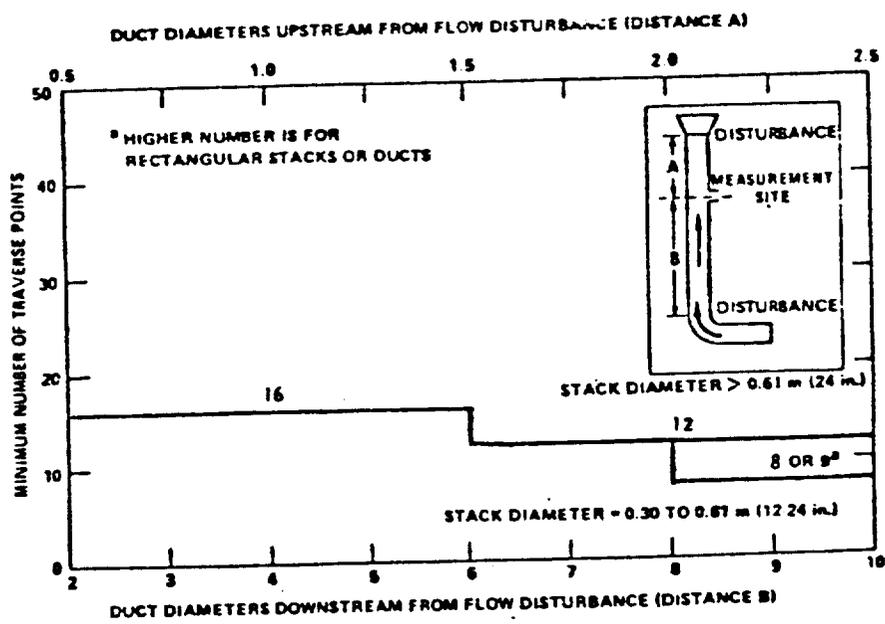


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

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_{wv} = 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.

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

for the metric system and

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

for the English system.

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

Equation 2-5

P_{bar} = Barometric pressure at measurement site, $mm\ Hg$ ($in.\ Hg$).

P_p = Stack static pressure, $mm\ Hg$ ($in.\ Hg$).

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

$= P_{bar} + P_p$

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, $^{\circ}C$ ($^{\circ}F$).

T_s = Absolute stack temperature, $^{\circ}K$, ($^{\circ}R$).
 $= 273 + t_s$ for metric

Equation 2-7

$= 460 + t_s$ for English

Equation 2-8

T_{std} = Standard absolute temperature, $293\ ^{\circ}K$ ($528\ ^{\circ}R$)

v_s = Average stack gas velocity, m/sec (ft/sec).

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

$3,600$ = Conversion factor, sec/hr .

18.0 = Molecular weight of water, $g/g\text{-mole}$ ($lb/lb\text{-mole}$).

5.2 Average stack gas velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{AVE} \sqrt{\frac{T_s (AVE)}{P_s M_s}}$$

Equation 2-9

5.3 Average stack gas dry volumetric flow rate.

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

Equation 2-10

METHOD 3 - MOLECULAR WEIGHT AND EXCESS AIR CALCULATIONS

Nomenclature.

M_d = Dry molecular weight, $g/g\text{-mole}$ ($lb/lb\text{-mole}$).

%EA = Percent excess air.

%CO₂ = Percent CO₂ by volume (dry basis).

%O₂ = Percent O₂ by volume (dry basis).

%CO = Percent CO by volume (dry basis).

%N₂ = Percent N₂ by volume (dry basis).

0.264 = Ratio of O₂ to N₂ in air, v/v .

0.280 = Molecular weight of N₂ or CO, divided by 100.

0.320 = Molecular weight of O₂, divided by 100.

0.440 = Molecular weight of CO₂, divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O₂, CO, and N₂ (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

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

Equation 3-1

NOTE: The equation above assumes that ambient air is used as the source of O₂ and that the fuel does not contain appreciable amounts of N₂ (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N₂ are present (coal, oil, and natural gas do not contain appreciable amounts of N₂) 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_d = 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).
- $V_{w(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).
- $V_{ws(std)}$ = 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.

$$V_{w(std)} = \frac{(V_f - V_i) \rho_w R T_{std}}{P_{std} M_w} = K_1 (V_f - V_i)$$

Equation 4-1

where:

$$K_1 = 0.001333 \text{ m}^3/\text{ml for metric units} \\ = 0.04707 \text{ ft}^3/\text{ml for English units}$$

2.3.3 Volume of water vapor collected in silica gel.

$$V_{ws(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w} = K_2 (W_f - W_i)$$

Equation 4-2

where:

$$K_2 = 0.001335 \text{ m}^3/\text{g for metric units} \\ = 0.04715 \text{ ft}^3/\text{g for English units}$$

2.3.4 Sample gas volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)} = K_3 Y \frac{V_m P_m}{T_m}$$

Equation 4-3

where:

$$K_3 = 0.3858 \text{ °K/mm Hg for metric units} \\ = 17.64 \text{ °R/in. Hg for English units}$$

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.

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

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_{wv} = Water vapor in the gas stream, proportion by volume.
 C_o = Acetone blank residue concentration, mg/g .
 c = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, $g/dscm$ ($g/dscf$).
 I = Percent of isokinetic sampling.
 L_o = 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 ($i=1, 2, 3, \dots, n$), 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, $18.0 g/g\text{-mole}$ ($18.0 lb/lb\text{-mole}$).
 m_c = Mass of residue of acetone 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, $0.06236\ mm\ Hg\cdot m^3/K\cdot g\text{-mole}$ ($21.85\ in.\ Hg\cdot ft^3/R\cdot lb\text{-mole}$).
 T_m = Absolute average dry gas meter temperature (see Figure 5-2), $^{\circ}K$ ($^{\circ}R$).
 T_s = Absolute average stack gas temperature (see Figure 5-2), $^{\circ}K$ ($^{\circ}R$).
 T_{std} = Standard absolute temperature, $293^{\circ}\ K$ ($528^{\circ}\ R$).
 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, $dscm$ ($dscf$).
 $V_{wv(std)}$ = 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_o = 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_i = Sampling time interval, from the beginning of a run until the first component change, min .

θ_j = 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 ($20^{\circ}\ C$, $760\ mm\ Hg$ or $68^{\circ}\ F$, $29.92\ in.\ Hg$) by using Equation 5-1.

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

Equation 5-1

where;

$K_1 = 0.3858\ ^{\circ}K/mm\ Hg$ for metric units
 $= 17.64\ ^{\circ}R/in.\ Hg$ 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_o . If L_p or L_i exceeds L_o , 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:

$$V_m - (L_p - L_o)\theta$$

(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:

$$\begin{aligned}
 & \left[V_m - (L_i - L_o)\theta_i \right. \\
 & \left. - \sum_{j=2}^n (L_j - L_o)\theta_j - (L_p - L_o)\theta_p \right]
 \end{aligned}$$

METHOD 5 - PARTICULATE EMISSION CONCENTRATION CALCULATIONS - (2)

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

6.4 Volume of water vapor.

$$V_{w(Std)} = V_{1c} \left(\frac{\rho_w}{M_w} \right) \left(\frac{RT_{Std}}{P_{Std}} \right) = K_2 V_{1c} \quad \text{Equation 5-2}$$

where:

$K_2 = 0.001333 \text{ m}^3/\text{ml}$ for metric units
 $= 0.04707 \text{ ft}^3/\text{ml}$ for English units.

6.5 Moisture Content.

$$B_w = \frac{V_{w(Std)}}{V_{m(Std)} + V_{w(Std)}} \quad \text{Equation 5-3}$$

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 $\pm 1^\circ \text{C}$ (2°F).

6.6 Acetone Blank Concentration.

$$C_a = \frac{m_a}{V_a \rho_a} \quad \text{Equation 5-4}$$

Equation 5-4

6.11 Isokinetic Variation.

6.11.1 Calculation From Raw Data.

$$I = \frac{100 T_s [K_1 V_{1c} + (V_{m1} T_{m1}) (P_{bar} + \Delta H/13.6)]}{60 \theta v_s P_s A_n} \quad \text{Equation 5-7}$$

Equation 5-7

where:

$K_1 = 0.003454 \text{ mm Hg} \cdot \text{m}^3/\text{ml} \cdot \text{K}$ for metric units.

$= 0.002669 \text{ in. Hg} \cdot \text{ft}^3/\text{ml} \cdot \text{R}$ for English units.

6.11.2 Calculation From Intermediate Values.

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

$$= K_1 \frac{T_s V_{m(Std)}}{P_s V_s A_n \theta (1 - B_w)}$$

Equation 5-8

6.7 Acetone Wash Blank.

$$W_a = C_a V_{aw} \rho_a \quad \text{Equation 5-5}$$

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.

$$c_p = (0.001 \text{ g/mg}) (m_p / V_{m(Std)}) \quad \text{Equation 5-6}$$

Equation 5-6

6.10 Conversion Factors:

From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	$2.205 \cdot 10^{-3}$
g/ft^3	g/m^3	35.31



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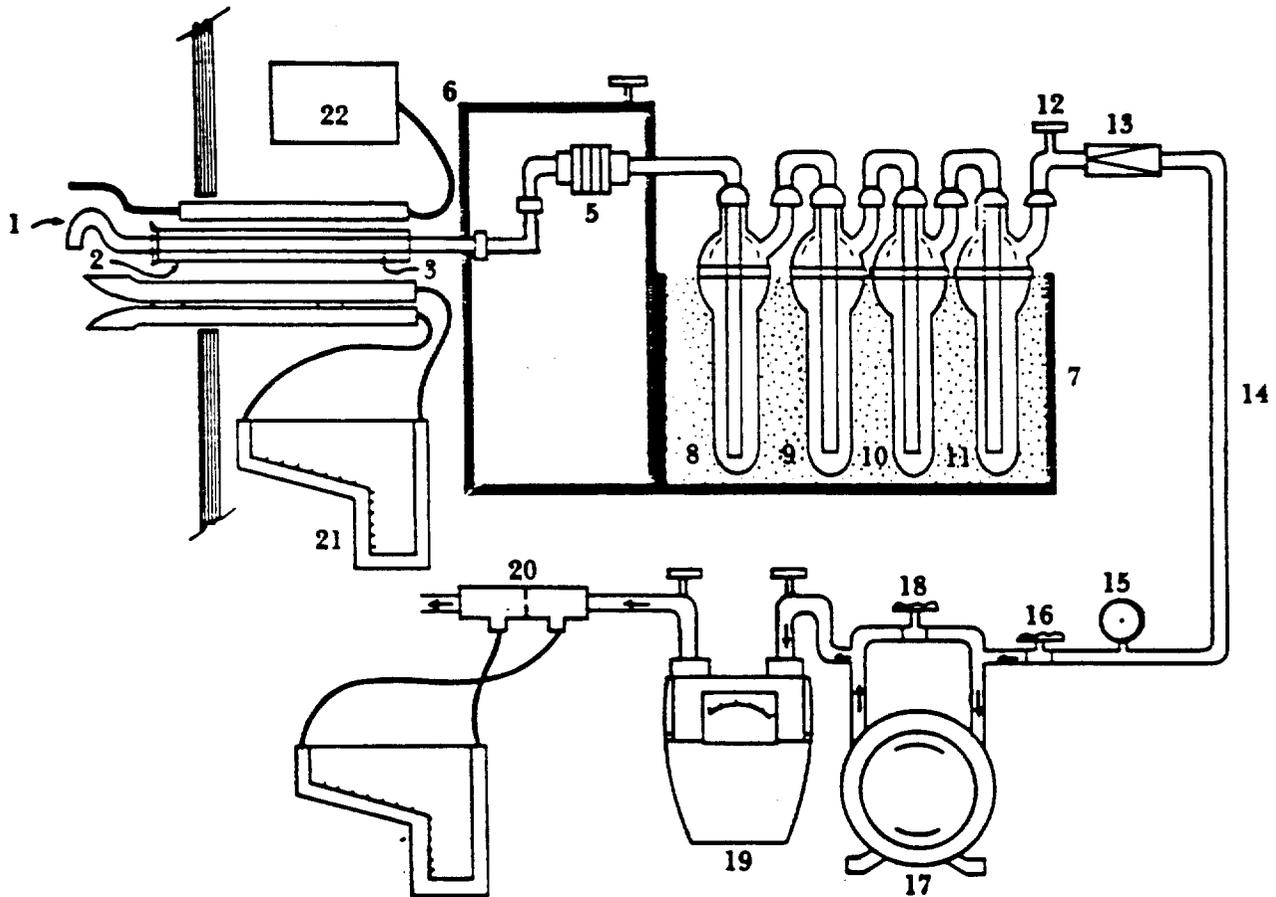


Figure 1. EPA Method 5 particulate sampling train

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 $120^{\circ}\text{C} \pm 14^{\circ}\text{C}$ ($248^{\circ}\text{F} \pm 25^{\circ}\text{F}$)
(or temperature specified in 40CFR subpart)
7. Impinger case
8. First impinger filled with H_2O (100 ml)
9. Greenburg-Smith (or modified Greenburg-Smith) impinger filled with H_2O (100 ml)
10. Third impinger - dry
11. Fourth impinger - filled with H_2O 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

SAMPLE CALCULATION SHEET

Client: Hi-Line Asphalt

Run #: 1

Date: 2/20

Particulate concentration

$$V_m = 17.647 * 23.924 * 1.010 * (30.23 + (2.565/13.6)) / 1000$$

Equation 5-1

$V_m = 30.779$ dscf

$W_a = m_a * v_{aw} / v_a$

Substitution of Equation 5-4 into 5-5

$W_a = 0.2 * 100 / 100$

$W_a = 0.2$ mg

$m_n = (\text{net weight filter catch}) + (\text{net weight "B" section}) - W_a + (\text{Backhalf})$

$m_n = 99.7 \text{ mg} = 246 + 20.4 - 0.2 + 44.9$

$c_s = [(0.001 \text{g/mg}) * (15.43 \text{gr/ft}) * 99.7 / 30.779]$

Equation 5-6

$c_s = 1.1 \text{ gr/dscf or } 1.1 \text{ gr/dscf} @ 12\% \text{ CO}_2 = c_s * 12\% / 100\%$

Moisture

$V_w(\text{std}) = 0.04707 * 112.6 \text{ ml or grams of water condensed}$

Equation 5-2

$V_w(\text{std}) = 5.30$ scf

$B_{ws} = (5.30) / (5.30 + 30.779)$

Equation 5-3

$B_{ws} = .1469$ %H₂O = 14.69 %

Molecular weight

$M_d = 0.440(1.7) + 0.320(16.3) + 0.280(82)$

Equation 3-2

$M_d = 28.92$ g/g-mole

$M_s = 28.92 * (1 - .1469) + 18.0 * .1469$

$M_s = 27.32$ g/g-mole

Stack gas velocity and volumetric flow rate

$v_s = 85.49 * .845 * 1.093 * \sqrt{664.9 / 27.32 / 30.30}$

Equation 2-9

$v_s = 70.8$ ft/sec (std) or 69.1 afps = $2.9 * 1.093 * .845 * \sqrt{664.9}$ (apx.)

$Q_{sd} = 3600 * (1 - .1469) * 70.8 * 10.773 * (528 / 664.9) * (30.3 / 29.92)$

Equation 2-10

$Q_{sd} = 1883.784$ dscf/hr / 60 min/hr

$Q_{sd} = 31392$ dscf/min or 4466 acfm = 69.1 afps * 10.773 sf * 60 (apx.)

Isokinetic variation

$I = 0.09450 * 30.779 * 664.9 / (30.30 * 70.8 * 60 * .0001827 * (1 - .1469))$

Equation 5-8

$I = 96$ %

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

Backhalf particulate"C" Section39.2 mg particulate in "C" Section beaker365 ml of water in condensers, including rinses112.6 ml of condensation in 1st, 2nd and 3rd bubblers (final weight - initial weight, assumes 1g/ml water density)252.4 ml of deionized, distilled water used in bubblers including rinses.002 mg/ml blank partic. = (.2 mg H₂O blank / 100 ml H₂O).51 mg of blank particulate= 38.69 mg of "C" partic. = 39.2 mg of partic. in "C" - .51 mg of blank"Cx" Section2.90 mg of particulate in "Cx" Section beaker.001 mg/ml of blank partic. = (.1 mg CH₂Cl₂ blank / 100 ml CH₂Cl₂).075 mg of blank particulate = (.75 ml * .001 mg/ml)= 2.825 mg of "Cx" partic = 2.90 mg of partic in "Cx" - .075 mg of blank"D" Section3.5 mg of particulate in "D" Section beaker.002 mg/ml of blank particulate (same as "B" Section).15 mg of blank particulate = (.75 ml * .002 mg/ml)= 3.35 mg of "D" partic. = 3.5 mg of partic. in "D" - .15 mg of blankTotal Backhalf Particulate+ 38.7 mg of "C" Section particulate+ 2.8 mg of "Cx" Section particulate+ 3.4 mg of "D" Section particulate+ NA mg of Backhalf filter (if applicable)= 44.9 mg of Backhalf particulate

PROCESS DATA

H1-Line Asphalt, Seattle

8/9/85

Plant Type :- RM-80, Tower Plant, Pug Mill

Manufacturer :- STANSTEEL

Serial # :- B-58213

Installation Date :- 1979

Type of Control Equipment :-
(Baghouse, scrubber, etc.) WAG, bit

Manufacturer :-

Production Rate :- ^{Tons} 200 per hour

Type Mix :-
(Class A, AB, etc) CLASS B

% Recycle :- 10%

Where added :- Hot Elevator ✓

Point in Drum
where Asphalt Oil added :- IN Pugmill ✓

Comment :-

Aggregate only in dryer

Mix temperature :- ~~300°F~~
325°F

Operators - Ray Monette -



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TRAVERSE SAMPLING DATA

Client <u>Hi-Line</u>	SCHEMATIC TRAVERSE LAYOUT	Start Time <u>0846</u>
Date <u>8-9-85</u>		Stop Time <u>0952</u>
Sample Location <u>Bayshore Outlet Stack</u>		Barometric <u>769</u>
Operators <u>PTA</u>		Pressure "Hg <u>30.28</u>
Sample Box # <u>1</u>		Static Pres "H ₂ O <u>+0.25</u>
Run# <u>2</u>		Production Rate _____
EQUIPMENT CHECKS		NOMOGRAPH SETUP
Initial/Final		% Moisture <u>19</u>
Leak Rate Cfm <u>L.021 L.02</u>	Stack Diameter _____	Meter Temp. <u>70</u>
Leak Test Vac <u>19" / 21"</u>	Distance Upstream _____	Stack Temp. <u>225</u>
<input checked="" type="checkbox"/> Pitots, Pretest	Distance Downstream _____	Meter ΔH _C <u>.944</u> Y <u>1.01</u>
<input checked="" type="checkbox"/> Pitots, Postest	Filter # <u>125019</u> tare _____ mgs	Pitot# <u>42</u> Side# <u>A</u>
<input checked="" type="checkbox"/> Orsat Sampling System	Final Wt. _____ Initial Wt. _____ Net Wt. _____	Cp <u>.845</u>
<input checked="" type="checkbox"/> Tedlar Bag	#1 Bubbler <u>679.3 - 576.0 =</u>	Nozzle Diameter <u>.183</u>
Thermocouple @ _____ °F	#2 Impinger <u>577.6 - 562.6 =</u>	C Factor _____
	#3 Bubbler <u>465.9 - 464.1 =</u>	Reference ΔP _____
	#4 Silica Gel <u>750.8 - 742.9 =</u>	
	TOTAL WATER VOLUME _____	

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu. Ft.	Pitot Reading (ΔP), In. H ₂ O	Orifice Setting (ΔH), In H ₂ O		Gas Meter Temp °F		Pump Vacuum In. Hg Guage	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	Opacity or Orsat Values
				Ideal	Actual	In	Out					
A 1	0	522.915	3.5	1.27	1.27	68	69	5	225	46	225	CO ₂ 1.5 O ₂ 16.5
2	2.5		4.6	1.67	1.67	70	69	7	226	47	220	
3	5		4.6	1.67	1.67	72	69	7	234	47	224	
4	7.5		4.6	1.67	1.67	74	69	7	236	43	228	
5	10		5.0	1.82	1.82	76	69	8	238	40	233	
6	12.5		5.0	1.82	1.82	77	69	8	237	49	229	
B 1	15		2.4	1.87	1.87	74	70	4 1/2	241	52	213	
2	17.5		2.4	.87	.87	74	70	4 1/2	240	50	223	
3	20		2.0	.72	.72	75	70	4	236	50	229	
4	22.5		4.6	.58	.58	75	71	3 1/2	232	50	232	
5	25		1.6	.58	.58	75	71	3 1/2	231	51	234	
6	27.5		1.75	.63	.63	75	71	3	233	51	229	
C 1	30		.95	.34	.34	73	71	2	240	54	215	
2	32.5		.80	.29	.29	73	71	1 1/2	242	52	226	
3	35		.50	.18	.18	73	71	1	244	53	229	
4	37.5		.37	.14	.14	72	71	1	247	54	213	
5	40		.70	.26	.26	73	71	1	250	54	205	
6	42.5		1.0	.38	.38	73	72	1 1/2	251	59	215	
D 1	45		.30	.11	.11	73	72	1	251	58	200	
2	47.5		.20	.08	.08	73	72	1	247	57	229	
3	50		.06	.02	.02	73	72	1	243	60	232	
4	52.5		.06	.02	.02	73	72	1	243	61	231	
5	55		.16	.06	.06	74	72	1	240	62	214	
6	57.5		.50	.18	.18	74	73	1	242	59	219	
	60	555/22										

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TRAVERSE SAMPLING DATA

Page 1 of

Client <u>Hi-Line</u>	SCHEMATIC TRAVERSE LAYOUT	Start Time <u>1054</u>
Date <u>8-9-85</u>		Stop Time <u>1324</u>
Sample Location <u>Dashwood Credit Stock</u>		Barometric Pressure "Hg <u>30.27</u>
Operators _____		Static Pres "H ₂ O <u>+0.25</u>
Sample Box # _____		Production Rate <u>x 200tph</u>
Run# <u>3</u>	Stack Diameter _____	NOMOGRAPH SETUP
EQUIPMENT CHECKS	Distance Upstream _____	% Moisture <u>19</u>
Initial/Final	Distance Downstream _____	Meter Temp. <u>75</u>
Leak Rate Cfm <u>4.01 / 4.01</u>	Filter # <u>125020</u> tare _____ mgs	Stack Temp. <u>225</u>
Leak Test Vac <u>20" / 15"</u>	Final Wt. _____ Initial Wt. _____ Net Wt. _____	ΔH@ <u>.944</u> y <u>1.01</u>
<input checked="" type="checkbox"/> Pitots, Pretest	#1 Bubbler <u>64.8 - 570.3</u>	Pitot# <u>42</u> Side# <u>A</u>
<input checked="" type="checkbox"/> Pitots, Postest	#2 Impinger <u>68.7 - 594.2</u>	Cp <u>.845</u>
<input checked="" type="checkbox"/> Orsat Sampling System	#3 Bubbler <u>98.0 - 493.2</u>	Nozzle Diameter <u>.183</u>
<input checked="" type="checkbox"/> Tedlar Bag	#4 Silica Gel <u>757.0 - 743.3</u>	C Factor _____
<input checked="" type="checkbox"/> Thermocouple @ _____ °F	TOTAL WATER VOLUME _____	Reference ΔP _____

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu. Ft.	Pitot Reading (ΔP), In. H ₂ O	Orifice Setting (ΔH), In H ₂ O		Gas Meter Temp °F		Pump Vacuum In. Hg Guage	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	Opacity or Orsat Values
				Ideal	Actual	In	Out					
A 1	0	555.390	3.5	1.28	1.28	77	75	5	270	58	226	CO ₂ 1.6
2	2.5		5.0	1.83	1.83	79	76	7	262	49	220	O ₂ 16.5
3	5		5.5	2.02	2.02	81	76	8	260	48	211	
4	7.5		5.5	2.02	2.02	84	77	8	261	50	217	
5	10		5.5	2.02	2.02	85	77	8 1/2	259	54	223	
6	12.5		5.5	2.02	2.02	84	78	8 1/2	252	58	212	
B 1	15		2.25	.86	.86	77	75	4	273	67	196	
2	17.5		2.6	1.0	1.0	78	76	4 1/2	261	57	211	
3	20		2.3	.88	.88	80	76	4	259	54	206	
4	22.5		2.05	.78	.78	81	76	3 1/2	252	54	217	
5	25		2.5	.95	.95	82	77	4 1/2	245	54	199	
6	27.5		2.9	1.13	1.13	83	78	5	236	55	190	
C 1	30		1.2	.48	.48	83	78	3	234	62	176	
2	32.5		1.0	.39	.39	83	79	3	238	59	148	
3	35		.70	.27	.27	83	79	2	240	61	194	
4	37.5		.50	.19	.19	83	80	2	239	62	186	
5	40		.60	.23	.23	83	80	2	237	62	197	
6	42.5		1.0	.39	.39	84	81	3	238	62	206	
D 1	45		.30	.12	.12	84	81	1	236	62	175	
2	47.5		.20	.08	.08	84	82	1	238	62	202	
3	50		.08	.03	.03	85	83	1	224	65	205	
4	52.5		.08	.03	.03	85	83	1	227	46	210	
5	55		.15	.06	.06	85	83	1	230	65	211	
6	57.5		.35	.14	.14	85	83	1	230	67	200	
67		590.39										

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TRAVERSE SAMPLING DATA

Client Hi-Line
Date 8-9-85
Sample Location Dugway Outlet Stack
Operators
Sample Box #
Run# 3

SCHEMATIC TRAVERSE LAYOUT

Stack Diameter
Distance Upstream
Distance Downstream

Start Time 1054
Stop Time 1324
Barometric Pressure "Hg 30.27
Static Pres "H2O +.75
Production Rate x 200 t/h

EQUIPMENT CHECKS

Initial/Final
Leak Rate Cfm 4.01/4.01
Leak Test Vac 20"/15
Pitots, Pretest
Pitots, Postest
Orsat Sampling System
Tedlar Bag
Thermocouple @ °F

NOMOGRAPH SETUP

% Moisture 19
Meter Temp. 75
Stack Temp. 225
Delta H .944 y 1.01
Pitot# 42 Side# A
Cp .845
Nozzle Diameter .183
C Factor
Reference Delta P

Filter # 125000 tare mgs
Final Initial Net
Wt. Wt. Wt.
#1 Bubbler 64.8 - 570.3
#2 Impinger 18.7 - 594.2
#3 Bubbler 498.0 - 493.2
#4 Silica Gel 757.0 - 743.3

TOTAL WATER VOLUME

Table with columns: Sample Point, Elap Time Min, Dry Gas Meter Reading Cu. Ft., Pitot Reading (Delta P), In. H2O, Orifice Setting (Delta H), In H2O, Gas Meter Temp, Pump Vacuum In. Hg Guage, Filter Box Temp, Imp. Exit Temp, Stack Temp, Opacity or Orsat Values.