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.

Glasgow 39500201 5/22/89

105.22 ton/hr, 101.02 ton/hr., 91.36 ton/hr.

3.23 lb/hr., 2.99 , 3.17

(PM)

controlled - no eff. given - front & back total

.0317 lb/ton [A]

99.2 TPH

3.13 lb PM/hr.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

OCT 23 1989

SUBJECT: Stack Test Review of the Glasgow Company Plant #7 (Asphalt Plant)
Philadelphia, Pa.
CDS# 39-7160-01579
AFS 42-101-

FROM: Jim Gouvas 3ES-11
POS

TO: Susan Insetta, Chief 3AM-21
AEP&SC

THRU: Vic Guide, Chief 3ES-11 Vu
POS

A review of the stationary source stack sampling report titled "Source Emissions Compliance Test Report Asphaltic Aggregate Dryer Stack, Glasgow Company, Philadelphia, Pennsylvania June 1989" submitted by Roy F. Weston, Inc. (RFW) West Chester, Pa. has been completed.

The tests (EPA Method 5 & PaDER Back Half) was conducted on the Asphalt Plant Aggregate Dryer Stack May 22, 1989.

The Dryer Dryer Stack Particulate emissions are regulated by PaDER Regulation 123.13. The following is the EPA calculated Emission Standard by test run:

Run #	Measured Emission Rate (lb/hr)	Allowable Emission Rate (lb/hr)
#1	3.23	11.40
#2	2.99	11.20
#3	3.17	10.74

The Dryer Stack was in compliance with the PaDER emission standards for all test runs. (See the attachments for the emission rate compliance determination calculations)

I have reviewed the test report's field testing procedures, calculations, and quality assurance procedures. I have found them in agreement with procedures required by EPA/PaDER Test Methods. The calculations, as presented, appear to be correct and the test report acceptable in content. The attachments are comparisons of emission rate calculations made by the writer using the raw data from the report's field testing data sheets.

Attachments: 1. Emission Rate Calculation Comparisons (EPA vs RFW)
2. EPA-Emission Rate Compliance Determination Calculations

EMISSION RATE CALCULATION COMPARISONS

FACILITY	GLASGOW COMPANY
PLACE	PHILADELPHIA, PA
CIS#	39-7160-01579
DATE OF TEST	5-22-89

NSPS	NO
SIP SOURCE	YES
NESHAP	NO
AUDIT SAMPLE	NO
PASS/FAIL	N/A

TESTING LAB	ROY F WESTON, INC. (RFW)
ADDRESS	WEST CHESTER, PA
PHONE #	215-692-3030
PROJECT #	2373-01-02-0076

UNIT	ASPHALT AGGREGATE DRYER STACK
TEST METHOD	EPA METHOD 5 + PaDER BACK HALF
TEST DATA UNITS:	lb/hr

TESTING PARAMETER PARTICULATES

RUN NUMBER	1	2	3	2 AVERAGE
EPA	3.23	2.99	3.17	3.13
RFW	3.23	2.99	3.15	3.13

TESTING PARAMETER ISOKINETICS

RUN NUMBER	1	2	3
EPA	102.60	98.40	97.00
RFW	102.50	98.40	97.00

IN ACCEPTABLE RANGE (90-110%) YES

REGULATION PaDER 123.13

EMISSION STANDARD CALCULATION A=0.76E .42
E=F*W
F=PROCESS FACTOR IN LB UNIT
F=0
W=PRODUCTION OR THROUGHPUT RATE IN UNITS HR
RUN #1 W=113.13 TON/HR

EMISSION RATE CALCULATION COMPARISONS

	RUN #2 W=101 TON/HR
	RUN #3 W=81.4 TON/HR
EMISSION STANDARD BY RUN #	RUN #1 A= 11.40 LB/HR
	RUN #2 A= 11.20 LB/HR
	RUN #3 A= 10.74 LB/HR
COMPLIANCE STATUS BY RUN #	RUN #1-IN COMPLIANCE
	RUN #2-IN COMPLIANCE
	RUN #3-IN COMPLIANCE

• EPA EMISSION RATE CALCULATIONS

FACILITY	GLASGOW COMPANY ASPHALT PLANT #7
LOCATION	PHILADELPHIA, PA
COS#	39-7160-01579
REGULATION	PaDER 123.13
TEST METHOD	EPA METHOD 5 & PaDER BACK HALF
DATE OF TEST	5-22-89

RUN #		1	2	4
NET SAMPLING TIME, Theta	min.	72	72	36
NOZZLE DIAMETER	in.	0.231	0.236	0.236
PITOT TUBE COEFFICIENT, Cp		0.84	0.84	0.84
DGM CAL. FACTOR, Y		1.003	1.003	1.003
BAROMETRIC PRESSURE	in.Hg.	29.96	29.96	29.96
METERED VOLUME, Vm	cu.ft.	50.237	52.205	26.72
METERED VOLUME, Vm(std)	dscf	49.139	50.618	25.975
METER TEMPERATURE	degF	84	89	89
WATER IN IMPINGERS, Vlc	ml.	153.5	124	49
PARTICULATE COLLECTED, Mn	mg.	66.5	61.7	32.2
FORMALDEHYDE COLLECTED	mg.			
STACK TEMPERATURE	degF	203	196	211
STACK DIAMETER	ft.	3.168	3.168	3.168
STATIC PRESSURE	in.Hg.	-0.019	-0.024	-0.048
STACK AREA	sq.ft.	7.88	7.88	7.88
% OXYGEN	%	16.5	16.9	17
% CARBON DIOXIDE	%	2.5	2.1	1.1
% MOISTURE	%	12.82	10.34	8.16
Mwd	lb/mol	29.06	29.01	28.86
Mws	lb/mol	27.64	27.87	27.97
MEASURED btu INPUT	Mbtu/hr	ERR	ERR	ERR
AVERAGE dH	in.Hg	1.56	1.71	1.85
AVERAGE SQRT dH		0.854	0.853	0.878
F-FACTOR	dscf/Mbtu	ERR	ERR	ERR
% EXCESS AIR	%			
% ISOKINETIC	%	102.6	98.4	97.0
SOURCE OPERATION DATA				
TOTAL AGGERGATE-P.R.	ton/hr	105.23	101	91.4
	lb/hr	210460	202000	182800
FLOW RATES				
-DRY, STD CONDITIONS	dscfm	18034	18548	19305
	lb/hr	82968	85191	88190
-WET, ACTUAL CONDITIONS	acfm	25957	25688	26719
	lb/hr	90460	91237	93099
	fpm	3293	3259	3390
PARTICULATE EMISSION	gr/dscf	0.0209	0.0188	0.0191
	@12% CO2	0.1002	0.1075	0.2087

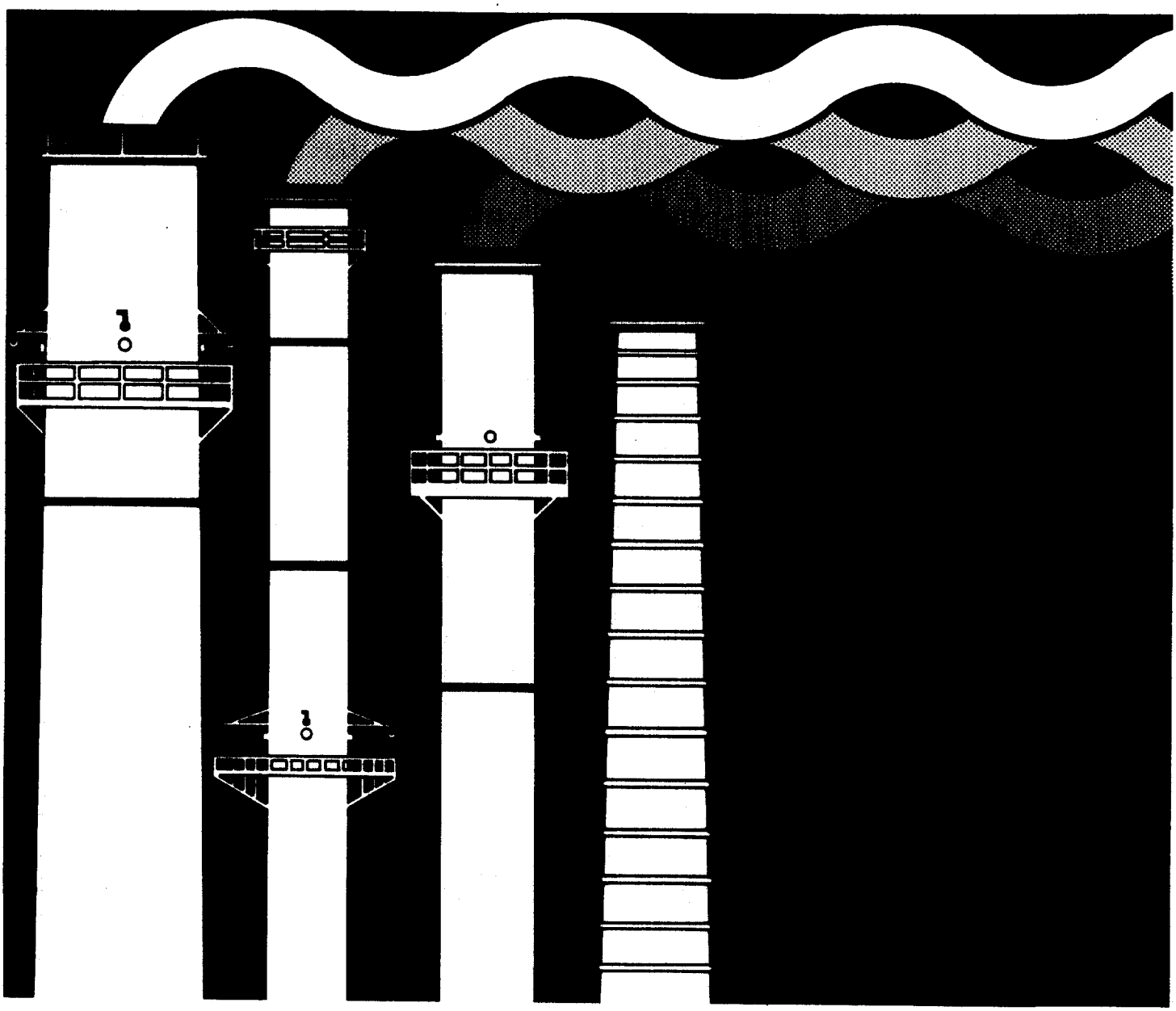
EPA EMISSION RATE CALCULATIONS

@ 7% O2	0.0650	0.0642	0.0669
lb/hr	3.2279	2.9902	3.1652

WESTON

DESIGNERS CONSULTANTS

215-692-3030



SOURCE EMISSIONS COMPLIANCE TEST REPORT

ASPHALTIC AGGREGATE DRYER STACK

GLASGOW COMPANY

Philadelphia, Pennsylvania

JUNE 1989

WESTON PROJECT NO. 2373-01-02-0076

J Neill

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1.0 SUMMARY

Glasgow Company contracted Roy F. Weston, Inc. (WESTON) to conduct a source testing and analysis program at its Philadelphia, Pennsylvania asphalt production facility. The primary objective of the program was to determine the particulate emissions compliance status of the Unit One asphalt aggregate dryer stack relative to the Pennsylvania Department of Environmental Resources (DER) allowable particulate emission limit for that source.

Testing procedures used during the survey conformed to U.S. Environmental Protection Agency (EPA) specifications modified as approved by the DER for application in Pennsylvania.

A summary of test results compared to the DER allowable emission concentration limits is presented in Table 1.

---

1 "Standards of Performance for New Stationary Sources," Code of Federal Regulations, Title 40, Part 60, Appendix A, Reference Methods.

2 "Source Testing Manual", Pennsylvania Department of Environmental Resources, Revision No. 1, January 1983.

GLASGOW COMPANY

PHILADELPHIA, PENNSYLVANIA

TABLE 1

SUMMARY OF PARTICULATE COMPLIANCE TEST RESULTS

ASPHALTIC AGGREGATE DRYER STACK

TEST NUMBER	TEST DATE	PERIOD	MEASURED CONCENTRATION GR/DSCF[1]	MASS EMISSION RATE MEASURED LB/HR	MASS EMISSION RATE PADER Allowable[2] LB/HR
One	5/22/89	0925 - 1043	0.021	3.23	11.40
Two	5/22/89	1200 - 1317	0.019	2.99	11.21
Three	5/22/89	1427 - 1503	0.019	3.16	10.74
Series Average	---	---	0.020	3.13	11.12

[1] gr/dscf = grains per dry standard cubic foot at standard conditions of 68°F and 29.92 inches mercury.

[2] Based on PADER Allowable Particulate Emission Rate Formula (PER), process charge rate (W) and process charge factor (F): $PER = 0.76E^{0.42}$; E = F X W, where, F = 6 lb/ton and W = 105.2, 101.0 and 91.4 tons/hr respectively.

2.0 INTRODUCTION

The Glasgow Company retained WESTON to conduct a source testing and analysis program at its Philadelphia, Pennsylvania asphalt production facility. The primary objective of the program was to determine the concentration and mass rate of particulate emissions from the Unit One aggregate dryer stack for comparison with the Pennsylvania Department of Environmental Resources (DER) allowable limit for that source.

WESTON's Air Quality Testing Services personnel performed the particulate emission testing on the dryer stack on May 22, 1989.

The particulate tests were performed according to EPA procedures, modified as approved by the DER for application in Pennsylvania.

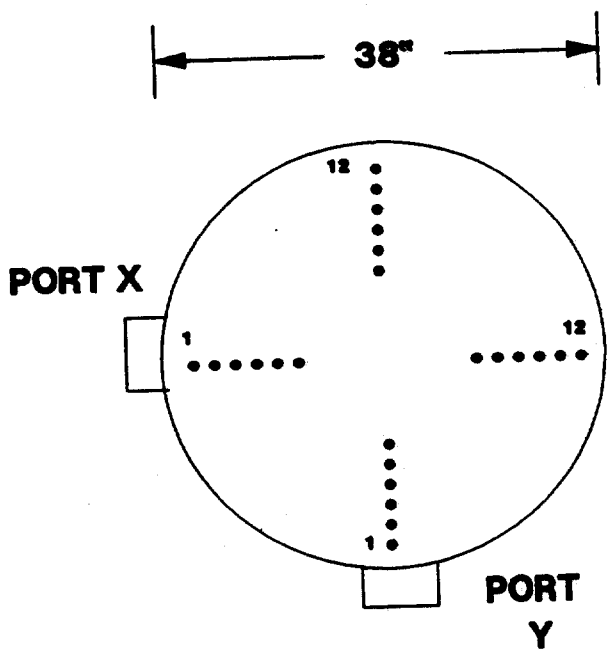
A summary of the compliance test results compared to DER allowable emission concentrations and mass emission rates are presented in Table 1 of Section 1. Detailed test data and results are presented in Table 2, Section 7, of this report. Descriptions of the test location, test equipment, test procedures, sample recovery techniques and analytical methods used during the survey are also included herein. Raw test data, laboratory reports, sample calculations, process operations data, equipment calibration records and a list of WESTON project participants are provided in Appendices A through F, respectively.

3.0 DESCRIPTION OF TEST LOCATION

Unit One Asphalt Aggregate Dryer Stack

Two 3-inch ID test ports, 90° apart, were installed in a straight section of the metal (38" ID) stack. The ports were placed > 4 diameters downstream from the ID fan discharge and > 1 diameter upstream from the stack discharge point. Twenty four traverse points (12 per port) were selected based on the minimum requirements of EPA Reference Method 1 to permit representative sampling at this test location. Figure 1 illustrates test port placement and traverse point locations.

GLASGOW COMPANY
PHILADELPHIA, PA



STACK CROSS-SECTIONAL VIEW

TRAVERSE POINT NUMBER	TRAVERSE POINT LOCATION (INCHES)
1	1.00
2	2.50
3	4.50
4	6.75
5	9.50
6	13.50
7	24.50
8	28.50
9	31.25
10	33.50
11	35.50
12	37.00

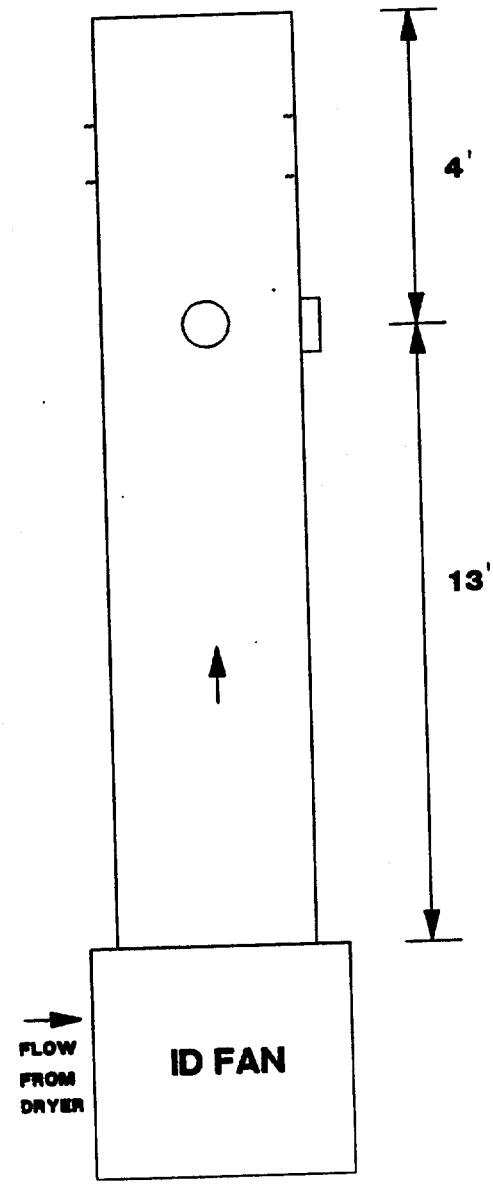


FIGURE 1
ASPHALTIC AGGREGATE DRYER
PORT AND TRAVERSE POINT LOCATIONS

4.0 DESCRIPTION OF SAMPLING TRAIN

Particulate

The sampling train utilized to perform the particulate sampling was an EPA Reference Method 5 train (see Figure 2).

A calibrated stainless steel nozzle was attached to a heated (~250°F) 4 ft. borosilicate probe. The probe was connected to a heated 250°F borosilicate filter holder containing a 9-cm Reeve Angel 934 AH glass fiber filter (preweighed to a constant 0.1 mg weight). The first and second impingers each contained 100 ml of distilled water, the third impinger was dry, and the fourth impinger contained 300 grams of dry preweighed silica gel. The second impinger was a standard Greenburg-Smith type; the first, third, and fourth were of a modified design. All impingers were maintained in a crushed ice bath. A Nutech control console with a leakless vacuum pump, a calibrated dry gas meter, a calibrated orifice, and inclined manometers were connected to the final impinger via an umbilical cord to complete the train.

Flue gas velocity was measured with a calibrated "S" type pitot tube (provided with extensions) fastened on the sampling probe. Flue gas temperature was monitored with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple positioned near the sampling nozzle. Filter box and impinger exit gas temperatures were monitored with a calibrated direct readout pyrometer equipped with chromel-alumel thermocouples positioned in the heated filter chamber and in the sample gas stream after the last impinger. Stack gas stream composition (carbon dioxide, oxygen, and carbon monoxide content) was determined utilizing an Orsat apparatus to analyze multi-point integrated samples of the flue gas for each test period.

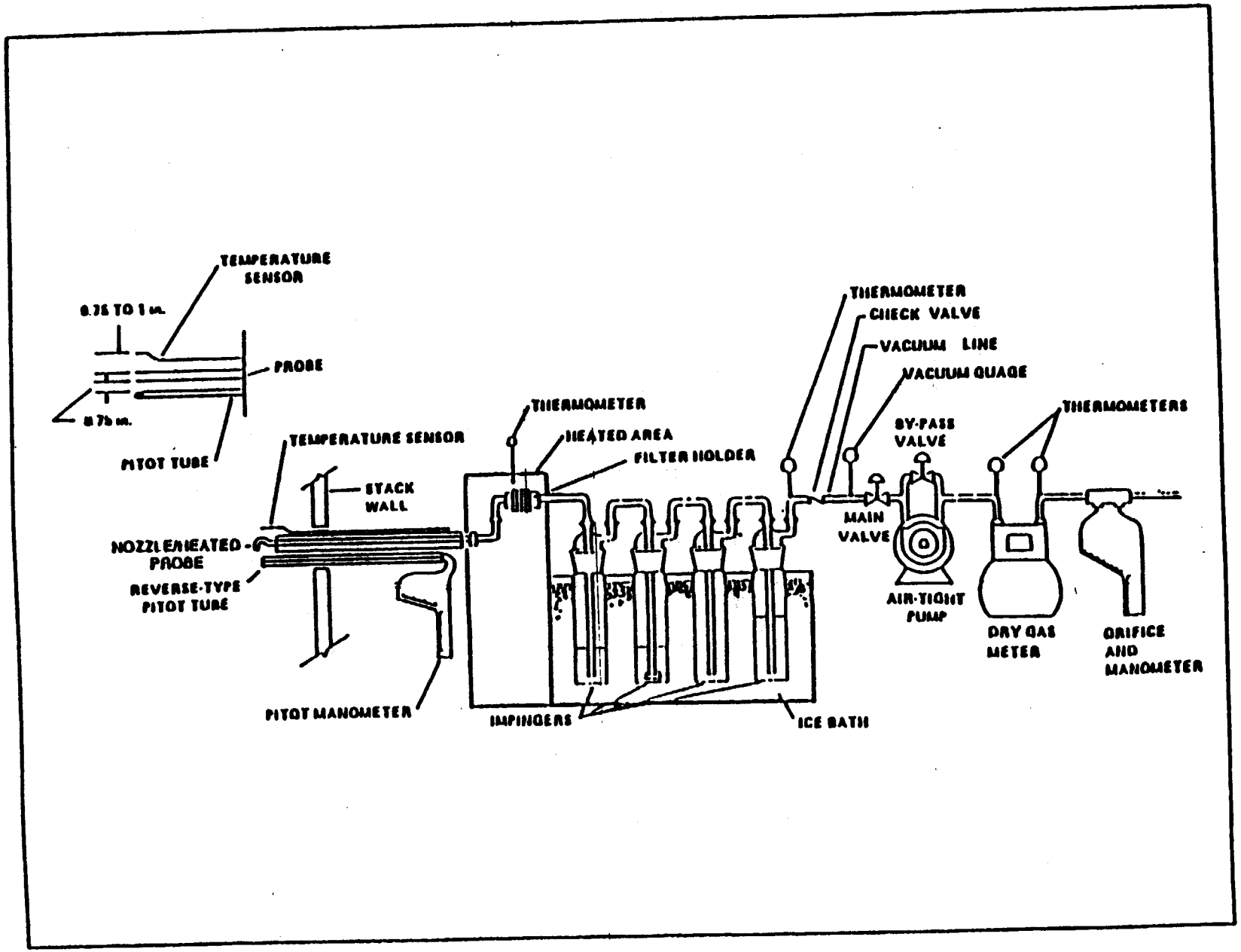


FIGURE 2 Particulate Sampling Train

EPA Reference Method 5

5.0 TEST PROCEDURES

5.1 PRELIMINARY TESTS

Preliminary test data was obtained at the stack sampling location. Stack geometry measurements were recorded, and traverse point distances calculated. A preliminary velocity traverse was performed at the location utilizing a calibrated "S"-type pitot tube and a Dwyer inclined manometer to determine velocity profiles. Flue gas temperatures were observed with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple. Water content was measured by conducting an EPA Reference Method 4 moisture test.

A check for the presence or absence of cyclonic flow was conducted at the test location prior to formal testing. The cyclonic flow check proved to be negative ($\bar{\alpha}$<20) thus verifying the suitability of the test site for obtaining representative samples.

Preliminary test data was used for nozzle sizing and nomagraph set-up for isokinetic sampling procedures. Calibration of probe nozzles, pitot tubes, metering systems, probe heaters, and temperature gauges was performed as specified in Section 5 of EPA Reference Method 5 test procedures (see Appendix D for calibration records).

5.2 FORMAL TESTS

A total of three particulate test runs were conducted on the stack during the test program.

Sampling for the first two tests consisted of twenty four traverse points, 12 per port axis. Readings were taken every two and one half minutes at each traverse point, resulting in a total test

length of 72 minutes. The third test was shortened due to the reduced production schedule. Only 12 traverse points were sampled along one axis for a test length of 36 minutes.

During particulate sampling, gas stream velocities were measured by inserting a calibrated "S"-type pitot tube into the stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each point, and the sampling rate was adjusted to maintain isokineticity. Flue gas temperatures were monitored at each point with the pyrometer and thermocouple. Multi-point integrated samples of the flue gas were collected during each test for Orsat analysis.

Temperature measurements were made at the filter holder chamber, the final impinger exit, and at the dry gas meter. Leak checks were performed as per EPA Reference Method 5 instructions prior to and after each run and/or port change.

6.0 ANALYTICAL PROCEDURES

Complete laboratory results are presented in Appendix B of this report.

6.1 PARTICULATE SAMPLE RECOVERY

At the conclusion of each test, the sampling train was dismantled, openings sealed, and the components transported to the field laboratory. Sample integrity was assured by maintaining chain-of-custody records.

A consistent procedure was employed for sample recovery as follows:

- The glass fiber filter(s) was removed from its holder with tweezers and placed in its original container (petri dish), along with any loose particulate and filter fragments (Sample 1).

- The probe and nozzle were separated and the particulate rinsed with distilled water into a borosilicate container with a teflon-lined closure while brushing a minimum of three times. Particulate adhering to the brush was rinsed with distilled water into the same container. The front-half of the filter holder and connecting glassware were rinsed with distilled water while brushing a minimum of three times. The rinses were combined (Sample 2).

- The sampling train components in the previous step were acetone rinsed and brushed in like manner and the particulate rinsed into a borosilicate container with a teflon-lined lid (Sample 3).

- The total liquid content of impingers one, two and three was measured volumetrically and the sample placed in a borosilicate container fitted with a teflon-lined closure (Sample 4). Also included in this sample was a distilled water rinse of the impingers and connectors.

- The components from the previous step were acetone washed and the sample was placed into a separate borosilicate container with a teflon-lined lid (Sample 5).

- The silica gel was removed from the last impinger and immediately weighed to the nearest 0.5 g.

- Samples of acetone and distilled water were retained for blank analysis.

Each sample bottle was level to clearly identify its contents. The height of the fluid was marked on each bottle. The samples were then placed in a locked shipping crate prior to transport to the WESTON laboratories.

6.2 PARTICULATE ANALYSIS

The particulate analysis proceeded as follows:

- The filters (Sample 1) and any loose fragments were desiccated for 24-hours and weighed to the nearest 0.1 milligram to a constant (± 0.5mg) weight.

- The front-half water and back-half impinger contents and water wash samples (Samples 2 and 4) were filtered separately using pre-weighed 0.22 micron membrane filters. The membrane filters were desiccated for 24 hours and weighed to the nearest 0.1 milligram to a

constant (± 0.5mg) weight. The resulting filtrates, along with a distilled water blank, were evaporated in an oven at 100°C in tared beakers, then desiccated to constant 0.1-mg weight.

- The front-half and back-half acetone wash samples (Samples 3 and 5, respectively) and an acetone blank were evaporated at ambient temperature and pressure in tared beakers, then desiccated to constant 0.1-mg weight.

The total weight of material measured in the front-half water-soluble, water-insoluble, and acetone-rinse fractions, plus the weight of material collected on the glass fiber filter, plus the back-half insoluble fraction represents the "total" Pennsylvania particulate catch for each train (see Table 2). Blank corrections were made where appropriate for all sample weights.

The back-half water soluble and acetone soluble catch fractions are reported, but the weights are not included in the emission calculations.

7.0 TEST RESULTS AND DISCUSSION

A summary of compliance test results is presented in Table 1, page 2 of this report. Detailed test data and test results summaries are included in Table 2 of this section.

The third test was shortened to only 12 traverse points along one axis for a total sampling time of 36 minutes. The test was shortened due to a limited amount of production needed on the day of testing. It should also be noted that during this third test there was a mechanical problem resulting in an interruption of production for approximately 8 minutes during sampling.

A representative of the City of Philadelphia Air Management Services Department was present to observe the testing.

All test data and test results shown herein are believed to be representative of process emissions encountered during the survey periods except for the process incongruities noted during the third test. No other process, sampling or analytical difficulties were noted during the test periods.

The average concentration measured during the program was 0.020 gr/dscf. The average particulate mass emission rate measured was 3.13 lbs/hr which was below the calculated average DER allowable limit of 11.12 lbs/hr.

GLASGOW COMPANY
PHILADELPHIA, PA

TABLE 2

SUMMARY OF PARTICULATE TEST DATA AND TEST RESULTS
ASPHALTIC AGGREGATE DRYER STACK

TEST DATA:			
Test run number	1	2	3
Test location	UNIT 1 DRYER STACK		
Test date	5-22-89	5-22-89	5-22-89
Test time period	0925-1043	1200-1317	1427-1503
SAMPLING DATA:			
Sampling duration, min.	72.0	72.0	36.0
Nozzle diameter, in.	0.231	0.236	0.236
Cross sectional nozzle area, sq.ft.	0.000291	0.000304	0.000304
Barometric pressure, in. Hg	29.96	29.96	29.96
Avg. orifice press. diff., in H2O	1.56	1.71	1.85
Avg. dry gas meter temp., deg F	84	89	89
Avg. abs. dry gas meter temp., deg. R	544	549	549
Total liquid collected by train, ml	153.5	124.0	49.0
Std. vol. of H2O vapor coll., cu.ft.	7.2	5.8	2.3
Dry gas meter calibration factor	1.003	1.003	1.003
Sample vol. at meter cond., dcf	50.237	52.205	26.780
Sample vol. at std. cond., dscf (1)	49.122	50.599	25.973
Percent of isokinetic sampling	102.5	98.4	97.0
GAS STREAM COMPOSITION DATA:			
CO2, % by volume, dry basis	2.5	2.1	1.1
O2, % by volume, dry basis	16.5	16.9	17.0
CO, % by volume, dry basis	0.0	0.0	0.0
N2, % by volume, dry basis	80.9	81.0	81.9
Molecular wt. of dry gas, lb/lb mole	29.07	29.02	28.86
H2O vapor in gas stream, prop. by vol.	0.128	0.103	0.082
Mole fraction of dry gas	0.872	0.897	0.918
Molecular wt. of wet gas, lb/lb mole	27.6	27.9	28.0
GAS STREAM VELOCITY AND VOLUMETRIC FLOW DATA:			
Static pressure, in. H2O	-0.26	-0.33	-0.65
Static pressure, in. Hg	-0.019	-0.024	-0.048
Absolute pressure, in. Hg	29.94	29.94	29.91
Avg. temperature, deg. F	203	196	211
Avg. absolute temperature, deg.R	663	656	671
Pitot tube coefficient	0.84	0.84	0.84
Total number of traverse points	24	24	12
Avg. gas stream velocity, ft./sec.	54.9	54.3	56.5
Stack/duct cross sectional area, sq.ft.	7.88	7.88	7.88
Avg. gas stream volumetric flow, wacf/min.	25900	25700	26700
Avg. gas stream volumetric flow, dscf/min.	18000	18500	19300
LABORATORY PARTICULATE REPORT:			
Frt-half acetone rinse, g	0.0050	0.0065	0.0040
Frt-half water sol., g	0.0073	0.0063	0.0066
Frt-half water insl., g	0.0206	0.0111	0.0050
Filter, g	0.0308	0.0366	0.0160
Back-half water insl., g	0.0028	0.0012	0.0006
Back-half water sol., g	0.0169	0.0238	0.0066
Back-half acetone rinse, g	0.0042	0.0028	0.0025
Total catch weight, g	0.0876	0.0883	0.0413
Total Pa. part. catch, g(2)	0.0665	0.0617	0.0322
PARTICULATE EMISSIONS:(3)			
Concentration, gr/dscf	0.021	0.019	0.019
Mass rate, lbs/hr	3.23	2.99	3.16
SOURCE OPERATIONS DATA			
Total aggregate, ton/hr	105.2	101.0	91.4
Total aggregate, lb/hr	210431	202036	182717

(1) Standard conditions = 68 deg. F. (20 deg. C.) and 29.92 inches Hg (760 mm Hg)
(2) Pennsylvania DER particulate catch does not include back-half water soluble and back-half acetone rinse catch fractions.
(3) Based on Pennsylvania catch weight

APPENDIX A

RAW TEST DATA

CLIENT: GLASGOW
FACILITY: PHILADELPHIA PA
TEST LOCATION: STACK
TEST RUN NO.: 1, 2, 3
TEST DATE: 5/22/84

ROY F. WESTON, INC.

EMISSION TEST DATA/REPORT
QA/QC CHECK LIST

	Initial Data Averages	Data Check 1	Data Check 2 (if req'd)	Data Completeness Check
Raw Test Data	SK	BS	JDO	✓
	Initial Lab Calculator	**Check 1**	**Check 2 (if req'd)**	**Data Completeness Check**
Laboratory Data	BS	PM		✓
	Initial Calculator	**Check 1**	**Check 2 (if req'd)**	**Reasonable-ness Check**
Test Result Calculations	SK	BS	JM	✓
	Author	**Check 1**	**Check 2 (if req'd)**	**Completeness Reasonable-ness Check**
Test Data Tables	BS	JM	JDO	✓
	Author	**Check 1**	**Check 2 (if req'd)**	**Table of Contents, Figure, page number Check**
Report Body	JM	JM	JDO	✓
	Originator	**Check 1**	**Check 2 (if req'd)**	
Appendices Completeness	JM	JDO	PMM	

Compilation Check: Page alignment and completeness

Draft Report (if required) _____

Final Report ✓

Date provided to Client: 6/16/89

Final Report Review:
PD BLS
PM BLS
SM/DM _____

etdr10.24

GLASGOW
Philadelphia, Pa.

Test Data	1	2	3
Run number	Unit 1 DRYER STACK		
Location			
Date	5-22-89	5-22-89	5-22-89
Time period	0925-1043	1200-1317	1427-1503
Operator	Mills/Marz	Mills/Marz	Mills/Marz
Inputs For Calcs.			
Sq. rt. delta P	0.853903	0.853040	0.878468
Delta H	1.55917	1.71417	1.85167
Stack temp. (deg.F)	202.71	196.25	211.00
Meter temp. (deg.F)	84.19	89.21	89.04
Sample volume (act.)	50.237	52.205	26.780
Barometric press. (in.Hg)	29.96	29.96	29.96
Volume H2O imp. (ml)	128.00	106.00	39.00
Weight chnge sil. gel (g)	25.50	18.00	10.00
% CO2	2.530	2.130	1.130
% O2	16.530	16.870	17.000
% CO	0.000	0.000	0.000
% N	80.940	81.000	81.870
Area of stack (sq.ft.)	7.88	7.88	7.88
Sample time (min.)	72.00	72.00	36.00
Static pressure (in.H2O)	-0.26	-0.33	-0.65
Nozzle dia. (in.)	0.231	0.236	0.236
Meter box cal.	1.0030	1.0030	1.0030
Cp of pitot tube	0.84	0.84	0.84
Laboratory Report Data			
Frt half acetone rinse, g	0.00500	0.00650	0.00400
Frt half water sol., g	0.00730	0.00630	0.00660
Frt half water insl., g	0.02060	0.01110	0.00500
Filter, g	0.03080	0.03660	0.01600
Back-half water insl., g	0.00280	0.00120	0.00060
Back-half water sol., g	0.01690	0.02380	0.00660
Back-half acetone., g	0.00420	0.00280	0.00250

5. Dry molecular weight of gas stream, lb/lb-mole.

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

$MW_d = (0.440 \times 2.53) + (0.320 \times 16.53) + (0.280 (80.94 + 0))$

$= 29.066$

Where:

MW_d	=	Dry molecular weight, lb/lb-mole.
$\%CO_2$	=	Percent carbon dioxide by volume, dry basis.
$\%O_2$	=	Percent oxygen by volume, dry basis.
$\%N_2$	=	Percent nitrogen by volume, dry basis.
%CO	=	Percent carbon monoxide by volume, dry basis.
0.440	=	Molecular weight of carbon dioxide, divided by 100.
0.320	=	Molecular weight of oxygen, divided by 100.
0.280	=	Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$MW_s = (MW_d \times M_d) + 18 (1 - M_d)$

$MW_s = 29.07 \times .872 + 18 (1 - .872)$

$= 27.65$

Where:

MW_s	=	Molecular weight of wet gas, lb/lb-mole.
18	=	Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$v_s = 85.49 \times C_p \times (\sqrt{\Delta p})\ avg. \times \left[\frac{T_s\ (avg)}{P_s \times MW_s}\right]^{\frac{1}{2}}$$

Where:

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, scf.

V_{wc} = Volume of liquid condensed in impingers, ml.

W_{wsg} = Weight of water vapor collected in silica gel, g.

0.04707 = Factor which includes the density of water (0.002201 lb/ml), the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) $(ft^3)/(lb\text{-}mole)(^oR)$; absolute temperature at standard conditions (528^oR), absolute pressure at standard conditions (29.92 in. Hg), ft^3/ml.

0.04715 = Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg)$(ft^3)/(lb\text{-}mole)(^oR)$, absolute temperature at standard conditions (528^oR), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content.

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

$$B_{ws} = \frac{7.23}{7.23 + 49.122} = 0.128 \text{ or } 12.8\%$$

Where:

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

4. Mole fraction of dry gas.

$$M_d = 1 - B_{ws}$$

$$M_d = 1 - 0.128 = 0.872$$

Where:

M_d = Mole fraction of dry gas, dimensionless

EPA METHOD 5

PARTICULATE SAMPLE CALCULATIONS

Client Glasgow

Plant Philadelphia

Test Run No. ONE

Test Date 5/22/89

Test Location Aggregate Dryer ONE

Test Period 0925-1043

1. Volume of dry gas sampled at standard conditions (68°F, 29.92 in. Hg), dscf.

$$V_{m(std)} = \frac{17.64 \times Y \times V_m \times (P_b + \frac{\overline{\Delta H}}{13.6})}{(\overline{T}_m + 460)}$$

$$V_{m(std)} = \frac{17.64 \times 1.003 \times 50.237 \times (29.96 + \frac{1.559}{13.6})}{(84.19 + 460)} = 49.122$$

Where:

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

V_m = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.

P_b = Barometric pressure, in. Hg.

$\overline{\Delta H}$ = Average pressure drop across the orifice meter, in. H_2O.

$\overline{T}_m$ = Average dry gas meter temperature, °F.

Y = Dry gas meter calibration factor.

17.64 = Factor that includes ratio of standard temperature (528°R) to standard pressure (29.92 in. Hg), °R/in. Hg.

13.6 = Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

$$V_{w(std)} = (0.04707 \times V_{wc}) + (0.04715 \times W_{wsg})$$

$$V_{w(std)} = (0.04707 \times 128) + (0.04715 \times 25.5) = 7.23$$

APPENDIX C

SAMPLE CALCULATIONS

0.22μ millipore filter

Stack #1

		TSVm		Tare wt.	final wt.	Δ wt
Run #1	FHW	426		0.0702	0.0908	0.0206
	BHW	495		0.0889	0.0917	0.0028
Run #2	FHW	470		0.0689	0.0800	0.0111
	BHW	495		0.0882	0.0894	0.012
Run #3	FHW	470		0.0694	0.0744	0.0050
	BHW	420		0.0884	0.0890	0.0006
H_2O Blank		275		0.0886	0.0886	0.0000

PARTICULATE SAMPLE ANALYSES

Analyst: Ken Date: 5-30-87

Plant: Glasgow Sampling Location: Stack #1 Run #: one

Test Date: 5-22-89 Test Period: Stack #: Process#:

8905L 425-

		Beaker #	Volume ml	Tare(1) grams	Tare(2) grams	Tare Avg.	Final(1) grams	Final(2) grams	Final Avg. grams	Δ wt. grams	Net wt. grams
005	FHA	S-8	3910	115.3275	115.3275	115.3275	115.3329	115.3329	115.3329	.0054	
008	FILTER, #	9600		.3916	.3918	.3917	.4226	.4226	.4226	.0309	
004	FHW	S-12	300	115.1035	115.1089	115.1087	115.1145	115.1147	115.1146	.0059	
	FH TOTAL										
006	BHW	S-14	300	116.8769	116.8769	116.8769	116.8877	116.8881	116.8879	.0110	
007	BHA	S-9	135	115.7296	115.7296	115.7296	115.7340	115.7340	115.7340	.0044	
	TOTAL										
	Comments										

Plant: Glasgow Sampling Location: Stack #1 Run #: Two

Test Date: 5-22-89 Test Period: Stack #: Process#:

ROY F. WESTON

		Beaker #	Volume ml	Tare(1) grams	Tare(2) grams	Tare Avg.	Final(1) grams	Final(2) grams	Final Avg. grams	Δ wt. grams	Net wt. grams
010	FHA	S-3	300	113.3790	113.3790	113.3790	113.3858	113.3858	113.3858	.0068	
013	FILTER, #	9642		.3928	.3930	.3929	.4297	.4295	.4296	.0367	
009	FHW	S-11	300	117.1841	117.1845	117.1843	117.1889	117.1893	117.1891	.0048	
	FH TOTAL										
011	BHW	S-10	300	118.4144	118.4144	118.4144	118.4296	118.4296	118.4296	.0152	
012	BHA	S-4	185	116.5312	116.5310	116.5311	116.5341	116.5341	116.5341	.0030	
	TOTAL										
	Comments										

Plant: Glasgow Sampling Location: Stack #1 Run #: Three

Test Date: 6-22-89 Test Period: Stack #: Process#:

		Beaker #	Volume ml	Tare(1) grams	Tare(2) grams	Tare Avg.	Final(1) grams	Final(2) grams	Final Avg. grams	Δ wt. grams	Net wt. grams
015	FHA	S-5	400	115.5221	115.5221	115.5221	115.5266	115.5266	115.5266	.0045	
018	FILTER, #	9674		.3881	.3881	.3881	.4044	.4040	.4042	.0161	
014	FHW	S-1	300	117.8472	117.8472	117.8472	117.8521	117.8523	117.8522	.0050	
	FH TOTAL										
016	BHW	S-13	300	115.5344	115.5344	115.5344	115.5399	115.5399	115.5399	.0055	
017	BHA	S-6	185	116.2070	116.2070	116.2070	116.2097	116.2097	116.2097	.0027	
	TOTAL										
	Comments										
003	ACETONE BLK	S-7	175	117.3067	117.3067	117.3067	117.3069	117.3069	117.3069	0.0002	
002	WATER BLK	S-15	275	116.9059	116.9059	116.9059	116.9066	116.9066	116.9066	0.0007	
001	Filter BLK	9703		.3647	.3648	.3647	.3649	.3649	.3649	0.0001	

CODE: FHA=Front half acetone wash BHW=Back half water (impinger contents + water wash) BHA=Back half acetone wash FH TOTAL=Front half catch weight TOTAL=Total train catch weight

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only
8905L425

Client: GLASGOW
Work Order: 2373-01-02
Date Rec'd.: 5/23/89 Date Due: 6-12-89
RFW Contact: Jack MILLS
Client Contact/Phone:

Refrigerator#											
#/Type Container											
Volume											
Preservative											
ANALYSES REQUESTED →	PA DOD PARTICULATE										

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected	PART								
014	014 Run 3 Front Half H2O	AIR	5/22/89	X								
015	015 Run 3 Front Half Acetone			X								
016	016 Run 3 Back Half H2O			X								
017	017 Run 3 Back Half Acetone			X								
018	018 Run 3 Filter #9674			X								

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
WI - Wipe
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time
5	Jack Mills	[illegible]	5/22/89	[illegible]					

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand Delivered
NOTES:
2 Ambient or Chilled
NOTES:
3 Received Broken/Leaking (Improperly Sealed) Y N
NOTES:
4 Properly Preserved Y N
NOTES:
5 Received Within Holding Times Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

RFW 21-21-001/A-7/88

7-115

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 06/09/89

CLIENT: GLASGOW
WORK ORDER: 2373-01-02-0000

WESTON BATCH #: 8905L425

SAMPLE	SITE ID	ANALYTE	RESULT	UNITS	REPORTING LIMIT
-001	BLNK FILT 97013	PARTICULATE	0.0001	grams	0.0000
-002	BLANK WATER	PARTICULATE	0.0007	grams	0.0000
-003	BLNK ACETONE	PARTICULATE	0.0002	grams	0.0000
-004	RUN 1 FRNT HALF H20	PARTICULATE	0.0059	grams	0.0000
-005	RUN 1 FRNT HALF ACET	PARTICULATE	0.0054	grams	0.0000
-006	RUN 1 BACK HALF H20	PARTICULATE	0.0110	grams	0.0000
-007	RUN 1 BACK HALF ACET	PARTICULATE	0.0044	grams	0.0000
-008	FILTER #9600 RUN1	PARTICULATE	0.0309	grams	0.0000
-009	RUN 2 FRNT HALF H20	PARTICULATE	0.0048	grams	0.0000
-010	RUN 2 FRNT HALF ACET	PARTICULATE	0.0068	grams	0.0000
-011	RUN 2 BACK HALF H20	PARTICULATE	0.0152	grams	0.0000
-012	RUN 2 BACK HALF ACET	PARTICULATE	0.0030	grams	0.0000
-013	FILTER #9642 RUN 2	PARTICULATE	0.0367	grams	0.0000
-014	RUN 3 FRNT HALF H20	PARTICULATE	0.0050	grams	0.0000
-015	RUN 3 FRNT HALF ACET	PARTICULATE	0.0045	grams	0.0000
-016	RUN 3 BACK HALF H20	PARTICULATE	0.0055	grams	0.0000
-017	RUN 3 BACK HALF ACET	PARTICULATE	0.0027	grams	0.0000
-018	RUN 3 FILTER #9674	PARTICULATE	0.0161	grams	0.0000

ROY F. WESTON, INC.

GLOSSARY OF TERMS - INORGANIC REPORTS

DATA QUALIFIERS

U - Indicates that the parameter was not detected at or above the reported limit. The associated numerical value is the sample detection limit.

* - Indicates that the original sample result is greater than 4x the spike amount added. The USEPA-CLP has determined that spike results on samples where this occurs may be unreliable and, therefore, the control limits are not applicable.

ABBREVIATIONS

MB - Method or preparation blank.
MS - Matrix Spike.
MSD - Matrix Spike Duplicate.
REP - Sample Replicate.
LC - Indicates a method LCS or Blank Spike.
NC - Not calculable, result below the detection limit.

LABORATORY CHRONOLOGY AND HOLDTIME REPORT

The test code listed indicates the specific analysis or preparation procedure employed. The codes may be interpreted as follows:

MAAW - Metals prep test for AA digestion, water matrix.
MAAS - Metals prep test for AA digestion, soil matrix.
MICW - Metals prep test for ICP digestion, water matrix.
MICS - Metals prep test for ICP digestion, soil matrix.

M**TO- This type of code indicates a total metal analysis (eg. MAGTO indicates an analysis for total silver).

M**SO- This type of code indicates a soluble metal analysis. (eg. MAGSO indicates an analysis for soluble silver).

M**EP- This type of code indicates an EPTOXICITY metals analysis (eg. MAGEP indicates an analysis for eptox silver).

I**TO- This type of code indicates a non-metallic total analysis. There is also a complimentary soluble analysis for each of these codes (eg. ICNTO indicates an analysis for total cyanide).

A suffix of -R or -S following these codes indicates a replicate or spike analysis respectively.

ROY F. WESTON INC.
LIONVILLE LABORATORY

CLIENT: GLASGOW
RFW #: 8905L425
W.O. #: 2373-01-02-0000

SAMPLES RECEIVED: 05-23-89

INORGANIC NARRATIVE

The following is a summary of the quality control results and a description of any problems encountered during the analysis of this batch of samples:

1. The analytical methods applied by the laboratory in the analysis of air samples contained in this batch were derived from the Federal Register, 40 CFR, Part 60, revised July 1,1988, The Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA - 600/4-84-041, May 1987, and NIOSH Manual of Analytical Methods, 2nd & 3rd Editions.

Mark F. Saunders 6/12/89
Mark F. Saunders Date
Wet Lab Unit Leader
Lionville Analytical Laboratory

Debra K. White 6/12/89
Debra K. White Date
Inorganic Section Manager
Lionville Analytical Laboratory

Inter-Office Memorandum

WESTON
MANAGERS DESIGNERS/CONSULTANTS

TO: Jeff O'Neill

FROM: Ben Shapiro DATE: 15 June 1989

PROJECT: Glasgow W.O. NO.: 2373-01-02

SUBJECT: ANALYTICAL Results for RFW Batch 8905L425

ACTION:

Enclosed are the analytical results for the above listed RFW batch. Also included are the raw data and a copy of the chain of custody record.

If I can provide any further information, please call.

APPENDIX B

LABORATORY REPORTS

GAS ANALYSIS DATA FORM

Plant GLASGOW Sample location STACK 1

Date 5/22/89 Run no. one-2-3 Operator MILLS

Sample type: single-point or multipoint, grab or integrated

Analytical method ORSAT # 1 Comments LEAK CHECK - GOOD

AMBIENT O_2 - 20.8

Sample point	24-hour clock time	% CO2 Reading 1	% O2 Reading 2	% O2 Net[a]	% CO Reading 3	% CO Net[b]	%N FACTOR
INT	Run 1	2.5	19.0	16.5	19.0	0.0	19
INT		2.6	19.0	16.4	19.0	0.0	19
INT		2.5	19.2	16.7	19.2	0.0	19.
AVE		2.53		16.53		0.0	19.0
INT	Run 2	2.2	19.0	16.8	19.0	0.0	19
INT	Run 2	2.2	19.0	16.8	19.0	0.0	19
INT	Run 2	2.0	19.0	17.0	19.0	0.0	19
AVE		2.13		16.87		0.0	19
INT	Run 3	1.2	18.2	17.0	18.2	0.0	18.2
INT		1.2	18.2	17.0	18.2	0.0	18.2
INT		1.0	18.0	17.0	18.0	0.0	18.0
AVE		1.13		17.00		0.0	18.13
Averages			----		----		

% N_2 FACTOR

$\% N_2 = 100 - (\% CO_2 + \% O_2 + \% CO) =$

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

[a] Net % O_2 = Reading 2 - Reading 1

[b] Net % CO = Reading 3 - Reading 2

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Glasbow Sample date 5/22/89

Sample location Stack 1 Run number 3

Sample recovery person Mills Recovery date 5/22/89

Filter/thimble number(s) 9674

MOISTURE

Impingers				Silica gel		
Final volume (wt)	~39	ml	(g)	Final wt	310 g	g
Initial volume (wt)	200	ml	(g)	Initial wt	300 g	g
Net volume (wt)	39	ml	(g)	Net wt	10 g	g
Total moisture	49		(g)			

187
52

Color of silica gel

Description of impinger water Clear colorless

RECOVERED SAMPLE

Blank filter container number	001 97013	Sealed	✓
Blank thimble container number		Sealed	
Filter/~~thimble~~ container number	018 #9674	Sealed	✓
Filter/thimble container number		Sealed	
Filter/thimble container number		Sealed	
Filter/thimble container number		Sealed	

Description of particulate

Front-half water rinse container number(s)	014	Liquid level marked ?	✓
Front-half acetone rinse container number(s)	015	Liquid level marked ?	✓
Impinger contents and back-half water rinse container number(s)	016	Liquid level marked ?	✓
Back-half acetone rinse container number	017	Liquid level marked ?	✓
Water blank container number	002	Liquid level marked ?	✓
Acetone blank container number	003	Liquid level marked ?	✓

Samples stored and locked ✓ JM

Remarks

Date of laboratory custody

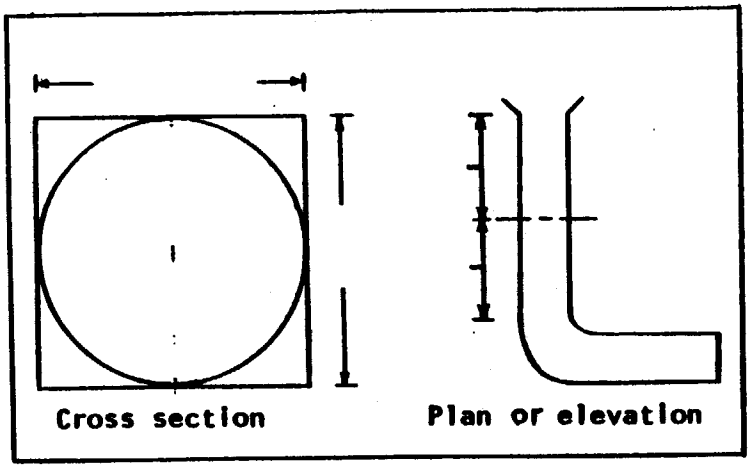
Laboratory personnel taking custody [illegible] 5/23/89 8:45 AM

Remarks

PARTICULATE FIELD DATA FORM

Sheet 1 of 2

Plant Glasgow
City Philadelphia
Location Unit 1
Operator Hidez / Barker
Run No. 3 Date 5-22-89
Ambient temp., °F 83
Baro. press. (P_b), in. Hg. 29.96
Sample box no.
Meter box no. Nutech 9
Meter box ΔH@ 1.922
Meter box cal. (Y) 1.003
Probe length, ft. 4/5
Probe liner material Borosilicate
Probe heater setting 35



Pitot tube identification no. P5
Pitot tube cal. factor (C_p) .84
Nozzle identification no. 216
Avg. nozzle diameter (D_n), in. .236
Pyrometer identification no. Nutech
Thermocouple identification no. —
Assumed moisture, % 13
Assumed temperature, °F. 284
Static pressure (P_{static}), in. H_2O -.63
C factor ____ Reference Δp
Initial leak rate .015 cfm @ 15 in. Hg
Final leak rate .005 cfm @ 5 in. Hg
Filter no. 9674
Comments:

K = 2.33

Test point schematic Bag Leak - OK / Line OK /

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
X	0	1427			307.645						
1	3		.47	1.09	309.4	85	86	193	2.0	67	229
2	6		.50	1.16	311.16	87	86	205	2.0	67	230
3	9		.52	1.21	313.0	90	89	204	2.5	66	230
4	12		.54	1.25	314.85	88	86	202	2.5	64	232
5	15		.56	1.30	316.82	89	87	209	2.5	65	229
6	18		.58	1.35	318.74	90	87	232	2.5	67	230
7	21		.84	1.95	321.15	91	87	231	3.0	67	231
8	24		1.1	2.56	323.65	93	88	233	3.0	64	233
9	27		1.2	2.79	326.40	93	88	215	3.5	60	231
10	30		1.1	2.56	329.08	93	88	210	3.5	62	229
11	33		1.1	2.56	331.75	94	89	204	3.5	64	231
12	36		1.05	2.44	334.425	94	89	194	3.5	64	229
			.8785	1.85	26.78	89.04		211.0			
	Total θ		Avg. $\sqrt{\Delta P}$ 0.878468	Avg. ΔH 1.85167	Total V_m 26.780	Avg. T_m 89.04		Avg. T_s 211.00	Max. vac. 3.5	Max. temp. 67	Min. 229 Max. 233

Comments: Static -.65 -.64 Unit was down for ≈ 8 minutes at ≈ 1430

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant GLASGOW Sample date 5/22/89

Sample location STACK -1 Run number TWO

Sample recovery person MILLS Recovery date 5/22/89

Filter/thimble number(s) 9642

MOISTURE

Impingers 190 / 116

Final volume (wt) 306 ml (g)

Initial volume (wt) 200 ml (g)

Net volume (wt) 106 ml (g)

Total moisture 124 (g)

Silica gel

Final wt 318 g ____ g

Initial wt 300 g ____ g

Net wt 18 g ____ g

Color of silica gel ½ Pink ½ Blue

Description of impinger water Clear Colorless

RECOVERED SAMPLE

Blank filter container number 001 97013 Sealed ✓

Blank thimble container number ____ Sealed ____

Filter/~~thimble~~ container number 013 #9642 Sealed ✓

Filter/thimble container number ____ Sealed ____

Filter/thimble container number ____ Sealed ____

Filter/thimble container number ____ Sealed ____

Description of particulate ____

Front-half water rinse container number(s) 009 Liquid level marked ? ✓

Front-half acetone rinse container number(s) 010 Liquid level marked ? ✓

Impinger contents and back-half water rinse container number(s) 011 Liquid level marked ? ✓

Back-half acetone rinse container number 012 Liquid level marked ? ✓

Water blank container number 002 Liquid level marked ? ✓

Acetone blank container number 003 Liquid level marked ? ✓

Samples stored and locked ✓ JM

Remarks ____

Date of laboratory custody P Morgan 5/23/89 8:45 am

Laboratory personnel taking custody ____

Remarks ____

Glascow

R-2 5-22-89

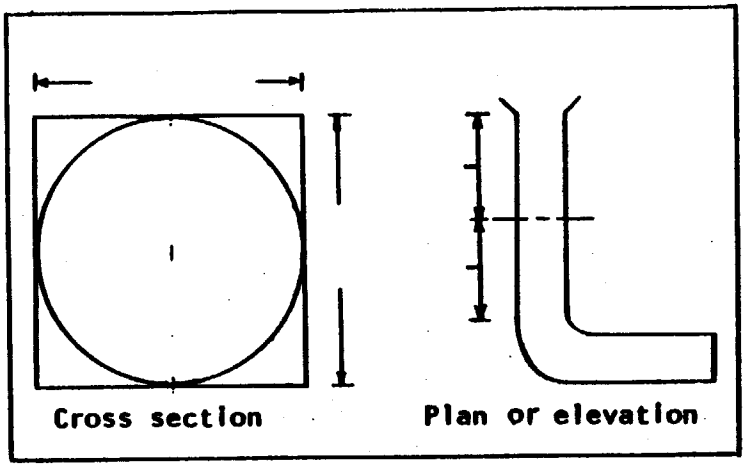
Sheet 2 of 2

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
Y	0	1241			280.95						
1	3		.63	1.46	283.00/283.5	89	88	171	2.0	67	228
2	6		.77	1.79	285.15	92	88	186	2.5	64	229
3	9		.76	1.77	287.30	92	89	203	2.5	62	230
4	12		.75	1.74	289.6	91	88	202	2.5	60	230
5	15		.70	1.63	291.7	93	89	203	2.5	60	229
6	18		.69	1.60	293.8	91	87	201	2.5	60	230
7	21		.75	1.74	296.0	92	89	202	2.5	62	232
8	24		.82	1.91	298.4	93	89	202	2.5	63	233
9	27		.78	1.81	300.5	95	90	203	2.5	63	235
10	30		.75	1.74	302.6	97	90	202	2.5	64	233
11	33		.64	1.49	304.7	96	90	204	2.5	64	230
12	36		.63	1.46	306.9	94	90	205	2.5	64	230
			~~.3540~~	1.67	25.92	90.9		198.6			
			.85								
	Total θ		Avg. $\sqrt{\Delta P}$ .853040	Avg. ΔH 1.71417	Total V_m 52.205	Avg. T_m 89.21		Avg. T_s 196.25	Max. vac. 3.0	Max. temp. 67	Min. 226 Max. 236

Comments:

PARTICULATE FIELD DATA FORM

Plant: Glasgow
City: Philadelphia
Location: Stack
Operator: Moore / Boiker / Mills
Run No.: Two Date: 5-22-89
Ambient temp., °F: 80
Baro. press. (P_b), in. Hg: 29.96
Sample box no.: NA
Meter box no.: Nutech 9
Meter box ΔH@: 1.922
Meter box cal. (Y): 1.003
Probe length, ft.: 4'
Probe liner material: Boro
Probe heater setting: 25



Pitot tube identification no.: P5
Pitot tube cal. factor (C_p): .84
Nozzle identification no.: 21G
Avg. nozzle diameter (D_n), in.: ~~.237~~ .236
Pyrometer identification no.: Nutech
Thermocouple identification no.: —
Assumed moisture, %: 12.0
Assumed temperature, °F: 235
Static pressure (P_{static}), in. H_2O: -.33
C factor ____ Reference Δp ____
Initial leak rate .014 cfm @ 15 in. Hg
Final leak rate .005 cfm @ 5 in. Hg
Filter no.: 9642
Comments:

K = 2.33

Test point schematic

ORSAT BAG LK CK – OK
Line LK ck – OK

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in. Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
K	0	1200			254.~~423~~ 615						
1	3		.42	.98	256.285	81	82	195	2.0	65	230
2	6		.50	1.16	258.085	83	84	197	2.0	65	229
3	9		.53	1.23	259.82	85	84	200	2.0	66	228
4	12		.56	1.30	261.73	85	84	196	2.0	66	226
5	15		.57	1.32	263.68	90	86	197	2.5	67	230
6	18		.60	1.39	265.78	90	85	195	2.5	67	236
7	21		.87	2.03	268.13	89	86	192	3.0	65	232
8	24		.98	2.28	270.73	92	87	194	3.0	65	230
9	27		1.1	2.56	273.26	95	87	193	3.0	65	229
10	30		.98	2.28	275.81	93	87	188	3.0	63	228
11	33		.97	2.26	278.42	94	88	189	3.0	64	236
12	36		.95	2.21	280.900	95	88	189	3.0	65	234
			.8568	1.75	26.285	87.5		193.8			
	Total θ		Avg. $\sqrt{\Delta P}$	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac 3.0	Max. temp. 67	Min. 228 Max. 236

Comments: MID PT LK ck OK .005-10

SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant GLASGOW Sample date 3/22/89

Sample location STACK - 1 Run number ONE

Sample recovery person MILLS Recovery date 3/22/89

Filter/thimble number(s) 9600

MOISTURE

Impingers	190 / 138		Silica gel		
Final volume (wt)	328 ml (g)		Final wt	325.5 g	g
Initial volume (wt)	200 ml (g)		Initial wt	300 g	g
Net volume (wt)	128 ml (g)		Net wt	25.5 g	g
Total moisture	153.5 (g)				

Color of silica gel 3/4 Pink - 1/4 Blue

Description of impinger water Clear - Colorless

RECOVERED SAMPLE

Blank filter container number	001 #97013	Sealed ✓
Blank thimble container number		Sealed
Filter/~~thimble~~ container number	008 #9600	Sealed ✓
Filter/thimble container number		Sealed
Filter/thimble container number		Sealed
Filter/thimble container number		Sealed

Description of particulate very Fine TAN particulate

Front-half water rinse container number(s)	004	Liquid level marked ? ✓
Front-half acetone rinse container number(s)	005	Liquid level marked ? ✓
Impinger contents and back-half water rinse container number(s)	006	Liquid level marked ? ✓
Back-half acetone rinse container number	007	Liquid level marked ? ✓
Water blank container number	002	Liquid level marked ? ✓
Acetone blank container number	003	Liquid level marked ? ✓

Samples stored and locked ✓ JM

Remarks

Date of laboratory custody

Laboratory personnel taking custody [illegible] 8:46 am 3/23/89

Remarks

RUN 1 7/21/09 GLASGOW

Sheet 2 of 2

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0				227.378						
Y 1	3	1007	.72	1.52	229.32	81	82	196	3.0	67	236
Y 2	6	1010	.74	1.56	231.39	83	83	198	3.0	67	237
3	9		.77	1.63	233.52	84	83	197	3.5	64	236
4	12		.75	1.59	235.53	85	82	200	3.5	63	238
5	15		.68	1.44	237.54	85	83	202	3.5	62	235
6	18		.65	1.37	239.60	85	82	197	3.0	62	236
7	21		.73	1.54	241.66	84	82	199	3.0	63	238
8	24		.79	1.67	243.7	85	82	196	3.0	63	238
9	27		.83	1.75	245.96	85	82	198	3.5	63	239
10	30		.82	1.73	248.24	86	83	201	3.5	63	241
11	33		.72	1.52	250.23	86	83	201	3.5	63	236
12	36	1043	.73	1.52	252.875	85	82	201	3.5	63	237
			.8621	1.57	25.497	83.45			3.5	67	
	Total θ		Avg. $\sqrt{\Delta P}$ .853903	Avg. ΔH 1.5594	Total V_m 50.237	Avg. T_m 84.1875		Avg. T_s 202.708	Max. vac 4.0	Max. temp. 68	Min. 235 Max. 243

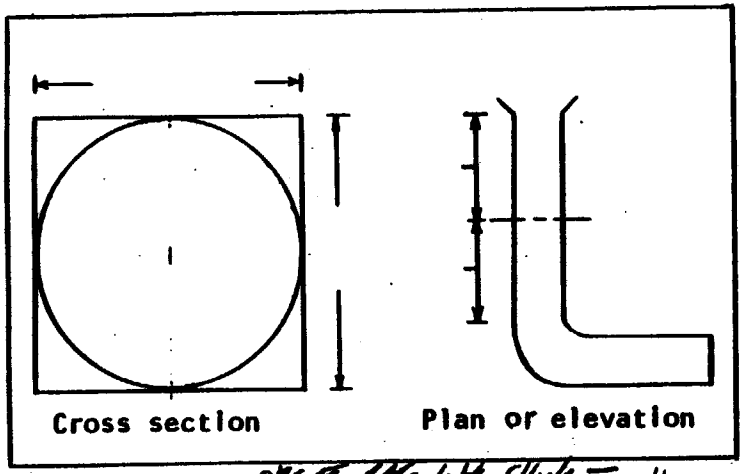
Comments: -.27 static

PARTICULATE FIELD DATA FORM

Sheet 1 of 2

Plant GLASGOW
City PHILADELPHIA
Location STACK 1
Operator Mills/Mace/Kinder
Run No. ONE Date 5/2/89
Ambient temp., °F 80
Baro. press. (P_b), in. Hg. 29.96
Sample box no. NA
Meter box no. NUTECH 9
Meter box ΔH@ 1.922
Meter box cal. (Y) 1.003
Probe length, ft. 4 FT
Probe liner material PYREX
Probe heater setting 35

K = 2.12



ORSAT Line leak check — OK

Test point schematic

Pitot tube identification no. P5
Pitot tube cal. factor (C_p) .84
Nozzle identification no. 21B
Avg. nozzle diameter (D_n), in. .231
Pyrometer identification no. NUTECH
Thermocouple identification no. —
Assumed moisture, % 12.0
Assumed temperature, °F. 230
Static pressure (Pstatic), in. H_2O -.26
C factor ___ Reference ΔP ___
Initial leak rate Ø cfm @ 15 in. Hg
Final leak rate .002 cfm @ 5 in. Hg
Filter no. 9600
Comments: INITIAL PITOT TUBE check ok
FINAL PITOT TUBE check ok

ORSAT Line leak check ok

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source (1) temperature (T_s), °F	Pump vacuum, in.Hg. gauge	(2) Impinger exit gas temp., °F.	(3) Filter box temp., °F.
X	0	0925			202.570						
1	3	0928	.44 (.44)	.93 (.93)	204.245	83	84	187	2.5	67	235
2	6	0931	.49	1.03	205.75	83	84	192	2.5	67	238
3	9	0934	.50	1.06	207.76	82	81	197	2.5	64	237
4	12	0937	.52	1.10	209.43	81	80	200	2.5	65	237
5	15	0940	.55	1.16	211.32	86	82	208	2.5	65	240
6	18	0943	.59	1.25	213.24	86	82	212	~~2.5~~ 3.0	65	239
7	21	0946	.86	1.82	215.62	86	81	213	3.5	67	239
8	24	0949	.94	1.99	217.74	86	81	213	3.5	67	238
9	27	0952	.98	2.07	220.04	88	83	214	4.0	68	239
10	30	0955	.98	2.07	222.45	93	85	216	4.0	66	242
11	33	0958	.96	2.03	224.87	95	87	215	4.0	65	243
12	36	1001	.98	2.07	227.310	93	86	311	4.0	66	241
					24.74	~~84.91~~		~~206.58~~			
	Total θ	36	Avg. $\sqrt{\Delta P}$ .8456	Avg. ΔH 1.54	Total V_m	Avg. T_m		Avg. T_s	Max. vac. 4.0	Max. temp. 68	Min. 235 Max. 243

Comments:

static avg -.25

Mod Lk ck — OK 227.372

MOISTURE DETERMINATION FORM

Plant Glasgow Date 5/02/89

Sample location STACK Run no. Prelim

Operator Mills/Marz/Gardner Barometric pressure (P_b), in. Hg. 29.96

Comments: Initial leak check -ok

Final leak check -ok

	24-hr. clock time	Gas meter reading, ft.^{3}	Orifice meter pressure differential (ΔH), in. H_2O	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.
Stop	0800	202.400	1.5	91	84
Start	0745	192.210	1.5	83	84
		Total V_m 10.190	Ave. ΔH 1.5	Avg. T_m 86	

Impinger volume

Final, ml 225

Initial, ml 200

Net, ml 25

Silica gel weight

Final, g 306

Initial, g 300

Net, g 6

Calculations

(1) P_b = 29.96

(2) Total V_m = 10.190

(3) Avg. ΔH = 1.5

(4) Avg. T_m = 86

(5) Net ml = 25

(6) Net g = 6

(7) $$V_{m(std)} = \frac{17.64 \times V_m (P_b + \frac{\Delta H}{13.6})}{(T_m + 460)} = \frac{17.64 \times 10.190 (29.96 + \frac{1.5}{13.6})}{(86 + 460)} = 9.89$$

(8) $$V_{w(std)} = (.04707 \times \text{Net ml}) + (.04715 \times \text{Net g}) =$$
$$(.04707 \times 25) + (.04715 \times 6) = 1.46$$

(9) $$\%M = \frac{100 \times V_{w(std)}}{V_{w(std)} + V_{m(std)}} = \frac{100 \times 1.46}{1.46 +} = 12.86\%$$

GAS VELOCITY AND VOLUME DATA FORM

Plant GLASGOW Location STACK
Date 5/22/89 Run no. Prelim 24-hr. clock time
Operators Mills/Baker Stack diameter or dimensions, in. 38"
Barometric pressure, in. Hg 29.96 Cross sectional area, ft.^{2} 7.88
Pitot tube identification no. P5 Cp .84

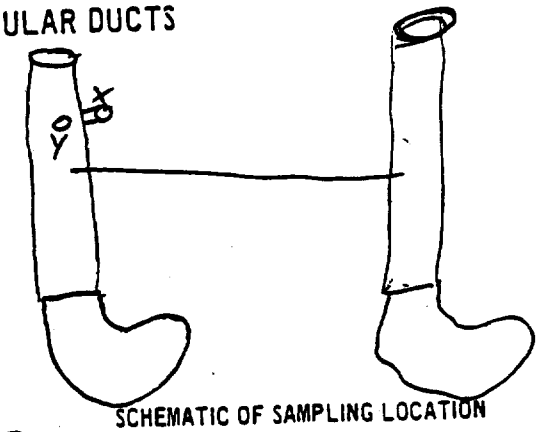
Traverse Point Number	Velocity head (Δp), in. H_2O	Stack Temperature (T_s), °F.	Static pressure (P static) in. H_2O	Cyclonic flow determination: Δp at 0° reference	Cyclonic flow determination: Angle (α) which yields a null Δp
X 1	.42	232			
2	.46	236			
3	.53	234		.02	<5
4	.63	234			
5	.64	227			
6	.73	238	-.37		
7	1.05	232		0	0
8	1.2	231			
9	1.25	231			
10	1.2	231			
11	1.1	230		-.05	<5
12	1.0	230			
Y 1	.38	212			
2	.82	221		.04	<5
3	.87	224			
4	.94	225			
5	.95	226			
6	.87	225	-.40		
7	1.1	224		0	0
8	1.3	224			
9	1.3	223			
10	1.3	223			
11	1.2	223		-.03	<5
12	1.05	222			
	.931	227.4			
	Avg. √ Δp	Avg. Ts	Avg. P static		Avg. α[a]

[a] Must be <10 degrees to be acceptable.

N
W E

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT GLASGOW UNIT 1
DATE 5/21/89
SAMPLING LOCATION STACK
INSIDE OF FAR WALL TO OUTSIDE OF PORT (DISTANCE A) 41 1/2
INSIDE OF NEAR WALL TO OUTSIDE OF PORT (DISTANCE B) 3 1/2"
STACK I.D. (DISTANCE A - DISTANCE B) 38"
NEAREST UPSTREAM DISTURBANCE 50" 10 DIA
NEAREST DOWNSTREAM DISTURBANCE 13' ≈ 4 DIA
CALCULATOR Jack Marks



SCHEMATIC OF SAMPLING LOCATION

AREA = 7.87 FT²

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF PORT (SUM OF COLUMNS 4 & 5)
XY 1	.021	38"	.798	1" 3 1/2	4 1/2
2	.067		2.546	2 1/2	6
3	.118		4.484	4 1/2	8
4	.177		6.726	6 3/4	10 1/4
5	.250		9.50	9 1/2	13
6	.356		13.528	13 1/2	17
7	.644		24.472	24 1/2	28
8	.750		28.50	28 1/2	32
9	.823		31.274	31 1/4	34 3/4
10	.882		33.516	33 1/2	37
11	.933		35.454	35 1/2	39
12	.979		37.202	37	40 1/2

V_s = 85.49 x .84 x .853903 x $\left[\frac{662.71}{29.94 \times 27.65}\right]^{\frac{1}{2}}$

= 54.86 Feet/Sec

Where:

V_s = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\left[\frac{(lb/lb\text{-}mole)(in.Hg)}{(^oR)\ (in.\ H_2O)}\right]^{\frac{1}{2}}$

C_p = Pitot tube coefficient, dimensionless.

T_s = Absolute gas stream temperature, ^oR. = $T_s, ^oF + 460$

P_s = Absolute gas stack pressure, in. Hg. = $P_b + \frac{P_{static}}{13.6}$

Δp = Velocity head of stack gas, in. H_2O

8. Average gas stream volumetric flow rate at actual conditions, wacf/hr.

$Q_{s(act)}$ = 3,600 x V_s x A_s

= 3,600 x 54.86 x 7.88 = 1556268 WACF/HR

or

25937 WACF/MIN

Where:

$Q_{s(act)}$ = Volumetric flow rate of wet stack gas at actual conditions, wacf/hr.

A_s = Cross-sectional area of stack, $ft.^2$

9. Average gas stream dry volumetric flow rate at standard conditions, dscf/hr.

$Q_{s(std)}$ = 17.64 x M_d x $\frac{P_s}{T_s}$ x $Q_{s(act)}$

= 17.64 x 0.872 x 1556268 x $\frac{29.94}{662.71}$ = 1081502 DSCF/HR

or

18025 DSCF/MIN

Where:

$Q_{s(std)}$ = Volumetric flow rate of dry stack gas at standard conditions, dscf/hr.

10. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.327 \times T_s \times V_{m(std)}}{V_s \times \theta \times P_s \times M_d \times (D_n)^2}$$

$$I = \frac{17.327 \times 662.71 \times 49.122}{54.86 \times 72 \times 29.94 \times .872 \times (.231)^2} = 102.5$$

Where:

I	=	Percent of isokinetic sampling.
θ	=	Total sampling time, minutes.
D_n	=	Diameter of nozzle, inches.
17.327	=	Factor which includes standard temperature (528°R), standard pressure (29.92 in.Hg), the formula for calculating area of circle $\frac{D^2}{4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(\text{in. Hg})\ (\text{in}^2)\ (\text{min})}{(^\circ\text{R})\ (\text{ft}^2)\ (\text{sec})}$

11. Particulate concentration, gr/dscf.

$$C_1 = 15.432 \times \frac{M_t}{V_{m(std)}}$$

$$C_1 = 15.432 \times \frac{.0665}{49.12} = .0209$$

Where:

C_1	=	Particulate concentration, gr/dscf.
M_t	=	Total weight of particulate caught by train, g.
15.432	=	Conversion factor of gr/g.

12. Particulate concentration, gr/wacf.

$$C_2 = C_1 \times \frac{Q_{s(std)}}{Q_{s(act)}} = \quad \times \frac{\quad}{\quad} = NA$$

Where:

C_2	=	Particulate concentration, gr/wacf.

13. Particulate mass emission rate, lb/hr.

PMR_t = $0.000142857 \times C_1 \times Q_{s(std)}$

= $0.000142857 \times .0209 \times 1,081,502$ = 3.23

Where:

PMR_t = Particulate mass emission rate, lb/hr.

0.000142857 = Conversion factor relating grains to pounds (7,000), lb/gr.

14. Conversion Factors:

From	To	Multiply by
in.	mm.	25.40
ft.	m.	0.3048
$ft.^2$	$m.^2$	0.092903
$ft.^3$	$m.^3$	0.028317
$gr/ft.^3$	$g/m.^3$	2.28833
lbs/hr.	g/hr.	453.59

Temperature

$^oC = 5/9\ (F-32)$

$^oR = {}^oF + 460$

$^oK = {}^oC + 273$

APPENDIX D

PROCESS OPERATIONS DATA

Every 15 Minutes ~ Approx During Tests Only
Unit #1 Dryer/Baghouse (of 2 Total) #4 Blend

Time	Pressure ΔP	T F Bag	T F Dryer	% Burner	T Asphalt	sheets for Trucks
9:29 AM	4.0	240°F	350°F	80%	300°	
9:35	3.8	240°	370°	70%	300°	
9:50	3.9	220°	365°	70%	300°	
10:05	3.9	220°	340°	60%	300°	
10:20	4.1	215°	340°	60%	300°	
10:35	4.2	225°	355°	60%	300°	
11:55	4.2	235°	350°	60%	300°	
12:10	3.9	220°	350°	50%	300°	
12:25	3.9	220°	340°	50%	300°	
12:40	3.9	225°	340°	60%	300°	
12:55	4.0	225°	350°	50%	300°	
1:10	3.9	230°	350°	80%	300°	
2:25	3.4	245°	370°	70%	300°	
2:40	3.6	230°	370°	60%	300°	
2:45	3.6	240°	380°	60%	300°	
3:00	3.8	225°	340°	50%	300°	

WESTON
DESIGNERS CONSULTANTS

CLIENT/SUBJECT GLASGOW INC
W.O. NO.
TASK DESCRIPTION TOT. AGG/HR
TASK NO.
PREPARED BY S. Kirkpatrick DEPT 1500 DATE 31 May, 1989
MATH CHECK BY DEPT DATE
METHOD REV. BY DEPT DATE
APPROVED BY
DEPT DATE

PER TEST - BY TIME OF ACTUAL TEST

	TEST 1	TEST 2	TEST 3
TIME	9:25 → 10:43 1.3 hrs	12:00 → 13:17 1.2833 hrs	14:27 → 15:03 0.60 hrs
AGG TOT	136.780 TONS	129.640 TONS	54.815 TONS
	105.2154 TONS/hr 210,430.7689 lbs/hr	101.01818 TONS/hr 202,036.3642 lbs/hr	91.3583 TONS/hr 182,716.6667 lbs/hr

---

Run 1

$A = 0.76\,E^{0.42}$

$E = F \times W$

$E = 6\,\frac{lbs}{TON}\left(105.21\,\frac{Tons}{Hr}\right)$

$E = 631\,\frac{lbs}{Hr}$

$A = 11.40\,\frac{lbs}{Hr}$

Run 2

$E = 6\,\frac{lbs}{TON}\left(101.02\,\frac{Tons}{Hr}\right)$

$E = 606\,\frac{lbs}{Hr}$

$A = 11.21\,\frac{lbs}{Hr}$

Run 3

$E = 6\,\frac{lbs}{TON}\left(91.36\,\frac{Tons}{Hr}\right)$

$E = 548\,\frac{lbs}{Hr}$

$A = 10.74\,\frac{lbs}{Hr}$

[illegible] INC
BEACH ST. & [illegible]
PHILA. PA. PHONE 215 [illegible]
ON JOB OFF JOB RETURN

TEST # 1

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO: HERB BLAU INC.
CUSTOMER NO. 1153
LOCATION: 2431 DIAMOND

TIME [illegible]
DATE 05/22/8[illegible]
ORDER NO.
TICKET NO. [illegible]
TRUCK NO.
PRODUCT 1D2H00[illegible]

UNIT PRICE
DELIVERY CHARGE
TAXABLE ☐ YES ☐ NO

AMOUNT
TRUCKER CODE [illegible]

DELIVERED BY
WEIGHMASTER [signature]
RECVD BY [signature]

[illegible]	[illegible]	[illegible]	[illegible]	AGG 3	[illegible]	AGG 5	[illegible]	AGG TOT	TARE	ASPHALT	[illegible]
1	0	2530	5980	0	0	0	5990	5990	[illegible]	339.0	[illegible]
2	0	2430	6010	0	0	0	6020	[illegible]	[illegible]	[illegible]	[illegible]
3	0	2510	5850	0	0	0	5920	5920	[illegible]	340.0	[illegible]
4	0	2700	6140	0	0	0	6140	6140	[illegible]	[illegible]	[illegible]
5	0	2490	5830	0	0	0	5930	5930	[illegible]	340.0	[illegible]
6	0	2530	5850	0	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	0	2470	5870	0	0	0	[illegible]	[illegible]	[illegible]	340.0	[illegible]

41,850 NET LOAD TOTAL
41,850 INSPECTOR

BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO DANELLA CONST.
CUSTOMER NO. 1258
LOCATION: [illegible]

TIME 09:43 DATE 05/22/89
ORDER NO. [illegible]
TICKET NO. 657929
TRUCK NO. 0165
PRODUCT ID2H00VC

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE 06

DELIVERED BY	WEIGHMASTER	RECVD BY
[illegible]	[illegible]	

1	0	2380	5680	0	0	0	5680	5680	.0	324.0	6004
2	0	2370	5690	0	0	0	5690	5690	.0	323.0	6013
3	0	2320	5630	0	0	0	5650	5650	.0	324.0	5974

58,870 INSPECTOR

BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821

ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO G. MASGAI & SON
CUSTOMER NO. 1762
LOCATION: ROHM & HAAS

TIME 09:55 DATE 05/22/89
ORDER NO.
TICKET NO. 657932
TRUCK NO. 70
PRODUCT ID2B00VC

UNIT PRICE
DELIVERED CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE 04

DELIVERED BY
WEIGHMASTER Louis A. Antolini
RECVD BY Jack Brown

1	0	1750	6340	4690	0	0	6360	6360	.0	287.0	6647
2	0	1840	6340	4670	0	0	6370	6370	.0	286.0	6656
3	0	1590	6330	4560	0	0	6380	6380	.0	285.0	6665

87,420 INSPECTOR

46 [illegible]

BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-[illegible]
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO GENERAL ASPHALT CO.
CUSTOMER NO. 096
LOCATION: [illegible] JEFFERSON

TIME 09:52 DATE 05/22/89
ORDER NO.
TICKET NO. 657931
TRUCK NO. 31
PRODUCT ID2H00VC

UNIT PRICE _____ AMOUNT _____
DELIVERY CHARGE _____ TRUCKER CODE 06
TAXABLE ☐ YES ☐ NO

DELIVERED BY	WEIGHMASTER	RECVD BY
	[illegible]	[illegible]

1	0	2410	4710	0	0	0	4710	4710	.0	270.0	4980
2	0	1930	4690	0	0	0	4730	4730	.0	269.0	4999

68,310 INSPECTOR

[illegible] 4 [illegible] 57[illegible]33

BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO J. J. DOUGHERTY & SON
CUSTOMER NO. 372
LOCATION: PENN SHIP

TIME 10:04 DATE 05/22/89
ORDER NO.
TICKET NO. 657933
TRUCK NO. DL5
PRODUCT BB-100VS

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE
TAXABLE YES NO

DELIVERED BY	WEIGHMASTER	RECVD BY
	[illegible]	

1	0	1710	6410	4650	0	0	6410	6410	.0	233.0	6643
2	0	1720	6410	4630	0	0	6410	6410	.0	233.0	6643
3	0	1700	6410	4710	0	0	6410	6410	.0	233.0	6643

106,650 INSPECTOR

GLASGOW INC
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2121
IN JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO J. J. DOUGHERTY & SON
CUSTOMER NO. 372
LOCATION: PENN SHIP

TIME 1008 DATE 05/22/89
ORDER NO.
TICKET NO. 657934
TRUCK NO. D45
PRODUCT BB-100VS

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE Ae

DELIVERED BY
WEIGHMASTER
RECVD BY

1	0	1440	5300	3940	0	0	5300	5300	.0	193.0	5493
2	10	1400	5300	3820	0	0	5300	5300	.0	193.0	5493
3	0	1390	5290	3820	0	0	5290	5290	.0	192.0	5482
4	0	1340	5280	3820	0	0	5310	5310	.0	193.0	5503

127,950 INSPECTOR

BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO J. J. DOUGHERTY & SON
CUSTOMER NO. 372
LOCATION: PENN SHIP

TIME 10:15 DATE 05/22/89
ORDER NO.
TICKET NO. 657935
TRUCK NO. D14
PRODUCT BB-100VS

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE 06

DELIVERED BY
WEIGHMASTER [signature]
RECVD BY [signature]

1	0	1650	5760	4260	0	0	5790	5790	.0	210.0	6000
2	0	1570	5760	4190	0	0	5790	5790	.0	210.0	6000
3	0	1580	5760	4170	0	0	5790	5790	.0	209.0	5999
4	0	1520	5760	4180	0	0	5770	5770	.0	209.0	5979
5	0	1550	5750	4410	0	0	5800	5800	.0	210.0	6010
6	10	1600	5760	4180	0	0	5790	5790	.0	209.0	5999
7	0	1570	5750	4190	0	0	5800	5800	.0	210.0	6010

168,380 INSPECTOR

HEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-[illegible]
IN JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO CLEVELAND MECH.
CUSTOMER NO. 2833
LOCATION: [illegible]

TIME 10:28 DATE 05/22/89

ORDER NO. 1964

TICKET NO. 457936

TRUCK NO. 1

PRODUCT ID2H00VC

UNIT PRICE

DELIVERY CHARGE

TAXABLE YES NO

AMOUNT

TRUCKER CODE 06

DELIVERED BY

WEIGHMASTER [illegible]

RECVD BY [illegible]

1	0	2270	4960	0	0	0	5040	5040	.0	288.0	5328
2	0	2300	4970	0	0	0	5060	5060	.0	288.0	5348
3	0	2180	4960	0	0	0	5050	5050	.0	288.0	5338

183,530

INSPECTOR

GLASGOW, INC
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739--2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO
CUSTOMER NO. TEST RUN #1
LOCATION: AGG. BINS

TIME 11:14
DATE 05/22/89
ORDER NO.
TICKET NO. 657939
TRUCK NO.
PRODUCT ID2B00VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE
TAXABLE YES NO

DELIVERED BY
WEIGHMASTER
RECVD BY

1	0	3010	5970	4190	6	0	0	5970	.0	.0	5970

235,130 TRUCKER

GLASGOW, INC
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO
CUSTOMER NO. TEST RUN #1
LOCATION: AGG. BINS

TIME 11:21
DATE 05/22/89
ORDER NO.
TICKET NO. 657940
TRUCK NO.
PRODUCT ID2B00VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE
TAXABLE YES NO

DELIVERED BY
WEIGHMASTER
RECVD BY

1	0	3090	5990	4210	0	0	0	5990	.0	.0	5990

TRUCKER

5 6: 94

GLASGOW, INC
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO
CUSTOMER NO. TEST RUN #1
LOCATION: AGG. BINS

TIME 11:28
DATE 05/22/89
ORDER NO.
TICKET NO. 657941
TRUCK NO.
PRODUCT 1D2B00VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE
TAXABLE YES NO

DELIVERED BY	WEIGHMASTER	RECVD BY

1	0	3550	6640	4670	0	0	0	6640	.0	.0	6640
3	10	3480	6650	5160	0	0	0	6650	.0	.0	6650
4	0	3550	6630	5260	0	0	0	6630	.0	.0	6630
5	220	4220	6610	5100	0	0	0	6610	.0	11.7	6622

39710

2 3[illegible] 6630 TRUCKER

GLASGOW, INC.
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO TEST RUN #1
CUSTOMER NO. AGG. BINS
LOCATION:

TIME 11:41 DATE 05/22/89
ORDER NO.
TICKET NO. [illegible]
TRUCK NO. [illegible]
PRODUCT ID2B00VC

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE

DELIVERED BY | WEIGHMASTER | RECVD BY

1	6	3460	5930	4290	0	0	0	5930	.0	.0	5930

2 [illegible] lb. TRUCKER
136.[illegible] tons

GI S W I
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2021
ON JOB OFF JOB RETURN

TEST #2

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO M. JOHNSON
CUSTOMER NO. 256
LOCATION: BRISTOL

TIME 12:01 DATE 05/22/89

ORDER NO. 1501

TICKET NO. 57744

TRUCK NO.

UNIT PRICE 23.50

AMOUNT 174.51

DELIVERY CHARGE

TRUCKER CODE 9.06

PRODUCT BB-100VS

TAXABLE ☑ YES ☐ NO 164.50 + 9.87

DELIVERED BY

WEIGHMASTER

RECVD BY

1	0	1170	4490	3300	0	0	4480	4480	.0	163.0	4643
2	0	1330	4480	3290	0	0	4510	4510	.0	164.0	4674
3	0	1140	4480	3240	0	0	4510	4510	.0	164.0	4674

13,500

INSPECTOR

46 657945

A 30 . NO

BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-739-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO J. J. DOUGHERTY & SON
CUSTOMER NO. 372
LOCATION: PENNSHIP

TIME 12:09 DATE 05/22/89
ORDER NO.
TICKET NO. 657945
TRUCK NO. D15
PRODUCT BB-100VS

UNIT PRICE _____ AMOUNT _____
DELIVERY CHARGE _____ TRUCKER CODE _____
TAXABLE ☐ YES ☐ NO

DELIVERED BY	WEIGHMASTER	RECVD BY
	[signature]	[signature]

1	0	1520	5770	4260	0	0	5770	5770	.0	209.0	5979
2	0	1610	5780	4250	0	0	5780	5780	.0	210.0	5990
3	10	1470	5770	4170	0	0	5800	5800	.0	210.0	6010
4	0	1530	5770	4180	0	0	5810	5810	.0	209.0	6019
5	0	1570	5770	4150	0	0	5770	5770	.0	209.0	5979
6	0	1470	5760	4160	0	0	5810	5810	.0	210.0	6020
7	0	1490	5760	4260	0	0	5800	5800	.0	210.0	6010

54,040 INSPECTOR

G[illegible] [illegible]C
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE 215-[illegible]-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO J. J. DOUGHERTY & SON
CUSTOMER NO. 372
LOCATION: PENNSHIP

TIME 12:22 DATE 05/22/89
ORDER NO.
TICKET NO. 657946
TRUCK NO. AC193
PRODUCT BB-100VS

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE 14

DELIVERED BY
WEIGHMASTER
RECVD BY

1	0	1610	5760	4260	0	0	5800	5800	.0	209.0	6009
2	0	1540	5760	4170	0	0	5800	5800	.0	210.0	6010
3	0	1510	5760	4160	0	0	5800	5800	.0	209.0	6009
4	0	1500	5760	4160	0	0	5790	5790	.0	209.0	5999
5	0	1550	5750	4267	0	0	5780	5780	.0	210.0	5990
6	10	1600	5760	4300	0	0	5800	5800	.0	209.0	6009
7	10	1500	5760	4160	0	0	5760	5760	.0	210.0	5970
8	10	1480	5750	4160	0	0	5790	5790	.0	209.0	5999

100,360 INSPECTOR

[illegible] 47

[illegible]
BEACH ST. & [illegible]
PHILA. PA. PHONE [illegible]-2821
ON JOB OFF JOB RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO PETRO TITE
CUSTOMER NO. 2655
LOCATION: 20th PENN

TIME 12:36 DATE 05/22/89
ORDER NO.
TICKET NO. 657947
TRUCK NO. 1
PRODUCT ID2H00VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE 06
TAXABLE YES NO

DELIVERED BY
RECVD BY

1	0	1600	3720	0	0	0	3780	3780	.0	216.0	3996
2	0	1870	3720	0	0	0	3790	3790	.0	216.0	4006

107,930 INSPECTOR

E_AL_OI_ _IC
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE [illegible]-2821
ON [illegible] OFF [illegible]

HAZARD WARNING: [illegible] burns from contact with [illegible] inhalation and eye irritation hazards from hydrogen sulfide gas.

TIME [illegible] DATE 05/22/[illegible]

SOLD TO J. J. [illegible]
CUSTOMER NO. 372
LOCATION: PENNY [illegible]

TICKET NO. 657948

TRUCK NO. DH

UNIT PRICE [illegible]
DELIVERY CHARGE [illegible]
TAXABLE YES NO

PRODUCT BB-100#8

DELIVERED BY [illegible]

RECV'D BY [illegible]

1	0	1590	5740	4230	[illegible]	[illegible]	5770	5770	.0	209.0	5979
2	0	1650	5740	4200	[illegible]	[illegible]	5800	5800	.0	209.0	6009
3	0	1500	5750	4400	[illegible]	[illegible]	5790	5790	.0	210.0	6000
4	0	1470	5760	4160	[illegible]	[illegible]	5790	5790	.0	210.0	6000
5	0	1740	5750	4230	[illegible]	[illegible]	5800	5800	.0	210.0	6010
6	0	1460	5750	4170	[illegible]	[illegible]	5790	5790	.0	210.0	6000
7	0	1640	5750	4170	[illegible]	[illegible]	5790	5790	.0	209.0	5999

148,460 INSPECTOR

GLASGOW, INC.
BEACH ST. & [illegible]
PHILA. PA. PHONE [illegible] 2821
ON JOB OFF [illegible]

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO: TOP SOIL PAVING [illegible] TIME 12:53 DATE 05/22/89
CUSTOMER NO. 2074
LOCATION: FAWKNER OLD [illegible] ORDER NO.
TICKET NO. 657949
UNIT PRICE AMOUNT TRUCK NO.
DELIVERY CHARGE TRUCKER CODE 06 PRODUCT ID2H00VC
TAXABLE YES NO

DELIVERED BY	[illegible]	RECVD BY
	[illegible]	

1	0	2250	5210	0	0	0	5290	5290	.0	302.0	5592
2	0	2160	5210	0	0	0	5290	5290	.0	302.0	5592
3	0	2530	5220	0	0	0	5300	5300	.0	303.0	5603
4	0	2200	5210	0	0	0	5290	5290	.0	302.0	5592
5	0	2160	5260	0	0	0	5290	5290	.0	301.0	5591

174,920 INSPECTOR

6 6 9

GLASGOW, INC. [illegible]
BEACH ST. & [illegible]ANNA
PHILA. PA. PHO[illegible] 215-239-282[illegible]
ON JOB OFF JO[illegible] RETURN

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO: HERB BLAU INC.
CUSTOMER NO. 1153
LOCATION: 24th DIAMOND

TIME 13:00 DATE 05/22/89
ORDER NO.
TICKET NO. 657950
TRUCK NO. 2

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

AMOUNT
TRUCKER CODE 00

PRODUCT ID2H00VC

DELIVERED BY

WEIGHMASTER [signature]

RECVD BY [signature]

1	0	2630	6220	0	0	0	6300	6300	.0	360.0	6660
2	0	2600	6180	0	0	0	6310	6310	.0	359.0	6669
3	0	2600	6220	0	0	0	6300	6300	.0	360.0	6660

193,830 INSPECTOR

96 (75)

E_AE_OL_ _IC
BEACH ST. & [illegible]
PHILA. PA. PHONE [illegible]2821
ON JOB OFF JOB [illegible]

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO DOLENTE
CUSTOMER NO. 601
LOCATION: BEDTION RD

TIME 1[illegible]:00 DATE 05/22/89
ORDER NO.
TICKET NO. 657951
TRUCK NO.
PRODUCT ID2H00VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE CU
TAXABLE YES NO

DELIVERED BY		RECVD BY
	[illegible]	[illegible]

1	0	2370	5650	.0	0	0	5680	5680	.0	323.0	6003

199,510 INSPECTOR

GLASGOW, INC.
BEACH ST.
PHILA., PA.
ON JOB OFF

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO: TEST RUN #2
CUSTOMER NO.: AGG BINNS
LOCATION:

DATE: 05/22/89
ORDER NO.:
TICKET NO.: 657953
TRUCK NO.:
PRODUCT: ID2B00VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE
TAXABLE YES NO

DELIVERED BY		RECVD BY

1	0	2930	5980	4200	0	0	0	5980	.0	.0	5980
2	10	3532	5990	4170	0	0	0	5990	.0	.0	5990
3	0	2943	5980	4230	0	0	0	5980	.0	.0	5980

217,460 INSPECTOR

L. G. I. IN
BEACH ST. & SUSQUEHANNA
PHILA. PA. PHONE [illegible]
ON JOB OFF JOB RETURN

[illegible] WARNING: Thermal burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO TEST RUN #2
CUSTOMER NO. AGG BINNS.
LOCATION:

TIME 13:42 DATE 06/22/89
ORDER NO.
TICKET NO. 657954
TRUCK NO.
PRODUCT ID2800VC

UNIT PRICE
AMOUNT
DELIVERY CHARGE
TRUCKER CODE
TAXABLE YES NO

DELIVERED BY	WEIGHMASTER	RECVD BY

1	0	3260	6000	4240	0	0	0	6000	.0	.0	6000
2	0	2950	5990	4230	0	0	0	5990	.0	8.0	5998
3	10	3030	6000	4230	0	0	0	6000	.0	.0	6000

235,450 INSPECTOR

GLASGOW, I...
BEACH ST. & ...
PHILA. PA. PHONE ... 2821
ON JOB OFF JOB ...

[illegible] WARNING: [illegible] burns from contact with hot liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO TEST RUN [illegible] TIME [illegible] DATE 05/22/89
CUSTOMER NO. AGG BINNS
LOCATION:
ORDER NO.
TICKET NO. 657955
TRUCK NO.
UNIT PRICE
DELIVERY CHARGE TRUCKER CODE
PRODUCT ID2B00VC
TAXABLE YES NO

DELIVERED BY								RECVD BY			
1	0	3580	5970	4230	0	0	0	5970	.0	.0	5970
2	0	3140	5990	4230	0	0	0	5990	.0	.0	5990
3	0	3060	5930	4240	0	0	0	5930	.0	.0	5930

253,340 INSPECTOR

4 — 57 56

[illegible] 2821

[illegible]

[illegible] HAZARD WARNING: [illegible] burns from contact with [illegible] liquid, inhalation, and eye irritation hazards from hydrogen sulfide gas.

SOLD TO: TEST RUN [illegible]
CUSTOMER NO. [illegible]
LOCATION:

TIME [illegible] DATE 05/22/89
ORDER NO.
TICKET NO. 657956
TRUCK NO.
PRODUCT ID2B00VC

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

DELIVERED BY	RECVD BY

1	0	3020	5940	[illegible]	[illegible]	0	0	5940	.0	.0	5940

259,280 lbs
129.640 tons

INSPECTOR

TEST 3

HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation and eye irritation hazards from hydrogen sulfide gas.

SOLD TO

CUSTOMER NO.

LOCATION

DATE 05/2[illegible]

30311

TICKET NO. 657987

TRUCK NO. 2163

PRODUCT FJH100VS

UNIT PRICE

DELIVERY CHARGE

TAXABLE YES NO

DELIVERED BY

RECVD BY

1	0	4250	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6400	[illegible]	486.0	6886
2	0	4250	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6360	[illegible]	486.0	6846
3	0	4160	6220	[illegible]	[illegible]	[illegible]	[illegible]	6220	0	486.0	6706

18,980 INSPECTOR

GLASGOW, [illegible]
BEACH ST [illegible]
PHILA. PA [illegible]
ON [illegible] OFF [illegible]

[illegible] HAZARD WARNING: Thermal burns from contact with hot liquid, inhalation and eye irritation hazards from hydrogen sulfide gas.

SOLD TO [illegible]
CUSTOMER [illegible]
LOCATION [illegible]

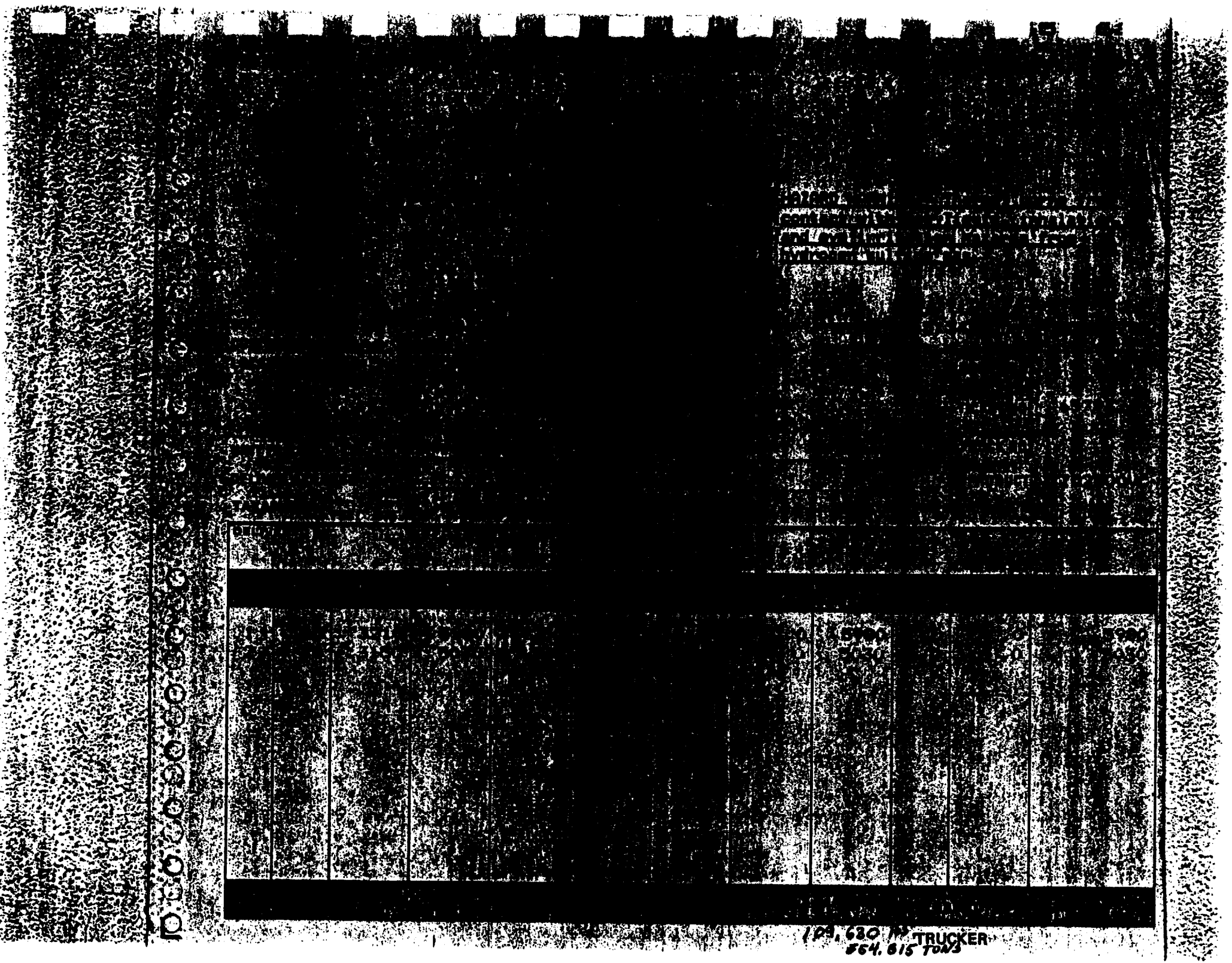
ORDER NO.
TICKET NO. 657[illegible]
TRUCK NO.
PRODUCT ID2B00VC

UNIT PRICE
DELIVERY CHARGE
TAXABLE YES NO

DELIVERED BY [illegible]

1	0	3130	[illegible]	[illegible]	[illegible]	[illegible]	0	6090	.0	.0	6080
2	0	3530	5990	[illegible]	[illegible]	[illegible]	0	5990	.0	.0	5990
3	0	3370	5980	4170	[illegible]	[illegible]	0	5980	.0	.0	5980

98,620 INSPECTOR


109,630 lbs
TRUCKER
564,815 TONS

APPENDIX E

EQUIPMENT CALIBRATION RECORDS

NOZZLE CALIBRATION DATA FORM

Date 5/22/89 Calibrated by [illegible]

Nozzle identification number	Nozzle diameter, inches[a]			ΔD,[b]	D_{avg}[c]
	D_1	D_2	D_3		
21G	.235	.237	.237	.002	.236
21B	.232	.230	.231	.002	.231

Where:

[a] $D_{1,2,3}$ = three different nozzle diamters, inches; each diameter must be measured to nearest 0.001 in.

[b] ΔD = maximum difference between any two diameters, inches. ΔD must be $\leq$ 0.004 in.

[c] D_{avg} = nozzle diameter = average of D_1, D_2 and D_3.

METER BOX CALIBRATION DATA AND CALCULATION FORM

New Calibration

Date 25 May 1988

Meter Box Number Nutech #9

Barometric pressure, P_b = 29.78 in. Hg

Calibrated by Bruce Wood

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	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	$\Delta H@_i$ in. H_2
0.5	5	105.776 110.750	75	78 79 80	77 77 77	78	12.8	1.009	1.856
.0	5	100.295 105.284	75	79 80 81	77 78 78	78.8	9.0	1.007	1.849
1.5	10	112.242 122.243	75	78 81 85	77 77 78	79.3	15.1	1.004	1.932
.0	10	122.731 132.789	75	84 86 88	77 78 79	82.	13.3	1.002	1.974
.0	10	133.793 143.955	75	86 89 90	79 79 79	83.7	10.9	.9927	1.997
4.0	10								
							Avg	Y 1.003	$\Delta H@$ 1.922

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\theta}{V_w}\right]^2$
0.5	0.0368	538.29.78-5 535-29.82-4.974 1.009	.01585 .000001 535-12.8 538-29.78 ÷5 ✓ 1.856
.0	0.0735	538.8-29.78-5 535-29.85-4.989 1.007	.0317 .000002 535-9.0 538.8-29.78 ÷5 ✓ 1.849
.5	0.110	539.3-29.78-10 535-29.89-10.001 1.004	.04755 .000003 535-15.1 539.3-29.78 ÷10 ✓ 1.932
2.0	0.147	542.29.78-10 535-29.93-10.058 1.0029	.0634 .0000039 535-13.3 542.29.78 ÷10 ✓ 1.974
.0	0.221	543.7-29.78-10 535-30.00-10.162	.0951 .0000059 535-10.9 543.7-29.78 ÷10 ✓ 1.997
.0	0.294		

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

MICHAEL BARKER

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers _____ Date 25 MAY 89 Meter box number NUTECH #9 Plant GLASGOW

Barometric pressure, P_b = 29.95 in.Hg Dry gas meter number 6843913 Pretest Y 1.007

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average (t_d)[1], °F	Time (θ), min	Vacuum setting, in. Hg.	Y_i	Y_i $\frac{V_w P_b (t_d + 460)}{V_d(P_b + \frac{\Delta H}{13.6})(t_w + 460)}$
1.0	10	408.557 398.310	70	86 89 91	85 85 86	87	18:06	4"	1.004	
1.0	10	418.917 408.557	70	86 88 91	85 86 86	87	18:06	4"	1.006	
1.0	10	429.134 418.917	70	86 89 91	86 85 85	87	18:00	4"	1.008	
									Y =	1.006

[1] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, $\frac{t_{d_i} + t_{d_o}}{2}$, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

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

$$\Delta H\theta_i = \frac{0.0317\,\Delta H}{P_b\,(t_d + 460)} \left[\frac{(t_w + 460)\,\theta}{V_w}\right]$$

M. J. Barker

TYPE S PITOT TUBE INSPECTION DATA FORM

PITOT TUBE P5

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 2 ° (<10°), α_2 = 1 ° (<10°), β_1 = 1 ° (<5°),

β_2 = 0 ° (<5°)

γ = 2 °, θ = 1 °, A = .952 cm (in.)

z = A sin γ = .033 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = .017 cm (in.); <.08 cm (<1/32 in.)

P_A .476 cm (in.) P_b .476 cm (in.)

D_t = .372 cm (in.)

Comments: Inspected 9/21/88 [illegible]

Calibration required? _____ yes ✓ no

WESTON

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 1/17/89 ~~Thermocouple~~ POTENTIOMETER number NTech 9

Ambient temperature 67 °F Barometric pressure 29.57 in. Hg

Calibrator Jeb Mills Reference: mercury-in-glass YES

other

Reference point number	Source[a] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[b] %
	ICE BATH	32°F	34.°F	+0.41%
	Ambient	67°F	67°F	0
	Hot oil	301°F	306°F	+0.66%

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °F} + 459.67) - (\text{test thermom temp, °F} + 459.67)}{\text{ref temp, °F} + 459.67}\right] 100 \leq 1.5\%.$

APPENDIX F

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

The following WESTON employees participated in this project:

Barry L. Jackson Project Director	EconENVIRONomics
Jeffrey D. O'Neill Section Manager	EconENVIRONomics
Jack Mills Project Scientist Assistant	EconENVIRONomics
Rick Marz Project Scientist Assistant	EconENVIRONomics
Ted Barker Senior Field Technician	EconENVIRONomics
Nancy Robertson Senior Laboratory Technician	EconENVIRONomics