Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

Commonwealth of Pennsylvania
Environmental Resources
August 26, 1988

Subject: Source Test Review

To: Data File
International Mill Service, Inc.
East Fallowfield Township, Chester County

From: Scott M. Darling
Air Pollution Control Engineer
Continuous Emission Monitoring Unit
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Continuous Emission Monitoring Unit

Chief, Source Testing and Monitoring Section

International Mill Service, Inc. operates an asphalt concrete plant in East Fallowfield Township, Chester County. The plant, which has a rated capacity of 320 tons/hours, consists of a rotary drum aggregate dryer fired with Natural Gas or No. 2 fuel oil and a pug mill to mix the liquid asphalt with the aggregate. Following the pug mill, the flue gas passes through a cyclone, a baghouse and are ducted to a stack and released into the atmosphere approximately 30 feet above grade.

On May 26 and 27, 1988, personnel from Gilbert/Commonwealth conducted particulate and visible emission testing in the stack. The tests were performed in accordance with the applicable test methods and are acceptable to the Department.

The following was extracted from the test reports

Run	Percent Isokinetic, %	Gr./DSCF	lbs./hr.	Opacity, %
1	99.8	0.0090	1.75	2.0
2	98.1	0.0081	1.67	5.0
3	96.6	0.0053	1.11	4.6

The allowable emission limits are 0.04 gr./DSCF and 12.3 lbs./hr.

SOURCE SAMPLING REPORT FOR MEASUREMENT OF PARTICULATE AND VISIBLE EMISSIONS

INTERNATIONAL MILL SERVICE
COATESVILLE FACILITY
ASPHALT BATCH PLANT

G/C, INC. REPORT R-10-0621-000-1
MAY, 1988

RECEIVED
AUG 1
DIV. OF FACILITIES MGMT.

SOURCE SAMPLING REPORT FOR MEASUREMENT OF PARTICULATE AND VISIBLE EMISSIONS

INTERNATIONAL MILL SERVICE
COATESVILLE FACILITY
ASPHALT BATCH PLANT

G/C, INC. REPORT R-10-0621-000-1
MAY, 1988

PREPARED BY

GILBERT/COMMONWEALTH, INC.
QUALITY ASSURANCE DIVISION
P.O. BOX 1498
READING, PENNSYLVANIA 19603

DAVID J. HOFFMANN
TESTING SUPERVISOR
TESTING SERVICES GROUP

Gilbert/Commonwealth engineers and consultants

GILBERT/COMMONWEALTH, INC., P.O. Box 1498, Reading, PA 19603/Tel. 215 775-2600/Cable Gilasoc/Telex 836-431

July 13, 1988

International Mill Service, Inc.
P.O. Box 348
Conneaville, PA 19320

Attention: Mr. George Warrick

RE: Submittal of Source Sampling Report
for Measurement of Particulate and
Visible Emissions
International Mill Service, Inc.
Conneaville Facility
Asphalt Batch Plant
G/C, Inc. Report R-10-0621-000-1

Gentlemen:

We are pleased to submit six copies of our Report R-10-0621-000-1, dated July 13, 1988. This report contains results of source sampling for particulate, visible emissions and determination of flue gas characteristics for the asphalt plant batch located at your Conneaville facility, as conducted on May 26-27, 1988.

The source sampling program defined by this report incorporates standard sampling procedures. The results of the sampling program are representative of flue gas emissions at the stack outlet of the baghouse under referenced normal operating conditions.

Information contained in this report and the accompanying Appendices includes field data, laboratory analyses, and a computer printout of all results developed by the testing program. We have attempted to present this information in a form that is readily discernible and suitable for your continued use.

Gilbert/Commonwealth, Inc., is pleased to have been of service to International Mill Service and trusts that this report will meet your complete acceptance.

Very truly yours,

David Hofmann
Testing Supervisor
Testing Services Group

DH:wjr

FOREWORD

The source sampling program as defined by this report was confined to measurement of particulate emissions and pertinent flue gas characteristics at the stack location for the asphalt batch plant during referenced operating conditions.

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FOREWORD		
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TABLES AND FIGURES

Tables

1. Summary of Test Results

Figures

1. Location of Sample Ports and Traverse Points, Asphalt Batch Plant

SECTION I - SUMMARY OF TEST RESULTS

A summary of test results from the source sampling program is presented in Table 1. As such, the results are considered representative of emission characteristics from the asphalt batch plant during referenced operating conditions. The results show the particulate emissions are below the limit of 0.04 gr/dscf.

TABLE 1

SUMMARY OF TEST RESULTS
INTERNATIONAL MILL SERVICE
COATESVILLE FACILITY

G/C, INC. REPORT R-10-0621-000-1

LOCATION	STACK		
RUN NO.	IMS-1	IMS-2	IMS-3
DATE	5/26/88	5/26/88	5/27/88
TIME			
Start	0912.	1204.	0931.
Stop	1113.	1409.	1108.
PROCESS RATE			
Tons/min.	2.51	2.63	2.67
FLUE GAS CHARACTERISTICS			
DSCFM	22,721	24,131	24,638
ACFM	35,371	37,282	40,137
Temperature, °F	219	220	242
Moisture, %	16.1	14.9	17.5
PARTICULATE EMISSIONS			
Gr/DSCF	.0090	.0081	.0053
lbs/hr	1.75	1.67	1.11
OPACITY, %	2.0	5.0	4.6

SECTION II - ANALYSIS

1. Introduction

The data presented in this report represents the results of source sampling exhaust emissions at the stack outlet location of the asphalt batch plant during referenced operating conditions.

Specific requirements of this source sampling program include the following:

a. Identification of final particulate and visible emissions from the asphalt batch plant.

b. Average flue gas temperature, moisture, and volume of flow at the sampling location.

c. Orsat analysis of flue gas conditions at the point of sampling.

d. Record of pertinent operating conditions during period of the test run.

The sampling program was completed on May 26-27, 1988 by the Gilbert field test crew, with the assistance of personnel assigned by International Mill Service and witnessed by the PADER.

2. Description of the Plant Exhaust System

The exhaust gases from the asphalt plant are controlled by a baghouse and are exhausted through a stack.

3. Sampling Program Procedures

To satisfy the objectives established for this project, the sampling program was set-up on a basis of using one test train positioned at the stack location and completing three test runs. A test run consisted of a particulate test using EPA Method 5 and a visible emissions test using EPA Method 9.

The location and number of sampling ports and traverse points are detailed in Figure 1.

4. Operating Conditions

In the execution of this sampling program, an attempt was made to achieve near normal load for the plant. The amount of product generated was recorded by the operator. This record is included in the summary table (see Table 1).

5. Results

Test data developed by each test run, together with analytical results from laboratory analysis of samples generated by the field sampling program, are reproduced in the Appendices included with this report. Information on basic gas characteristics developed by each test run is contained in the printout of the computer program included as Appendix B.

A summary of pertinent test results and essential information to evaluate test results developed for each test run is included with this report as Table 1.

6. Discussion

6.1 Sampling Conditions

All field sampling work was completed out of doors and subject to prevailing weather conditions; however, there were no interruptions in the operation of individual test trains due to equipment or weather problems.

During the completion of this test program, the plant was maintained near the normal load condition.

6.2 Exhaust Flue Gas Volume and Composition

Test data for measurement of exhaust flue gas volume and related velocities developed by traversing of the stack show that the measured gas volumes between tests were consistent with expected values. For purposes of this report, indicated emissions are based on these measured gas volumes.

6.3 Unit Operating Conditions

This sampling program was undertaken as a compliance test program for the asphalt batch plant during representative load operating conditions. In the execution of this program, all applicable operation conditions were referenced.

Operating conditions were monitored throughout the duration of the sampling program by International Mill Service personnel.

6.4 Emissions

6.4.1 Particulate

The reported particulate emissions as summarized in Table 1 are expressed as a concentration (grains/SCF) and emission rate (lbs/hour) as measured. The particulate emissions for all three runs are within any applicable limitations.

6.4.2 Visible

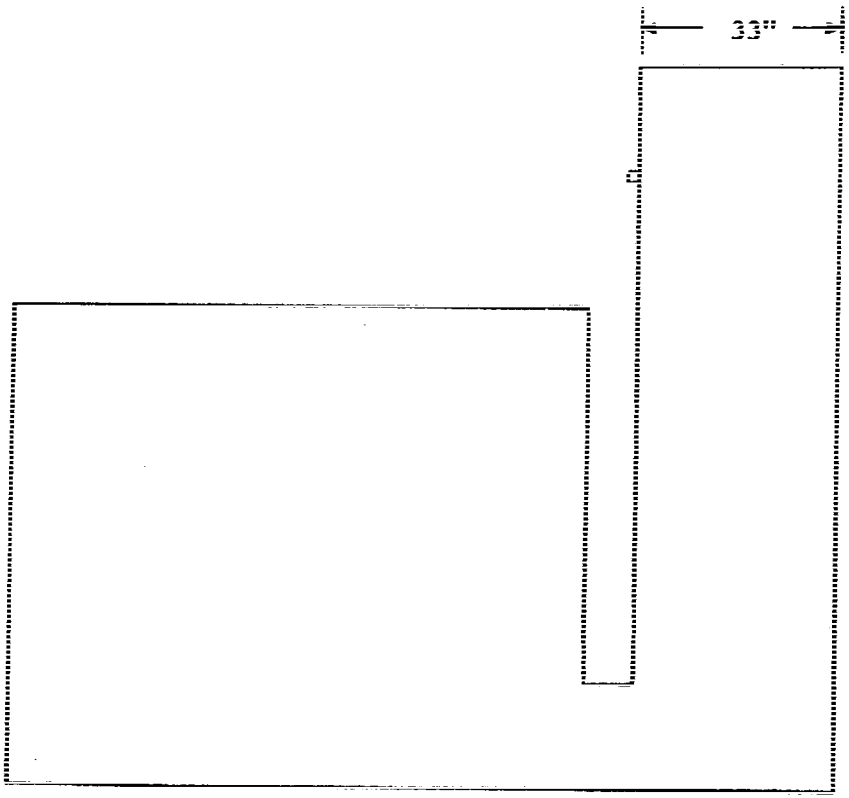
The reported visible emissions as summarized in Table 1 are expressed as a percent (%). The visible emissions for all three runs are within any applicable limitations.

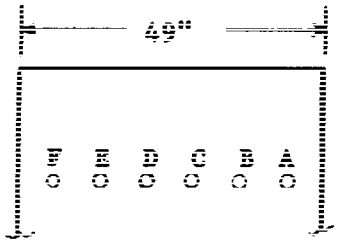
TABLE 1

SUMMARY OF TEST RESULTS
INTERNATIONAL MILL SERVICE
COATESVILLE FACILITY

G/C, INC. REPORT R-10-0621-000-1

LOCATION	STACK		
RUN NO.	IMS-1	IMS-2	IMS-3
DATE	5/26/88	5/26/88	5/27/88
TIME			
Start	0912.	1204.	0931.
Stop	1113.	1409.	1108.
PROCESS RATE			
Tons/min.	2.51	2.63	2.67
FLUE GAS CHARACTERISTICS			
DSCFM	22,721	24,131	24,638
ACFM	35,371	37,282	40,137
Temperature, °F	219	220	242
Moisture, %	16.1	14.9	17.5
PARTICULATE EMISSIONS			
Gr/DSCF	.0090	.0081	.0053
lbs/hr	1.75	1.67	1.11
OPACITY, %	2.0	5.0	4.6





Point No.	Distance From Port, Inches
1	4.12
2	13.38
3	20.63
4	28.88

FIGURE 1
SAMPLE PORTS AND TRAVERSE POINTS
ASPHALT BATCH PLANT
INTERNATIONAL MILL SERVICE, INC.
C/C, INC. REPORT R-10-0621-000-1

SECTION III

APPENDICES

SECTION III - APPENDICES

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   (Flue Gas Characteristics, Isokinetic Calculations, and Test Results for Particulate Emissions)

9. Sample Calculations

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.1 STANDARD EPA TEST METHODS

2.2 ACTUAL SAMPLING PROCEDURES/PARTICULATE

2.3 ANALYTICAL METHODS/PARTICULATE

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.1 STANDARD EPA TEST METHODS

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.2 ACTUAL SAMPLING PROCEDURES/PARTICULATE

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.2 ACTUAL SAMPLING PROCEDURES/PARTICULATE

Particulate matter in the exhaust gas stream at the stack sampling location was sampled according to procedures and type of equipment as basically described in EPA Method 5 (see Appendix 2.1 for a complete description).

In place of the fragile glass material, the in-stack probe liner was constructed of high corrosion resistant Inconel stainless steel, which was enclosed in an outer protective sheath and heat traced to minimize condensation within the probe.

The basic test train consisted of a stainless steel nozzle followed by a heated probe liner, glass fiber filter, and glass impingers with all glass connectors.

The required sampling time for the compliance test, in terms of time per traverse point and overall sampling time per individual test run, was selected on the basis of maintaining a minimum sampling time of 3 minutes at each of the traverse points.

The test program was completed with one test train located at the stack. All sampling activities were halted in the event of any test equipment malfunction or at the report of any operational problem. There was no planned interruption or extensive delay during the completion of the test runs.

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.3 ANALYTICAL METHODS/PARTICULATE

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.3 ANALYTICAL METHODS/PARTICULATE

The reported particulate emissions included the total particulate catch from the water then acetone wash of the nozzle and probe, plus accumulations on the glass fiber filter. The impinger water was filtered through a .22 micron filter. These results along with the probe wash and glass fiber filter are considered particulate emissions in the Commonwealth of Pennsylvania.

The soluble water from the impingers was dried down and weighed. This particulate weight is only reported and is not counted toward the total particulate weight.

In the clean-up of the front half of the sampling equipment, the nozzle from the front of the probe was removed, brushed out, and washed with water then acetone. The probe liner was also brushed out and washed with water then acetone. The glass fiber filter was removed from the fritted disc of the filter holder and replaced in its petri dish. All adhering filter particles were removed from the silicone rubber gasket and placed in the same petri dish prior to sealing for transport back to the Gilbert assigned laboratory for final analysis. The filter holder was then washed with water then acetone and combined with the probe and nozzle wash.

The clean-up procedure for the back half of the sampling train initially involved removal of the silica gel from the last impinger and replacement in its original container for final weighing to determine moisture pickup. Water collected in the impingers was measured and placed in a sample bottle. The impingers and glass connectors were rinsed with water then acetone. This rinse was also placed in sample bottles to be analyzed.

Laboratory analysis of samples collected during the test run proceeded according to EPA Method 5 (Appendix 2.1).

All critical items of sampling and analytical equipment were certified and/or calibrated for accuracy and results considered within acceptable limits for source sampling operations (see Appendix 7).

APPENDIX 3

OPERATING DATA

Operator Data

Test #1

Date	9/6				
Time	907	937	946	1034	1109
Barrel Dif	2	2	2	2	2
Barrel Scale	24	23	23	23	24
Barrel Temp	328	332	335	335	334
Barrel Press	1592	2044	2636	2962	3291

2.84 2.18

Avg. 251 Tons/hr.

OPERATING DATA

TEST 2

Date					
Time	1209	1246	1116	1154	1215
Exhaust Dp	2	2	2	2	2
Burner Setting	28	26	28	29	28
Average Temp	318	335	335	339	340
Average Pressure	5918	5838	6061	6925	7645

2.6 3.0

Avg 2.3

Operator Dana

Test #3

Date 5/27

Time	948	1005	1028	1105
Barometer Hg	2	2	2	2
Orifice Sample	3	28	29	28
Exhaust Temp	350	338	370	335
Manifold Pressure (Torr)	4338	5860	5969	6945

Aug 2 67

Fuel Propane

APPENDIX 4

ANALYTICAL RESULTS FOR PARTICULATES

(CLEAN-UP SHEETS)

SSM
SPOTS, STEVENS and McCOY, INC.
ENGINEERS • PLANNERS • SCIENTISTS

CERTIFICATE OF ANALYSIS

CLIENT: GILBERT/COMMONWEALTH, INC.
P. O. BOX 1498
READING, PA. 19603

DATE REPORTED: 6/7/88
REPORT NO: 8816717
DATE SAMPLED: 5/27/88
DATE RECEIVED: 6/2/88
PURCHASE NO.: 51922
ORDER NO.: 13361-000

SAMPLE TYPE: STACK
SAMPLED BY: CLIENT
SAMPLE IDENTIFICATION: IMS
W.O. 10-0621-000

Lab. No.	Run	Particulate Source	Particulate Wt. (mg)
8816717-1	IMS-1	Impinger Water	39.4
8816717-1	IMS-1	Impinger Water (> 0.22 um Filter)	1.7
8816717-1	IMS-1	Impinger Acetone	1.1
8816717-1	IMS-1	Probe Water	4.6
8816717-1	IMS-1	Probe Acetone	21.3
8816717-1	IMS-1	Filter	1.3

Lab. No.	Run	Particulate Source	Particulate Wt. (mg)
8816717-2	IMS-2	Impinger Water	7.8
8816717-2	IMS-2	Impinger Water (> 0.22 um Filter)	1.0
8816717-2	IMS-2	Impinger Acetone	0.9
8816717-2	IMS-2	Probe Water	24.3
8816717-2	IMS-2	Probe Acetone	6.6
8816717-2	IMS-2	Filter	0.0

HOME OFFICE
3655 N. Wyomissing Blvd.
P.O. Box 807
Reading PA 19610-0307
(215) 376-0601

ANALYTICAL LABORATORIES
90 Noble Street
P.O. Box 257
Reading PA 19601-0257
(215) 371-0601

LEHIGH VALLEY OFFICE
MacAllum Office Plaza Suite 401
3730 Lehigh Street
Allentown PA 18103-3030
(215) 433-4101

BALTIMORE OFFICE
900 Fairmount Avenue
Suite 100
Baltimore MD 21204-2010
(301) 494-0600

GILBERT/COMMONWEALTH, INC.
REPORT #8816717

Lab. No.	Run	Particulate Source	Particulate Wt. (mg)
8816717-3	IMS-3	Impinger Water	9.2
8816717-3	IMS-3	Impinger Water (> 0.22 um Filter)	1.5
8816717-3	IMS-3	Impinger Acetone	1.7
8816717-3	IMS-3	Probe Water	7.8
8816717-3	IMS-3	Probe Acetone	10.0
8816717-3	IMS-3	Filter	1.8

Respectfully submitted,

CARL J. NUMMER - GROUP LEADER
LABORATORY SERVICES

cc: D. Hofmann

GERMET ASSOCIATES, INC.
AIR POLLUTION CONTROL DIV.
PARTICULATE CLEAN UP AND REPORT SHEET

Run Date: 5/27/89 Client: TMS
Run No.: TMS-1 W. O. No.: 1989A1-888
Sample Loc No.: 4 Plant: Cardinal
Operator: DCS Sampling Location: Stack

PHOSPHORUS

Phosphorus Tank Probe, Stainless Holder, Quartz Crucible, Plug, Front Half Filter Holder-Bottom Rinse — Lab No. 6777-7 Bottom: 4.6 g; Lab No. 6777-7 Bottom: 3.3 g

Laboratory Results

Sample No.	Lab No.	Results, Grams
		g
		g
		g
		g

Stainless porcelainite weight: g

Filter No.	Lab No.	Results, Grams
S-4A1	6777-1	g
		g
		g
		g

Filter porcelainite weight: 1.3 g

PHOSPHORUS Sub Total: 9.2 g — 2.2

ACID HOLE

Impinger Contents and Water Rinse of Impingers Connectors and Back Half of Filter Holder — Lab No. 6777-2 Rinse-Chloroform Bottom: g; Collected on 0.22μ Filter: 1.7 g; Aqueous Residue: 39.4 g — 66.6

Impinger, Connectors and Back Half of Filter Holder - Acetone Rinse — Lab No. 6777-3 Bottom: 1.1 g

ACID HALF Sub Total: 68.0 g

SUM WEIGHT: 2.2 g

MOISTURE

Impingers:

	319
	306
	14
Final Volume	404
Initial Volume	395
Net Volume	9.0

Silica Gel:

Weight after test:	313			
Weight before test:	303			
Net Weight	10			
Container No.:	1.	2.	3.	4.

SUM WEIGHT-Silica Gel: 10 g

SUM VOLUME, Impingers: 14.0 ml

TOTAL MOISTURE: 3.9 g

Comments:

LAB: SAMP RECEIVED 6/1/89
SAMP RECEIVED 6/1/89

Technical Director

GPE/AIC 12/76

GRANITE ASSOCIATES, INC.
ARE POLLUTION CONTROL DEPT.
PARTICULATE CLEAN UP AND IMPINGER SHEET

Run Date: 5/20/79 Client: LMS

Run No.: LMS-3 W. O. No.: 15196-196

Sample Box No.: 4 Plant: Centralia

Operator: [illegible] Sampling Location: [illegible]

FRONT HALF

Laboratory Results

Probe-Nozzle Wash Lab No. 6212-2 Results 943 mg

Probe, Nozzle Holder, Spokane Organic, Flask, Front Half Filter Holder-Nozzle Wash Lab No. 6212-3 Results 68 mg

Filter No.	Lab No.	Results
		mg
		mg
		mg
		mg

Filterable particulate weight mg

Filter No.	Lab No.	Results
S-692	6212-2	mg
		mg
		mg
		mg

Filter particulate weight 0.0 mg

FRONT HALF Sub Total 943 mg

BACK HALF

Impinger Contents and Water Wash of Impingers Connectors and Back Half of Filter Holder

Lab No. 6212-4 Ether-Chloroform Insoluble mg

Collected on 0.45u Filter 268 mg

Aqueous Insoluble 9.8 mg

Impinger, Connectors and Back Half of Filter Holder - Acetone Wash

Lab No. 6212-3 Results 8.2 mg

BACK HALF Sub Total 9.2 mg

OVER ORGANIC 952 mg

MOISTURE

Impingers:

	245
	195
	0

Final Volume 439

Initial Volume 300

Net Volume 139

Weight

Weight after cone: 359

Weight before cone: 332

Net Weight 27

Container No.: 1. 2. 3. 4.

OVER WEIGHT-Silica Gel 27 mg

OVER VOLUME, Impingers 139 ml

TOTAL MOISTURE 245 mg

Comments:

LAB: DATE RECEIVED [illegible]

DATE REVIEWED [illegible]

[illegible]
CHEMISTRY SUPERV.

HPB/LPS 11/76

GENERAL ANALYTICAL, INC.
AIR POLLUTION CONTROL DIV.
PARTICULATE CLEAN UP AND WEIGHT SHEET

Run Date: 5-27-88 | Client: TVS
Run No.: 2045-3 | W. O. No.: 1880-1055
Sample Box No.: 3 | Plant: Sandusky
Operator: B.C.S. | Sampling Location: Stack

FRONT HALF

Acetone-Insoluble Wash — Laboratory Results
Probe, Nozzle Holder, Cyclone (Opposed), Flask, Front HALF Filter Holder-Acetone Wash — Lab No. 6272-3 — Residue 2.8 mg
Lab No. 6273-3 — Residue 1.9 mg

Nozzle No.	Lab No.	Residue Weight
		mg
		mg
		mg
		mg

Nozzle percentage catch ____ %

Filter No.	Lab No.	Residue Weight
5-453	6270-3	mg
		mg
		mg
		mg

Filter percentage catch 1.8 %

FRONT HALF Sub Total 19.6 mg

BACK HALF

Impinger Contents and Rinse Wash of Impingers Connection and Back Half of Filter Holder

Lab No. 6272-3 Ether-Chloroform Recover ____ mg
Collected on 0.3 Ml Filter 45 mg
Aqueous Residue 95 mg

Impinger, Connection and Back Half of Filter Holder - Acetone Wash

Lab No. 6273-3 Residue 17 mg
BACK HALF Sub Total 140 mg
TOTAL WEIGHT 320 mg

MOISTURE

Impingers:
335
645
85

Final Volume 555
Initial Volume 300
Net Volume 255

GRAVIMETRIC

Weight after cook: 157
Weight before cook: 136
Net Weight: 20
Container No.: 1. 2. 3. 4.

TOTAL WEIGHT-BLANK Cor. 19 mg
TOTAL VOLUME, Impingers 0.07 ml
TOTAL WEIGHT 0.75 mg

Comments:

Lab: DATE RECEIVED 6/2/88
DATE RECORDED 6/2/88

MANAGER SIGNATURE

APPROVED 12/76

APPENDIX 5

RAW FIELD DATA

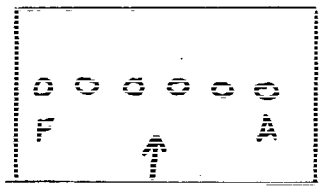
Sheet 1 of 2

PARTICULATE FIELD DATA

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point

SECTOR



Client: IMS

W. O. No.: 1886-21000

Plant: Cockeville

Run No.: IMS-1

Location: Stack

Date: 5/26/88

Operator: DCW

Sample Box No.:

Meter Box No.: 1923

Meter ΔH:

C Factor:

Pitot Calibration: 0.84

Trimble No.: –

Filter No.: 5-601

Ambient Temp. °F:

Bar. Press. "Hg: 29.34

Assumed Moisture %: 20

Heater Box Setting, °F: 250

Probe Tip Dia., in.:

Probe Length:

Probe Heater Setting:

Avg. ΔP: Avg. ΔH:

48.15 7.13 1. 12.98 2. 29.63 3. 33.71 4. 48.65 5.

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	DRY GAS METER, cf	PITOT IN. H2O ΔP	ORIFICE ΔH IN. H2O DESIRED	ORIFICE ΔH IN. H2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP. °F	IMPINGER TEMP. °F	O_2	STACK TEMP. °F
F-1		0912	0.0	478.631	0.91		2.50	66.	58.	/	245	52		222.
2			3.0	481.3	1.20		3.30	68.	58.		250			224.
3			6.0	483.7	1.15		3.20	67.	59.		255		15.1	223.
4			9.0	486.8	0.92		2.62	66.	59.		260	50		227.
Stop			12.0	489.056										
A-1		0927	0.0	489.056	0.70		1.97	65.	60.	/	265	52		229.
2			3.0	491.4	1.05		2.88	67.	60.		270			231.
3			6.0	493.8	0.96		2.70	70.	62.		270			232.
4			9.0	–	0.90		2.49	70.	62.		270	54	14.9	232.
Stop			12.0	496.929										
B-1		0942	0.0	496.929	0.59		1.65	69.	64.		265	56		230.
2			3.0	501.2	0.77		2.12	70.	65.		265			233.

COMMENTS:

Q2 329 / 303 / 26

476 / 300 / 176

-.40 / -.40

ave

9.64

Client IMS

PARTICULATE FIELD DATA
(continued)

Sheet 2 of 2

W.O. No. 10962,066

Plant Cookeville

Location stack

Run No. IMS-1

Date 5/26/88

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	DRY GAS METER, CF	PITOT IN. H_2O ΔP	ORIFICE ΔH IN. H_2O DESIRED	ORIFICE ΔH IN. H_2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	IMPINGER TEMP °F	O_2	STACK TEMP. °F
D-3			6.0	503.4	0.56		1.57	70.	66.		260			224.
4			9.0	505.6	0.68		1.88	66.	65.		250			218.
stop			12.0	507.570										
C-1		1032.	0.0	507.570	0.52		1.45	67.	65.		250	52		217.
2			3.0	509.5	0.55		1.52	68.	65.		255			220.
3			6.0	511.6	0.48		1.35	69.	65.		255			222.
4			9.0	513.4	0.54		1.50	70.	65.		260	54		218.
stop			12.0	515.378										
D-1		1046.	0.0	515.378	0.40		1.12	69.	66.		265	56		219.
2			3.0	517.2	0.46		1.12	70.	67.		270		16.3	212.
3			6.0	518.9	0.34		0.96	70.	67.		270		17.9	216
4			9.0	521.2	1.40		3.95	72.	68.		265	58		217.
stop			12.0	523.470										
A-1		1101.	0.0	523.470	0.18		0.51	71.	69.		260	60		218.
2			3.0	524.7	0.20		0.56	70.	68.		255		17.0	220.
3			6.0	526.2	0.32		0.90	71.	67.		250			223.
4			9.0	527.8	0.38		1.06	71.	68.		250	62		228.
stop			12.0	529.498										
END														
				979.6										
				50.8										

COMMENTS:

950 down
1016 up

-.28
-.30
-.15
-.15

Leak at 3" dead

CO_2
2.8 9.6

Sheet 1 of 2

PARTICULATE FIELD DATA

Pg 18

Client: TMS

VERY IMPORTANT - FILL IN ALL BLANKS

Pitot Calibration: 0.84

W. O. No.: 10062-1005

Read and record at the start of each test point

Thimble No.: —

Plant: Cockrill

SKETCH

Filter No.: S-602

Run No.: TMS-2

Ambient Temp. °F:

Location: Stack

Bar. Press. "Hg: 29.20

Date: 5/26/88

Assumed Moisture %: 20

Operator: DCW

Heater Box Setting, °F: 250

Sample Box No.: 4

Probe Tip Dia., In.: 0.250

Meter Box No.: 1923

Probe Length:

MeterΔH:

Probe Heater Setting:

C Factor:

Avg. ΔP: Avg. ΔH:

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	DRY GAS METER, CF	PITOT IN. H2O ΔP	ORIFICE ΔH IN. H2O DESIRED	ORIFICE ΔH IN. H2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP. °F	IMPINGER TEMP. °F	O_2	STACK TEMP. °F
A-1		1204.	0.0	533.308	0.40		1.13	70.	67.	-	245	59		245.
2			1.5	—	0.42		1.19	71.	68.		250		16.7	247.
3			7.0	537.4	0.31		0.88	72.	68.		255			247.
4			10.5	539.3	0.35		0.97	73.	69.		260	56		251.
1408			14.0	540.797										
B-1		1239.	0.0	540.797	0.40		1.13	70.	68.		255	56		247.
2			3.5	543.0	0.39		0.96	71.	69.		255			248.
3			7.0	544.7	0.35		0.98	72.	69.		250			249.
4			10.5	546.7	0.39		1.11	74.	69.		255	56		246.
1408			14.0	548.720										
C-1		1257.	0.0	548.720	0.55		1.55	74.	70.		260	58		244.
2			3.5	551.2	0.49		1.38	74.	70.		260		12.9	243.

COMMENTS:

1218 down -.19

1238 up -.23

2.6 CO_2

Client IMS

W.O. No. 10962-1000

Plant Cedar Mill

Run No. IMS-2

PARTICULATE FIELD DATA
(continued)

Sheet 2 of 2

Location Stack

Date 5/26/88

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	DRY GAS METER, CF	PITOT IN. H_2O ΔP	ORIFICE ΔH IN. H_2O DESIRED	ORIFICE ΔH IN. H_2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	IMPINGER TEMP °F	O_2	STACK TEMP. °F
C-3			7.0	553.4	0.55		1.05	76.	71.	–	260			192.
4			10.5	555.5	0.56		1.57	78.	74.		265	60		198.
Stop			14.0	558.110										
D-1		1019.	6.0	558.110	0.52		1.47	74.	72.		270	60		230.
2			8.5	560.7	0.74		2.10	75.	72.		270			234.
3			11.0	563.0	0.92		2.58	77.	72.		265			229.
4			14.5	566.4	1.15		3.28	80.	73.		260	62		223.
Stop			18.0	569.344										
E-1		1339.	6.0	569.344	0.70		1.98	72.	73.	2	260	64		226
2			8.5	572.6	1.35		3.85	78.	74.		255		166	229
3			11.0	576.0	1.45		4.08	80.	74.		270			243.
4			14.5	579.5	1.46		4.10	82.	77.		265	64		270.
Stop			18.0	582.795										
F-1		1355.	6.0	582.795	1.10		3.10	80.	74.		265	64		221.
2			8.5	586.3	1.35		3.85	82.	75.		260			223.
3			11.0	589.9	1.38		4.02	83.	75.		265			227.
4			14.5	592.7	1.30		3.75	84.	76.		260	66		237.
Stop			18.0	596.242										
End														
				598.1										

COMMENTS:

down 1309. .28
up 1319. .34

down 1339. .75
up 1339. .65

leak of 7" Hg

CO_2
2.8
2.8

257
232
27

Sheet 1 of 12

PARTICULATE FIELD DATA

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point

SKETCH

Client: IMS

W. O. NO.: 1[illegible]

Plant: Cooksville

Run No.: IMS-3

Location: Stack

Date: 5/2-7/88

Operator: [illegible]

Sample Box No.: 4

Meter Box No.: 1923

MeterΔH:

C Factor:

Pitot Calibration: 0.84

Thimble No.: —

Filter No.: 5-603

Ambient Temp. °F: 55

Bar. Press. "Hg: 29.67

Assumed Moisture %:

Heater Box Setting, °F: 250

Probe Tip Dia., in.: 0.250

Probe Length:

Probe Heater Setting:

Avg. ΔP: Avg. ΔH:

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	DRY GAS METER, cf	PITOT IN. H2O ΔP	ORIFICE ΔH IN. H2O DESIRED	ORIFICE ΔH IN. H2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP. °F	IMPINGER TEMP. °F	O2	STACK TEMP. °F
A-1		0931	0.0	576.418	0.19		0.56	74	67	-	245	50		222
2			2.5	578.0	0.21		0.63	72	67		250		16.1	222
3			7.0	579.7	0.27		0.73	73	67		255		16.9	226
4			10.5	581.1	0.22		0.60	70	68		255	46		222
Stop			14.0	602.476										
B-1		0947	0.0	602.476	0.33		0.91	76	70		260	48		231
2			3.5	604.9	0.32		0.88	72	70		265		15.7	236
3			7.0	606.8	0.31		0.85	79	74		270			237
4			10.5	608.9	0.36		0.99	80	72		270	50		243
Stop			14.0	610.517										
C-1		1003	0.0	610.517	0.47		1.30	82	74		265	52		238
2			3.5	612.8	0.60		1.67	84	74		260		16.1	223

COMMENTS: 6 / 8

.32 / .19

230 / 245 / 80 / 555

6.1 29

O_2: 18.0 / 18.0

CO_2: 4.0 / 3.8

416

Client: IMS

PARTICULATE FIELD DATA
(continued)

Sheet 2 of 2

W.O. No. 109621000

Plant: Cadillac

Location: Hack

Run No. IMS-3

Date: 5/27/98

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	DRY GAS METER, CF	PITOT IN. H_2O ΔP	ORIFICE ΔH IN. H_2O DESIRED	ORIFICE ΔH IN. H_2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	IMPINGER TEMP °F	O_2	STACK TEMP. °F
3			2.0	607.2	0.63		1.72	85.	75.		255			224.
4			10.5	617.6	1.05		2.85	66.	76.	1	250	54		242.
Stop			14.0	620.415										
D-2		1019.	0.0	620.415	0.68		1.87	86.	77.		250	56		273.
2			3.5	623.0	0.73		2.00	87.	79.		245		19.1	272.
3			7.0	625.6	1.30		3.60	92.	80.	2	250			258.
4			10.5	628.1	1.40		3.82	94.	81.		255	58		261.
Stop			14.0	632.280										
E-1		1035.	0.0	632.280	1.10		3.03	92.	82.		260	60		263.
2			3.5	635.9	1.35		4.55	94.	83.		265			265.
3			7.0	638.7	1.40		5.72	95.	84.		270		17.8	254.
4			10.5	642.5	1.60		4.25	97.	86.	3	270	62	13.8	250.
Stop			14.0	645.155										
F-1			0.0	645.155	1.40		3.02	79.	84.		265	64		
2			3.5	647.7	1.70		4.55	96.	85.		260		13.4	250.
3			7.0	650.3	1.50		3.95	99.	86.		255			250.
4			10.5	652.8	1.30		3.45	102.	88.		250	66		257.
Stop			14.0	655.402										
12:00														

COMMENTS:

6 — 1.42
8 — 1.57
10 — 1.50
12 — 1.58

Isolated "dead"

18.0 — CO_2 5.2
18.4 — 5.4
17.4 — 4.7
5.4

(18.5)

APPENDIX 6

VISIBLE EMISSION DATA

APPENDIX 7

CALIBRATION DATA

Gilbert/Commonwealth Inc.
Testing Services Group
METER BOX CALIBRATION

DATE: 5/11/88 METER BOX NUMBER: 1933

BAROMETRIC PRESS. (Pb) = 29.60 in. Hg CALIBRATED BY: Burger

Orifice Manometer Setting (delta H) in. H2O	GAS VOLUME Wet Test Meter (Vw) cu. ft.	Dry Gas Meter (Vd) cu. ft.	TEMPERATURES Wet Test Meter (Tw) deg. F	Dry Gas Meter Inlet (Tdi) deg. F	Outlet (Tdo) deg. F	Average (Td) deg. F	Time min.	Yi	delta H
0.5	5.000	5.135	71	78	75	76.5	12.83	0.98	1.
1.0	5.000	5.102	71	86	78	82.0	9.37	0.98	1.
1.5	10.250	10.759	71	94	84	89.0	16.23	0.98	2.
2.0	10.250	10.783	71	100	90	95.0	14.22	0.99	2.
3.0	10.000	10.543	71	104	93	98.5	11.57	0.99	2.
4.0	10.500	11.068	71	108	95	101.5	10.48	0.99	2.
							AVERAGE Yi	0.99	

FORMULAS

$$Yi = \frac{(Vw)(Pb)(Td+460)}{(Vd)(Pb+(H/13.6))(Tw+460)}$$

$$\text{delta H@i} = \frac{0.921}{(Km)(Km)}$$

$$Km = Qm \sqrt{\frac{(Pb)(29)}{(Tdm+460)(\text{delta H})}}$$

METER BOX CALIBRATION

Date 7/8/08 Meter box number 1923

Barometric pressure, P_b = 30.10 in Hg Calibrated by [illegible]

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft³	Gas volume: Dry gas meter (V_d), ft³	Temperatures: Wet test meter (t_w), °F	Temperatures: Dry gas meter: Inlet (t_{d_i}), °F	Temperatures: Dry gas meter: Outlet (t_{d_o}), °F	Temperatures: Dry gas meter: Avg[a] (t_d), °F	Time (θ), min	Y_i	$\Delta H@_i$
0.5	5.0	5.086	90.	90.	88.	89	12.62	1.0	1.79
1.0	5.50	5.599		94.	89	91.5	10.57	1.0	1.99
1.5	10.0	10.135		98.	90.	94.	15.37	1.01	1.03
2.0	10.0	10.191		101.	91	96.	13.52	1.01	2.10
3.0	10.50	10.722		103.	93	98	11.87	1.0	3.17
4.0	10.0	10.209		104.	93	98.5	9.93	1.0	3.59

Avg 1.00

$$H \qquad \frac{H}{13.6} \qquad Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{H}{13.6}\right)(t_w + 460)}$$

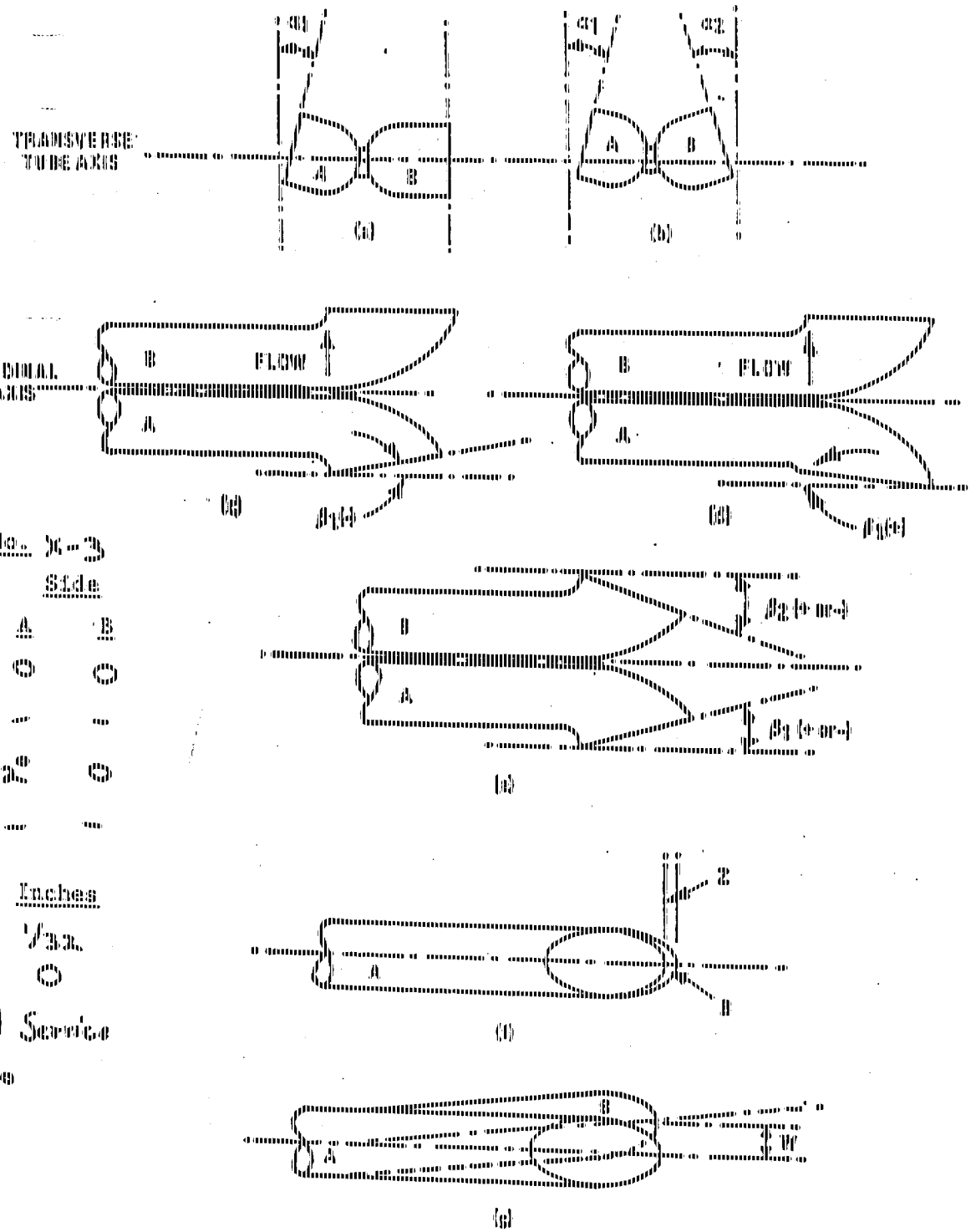
0.5	0.04	$Y_i = \frac{(5.0)(30.10)(549)}{(5.086)(30.09)(590)} = 1.00$
1.0	0.07	$Y_i = \frac{(5.5)(30.10)(554.5)}{(5.599)(30.09)(590)} = 1.00$
1.5	0.11	$Y_i = \frac{(10.0)(30.10)(559)}{(10.135)(30.09)(590)} = 1.01$
2.0	0.15	$Y_i = \frac{(10.0)(30.10)(556)}{(10.191)(30.09)(590)} = 1.01$
3.0	0.22	$Y_i = \frac{(10.5)(30.10)(558)}{(10.722)(30.09)(590)} = 1.00$
4.0	0.29	$Y_i = \frac{10.0 \times 30.10 \times 558.5}{10.209 \times 30.09 \times 590} = 1.00$

GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS READING, PA.	CLIENT / PROJECT	FILING CODE / NO. / PAGE / OF
SYSTEM		BOOKER 4-2864 DATE 2-8-80
CALCULATION: AH 8-1-1923		CHECKED BY RGW DATE

AH	$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$	$K = Q \sqrt{\frac{P}{A}}$	$AH = \frac{Q^2}{(K)^2}$	
0.5	$Q = \frac{5.06}{.62}\left(\frac{59}{59}\right) = .82$	$K = .82\sqrt{\frac{30.1}{59}}\left(\frac{.89}{.68}\right) = .78$	$AH = \frac{.82^2}{(.78)^2}$	$= 1.29$
1.0	$Q = \frac{5.29}{1.35}\left(\frac{59}{55.5}\right) = .51$	$K = .51\sqrt{\frac{30.1}{59}}\left(\frac{.89}{.68}\right) = .60$	$AH = \frac{.51^2}{(.60)^2}$	$= 1.29$
1.5	$Q = \frac{10.35}{0.37}\left(\frac{59}{55.8}\right) = .65$	$K = .65\sqrt{\frac{30.1}{56}}\left(\frac{.89}{.68}\right) = .77$	$AH = \frac{.65^2}{(.77)^2}$	$= 2.03$
2.0	$Q = \frac{10.47}{1.57}\left(\frac{55.1}{55.6}\right) = .79$	$K = .79\sqrt{\frac{30.1}{55.1}}\left(\frac{.89}{.68}\right) = .62$	$AH = \frac{.79^2}{(.62)^2}$	$= 2.10$
3.0	$Q = \frac{10.72}{1.85}\left(\frac{55.1}{56.0}\right) = .92$	$K = .92\sqrt{\frac{30.1}{55.1}}\left(\frac{.89}{.68}\right) = .65$	$AH = \frac{.92^2}{(.65)^2}$	$= 2.12$
4.0	$Q = \frac{10.84}{2.13}\left(\frac{55.1}{55.5}\right) = 1.02$	$K = 1.02\sqrt{\frac{30.1}{55.1}}\left(\frac{.89}{.68}\right) = .69$	$AH = \frac{1.02^2}{(.69)^2}$	$= 2.24$

GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS READING, PA.	CLIENT: Industrial PSU Service	FILING CODE: 1-0-0SA-000
	PROJECT: Apple Butt Plant	W.O. / PAGE: 3E
SYSTEM:		ENGINEER:
		DATE: 8/30/89
SUBSYSTEM/TYPE: Pot Meter-Thermocouple Calibration		REVIEWED BY:
		DATE:

Pot Meter #	8
Thermocouple Type	K
Ice Bath Temperature °F	33.9
Certified Mercury Bulb °F	32
Ambient Temperature °F	73.4
Certified Mercury Bulb °F	72
Boiling H_2O °F	
Certified Mercury Bulb °F	
Hot Synthetic Oil °F	393.9
Certified Mercury Bulb °F	394
Remarks:	



Pitot No. X-3

Reference	Side A	Side B
A_1	0	0
A_2	—	—
B_1	0	0
B_2	—	—

Reference	Inches
z	1/32
w	0

Intertechnical Mfg Service

10-0661-009

9/03/00

Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of $C_p(s)$ so long as α_1 and $\alpha_2 < 10°$, β_1 and $\beta_2 < 5°$, $z < 0.32$ cm (1/8 in.) and $w < 0.08$ cm (1/32 in.) (citation 11 in Section 6).

APPENDIX 8

COMPUTER PRINTOUT

(FLUE GAS CHARACTERISTICS, ISOKINETIC CALCULATIONS,

AND TEST RESULTS FOR PARTICULATE EMISSIONS)

ISOKINETIC SAMPLING ANALYSIS

PROGRAM - 1005

CLIENT NAME - INTERNATIONAL MILL SERVICE

PLANT LOCATION - COATESVILLE PA

PROCESS - ASPHALT BATCH PLANT

CONTROL EQUIPMT - BAGHOUSE

SAMPLING POINT- EXHAUST STACK

POLLUTANTS - PARTICULATE

GILBERT ASSOCIATES, INC.
READING, PENNA.
100621000 07/13/88

RESULTS OF FLOW AND ISOKINETIC CALCULATIONS -

RUN NUMBER -			IMS-1	IMS-2	IMS-3
DATE OF RUN -			5-26-88	5-26-88	5-27-88
TIME AT BEGINNING OF RUN			918.0	1206.0	931.0
TIME AT END OF RUN			1113.0	1409.0	14.0
DN	SAMPLING NOZZLE DIAMETER	IN.	0.250	0.250	0.250
Y	DRY GAS METER FACTOR	-	0.998	0.998	0.998
PB	BAROMETRIC PRESSURE	IN. HG. ABS.	29.34	29.20	29.54
TT	NET TIME OF TEST	MIN.	72.0	84.0	84.0
VM	SAMPLED GAS VOLUME	CU. FT.	58.777	63.814	63.484
TM	AVG. GAS METER TEMPERATURE	DEGR. F.	66.	74.	82.
PM	AVG. ORIFICE PRESSURE DROP	IN. H2O	1.87	2.11	2.58
VMSTD	VOLUME OF DRY GAS SAMPLED	DSCF	49.788	60.597	60.262
VW	H2O FROM IMPINGER, SILICA GEL	ML	262.0	225.0	275.0
VWGAS	H2O COLLECTED AT STD.COND.	STD. CU. FT.	9.514	10.597	12.952
M	STACK GAS MOISTURE BY VOLUME	PERCENT	16.1	14.9	17.5
	CO2 IN DRY STACK GASES	PERCENT	2.9	2.7	0.8
	O2 IN DRY STACK GASES	PERCENT	16.2	16.5	15.3
	CO IN DRY STACK GASES	PERCENT	0.0	0.0	0.0
	N2 IN DRY STACK GASES	PERCENT	80.9	80.8	79.9
MD	MOL FRACTION OF DRY GAS	-	0.84	0.85	0.82
MWD	MOL WGT. OF STACK GAS, DRY	-	29.11	29.09	27.58
EA	EXCESS AIR	PERCENT	314.1	341.5	264.1
MW	MOL WGT. OF STACK GAS, WET	-	27.33	27.44	27.38
AS	STACK AREA	SQ. IN.	1617.0	1617.0	1617.0
PST	STATIC PRESSURE OF STACK GAS	IN. HG.	-0.01	-0.02	-0.03
PS	STACK GAS PRESSURE	IN. HG. ABS.	29.33	29.18	29.51
TS	AVG. STACK TEMPERATURE	DEGR. F.	219.	230.	242.
CP	PITOT TUBE COEFFICIENT	-	0.840	0.840	0.840
VS	STACK GAS VELOC., STACK COND.	APFM	3150.	3320.	3575.
QS	STACK GAS VOL., DRY STD. COND.	DSCFM	22721.	24131.	24638.
QA	STACK GAS VOLUME, STACK COND.	ACFM	35371.	37282.	40157.
I	ISOKINETIC RATIO	PERCENT	99.8	98.1	96.6

GRAIN LOADING AND EMISSION CALCULATIONS -

RUN NUMBER -		IM3-1	IM3-2	IM3-3
DATE OF RUN -		5-26-88	5-26-88	5-27-88
PROBE AND CYCLONE	MILLIGRAMS	25.90	30.90	17.80
	GRAINS/ACF	0.0051	0.0061	0.0020
	GRAINS/SCF	0.0080	0.0079	0.0043
	LB/HR - CONC	1.56	1.65	0.95
	LB/HR - AREA	1.57	1.68	0.92
	LB/HR - AVG	1.56	1.61	0.94
FILTER	MILLIGRAMS	3.00	1.00	3.30
TOTAL - ABOVE ITEMS	MILLIGRAMS	28.90	31.90	21.10
	GRAINS/ACF	0.0057	0.0062	0.0033
	GRAINS/SCF	0.0090	0.0081	0.0055
	LB/HR - CONC	1.74	1.66	1.13
	LB/HR - AREA	1.76	1.65	1.09
	LB/HR - AVG	1.75	1.67	1.11
TOTAL - INCL. IMPINGER CATCH	MILLIGRAMS	69.40	49.60	38.00
	GRAINS/ACF	0.0138	0.0067	0.0059
	GRAINS/SCF	0.0215	0.0109	0.0081
	LB/HR - CONC	4.19	2.14	1.71
	LB/HR - AREA	4.19	2.16	1.64
	LB/HR - AVG	4.19	2.12	1.68

LISTING OF FIELD DATA AND RESULTS AT EACH POINT

POINT NO.	POINT DISTANCE (IN)	CLOCK TIME	TIME INCREMT (MINS)	DRY GAS METER (CF)	ORIFICE DELTA H (IN. H2O)	GAS TEMPERATURES IN (DEGREES F)	GAS TEMPERATURES OUT (DEGREES F)	VELOCITY HEAD (IN. H2O)	STACK PRESS (IN. H2O)	STACK TEMP (DEGR. F)	(VEL. HD.)X (STACK TEMP.) (IN. H2O-DEG R)	SQR ROOT OF PREVIOUS RESULT	STACK GAS VEL (AFPM)
RUN NO. -	INS-1												
P-1	0.0	912.0	0.0	478.651	2.50	68.0	58.0	0.910	-0.15	222.0	620.62	24.91	3792.0
P-2	0.0	915.0	3.0	481.300	3.30	62.0	58.0	1.200	-0.15	224.0	820.80	28.65	4368.9
P-3	0.0	918.0	6.0	483.700	3.20	64.0	58.0	1.150	-0.15	223.0	785.45	28.03	4265.7
P-4	0.0	921.0	9.0	486.000	2.52	66.0	59.0	0.920	-0.15	217.0	622.84	24.96	3798.8
STOP		924.0	12.0	488.854									
E-1	0.0	927.0	0.0	489.856	1.97	65.0	60.0	0.700	-0.15	209.0	468.30	21.64	3293.9
E-2	0.0	930.0	3.0	491.400	2.88	67.0	60.0	1.050	-0.15	211.0	704.55	26.54	4040.3
E-3	0.0	933.0	6.0	493.000	2.70	70.0	62.0	0.960	-0.15	210.0	641.84	25.33	3856.2
E-4	0.0	936.0	9.0	0.0	2.40	70.0	62.0	0.900	-0.15	217.0	609.30	24.68	3757.2
STOP		939.0	12.0	498.929									
D-1	0.0	942.0	0.0	498.929	1.65	69.0	64.0	0.590	-0.15	220.0	481.20	20.93	3048.8
D-2	0.0	945.0	3.0	501.200	2.12	70.0	65.0	0.770	-0.15	223.0	525.91	22.93	3478.7
D-3	0.0	948.0	6.0	503.400	1.57	70.0	66.0	0.560	-0.15	224.0	383.04	19.57	2979.0
D-4	0.0	951.0	9.0	505.600	1.80	66.0	65.0	0.640	-0.15	218.0	441.84	21.47	3268.3
STOP		954.0	12.0	507.579									
C-1	0.0	1032.0	0.0	507.579	1.45	67.0	65.0	0.520	-0.15	217.0	352.84	18.76	2855.0
C-2	0.0	1035.0	3.0	509.500	1.52	68.0	65.0	0.550	-0.15	220.0	374.88	19.34	2943.7
C-3	0.0	1038.0	6.0	511.200	1.35	69.0	65.0	0.480	-0.15	222.0	327.36	18.09	2754.0
C-4	0.0	1041.0	9.0	513.400	1.50	70.0	65.0	0.540	-0.15	218.0	366.12	19.13	2912.5
STOP		1044.0	12.0	515.378									
B-1	0.0	1044.0	0.0	515.378	1.12	69.0	64.0	0.400	-0.15	219.0	268.80	16.37	2491.8
B-2	0.0	1049.0	3.0	517.200	1.12	70.0	67.0	0.400	-0.15	212.0	268.80	16.40	2490.6
B-3	0.0	1052.0	6.0	518.900	0.95	70.0	67.0	0.340	-0.15	216.0	229.84	15.16	2307.6
B-4	0.0	1055.0	9.0	521.200	1.92	73.0	68.0	1.400	-0.15	217.0	947.80	30.79	4686.1
STOP		1058.0	12.0	523.478									
A-1	0.0	1101.0	0.0	523.478	0.51	71.0	69.0	0.180	-0.15	218.0	122.04	11.05	1681.5
A-2	0.0	1104.0	3.0	524.700	0.56	70.0	68.0	0.200	-0.15	220.0	134.00	11.58	1775.1
A-3	0.0	1107.0	6.0	526.200	0.90	71.0	67.0	0.320	-0.15	227.0	219.04	14.80	2256.9
A-4	0.0	1110.0	9.0	527.800	1.06	71.0	68.0	0.380	-0.15	228.0	261.44	16.17	2461.2
STOP		1113.0	12.0	529.488									

LISTING OF FIELD DATA AND RESULTS AT EACH POINT

POINT NO.	POINT DISTANCE (IN)	CLOCK TIME	TIME INCRMT (MINS)	DRY GAS METER (CF)	ORIFICE DELTA H (IN. H2O)	GAS TEMPERATURES IN (DEGREES F)	GAS TEMPERATURES OUT (DEGREES F)	VELOCITY HEAD (IN. H2O)	STACK PRESS (IN. H2O)	STACK TEMP (DEGR. F)	(VEL. HD.)X (STACK TEMP.) (IN. H2O-DEG R)	SQR ROOT OF PREVIOUS RESULT	STACK GAS VEL (AFPM)
RUN NO. -	IMS-2												
A-1	0.0	1204.0	0.0	535.228	1.13	70.0	67.0	0.400	-0.26	215.0	270.00	16.43	2502.3
A-2	0.0	1207.5	3.5	0.0	1.19	71.0	68.0	0.420	-0.26	217.0	284.34	16.86	2567.9
A-3	0.0	1211.0	7.0	537.400	0.88	72.0	68.0	0.310	-0.26	219.0	218.49	14.81	2209.4
A-4	0.0	1214.5	10.5	539.300	0.71	73.0	69.0	0.250	-0.26	221.0	176.25	13.05	1987.0
STOP		1218.0	14.0	540.797									
B-1	0.0	1239.0	0.0	540.797	1.13	70.0	68.0	0.400	-0.26	211.0	268.40	16.38	2475.9
B-2	0.0	1242.5	3.5	543.800	0.96	71.0	69.0	0.340	-0.26	213.0	228.82	15.13	2303.6
B-3	0.0	1246.0	7.0	544.700	0.98	72.0	69.0	0.350	-0.26	209.0	234.15	15.30	2338.3
B-4	0.0	1249.5	10.5	546.700	1.11	74.0	69.0	0.390	-0.26	205.0	259.35	16.10	2452.4
STOP		1253.0	14.0	548.720									
C-1	0.0	1255.0	0.0	548.720	1.55	74.0	70.0	0.550	-0.26	201.0	303.55	17.07	2983.6
C-2	0.0	1258.5	3.5	551.200	1.38	74.0	70.0	0.490	-0.26	203.0	324.27	18.02	2744.6
C-3	0.0	1262.0	7.0	553.400	1.55	76.0	71.0	0.550	-0.26	202.0	364.10	19.08	2985.8
C-4	0.0	1265.5	10.5	555.300	1.37	78.0	71.0	0.860	-0.26	198.0	368.48	19.20	2923.2
STOP		1269.0	14.0	558.110									
D-1	0.0	1319.0	0.0	558.110	1.47	74.0	72.0	0.520	-0.26	230.0	358.88	18.94	2884.6
D-2	0.0	1322.5	3.5	560.700	2.10	75.0	72.0	0.740	-0.26	224.0	513.56	22.66	3451.8
D-3	0.0	1326.0	7.0	563.000	2.58	77.0	73.0	0.920	-0.26	224.0	629.28	25.09	3820.1
D-4	0.0	1329.5	10.5	566.400	3.28	80.0	73.0	1.150	-0.26	223.0	785.45	28.03	4267.9
STOP		1333.0	14.0	569.364									
E-1	0.0	1359.0	0.0	569.364	1.98	77.0	75.0	0.700	-0.26	226.0	488.28	21.91	3337.1
E-2	0.0	1362.5	3.5	572.400	3.85	78.0	74.0	1.350	-0.26	229.0	930.15	30.50	4644.4
E-3	0.0	1366.0	7.0	576.000	4.08	80.0	74.0	1.430	-0.26	243.0	1019.35	31.93	4862.0
E-4	0.0	1369.5	10.5	579.500	3.98	82.0	74.0	1.400	-0.26	240.0	980.00	31.30	4767.3
STOP		1373.0	14.0	582.795									
F-1	0.0	1393.0	0.0	582.795	3.18	80.0	74.0	1.100	-0.26	221.0	749.10	27.37	4168.9
F-2	0.0	1396.5	3.5	586.300	3.65	82.0	75.0	1.350	-0.26	223.0	922.05	30.37	4624.2
F-3	0.0	1402.0	7.0	589.900	2.62	83.0	75.0	0.900	-0.26	227.0	673.26	25.95	3951.4
F-4	0.0	1405.5	10.5	592.700	3.75	84.0	76.0	1.300	-0.26	237.0	906.10	30.10	4584.8
STOP		1409.0	14.0	596.242									

POINT NO.	POINT DISTANCE (IN)	CLOCK TIME	TIME INCRMT (MINS)	DRY GAS METER (CF)	ORIFICE DELTA H (IN. H2O)	GAS TEMPERATURES IN (DEGREES F)	GAS TEMPERATURES OUT (DEGREES F)	VELOCITY HEAD (IN. H2O)	STACK PRESS (IN. H2O)	STACK TEMP (DEGR. F)	(VEL. HD.)X (STACK TEMP.) (IN. H2O-DEG R)	SQR ROOT OF PREVIOUS RESULT	STACK GAS VEL (AFPM)
			TT	VM	PM	TM			PST	TS			
OVERALL RESULTS			84.0 (MET)	63.919 (MET)	2.11 (AVG)	73.8 (AVG)		0.769 (AVG)	-0.26 (AVG)	319.4 (AVG)	312.25 (AVG)	21.88 (AVG)	3320.3 (AVG)

POINT NO.	POINT DISTANCE (IN)	CLOCK TIME	TIME INCRMT (MINS)	DRY GAS METER (CF)	ORIFICE DELTA H (IN. H2O)	GAS TEMPERATURES IN (DEGREES F)	GAS TEMPERATURES OUT (DEGREES F)	VELOCITY HEAD (IN. H2O)	STACK PRESS (IN. H2O)	STACK TEMP (DEGR. F)	(VEL. HD.)X (STACK TEMP.) (IN. H2O-DEG R)	SQR ROOT OF PREVIOUS RESULT	STACK GAS VEL (APPM)
			TT	VM	PM	TM			PST	TS			
OVERALL RESULTS			84.0 (NET)	63.484 (NET)	2.36 (AVG)	81.6 (AVG)		0.572 (AVG)	-0.43 (AVG)	242.1 (AVG)	618.84 (AVG)	23.58 (AVG)	3574.6 (AVG)

APPENDIX 9

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Particulate Isokinetic Sampling

I. Calculations for stack volume and Isokinetic Ratio

Time	Dry Gas Meter Ft^3	Pitot ΔP, In. H_2O	Orifice ΔH, In. H_2O	Dry Gas Temp °F In	Dry Gas Temp °F Out	Stack Static Pressure In. H_2O	Stack Temp °F
T	VM	ΔP	PM	TMI	TMO	PST	TS

1. DN = Nozzle Diameter, inches

2. PB = Barometric Pressure, inches Hg

3. TT = Net Sampling Time, minutes

4. VM = VM final - VM initial = Sample Gas Volume, Ft^3

5. TM = Average Dry Gas Temperature at Meter, °F

$$TM = \frac{\text{Avg. TMI} + \text{Avg. TMO}}{2}$$

6. PM = Average Orifice Pressure Drop, inches H_2O

$$PM = \text{Avg. } \Delta H$$

7. Volume of dry gas sampled at standard conditions[a], DSCF

$$VMSTD = \frac{17.65 \times VM \times Y \left(BP + \frac{PM}{13.6}\right)}{(TM + 460)}$$

8. VW = Total Water Collected = gm H_2O Silica gel + ml Imp. H_2O = ml

9. Volume of water vapor at standard conditions[b], SCF

$$VW \text{ gas} = 0.0471 \times VW = SCF$$

10. Percent moisture in stack gas

$$\% M = \frac{100 \times VW \text{ gas}}{VM \text{ STD} + VW \text{ gas}}$$

11. Mole fraction of dry gas

$$MD = \frac{100 - \%M}{100}$$

12. Molecular weight of dry stack gas

$$MWD = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + \left[(\%CO + \%N_2) \times \frac{28}{100} \right]$$

12A. $XEA = \%\ Excess\ Air = \frac{[(\%\ O_2) - 0.5\ (\%CO)]}{0.264\ (\%N_2) - [(\%O_2) + 0.5\%\ (CO)]} \times 100$

13. Molecular weight of wet stack gas

$$MW = MWD \times MD + 18\ (1 - MD)$$

14. AS = Stack Area, square inches

15. PS = Stack Pressure, inches Hg

$$PS = PB \pm Avg.\ PST$$

$$NOTE:\ PST\ in.\ Hg. = \frac{PST\ in.\ H_2O}{13.6}$$

16. TS = Average Stack Temperature, °F

TS = Average TS

17. SDE = Average $\sqrt{\text{Velocity Head } (\Delta P) \times (\text{Stack Temperature} + 460)}$

(Calculated each time)

$$SDE = Avg\ \sqrt{\Delta P \times (TS + 460)}$$

18. Stack gas velocity at stack conditions, fpm

$$VS = 5130 \times Cp \times Avg(SDE) \times \left[\frac{1}{PS \times MW}\right]^{1/2} = FPM$$

Cp = pitot tube coefficient

19. Stack gas volumetric flow rate at standard conditions[c], DSCFM

$$Q_s = \frac{0.123 \times VS \times AS \times MD \times PS}{(TS + 460)} = DSCFM$$

20. Stack gas volumetric flow rate at stack conditions, ACFM

$$Q_a = \frac{.05667 \times QS\ (TS + 460)}{PS \times MD} = ACFM$$

21. Percent isokinetic

$$\%I = \frac{1.032 \times (TS + 460) \times VMSTD}{VS \times TT \times PS \times MD \times (DN)^2}$$

NOTES: [a]Dry standard cubic feet at 69°F, 29.92 in. Hg.

[b]Standard conditions at 68°F, 29.92 in. Hg.

[c]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

II. Calculations for grain loading and emission rates

22. Particulate, gr/DSCF

$$gr/DSCF = 0.0154 \times \frac{mg}{VMSTD}$$

23. Particulate at stack conditions, gr/ACF

$$gr/ACF = \frac{17.65\ gr/DSCF \times PS \times MD}{(TS + 460)}$$

24. Particulate, lb/hr conc. method

$$lb/hr = 0.00857 \times gr/DSCF \times QS$$

25. Particulate lb/hr area method $= 0.132 \times \frac{mm\ particulate \times AS}{\left(\frac{DN^2}{2}\right) \times TT}$

26. Particulate, combustion

$$\frac{lb/hr}{10^6\ BTU/hr}$$

27. Particulate, process lb/ton

$$lb/ton = \frac{lb/hr}{tons/hr}$$

28. Particulate, lb/MMBTU, F-Factor Method =

Using O_2 =

$$\frac{0.0154 \times mg \times F\text{-}Factor \times 20.9}{7000 \times VMSTD \times (20.9 - \%O_2)}$$

Using CO_2:

$$\frac{0.0154 \times mg \times F\text{-}Factor \times 100}{7000 \times VMSTD \times \%\ CO_2}$$

29. F-Factor, dscf/mmBtu

O_2 Format:

$$F\text{-}Factor = \frac{10^6(3.64(\%H) + 1.53(\%C) + 0.57(\%S) + 0.14(\%N) - 0.46(\%O_2))}{GCV}$$

CO_2 Format:

$$\frac{10^6(0.321)(\%C)}{GCV}$$