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EMISSION TEST REPORT

PERFORMANCE EVALUATION
LANDFILL-GAS ENCLOSED FLARE
BROWNING-FERRIS INDUSTRIES

Chicopee

September 1990

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Reviewed by: Richard W. Gerstle, P.E.

PN: 50014

CHESTER TOWERS

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REPORT CERTIFICATION

The sampling and analysis performed for this report were carried out under my direction and supervision.

Date: 9-28-90 Signature: Daniel E. Fitzgerald

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date: 9-28-90 Signature: Richard W. Gerstle
Richard W. Gerstle, P.E.

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SECTION 1

INTRODUCTION

On August 15, 1990, personnel from PEI Associates, Inc. (PEI) conducted atmospheric emission tests on an enclosed flare operated by Browning-Ferris Industries (BFI) in Chicopee, Massachusetts. Landfill gas containing methane (CH_4) is collected from a series of wells and supplied to the flare as fuel for the flame.

Tests were conducted at the inlet to the flare and at the flare stack to determine the destruction efficiency of nonmethane organics (NMO) and selected volatile organic compounds (VOCs). Tests were conducted to determine the outlet mass emission rates of hydrochloric acid (HCl), sulfur dioxide (SO_2), and selected VOCs.

Mr. Matt Williams of BFI coordinated the process operations throughout the sampling program, and Mr. Dan Fitzgerald of PEI coordinated all testing activities.

SECTION 2

SUMMARY OF RESULTS

Table 2-1 presents a summary of the flare and flue gas conditions during the testing program. During the sampling program, volumetric flow rates were determined by procedures described in EPA Method 2.* This method was adequate in determining the flare inlet gas velocity; however, the velocity measured at the flare stack was very low. The pressure drop measured across the S-type pitot tube was very low and near the level of detection on a 0- to 0.25-in. manometer, thereby increasing potential error in the methodology. Appropriate data were obtained during the sampling program to use an alternative method for low-flow determination. Procedures following those similar to EPA Method 2B* were used to determine the flare stack flow rate in addition to Method 2. Method 2B uses a carbon balance method to calculate the flow rate downstream of a combustion source. See Appendix A for example calculations and Appendix D for procedures used to collect data used for this determination.

Flare inlet flow rates averaged 1060 dry standard cubic feet per minute (dscfm) [1150 actual cubic feet per minute (acfm)]. Temperature averaged 101°F; moisture (H_2O) content, 3.1 percent; carbon dioxide (CO_2) content, 30.2 percent; oxygen (O_2) content, 2.0 percent; and methane (CH_4) content, 47.8 percent.

Flare stack flow rates by EPA Method 2 averaged 11,400 dscfm (44,500 acfm), compared with 10,200 dscfm determined by carbon balance. Temperature of the flue gas averaged 1402°F; H_2O content, 9.7 percent; CO_2 content, 8.1 percent; and O_2

* 40 CFR 60, Appendix A, July 1989.

TABLE 2-1. SUMMARY OF FLUE GAS EMISSIONS

Run No.	Sampling location	Flue gas flow rate			Temperature, °F	Moisture, %	O_2, %	CO_2, %	CH_4, %	N_2, %
		acfm	dscfm[a]	dscfm[b]						
B2-I-1	Inlet	1,120	1,050		96	3.1	2.2	29.7	47.3	20.5
B2-O-1	Stack	41,000	10,600		1393	9.9	11.8	8.0		80.2
				10,100						
B2-I-2	Inlet	1,140	1,050		100	3.1	2.1	30.3	47.6	19.9
B2-O-2	Stack	43,600	11,100		1418	9.9	11.8	8.0		80.2
				10,500						
B2-I-3	Inlet	1,160	1,070		102	3.1	1.8	30.3	48.4	19.5
B2-O-3	Stack	45,100	11,400		1430	9.8	12.2	8.0		79.8
				10,400						
B2-I-4	Inlet	1,180	1,070		103	3.1				
B2-O-4	Stack	46,900	11,700		1434	9.6	12.2	8.1		79.7
				10,300						
B2-I-5	Inlet	1,170	1,060		103	3.1				
B2-O-5	Stack	44,500	11,300		1403	9.5	12.4	8.2		79.4
				10,100						
B2-I-6	Inlet	1,160	1,060		103	3.1				
B2-O-6	Stack	45,100	11,700		1366	9.6	12.3	8.2		79.5
				10,100						
B2-I-7	Inlet	1,160	1,060		100	3.1				
B2-O-7	Stack	45,500	11,800		1367	9.6	12.1	8.2		79.7
Average	Inlet	1,150	1,060		101	3.1	2.0	30.2	47.8	20.0
	Stack	44,500	11,400	10,200	1402	9.7	12.1	8.1		79.8

[a] Results from EPA Method 2 determination.

[b] Results from carbon balance using the average inlet volumetric flow rates from corresponding pretest and posttest measurements.

content, 12.1 percent. All flare stack emission rates are calculated using the flow-rate value obtained from the carbon balance, since this should be more accurate.

Table 2-2 presents a pollutant emissions summary of the data obtained during the sampling program. Pollutant emission data concentrations are presented in parts per million (ppm) by volume and micrograms per cubic meter ($\mu g/m^3$). Mass emission rates are presented in pounds per hour (lb/h). The product of the pollutant concentration and the flue gas flow rate yields the mass emission rate.

Table 2-3 presents the HCl emissions data collected from the flare inlet and stack locations. Inlet concentrations were determined from sample aliquots taken from the canisters used to determine the individual VOC concentrations. Levels of chloride (Cl^-) presented as HCl were below detection at the inlet. The level of detection for the inlet HCl concentrations was much higher than that of the outlet samples. The detection limit depends on the volume of sample obtained during the testing. The volume of gas taken from the canister is much smaller than the sample volume analyzed for by the EPA Method 26 sampling procedures. The HCl concentrations measured at the stack by EPA draft Method 26 averaged 9.8 ppm (15,000 $\mu g/m^3$), which corresponds to an average mass emission rate of 0.575 lb/h. Outlet mass emission rates of HCl correspond well to the inlet emission rates determined for total organic bound chloride.

Table 2-4 presents data on SO_2 emissions from the flare stack. Concentrations average 2.1 ppm (5600 $\mu g/m^3$) of SO_2, which corresponds to a mass emission rate of 0.22 lb/h.

Testing was conducted to determine the removal efficiency of NMOs fed to the landfill gas flare. Method 25* was used to make this determination since it is the EPA reference method for NMOs, and proposed Federal regulations plan to use NMO removal efficiency as a surrogate determination of the methane removal efficiency. However, the analytical detection limits of the Methods 25 analyzer restricted the

* 40 CFR, Appendix A, July 1989.

TABLE 2-2. SUMMARY OF POLLUTANT EMISSIONS

Pollutant	Sampling site	Concentration		Emission rate, lb/h
		ppm	$\mu g/m^3$	
CO	Stack	236	274,000	10.64
HCl	Inlet	<132	<200,000	<0.793
	Stack	9.8	15,000	0.575
NO_x	Stack	14.6	27,900	1.08
SO_2	Stack	2.1	5,600	0.22
NMO	Inlet	709	354,000	1.40
	Stack	<11	<5,300	<0.206
VOCs				
Benzene	Inlet	4.82	15,700	0.0621
	Stack	<0.0062	<20	<0.0008
Benzyl chloride	Inlet	<0.18	<925	<0.0037
	Stack	<0.0038	<20	<0.0008
Carbon tetrachloride	Inlet	<0.14	<925	<0.0037
	Stack	<0.0031	<20	<0.0008
Chlorobenzene	Inlet	<0.20	<925	<0.0037
	Stack	<0.0043	<20	<0.0008
Chloroform	Inlet	<0.19	<925	<0.0037
	Stack	<0.0040	<20	<0.0008
Dichlorobenzene	Inlet	<0.15	<925	<0.0037
	Stack	<0.0033	<20	<0.0008
1,1-Dichloroethane	Inlet	5.02	20,700	0.0819
	Stack	<0.0049	<20	<0.0008
1,2-Dichloroethane	Inlet	<0.22	<925	<0.0037
	Stack	<0.0049	<20	<0.0008
1,1-Dichloroethene	Inlet	<0.23	<925	<0.0037
	Stack	<0.0050	<20	<0.0008
Methylene chloride	Inlet	11.9	42,000	0.1666
	Stack	2.12	7,500	0.2911
Tetrachloroethene	Inlet	1.59	11,000	0.0436
	Stack	<0.0029	<20	<0.0008
Toluene	Inlet	119	456,700	1.8109
	Stack	0.0076	29	<0.0011

(continued)

TABLE 2-2 (continued)

Pollutant	Sampling site	Concentration ppm	Concentration $\mu g/m^3$	Emission rate, lb/h
1,1,1-Trichloroethane	Inlet	1.14	6,300	0.0250
	Stack	<0.0036	<20	<0.0008
Trichloroethene	Inlet	2.20	12,000	0.0476
	Stack	<0.0037	<20	<0.0008
Vinyl chloride	Inlet	8.59	22,300	0.0885
	Stack	<0.0077	<20	<0.0008
Xylenes (total)	Inlet	41.5	183,300	0.7269
	Stack	<0.0045	<20	<0.0008
Total sulfur				
Dimethyl sulfide	Inlet	<0.03	<86	<0.0003
Ethyl mercaptan	Inlet	0.33	810	0.0033
Hydrogen sulfide	Inlet	<0.22	<320	<0.0013
Methyl mercaptan	Inlet	0.11	230	0.0009

TABLE 2-3. SUMMARY OF HCl EMISSIONS

Run No.	Sampling site	Date (1990)	Time (24-h)	Concentration ppm	Concentration $\mu g/m^3$	Emission rate, lb/h
B25-I-1	Inlet	8/15	0812-0948	<132	<200,000	<0.786
B26-1	Outlet	8/15	0812-0948	9.4	14,000	0.539
B25-I-2	Inlet	8/15	1100-1200	<132	<200,000	<0.793
B26-2	Outlet	8/15	1100-1200	9.2	14,000	0.547
B25-I-3	Inlet	8/15	1314-1414	<132	<200,000	<0.799
B26-3	Outlet	8/15	1314-1414	10.8	16,000	0.639
Average	Inlet			<132	<200,000	<0.793
	Outlet			9.8	15,000	0.575

TABLE 2-4. SUMMARY OF SO_2 EMISSIONS

Run No.	Date (1990)	Time (24-h)	Concentration ppm	Concentration $\mu g/m^3$	Emission rate, lb/h
B6-0-1[a]	8/15	1527-1612	2.6	6900	0.27
B6-0-2[a]	8/15	1730-1817	2.3	6000	0.23
B6-0-3[a]	8/15	1900-1945	1.5	4000	0.15
Average			2.1	5600	0.22

[a] Average of two 20-minute sampling trains collected during the sampling period.

calculated removal efficiencies. The detection limit of the Method 25 analyzer was approximately 11 ppm as carbon (C_1), and all samples taken from the flare stack were less than this. All stack emissions of NMOs are presented as a less-than value and the actual mass rate is somewhere between the reported value and zero. Using the less-than value to calculate the removal efficiency results in a greater-than value somewhere between the reported value and 100 percent. Therefore, if the detection limit is lowered, then the calculated removal efficiency increases. The GC/MS analysis of specific compounds is capable of achieving detection limits of near 20 parts per billion (ppb). Therefore, the GC/MS data provides the more accurate determination of removal efficiency. This can be used as a surrogate determination to overall removal efficiency. Toluene is an excellent surrogate in this determination since it is the prominent VOC in the inlet sample and has a high ranking in the thermal stability index.* If an identified VOC with an assigned thermal stability ranking is removed by thermal destruction, then compounds of lower ranking (higher numerically) are theoretically removed also. Toluene has a thermal stability ranking of 35. Benzene, dichlorobenzene, and chlorobenzene have higher rankings, but are limited to the levels of detection. Dichlorobenzene and chlorobenzene were not detected at either the inlet or stack; therefore, they are not suitable for the determination of removal efficiency. Removal efficiency calculated by benzene levels are not completely representative, since it is limited by the outlet detection limit. Toluene was detected at the inlet and stack; therefore, the removal efficiency can be accurately calculated. Removal efficiency based on the average inlet and average stack toluene mass emission rates is calculated at 99.94 percent, as compared to the detection limited NMO results at greater than 84.5 percent removal.

Tables 2-5a and 2-5b present the calculated removal effiency data for both NMOs and toluene. Table 2-5a presents the concentration and mass emission rate of

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* EPA 625/6-89/019. Guidance on Setting Permit Conditions and Reporting Trial Burn Results, Volume II of the Hazardous Waste Incineration Guidance Series, January 1989.

TABLE 2-5A. REMOVAL EFFICIENCY BASED ON METHOD 25 (NMO) RESULTS

Run No.	Sampling site	Date (1990)	Time (24-h)	Concentration ppm	Concentration $\mu g/m^3$	Mass emission rate, lb/h	Removal efficiency, %
B25-I-1	Inlet	8/15	0812-0948	878	438,000	1.722	>90.1
B25-0-1	Stack	8/15	0812-0948	<9	<4,500	<0.170	
B25-I-2	Inlet	8/15	1100-1200	538	269,000	1.065	>79.8
B25-0-2	Stack	8/15	1100-1200	<11	<5,500	<0.215	
B25-I-3	Inlet	8/15	1314-1414	712	355,000	1.420	>83.5
B25-0-3	Stack	8/15	1314-1414	<12	<6,000	<0.234	
Average	Inlet			709	354,000	1.402	>84.5
	Stack			<11	<5,300	<0.206	

TABLE 2-5B. REMOVAL EFFICIENCY BASED ON GC/MS TOLUENE RESULTS

Run No.	Sampling site	Date (1990)	Time (24-h)	Concentration ppm	Concentration $\mu g/m^3$	Mass emission rate, lb/h	Removal efficiency, %
B25-I-1	Inlet	8/15	0812-0948	112	430,000	1.690	99.3
B25-0-1	Stack	8/15	0812-0948	0.007	28	0.0011	
B25-I-2	Inlet	8/15	1100-1200	125	480,000	1.904	99.4
B25-0-2	Stack	8/15	1100-1200	0.007	27	0.0011	
B25-I-3	Inlet	8/15	1314-1414	120	460,000	1.839	99.93
B25-0-3	Stack	8/15	1314-1414	0.008	31	0.0012	
Average	Inlet			119	457,000	1.811	99.94
	Stack			0.008	29	0.0011	

NMOs from the flare inlet and stack. Flare inlet concentrations average 709 ppm (354,000 $\mu g/m^3$), which corresponds to an average mass emission rate of 1.402 lb/h. Stack NMO levels were below analytical detection of 11 ppm (5,300 $\mu g/m^3$). If this value is used to calculate a theoretical stack mass emission rate, a value of <0.206 lb/h is obtained.

Table 2-5b presents the concentration and mass emission rate of toluene from the flare inlet and stack. Flare inlet concentrations averaged 119 ppm (457,000 $\mu g/m^3$), which corresponds to an average mass emission rate of 1.811 lb/h. The average stack concentration was 0.008 ppm (29 $\mu g/m^3$). The average mass emission rate of toluene was 0.0011 lb/h.

All selected VOCs measured at the inlet were at levels below detection at the stack with the exception of methylene chloride and toluene. Methylene chloride is used in laboratory extraction processes. EPA reference methods require extraction with methylene chloride and, therefore, it is a common laboratory contaminant in any lab conducting EPA analyses. Analysis of blank field canister that was pressurized with ultrapure helium showed methylene chloride present as an analytical contaminant. Outlet concentrations were comparable to those found in the sample blank; therefore, to designate these levels as representative of the flare stack composition may be erroneous. Methylene chloride may exist in both the inlet and stack; however, accurate quantitation is precluded because it is an artifact of laboratory contamination. Table 2-6 presents data on the concentration and mass emission rates for the selected VOC's analyzed by GC/MS.

Removal efficiency is not shown in compounds that were not detected at either the inlet or stack.

Emission data are presented in Table 2-1 on flare stack concentration and mass emission rate of nitrogen oxide (NO_x). Three sampling runs were conducted, each of

TABLE 2-6. SUMMARY OF SELECTED VOC POLLUTANTS

POLLUTANT	SAMPLING SITE	CONCENTRATION								MASS EMISSION RATE				% Removal Efficiency			
		Run 1		Run 2		Run 3		AVERAGE		Run 1	Run 2	Run 3	Avg.	Run 1	Run 2	Run 3	
		ppm	µg/m3	ppm	µg/m3	ppm	µg/m3	ppm	µg/m3	lb/h	lb/h	lb/h	lb/h	µg/m3	ppm	µg/m3	AVERAGE
benzene 3V	Inlet	4.82	15,000	4.82	16,000	4.82	16,000	4.82	15,700	0.0589	0.0635	0.0640	0.0621	>98.81	>98.74	>98.59	>98.72
	outlet	<0.006	<18	<0.006	<20	<0.007	<23	<0.006	<20	<0.0007	<0.0008	<0.0009	<0.0008				
benzyl chloride BC	Inlet	<0.17	<905	<0.18	<950	<0.17	<920	<0.17	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA[a]	NA	NA	NA
	outlet	<0.003	<18	<0.004	<20	<0.004	<23	<0.004	<20	<0.0007	<0.0008	<0.0009	<0.0008				
carbon tetrachloride 6V	Inlet	<0.14	<905	<0.18	<950	<0.18	<920	<0.14	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA	NA	NA	NA
	outlet	<0.003	<18	<0.004	<20	<0.004	<23	<0.003	<20	<0.0007	<0.0008	<0.0009	<0.0008				
chlorobenzene 7V	Inlet	<0.18	<905	<0.20	<950	<0.20	<920	<0.20	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA	NA	NA	NA
	outlet	<0.004	<18	<0.004	<20	<0.005	<23	<0.004	<20	<0.0007	<0.0008	<0.0009	<0.0008				
chloroform 11V	Inlet	<0.18	<905	<0.18	<950	<0.18	<920	<0.19	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA	NA	NA	NA
	outlet	<0.004	<18	<0.004	<20	<0.005	<23	<0.004	<20	<0.0007	<0.0008	<0.0009	<0.0008				
dichlorobenzene DCB	Inlet	<0.18	<905	<0.18	<950	<0.18	<920	<0.18	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA	NA	NA	NA
	outlet	<0.003	<18	<0.003	<20	<0.004	<23	<0.003	<20	<0.0007	<0.0008	<0.0009	<0.0008				
1,1-dichloroethane 14V	Inlet	4.86	20,000	5.1	21,000	5.1	21,000	5.02	20,700	0.0786	0.0833	0.0839	0.0819	>98.5	>98.4	>98.3	>98.4
	outlet	<0.004	<18	<0.006	<20	<0.006	<23	<0.020	<20	<0.0012	<0.0013	<0.0014	<0.0013				
1,2-dichloroethane 15V	Inlet	<0.22	<905	<0.23	<950	<0.22	<920	<0.22	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA	NA	NA	NA
	outlet	<0.006	<18	<0.006	<20	<0.006	<23	<0.005	<20	<0.0007	<0.0008	<0.0009	<0.0008				
1,1-dichloroethene 16V,A	Inlet	<0.23	<905	<0.24	<950	<0.23	<920	<0.23	<925	<0.0036	<0.0038	<0.0037	<0.0037	NA	NA	NA	NA
	outlet	<0.004	<18	<0.006	<20	<0.006	<23	<0.005	<20	<0.0007	<0.0008	<0.0009	<0.0008				
methylene chloride[b] 22V	Inlet	11.04	39,000	12.45	44,000	12.17	43,000	11.88	42,000	0.1533	0.1748	0.1719	0.1666	-36.42	-66.43	-95.23	-73.36
Dichloromethane	outlet	1.58	5,600	2.36	8,300	2.43	8,600	4.30	7,500	0.2122	0.3255	0.3356	0.2911				
tetrachloroethene 24VA	Inlet	1.59	11,000	1.59	11,000	1.59	11,000	1.59	11,000	0.0432	0.0436	0.0440	0.0436	>98.36	>98.17	>97.95	>98.17
	outlet	<0.003	<18	<0.003	<20	<0.003	<23	<0.003	<20	<0.0007	<0.0008	<0.0009	<0.0008				
toluene 25V	Inlet	112.2	430,000	125.3	480,000	120.6	460,000	119.2	457,000	1.6896	1.9042	1.8387	1.8109	99.93	99.94	99.93	99.94
	outlet	0.007	26	0.008	27	0.008	31	0.008	29	0.0011	0.0011	0.0012	0.0011				
1,1,1-trichloroethane 27V	Inlet	1.08	8,000	1.17	8,500	1.16	8,400	1.13	8,300	0.0236	0.0258	0.0256	0.0250	>97.03	>96.90	>96.48	>96.81
	outlet	<0.003	<18	<0.004	<20	<0.004	<23	<0.004	<20	<0.0007	<0.0008	<0.0009	<0.0008				
trichloroethene 29VA	Inlet	2.2	12,000	2.2	12,000	2.2	12,000	2.2	12,000	0.0472	0.0478	0.0480	0.0478	>98.52	>98.32	>98.13	>98.32
	outlet	<0.003	<18	<0.004	<20	<0.004	<23	<0.004	<20	<0.0007	<0.0008	<0.0009	<0.0008				
vinyl chloride 31V	Inlet	8.46	22,000	8.65	23,000	8.46	22,000	8.59	22,300	0.0865	0.0912	0.0879	0.0885	>99.19	>99.12	>98.98	>99.10
	outlet	<0.007	<18	<0.008	<20	<0.009	<23	<0.008	<20	<0.0007	<0.0008	<0.0009	<0.0008				
xylenes (total) XYL	Inlet	63.48	170,000	47.54	210,000	36.48	170,000	40.21	183,300	0.6660	0.8331	0.8795	0.7269	>99.90	>99.90	>99.87	>99.89
	outlet	<0.004	<18	<0.005	<20	<0.005	<23	<0.005	<20	<0.0007	<0.0008	<0.0009	<0.0008				

[a] NA - Not Applicable
[b] Artifact from laboratory contamination.

which consisted of four flask grab samples, as described in EPA Method 7A.* Average results for Sampling Run B7-1 consist of the average value obtained from three flasks. After return to the laboratory, the second flask obtained during the first sampling period was under higher vacuum than the other 11 sampled flasks. The analytical results presented levels below detection and were not consistent with the other sampled flasks; therefore, this sample was deemed nonrepresentative and was not used in the emission calculations. NO_x concentrations averaged 14.6 pp, (27,900 $\mu g/m^3$), which corresponds to an average mass emission rate of 1.08 lb/h.

TABLE 2-7. SUMMARY OF NITROGEN OXIDES EMISSIONS

Run No.	Date (1990)	Time (24-h)	Concentration		Mass emission rate, lb/h
			ppm	$\mu g/m^3$	
B7-1[a]	8/15	0812-0948	12.9	24,700	0.94
B7-2	8/15	1100-1200	15.3	29,300	1.14
B7-3	8/15	1314-1414	15.6	29,900	1.17
Average			14.6	27,900	1.08

[a] Average of three flasks.

Table 2-8 presents data on the emissions of carbon monoxide (C)). These data were obtained by procedures described in EPA Method 10.* Concentrations averaged 236 ppm (274,000 $\mu g/m^3$), which corresponds to an average mass emission rate of 10.64 lb/h.

TABLE 2-8. SUMMARY OF CARBON MONOXIDE EMISSIONS

Run No.	Date (1990)	Time (24-h)	Concentration		Mass emission rate, lb/h
			ppm	$\mu g/m^3$	
B10-0-1	8/15	0812-0948	208	242,000	9.18
B10-0-2	8/15	1100-1200	282	328,000	12.88
B10-0-3	8/15	1314-1414	217	253,000	9.86
Average			236	274,000	10.64

* 40 CFR 60, Appendix A, July 1989.

Landfill gas at the flare inlet sampling site was analyzed for sulfur-containing compounds. Table 2-9 presents the data obtained from this analysis. Total sulfur average mass emission rate was determined by the sum of the averages of ethyl mercaptan, dimethyl sulfide, hydrogen sulfide, and methyl mercaptan. The total sulfur mass emission rate averaged 0.0058 lb/h.

TABLE 2-9. FLARE INLET TOTAL SULFUR EMISSIONS

Run No.	Pollutant	Concentration ppm	Concentration $\mu g/m^3$	Mass emission rate, lb/h
BFG-I-1	Ethyl mercaptan	0.12	310	0.0012
	Dimethyl sulfide	0.02	52	0.0002
	Hydrogen sulfide	ND[a]	ND	ND
	Methyl mercaptan	0.20	400	0.0016
	Total sulfur			0.0030
BFG-I-2	Ethyl mercaptan	0.85	2200	0.0087
	Dimethyl sulfide	0.08	200	0.0008
	Hydrogen sulfide	ND	ND	ND
	Methyl mercaptan	0.01	20	0.0001
	Total sulfur			0.0096
BFG-I-3	Ethyl mercaptan	0.01	26	0.0001
	Dimethyl sulfide	ND	ND	ND
	Hydrogen sulfide	0.67	950	0.0038
	Methyl mercaptan	0.13	260	0.0010
	Total sulfur			0.0049
Average	Ethyl mercaptan	0.33	810	0.0033
	Dimethyl sulfide	<0.03	<86	<0.0003
	Hydrogen sulfide	<0.22	<320	<0.0013
	Methyl mercaptan	0.11	230	0.0009
	Total sulfur			0.0058

[a] ND = Not detected.

Tables 2-10 and 2-11 present data on the gas chromatograph/mass spectrometer (GC/MS) scan for other VOCs not analyzed for specifically. Retention times in which each VOC elutes to the detector are listed in these tables. Retention times are the only way to label unidentified VOC's. Dichlorodifluoromethane, acetone, trichlorofluoromethane, 1,2-dichloroethane, ethyl benzene, and styrene were identified at the

TABLE 2-10. SUMMARY OF NONTARGET VOCs - FLARE INLET

Compound name	Retention time, min.	Concentration, $\mu g/m^3$ Run No. B25-I-1	B25-I-2	B25-I-3	Emission rate, lb/h Run No. B25-I-1	B25-I-2	B25-I-3
Dichlorodifluoromethane	2:16	40,000	40,000	40,000	0.1572	0.1587	0.1599
Acetone	5:44	70,000	60,000	80,000	0.2750	0.2380	0.3197
Trichlorofluoromethane	6:38	3,000	3,000	3,000	0.0118	0.0119	0.0120
1,2-Dichloroethene	9:22	20,000	30,000	30,000	0.0786	0.1190	0.1199
Hydrocarbon	10:16		20,000	20,000		0.0793	0.0799
Hydrocarbon	12:34	30,000	40,000	40,000	0.1179	0.1587	0.1599
Hydrocarbon[a]	13:28	20,000	30,000	20,000	0.0786	0.1190	0.0799
Hydrocarbon	15:38		40,000	30,000		0.1587	0.1199
Hydrocarbon[b]	16:02		40,000			0.1587	
Hydrocarbon	17:40	60,000	70,000	60,000	0.2357	0.2777	0.2398
Hydrocarbon	19:28	20,000	20,000	20,000	0.0786	0.0793	0.0799
Hydrocarbon	20:48		80,000	80,000		0.3173	0.3197
Hydrocarbon	24:00		20,000			0.0793	
Unknown	24:34	30,000		30,000	0.1179		0.1199
Ethylbenzene	25:34	300,000	40,000	300,000	1.1787	0.1587	1.1990
Hydrocarbon	25:38	20,000			0.0786		
Hydrocarbon	26:06		40,000	40,000		0.1587	0.1599
Styrene	28:22	20,000	20,000	20,000	0.0786	0.0793	0.0799
Unknown	29:34		40,000		0.0000	0.1587	
Total					2.4871	2.5108	3.2492

[a] Possible alkane.

[b] Possible alkane, tentatively identified as hexane in Sample Run B25-1-2.

TABLE 2-11. SUMMARY OF NONTARGET VOCs - FLARE STACK

Compound name	Retention time, min.	Concentration, $\mu g/m^3$ Run No. B25-I-1	B25-I-2	B25-I-3	Emission rate, lb/h Run No. B25-I-1	B25-I-2	B25-I-3
Unknown	1:16	1000			0.0379		
	2:24	200			0.0076		
	3:22	100			0.0038		
	5:22			9			0.0004
	6:30	30			0.0011		
	18:42	300	300	300	0.0114	0.0118	0.0117
Total					0.0617	0.0118	0.0121

SECTION 3

QUALITY ASSURANCE

Because the desired end product of testing is representative emission results, quality assurance is one of the main facets of stack sampling. Quality assurance guidelines outline considerations pertinent to the production of good data. Emission results are considered to be good, reliable data only when the correct quality assurance measures are taken. Outlined below are the steps taken to ensure quality data from our testing procedures.

Routine standard reference method quality control procedures were followed throughout this test series. These included, but were not limited to, the following:

- Calibration of field sampling equipment. Table 3-1 summarizes calibration of equipment used for this test series. Calibration guidelines are described in more detail in Appendix E.
- Train configuration and calculation checks.
- Onsite quality assurance checks, such as leak checks of the sampling train, pitot tube, and Orsat line.
- Use of designated analytical equipment and sampling reagent.
- Lab analysis quality assurance procedures. Table 3-2 outlines quality assurance results for analysis of field samples.
- Internal and external audits to ensure accuracy in sampling and analysis.

TABLE 3-1. FIELD EQUIPMENT CALIBRATION

Equipment	ID No.	Calibrated against	Allowable error	Actual error	Within allowable limits	Comments
Meter box	FT-7	Wet test meter	Y ±0.02	±0.004	X	
			ΔH@ ±0.15	-0.08	X	
			(Y ± 0.05 of Y post-test)	+0.002	X	
Pitot tubes	301	Geometric specifications	a	a	OK	Visually inspected on site
	523			a	OK	
				a		
Digital indicator	FT-7	Millivolt signals	±0.5%	-0.4%	X	Pretest
	122			+0.3%	X	Pretest
Stack thermocouple	646	ASTM-3F	±1.5%	-0.4%	X	
	734			+0.0%	X	
Orsat analyzer	142	Calibration gas	±0.5%	0.0%	X	CO_2
				-0.2%	X	O_2
Impinger thermocouples	I-22	ASTM-3F	±1.5°F	±1°F	X	
Trip balance	Mettler	Typs S weights	±0.5 g	-0.01 g	X	
Barometer	414	NBS-traceable barometer	±0.10 in.Hg	-0.01 in.Hg	X	Pretest
				+0.01 in.Hg	X	Posttest
Dry gas thermocouple	FT-7	ASTM-3F	±5°F	-1°F	X	Inlet
				±1°F	X	Outlet

TABLE 3-2. ANALYTICAL AUDIT RESULTS

Analyte	Theoretical value	Reported value	Percent recovery
SO_2, Audit No. 2529, Lot No. 0587	617 mg/dscm	620 mg/dscfm	100.4
NO_x, Audit No. 7272, Lot No. 0486	350 μg	NR[a]	101
Chloride			
Stack	4 mg/L	NR	93.5, 103, 99.2
Inlet	4 mg/L	NR	98.5, 101, 99.5, 98.5, 101

[a] NR = Not reported

Sampling equipment, reagents, and analytical procedures for this test series met all necessary guidelines set forth for accurate test results. Calibration showed that all pollutant sampling equipment was within the limits described in "Quality assurance Handbook for Air Pollution Measurement Systems, Volume III."*

Table 3-2 presents data on the quality assurance procedures for SO_2 and HCl samples. An EPA-supplied audit vial containing a concentration of sulfate ion (SO_4^{-2}) was analyzed to verify the titration technique of the analyst. An EPA-supplied audit vial containing a concentration of nitrate ion (NO^{3-}) was analyzed by ion chromatography to determine instrument accuracy. The reported value is compared with the theoretical value and reported as percent recovery. For HCl analysis, a standard reference solution (SRS) is prepared in house with a known quantity of chloride ions. Triplicate analysis by ion chromatography (IC) was conducted and this reported value was compared with the SRS theoretical value as percent recovery.

Table 3-3 presents the data on percent recovery of surrogate compounds that were injected onto the Tenax sorbent traps. The sorbent traps were the analytical collection media prior to injection to the detector. Three compounds were used as a surrogate determination of the percent recovery of the VOCs contained in the canister.

*EPA-600/4-77-027b, August 1977.

TABLE 3-3. SAMPLE CANISTER SURROGATE RECOVERY

Run No.	Compound percent recovery		
	d4-1,2-Dichloroethane	d8-toluene	p-Bromofluoroben-zene
B25-I-1	97	103	86
B25-I-1 duplicate	96	110	93
B25-I-2	105	102	97
B25-I-3	99	104	88
B25-O-1	110	100	87
B25-O-2	100	98	86
B25-O-3	105	99	86
Blank - 8/24/90	102	96	99
Blank - 9/15/90	96	101	86

SECTION 4

PROCESS DESCRIPTION

Browning-Ferris Industries, Inc., operates an enclosed ground flare to control CH_4 and NMOs contained in the landfill gas collected from their disposal site in Chicopee, Massachusetts. Figure 4-1 presents a layout of the methane control system.

The enclosed ground flare is a McGill Model No. EGF-41. The round stack is constructed of 1/4-in. carbon steel with a 2-in. refractory lining and dimensions of 8-ft o.d. by 35-ft overall height (see Figure 5-2). The combustion of landfill gas is conducted through a three-burner system with flame stabilizers constructed of stainless steel for high-temperature-corrosion resistance. The system is equipped with a flame arrestor to prevent flashback in the event the gas flow is lost. A pilot assembly designed for 60,000 Btu/h, fueled by propane, and equipped with an electric spark igniter is used to initiate combustion. Combustion air is controlled by manually operated dampers located near the bottom of the flare assembly. Flare temperature is also adjusted by regulating the dampers. If temperature exceeds 2100°F (because of possible damage to the inner refractory lining) or a flame failure is detected, the system will shut down automatically. The shutdown will turn off the landfill gas blowers and close the 8-in. inlet block valve to prevent the flow of landfill gas to the flare.

The landfill gas at the inlet had an average heat content of 484.2 Btu per dry standard cubic feet. Based on an average inlet flow rate of 1060 dscfm, the average heat input was 30.8 million Btu per hour (10^6 Btu/h) during the sampling program.

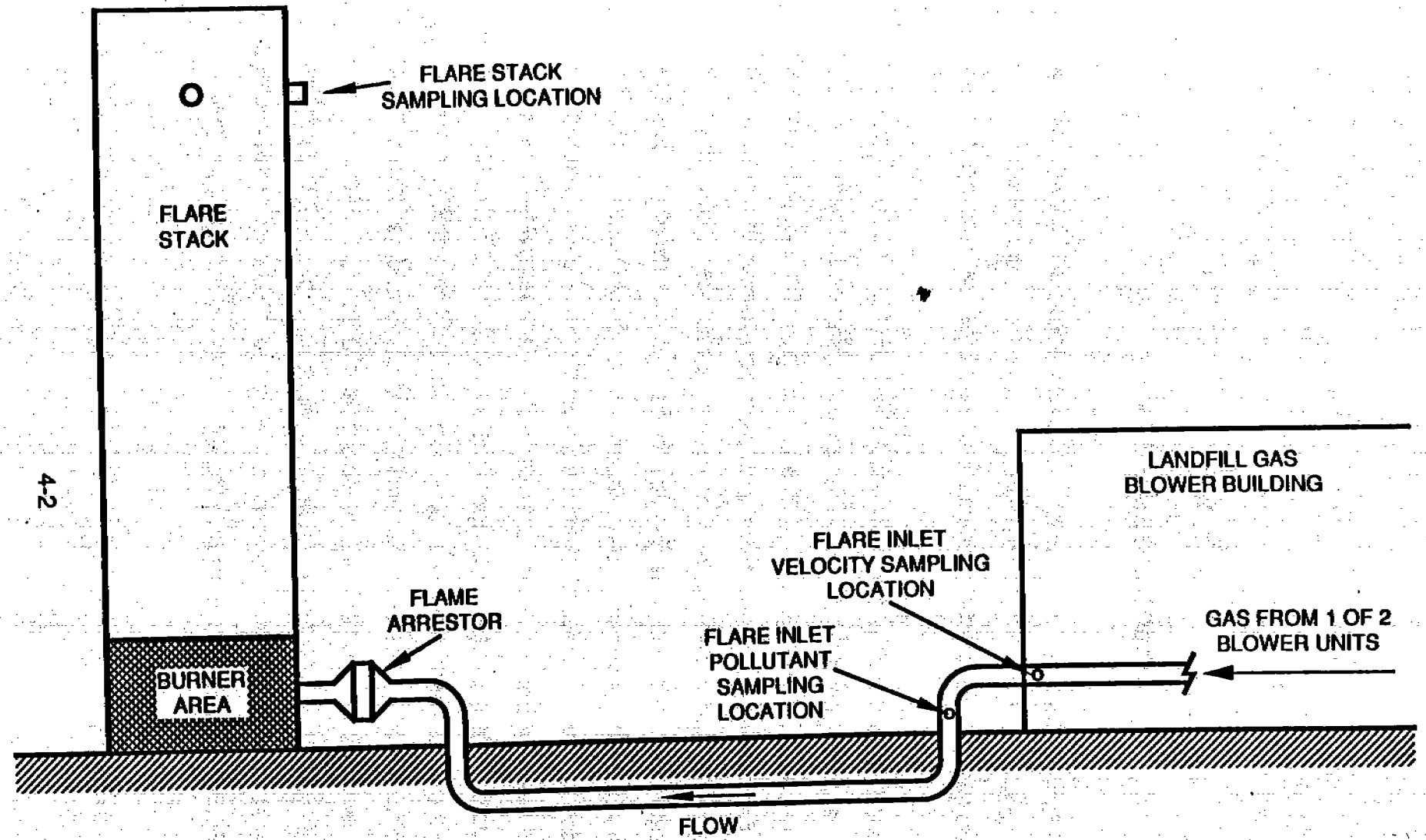

Figure 4-1. Methane control system.

The landfill gas at the inlet had an average heat content of 484.2 Btu per dry standard cubic foot. Based on an average inlet flow rate of 1060 dscfm, the average heat input was 30.8 million Btu per hour (10^6 Btu/h) during the sampling program.

SECTION 5

SAMPLING LOCATIONS AND FLOW RATE TEST METHODS

Emission testing was conducted at the duct supplying landfill gas to the flare burner system (flare inlet) and at the final atmospheric vent (flare stack).

Flare Inlet

As depicted in Figure 5-1, the two flare inlet sampling ports used for testing were located 7.0 duct diameters downstream and greater than 8 duct diameters upstream from the nearest flow disturbances. A total of 12 sampling points (6 per port) were used to traverse the cross-sectional area of the 7-3/4-in.-i.d. round duct.

Velocity and Gas Temperature

All gas velocities were measured with a Type-S pitot tube and a 0- to 0.250-in. inclined manometer. In all cases, velocities were measured at each sampling point across the stack to determine an average value according to procedures described in EPA Method 2.* Temperatures were measured at each point with a thermocouple and digital temperature indicator.

Molecular Weight

Flue gas composition and molecular weight were determined by ASTM Method D1945.** Stainless steel canisters with a volume of 300 cm^3 were used for sampling the landfill gas. Analysis for carbon dioxide, oxygen, nitrogen, methane, and other fuel

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* 40 CFR 60, Appendix A, July 1989.

** Annual Book of ASTM Standards, Section 5, Volume 05.05.

TRAVERSE POINT NO.	DISTANCE FROM INSIDE WALL, in.
1	1/2
2	1
3	1-3/4
4	2-5/8
5	4
6	7-7/8
7	9-1/4
8	10-1/8
9	10-7/8
10	11-3/8

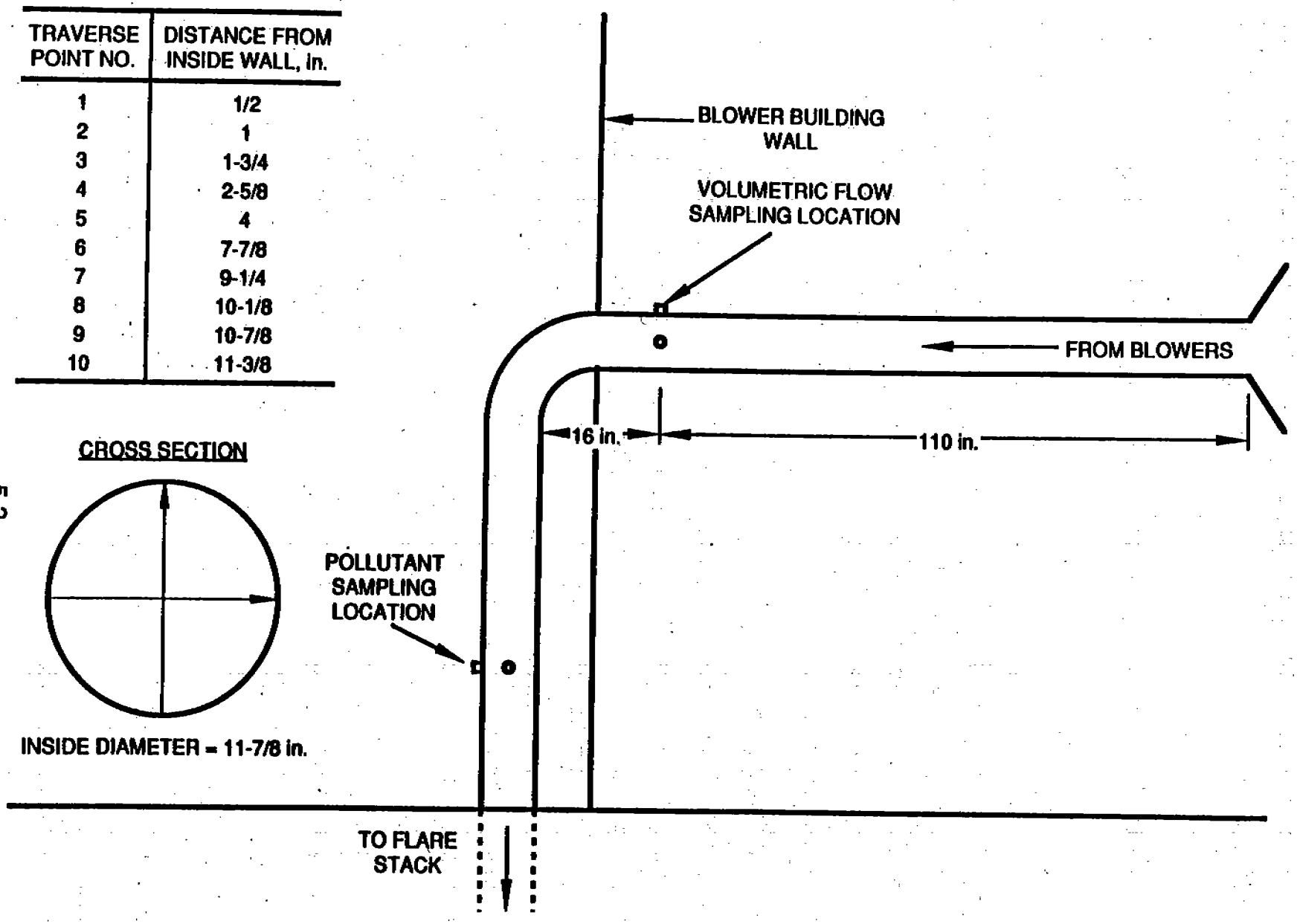

Figure 5-1. Flare inlet sampling location.

components was conducted by a gas chromatograph equipped with a thermal conductivity detector (GC-TCD).

Moisture

The percentage of water vapor was determined by the wet bulb/dry bulb procedure.

Flare Stack

As depicted in Figure 5-2, four sampling ports were located 3.3 stack diameters downstream and 0.5 stack diameter upstream of the nearest flow disturbances. Of the four sampling ports, only two were used to gain access to the exhaust gas stream. A total of 24 sampling points (12 per port) were used to traverse the cross-sectional area of the 91-1/2-in.-i.d. round stack.

Velocity and Gas Temperature

All gases were measured with a Type-S pitot tube and a 0- to 0.250-inch inclined manometer. During the test program, velocities were measured at each sampling point across the stack in accordance with procedures described in EPA Method 2* to determine an average value. During the sampling program, pressure drops across the pitot tube were extremely low (<0.050-in.H_2O). Such low pressure drops greatly decrease the accuracy of the method. Based on a review of the flare stack flow data and considering the decreased accuracy, an alternative method was used to represent the flow data in addition to the data collected by Method 2* procedures. This alternative method involved the use of calculations derived for EPA Method 2B* to determine flare stack exhaust flow rate. In this method, the flare stack exhaust flow rate is determined by carbon balance.

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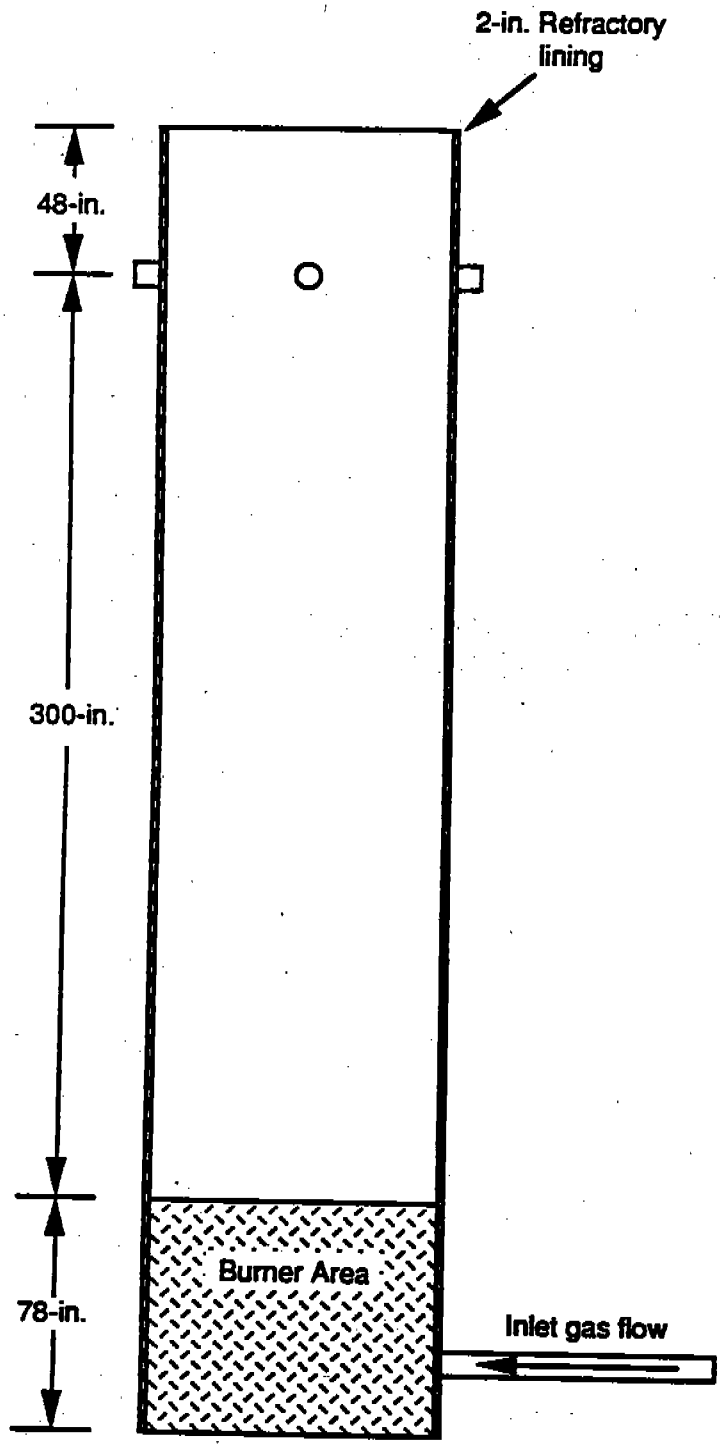
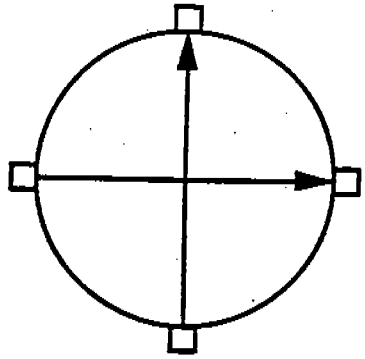
* 40 CFR 60, Appendix A, July 1989.





Inside diameter = 91.5-in
Sample port diameter = 3-in.

TRAVERSE POINT LOCATION

TRAVERSE POINT NO.	DISTANCE FROM INSIDE WALL, in.
1	1-7/8
2	6-1/8
3	10-3/4
4	16-1/4
5	22-7/8
6	32-5/8
7	58-7/8
8	68-5/8
9	75-1/4
10	80-3/4
11	85-3/8
12	89-5/8

Figure 5-2. Flare Outlet Sampling Location

APPENDIX A

COMPUTER PRINTOUTS AND EXAMPLE CALCULATIONS

validated 3/1

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	B2-I-1

DATE :	8/15/90	**BAROMETRIC PRES., in. Hg :**	30.2
TIME(24-HR) :	723	**STATIC PRES., in. H2O :**	3
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	110.75	**DRY MOLECULAR WEIGHT:**	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP. deg. F
1	0.070	93
2	0.105	94
3	0.125	95
4	0.170	96
5	0.180	96
6	0.180	96
7	0.200	96
8	0.200	96
9	0.180	96
10	0.170	95
11	0.140	95
12	0.150	96
13	0.180	96
14	0.190	96
15	0.180	96
16	0.190	96
17	0.190	96
18	0.220	96
19	0.200	96
20	0.170	96
	0.170	96

MW 9/14/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	B2-I-2

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	30.14
TIME(24-HR) :	1018	STATIC PRES., in. H2O :	3.2
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	110.75	DRY MOLECULAR WEIGHT:	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.135	99
2	0.150	99
3	0.160	100
4	0.190	100
5	0.190	100
6	0.200	101
7	0.190	101
8	0.190	101
9	0.170	101
10	0.160	100
11	0.120	100
12	0.140	100
13	0.160	100
14	0.160	100
15	0.150	100
16	0.180	100
17	0.200	100
18	0.210	100
19	0.180	100
20	0.200	100
	0.172	100

MW 9/10/90

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	B2-I-3

DATE :	8/15/90	**BAROMETRIC PRES., in. Hg :**	30
TIME(24-HR) :	1239	**STATIC PRES., in. H2O :**	3.1
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	110.75	**DRY MOLECULAR WEIGHT:**	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.130	100
2	0.135	101
3	0.170	102
4	0.185	102
5	0.190	102
6	0.190	102
7	0.170	102
8	0.210	102
9	0.190	102
10	0.190	102
11	0.120	102
12	0.150	102
13	0.200	102
14	0.130	102
15	0.220	102
16	0.190	102
17	0.210	102
18	0.190	102
19	0.200	102
20	0.190	102
	0.178	102

MW 9/14/90

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	B2-I-4

DATE :	10/15/90	**BAROMETRIC PRES., in. Hg :**	29.56
TIME(24-HR) :	1452	**STATIC PRES., in. H2O :**	3.1
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	110.75	**DRY MOLECULAR WEIGHT:**	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.130	102
2	0.150	102
3	0.160	103
4	0.175	102
5	0.200	103
6	0.190	103
7	0.210	102
8	0.210	103
9	0.175	103
10	0.170	103
11	0.130	103
12	0.180	102
13	0.180	103
14	0.170	103
15	0.210	103
16	0.210	103
17	0.200	103
18	0.220	102
19	0.180	103
20	0.180	103
	0.182	103

OK 9-12-90

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT : BFI - Chicopee
SAMPLE LOCATION : Flare Inlet

Run No:	B2-I-1	B2-I-2	B2-I-3	B2-I-4	AVERAGE
STACK PRESSURE, in Hg :	30.42	30.38	30.23	29.79	30.20
STACK TEMP., deg. F :	96	100	102	103	100
MOLECULAR WEIGHT, DRY :	27.16	27.16	27.16	27.16	27.16
MOLECULAR WEIGHT, STACK :	26.88	26.88	26.88	26.88	26.88
AVG. SQRT. VELOCITY HEAD :	0.41	0.41	0.42	0.42	0.42
VELOCITY, fps :	24.21	24.59	25.11	25.57	24.87
ACTUAL CUBIC FEET/ MINUTE :	1117	1135	1159	1180	1148
)RY STANDARD CUBIC FEET/ MINUTE :	1046	1052	1066	1068	1058

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	B2-I-5

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	29.7
TIME(24-HR) :	1640	STATIC PRES., in. H2O :	3.1
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	110.75	DRY MOLECULAR WEIGHT:	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.135	102
2	0.150	103
3	0.180	103
4	0.190	103
5	0.200	103
6	0.170	103
7	0.170	103
8	0.220	103
9	0.190	103
10	0.180	103
11	0.120	102
12	0.135	102
13	0.170	103
14	0.180	103
15	0.190	103
16	0.210	103
17	0.200	103
18	0.195	103
19	0.200	103
20	0.180	103
	0.178	103

MW 9/10/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated:

PLANT :	BFI - Chicopee		
SAMPLE LOCATION :	Flare Inlet		
RUN NUMBER :	B2-I-6		
DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	29.7
TIME(24-HR) :	1831	STATIC PRES., in. H2O :	3
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	110.75	DRY MOLECULAR WEIGHT:	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEM deg. F
1	0.140	102
2	0.120	102
3	0.180	103
4	0.180	103
5	0.180	103
6	0.210	102
7	0.210	102
8	0.165	102
9	0.200	103
10	0.200	103
11	0.110	102
12	0.130	102
13	0.140	103
14	0.190	102
15	0.200	102
16	0.190	103
17	0.220	103
18	0.190	102
19	0.200	103
20	0.180	103
	0.177	103

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	B2-I-7

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	29.7
TIME(24-HR) :	2001	STATIC PRES., in. H2O :	3
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.1	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	110.75	DRY MOLECULAR WEIGHT:	27.2
NO. OF TRAVERSE PTS. :	20		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.155	100
2	0.120	100
3	0.170	100
4	0.170	100
5	0.170	100
6	0.190	100
7	0.180	100
8	0.210	100
9	0.200	100
10	0.170	100
11	0.110	100
12	0.170	100
13	0.180	100
14	0.200	100
15	0.200	100
16	0.210	100
17	0.210	100
18	0.190	100
19	0.180	100
20	0.170	100
	0.178	100

MW 040800

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee		
SAMPLE LOCATION :	Flare Inlet		
Run No:	B2-I-5	B2-I-6	B2-I-7
STACK PRESSURE, in Hg :	29.93	29.92	29.92
STACK TEMP., deg. F :	103	103	100
MOLECULAR WEIGHT, DRY :	27.16	27.16	27.16
MOLECULAR WEIGHT, STACK :	26.88	26.88	26.88
AVG. SQRT. VELOCITY HEAD :	0.42	0.42	0.42
VELOCITY, fps :	25.29	25.14	25.19
ACTUAL CUBIC FEET/ MINUTE :	1167	1160	1162
DRY STANDARD CUBIC FEET/ MINUTE :	1061	1055	1062

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	B2-O-1

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	30.2
TIME(24-HR) :	740	STATIC PRES., in. H2O :	-0.065
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.9	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.0
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	11.8

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.008	1220
2	0.020	1340
3	0.025	1380
4	0.025	1410
5	0.027	1413
6	0.025	1440
7	0.026	1419
8	0.018	1390
9	0.016	1425
10	0.015	1417
11	0.012	1417
12	0.011	1410
13	0.010	1250
14	0.015	1390
15	0.022	1398
16	0.025	1389
17	0.035	1502
18	0.035	1494
19	0.025	1424
20	0.025	1374
21	0.020	1364
22	0.023	1385
23	0.020	1394
24	0.018	1388
	0.021	1393

MW 9/20/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	B2-O-2

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	30.14
TIME(24-HR) :	1036	STATIC PRES., in. H2O :	-0.06
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.9	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.0
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	11.8

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.030	1430
2	0.030	1436
3	0.035	1470
4	0.030	1423
5	0.035	1473
6	0.035	1460
7	0.025	1430
8	0.015	1400
9	0.010	1397
10	0.009	1454
11	0.005	1422
12	0.003	1416
13	0.025	1380
14	0.040	1391
15	0.035	1420
16	0.035	1442
17	0.030	1369
18	0.035	1412
19	0.027	1416
20	0.023	1409
21	0.018	1370
22	0.015	1362
23	0.016	1416
24	0.017	1427
	0.024	1418

MW 3109

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	B2-O-3

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	30
TIME(24-HR) :	1250	STATIC PRES., in. H2O :	-0.075
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.8	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.0
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	12.2

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.020	1348
2	0.022	1340
3	0.032	1353
4	0.032	1378
5	0.024	1344
6	0.030	1397
7	0.027	1418
8	0.023	1427
9	0.015	1390
10	0.017	1420
11	0.010	1410
12	0.007	1432
13	0.025	1350
14	0.024	1484
15	0.025	1458
16	0.032	1470
17	0.035	1570
18	0.030	1555
19	0.025	1538
20	0.030	1460
21	0.025	1470
22	0.030	1425
23	0.025	1440
24	0.023	1453
	0.025	1430

MW 1-90

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	B2-O-4

DATE :	8/15/90	**BAROMETRIC PRES., in. Hg :**	29.56
TIME(24-HR) :	1510	**STATIC PRES., in. H2O :**	-0.06
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.6	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	6575.54	**PERCENT CO2 :**	8.1
NO. OF TRAVERSE PTS. :	24	**PERCENT O2 :**	12.2

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.022	1440
2	0.030	1454
3	0.027	1417
4	0.033	1430
5	0.032	1480
6	0.030	1452
7	0.030	1461
8	0.023	1451
9	0.014	1391
10	0.016	1430
11	0.010	1439
12	0.009	1414
13	0.022	1350
14	0.031	1362
15	0.027	1406
16	0.035	1411
17	0.037	1430
18	0.032	1455
19	0.036	1437
20	0.033	1465
21	0.031	1464
22	0.025	1462
23	0.022	1434
24	0.019	1487
	0.026	1434

MW 9/10/90

validated 3/15/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT : BFI - Chicopee
SAMPLE LOCATION : Flare Stack

Run No:	B2-O-1	B2-O-2	B2-O-3	B2-O-4	AVERAGE
STACK PRESSURE, in Hg :	30.20	30.14	29.99	29.56	29.97
STACK TEMP., deg. F :	1393	1418	1430	1434	1419
MOLECULAR WEIGHT, DRY :	29.75	29.75	29.77	29.78	29.76
MOLECULAR WEIGHT, STACK :	28.59	28.59	28.61	28.65	28.61
AVG. SQRT. VELOCITY HEAD :	0.14	0.15	0.15	0.16	0.15
VELOCITY, fps :	14.98	15.92	16.48	17.11	16.12
ACTUAL CUBIC FEET/ MINUTE :	41033	43616	45148	46872	44168
)RY STANDARD CUBIC FEET/ MINUTE :	10631	11130	11403	11667	11208

validated 3/

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	B2-O-5

DATE :	8/15/90	**BAROMETRIC PRES., in. Hg :**	29.7
TIME(24-HR) :	1715	**STATIC PRES., in. H2O :**	-0.06
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.5	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	6575.54	**PERCENT CO2 :**	8.2
NO. OF TRAVERSE PTS. :	24	**PERCENT O2 :**	12.4

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP deg. F
1	0.020	1199
2	0.020	1199
3	0.033	1365
4	0.027	1392
5	0.034	1460
6	0.028	1405
7	0.028	1403
8	0.023	1416
9	0.012	1395
10	0.015	1429
11	0.011	1435
12	0.010	1431
13	0.017	1360
14	0.023	1380
15	0.028	1396
16	0.028	1401
17	0.037	1495
18	0.037	1470
19	0.030	1488
20	0.028	1440
21	0.025	1435
22	0.025	1450
23	0.018	1396
24	0.020	1422
	0.024	1403

MW 9/10/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	BFI - Chicopee
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	B2-O-6

DATE :	8/15/90	BAROMETRIC PRES., in. Hg :	29.7
TIME(24-HR) :	1844	STATIC PRES., in. H2O :	-0.06
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.6	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.2
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	12.3

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.015	1121
2	0.026	1231
3	0.030	1320
4	0.032	1380
5	0.032	1409
6	0.030	1392
7	0.031	1424
8	0.023	1390
9	0.023	1409
10	0.013	1344
11	0.014	1364
12	0.013	1409
13	0.016	1300
14	0.017	1320
15	0.030	1350
16	0.033	1380
17	0.032	1412
18	0.030	1378
19	0.030	1414
20	0.034	1425
21	0.028	1387
22	0.026	1408
23	0.025	1412
24	0.019	1393
	0.025	1366

MW 9/6/90

validated 3/15/9

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee		
SAMPLE LOCATION :	Flare Stack		
RUN NUMBER :	B2-O-7		
DATE :	8/15/90	**BAROMETRIC PRES., in. Hg :**	29.7
TIME(24-HR) :	2014	**STATIC PRES., in. H2O :**	-0.06
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	9.6	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	6575.54	**PERCENT CO2 :**	8.2
NO. OF TRAVERSE PTS. :	24	**PERCENT O2 :**	12.1

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.017	1300
2	0.023	1317
3	0.030	1340
4	0.030	1378
5	0.030	1394
6	0.032	1389
7	0.030	1411
8	0.026	1376
9	0.018	1378
10	0.017	1361
11	0.020	1399
12	0.014	1372
13	0.016	1300
14	0.023	1310
15	0.023	1310
16	0.032	1366
17	0.025	1303
18	0.036	1413
19	0.035	1424
20	0.030	1391
21	0.030	1390
22	0.030	1403
23	0.025	1418
24	0.016	1355
	0.025	1367

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	BFI - Chicopee		
SAMPLE LOCATION :	Flare Stack		
Run No:	B2-O-5	B2-O-6	B2-O-7
STACK PRESSURE, in Hg :	29.70	29.70	29.70
STACK TEMP., deg. F :	1403	1366	1367
MOLECULAR WEIGHT, DRY :	29.81	29.80	29.80
MOLECULAR WEIGHT, STACK :	28.69	28.67	28.66
AVG. SQRT. VELOCITY HEAD :	0.15	0.16	0.16
VELOCITY, fps :	16.24	16.47	16.60
ACTUAL CUBIC FEET/ MINUTE :	44491	45130	45480
DRY STANDARD CUBIC FEET/ MINUTE :	11328	11712	11795

EMISSION CALCULATIONS

Client Browning-Ferris Industries | PN 50014 | Sheet No. 10
Location Chicopee Flare Inlet | Checked By DH | Date 9-2-
Subject Molecular Weight Inlet Flue Gas | Computed By [signature] | Date 9-18-

Molecular Weight , lb/lb-mole

$$M_d = \left(\%CH_4 \times \frac{MW_{CH_4}}{100}\right) + \left(\%N_2 \times \frac{MW_{N_2}}{100}\right) + \left(\%O_2 \times \frac{MW_{O_2}}{100}\right) + \left(\%CO_2 \times \frac{MW_{CO_2}}{100}\right) + \left(\%C_2H_6 \times \frac{MW_{C_2H_6}}{100}\right)$$

where:

M_d = Dry molecular weight of flue gas, lb/lb-mole
MW_{CH_4} = Average molecular weight of methane, 16 lb/lb-mole*
MW_{N_2} = Average molecular weight of nitrogen, 28 lb/lb-mole*
MW_{O_2} = Average molecular weight of oxygen, 32 lb/lb-mole*
MW_{CO_2} = Average molecular weight of carbon dioxide, 44 lb/lb-mole*
$MW_{C_2H_6}$ = Average molecular weight of ethane, 30 lb/lb-mole*

*results from flue gas analysis of inlet landfill gas by ASTM Method D 1945.

RESULTS:

$$BFG-I-1 = \left(47.3 \times \frac{16}{100}\right) + \left(20.5 \times \frac{28}{100}\right) + \left(2.2 \times \frac{32}{100}\right) + \left(29.7 \times \frac{44}{100}\right) + \left(0.3 \times \frac{30}{100}\right) = 27.17$$

$$BFG-I-2 = \left(47.6 \times \frac{16}{100}\right) + \left(19.9 \times \frac{28}{100}\right) + \left(2.1 \times \frac{32}{100}\right) + \left(30.3 \times \frac{44}{100}\right) + \left(0.0 \times \frac{30}{100}\right) = 27.19$$

$$BFG-I-2 = \left(48.4 \times \frac{16}{100}\right) + \left(19.5 \times \frac{28}{100}\right) + \left(1.8 \times \frac{32}{100}\right) + \left(30.3 \times \frac{44}{100}\right) + \left(0.0 \times \frac{30}{100}\right) = 27.11$$

Average = 27.16 lb/lb-mole

EMISSION FLOW RATE CALCULATIONS

lient Browning-Ferris Industries
ocation Chicopee Flare Stack
ubject Flow Rate by Carbon Balance

PN 50014 Sheet No. 1 of 1
Checked By DH Date 5-25-90
Computed By [signature] Date 5-18-90

Flare Flow Rate by Carbon Balance

$$Q_{std_{stack}} = \left(Q_{std_{inlet}}\right) \frac{\left(\%CH_{4_{inlet}}\right) + \left(\%CO_{2_{inlet}}\right) + \left[(2) \times \left(\%C_2H_{6_{inlet}}\right)\right]}{\left(\%CO_{2_{outlet}}\right)}$$

where:

$Q_{std_{stack}}$ = Volumetric flow rate of stack gas, dscfm.

$Q_{std_{inlet}}$ = Volumetric flow rate of inlet gas measured by EPA Method 2, dscfm.

$\%CH_{4_{inlet}}$ = Average percent concentration of methane in inlet flue gas.*

$\%CO_{2_{inlet}}$ = Average percent concentration of carbon dioxide in inlet flue gas.*

$\%C_2H_{6_{inlet}}$ = Average percent concentration of ethane in inlet flue gas.*

$\%CO_{2_{outlet}}$ = Percent concentration of carbon dioxide in outlet flue gas.

*results from flue gas analysis of inlet landfill gas by ASTM Method D 1945.

RESULTS:

$$B3-O-1 = (1{,}049)\frac{(47.8+30.1+0.2)}{8.1} = 10{,}114 \checkmark$$

$$B3-O-2 = (1{,}059)\frac{(47.8+30.1+0.2)}{7.9} = 10{,}469 \checkmark$$

$$B3-O-3 = (1{,}067)\frac{(47.8+30.1+0.2)}{8.0} = 10{,}417 \checkmark$$

Average = 10,244 dscfm

$$B3-O-4 = (1{,}065)\frac{(47.8+30.1+0.2)}{8.1} = 10{,}269 \checkmark$$

$$B3-O-5 = (1{,}058)\frac{(47.8+30.1+0.2)}{8.2} = 10{,}077 \checkmark$$

$$B3-O-6 = (1{,}059)\frac{(47.8+30.1+0.2)}{8.2} = 10{,}086 \checkmark$$

EMISSION RATE CALCULATIONS

Client Browning-Ferris Industries
Location Chicopee Flare Inlet
Subject Sulfur Emissions

PN 50014 Sheet No. 1 of 4
Checked By DH Date 5-25-5
Computed By [illegible] Date 9-18-90

Inlet Mass Emission Rates of Sulfur Compounds

$$pmr = \left(\frac{(C_s)(MW)(Q_{std})(60)}{(24.04)(35.315)(453.6 \times 10^3)} \right)$$

where:

pmr = Pollutant mass emission rate, lb/h.
C_s = Concentration of pollutant measured, ppm.
MW = Molecular weight of pollutant, mg/mg-mole.
Q_{std} = Volumetric flow rate of flue gas, dscfm.
60 = Conversion factor, minutes per hour.
24.04 = Molecular gas volume at 68 °F and 29.92 in.Hg., ml/mg-mole.
35.315 = Conversion factor, cubic feet per cubic meter.
453.6×10^3 = Conversion factor, milligrams per pound.

FLARE INLET RESULTS:

HYDROGEN SULFIDE

BFG-I-1

$$H_2S = \frac{(0.00)(34.08)(1,049)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = ND$$ ✓

BFG-I-2

$$H_2S = \frac{(0.00)(34.08)(1,059)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = ND$$ ✓

BFG-I-3

$$H_2S = \frac{(0.67)(34.08)(1,067)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0038$$ ✓

Average

H_2S rate: **<0.0013 lb/h** ✓

METHYL MERCAPTAN

BFG-I-1

$$CH_3SH = \frac{(0.20)(48.10)(1,049)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0016$$ ✓

(Continued)

EMISSION RATE CALCULATIONS

BFG-I-2

$$CH_3SH = \frac{(0.01)(48.10)(1,059)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0001$$

BFG-I-3

$$CH_3SH = \frac{(0.13)(48.10)(1,067)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0010$$

Average

CH_3SH rate: **0.0009 lb/h**

ETHYL MERCAPTAN

BFG-I-1

$$C_2H_5SH = \frac{(0.12)(62.13)(1,049)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0012$$

BFG-I-2

$$C_2H_5SH = \frac{(0.85)(62.13)(1,059)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0087$$

BFG-I-3

$$C_2H_5SH = \frac{(0.01)(62.13)(1,067)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0001$$

Average

C_2H_5SH rate: **0.0033 lb/h**

DIMETHYL SULFIDE

BFG-I-1

$$(CH_3)_2S = \frac{(0.02)(62.13)(1,049)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0002$$

BFG-I-2

$$(CH_3)_2S = \frac{(0.08)(62.13)(1,059)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 0.0008$$

BFG-I-3

$$(CH_3)_2S = \frac{(0.00)(62.13)(1,067)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = ND$$

Average

$(CH_3)_2S$ rate: **<0.0003 lb/h**

(continued)

EMISSION RATE CALCULATIONS

Concentration conversion parts per million to micrograms per cubic meter

$$\mu g/m^3 = C_s \times \frac{(MW)(1000)}{24.04}$$

where:

$\mu g/m^3$ = micrograms per cubic meter

C_s = Concentration of pollutant measured, ppm.

MW = Molecular weight of pollutant, mg/mg-mole.

1000 = Conversion factor, micrograms per milligram.

24.04 = Molecular gas volume at 68 °F and 29.92 in.Hg., ml/mg-mole.

HYDROGEN SULFIDE

BFG-I-1

$$H_2S = 0.00 \times \frac{(34.08)(1000)}{24.04} = ND$$

BFG-I-2

$$H_2S = 0.00 \times \frac{(34.08)(1000)}{24.04} = ND$$

BFG-I-3

$$H_2S = 0.67 \times \frac{(34.08)(1000)}{24.04} = 950$$

Average

H_2S rate: <320 $\mu g/m^3$

METHYL MERCAPTAN

BFG-I-1

$$CH_3SH = 0.20 \times \frac{(48.10)(1000)}{24.04} = 400$$

BFG-I-2

$$CH_3SH = 0.01 \times \frac{(48.10)(1000)}{24.04} = 20$$

BFG-I-3

$$CH_3SH = 0.13 \times \frac{(48.10)(1000)}{24.04} = 260$$

Average

CH_3SH rate: <230 $\mu g/m^3$

ETHYL MERCAPTAN

BFG-I-1

$$C_2H_5SH = 0.12 \times \frac{(62.13)(1000)}{24.04} = 310$$

BFG-I-2

(continued)

EMISSION RATE CALCULATIONS

$$C_2H_5SH = 0.85 \times \frac{(62.13)(1000)}{24.04} = 2,200$$

BFG-I-3

$$C_2H_5SH = 0.01 \times \frac{(62.13)(1000)}{24.04} = 26$$

Average

C_2H_5SH rate: **812 µg/m³**

DIMETHYL SULFIDE

BFG-I-1

$$(CH_3)_2S = 0.02 \times \frac{(62.13)(1000)}{24.04} = 52$$

BFG-I-2

$$(CH_3)_2S = 0.08 \times \frac{(62.13)(1000)}{24.04} = 207$$

BFG-I-3

$$(CH_3)_2S = 0.00 \times \frac{(62.13)(1000)}{24.04} = ND$$

Average

$(CH_3)_2S$ rate: **<86 µg/m³**

validated 3/13/90

Moisture and Vmstd Calculations

Plant: BFI - Chicopee **Date:** 8/15/90

Run No.	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm ° F	Vlc ml	Vmstd scf	Moisture %
B6-O-1A	12.385	0.989	29.52	1.00	118	24.7	11.077	9.50
B6-O-1B	12.555	0.989	29.52	1.00	117	27.2	11.248	10.22
B6-O-2A	12.283	0.989	29.70	1.00	108	27.1	11.242	10.19
							11.189	**9.97**

MW 9/10/90

validated 3/13/90

Moisture and Vmstd Calculations

Plant: BFI - Chicopee **Date:** 8/15/90

Run No.	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm ° F	Vlc ml	Vmstd scf	Moisture %
B6-O-2B	12.244	0.989	29.70	1.00	108	26.1	11.201	9.88
B6-O-3A	12.350	0.989	29.70	1.00	104	25.8	11.371	9.65
B6-O-3B	12.360	0.989	29.70	1.00	106	25.3	11.350	9.50
							11.307	**9.68**

MW 9/14/90

validated 3/13/90

Moisture and Vmstd Calculations

Plant: BFI - Chicopee **Date:** 8/15/90

Run No.	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm ° F	Vlc ml	Vmstd scf	Moisture %
B26-1	44.266	0.989	30.20	1.46	105	93.5	41.436	9.60
B26-2	44.544	0.989	30.14	1.46	110	91.8	41.266	9.48
B26-3	44.429	0.989	30.00	1.46	116	91.9	40.542	9.64
							41.081	**9.57**

SO2 EMISSIONS CALCULATIONS

Plant: Browning-Ferris, Chicopee **Sampling location:** Flare Stack **Date:** 8/15/90

Run No.	Test Time (24-hr)	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm °F	Vmstd scf	Vt ml	Vtb ml	Vsoln ml	N eq/l	Va ml	CSO2 ppm	Qsstd dscfm	ESO2 lb/h
B6-O-1A	1527-1547	12.385	0.989	29.52	1.00	117.5	11.077	0.11	0.01	1000	0.0096	20	1.84	10269	0.19
B6-O-1B	1552-1612	12.555	0.989	29.52	1.00	116.5	11.248	0.20	0.01	1000	0.0096	20	3.44	10269	0.35
Average													2.64		0.27
B6-O-2A	1730-1750	12.283	0.989	29.70	1.00	107.8	11.242	0.15	0.01	1000	0.0096	20	2.54	10077	0.25
B6-O-2B	1757-1817	12.244	0.989	29.70	1.00	108.0	11.201	0.12	0.01	1000	0.0096	20	2.00	10077	0.20
Average													2.27		0.23
B6-O-3A	1900-1920	12.350	0.989	29.70	1.00	104.4	11.371	0.13	0.01	1000	0.0096	20	2.06	10086	0.21
B6-O-3B	1925-1945	12.360	0.989	29.70	1.00	105.9	11.350	0.07	0.01	1000	0.0096	20	0.99	10086	0.10
Average													1.52		0.15
3 - RUN AVERAGE													2.14		0.22

OK 9-18-90

NOx Emissions Calculations

PLANT : BFI - Chicopee
LOCATION : Flare Stack
DATE : 8/15/90

	Final	Initial
Barometric Pressure(in. Hg):	29.50	30.10

Run No.	Test Time (24-hr)	Flask Volume ml	Final Pressure in. Hg.	Final Temp. °F	Initial Pressure in. Hg	Initial Temp. °F	Sample Volume ml	PNOx ug	CPPM ppm	Qsstd dscfm	NOx Emissions lb/dscf	NOx Emissions lb/h
B7-1A	0815	2058.9	3.4	72	28.80	80	1674.5	43.5	13.57	10114	1.62E-06	0.98
B7-1B	0830	1991.1	17.5	72	28.50	80	679.8	ND*	#VALUE!	10114	#VALUE!	#VALUE!
B7-1C	0919	1990.4	4.2	72	28.80	85	1566.7	35.2	11.74	10114	1.40E-06	0.85
B7-1D	0935	2062.0	1.1	72	28.40	90	1807.9	46.6	13.47	10114	1.61E-06	0.98
Average									12.93		1.54E-06	0.94
B7-2A	1115	2029.0	3.4	72	28.40	110	1629.5	47.0	15.07	10469	1.80E-06	1.13
B7-2B	1130	2014.9	3.0	72	28.40	110	1644.5	47.3	15.03	10469	1.80E-06	1.13
B7-2C	1140	2049.2	3.2	72	28.60	105	1671.1	55.7	17.42	10469	2.08E-06	1.31
B7-2D	1152	2051.0	2.9	72	28.40	105	1680.1	43.4	13.50	10469	1.61E-06	1.01
Average									15.25		1.82E-06	1.14
B7-3A	1326	2073.3	3.0	72	28.40	110	1692.7	46.6	14.38	10417	1.72E-06	1.07
B7-3B	1340	2029.4	0.8	72	28.40	110	1802.7	49.6	14.38	10417	1.72E-06	1.07
B7-3C	1355	1946.2	2.8	72	28.40	100	1598.6	61.7	20.17	10417	2.41E-06	1.51
B7-3D	1405	1979.3	2.9	72	28.40	90	1617.8	42.0	13.56	10417	1.62E-06	1.01
Average									15.62		1.87E-06	1.17
Overall Average									14.60		1.74E-06	1.08

* ND- Not Detected, sample considered non representative; therefore, not used in emission calculations.

OK 9-18-90

EMISSION RATE CALCULATIONS

Client Browning-Ferris Industries
Location Chicopee Flare Stack
Subject CO Emissions

PN 50014 Sheet No. 1 of 2
Checked By ____ Date ____
Computed By [signature] Date 1-15-91

Carbon Monoxide (CO) Mass Emission Rate

$$pmr = \left(\frac{(C_s)(28)(Q_{std})(60)}{(24.04)(35.315)(453.6 \times 10^3)} \right)$$

$= \frac{ppm \cdot \frac{mg}{mg\text{-}mole} \cdot \frac{ft^3}{min} \cdot \frac{min}{hr}}{\frac{ml}{mg\text{-}mole} \cdot \frac{ft^3}{m^3} \cdot \frac{mg}{lb}}$

where:

pmr = Pollutant mass emission rate, lb/h.
C_s = Concentration of CO measured, ppm. (ml/m^3)
28 = Molecular weight of CO, mg/mg-mole.
Q_{std} = Volumetric flow rate of flue gas, dscfm.
60 = Conversion factor, minutes per hour.
24.04 = Molecular gas volume at 68 °F and 29.92 in.Hg., ml/mg-mole.
35.315 = Conversion factor, cubic feet per cubic meter.
453.6×10^3 = Conversion factor, milligrams per pound.

FLARE STACK RESULTS:

B10-O-1

$$CO = \frac{(208)(28)(10{,}114)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 9.18$$

B10-O-2

$$CO = \frac{(282)(28)(10{,}469)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 12.88$$

Different numbers than the ones given in summary table (table 2-1)

Average

CO mass emission rate: **10.64 lb/h**

B10-O-3

$$CO = \frac{(217)(28)(10{,}417)(60)}{(24.04)(35.315)(453.6 \times 10^3)} = 9.86$$

Based on Avg. Summary table values

$$CO = \frac{(236)(28)(11{,}400)(60)}{379 \times 10^6} = 11.92 \text{ lbs/hr}$$

485 → 9.319

NOx:

$$NO_x = \frac{(14.6)(46)(11{,}400)(60)}{379 \times 10^6} = 1.212 \text{ lbs/hr}$$

0.0114

(continued)

EMISSION RATE CALCULATIONS

Concentration conversion parts per million to micrograms per cubic meter

$$mg/m^3 = C_s \times \frac{MW_{CO}}{24.04}$$

where:

mg/m^3 = micrograms per cubic meter

C_s = Concentration of CO measured, ppm.

MW = Molecular weight, mg/mg-mole, CO = 28.

24.04 = Molecular gas volume at 68 °F and 29.92 in.Hg., ml/mg-mole.

INLET

B10-O-1

$$CO = 208 \times \frac{28}{24.04} = 242$$

B10-O-2

$$CO = 282 \times \frac{28}{24.04} = 328$$

B10-O-3

$$CO = 217 \times \frac{28}{24.04} = 253$$

Average Stack CO mg/m^3 = 274

EMISSION RATE CALCULATIONS

ient Browning-Ferris
ocation Chicopee Flare Inlet
ubject Method 25 Results - NMO

PN 50014 Sheet No. 1 of 1
Checked By DA Date 9-25-90
Computed By [illegible] Date 9-19-90

Carbon emission rate, lb/h

$$E_c = Q_{s\,std} \times 60 \times \frac{ppmC_1 \times 12}{385.1 \times 10^6}$$

where:

E_c = Mass emission rate as carbon, pounds per hour
ppmC = Parts per million of carbon from analytical data sheet
$Q_{s\,std}$ = Volumetric flow rate, dry standard cubic feet per hour
60 = Conversion factor, minutes to hours
12 = Molecular weight of carbon, pound per pound-mole
385.1×10^6 = Conversion factor, cubic foot-ppm per pound-mole

RESULTS:

$$B25-I-1 = (1{,}049)(60)\frac{(878)(12)}{(385.1\times 10^6)} = 1722 \checkmark$$

$$B25-I-2 = (1{,}059)(60)\frac{(538)(12)}{(385.1\times 10^6)} = 1065 \checkmark$$

$$B25-I-3 = (1{,}067)(60)\frac{(712)(12)}{(385.1\times 10^6)} = 1420 \checkmark$$

Average = 1.402 lb/h ✓

EMISSION RATE CALCULATIONS

Client Browning-Ferris
Location Chicopee Flare Outlet
Subject Method 25 Results - NMO

PN 50014
Checked By OH
Computed By

Sheet No. 1 of 1
Date 9-28-90
Date 9-18-90

Carbon emission rate, lb/h

$$E_c = Q_{s\,std} \times 60 \times \frac{ppmC_1 \times 12}{385.1 \times 10^6}$$

where:

E_c = Mass emission rate as carbon, pounds per hour
ppmC = Parts per million of carbon from analytical data sheet
$Q_{s\,std}$ = Volumetric flow rate, dry standard cubic feet per hour
60 = Conversion factor, minutes to hours
12 = Molecular weight of carbon, pound per pound-mole
385.1×10^6 = Conversion factor, cubic foot-ppm per pound-mole

RESULTS:

$$B25-O-2 = (10{,}114)(60)\frac{(<9)(12)}{(385.1\times 10^6)} = <0.170$$ ✓

$$B25-O-2 = (10{,}469)(60)\frac{(<10)(12)}{(385.1\times 10^6)} = <0.215$$ ✓

$$B25-O-3 = (10{,}417)(60)\frac{(<12)(12)}{(385.1\times 10^6)} = <0.234$$ ✓

Average = <0.206 lb/h ✓

EMISSION FLOW RATE CALCULATIONS

Client: Browning - Ferris Industries | PN: 50014 | Sheet No.: 1 of 1

Location: Chicopee Flare Flare | Checked By: DH | Date: 9-28-90

Subject: NMO Removal Efficiency as Carbon | Computed By: [illegible] | Date: 9-20-90

Removal Efficiency as Carbon

$$\%DRE = \frac{pmr_{inlet} - pmr_{outlet}}{pmr_{inlet}} \times 100$$

where:

$\%DRE$ = Destruction removal efficiency, percent..

pmr_{inlet} = Inlet mass emission rate, lb/h.*

pmr_{outlet} = Outlet mass emission rate, lb/h.*

RESULTS:

$$\%DRE(B25-I-1/B25-O-1) = \frac{1.722 - <0.170}{1.722} \times 100 = > 90.1 \checkmark$$

$$\%DRE(B25-I-2/B25-O-2) = \frac{1.065 - <0.215}{1.065} \times 100 = > 79.8 \checkmark$$

$$\%DRE(B25-J-3/B25-O-3) = \frac{1.420 - <0.234}{1.420} \times 100 = > 83.5 \checkmark$$

VOLATILE ORGANIC EMISSIONS CALCULATIONS

PLANT: Browning-Ferris Industries **DATE:** 8/15/90

SAMPLE LOCATION: Chicopee Flare Inlet

	Volumetric Flow, dscfm			
	1,049	1,059	1,067	
	Pollutant Concentration, µg/m3			
	RUNS			AVERAGE
POHC	B25-I-1	B25-I-2	B25-I-3	
VINYL CHLORIDE	22,000	23,000	22,000	22,333
METHYLENE CHLORIDE	39,000	44,000	43,000	42,000
1,1-DICHLOROETHENE	<905	<950	<920	<925
1,1-DICHLOROETHANE	20,000	21,000	21,000	20,667
CHLOROFORM	<905	<950	<920	<925
1,2-DICHLOROETHANE	<905	<950	<920	<925
1,1,1-TRICHLOROETHANE	6,000	6,500	6,400	6,300
CARBON TETRACHLORIDE	<905	<950	<920	<925
TRICHLOROETHENE	12,000	12,000	12,000	12,000
BENZENE	15,000	16,000	16,000	15,667
TETRACHLOROETHENE	11,000	11,000	11,000	11,000
TOLUENE	430,000	480,000	460,000	456,667
CHLOROBENZENE	<905	<950	<920	<925
TOTAL XYLENES	170,000	210,000	170,000	183,333
DICHLOROBENZENE	<905	<950	<920	<925
BENZYL CHLORIDE	<905	<950	<920	<925

	Emission Rate, lb/h			
	RUNS			AVERAGE
POHC	B25-I-1	B25-I-2	B25-I-3	
VINYL CHLORIDE	0.0865	0.0912	0.0879	0.0885
METHYLENE CHLORIDE	0.1533	0.1746	0.1719	0.1666
1,1-DICHLOROETHENE	<0.0036	<0.0038	<0.0037	<0.0037
1,1-DICHLOROETHANE	0.0786	0.0833	0.0839	
CHLOROFORM	<0.0036	<0.0038	<0.0037	<
1,2-DICHLOROETHANE	<0.0036	<0.0038	<0.0037	<
1,1,1-TRICHLOROETHANE	0.0236	0.0258	0.0256	
CARBON TETRACHLORIDE	<0.0036	<0.0038	<0.0037	<
TRICHLOROETHENE	0.0472	0.0476	0.0480	
BENZENE	0.0589	0.0635	0.0640	
TETRACHLOROETHENE	0.0432	0.0436	0.0440	
TOLUENE	1.6898	1.9042	1.8387	
CHLOROBENZENE	<0.0036	<0.0038	<0.0037	<
TOTAL XYLENES	0.6680	0.8331	0.6795	
DICHLOROBENZENE	<0.0036	<0.0038	<0.0037	<0.0037
BENZYL CHLORIDE	<0.0036	<0.0038	<0.0037	<0.0037

* all "less than" signs (<) indicate values which were below the analytical detection limit. These detection limit values were used in the relevant calculations.

DF 4-18-90

VOLATILE ORGANIC EMISSIONS CALCULATIONS

PLANT: Browning-Ferris Industries **DATE:** 8/15/90

SAMPLE LOCATION: Chicopee Flare Outlet

	Volumetric Flow, dscfm			
	10,114	10,469	10,417	
	Pollutant Concentration, µg/m3			
	RUNS			AVERAGE
POHC	B25-O-1	B25-O-2	B25-O-3	
VINYL CHLORIDE	<18	<20	<23	<20
METHYLENE CHLORIDE	5,600	8,300	8,600	7,500
1,1-DICHLOROETHENE	<18	<20	<23	<20
1,1-DICHLOROETHANE	<18	<20	<23	<20
CHLOROFORM	<18	<20	<23	<20
1,2-DICHLOROETHANE	<18	<20	<23	<20
1,1,1-TRICHLOROETHANE	<18	<20	<23	<20
CARBON TETRACHLORIDE	<18	<20	<23	<20
TRICHLOROETHENE	<18	<20	<23	<20
BENZENE	<18	<20	<23	<20
TETRACHLOROETHENE	<18	<20	<23	<20
TOLUENE	28	27	31	29
CHLOROBENZENE	<18	<20	<23	<20
TOTAL XYLENES	<18	<20	<23	<20
DICHLOROBENZENE	<18	<20	<23	<20
BENZYL CHLORIDE	<18	<20	<23	<20
	Emission Rate, lb/h			
	RUNS			AVERAGE
POHC	B25-O-1	B25-O-2	B25-O-3	
VINYL CHLORIDE	<0.0007	<0.0008	<0.0009	<0.0008
METHYLENE CHLORIDE	0.2122	0.3255	0.3356	0.2911
1,1-DICHLOROETHENE	<0.0007	<0.0008	<0.0009	<0.0008
1,1-DICHLOROETHANE	<0.0007	<0.0008	<0.0009	<0.0008
CHLOROFORM	<0.0007	<0.0008	<0.0009	<0.0008
1,2-DICHLOROETHANE	<0.0007	<0.0008	<0.0009	<0.0008
1,1,1-TRICHLOROETHANE	<0.0007	<0.0008	<0.0009	<0.0008
CARBON TETRACHLORIDE	<0.0007	<0.0008	<0.0009	<0.0008
TRICHLOROETHENE	<0.0007	<0.0008	<0.0009	<0.0008
BENZENE	<0.0007	<0.0008	<0.0009	<0.0008
TETRACHLOROETHENE	<0.0007	<0.0008	<0.0009	<0.0008
TOLUENE	0.0011	0.0011	0.0012	0.0011
CHLOROBENZENE	<0.0007	<0.0008	<0.0009	<0.0008
TOTAL XYLENES	<0.0007	<0.0008	<0.0009	<0.0008
DICHLOROBENZENE	<0.0007	<0.0008	<0.0009	<0.0008
BENZYL CHLORIDE	<0.0007	<0.0008	<0.0009	<0.0008

* all "less than" signs (<) indicate values which were below the analytical detection limit. These detection limit values were used in the relevant calculations.

EMISSION FLOW RATE CALCULATIONS

Client Browning - Ferris Industries
Location Chicopee Flare
Subject Toluene Removal Efficiency

PN 50014 Sheet No. 1 of 1
Checked By DJ Date 9/26/94
Computed By [signature] Date 9-23-94

Destruction Removal Efficiency

$$\%DRE = \frac{pmr_{inlet} - pmr_{outlet}}{pmr_{inlet}} \times 100$$

where:

%DRE = Destruction removal efficiency, percent..
pmr_{inlet} = Inlet mass emission rate, lb/h.*
pmr_{outlet} = Outlet mass emission rate, lb/h.*

RESULTS: Toluene

$$\%DRE(B25-I-1/B25-O-1) = \frac{16898 - 0.0011}{1.6898} \times 100 = 99.93 \checkmark$$

$$\%DRE(B25-I-2/B25-O-2) = \frac{19042 - 0.0011}{1.9042} \times 100 = 99.94 \checkmark$$

$$\%DRE(B25-I-3/B25-O-3) = \frac{18387 - 0.0012}{1.8387} \times 100 = 99.93 \checkmark$$

Plant: Browning-Ferris Industries **Date:** 8/15/90

Sampling Location: Flare Inlet

conc. mg/m³

Compound Name	Retention Time, minutes	Run Numbers B25-I-1	B25-I-2	B25-I-3	Volumetric Flow, dscfm: 1,049	1,059	1,067 — Emission Rate, lb/h: Run Numbers B25-I-1	B25-I-2	B25-I-3
dichlorodifluoromethane	2:16	40,000	40,000	40,000	0.1572	0.1587	0.1599		
acetone	5:44	70,000	60,000	80,000	0.2750	0.2380	0.3197		
trichlorofluoromethane	6:38	3,000	3,000	3,000	0.0118	0.0119	0.0120		
1,2-dichloroethane	9:22	20,000	30,000	30,000	0.0786	0.1190	0.1199		
hydrocarbon	10:16		20,000	20,000		0.0793	0.0799		
hydrocarbon	12:34	30,000	40,000	40,000	0.1179	0.1587	0.1599		
hydrocarbon	13:28	20,000	30,000	20,000	0.0786	0.1190	0.0799		
hydrocarbon*	15:38		40,000	30,000		0.1587	0.1199		
hydrocarbon	16:02		40,000			0.1587			
hydrocarbon**	17:40	60,000	70,000	60,000	0.2357	0.2777	0.2398		
hydrocarbon	19:28	20,000	20,000	20,000	0.0786	0.0793	0.0799		
hydrocarbon	20:48		80,000	80,000		0.3173	0.3197		
hydrocarbon	24:00		20,000			0.0793			
unknown	24:34	30,000		30,000	0.1179		0.1199		
ethyl benzene	25:34	300,000	40,000	300,000	1.1787	0.1587	1.1990		
hydrocarbon	25:38	20,000			0.0786				
hydrocarbon	26:00		40,000	40,000		0.1587	0.1599		
styrene	28:22	20,000	20,000	20,000	0.0786	0.0793	0.0799		
unknown	29:34		40,000		0.0000	0.1587			
				Total	2.4871	2.5108	3.2492		

* possible alkane

* possible alkane, tentatively identified as hexane in sample run B25-I-2

GC/MS Scan For Non-target VOCs

Plant: Browning-Ferris Industries **Date:** 8/15/90

Sampling Location: Flare Outlet

Compound Name	Retention Time, minutes	Run Numbers			Volumetric Flow, dscfm		
		B25-O-1	B25-O-2	B25-O-3	10,114	10,469	10,417
					Emission Rate, lb/h		
					Run Numbers		
		B25-O-1	B25-O-2	B25-O-3	B25-O-1	B25-O-2	B25-O-3
unknown	1:16	1,000			0.0379		
unknown	2:24	200			0.0076		
unknown	3:22	100			0.0038		
unknown	5:22			9			0.0004
unknown	6:30	30			0.0011		
unknown	18:42	300	300	300	0.0114	0.0118	0.0117
				Total	0.0617	0.0118	0.0121

EMISSION RATE CALCULATIONS

Client Browning-Ferris Industries
Location Chicopee Flare Inlet
Subject HCl Emissions

PN 50014 Sheet No. 1 of 2
Checked By [illegible] Date 5/12/95
Computed By [illegible] Date 5-18-50

Hydrochloric acid (HCl) Mass Emission Rate

$$pmr = \left(\frac{(C_s)(28{,}317)(Q_{std})(60)}{(453.6 \times 10^6)} \right)$$

where:

pmr = Pollutant mass emission rate, lb/h.
C_s = Concentration of pollutant collected, µg/ml.
28,317 = Conversion factor, milliliters per cubic foot.
Q_{std} = Volumetric flow rate of flue gas, dscfm.
60 = Conversion factor, minutes per hour.
453.6×10^6 = Conversion factor, micrograms per pound.

FLARE INLET RESULTS:

B25-I-1

$$HCl = \frac{(< 0.2)(28{,}317)(1{,}049)(60)}{(453.6 \times 10^6)} = < 0.786$$

B25-I-2

$$HCl = \frac{(< 0.2)(28{,}317)(1{,}059)(60)}{(453.6 \times 10^6)} = < 0.793$$

B25-I-3

$$HCl = \frac{(< 0.2)(28{,}317)(1{,}067)(60)}{(453.6 \times 10^6)} = < 0.799$$

Average

HCl mass emission rate: <0.793 lb/h

(continued)

Concentration conversion micrograms per milliliter to parts per million

$$ppm = \frac{(C_s)(1000)(24.04)}{(MW)}$$

where:

ppm = Parts per million

C_s = Concentration of pollutant collected, µg/ml.

1000 = Conversion factor, milliliters per liter.

24.04 = Molecular gas volume at 68 °F and 29.92 in.Hg., µl/µg-mole.

MW = Molecular weight, µg/µg-mole, HCl = 36.47

INLET

B25-I-1

$$HCl = \frac{(< 0.2)(1000)(24.04)}{(36.47)} = < 132$$

B25-I-2

$$HCl = \frac{(< 0.2)(1000)(24.04)}{(36.47)} = < 132$$

B25-I-3

$$HCl = \frac{(< 0.2)(1000)(24.04)}{(36.47)} = < 132$$

Average Stack HCl ppm = <132

EMISSION RATE CALCULATIONS

Client Browning-Ferris Industries
Location Chicopee Flare Stack
Subject HCl Emissions

PN 50014 Sheet No. 1 of 2
Checked By _____ Date 9-24-90
Computed By _____ Date 9-18-90

Hydrochloric acid (HCl) Mass Emission Rate

$$pmr = \left(\frac{(M_n)(Q_{std})(60)}{(V_{m_{std}})(453.6 \times 10^3)} \right)$$

where:

pmr = Pollutant mass emission rate, lb/h.
M_n = Mass of pollutant collected, mg.
Q_{std} = Volumetric flow rate of flue gas, dscfm.
60 = Conversion factor, minutes per hour.
$V_{m_{std}}$ = Volume of gas sampled at standard conditions, dscf.
453.6×10^3 = Conversion factor, milligrams per pound.

FLARE STACK RESULTS:

B26-1

$$HCl = \frac{(16.7)(10,114)(60)}{(41.436)(453.6 \times 10^3)} = 0.539$$

B26-2

$$HCl = \frac{(16.3)(10,469)(60)}{(41.266)(453.6 \times 10^3)} = 0.547$$

B26-3

$$HCl = \frac{(18.8)(10,417)(60)}{(40.542)(453.6 \times 10^3)} = 0.639$$

Average

HCl mass emission rate: **0.575 lb/h**

(continued)

EMISSION RATE CALCULATIONS

Concentration conversion micrograms per cubic foot to parts per million

$$ppm = \frac{(M_n)(35.315)(24.04)}{(V_{m_{std}})(MW)}$$

where:

ppm = Parts per million

M_n = Mass of pollutant collected, mg.

35.315 = Conversion factor, cubic feet per meter.

$V_{m_{std}}$ = Volume of gas sampled at standard conditions, dscf

24.04 = Molecular gas volume at 68 °F and 29.92 in.Hg., µl/µg-mole.

MW = Molecular weight, µg/µg-mole, HCl = 36.47

STACK

B26-1

$$HCl = \frac{(16.7)(35.315)(24.04)}{(41.436)(36.47)} = 9.38$$

B26-2

$$HCl = \frac{(16.3)(35.315)(24.04)}{(41.266)(36.47)} = 9.20$$

B26-3

$$HCl = \frac{(18.8)(35.315)(24.04)}{(40.542)(36.47)} = 10.8$$

Average Stack HCl ppm = **9.79**

VOC Mass Emission Rate as Total Organic Chloride

Plant: BFI- Chicopee **Site:** Flare Inlet
Date: 8/15/90 **Run Number:** B25-I-1

MOLE. WEIGHT	COMPOUND	FORMULA	µg/m3	as Cl µg/m3
126.58	BENZYL CHLORIDE	C6H5CH2Cl	<905	<254
153.84	CARBON TETRACHLORIDE	CCl4	<905	<834
112.56	CHLOROBENZENE	C6H5Cl	<905	<285
119.39	CHLOROFORM	CHCl3	<905	<806
147	DICHLOROBENZENE	C6H4Cl2	<905	<437
99	1,1-DICHLOROETHANE	CH3CHCl2	20,000	14,327
97	1,1-DICHLOROETHENE	CH2CCl2	<905	<662
99	1,2-DICHLOROETHANE	CH2ClCH2Cl	<905	<648
97	1,2-DICHLOROETHENE	ClCHCHCl	20,000	14,623
120.92	DICHLORODIFLUOROMETANE	CCl2F2	40,000	23,460
84.94	METHYLENE CHLORIDE	CH2Cl2	39,000	32,563
165.82	TETRACHLOROETHENE	CCl2CCl2	11,000	9,409
133.42	1,1,1-TRICHLOROETHANE	CH3CCl3	6,000	4,784
131.4	TRICHLOROETHENE	CHClCCl2	12,000	9,715
137.38	TRICHLOROFLUOROMETHANE	FCCl3	3,000	2,323
62.5	VINYL CHLORIDE	CH2CHCl	22,000	12,482

Total concentration of chloride, µg/m3= **127,612**

Total concentration of chloride, ppm= **66.51**

Volumetric flow rate, dscfm= **1049**

Mass emission rate of chloride, lb/h= **0.5014**

VOC Mass Emission Rate as Total Organic Chloride

Plant: BFI- Chicopee **Site:** Flare Inlet
Date: 8/15/90 **Run Number:** B25-I-2

MOLE. WEIGHT	COMPOUND	FORMULA	µg/m3	as Cl µg/m3
126.58	BENZYL CHLORIDE	C6H5CH2Cl	<950	<266
153.84	CARBON TETRACHLORIDE	CCl4	<950	<876
112.56	CHLOROBENZENE	C6H5Cl	<950	<299
119.39	CHLOROFORM	CHCl3	<950	<846
147	DICHLOROBENZENE	C6H4Cl2	<950	<458
99	1,1-DICHLOROETHANE	CH3CHCl2	21,000	15,044
97	1,1-DICHLOROETHENE	CH2CCl2	<950	<695
99	1,2-DICHLOROETHANE	CH2ClCH2Cl	<950	<681
97	1,2-DICHLOROETHENE	ClCHCHCl	30,000	21,934
120.92	DICHLORODIFLUOROMETANE	CCl2F2	40,000	23,460
84.94	METHYLENE CHLORIDE	CH2Cl2	44,000	36,737
165.82	TETRACHLOROETHENE	CCl2CCl2	11,000	9,409
133.42	1,1,1-TRICHLOROETHANE	CH3CCl3	6,500	5,183
131.4	TRICHLOROETHENE	CHClCCl2	12,000	9,715
137.38	TRICHLOROFLUOROMETHANE	FCCl3	3,000	2,323
62.5	VINYL CHLORIDE	CH2CHCl	23,000	13,049

Total concentration of chloride, µg/m3= **140,976**

Total concentration of chloride, ppm= **95.57**

Volumetric flow rate, dscfm= **1059**

Mass emission rate of chloride, lb/h= **0.5592**

VOC Mass Emission Rate as Total Organic Chloride

Plant: BFI- Chicopee **Site:** Flare Inlet
Date: 8/15/90 **Run Number:** B25-I-3

MOLE. WEIGHT	COMPOUND	FORMULA	µg/m3	as Cl µg/m3
126.58	BENZYL CHLORIDE	C6H5CH2Cl	<920	<256
153.84	CARBON TETRACHLORIDE	CCl4	<920	<848
112.56	CHLOROBENZENE	C6H5Cl	<920	<290
119.39	CHLOROFORM	CHCl3	<80	<80
147	DICHLOROBENZENE	C6H4Cl2	<920	<444
99	1,1-DICHLOROETHANE	CH3CHCl2	21,000	15,044
97	1,1-DICHLOROETHENE	CH2CCl2	<920	<673
99	1,2-DICHLOROETHANE	CH2ClCH2Cl	<920	<659
97	1,2-DICHLOROETHENE	ClCHCHCl	30,000	21,934
120.92	DICHLORODIFLUOROMETANE	CCl2F2	40,000	23,460
84.94	METHYLENE CHLORIDE	CH2Cl2	43,000	35,903
165.82	TETRACHLOROETHENE	CCl2CCl2	11,000	9,409
133.42	1,1,1-TRICHLOROETHANE	CH3CCl3	6,400	5,103
131.4	TRICHLOROETHENE	CHClCCl2	12,000	9,715
137.38	TRICHLOROFLUOROMETHANE	FCCl3	3,000	2,323
62.5	VINYL CHLORIDE	CH2CHCl	22,000	12,482

Total concentration of chloride, µg/m3= 136,624

Total concentration of chloride, ppm= 93.98

Volumetric flow rate, dscfm= 1059

Mass emission rate of chloride, lb/h= 0.5499

VOC Mass Emission Rate as Total Organic Chloride

Plant: BFI- Chicopee **Site:** Flare Stack
Date: 8/15/90 **Run Number:** B25-O-1

MOLE WEIGHT	COMPOUND	FORMULA	µg/m3	as Cl µg/m3
126.58	BENZYL CHLORIDE	C6H5CH2Cl	<18	<5
153.84	CARBON TETRACHLORIDE	CCl4	<18	<17
112.56	CHLOROBENZENE	C6H5Cl	<18	<6
119.39	CHLOROFORM	CHCl3	<18	<16
147	DICHLOROBENZENE	C6H4Cl2	<18	<9
99	1,1-DICHLOROETHANE	CH3CHCl2	<18	<13
97	1,1-DICHLOROETHENE	CH2CCl2	<18	<13
99	1,2-DICHLOROETHANE	CH2ClCH2Cl	<18	<13
97	1,2-DICHLOROETHENE	ClCHCHCl	<18	<13
120.92	DICHLORODIFLUOROMETANE	CCl2F2	<18	<11
84.94	METHYLENE CHLORIDE	CH2Cl2	5,600	4,676
165.82	TETRACHLOROETHENE	Cl2CCCl2	<18	<15
133.42	1,1,1-TRICHLOROETHANE	CH3CCl3	<18	<14
131.4	TRICHLOROETHENE	CHClCCl2	<18	<15
137.38	TRICHLOROFLUOROMETHANE	FCCl3	<18	<14
62.5	VINYL CHLORIDE	CH2CHCl	<18	<10

Total concentration of chloride, µg/m3= 4,859

Total concentration of chloride, ppm= 3.29

Volumetric flow rate, dscfm= 10114

Mass emission rate of chloride, lb/h= 0.1841

VOC Mass Emission Rate as Total Organic Chloride

Plant: BFI- Chicopee **Site:** Flare Stack
Date: 8/15/90 **Run Number:** B25-O-2

MOLE. WEIGHT	COMPOUND	FORMULA	µg/m3	as Cl µg/m3
126.58	BENZYL CHLORIDE	C6H5CH2Cl	<20	<6
153.84	CARBON TETRACHLORIDE	CCl4	<20	<18
112.56	CHLOROBENZENE	C6H5Cl	<20	<6
119.39	CHLOROFORM	CHCl3	<20	<18
147	DICHLOROBENZENE	C6H4Cl2	<20	<10
99	1,1-DICHLOROETHANE	CH3CHCl2	<20	<14
97	1,1-DICHLOROETHENE	CH2CCl2	<20	<15
99	1,2-DICHLOROETHANE	CH2ClCH2Cl	<20	<14
97	1,2-DICHLOROETHENE	ClCHCHCl	<20	<15
120.92	DICHLORODIFLUOROMETANE	CCl2F2	<20	<12
84.94	METHYLENE CHLORIDE	CH2Cl2	8,300	6,930
165.82	TETRACHLOROETHENE	Cl2CCl2	<20	<17
133.42	1,1,1-TRICHLOROETHANE	CH3CCl3	<20	<16
131.4	TRICHLOROETHENE	CHClCCl2	<20	<16
137.38	TRICHLOROFLUOROMETHANE	FCCl3	<20	<15
62.5	VINYL CHLORIDE	CH2CHCl	<20	<11

Total concentration of chloride, µg/m3= **7,134**

Total concentration of chloride, ppm= **4.84**

Volumetric flow rate, dscfm= **10469**

Mass emission rate of chloride, lb/h= **0.2797**

VOC Mass Emission Rate as Total Organic Chloride

Plant: BFI- Chicopee **Site:** Flare Stack
Date: 8/15/90 **Run Number:** B25-O-3

MOLE WEIGHT	COMPOUND	FORMULA	µg/m3	as Cl µg/m3
126.58	BENZYL CHLORIDE	C6H5CH2Cl	<23	<6
153.84	CARBON TETRACHLORIDE	CCl4	<23	<21
112.56	CHLOROBENZENE	C6H5Cl	<23	<7
119.39	CHLOROFORM	CHCl3	<23	<20
147	DICHLOROBENZENE	C6H4Cl2	<23	<11
99	1,1-DICHLOROETHANE	CH3CHCl2	<23	<16
97	1,1-DICHLOROETHENE	CH2CCl2	<23	<17
99	1,2-DICHLOROETHANE	CH2ClCH2Cl	<23	<16
97	1,2-DICHLOROETHENE	ClCHCHCl	<23	<17
120.92	DICHLORODIFLUOROMETANE	CCl2F2	<23	<13
84.94	METHYLENE CHLORIDE	CH2Cl2	8,600	7,181
165.82	TETRACHLOROETHENE	Cl2CCCl2	<23	<20
133.42	1,1,1-TRICHLOROETHANE	CH3CCl3	<23	<18
131.4	TRICHLOROETHENE	ClHCCCl2	<23	<19
137.38	TRICHLOROFLUOROMETHANE	FCCl3	<23	<18
62.5	VINYL CHLORIDE	CH2CHCl	<23	<13

Total concentration of chloride, µg/m3= **7,415**

Total concentration of chloride, ppm= **5.03**

Volumetric flow rate, dscfm= **10417**

Mass emission rate of chloride, lb/h= **0.2893**

APPENDIX B

FIELD DATA

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant Browning Ferris Industries

Date 8/16/90

Sampling location Outlet

Inside of far wall to outside of nipple 99"

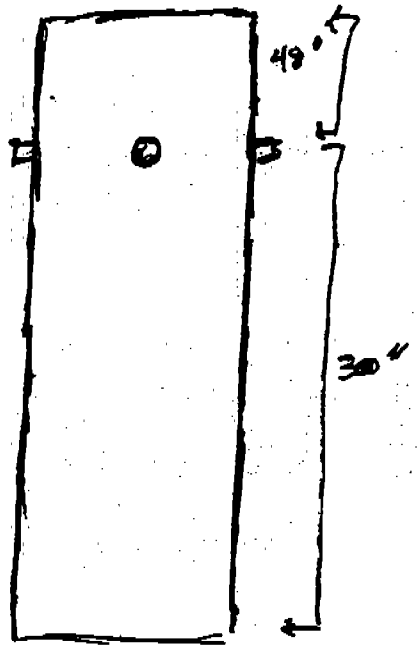
Inside of near wall to outside of nipple (nipple length) 7.5"

Stack I.D. 91.5"

Nearest upstream disturbance _____ dd

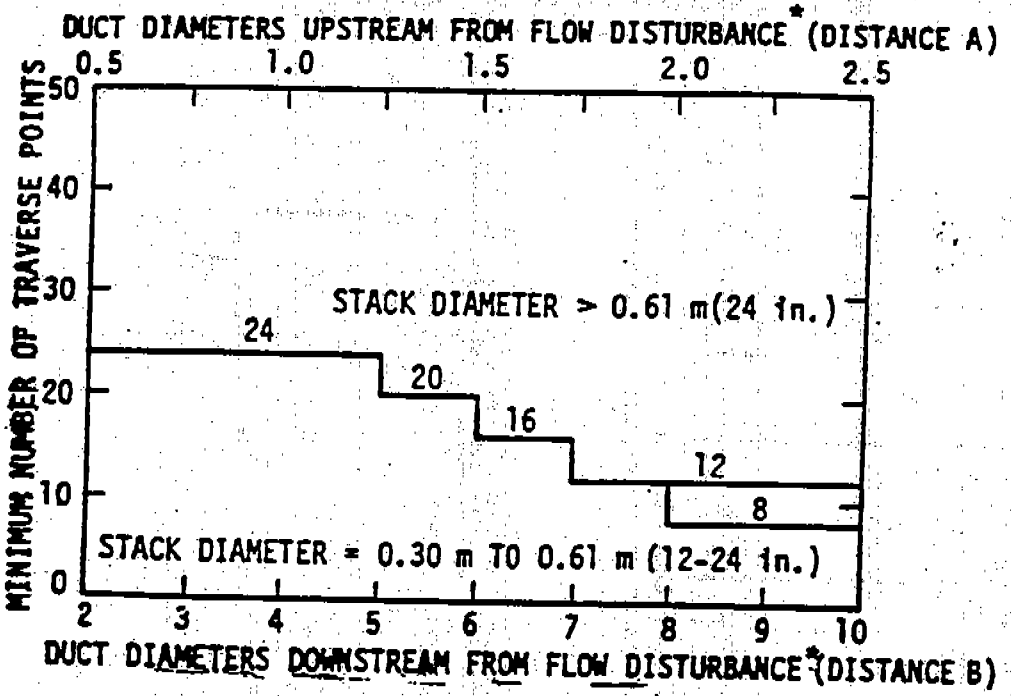
Nearest downstream disturbance _____ dd

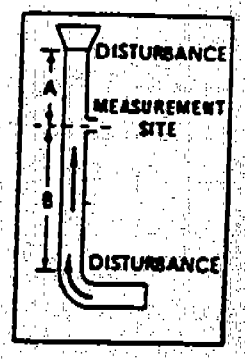
Calculated by R. Kolde



SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	NIPPLE LENGTH	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	0.021	91.5"	1 7/8"	7 1/2"	9 3/8"
2	0.067		6 1/8"		13 3/8"
3	0.118		10 3/4"		18 1/4"
4	0.177		16 1/4"		23 3/4"
5	0.250		22 7/8"		30 3/8"
6	0.356		32 5/8"		40 1/8"
7	0.644		58 7/8"		66 3/8"
8	0.750		68 5/8"		76 1/8"
9	0.823		75 1/4"		82 3/4"
10	0.882		80 3/4"		88 1/8"
11	0.933		85 3/8"		92 7/8"
12	0.979		89 5/8"		97 1/8"





* FROM POINT OF ANY TYPE OF DISTURBANCE (BEND, EXPANSION, CONTRACTION, ETC.)

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS
(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter					
	2	4	6	8	10	12
1	14.6	6.7	4.4	3.2	2.6	2.1
2	85.4	25.0	14.6	10.5	8.2	6.7
3		75.0	29.6	19.4	14.6	11.8
4		93.3	70.4	32.3	22.6	17.7
5			85.4	67.7	34.2	25.0
6			95.6	80.6	65.8	35.6
7				89.5	77.4	64.4
8				96.8	85.4	75.0
9					91.8	82.3
10					97.4	88.2
11						93.3
12						97.9

THERMOCOUPLE DIGITAL INDICATOR
AUDIT DATA SHEET

Date 8/17/90 Indicator No. FT-7 Operator R. Webb

Test Point No.	Millivolt signal*	Equivalent temperature, °F*	Digital indicator temperature reading, °F	Difference, %
1		0	-1	.22
2		100	99	.18
3		500	501	-.10
4		1000	1001	-.07

Percent difference must be less than or equal to 0.5%.

Percent difference:

$$\frac{(\text{Equivalent temperature } °R - \text{Digital indicator temperature reading } °R)(100\%)}{(\text{Equivalent temperature } °R)}$$

Where °R = °F + 460°F

* These values are to be obtained from the calibration data sheet for the calibration device.

FIELD AUDIT REPORT: DRY GAS METER BY CRITICAL ORIFICE

DATE: 8/14/90 CLIENT: Browning-Ferris Industries

BAROMETRIC PRESSURE (P_{bar}): 29.98 in.Hg METER BOX NO. FT-7

ORIFICE NO. 10 PRETEST Y: .999 ΔH@ 1.46 in.H_2O

ORIFICE K FACTOR: 4.715 x 10^{-4} AUDITOR: R. Kolde

Orifice manometer reading ΔH, in.H_2O	Dry gas meter reading V_i/V_f, ft^3	Temperatures: Ambient T_{ai}/T_{af}, °F	Ambient Average T_a, °F	Dry gas meter Inlet T_{ii}/T_{if}, °F	Dry gas meter Outlet T_{oi}/T_{of}, °F	Dry gas meter Average T_m, °F	Duration of run Ø, min.
1.45	115.000	75	75	72	72	73.5	13.10.70
	125.000	75	535°R	76	74	533.5	

Dry gas meter V_m, ft^3	$V_{m_{std}}$, ft^3	$V_{m_{act}}$, ft^3	Audit, Y	Y deviation, %	Audit ΔH@, in.H_2O	ΔH@ Deviation, in.H_2O
10.000	9.953	9.700	.975	-1.4	1.48	.02

$$V_{m_{std}} = \frac{17.647(V_m)(P_{bar} + \Delta H/13.6)}{(T_m + 460)} = \quad ft^3$$

$$V_{m_{act}} = \frac{1203(\ \emptyset\ )(\ K\ )(P_{bar})}{(T_a + 460)^{1/2}} = \quad ft^3$$

$$\text{Audit Y} = \frac{V_{m_{act}}}{V_{m_{std}}} = \qquad \text{Y deviation} = \frac{\text{Audit Y} - \text{Pretest Y}}{\text{Pretest Y}} \times 100 =$$

$$\text{Audit } \Delta H@ = (0.0317)(\Delta H)(P_{bar})(T_m + 460)\left[\frac{\emptyset}{Y\,(V_m)(P_{bar} + \Delta H/13.6)}\right]^2 = \quad \text{in.}H_2O$$

Audit Y must be in the range, pretest Y ±0.05 Y.
Audit ΔH@ must be in the range pretest ΔH@ ±0.15 inches H_2O.

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI - CHICOPEE, MASS Date 8-15-90

Sampling Location FLARE INLET Clock Time 0723

Run No. B2-I-1 Operator D. FITZGERALD/R. KOLDE

Barometric Pressure, in.Hg 30.20 Static Pressure, in.H_2O +3.0

Moisture, % 3.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 11 7/8 ~~Side 2~~

DRY BULB = 96°F
WET BULB = 82°F

PITOT #301
THERM #646
DIGITAL #122

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
H-1	0.070	93
2	0.105	94
3	0.125	95
4	0.170	96
5	0.180	96
6	0.190	96
7	0.200	96
8	0.200	96
9	0.180	96
10	0.170	95
V-11	0.140	95
12	0.150	96
13	0.180	96
14	0.190	96
15	0.180	96
16	0.190	96
17	0.190	96
18	0.220	96
19	0.200	96
20	0.170	96

CALCULATIONS

$$M_s = Md \times \left(1 - \frac{H_2O}{100}\right) + 18\left(\frac{H_2O}{100}\right)$$

$$M_s = (\quad) \times \left(1 - \frac{\quad}{100}\right) + 18\left(\frac{\quad}{100}\right)$$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$$

$$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{x}}$$

$V_s =$ ft/s

$A_s =$ ft²

$$Q_s = V_s \times A_s \times \frac{60\ s}{m}$$

$Q_s =$ x x 60

$Q_s =$ acfm

$$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times \left(1 - \frac{H_2O\ \%}{100}\right)$$

$$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times \left(1 - \frac{\quad}{100}\right)$$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI-CHICOPEE, MASS Date 8-15-90

Sampling Location FLARE INLET Clock Time 1018

Run No. BZ-I-2 Operator D.FITZGERALD/R.KOLBE

Barometric Pressure, in.Hg 30.14 Static Pressure, in.H_2O ~~-0.8~~ +3.2

Moisture, % 3.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 11 7/8 ~~Side 2~~ →

DryBulb = 100°F DIGITAL # 122

WetBulb = 82°F PITOT # 301

THERM # 646

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
A-1	~~0.130~~ 0.135	~~99~~
2	0.150	~~99~~
3	0.160	100
4	0.190	100
5	0.190	100
6	0.200	101
7	0.190	101
8	0.190	101
9	0.170	101
10	0.160	100
V-11	0.120	100
12	0.140	100
13	0.160	100
14	0.160	100
15	0.150	100
16	0.180	100
17	0.200	100
18	0.210	100
19	0.180	100
20	0.200	100

CALCULATIONS

$M_s = Md \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O\ s}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s = \quad \times \quad \times 60$

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ s}{100})$

$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI - CHICOPEE, MASS. Date 8-15-90

Sampling Location FLARE INLET Clock Time 1239

Run No. BZ-I-3 Operator D.F. TEGEKAS / R. KANE

Barometric Pressure, in.Hg 30.00 Static Pressure, in.H_2O +3.1

Moisture, % 3.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 11 7/8 Side 2 →

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
A-1	0.130	100
2	0.135	101
3	0.170	102
4	0.185	102
5	0.150	102
6	0.140	102
7	0.170	102
8	0.210	102
9	0.190	102
10	0.190	102
B-11	0.120	102
12	0.150	102
13	0.200	102
14	~~0.150~~ 0.130	102
15	0.220	102
16	0.190	102
17	0.210	102
18	0.190	102
19	0.200	102
20	0.190	102

CALCULATIONS

$M_s = Md \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s = \quad \times \quad \times 60$

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI - CHICOPEE, MASS. Date 10-15-90

Sampling Location FLARE INLET Clock Time 1452

Run No. ~~BZ-I-4~~ BZ-I-4 Operator D FITZGERALD / R. KOLKE

Barometric Pressure, in.Hg 29.56 Static Pressure, in.H_2O 3.10

Moisture, % 3.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 117/8 ~~Side 2~~ →

DIGITAL #122
PITOT #301
THERM #646

DRY BULB = 102°F
WET BULB = 82°F

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
H-1	0.130	102
2	0.150	102
3	0.160	103
4	0.175	102
5	0.200	103
6	0.190	103
7	0.210	102
8	0.210	103
9	0.175	103
10	0.170	103
V-11	0.130	103
12	0.180	102
13	0.180	102
14	0.170	103
15	0.210	103
16	0.210	103
17	0.200	103
18	0.220	102
19	0.180	103
20	0.180	103

CALCULATIONS

$M_s = Md \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O\ s}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s =$ × × 60

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} =$ × 17.647 × $\frac{\quad}{\quad}$ × $(1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BEI - CHICOPEE, MASS Date 8-15-90

Sampling Location FLARE INLET Clock Time 1640

Run No. B2-I-5 Operator D.FITZGERALD / R. KOLDE

Barometric Pressure, in.Hg 29.70 Static Pressure, in.H_2O 3.1

Moisture, % 3.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 11 7/8 Side 2 →

DIGITAL # 122
PITOT # 301
THERM # 646

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
A-1	0.135	102
2	0.150	103
3	0.180	103
4	0.190	103
5	0.200	103
6	0.170	103
7	0.170	103
8	0.220	103
9	0.190	103
10	0.180	103
B-11	0.120	102
12	0.135	102
13	0.170	103
14	0.180	103
15	0.190	103
16	0.210	103
17	0.200	103
18	0.195	103
19	0.200	103
20	0.180	103

CALCULATIONS

$$M_s = Md \times \left(1 - \frac{H_2O}{100}\right) + 18\left(\frac{H_2O_s}{100}\right)$$

M_s = ( ) × (1 − ——/100) + 18 (——/100)

M_s =

T_s = °F = °R = (°F + 460)

$$P_s = P_b + \frac{S.P.}{13.6} = (\quad) \div 13.6$$

P_s = in.Hg

$\sqrt{\Delta P}$ =

$$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$$

V_s = 85.49 × ( ) × ( ) × √——

V_s = ft/s

A_s = ft²

$$Q_s = V_s \times A_s \times \frac{60\ s}{m}$$

Q_s = × × 60

Q_s = acfm

$$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times \left(1 - \frac{H_2O\ s}{100}\right)$$

$Q_{s_{std}}$ = × 17.647 × —— × (1 − ——/100)

$Q_{s_{std}}$ = dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI - CHICOPEE, MASS. Date 8-15-90

Sampling Location FLARE INLET Clock Time 1831

Run No. BZ-I-6 Operator D. FITZGERALD / R. KOLB

Barometric Pressure, in.Hg 29.70 Static Pressure, in.H_2O +3.0

Moisture, % 5.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 117/8 ~~Side 2~~ >

DIGITAL # 122

PITOT # 301

THERM # 646

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
H-1	0.140	102
2	0.120	102
3	0.180	103
4	0.180	103
5	0.180	103
6	0.210	102
7	0.210	102
8	0.165	102
9	0.200	103
10	0.200	103
V-11	0.110	102
12	0.130	102
13	0.140	103
14	0.140	102
15	0.200	102
16	0.140	103
17	0.220	103
18	0.190	102
19	0.200	103
20	0.180	103

CALCULATIONS

$$M_s = Md \times \left(1 - \frac{H_2O}{100}\right) + 18\left(\frac{H_2O\ s}{100}\right)$$

$$M_s = (\quad) \times \left(1 - \frac{\quad}{100}\right) + 18\left(\frac{\quad}{100}\right)$$

$$M_s =$$

$$T_s = \quad °F = \quad °R = (°F + 460)$$

$$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$$

$$P_s = \quad in.Hg$$

$$\sqrt{\Delta P} =$$

$$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$$

$$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$$

$$V_s = \quad ft/s$$

$$A_s = \quad ft^2$$

$$Q_s = V_s \times A_s \times \frac{60\ s}{m}$$

$$Q_s = \quad \times \quad \times 60$$

$$Q_s = \quad acfm$$

$$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times \left(1 - \frac{H_2O\ s}{100}\right)$$

$$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times \left(1 - \frac{\quad}{100}\right)$$

$$Q_{s_{std}} = \quad dscfm$$

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI - CHICOPEE, MASS Date 8-15-90

Sampling Location FLARE INLET Clock Time 2001

Run No. B2-I-7 Operator D.FITZGERALD/R.KOLLE

Barometric Pressure, in.Hg 29.70 Static Pressure, in.H_2O +3.0

Moisture, % 3.1 Molecular wt., Dry 27.16 Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 11 7/8 ~~Side 2~~

DIGITAL ~~#~~ 122

PITOT #301

THERM #646

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
H-1	0.155	100
2	0.120	100
3	0.170	100
4	0.170	100
5	0.170	100
6	0.190	100
7	0.180	100
8	0.210	100
9	0.200	100
10	0.170	100
V-11	0.110	100
12	0.170	100
13	0.180	100
14	0.200	100
15	0.200	100
16	0.210	100
17	0.240	100
18	0.190	100
19	0.180	100
20	0.170	100

CALCULATIONS

$$M_s = Md \times \left(1 - \frac{H_2O}{100}\right) + 18\left(\frac{H_2O_s}{100}\right)$$

$$M_s = (\quad) \times \left(1 - \frac{\quad}{100}\right) + 18\left(\frac{\quad}{100}\right)$$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$$

$P_s =$ in.Hg

$\overline{\sqrt{\Delta P}} =$

$$V_s = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{T_{s_a} \text{ °R}}{P_s \times M_s}}$$

$$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$$

$V_s =$ ft/s

$A_s =$ ft²

$$Q_s = V_s \times A_s \times \frac{60 \text{ s}}{\text{m}}$$

$Q_s =$ x x 60

$Q_s =$ acfm

$$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times \left(1 - \frac{H_2O\ \%}{100}\right)$$

$$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times \left(1 - \frac{\quad}{100}\right)$$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City Browning-Ferris Industries Chicopee Date 8/15/90

Sampling Location Flare Outlet Clock Time 0740

Run No. B2-0-1 Operator DF/DK

Barometric Pressure, in.Hg 30.20 Static Pressure, in.H_2O -0.065

Moisture, % 9.9 Molecular wt., Dry 31.75 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" Side 2

Pitot = 523
Thermo = 734
Original = FF-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
C-1	0.005	1220
2	0.020	1340
3	0.025	1350
4	0.025	1410
5	0.027	1413
6	0.025	1440
7	0.026	1419
8	0.018	1390
9	0.016	1426
10	0.015	1417
11	0.012	1417
12	0.011	1410
S-1	0.010	1250
2	0.015	1390
3	0.022	1348
4	0.025	1389
5	0.035	1502
6	0.035	1494
7	0.026	1424
8	0.025	1394
9	0.020	1369
10	0.023	1385
11	0.020	1394
12	0.013	1388

CALCULATIONS

$M_s = Md \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O\ \%}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s = \quad \times \quad \times 60$

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI Chicopee, Mass. Date 8/15/90

Sampling Location Flare Outlet Clock Time 1036

Run No. B2-0-2 Operator DF/RK

Barometric Pressure, in.Hg 30.46 Static Pressure, in.H_2O -0.060

Moisture, % ~~7.7~~ 9.9 Molecular wt., Dry 29.76 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" Side 2

Pitot # 523

Thermo # 734

Digital # FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S- 1	0.030	1430
2	0.030	1436
3	0.035	1470
4	0.030	1423
5	0.035	1473
6	0.035	1460
7	0.025	1430
8	0.015	1400
9	0.010	1397
10	0.009	1454
11	0.005	1422
12	0.003	1416
E- 1	0.025	1380
2	0.040	1391
3	0.035	1420
4	0.035	1442
5	0.030	1369
6	0.035	1412
7	0.027	1416
8	0.023	1409
9	0.018	1370
10	0.015	1362
11	0.016	1416
12	0.017	1427

CALCULATIONS

$M_s = M_d \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{x}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s =$ x x 60

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} =$ x 17.647 x $\frac{\quad}{\quad}$ x $(1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI Chicopee, Mass. Date 8/15/90

Sampling Location Flare Outlet Clock Time 1250

Run No. B2-0-3 Operator DF/RK.

Barometric Pressure, in.Hg 30.00 Static Pressure, in.H_2O −0.075

Moisture, % 7.8 Molecular wt., Dry 29.76 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" ~~Side 2~~ ⟹

Pitot # 523

Thermo # 734

Digital FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
5-1	0.020	1348
2	0.022	1340
3	0.032	1353
4	0.032	1378
5	0.024	1344
6	0.030	1377
7	0.027	1418
8	0.023	1427
9	0.015	1390
10	0.017	1420
11	0.010	1410
12	0.007	1432
6-1	0.025	1360
2	0.024	1484
3	0.025	1458
4	0.032	1470
5	0.035	1570
6	0.030	1565
7	0.025	1538
8	0.030	1460
9	0.025	1470
10	~~0.030~~ 0.030	1425
11	0.025	1440
12	0.023	1453

CALCULATIONS

$$M_s = M_d \times \left(1 - \frac{H_2O}{100}\right) + 18\left(\frac{H_2O}{100}\right)$$

$$M_s = (\quad) \times \left(1 - \frac{\quad}{100}\right) + 18\left(\frac{\quad}{100}\right)$$

$$M_s =$$

$$T_s = \quad °F = \quad °R = (°F + 460)$$

$$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$$

$$P_s = \quad in.Hg$$

$$\sqrt{\Delta P} =$$

$$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$$

$$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$$

$$V_s = \quad ft/s$$

$$A_s = \quad ft^2$$

$$Q_s = V_s \times A_s \times \frac{60\ s}{m}$$

$$Q_s = \quad \times \quad \times 60$$

$$Q_s = \quad acfm$$

$$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times \left(1 - \frac{H_2O\ \%}{100}\right)$$

$$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times \left(1 - \frac{\quad}{100}\right)$$

$$Q_{s_{std}} = \quad dscfm$$

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI Chicopee, Mass Date 8/15/90

Sampling Location Flare Outlet Clock Time 1510

Run No. ~~Blank~~ BZ-0-4 Operator DF/RK

Barometric Pressure, in.Hg 29.56 Static Pressure, in.H_2O -0.060

Moisture, % 9.6 Molecular wt., Dry 29.77 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" ~~Side 2~~ →

Pitot # 523
Thermo # 734
Digital # FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.022	1440
2	0.030	1454
3	0.027	1417
4	0.033	1430
5	0.032	1480
6	0.030	1452
7	0.030	1461
8	0.023	1451
9	0.014	1391
10	0.016	1430
11	0.010	1439
12	0.009	1414
E-1	0.022	1350
2	0.031	1362
3	0.027	1406
4	0.035	1411
5	0.037	1430
6	0.032	1455
7	0.036	1437
8	0.033	1465
9	0.031	1464
10	0.025	1462
11	0.022	1434
12	0.019	1489

CALCULATIONS

$M_s = Md \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s =$ x x 60

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} =$ x 17.647 x $\frac{\quad}{\quad}$ x $(1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City BFI Chicopee, Mass Date 8/15/90

Sampling Location FLARE STACK Clock Time 1715

Run No. B2-0-5 Operator RF/R.K.

Barometric Pressure, in.Hg 29.70 Static Pressure, in.H_2O -0.060

Moisture, % 9.5 Molecular wt., Dry 29.80 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" Side 2

Pitot # 523

Thermo # 734

Digital # FT-1

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.020	1459
2	0.020	1419
3	0.033	1366
4	0.027	1392
5	0.034	1460
6	0.028	1405
7	0.026	1403
8	0.023	1446
9	0.012	1395
10	0.015	1429
11	0.011	1435
12	0.010	1431
E-1	0.017	1360
2	0.023	1380
3	0.028	1396
4	0.028	1401
5	0.037	1405
6	0.037	1470
7	0.030	1488
8	0.028	1440
9	0.025	1435
10	0.025	1450
11	0.018	1396
12	0.020	1427

CALCULATIONS

$$M_s = Md \times \left(1 - \frac{H_2O}{100}\right) + 18\left(\frac{H_2O\ \%}{100}\right)$$

$$M_s = (\quad) \times \left(1 - \frac{\quad}{100}\right) + 18\left(\frac{\quad}{100}\right)$$

$$M_s =$$

$$T_s = \quad °F = \quad °R = (°F + 460)$$

$$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$$

$$P_s = \quad in.Hg$$

$$\sqrt{\Delta P} =$$

$$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$$

$$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$$

$$V_s = \quad ft/s$$

$$A_s = \quad ft^2$$

$$Q_s = V_s \times A_s \times \frac{60\ s}{m}$$

$$Q_s = \quad \times \quad \times 60$$

$$Q_s = \quad acfm$$

$$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times \left(1 - \frac{H_2O\ \%}{100}\right)$$

$$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times \left(1 - \frac{\quad}{100}\right)$$

$$Q_{s_{std}} = \quad dscfm$$

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City Browning-Ferris Industries Chicopee Date 8/15/90

Sampling Location Flare Outlet Clock Time 1844

Run No. BZ-0-6 Operator D Fitzgerald / R. Hebb

Barometric Pressure, in.Hg 29.70 Static Pressure, in.H_2O -0.060

Moisture, % 9.6 Molecular wt., Dry 29.81 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" ~~Side 2~~ ⟹

Pitot # 523
Therm # 734
Digital # FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.015	1121
2	0.026	1231
3	0.030	1320
4	0.032	1380
5	0.032	1409
6	0.030	1392
7	0.031	1424
8	0.023	1340
9	0.023	1409
10	0.013	1344
11	0.014	1364
12	0.013	1409
E-1	0.016	1300
2	0.017	1320
3	0.030	1350
4	0.033	1380
5	0.032	1412
6	0.030	1378
7	0.030	1414
8	0.034	1425
9	0.028	1387
10	0.026	1408
11	0.025	1412
12	0.019	1393

CALCULATIONS

$M_s = Md \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O\ \%}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s = \quad \times \quad \times 60$

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City Browning Ferris Industries Chicopee Date 8/15/90

Sampling Location Flare Outlet Clock Time 2014

Run No. B2-0-7 Operator P. Fitzgerald / RKell

Barometric Pressure, in.Hg 29.70 Static Pressure, in.H_2O −0.060

Moisture, % 9.6 Molecular wt., Dry 29.80 Pitot Tube, Cp .84

Stack Dimension, in. Diameter or Side 1 91.5" ~~Side 2~~ →

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.017	1300
2	0.023	1317
3	0.030	1340
4	0.030	1378
5	0.030	1394
6	0.032	1389
7	0.030	1411
8	0.026	1376
9	0.018	1378
10	0.017	1261
11	0.020	1399
12	0.014	1372
E-1	0.016	1300
2	0.023	1310
3	0.023	1310
4	0.032	1306
5	0.025	1303
6	0.036	1413
7	0.035	1424
8	0.030	1391
9	0.030	1390
10	0.030	1403
11	0.025	1419
12	0.016	1355

CALCULATIONS

$M_s = M_d \times (1 - \frac{H_2O}{100}) + 18 (\frac{H_2O\ \%}{100})$

$M_s = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$M_s =$

$T_s =$ °F = °R = (°F + 460)

$P_s = P_b + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s, °R}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ ft/s

$A_s =$ ft²

$Q_s = V_s \times A_s \times \frac{60\ s}{m}$

$Q_s =$ × 60

$Q_s =$ acfm

$Q_{s_{std}} = Q_s \times 17.647 \times \frac{P_s}{T_s} \times (1 - \frac{H_2O\ \%}{100})$

$Q_{s_{std}} =$ × 17.647 × × $(1 - \frac{\quad}{100})$

$Q_{s_{std}} =$ dscfm

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BFI - CHICOPEE, MASS.
DATE 8-15-90 TEST NO B3-0-1
SAMPLING TIME (24-hr CLOCK) 0814-0947
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED, (CONTINUOUS))
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 82°F
OPERATOR ~~ZG~~
ORSAT LEAK CHECKED ✓ #142

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	8.0	8.0	8.0	8.0			8.0	44/100	3.520
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	19.8	11.8	19.8	11.8			11.8	32/100	3.776
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0 ~~80.2~~	80.2	100.0	80.2			80.2	28/100	22.456
							TOTAL		29.75

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BFI - Chicopee, Mass.
DATE ~~8~~ 8-15-90 TEST NO B3-0-2
SAMPLING TIME (24-hr CLOCK) 1102 - 1158
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 82°F
OPERATOR TOJ
ORSAT LEAK CHECKED ✓ #142

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	~~8~~0	8.0	7.8	7.8			7.9	44/100	3.476
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.4	12.4	20.2	12.4			12.4	32/100	3.968
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0	79.6	100.0	79.8			79.7	28/100	22.316
								TOTAL	29.76

B-21

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BFI - CHICOPEE, MASS
DATE 8-15-90 TEST NO B3-0-3
SAMPLING TIME (24-hr CLOCK) 1316-1413
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED (CONTINUOUS))
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 82°F
OPERATOR [illegible]
ORSAT LEAK CHECKED ✓

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	8.0	8.0	8.0	8.0			8.0	44/100	3.520
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.0	12.0	20.0	12.0			12.0	32/100	3.840
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0	80.0	100.0	80.0			80.0	28/100	22.400
								TOTAL	29.76

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BFI-CHICOPEE, MASS
DATE 8-15-90 TEST NO B3-0-4
SAMPLING TIME (24-hr CLOCK) 1732-1816
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED, (CONTINUOUS))
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 78°F
OPERATOR D FITZGERALD
ORSAT LEAK CHECKED ✓ #142

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	8.2	8.2	8.0	8.0			8.1	44/100	3.564
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.4	12.2	20.4	12.4			12.3	32/100	3.936
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0	79.6	100.0	79.6			79.6	28/100	22.288
								TOTAL	29.79

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BFI - CHICOPEE, MASS.
DATE 8-15-90 TEST NO B3-O-S
SAMPLING TIME (24-hr CLOCK) 1527 - 1612
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 76°F
OPERATOR D. FITZGERALD
ORSAT LEAK CHECKED ✓ #142

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	8.2	8.2	8.2	8.2			8.2	44/100	3.608
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.8	12.6	20.6	12.4			12.5	32/100	4.000
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0	79.2	100.0	79.4			79.3	28/100	22.204
								TOTAL	29.81

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Browning-Ferris Industries Chicopee
DATE 8/15/90 TEST NO B3-O-6
SAMPLING TIME (24-hr CLOCK) 1900 - 1944
SAMPLING LOCATION Flue Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) Integrated
ANALYTICAL METHOD Orsat Analyzer
AMBIENT TEMPERATURE 70 °F
OPERATOR R Wolfe
ORSAT LEAK CHECKED ✓

COMMENTS:

GAS \ RUN	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	8.4	8.4	8.0	8.0			8.2	44/100	3.608
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	~~18.4~~ 20.4	~~12.0~~ 12.0	20.2	12.2			12.1	32/100	3.872
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0	79.6	100.0	79.8			79.7	28/100	22.316
								TOTAL	29.80

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
BFI Chicopee, Mass	8/15/90	Flare Outlet	SO2	B6-04A

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kolodi	29.52	-.060	90°F	—	91.5"	.84	5' Inconel	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	F7-7	1.46	.989	739	523	I-22	320	16	.003	5	.001	—	—	—		

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1527	260.215		1.00	1.00	1571	117	116	5	—	68
1	5	1532	263.300	—	1.00	1.00	1547	117	116	5	—	68
2	10	1537	266.400	—	1.00	1.00	1489	119	117	5	—	68
3	15	1542	269.500	—	1.00	1.00	1530	120	118	5	—	68
4	20	1547	272.600	—	1.00	1.00						

SO_2 TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI - Chicopee, Mass Sample date 8-15-90

Sample location Flare Stack Recovery date 8-15-90

Run number B6-0-1A Recovered by D. Fitzgerald

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	540.9 g	641.6 g	598.3 g	871.3 g
Initial wt	571.6 g	617.7 g	582.0 g	856.1 g
Net wt	-30.7 g	23.9 g	16.3 g	15.2 g

Total moisture 24.7 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15447A Liquid level marked

Impinger contents container no. 15445A Liquid level marked

H_2O blank container no. 15448A Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
BFI Chicopee, Mass	8/15/90	Flare Outlet	SO_2	B6-0-~~###~~ 1B

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Holde	29.52	-.080	90°F	—	91.5"		.84	5' Inconel	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	FT-7	1.46	.989	734	523	I-22	320	16	.002	5	.001	—	—	—		

Velocity traverse

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, In. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1552	272.760									
1	5	1557	275.960	—	1.00	1.00	1531	117	116	5	—	68
2	10	1602	279.050	—	1.00	1.00	1520	117	116	5	—	68
3	15	1607	282.200	—	1.00	1.00	1505	117	116	5	—	68
4	20	1612	285.315	—	1.00	1.00	1550	117	116	5	—	68

SO_2 TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI-CHICOPEE, MASS Sample date 8-15-90

Sample location FLARE STACK Recovery date 8-15-90

Run number B6-0-1B Recovered by D. FITZGERALD

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	577.8 g	626.9 g	619.0 g	688.1 g
Initial wt	593.1 g	603.2 g	608.3 g	680.0 g
Net wt	-15.3 g	23.7 g	10.7 g	8.1 g

Total moisture 27.2 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15447A Liquid level marked

Impinger contents container no. 15449A Liquid level marked

H_2O blank container no. 15448A Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
BFI Chicopee, Mass	8/15/90	Flare Outlet	SO_2 (Method 6)	B6-0-2A

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kolde	29.70	-.060	90 °F	—	91.5"		.84	5' Thermal	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL)		TRAIN LEAK CHECK (FINAL)		K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK	
								in. Hg	CFM	in. Hg	CFM				INIT.	FINAL
	F7-7	1.46	.989	734	523	I-22	320	16	.004	10	.002	—	—	—		

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
					DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
	0	1730	285.496	—	1.00	1.00	1550	109	107	10	—	68
1	5	1735	288.500	—	1.00	1.00	1562	109	107	10	—	68
2	10	1740	291.610	—	1.00	1.00	1487	108	107	10	—	68
3	15	1745	294.710	—	1.00	1.00	1519	108	107	10	—	68
4	20	1750	297.729	—	1.00	1.00						

SO_2 TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI-CHICOPEE, MASS. Sample date 8-15-90

Sample location FLARE STACK Recovery date 8-15-90

Run number B6-0-2A Recovered by D. FITZGERALD

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	567.6 g	617.9 g	611.2 g	704.7 g
Initial wt	584.3 g	594.0 g	601.9 g	694.1 g
Net wt	-16.7 g	23.9 g	9.3 g	10.6 g

Total moisture 27.1 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15447A Liquid level marked

Impinger contents container no. 15450A Liquid level marked

H_2O blank container no. 15448A Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
BFI Chicopee, Mass	8/15/90	Flue Outlet	Dioxin	86-0-28

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)		PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kalb	29.70	-0.060	85°	—	91.5		.84	5' Inconel	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	FT-7	1.46	.989	734	532	I-22	320	16	.002	10	.001	—	—	—		

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1757	297.925	—	1.00	1.00	1450	108	107	10	—	67
1	5	1802	301.040	—	1.00	1.00	1550	108	108	10	—	68
2	10	1807	304.010	—	1.00	1.00	1516	109	108	10	—	68
3	15	1812	307.080	—	1.00	1.00	1530	109	108	10	—	67
4	20	1817	310.169	—								

SO_2 TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BF1-Chicopee, Mass Sample date 8-15-90

Sample location Flare Stack Recovery date 8-15-90

Run number B6-0-2B Recovered by [signature]

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	557.2 g	608.0 g	629.4 g	711.2 g
Initial wt	575.5 g	584.0 g	619.1 g	701.1 g
Net wt	−18.3 g	24.0 g	10.3 g	10.1 g

Total moisture 26.1 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15447A Liquid level marked [signature]

Impinger contents container no. 10849A Liquid level marked [signature]

H_2O blank container no. 15448A Liquid level marked [signature]

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Browning-Ferris Industries Chicopee	9 11 5 190	Flare Outlet	SO_2	B6-0-3A

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kolcle	29.70	-0.06	75°F	—	91.5"	.84	5' Inconnel	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	FT-7	1.46	.989	734	523	I-22	320	16	.003	10	.001	—	—	—		

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1900	310.358									
1	5	1905	313.450	—	1.00	1.00	1421	105	103	10	—	67
2	10	1910	316.540	—	1.00	1.00	1485	105	103	10	—	68
3	15	1915	319.700	—	1.00	1.00	1463	105	104	10	—	68
4	20	1920	322.708	—	1.00	1.00	1471	105	105	10	—	68

SO_2 TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI - CHICOPEE, MASS. Sample date 8-15-90

Sample location FLARE STACK Recovery date 8-15-90

Run number B6-0-3A Recovered by D. FITZGERALD / R. KOZAK

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	576.2 g	623.3 g	617.1 g	698.7 g
Initial wt	595.4 g	600.1 g	605.9 g	688.1 g
Net wt	-19.2 g	23.2 g	11.2 g	10.6 g

Total moisture 25.8 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15447A Liquid level marked

Impinger contents container no. 10850A Liquid level marked

H_2O blank container no. 15448A Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Browning Ferris Industries Chicopee	8/15/90	Flare Outlet	SO2	B6-0-3B

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Hollis	29.70	-0.060	75°F	—	9 1/2"	.84	5' Inconel	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	FT-7	1.46	.989	734	527	E12	320	16	.008	10	.003	—	—	—		

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	DRY GAS METER TEMPERATURE OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1925	322,910									
1	5	1930	326,000	—	1.00	1.00	1430	106	105	10	—	68
2	10	1935	329,100	—	1.00	1.00	1463	107	105	10	—	68
3	15	1940	332,100	—	1.00	1.00	1456	107	105	10	—	68
4	20	1945	335,270	—	1.00	1.00	1440	107	105	10	—	68

TOWN of

SO_2 TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI - Chicopee, Mass. Sample date 8-15-90

Sample location Flare Stack Recovery date 8-15-90

Run number B6-0-3B Recovered by D. Fitzgerald

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	563.7 g	618.7 g	613.7 g	715.0 g
Initial wt	583.3 * g	594.6 g	603.2 g	704.7 g
Net wt	-19.6 g	24.1 g	10.5 g	10.3 g

Total moisture 25.3 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15447A Liquid level marked

Impinger contents container no. 10851A Liquid level marked

H_2O blank container no. 15448A Liquid level marked

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

NITROGEN OXIDE FIELD DATA SHEET

PLANT: Browning-Ferris Industries — CITY: Chicopee

SAMPLE LOCATION: Flare Outlet — DATE: 8/15/90 (1, 2, 3)

OPERATOR: R. Kelly — INITIAL BAROMETRIC PRESSURE: 30.20, 30.14, 30.00 In. Hg

REAGENT VOLUME: 25 ml — FINAL BAROMETRIC PRESSURE: 29.50 In. Hg

RUN NO.	SAMPLE TIME (24 hr.)	FLASK AND VALVE NO's	VOLUME OF FLASK AND VALVE, ml	FLASK TEMP. (INITIAL), °F	INITIAL FLASK PRESSURE		FLASK TEMP. (FINAL) °F	FINAL FLASK PRESSURE	
					LEG 1 In. Hg	LEG 2 In. Hg		LEG 1 In. Hg	LEG 2 In. Hg
B7-1A	0815	CC	2058.7	80°F	15.0	13.8	72	1.6	1.8
B7-2B	0830	5B	1991.1	80°F	14.9	13.6	72	8.6	8.9
B7-1C	~~0845~~ 0919	5HD	1990.4	85°F	15.0	13.8	72	2.2	2.0
B7-1D	0935	LL	2062.0	90°F	14.8	13.6	72	.5	.6
				~~110°F~~					
B7-2A	1115	FF	2029.0	110°F	14.8	13.6	72	1.6	1.8
B7-2B	1130	6C	2014.9	110°F	14.8	13.6	72	1.5	1.5
B7-2C	1140	HH	2049.2	105°F	14.9	13.7	72	1.6	1.6
B7-2D	1152	MN	2051.0	105°F	14.8	13.6	72	1.6	1.~~6~~3
B7-3A	1326	FV	2073.3	110°F	14.8	13.6	72	1.5	1.5
B7-3B	1340	2HD	2029.4	110°F	14.8	13.6	72	.4	.4
B7-3C	1355	8KB	1946.2	100°F	14.8	13.6	72	1.3	1.3
B7-3D	1405	6KB	1979.3	90°F	14.8	13.6	72	1.6	1.3

Completed by M. Kuetter
8/17/90

Method 10

Integrated Bag Sampling Field Data

Run No. B10-0-1

Date 8/15/90 Plant Browning-Ferris Industries Chicopee

Sampling location Flare Outlet

Barometric pressure 30.20 " Hg. Ambient temp. 70 °F

Stack temp. 1430 °F Operator R. Kolak

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q ft^3/min.
0914 start	Midpoint	1000 cc/min
* 0941 stop	* Midpoint	1000 cc/min
* 0946 restart	Midpoint	1000 cc/min
0948 end	Midpoint	1000 cc/min

Method 10

Integrated Bag Sampling Field Data

Run No. B10-0-3

Date 8/15/90 Plant Browning Ferris Industries Chicago

Sampling location Flare Outlet

Barometric pressure 30.14 " Hg. Ambient temp. 90 °F °F

Stack temp. 1445 °F Operator R. Kolak

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q ft^3/min.
1100	Mid point	1000 cc/min
1130	Mid point	1000 cc/min
1200	Mid point	1000 cc/min

Method 10

Integrated Bag Sampling Field Data

Run No. B10-A-3

Date 8/15/90 Plant Browning Ferris Industries - Chicopee

Sampling location Flare Outlet

Barometric pressure 30.00 " Hg. Ambient temp. 100 °F

Stack temp. 1530 °F Operator B. Kelly

Sample bag leak checked ✓ Sample train leak checked ✓

Time	Traverse point	Rate meter flow rate, Q ft^3/min.
1314	Mid-point	1000 cc/min
1344	Mid-point	1000 cc/min
1414	Mid-point	1000 cc/min

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Browning-Ferris Industries	8/15/90	Flare Outlet	HCl	B26-1

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kolak	30.20	-.060	70°		91.5"	.84	5' Inconel	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	FT-7	1.46	.789	734	523	I-22	320	16	.010	5	.103	—	—	250		

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, In. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	0817	125.764	—	1.46	1.46	1450	100	97	3	250	68
1	10	0922	137.150	—	1.46	1.46	1419	103	102	3	250	68
2	20	0832	147.080	—	1.46	1.46	1401	105	105	3	250	65
3	30	0840	147.900	—	1.46	1.46	1432	107	106	3	251	65
4	40	0850	155.300	—	1.46	1.46	1426	109	107	3	248	66
5	50	0938	162.800	—	1.46	1.46	1405	110	108	3	250	67
6	60	0948	170.030	—								

TOWN COD

HCl
SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI-CHICOPEE, MASS. Sample date 8-15-90
Sample location FLARE STACK Recovery date 8-15-90
Run number BZ6-1 Recovered by D. FITZGERALD

MOISTURE

	1st	2nd	3rd	4th
Impingers	g	g	g	g
Final weight	648.0 g	610.0 g	603.4 g	711.9 g
Initial weight	589.8 g	590.2 g	599.0 g	700.8 g
Net Gain	58.2 g	19.8 g	4.4 g	11.1 g

Description of impinger contents Clear

Total moisture 93.5 g

RECOVERED SAMPLE

0.1N H_2SO_4 impinger contents and rinse container no. 1544ZA Liquid level marked

0.1N H_2SO_4 blank container no. 1544GA Liquid level marked

Samples stored and locked
Remarks

LABORATORY CUSTODY

Received by Date
Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
BEZ Chicopee Mass	8/15/90	Flare Outlet	HCl (M.26)	BZ6-2

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kolde	30.14	-.06	90°F	—	9.5	.84	5' Evaunt	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	FT-7	1.46	.989	734	523	T-22	520	16	.004	5	.001	—	—	250		

Velocity Traverse

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1100	170.856	—								
1	10	1110	178.000	—	1.46	1.46	1477	107	106	4	250	66
2	20	1120	185.430	—	1.46	1.46	1439	108	107	4	248	68
3	30	1130	192.920	—	1.46	1.46	1444	110	108	5	252	68
4	40	1140	200.440	—	1.46	1.46	1472	112	109	5	248	68
5	50	1150	207.920	—	1.46	1.46	1435	113	111	5	251	67
6	60	1200	215.480	—	1.46	1.46	1477	115	112	5	250	66

HCl

SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI - CHICOPEE MASS
Sample location FLARE STACK
Run number B26-2
Sample date 8-15-90
Recovery date 8-15-90
Recovered by D. FITZGERALD

MOISTURE

	1st	2nd	3rd	4th
Impingers	g	g	g	g
Final weight	642.5 g	618.9 g	604.3 g	723.7 g
Initial weight	600.1 g	593.6 g	596.3 g	707.6 g
Net Gain	42.4 g	25.3 g	8.0 g	16.1 g

Description of impinger contents Clear

Total moisture 91.8 g

RECOVERED SAMPLE

0.1N H_2SO_4 impinger contents and rinse container no. 15443A
Liquid level marked ✓

0.1N H_2SO_4 blank container no. 15446A
Liquid level marked ✓

Samples stored and locked
Remarks

LABORATORY CUSTODY

Received by
Date
Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
BFI Chesapeake Mass	8/15/18	Flare Outlet	HCl	BZ6-3

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE Cp	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Hilde	30.00	-.060	100°	—	9/5	.84	5' Heated	—	—

MOISTURE (%)	METER BOX NO.	METER ΔH@	METER CAL. FACTOR (Y)	THERM. NO.	PITOT NO.	IMP. THERM. NO.	ORSAT NO.	TRAIN LEAK CHECK (INITIAL) In. Hg	TRAIN LEAK CHECK (INITIAL) CFM	TRAIN LEAK CHECK (FINAL) In. Hg	TRAIN LEAK CHECK (FINAL) CFM	K FACTOR	PROBE HEAT (°F)	BOX HEAT (°F)	PITOT LEAK CHECK INIT.	PITOT LEAK CHECK FINAL
	E-7	1.46	.989	734	523	F-22	320	16	.003	5	.001	—	—	250		

Chris Travis

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (Vm), ft^3	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMP. (Ts), °F	DRY GAS METER TEMPERATURE INLET (T_{m} in), °F	DRY GAS METER TEMPERATURE OUTLET (T_{m} out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1314	215.609	—	1.46	1.46	1514	112	111	4	250	68
1	10	1324	223.100	—	1.46	1.46	1525	116	114	4	257	60
2	20	1334	230.440	—	1.46	1.46	1498	117	114	4	256	68
3	30	1344	237.900	—	1.46	1.46	1465	118	115	4	257	68
4	40	1354	245.300	—	1.46	1.46	1559	119	116	4	260	67
5	50	1404	252.650	—	1.46	1.46	1514	120	118	4	258	68
6	60	1414	260.038									

DUPLICATE

HCl
SAMPLE RECOVERY AND INTEGRITY SHEET

Plant BFI - CHICOPEE MASS — Sample date 8-15-90
Sample location FLARE STACK — Recovery date 8-15-90
Run number B26-3 — Recovered by D. FITZGERALD

MOISTURE

	1st	2nd	3rd	4th
Impingers	g	g	g	g
Final weight	645.8 g	612.7 g	577.5 g	705.4 g
Initial weight	585.3 g	599.1 g	574.2 g	690.9 g
Net Gain	60.5 g	13.6 g	3.3 g	14.5 g

Description of impinger contents Clear

Total moisture 91.9 g

RECOVERED SAMPLE

0.1N H_2SO_4 impinger contents and rinse container no. 15444A — Liquid level marked ✓

0.1N H_2SO_4 blank container no. 15446A — Liquid level marked ✓

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by — Date

Remarks

METHOD 25 FIELD DATA

Plant BFI City CHICOPEE, MASS Date 8-15-90
Run No. B25-I-1 Sample Location FLARE INLET
Operator D. FITZGERALD
Tank No. 02706 Tank Volume, Liters
Trap No. N/A ~~Rotameter~~ No. #4
Sampling Rate 80 cc/min. Filter Type N/A in stack
N/A out of stack

SAMPLE TRAIN DATA

	Barometric pressure, mm Hg	Ambient temperature, °F	Sample tank guage vacuum, mm Hg
Pre-test	767	62	752
Post-test	766	74	127

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0	~~767~~ 752	5	737	~~30~~ 15	~~0.78~~ 0.39

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
0812	0	752			
0822	10	615			
0832	20	498			
~~0842~~ 0841*	~~30~~ 29	~~384~~			
0927	40	272			
0937	50	191			
0947	60	127			

* Power loss to flare; automatic flame out. Restart @ 0916

* Leak rate cc/min = $\frac{\Delta P, \text{ cm (volume, cm}^3\text{)}}{Pb, \text{ cm} \times \text{time, min.}}$

FUEL GAS CYLINDER # BS-3

Leak rate must be <0.01 x sampling rate
(volume = 100 cm³ for less than 4 ft. probe)

METHOD 25 FIELD DATA

Plant BFI
Run No. B25-I-2
Operator D FITZGERALD
Tank No. 026Re
Trap No. N/A
Sampling Rate 80 cc/min.

City CHICOPEE, MASS
Sample Location FLARE INLET
Date 8-15-90
Tank Volume, Liters
~~Rotameter~~ No. 4
Filter Type _____ in stack
_____ out of stack

SAMPLE TRAIN DATA

	Barometric pressure, mm Hg	Ambient temperature, °F	Sample tank guage vacuum, mm Hg
Pre-test	765	76	754
Post-test	763	78	135

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0	765	6	742	23	0.50

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
1100	0	754			
1110	10	635			
1120	20	516			
1130	30	389			
1140	40	274			
1150	50	185			
1200	60	135			

* Leak rate cc/min = $\frac{\Delta P, \text{ cm (volume, cm}^3\text{)}}{Pb, \text{ cm} \times \text{time, min.}}$ FUEL GAS CYLINDER = 2-5

Leak rate must be <0.01 x sampling rate
(volume = 100 cm^3 for less than 4 ft. probe)

METHOD 25 FIELD DATA

Plant BFI City CHICOPEE, MASS. Date 8-15-90
Run No. B25-I-3 Sample Location FLARE INLET
Operator D. FITZGERALD
Tank No. 02305 Tank Volume, Liters
Trap No. ~~Rotameter~~ No. #4
Sampling Rate 80 cc/min. Filter Type _____ in stack
_____ out of stack

SAMPLE TRAIN DATA

	Barometric pressure, mm Hg	Ambient temperature, °F	Sample tank guage vacuum, mm Hg
Pre-test	762	78	752
Post-test	758	82	135

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0	762	14	742	20	0.2

SAMPLING DATA

Time		Guage vacuum mm Hg	Temperatures, °F		
Clock	Sampling		Probe	Filter inlet	Filter outlet
1314	0	762			
1324	10	628			
1334	20	516			
1344	30	390			
1354	40	289			
1404	50	141			
1414	60	135			

* Leak rate cc/min = $\frac{\Delta P,\ cm\ (volume,\ cm^3)}{Pb,\ cm \times time,\ min.}$

FUEL GAS CYLINDER = 8-5

Leak rate must be <0.01 x sampling rate
(volume = 100 cm^3 for less than 4 ft. probe)

METHOD 25 FIELD DATA

Plant Browning-Ferris City Glasgow Date 5/15/90
Run No. BFI-0-1 Sample Location Flare Outlet
Operator R. Kirk
Tank No. 010 Tank Volume, Liters
Trap No. — Rotameter No. #3 Flow Controller
Sampling Rate 80 cc/min. Filter Type _____ in stack
_____ out of stack

SAMPLE TRAIN DATA

	Barometric pressure, mm Hg ( )	Ambient temperature, °F	Sample tank guage vacuum, mm Hg
Pre-test	30.20	70	745
Post-test	30.14	85	130

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0645	745	0650	743		

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
0812	0	745	—	—	—
0822	10	580	—	—	—
0832	20	425	—	—	—
* 0841	30	396	—	—	—
0926	40	220	—	—	—
0936	50	200	—	—	—
0946	60	130	—	—	—

* Leak rate cc/min = $\frac{\Delta P, \text{ cm (volume, cm}^3\text{)}}{Pb, \text{ cm x time, min.}}$

Leak rate must be <0.01 x sampling rate
(volume = 100 cm³ for less than 4 ft. probe)

METHOD 25 FIELD DATA

Plant BFI City Chicopee Date 8/15/90
Run No. B25-C-2 Sample Location Flare Outlet
Operator R. Kulda
Tank No. 03776 Tank Volume, Liters
Trap No. — Rotameter No. #5 Flow Controller
Sampling Rate 80 cc/min. Filter Type _____ in stack
_____ out of stack

SAMPLE TRAIN DATA

	Barometric pressure, mm Hg	Ambient temperature, °F	Sample tank guage vacuum, mm Hg
Pre-test	30.14	85°	750
Post-test	30.00	90°F	200

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
1000	270	1005	274	2	

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
1100	0	750	—	—	—
1110	10	660	—	—	—
1120	20	572	—	—	—
1130	30	486	—	—	—
1140	40	390	—	—	—
1150	50	308	—	—	—
1200	60	200	—	—	—

* Leak rate cc/min = $\frac{\Delta P, \text{ cm (volume, cm}^3\text{)}}{Pb, \text{ cm x time, min.}}$

Leak rate must be <0.01 x sampling rate
(volume = 100 cm^3 for less than 4 ft. probe)

METHOD 25 FIELD DATA

Plant BFI
Run No. B25-0-3
Operator R. Gale
Tank No. 03774
Trap No. —
Sampling Rate 80 cc/min.

City Chicopee, Mass
Sample Location Flare Outlet
Date 8/15/90
Tank Volume, Liters
Rotameter No. #5 Controller
Filter Type _____ in stack
_____ out of stack

SAMPLE TRAIN DATA

	Barometric pressure, mm Hg	Ambient temperature, °F	Sample tank guage vacuum, mm Hg
Pre-test	762 (3000)	100°F	750
Post-test	2952	100°F	240

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
1120	280	1125	280		

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
1314	0	750	—	—	—
1324	10	660	—	—	—
1334	20	568	—	—	—
1344	30	485	—	—	—
1354	40	408	—	—	—
1404	50	328	—	—	—
1414	60	240	—	—	—

* Leak rate cc/min = $\frac{\Delta P, \text{ cm (volume, cm}^3\text{)}}{Pb, \text{ cm} \times \text{time, min.}}$

Leak rate must be <0.01 x sampling rate
(volume = 100 cm^3 for less than 4 ft. probe)

DAILY CO CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant: BFI-CHICOPEE
Location: FLARESTACK
Date: 8-15-90
Operator: D. FITZGERALD
PN: 50014
Run No.: B10-0-1,2,3

Monitor: BENDIX
Span value: ~~5000ppm~~ 445ppm
Chart scale: 100
Pbar, in.Hg: 30.00
Tamb, deg. F: 82
Time, Pretest: 1340 Post-test: 1610

Cylinder No.	Cal. gas conc., ppm	Chart divisions		Concentration predicted by equation*		Analyzer cali-bration error,** % of span	Drift,*** % of span
		Pretest	Posttest	Pretest	Posttest		
ALM-015399	0	4.9	4.9	-0.3	-0.3	-0.1	0.0
ALM-1768	24.8	9.9	9.9	24.4	24.4	-0.1	0.0
ALM-002868	49.9	25.4	25.3	101.0	100.5	0.2	-0.1
AAL-9158	224	50.2	50.1	223.5	223.1	-0.1	-0.1

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ x = ppm y = chart division

For data reduction:

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(\text{CD} - 4.457)}{(0.2024)}$$

Correlation coef. = 0.99997

** Analyzer cal. error, % span = $\frac{(\text{Cal. gas conc.} - \text{conc. predicted}) \times 100}{\text{Span value}}$

Acceptable limit = ≤2% of span

*** Drift % span = $\frac{(\text{Posttest cal. response} - \text{initial cal. response}) \times 100}{\text{Span value}}$

Acceptable limit ≤10% of span in 8 hours (EPA Method 10)

Minimum detectable limit = 2% of span or 10 ppm

Maximum zero drift = 0.1 % of span or 0.4 (ppm) or % (circle one)

Maximum cal. drift = 0.2 % of span or 0.9 (ppm) or % (circle one)

COMMENTS: Pretest or posttest (circle one) calibration used to quantitate sample data. Posttest is used if drift exceeds limits and if post-test yields higher concentrations.

DOWNLOAD

INITIAL CO CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant: BFI-CHICOPEE, MASS.
Location: FLARE STACK
Date: 8-14-90
Operator: D. FITZGERALD
PN: 30014

Monitor: BENDIX
Span value: ~~250~~ 235 ppm
Chart scale: 100
Pbar, in.Hg: 29.98
Tamb, °F: 76

Cylinder No.	Cal. gas conc., ppm	Chart divisions: Direct injection to monitor	Chart divisions: Injection through system	Concentration predicted by equation,* Direct System	Calibration error,** % of span	Sampling system bias,*** % of span
ALM-015399	0	4.9	5.1	-0.6	-0.2	+0.2
ALM-1768	24.8	14.6	14.7	24.8	0.0	+0.1
ALM-002868	99.9	43.7	43.8	101.0	0.4	+0.1
AAL-9158	224	90.5*	90.6	223.5	-0.2	+0.1

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ x = ppm y = chart division

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(\text{CD} - 5.129)}{(0.3819)}$$

Correlation coef. = 099997

** Calibration error, % span = $\frac{(\text{Cal. gas conc.} - \text{conc. predicted})}{\text{Span value}} \times 100$

Acceptable limit ≤2% of span

*** Sampling system bias =

$$\frac{(\text{Direct injection gas conc.} - \text{system injection gas conc.})}{\text{Span value}} \times 100$$

Acceptable limit ≤5% of span

Minimum detectable limit = 2 percent of span or 5 ~~4.7~~ ppm

Rise time to 90% of response for high cal. gas value: (direct), system.

System: 62 s, 60 s, 61 s Avg. 61 s
80 81 81

Acceptable limits ≤30 seconds (direct injection).

Response for system injections must also be recorded.

Precision = difference in chart division response for two repeated injections of the same gas concentration = 90.5 - 90.6 = 0.1 % (clock time = 1118)

Acceptable limits = ± 2 percent of full scale.

COMMENTS: _____

DAILY CO CEM CALIBRATION AND PERFORMANCE EVALUATION

Plant: BFI - Chicopee, Mass
Location: Flare Stack
Date: 8-15-90
Operator: D. Fitzgerald
PN: 50014
Run No.: B10-0-1, 2, 3

Monitor: Bendix
Span value: ~~250 ppm~~ 232 ppm
Chart scale: 100
Pbar, in.Hg: 30.10
Tamb, deg. F: 78
Time, Pretest: 1124 Post-test: 1523

Cylinder No.	Cal. gas conc., ppm	Chart divisions: Pretest	Chart divisions: Posttest	Concentration predicted by equation*: Pretest	Concentration predicted by equation*: Posttest	Analyzer calibration error,** % of span	Drift,*** % of span
ALM-015399	0	5.0	5.0	-0.5	-0.5	-0.2	0.0
ALM-1768	24.8	14.9	14.8	25.0	24.8	0.1	-0.1
ALM-002868	~~99.7~~ 99.9	44.1	44.0	100.5	100.2	0.2	-0.1
AAL-9158	224	91.8	91.4	223.7	222.7	-0.1	-0.4

* Perform linear regression of pretest cal. gas concentration vs. chart divisions to determine following equation:

$y = mx + b$ x = ppm y = chart division

For data reduction:

$$\text{Pollutant ppm/\%} = \frac{(\text{Chart division} - b)}{m} = \frac{(\text{CD} - 5.207)}{(0.3871)}$$

Correlation coef. = 0.99999

** Analyzer cal. error, % span = $\frac{(\text{Cal. gas conc.} - \text{conc. predicted}) \times 100}{\text{Span value.}}$

Acceptable limit = ≤2% of span

*** Drift % span = $\frac{(\text{Posttest cal. response} - \text{initial cal. response}) \times 100}{\text{Span value}}$

Acceptable limit ≤10% of span in 8 hours (EPA Method 10)

Minimum detectable limit = 2% of span or ~~5~~ 4.6 ppm

Maximum zero drift = 0.2 % of span or ~~0.5~~ 0.5 ppm or % (circle one)

Maximum cal. drift = 0.4 % of span or 0.9 ppm or % (circle one)

COMMENTS: Pretest or posttest (circle one) calibration used to quantitate sample data. Posttest is used if drift exceeds limits and if posttest yields higher concentrations.

CEM DATA REDUCTION SHEET FOR BAG ANALYSIS OR NONSTEADY READINGS

Date 8-29-90 Parameter SO_2, NO_x,* CO_2, O_2, (CO), THC

Operator [illegible] PN 50014 Location BFI - CHICOPEE; FLARE STACK

Pollutant ppm/% = $\frac{\text{(Chart division x b)}}{\text{m}} = \frac{(CD - 5,207)}{(0,3871)} = \frac{(CD - 4,957)}{0.2024}$ Δ

Run No.	Time** (24-H)	Duration, min	Average chart division	Conc.	Conc. x min***	Comments
B10-0-1	0814-	60	85.7	208		
Dup.	0947		85.5	207	208 ppm	
B10-0-2	1102-	56	62.0	282		
Dup.	1158		62.1	282	282 ppm	USE CURVE FROM 445 ppm SPAN CALIBRATION. Δ
B10-0-3	1314-	60	89.1	217		
Dup.	1414		89.3	217	217 ppm	

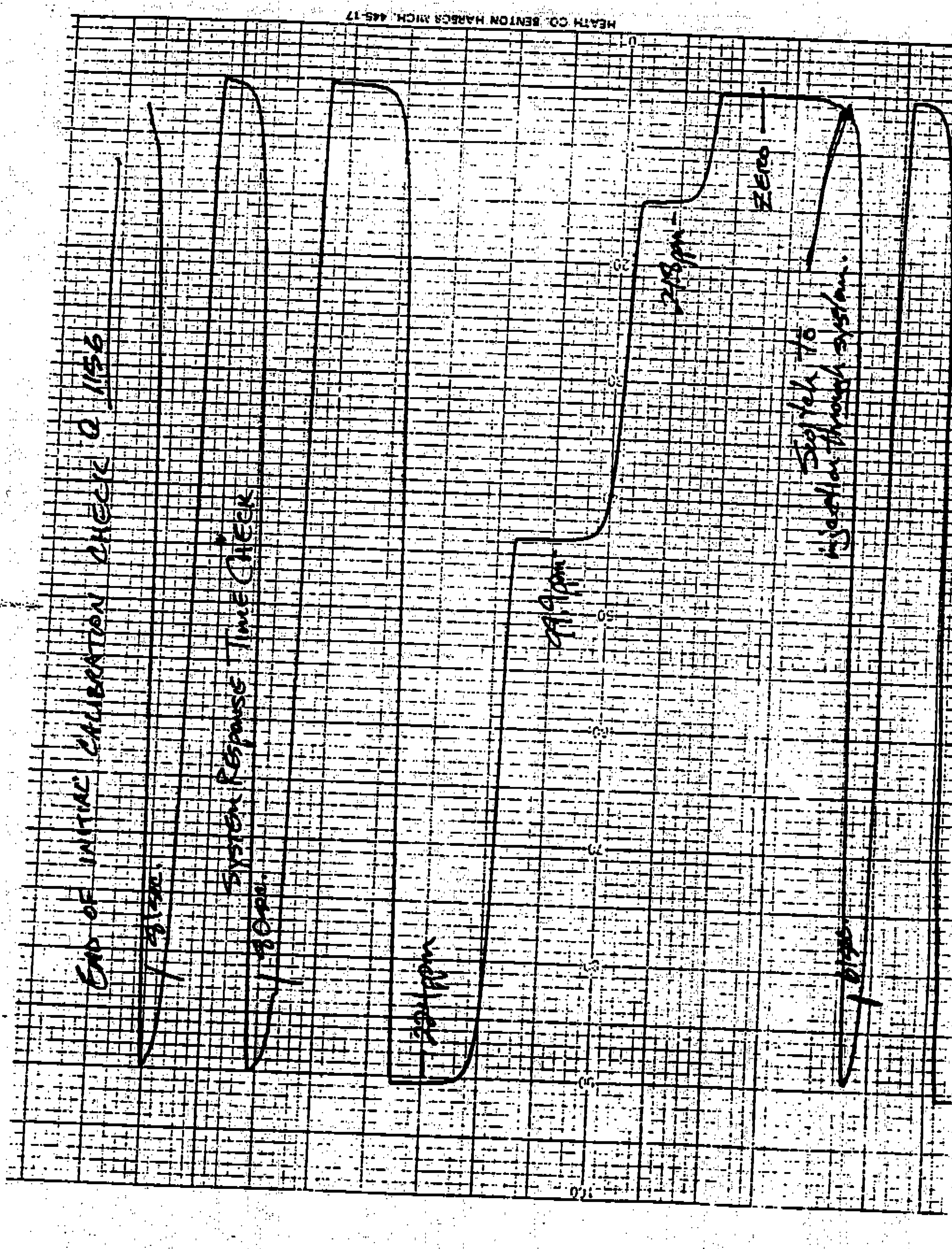
* For NO_x, indicate whether NO, NO + NO_2, or NO_2 for specific interval.

** Indicate whether time interval is from beginning of first time to beginning of second time or to end of second time (circle one, or describe alternate).

*** For overall average concentration, divide the sum of conc. x minutes by the total minutes.

Calculated by [illegible] on 8-29-90 Checked by _____ on _____

Response Time to 90% = 12 sec.
Zero Gas
999 PPM
10 PPM
Span = 0.25 mV
Range 0 - 100 mV
Speed 0.2 INCH/MIN
2220
(N2)
CO
8-14-90
CALIBRATION
DIRECT INJECTION


HEATH CO. BENTON HARBOR MICH. 445-17
END OF INITIAL CALIBRATION CHECK @ 1156
SYSTEM RESPONSE TIME CHECK
ZERO

HEATH CO. BENTON HARBOR MICH. 446-T
0
10
20
30
40
50
60
70
80
90
100

Dawn
PRINTED IN U.S.A.
NICHL 446-17
0
10
20
30
40
50
60
70
80
90
100
Sample Time
Bag
Sample Time
Bag

HEATH CO. BENTON HARBOR MICH. 445-17
0
10
20
30
40
50
60
70
80
90
100
11
12
13
14
15
16
17
18
19
20
21
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23
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85
86
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92
93
94
95
96
97
98
99
100

HEATH CO. BENTON HAR
PRINTED IN U.S.A.
0
10
20
30
40
50
60
70
80
90
100
Bldg Shower Line
Bldg-Main
Bldg-Main
Bldg Shower Line

PRINTED IN U.S.A.
N HARBOR NICHL 446-17
0
10
20
30
40
50
60
70
80
Test Hole #2
Test Hole #1
Proposed Treatment Area
Proposed Treatment Area
Test Hole #3

HEATH CO. BENTON HARBOR MICH. 445.17
0
10
20
30
40
50
60
70
80
90
100
Southern Pacific
Northern Pacific
Wabash
Heath
Legend

left
right
middle
bottom

APPENDIX C

LABORATORY DATA

MARKWEST HYDROCARBON PARTNERS, LTD.
P.O. BOX 878, U.S. RT. 33
SOUTH SHORE, KY 41175
(606)932-7111

BFG-I-1

NAME: PEI ASSOCIATES
ADDRESS: 11499 CHESTER ROAD
CINCINNATI, OH 45246

WELL NAME(S): BFI-DAVISSON (DVL# 85-3)
WELL LOCATION: MASON-MASON

GAS ANALYSIS: 1ST 5-1985 5-17-85 AT 8:00 AM
SAMPLE DATE: 5-15-85

COMPONENT	MOL%	GPM
METHANE	87.02	
ETHANE	7.73	2.061
PROPANE	2.63	0.725
ISO-BUTANE	0.33	0.108
N-BUTANE	0.60	0.190
ISO-PENTANE	0.21	0.077
N-PENTANE	0.26	0.093
HEXANES+	0.19	0.083
NITROGEN	0.49	
ARGON/OXYGEN	0.01	
CO2	0.71	
HYDROGEN	0.00	
	100.00	3.391

LABORATORY CALCULATIONS:

GROSS BTU/CF*	978.8
DRY BTU/SCF	963.1
SPECIFIC GRAVITY	0.6787

GASOLINE CONTENT (GPM):

PENTANES + HEAVIER	0.00001
BUTANES & HEAVIER	0.00000
PROPANE & HEAVIER	0.00000
ETHANE + HEAVIER	0.00002

*(60 deg.F. 14.73 psia. sat'd)

THESE ANALYSES ARE BASED ON SAMPLES OF MATERIALS SUPPLIED BY THE CLIENT TO MARKWEST HYDROCARBON PARTNERS, LTD. THEY ARE FOR EXCLUSIVE AND CONFIDENTIAL USE OF OUR CLIENTS. THE ANALYSIS REPRESENTS THE BEST JUDGEMENT OF MARKWEST HYDROCARBON PARTNERS, LTD.; BUT, MARKWEST HYDROCARBON PARTNERS, LTD., ITS DIRECTORS, OFFICERS OR EMPLOYEES ASSUME NO RESPONSIBILITY AND MAKE NO WARRANTY OR REPRESENTATIONS AS TO THE PRODUCTIVITY, PROPER OPERATIONS OF PROFITABILITY OF ANY OIL, GAS, OTHER MINERAL WELL OR OTHER OPERATIONS OR FACILITIES IN CONNECTION WITH WHICH SUCH REPORT IS USED OR RELIED UPON.

Rebecca Nelson
LABORATORY TECHNICIAN

BFG-I-2

MARKWEST HYDROCARBON PARTNERS, LTD.
P.O. BOX 878, U.S. RT. 33
SOUTH SIDE, WV 45779
(606) 932-7111

NAME: PEI ASSOCIATES
ADDRESS: 11499 CHESTER ROAD
CINCINNATI, OH 45246

WELL NAME(S): STATION TWO (DUAL 3-8)
WELL LOCATION: WAYNE COUNTY, WV

GAS ANALYZED: DRY [illegible] GAS AT 3150 PSIG
SAMPLE DATE: 8-18-97

COMPONENT	MOL%	GPM
METHANE	87.61	
ETHANE	6.07	1.623
PROPANE	3.03	0.833
ISO-BUTANE	0.41	0.134
N-BUTANE	0.59	0.186
ISO-PENTANE	0.21	0.077
N-PENTANE	0.09	0.033
HEXANES+	0.11	0.047
NITROGEN	1.77	
CARBON DIOXIDE	0.12	
OXYGEN	0.00	
HYDROGEN	0.00	
	100.00	2.933

CALCULATED PROPERTIES

BTU/CU.FT.	1031.2
BTU/LB	480.7
SPECIFIC GRAVITY	0.5805

SPECIFIC CONTENT (GPM):

PENTANES & HEAVIER	0.00000
BUTANES & HEAVIER	0.00000
PROPANE & HEAVIER	0.00000
ETHANE & HEAVIER	0.00000

@ 60 deg.F, 14.73 psia, sat'd

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Rebecca Hodson

[illegible] TECHNICIAN

MARKWEST HYDROCARBON PARTNERS, LTD.
P.O. BOX 878, L.S. ST. 20
SOUTH EATON, OH 45178
(606)932-7111

NAME: PSI ASSOCIATES
ADDRESS: 11499 CHESTER ROAD
CINCINNATI, OH 45246

BFG-I-3

WELL NAME(S): BFI-CHESTER (CYLE 8-8)
WELL LOCATION: MORGAN/WEST

GAS ANALYSIS: BFI CHESTER 8-17-87 AT 9:40 AM
SAMPLE DATE: 8-18-87

COMPONENT	MOL%	GPM
METHANE	48.42	
ETHANE	0.12	0.000
PROPANE	0.01	0.000
ISO-BUTANE	0.00	0.000
N-BUTANE	0.01	0.000
ISO-PENTANE	0.00	0.000
N-PENTANE	0.00	0.000
HEXANES+	0.00	0.000
NITROGEN	15.37	
OXYGEN (ARGON)	1.77	
CO2	34.31	
HYDROGEN	0.00	
TOTAL	100.00	0.000

LABORATORY CALCULATIONS:

GROSS BTU/SCF:	461.5
DRY BTU/SCF	485.7
SPECIFIC GRAVITY	0.7067

GASOLINE CONTENT (GPM):

PENTANES & HEAVIER	0.00000
BUTANES & HEAVIER	0.00000
PROPANE & HEAVIER	0.00000
ETHANE & HEAVIER	0.00000

@(60 deg.F. 14.73 psia. sat'd)

THESE ANALYSES ARE BASED ON SAMPLES OR MATERIALS SUPPLIED BY THE CLIENT TO MARKWEST HYDROCARBON PARTNERS, LTD. THEY ARE FOR EXCLUSIVE AND CONFIDENTIAL USE OF OUR CLIENTS. THE ANALYSIS REPRESENTS THE BEST JUDGEMENT OF MARKWEST HYDROCARBON PARTNERS, LTD.; BUT, MARKWEST HYDROCARBON PARTNERS, LTD., ITS DIRECTORS, OFFICERS OR EMPLOYEES ASSUME NO RESPONSIBILITY AND MAKE NO WARRANTY OR REPRESENTATIONS AS TO THE PRODUCTIVITY, PROPER OPERATIONS OR PROFITABILITY OF ANY OIL, GAS, OTHER MINERAL WELL OR OTHER OPERATIONS OR FACILITIES IN CONNECTION WITH WHICH SUCH REPORT IS USED OR RELIED UPON.

BECCA Nelson
OPERATION TECHNICIAN

METHOD 6 SULFUR DIOXIDE ANALYTICAL DATA

Plant BFI Date 8-23-90

Sample location FLARE STACK Analyst G Thress

STANDARDIZATION OF TITRANT

			Vol. of titrant	Normality of Titrant	
Titrant Used	$Ba(ClO_4)_2$	1	20.70 ml	.0096 N	
Normality of H_2SO_4 Std.	0.01	2	20.75 ml	.0096 N	.0096 N (Avg.)(N_2)
Volume of Std.	20	3	20.76 ml	.0096 N	

CONTROL SAMPLE ANALYSIS

			Vol. of titrant	
Normality of $(NH_4)_2SO_4$	(N_1) 0.01	1	20.00 ml	
Volume of $(NH_4)_2SO_4$	(V_1) 20	2	20.01 ml	20.0 ml (Avg.) V_2
Meq_1 $(NH_4)_2SO_4$	$(N_1 \times V_1)$ 0.20	3	20.06 ml	

$\frac{Meq_1}{Meq_2}$ = 1.04 = 0.95 to 1.05 Meq_2 $(NH_4)_2SO_4$ $(N_2 \times V_2)$ = .192

SAMPLE ANALYSIS

Run No.	Total volume of sample	Sample aliquot	Volume of titrant, V_t, ml			
			1st titration	2nd titration	3rd titration	Avg.
BLANK H_2O_2		20ml	.01	.01		.01
0567 AUDIT NO. 2529	100ml	20ml	8.5	8.45		8.48
BG-0-3B	1000ml	20ml	0.05	0.08		.065
BG-0-3A	1000ml	20ml	0.10	0.15		0.125
BG-0-2A	1000ml	20ml	0.15	0.15		0.15
BG-0-2B	1000ml	20ml	0.12	0.12		0.12
BG-0-1B	1000ml	20ml	0.20	0.20		0.20
BG-0-1A	1000ml	20ml	0.12	0.10		0.11

$\frac{\text{1st titration}}{\text{2nd titration}}$ = 0.99 to 1.01 or 1st titration - 2nd titration ≤0.2 ml.

Signature of analyst G Thress Signature of reviewer _____

MARKWEST

MarkWest Hydrocarbon Partners, Ltd.
P. O. Box 575
South Shore, KY 41175
(606) 932-3111

Run No. BFG-I-1

ANALYSIS RESULTS SUMMARY

Well Name & No. - CYL BS-3

Well Location - MASSACHUSETTS (BFI-CHICOPEE)

Date Sampled - 8-15-90

Date Received - 8-17-90

Date Analysis Run - 8-22-90

Sulfur Determination:

HYDROGEN SULFIDE = 0.00 ppm
METHYL MERCAPTAN = 0.20 ppm
ETHYL MERCAPTAN = 0.12 ppm
DIMETHYL SULFIDE = 0.02 ppm
TOTAL SULFUR = 0.34 ppm

Rebecca Hobson
LABORATORY TECHNICIAN

These analyses are based on samples or materials supplied by the client of MarkWest Hydrocarbon Partners, Ltd. They are for exclusive and confidential use of our clients. The analysis represents the best judgement of MarkWest Hydrocarbon Partners, Ltd.; but MarkWest Hydrocarbon Partners, Ltd., its directors, officers or employees, assume no responsibility and make no warranty or representations as to the productivity, proper operations or profitability of any oil, gas, other mineral well or other operations or facilities in connection with which such report is used or relied upon.

MARKWEST

MarkWest Hydrocarbon Partners, Ltd.
P. O. Box 575
South Shore, KY 41175
(606) 932-3111

Run No: BFG-I-2

ANALYSIS RESULTS SUMMARY

Well Name & No. - CYL#2-S

Well Location - MASSACHUSETTS (BFI-CHICOPEE)

Date Sampled - 8-15-90

Date Received - 8-17-90

Date Analysis Run - 8-22-90

Sulfur Determination:

HYDROGEN SULFIDE = 0.00 ppm
METHYL MERCAPTAN = 0.01 ppm
ETHYL MERCAPTAN = 0.85 ppm
DIMETHYL SULFIDE = 0.08 ppm
TOTAL SULFUR = 0.94 ppm

ELTON NELSON
LABORATORY TECHNICIAN

MARKWEST

MarkWest Hydrocarbon Partners, Ltd.
P. O. Box 575
South Shore, KY 41175
(606) 932-3111

Run No.: BFG-I-3

ANALYSIS RESULTS SUMMARY

Well Name & No. - CYL#8-S

Well Location - MASSACHUSETTS (BFI-CHICOPEE)

Date Sampled - 8-15-90

Date Received - 8-17-90

Date Analysis Run - 8-22-90

Sulfur Determination:

HYDROGEN SULFIDE = 0.67 ppm
METHYL MERCAPTAN = 0.13 ppm
ETHYL MERCAPTAN = 0.01 ppm
DIMETHYL SULFIDE = 0.00 ppm
TOTAL SULFUR = 0.81 ppm

Rebecca Nelson
LABORATORY TECHNICIAN

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

BFI Chicopee

Date: September 4, 1990

Attn: Mr. Dan Fitzgerald (PEI)

Job Number PN 50014

This is the Certificate of Analysis for the following samples:

Client Project ID:	BFI Chicopee
Date Received:	August 20, 1990
Work Order:	X0#08-120
Number of Samples:	13
Sample Type:	NOX

I. Introduction

Twelve NOX samples and one reagent blank arrived at ITAS Cincinnati on August 20, 1990. The samples were sent for analytical work in support of monitoring work at BFI Chicopee. The samples were collected on August 15, 1990 and were labeled as follows:

NOX Flask B7-1A	NOX Flask B7-2A	NOX Flask B7-3A	Reagent Blank Solution
NOX Flask B7-1B	NOX Flask B7-2B	NOX Flask B7-3B	
NOX Flask B7-1C	NOX Flask B7-2C	NOX Flask B7-3C	
NOX Flask B7-1D	NOX Flask B7-2D	NOX Flask B7-3D	

NOX Reagent

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analysis requested was NOX by EPA Method 7A.

Reviewed and Approved by: (for KM)

Jon Mueller
Inorganic Group Leader
08120

Client: BFI Chicopee
Work Order: X0-08-120
00812001

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, Total ug

Client Sample ID	Lab No.	1st Run	2nd Run	Avg.
NOX Flask # B7-1A	01	44.7	42.3	43.5
NOX Flask # B7-1B	02	ND	ND	ND
NOX Flask # B7-1C	03	33.9	36.3	35.2
NOX Flask # B7-1D	04	46.4	46.9	46.6
NOX Flask # B7-2A	05	47.0	47.1	47.0
NOX Flask # B7-2B	06	48.2	46.4	47.3
NOX Flask # B7-2C	07	54.4	57.0	55.7
NOX Flask # B7-2D	08	44.4	42.4	43.4
NOX Flask # B7-3A	09	44.5	48.8	46.6
NOX Flask # B7-3B	10	49.5	49.8	49.6
NOX Flask # B7-3C	11	59.8	63.6	61.7
NOX Flask # B7-3D	12	41.3	42.6	42.0
Reagent Blank Solution	13	ND	ND	ND
Detection Limit			30	

ND = Not Detected

Quality Control
Audit Solutions

Audit	Theoretical Value	Percent Recovery
Audit # 7272 Lot # 0486	350	101, 101

LABORA

Corrected Report

Mr. Dan Fitzgerald
PEI ASSOCIATES, INC.
11499 Chester Road
Cincinnati, OH 45246

Page 1
Report Date : 09/11/90
HEG Task # : 90080389
HEG P/N, Acct:

P.O. Number: 5138
Proj #: 50014

Date Received: 08/29/90

HEG Sample # : 9014621 Sample Date: 08/15/90 Sample Priority: Normal
Sample ID : B25-O-3

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 5 X D.F. 2.30 = <12	

HEG Sample # : 9014622 Sample Date: 08/15/90 Sample Priority: Normal
Sample ID : B25-I-3

Parameter	Units	Results	Comments
Non Methane Organics	ppm	387 X D.F 1.84 = 712	as Hexane?

HEG Sample # : 9014623 Sample Date: 08/15/90 Sample Priority: Normal
Sample ID : B25-I-2

Parameter	Units	Results	Comments
Non Methane Organics	ppm	283 X D.F. 1.90 = 538	

HEG Sample # : 9014624 Sample Date: 08/15/90 Sample Priority: Normal
Sample ID : B25-O-2

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 5 X D.F. 2.23 = <11	

D.F = Dilution Factor

LABORATORY ANALYSIS REPORT

Mr. Dan Fitzgerald
PEI ASSOCIATES, INC.
11499 Chester Road
Cincinnati, OH 45246

Page 2
Report Date : 09/11/90
HEG Task # : 90080389
HEG P/N, Acct:

HEG Sample # : 9014625 Sample Date: 08/15/90 Sample Priority: Normal
Sample ID : Blank

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 5	

HEG Sample # : 9014626 Sample Date: 08/15/90 Sample Priority: Normal
Sample ID : B25-I-1

Parameter	Units	Results	Comments
Non Methane Organics	ppm	485	D.F. X 1.81 = 878

D.F. = Dilution Factor

HAYDEN

LABORATORY ANALYSIS REPORT

Mr. Dan Fitzgerald
PEI ASSOCIATES, INC.
11499 Chester Road
Cincinnati, OH 45246

Page 1
Report Date : 09/11/90
HEG Task # : 90090083
HEG P/N, Acct:

P.O. Number: 5138
Proj #: 50014

Date Received: 09/10/90

HEG Sample # : 9015300 Sample Date: 08/15/90 Sample Priority: Emergency
Sample ID : TO14/25, B25-O-1

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 5	D.F. X 1.83 = < 9

D.F. = Dilution Factor

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

PEI Associates, Inc.

Date: September 24, 1990

Attn: Mr. Dan Fitzgerald (PEI)

Job Number PN 50014

This is the Certificate of Analysis for the following samples:

Client Project ID:	BFI Chicopee
Date Received:	August 20, 1990
Work Order:	X0-09-062
Number of Samples:	7
Sample Type:	Canisters

I. Introduction

Seven canister samples arrived at ITAS Cincinnati on August 20, 1990. The samples were sent for analytical work in support of monitoring work for BFI Chicopee. The samples were labeled as follows:

Canister # B15-I-1	Canister # B25-O-1	Blank Canister
Canister # B15-I-2	Canister # B25-O-2	
Canister # B15-I-3	Canister # B25-O-3	

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analyses requested were the 16 Volatile Organic Compounds in the Table A-1 provided for this project and chloride by EPA Method 26. The chloride results were converted and are expressed as HCl.

Reviewed and Approved by:

C. Craig Crume
Project Manager
009062

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

IV. Data Report Qualifiers

Following are descriptions of data report qualifiers which may have been used in this analytical report.

ND The analyte was not detected in the sample or extract. The value reported in parentheses after the "ND" is the detection limit for that compound in that sample.

U The analyte was not detected in the sample or extract. The value reported with the "U" is the detection limit for that compound in that sample.

VALUE The result is a value equal to or greater than the detection limit for that compound.

J Indicates an estimated value. This flag is used when mass spectral data indicates the presence of the compound, but the result is less than the specified detection limit.

B This flag is used whenever the analyte is found in the blank as well as in the sample.

E This flag indicates that the quantity of this compound detected in this sample is above the linear range of the instrument. Results are probably lower than actual.

V. Comments

The values for methylene chloride for the outlets were taken from the analysis on August 24, 1990. All other values were taken from September 15, 1990.

Client: BFI Chicopee
Work Order: X0-09-062
00906202

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results

Client Sample ID	Lab No.	HCl, ug/ml gas	Detection Limit
Canister # B25-I-1	01	ND	0.2
Canister # B25-I-2	02	ND	0.2
Canister # B25-I-3	03	ND	0.2

ND = Not Detected

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Chloride	4	98.5, 101, 99.5, 98.5, 1

.ient: BFI Chicopee
)rk Order: X0-09-062
)906203

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

.trix: Air

.mple Wt/Vol: 10 ml

vel: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:
Canister # B25-I-1
Lab Sample No:
X0-09-062-01
Date Received: 8-20-90
Date Analyzed: 8-24-90

Dilution Factor: 1.81

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	6000	
75-34-4	1,1-Dichloroethene	905	U
75-35-3	1,1-Dichloroethane	20000	
107-06-2	1,2-Dichloroethane	905	U
71-43-2	Benzene	15000	
	Benzyl Chloride	NA	
56-23-5	Carbon Tetrachloride	905	U
108-90-7	Chlorobenzene	905	U
67-66-3	Chloroform	905	U
	Dichlorobenzene, total	NA	
75-09-2	Methylene Chloride	39000	
127-18-4	Tetrachloroethene	11000	
108-88-3	Toluene	430000	
1330-20-7	Total Xylenes	170000	
79-01-6	Trichloroethene	12000	
75-01-4	Vinyl Chloride	22000	

NA = Not Analyzed. This data is for comparison purposes only.

Client: BFI Chicopee
Work Order: X0-09-062
009062B

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 10 ml

Level: (low/med) Med

% Moisture: not dec. N/A

Client Sample ID:
Canister # B25-I-1
Lab Sample No:
X0-09-062-01 Dup.
Date Received: 8-20-90
Date Analyzed: 9-15-90

Dilution Factor: 1.81

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	5700	
75-34-4	1,1-Dichloroethene	450	U
75-35-3	1,1-Dichloroethane	16000	
107-06-2	1,2-Dichloroethane	450	U
71-43-2	Benzene	15000	
56-23-5	Carbon Tetrachloride	450	U
108-90-7	Chlorobenzene	450	U
67-66-3	Chloroform	450	U
75-09-2	Methylene Chloride	45000	
127-18-4	Tetrachloroethene	9900	
108-88-3	Toluene	430000	
1330-20-7	Total Xylenes	130000	
79-01-6	Trichloroethene	9800	
75-01-4	Vinyl Chloride	18000	

lient: BFI Chicopee
ork Order: X0-09-062
0906204

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

atrix: Air

Client Sample ID:
Canister # B25-I-2
Lab Sample No:
X0-09-062-02

ample Wt/Vol: 10 ml

evel: (low/med) Med

Moisture: not dec. N/A

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90
Dilution Factor: 1.9

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	6500	
75-34-4	1,1-Dichloroethene	950	U
75-35-3	1,1-Dichloroethane	21000	
107-06-2	1,2-Dichloroethane	950	U
71-43-2	Benzene	16000	
	Benzyl Chloride	950	U
56-23-5	Carbon Tetrachloride	950	U
108-90-7	Chlorobenzene	950	U
67-66-3	Chloroform	950	U
	Dichlorobenzene, total	950	U
75-09-2	Methylene Chloride	44000	
127-18-4	Tetrachloroethene	11000	
108-88-3	Toluene	480000	
1330-20-7	Total Xylenes	210000	
79-01-6	Trichloroethene	12000	
75-01-4	Vinyl Chloride	23000	

Client: BFI Chicopee
Work Order: XO-09-062
00906205

IT ANALYTICAL SERVICE
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 10 ml

Level: (low/med) Med

% Moisture: not dec. N/A

Client Sample ID:
Canister # B25-I-3
Lab Sample No:
XO-09-062-03
Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90
Dilution Factor: 1.84

CONCENTRATION UNITS:
ug/m3

CAS NO.	COMPOUND		
71-55-6	1,1,1-Trichloroethane	6400	
75-34-4	1,1-Dichloroethene	920	U
75-35-3	1,1-Dichloroethane	21000	
107-06-2	1,2-Dichloroethane	920	U
71-43-2	Benzene	16000	
	Benzyl Chloride	920	U
56-23-5	Carbon Tetrachloride	920	U
108-90-7	Chlorobenzene	920	U
67-66-3	Chloroform	920	U
	Dichlorobenzene, total	920	U
75-09-2	Methylene Chloride	43000	
127-18-4	Tetrachloroethene	11000	
108-88-3	Toluene	460000	
1330-20-7	Total Xylenes	170000	
79-01-6	Trichloroethene	12000	
75-01-4	Vinyl Chloride	22000	

Client: BFI Chicopee
Work Order: X0-09-062
0906299

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 0.5 L

Level: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:
Canister # B25-O-1
Lab Sample No:
X0-09-062-07
Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90
Dilution Factor: 1.83

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	18	U
75-34-4	1,1-Dichloroethene	18	U
75-35-3	1,1-Dichloroethane	18	U
107-06-2	1,2-Dichloroethane	18	U
71-43-2	Benzene	18	U
	Benzyl Chloride	18	U
56-23-5	Carbon Tetrachloride	18	U
108-90-7	Chlorobenzene	18	U
67-66-3	Chloroform	18	U
	Dichlorobenzene, total	18	U
75-09-2	Methylene Chloride	5600	B
127-18-4	Tetrachloroethene	18	U
108-88-3	Toluene	28	
1330-20-7	Total Xylenes	18	U
79-01-6	Trichloroethene	18	U
75-01-4	Vinyl Chloride	18	U

Client: BFI Chicopee
Work Order: X0-09-062
00906208

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 0.5 L

Level: (low/med) Med

% Moisture: not dec. N/A

Client Sample ID:
Canister # B25-O-2
Lab Sample No:
X0-09-062-04
Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90
Dilution Factor: 2.23

CONCENTRATION UNITS:
ug/m3

CAS NO.	COMPOUND		
71-55-6	1,1,1-Trichloroethane	20	U
75-34-4	1,1-Dichloroethene	20	U
75-35-3	1,1-Dichloroethane	20	U
107-06-2	1,2-Dichloroethane	20	U
71-43-2	Benzene	20	U
	Benzyl Chloride	20	U
56-23-5	Carbon Tetrachloride	20	U
108-90-7	Chlorobenzene	20	U
67-66-3	Chloroform	20	U
	Dichlorobenzene, total	20	U
75-09-2	Methylene Chloride	8300	B
127-18-4	Tetrachloroethene	20	U
108-88-3	Toluene	27	
1330-20-7	Total Xylenes	20	U
79-01-6	Trichloroethene	20	U
75-01-4	Vinyl Chloride	20	U

ient: BFI Chicopee
rk Order: X0-09-062
906206

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

trix: Air

mple Wt/Vol: 0.5 L

vel: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:
Canister # B25-0-3
Lab Sample No:
X0-09-062-05
Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90
Dilution Factor: 2.3

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	23	U
75-34-4	1,1-Dichloroethene	23	U
75-35-3	1,1-Dichloroethane	23	U
107-06-2	1,2-Dichloroethane	23	U
71-43-2	Benzene	23	U
	Benzyl Chloride	23	U
56-23-5	Carbon Tetrachloride	23	U
108-90-7	Chlorobenzene	23	U
67-66-3	Chloroform	23	U
	Dichlorobenzene, total	23	U
75-09-2	Methylene Chloride	8600	B
127-18-4	Tetrachloroethene	23	U
108-88-3	Toluene	31	
1330-20-7	Total Xylenes	23	U
79-01-6	Trichloroethene	23	U
75-01-4	Vinyl Chloride	23	U

Client: BFI Chicopee
Work Order: X0-09-062
00906230

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 150 ml

Level: (low/med) Med

% Moisture: not dec. N/A

Client Sample ID:
Blank Canister
Lab Sample No:
X0-09-062-06
Date Received: 8-20-90
Date Analyzed: 8-24-90

Dilution Factor: 1

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	30	U
75-34-4	1,1-Dichloroethene	30	U
75-35-3	1,1-Dichloroethane	30	U
107-06-2	1,2-Dichloroethane	30	U
71-43-2	Benzene	30	U
	Benzyl Chloride	NA	
56-23-5	Carbon Tetrachloride	30	U
108-90-7	Chlorobenzene	30	U
67-66-3	Chloroform	30	U
	Dichlorobenzene, total	NA	
75-09-2	Methylene Chloride	1100	
127-18-4	Tetrachloroethene	30	U
108-88-3	Toluene	30	U
1330-20-7	Total Xylenes	30	U
79-01-6	Trichloroethene	30	U
75-01-4	Vinyl Chloride	30	U

NA = Not Analyzed

lient: BFI Chicopee
ork Order: X0-09-062
0906207

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

atrix: Air

mple Wt/Vol: 1 Liter

evel: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:
Blank Canister
Lab Sample No:
X0-09-062-06
Date Received: 8-20-90
Date Analyzed: 9-15-90

Dilution Factor: 1

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
71-55-6	1,1,1-Trichloroethane	5	U
75-34-4	1,1-Dichloroethene	5	U
75-35-3	1,1-Dichloroethane	5	U
107-06-2	1,2-Dichloroethane	5	U
71-43-2	Benzene	5	U
	Benzyl Chloride	5	U
56-23-5	Carbon Tetrachloride	5	U
108-90-7	Chlorobenzene	5	U
67-66-3	Chloroform	5	U
	Dichlorobenzene, total	5	U
75-09-2	Methylene Chloride	5	U
127-18-4	Tetrachloroethene	5	U
108-88-3	Toluene	5	U
1330-20-7	Total Xylenes	5	U
79-01-6	Trichloroethene	5	U
75-01-4	Vinyl Chloride	5	U

Client: BFI Chicopee
Work Order: X0-09-062
00906217

IT ANALYTICAL SERVIC
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister # B25-I-1

Matrix: Canister

Lab Sample ID: X0-09-062-01

Sample Wt/Vol: 10 ml

Level: (low/med) Med

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Dilution Factor: 1.81

Column: Capillary

CONCENTRATION UNITS: ug/m3

Number TICs Found: 12

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q
	1,2-DICHLOROETHENE*	9:22	20000	J
	HYDROCARBON	12:34	30000	J
	HYDROCARBON	13:28	20000	J
	HYDROCARBON	17:40	60000	J
	UNKNOWN	24:34	30000	J
	ETHYL BENZENE*	25:34	300000	J
	HYDROCARBON	25:38	20000	J
	HYDROCARBON	19:28	20000	J
	ACETONE*	5:44	70000	J
	STYRENE*	28:22	20000	J
	DICHLORODIFLUOROMETHANE*	2:16	40000	J
	TRICHLOROFLUOROMETHANE*	6.38	3000	J
	* CALIBRATED TARGETS			

Client: BFI Chicopee
Work Order: X0-09-062
00906215

IT ANALYTICAL SERVICES
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister # B25-I-2

Matrix: Canister
Sample Wt/Vol: 10 ml

Lab Sample ID: X0-09-062-02

Level: (low/med) Med

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Column: Capillary

Dilution Factor: 1.9

Number TICs Found: 17

CONCENTRATION UNITS: ug/m3

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q
	1,2-DICHLOROETHENE*	9:22	30000	J
	HYDROCARBON	10:16	20000	J
	HYDROCARBON	12:36	40000	J
	HYDROCARBON	13:28	30000	J
	HYDROCARBON	15:38	40000	J
	HYDROCARBON	16:02	40000	J
	HEXANE	17:42	70000	J
	HYDROCARBON	19:28	20000	J
	HYDROCARBON	20:48	80000	J
	HYDROCARBON	24:00	20000	J
	UNKNOWN	29:34	40000	J
	ETHYL BENZENE*	25:36	40000	J
	HYDROCARBON	26:00	40000	J
	ACETONE*	5:44	60000	J
	STYRENE*	27:50	20000	J
	DICHLORODIFLUOROMETHANE*	2:14	40000	J
	TRICHLOROFLUOROMETHANE*	6:38	3000	J

* CALIBRATED TARGETS

Client: BFI Chicopee
Work Order: X0-09-062
00906216

IT ANALYTICAL SERVICES
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister # B25-I-3

Matrix: Canister

Lab Sample ID: X0-09-062-03

Sample Wt/Vol: 10 ml

Level: (low/med) Med

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Dilution Factor: 1.84

Column: Capillary

CONCENTRATION UNITS: ug/m3

Number TICs Found: 15

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q
	HYDROCARBON	10:16	20000	J
	HYDROCARBON	12:36	40000	
	HYDROCARBON	13:30	20000	J
	ALKANE	15:40	30000	J
	ALKANE	17:42	60000	J
	HYDROCARBON	19:28	20000	J
	1,2-DICHLOROETHENE*	9:22	30000	J
	HYDROCARBON	20:48	80000	J
	UNKNOWN	24:36	30000	J
	HYDROCARBON	26:00	40000	J
	ETHYL BENZENE*	25:36	300000	J
	ACETONE*	5:46	80000	J
	STYRENE*	28:26	20000	J
	DICHLORODIFLUOROMETHANE*	2:14	40000	J
	TRICHLOROFLUOROMETHANE*	6:40	3000	J
	* CALIBRATED TARGETS			

Client: BFI Chicopee
Work Order: XO-09-062
00906218

IT ANALYTICAL SERVICES
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister # B25-O-1

Matrix: Canister

Lab Sample ID: XO-09-062-07

Sample Wt/Vol: 0.5 L

Level: (low/med) Med

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Column: Capillary

Dilution Factor: 1.83

CONCENTRATION UNITS: ug/m3

Number TICs Found: 5

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q
	UNKNOWN	1:16	1000	
	UNKNOWN	2:24	200	
	UNKNOWN	3:22	100	
	UNKNOWN	6:30	30	
	UNKNOWN	18:42	300	

Client: BFI Chicopee
Work Order: X0-09-062
00906219

IT ANALYTICAL SERVIC
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister # B25-O-2

Matrix: Canister

Lab Sample ID: X0-09-062-04

Sample Wt/Vol: 0.5 L

Level: (low/med) Med

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Dilution Factor: 2.23

Column: Capillary

CONCENTRATION UNITS: ug/m3

Number TICs Found: 1

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q
	UNKNOWN	18:42	300	

Client: BFI Chicopee
Work Order: XO-09-062
00906221

IT ANALYTICAL SERVICES
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister # B25-O-3

Matrix: Canister

Lab Sample ID: XO-09-062-05

Sample Wt/Vol: 0.5 L

Level: (low/med) Med

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Dilution Factor: 2.3

Column: Capillary

CONCENTRATION UNITS: ug/m3

Number TICs Found: 2

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q
	UNKNOWN	5:22	9	
	UNKNOWN	18:42	300	

Client: BFI Chicopee
Work Order: XO-09-062
00906220

IT ANALYTICAL SERVICE
CINCINNATI, OH

ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Canister Blank

Matrix: Canister

Lab Sample ID: XO-09-062-06

Sample Wt/Vol: 1 Liter

Level: (low/med)

Date Received: 8-20-90
Date Analyzed: 8-24 and 9-15-90

% Moisture: not dec. N/A

Dilution Factor: 1

Column: Capillary

CONCENTRATION UNITS: ug/m3

Number TICs Found: NONE

CAS NO.	COMPOUND NAME	RT	EST. CONC	Q

Client: BFI Chicopee
Work Order: XO-09-062
109062C

IT ANALYTICAL SERVICES
CINCINNATI, OH

Quality Assurance Data

Surrogate Recovery, Percent

Client Sample ID	Lab No.		d4-1,2-dichloroethane	d8-Toluene	p-Bromofluorobenzene
Canister # B25-I-1	01		97	103	86
Canister # B25-I-1	01 Dup.		96	110	93
Canister # B25-I-2	02		105	102	97
Canister # B25-I-3	03		99	104	88
Canister # B25-O-2	04		100	98	86
Canister # B25-O-3	05		105	99	86
Canister Blank	06	(8-24-90)	102	96	99
Canister Blank	06	(9-15-90)	96	101	86
Canister # B25-O-1	07		110	100	87

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

BFI Chicopee

Date: September 17, 1990

Attn: Mr. Dan Fitzgerald (PEI)

Job Number PN 50014

This is the Certificate of Analysis for the following samples:

Client Project ID:	BFI Chicopee
Date Received:	August 17, 1990
Work Order:	XO-08-122
Number of Samples:	4
Sample Type:	Impinger Solutions

I. Introduction

Four Impinger samples arrived at ITAS Cincinnati on August 17, 1990. The samples were sent for analytical work in support of monitoring work at BFI Chicopee. The samples were labeled as follows:

Impinger Solution B26-1
Impinger Solution B26-2
Impinger Solution B26-3
Impinger Solution Blank

II. Analytical Results/Methodology

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information, the analytical results, and the appropriate detection limits.

The analysis requested was chloride by EPA Method 26. The results were converted and reported as HCL.

Reviewed and Approved by:

C. Craig Crume
Project Manager
008122

III. Quality Control

Immediately following the analytical data for the samples can be found the QA/QC information that pertains to these samples. The purpose of this information is to demonstrate that the data enclosed is scientifically valid and defensible. This QA/QC data is used to assess the laboratory's performance during the analysis of the samples it accompanies. All quantitations were performed from within the calibrated range of the analytical instrument.

Client: BFI Chicopee
Work Order: XO-08-122
00812201

IT ANALYTICAL SERVI
CINCINNATI, OH

Analytical Results

Client Sample ID	Lab No.	HCL, mg	Total Volume, ml
Impinger Solution B26-1	01	16.7	457
Impinger Solution B26-2	02	16.3	427
Impinger Solution B26-3	03	18.8	419
Impinger Solution Blank	04	<1.3 mg/L	255
Detection Limit		<1.3 mg/L	NA

NA = Not Applicable
ND = Not Detected

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Precent Recovery
Chloride	4	93.5, 103, 99.2

APPENDIX D

SAMPLING AND ANALYTICAL PROCEDURES

DETERMINATION OF SELECTED VOLATILE ORGANIC COMPOUNDS AND TOTAL GASEOUS NONMETHANE ORGANIC EMISSIONS

Sampling and analysis for selected volatile organic compounds (VOC) and total gaseous nonmethane organic compounds (NMO) were conducted according to sampling procedures described in EPA Method T014* and proposed EPA Method 25C. Since both methodologies require evacuated canisters as the collection media, one sample was obtained and analyzed by the respective procedures of each method for the required pollutants.

SAMPLING APPARATUS

A schematic of the sampling apparatus used at the landfill gas flare inlet is shown in Figure D-1. Figure D-2 depicts the sampling apparatus used at the landfill gas flare outlet. The outlet sampling train differs from the inlet by the addition of moisture drop out jar. The moisture drop out jar was used to drop out possible condensation produced by cooling down the exhaust gases from the exit of the landfill gas flare. The sampling trains to be used in these tests met design specifications established by the U.S. Environmental Protection Agency. Assembled by PEI personnel, the train consists of the following:

Gas Collection Tank - 316 stainless steel tank with premeasured volume of approximately 6.0 liters. Tank is fitted with a valve and the interior surfaces are SUMMA™ passivated.

Sampling Regulator System - A mercury manometer to monitor changes in tank pressure during sampling, stainless steel flow shut-off valve to start and stop sample flow, 2-µm sintered stainless steel in-line filter and calibrated pre-set stainless steel flow meter to maintain constant flow rate.

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* EPA-600/4-84-041, "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", April 1984.

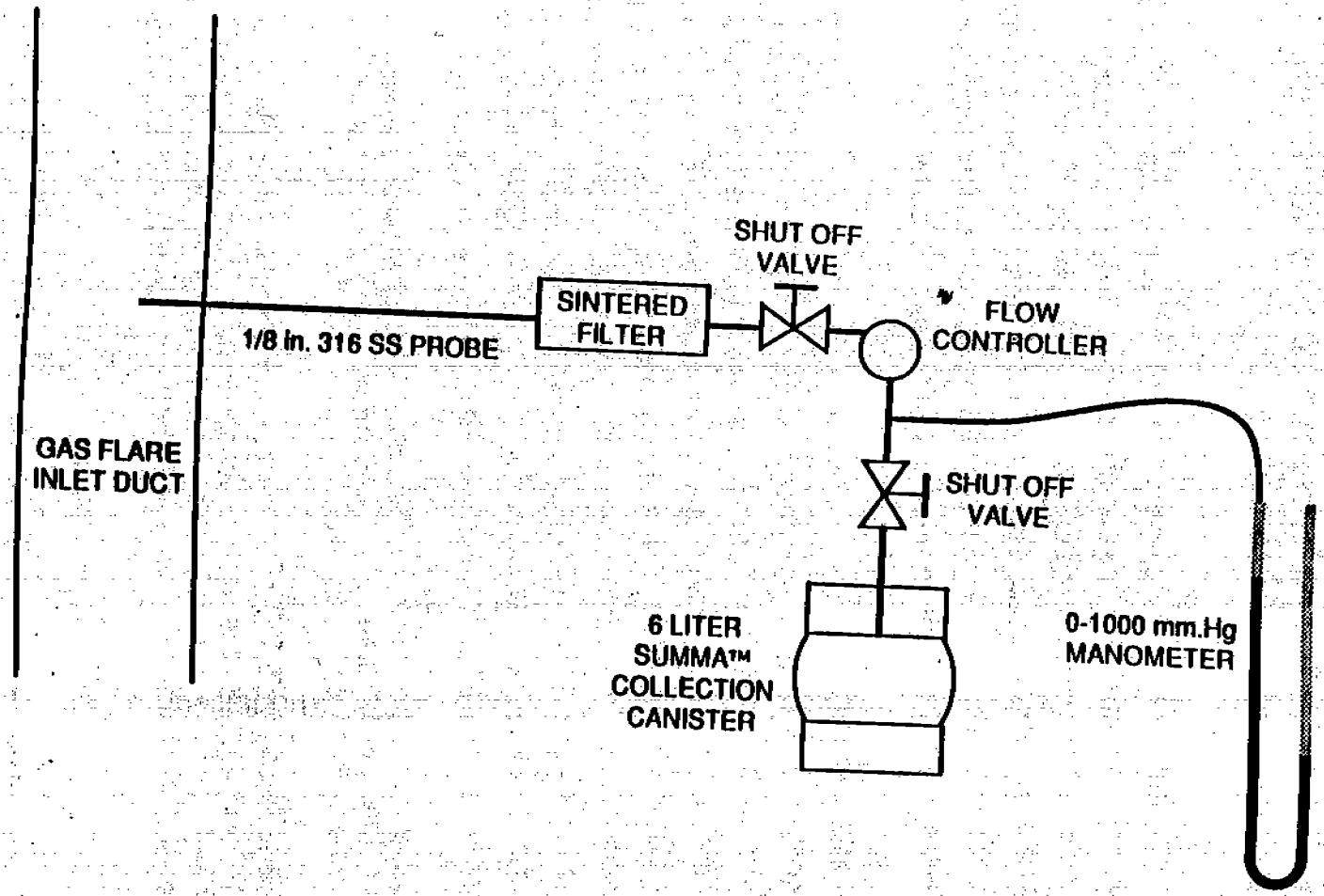

Figure D-1. VOC/NMO sampling train - flare inlet.

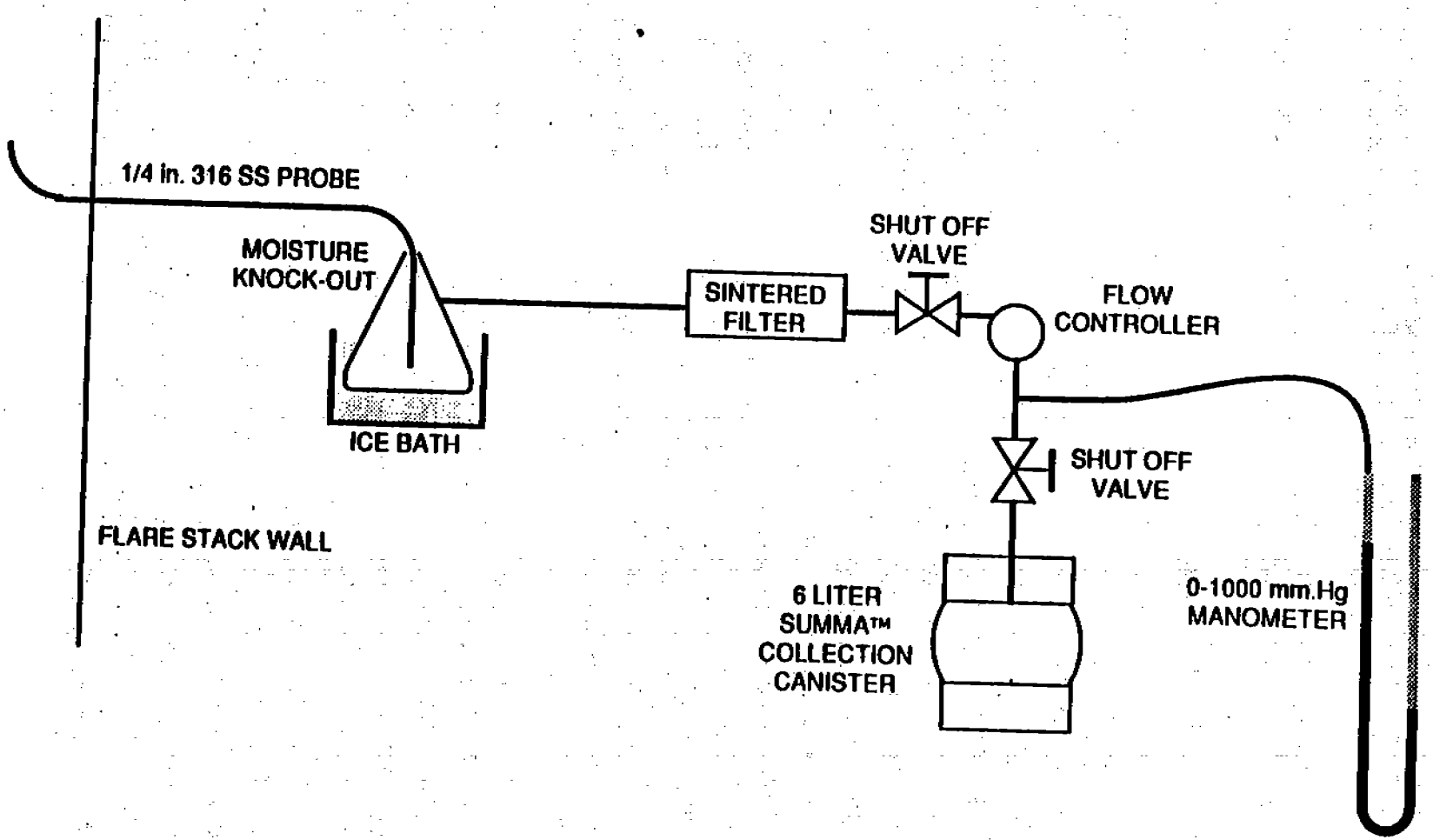

Figure D-2. VOC/NMO sampling train - flare outlet.

Pressure Gauge - U-tube mercury manometer with a range of 0 to 1000 millimeters of mercury (mm.Hg.)to measure tank pressure to the nearest 1 mm.Hg.

Vacuum Pump - Single-stage vacuum pump to evacuate sample tanks to an absolute pressure of 10 mm.Hg.

SAMPLING PROCEDURES

Prior to sampling, the collection tank is evacuated to 10 mm.Hg. absolute pressure and the sampling train is allowed to sit for a period of 60 minute. An acceptable leak check is considered to be no change in pressure during this period. This procedure was conducted in the laboratory before transport to the sampling site. At the sampling site and prior to sampling, the internal pressure was checked and recorded to verify no leakage occurred during transport. Sampling proceeded if the tank pressure is within 10 mm. Hg. of absolute pressure. If the canister failed this check, it was either discarded or re-evacuated and observed to determine the movement within a 60 minute period. If at this time no change was observed the canister was considered acceptable for use. The sampling trains were assembled as shown in Figures D-1 and D-2. The outlet sampling train was leak-checked from the probe inlet to the shut-off valve on the collection tank. This was conducted following procedures described in EPA Method 25.* The ambient temperature and barometric pressure were recorded.

After the leak check, the probe is inserted into the gas stream, the valve connecting to the collection tank is closed, and the sampling train is purged with sample gas using the vacuum pump. At least 2 sample probe volumes will be evacuated from the system at a flow rate similar to that of sampling. Once the purge is complete, sampling is begun by closing the vacuum pump valve, opening the collection tank valve. The flow is maintained at a constant rate by the pre-set flow controller. Manometer readings are recorded at 10-minute intervals throughout the sampling period.

After completion of the test, the collection tank pressure and temperature are measured and the train is disassembled and transported to the laboratory for the appropriate analyses.

* 40 CFR 60, Appendix A, July 1989.

ANALYTICAL PROCEDURE FOR SELECTED VOC'S

Since the collection tanks were sampled down to near ambient pressures, the tanks were pressurized with humidified helium in the laboratory to facilitate sample travel from the canister due to positive pressure release. A dilution factor was calculated for each canister and is reported on the analytical data sheets presented in Appendix C. Analysis were performed for the pollutants listed in Table D-1 by extracting an aliquot from the collection tank and injecting it onto a tenax sorbent tube. The tenax sorbent tube is subsequently thermally desorbed onto a sorbent trap and then routed to the detector. Sample components are separated by gas chromatography (GC) utilizing fused silica capillary columns. Mass analysis is performed on each peak and ion counts recorded for quantitation by GC/MS full scan.

Table D-1. VOC Compounds

Compounds	Compounds
benzene	tetrachloromethane
benzyl chloride	toluene
chlorobenzene	1,1,1-trichloroethane
dichlorobenzene	1trichloroethylene
1,1-dichloroethane	trichloromethane
1,2-dichloroethane	vinyl chloride
1,1-dichloroethene	xylene
dichloromethane	organic nitrogen
tetrachloroethylene	organic chlorine

Quality Assurance

Each SUMMA™ polished collection tank is cleaned and batch blank checked before sampling. The cleaning cycle consists of placing the tanks on a manifold system within a 150°C heated oven, then subsequently evacuating and pressurizing the tanks. The evacuation/pressurization cycles are conducted 25 times and then the canisters are removed under vacuum. One tank is blank checked from each batch and the batch is considered clean if all target compounds are less than 0.2 ppb and there are no unknown peaks not already present in the direct analysis of the ultra pure air. certification.

Daily tuning will be performed on the analytical system with 4-bromo-fluorobenzne (4-BFB) and meet the key ions and ion abundance criteria of T014.

Daily multi-point calibrations of the analytical system will be conducted. This includes a three-point multi-level calibration and humid zero air..

Sample identities are confirmed using Triple Plot mass spectra which simultaneously display the enhanced target compound spectra, the unenhanced target compound spectra and the library spectra of the target compound.

ANALYTICAL PROCEDURES FOR NMO's

These analyses were conducted by Hayden Environmental of Miamisburg, Ohio. Hayden uses the procedures described in the reference method (EPA 25, 40 CFR 60, Appendix A). The following sections describe the calibration criteria and quality assurance procedures specified for the method. Data received from Hayden was as analyzed; therefore, the respective dilution factor was applied to the analytical results to obtain the corrected value. These data are presented in Appendix C.

FID Calibration and Linearity Check

Prior to analysis of each set of samples, the linearity of the NMO analyzer FID is checked by calibration with gas standards of propane in air, at concentrations ranging from 19 to 3000 ppm. The FID linearity is considered acceptable if the response for each propane standard is within ±5 percent of the mean response from all four standards.

Oxidation and Reduction Catalyst Efficiency Check

The performance of the oxidation and reduction catalysts are checked prior to the analysis of each set of samples. Before the catalyst checks are performed, triplicate injections of 10,000 ppm methane are made with both the oxidizer and methanizer bypassed to establish a baseline methane response. For a check of the oxidizer performance, triplicate injections of 10,000 ppm methane are made with the carrier gas passing through the oxidizer and bypassing the methanizer. Complete conversion of the methane to CO_2 is confirmed by the fact that no methane response is obtained at the FID. After confirming that the oxidizer is operating at near 100 percent efficiency (no FID response), the reduction catalyst is checked. Triplicate injections of 10,000 ppm

methane are made with both the oxidizer and methanizer in line. The reduction catalyst performance is acceptable if the response for methane is within ±5 percent of what it was with the oxidizer and methanizer bypassed.

System Operation Check and Daily Response Factors

Prior to and at the conclusion of daily analysis of samples, FID response factors are determined and the system operation checked by making triplicate injections of four component gas mixtures through both the oxidation and reduction catalysts. The four component mixtures consist of 50 ppm carbon monoxide, 2 percent carbon dioxide, 500 ppm methane, and propane. The propane concentrations of these standards are about 20, 100, or 1000 ppm. The response factors for the sample analyses are determined form the integrated peaks created by carbon dioxide and propane.

NMO Analyzer Blank--

The blank value for the NMO analyzer is checked between each analysis of calibration gas or sample tanks by purging the sample loop with dry, clean nitrogen and injecting the nitrogen as a sample. An acceptable blank level is less than 10 ppm C_1.

DETERMINATION OF SULFUR DIOXIDE EMISSIONS

Sampling procedures used during this test program follow those described in EPA Method 6.*

SAMPLING APPARATUS

The sulfur dioxide (SO2) sampling train used in these tests meets design specifications established by the Federal EPA and is assembled by PEI personnel. It consists of:

Probe - 5/8-in. Hasteloy (C-276) tube. A plug of quartz wool is placed in the end of the probe to remove particulate matter.

Impingers - Four impingers connected in series with glass ball joints. The first and third impingers are of the Greenburg-Smith design. The second and fourth impingers are modified by replacing the tip with a 1/2-in. i.d. glass tube extending to within 1/2-in. from the bottom of the flask. Glass wool is placed in the first U-joint to prevent sulfuric acid mist carryover.

Metering System - Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, dry gas meter with 2 percent accuracy, and related equipment to maintain a constant sampling rate and to determine total sample volume.

Barometer - Aneroid type to measure atmospheric pressure to ±0.1 in.Hg.

SAMPLING REAGENTS

Water - Deionized, distilled to conform to ASTM specifications D1193-74, Type 3.

Isopropanol, 80%

Hydrogen Peroxide, 3%

* 40 CFR 60, Appendix A, July 1989.

ANALYTICAL REAGENTS

Water - Deionized, distilled

Isopropanol, 80%

Thorin Indicator

Barium Perchlorate Solution, 0.01 N

Sulfuric Acid Standard, 0.0100 N

Ammonium Sulfate Standard, 0.0100 N

SAMPLING PROCEDURE

After the sampling site and the required traverse points are selected, the stack pressure, temperature, moisture, and range of velocity head are measured according to procedures described in Methods 1 through 4.*

One sampling point is chosen and the train is assembled as follows: 100 milliliters (ml) of 80% isopropanol in the first impinger, 100 ml of 3 percent hydrogen peroxide in both the second and third impingers, and 200 grams of silica gel in the fourth impinger. A portion of each reagent is retained for use as a blank. The train is assembled as shown in Figure D-3. The sampling train is leak-checked at the sampling site before and after each test by plugging the inlet to the first impinger and pulling a 10-in.Hg. vacuum. All leaks are corrected before sampling begins. The probe heater setting is adjusted during sampling to prevent any visible condensation. Crushed ice is placed around the impingers and more ice is added during the test to keep the temperature of the gases leaving the last impinger at 68°F or less.

At the completion of each test, the train is removed from the stack and purged for 15 minutes.

SAMPLE RECOVERY

The contents of the first impinger are measured and discarded. The contents of the second and third impingers are measured and placed in a leak-free polyethylene container. The second and third impingers and connecting glassware are then rinsed with distilled, deionized water and this rinse is added

* 40 CFR 60, Appendix A, July 1989.

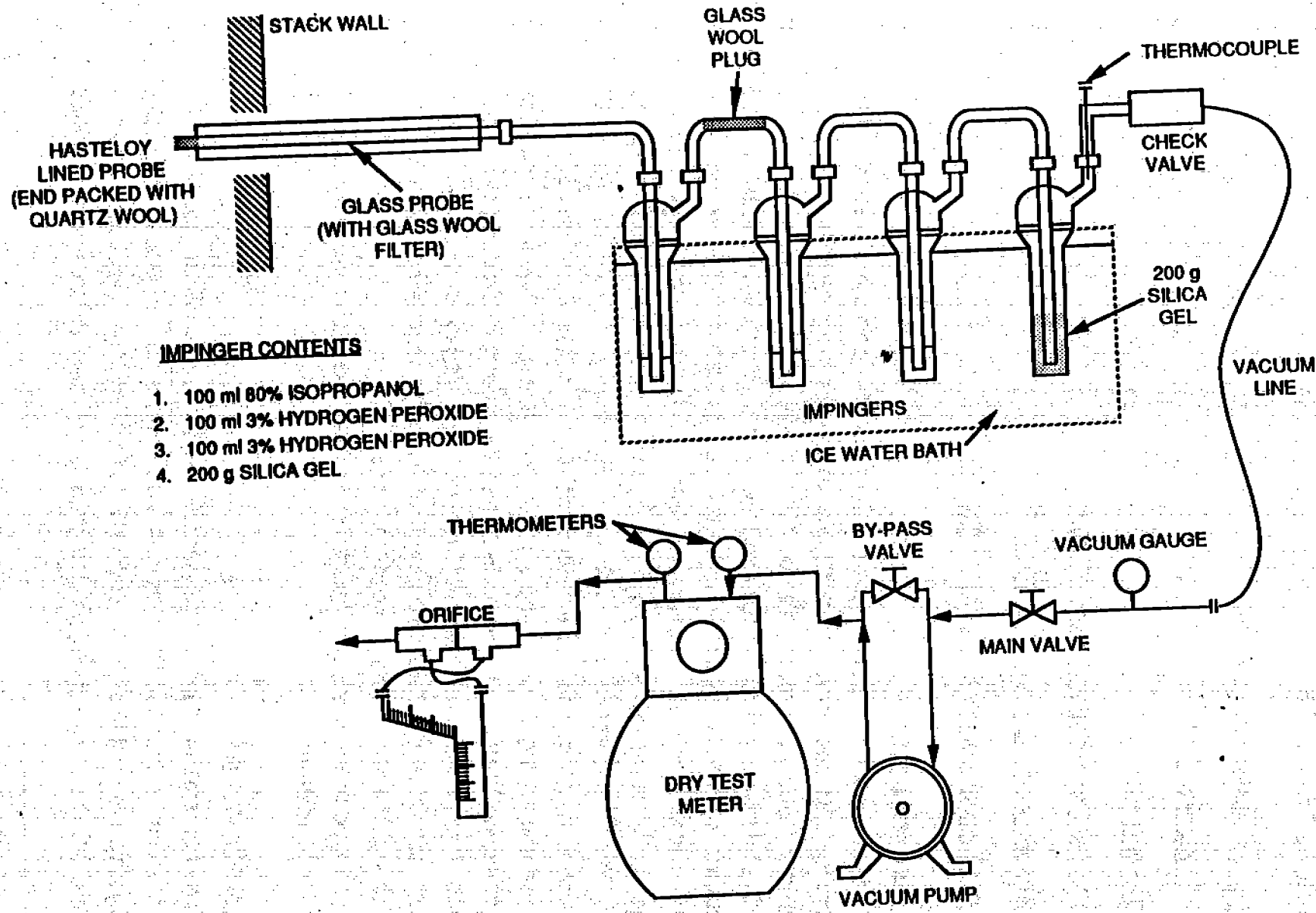

Figure D-3. Sulfur dioxide sampling train.

to the same polyethylene container. The container is sealed and identified, and the liquid level is marked.

ANALYTICAL PROCEDURES

The volume of each sample is recorded and diluted to 1000 ml with deionized, distilled water. An appropriate aliquot of this solution is pipetted into a 250-ml Erlenmeyer flask. Deionized, distilled water is added to bring the volume to 20 ml. 80 ml of 100% isopropanol and two to four drops of thorin indicator are added. The solution is titrated to a pink end point using 0.01 N barium perchlorate. A blank is titrated in the same manner as the samples.

DETERMINATION OF NITROGEN OXIDE EMISSIONS

The following method is used for this test program. Sampling procedures follow those described in EPA Method 7A.*

SAMPLING APPARATUS

The nitrogen oxide (NO_x) sampling train used in these tests meets design specifications established by the Federal EPA. Assembled by PEI personnel, it consists of the following:

Probe - 5/8-in. Hasteloy (C-276) tube. A plug of quartz wool is placed in the end of the probe to remove particulate matter, as shown in Figure D-4.

Collection Flask - Two-liter borosilicate, round-bottom flask, with short neck and 24/40 standard taper opening, protected against implosion or breakage.

Flask Valve - Two-way stopcock connected to a 24/40 standard taper joint.

Manifold - Consists of a two- and three-way Teflon™ stopcock and connected 24/10 standard taper joints.

Temperature Gauge - Dial-type thermometer capable of measuring 2°F intervals from 25° to 125°F.

Vacuum Line - Tubing capable of withstanding a vacuum of 3 in.Hg. absolute pressure.

Pump - Capable of evacuating the collection flask to a pressure equal to or less than 3 in.Hg. absolute.

Barometer - Aneroid type to measure atmospheric pressures to ±0.1 in.Hg.

* 40 CFR 60, Appendix A, July 1989.

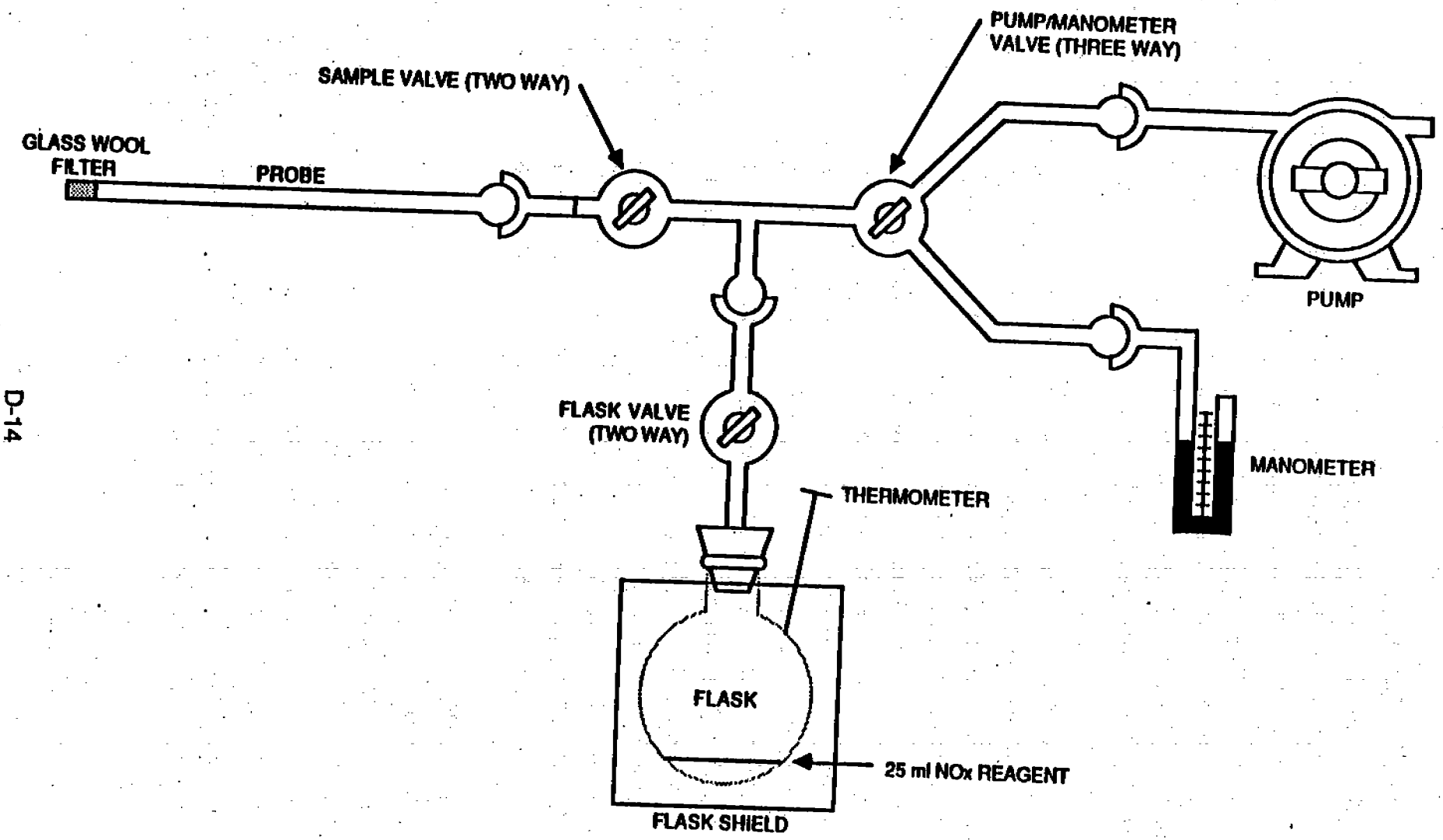

Figure D-4. Nitrogen Oxide Sampling Train

SAMPLING PROCEDURE

After selecting the sampling site and the minimum number of traverse points, the stack pressure, temperature, moisture, and range of velocity head are measured according to procedures described in EPA Methods 1 through 4.*

One sampling point, representing the average flow rate, is chosen. The sampling flask is charged with 25 ml of absorbing solution (made by mixing 1 liter of distilled water, 2.8 ml of concentrated H_2SO_4, and 6 ml of 3 percent H_2O_2). A portion of the reagent is retained for use in preparing the calibration standards.

With the sample valve closed, the flask valve open, and the pump/manometer valve open to pump, the flask is evacuated to less than 3 in.Hg. absolute pressure. Flask vacuum is determined by moving the pump/manometer valve to manometer. Leakage is checked by observing the manometer for pressure fluctuation. Any variation greater than 0.4 in.Hg. over a 1-minute period is corrected before sampling.

With the flask valve closed, the sample valve open, and the pump/manometer valve turned to pump, the sample apparatus is purged for 5 minutes. The probe heater setting is adjusted to prevent any visible condensation. With the sample valve closed and the pump/manometer valve open to manometer, an initial flask vacuum is determined by opening the flask valve. The sample valve is then slowly opened, allowing stack gas to enter the flask. The vacuum is allowed to drop to 3 in.Hg. (approximately 15 seconds), and then the sample and flask valves are closed. The flask is shaken for 5 minutes to ensure contact between the sample and absorbing solution.

SAMPLE RECOVERY PROCEDURE

The collection flasks are transported to PEI for sample recovery. The flasks are set aside for a minimum of 16 hours. At the end of that period, the flasks are shaken for 2 minutes and the final flask pressure and temperatures are measured. All pertinent data are recorded on the recovery data sheets.

The contents of the flasks are measured volumetrically and transferred to a polyethylene container. The flask is then rinsed with two separate 5-ml portions of deionized, distilled water, and the solution is added to the same container.

---

* 40 CFR 60, Appendix A, July 1989.

ANALYTICAL PROCEDURE

The volume of absorbing solution is recorded and diluted to 50 ml with deionized, distilled water. A 5-ml aliquot of this solution is pipetted to a volumetric flask and diluted to 50 ml with deionized water. The samples from the second dilution are analyzed by ion chromatography. A calibration curve of µg NO_x versus peak area response is prepared using standards of known concentration.

DETERMINATION OF CARBON MONOXIDE (CO) EMISSIONS

Sampling and analysis of CO emissions will follow those procedures described in EPA Method 10.*

SAMPLING APPARATUS

The sampling apparatus (shown in Figure D-5) meets all the design specifications established by the Federal EPA. It consists of:

Probe - Constructed of 3/8-in. i.d. 316 stainless steel tube and equipped with a filter to remove particulate matter.

Moisture Knock-out - 1 1/2-in. o.d. column constructed of Teflon™ and containing silica gel to remove water vapor.

Rate Meter - Rotometer with needle valve to maintain a constant flow rate throughout the sampling period in a range from 0 to 1.0 liter per minute.

Sample Pump - A leak-free diaphragm type to provide a constant flow through the rate meter.

Sample Bag - Leak-free with approximately a 70 liter capacity. Manufactured by Calibrated Instruments, Inc., the bag is a patented 5-ply construction containing layers of polyethylene, polyamid, aluminum foil, polyvinyldechloride, and polyester.

The sample bag is initially evacuated and the sample train is set up as shown in Figure D-5. The probe is placed in the stack and the sampling line purged before sample collection. After purging the bag is connected to the sampling system and a gas sample is collected at a constant rate throughout the predetermined sampling period.

ANALYSIS

An NDIR spectrometer is used for CO analysis of sample bags. The infrared gas analyzer utilizes a measurement principle based on CO having a

* 40 CFR 60, Appendix A, July 1989.

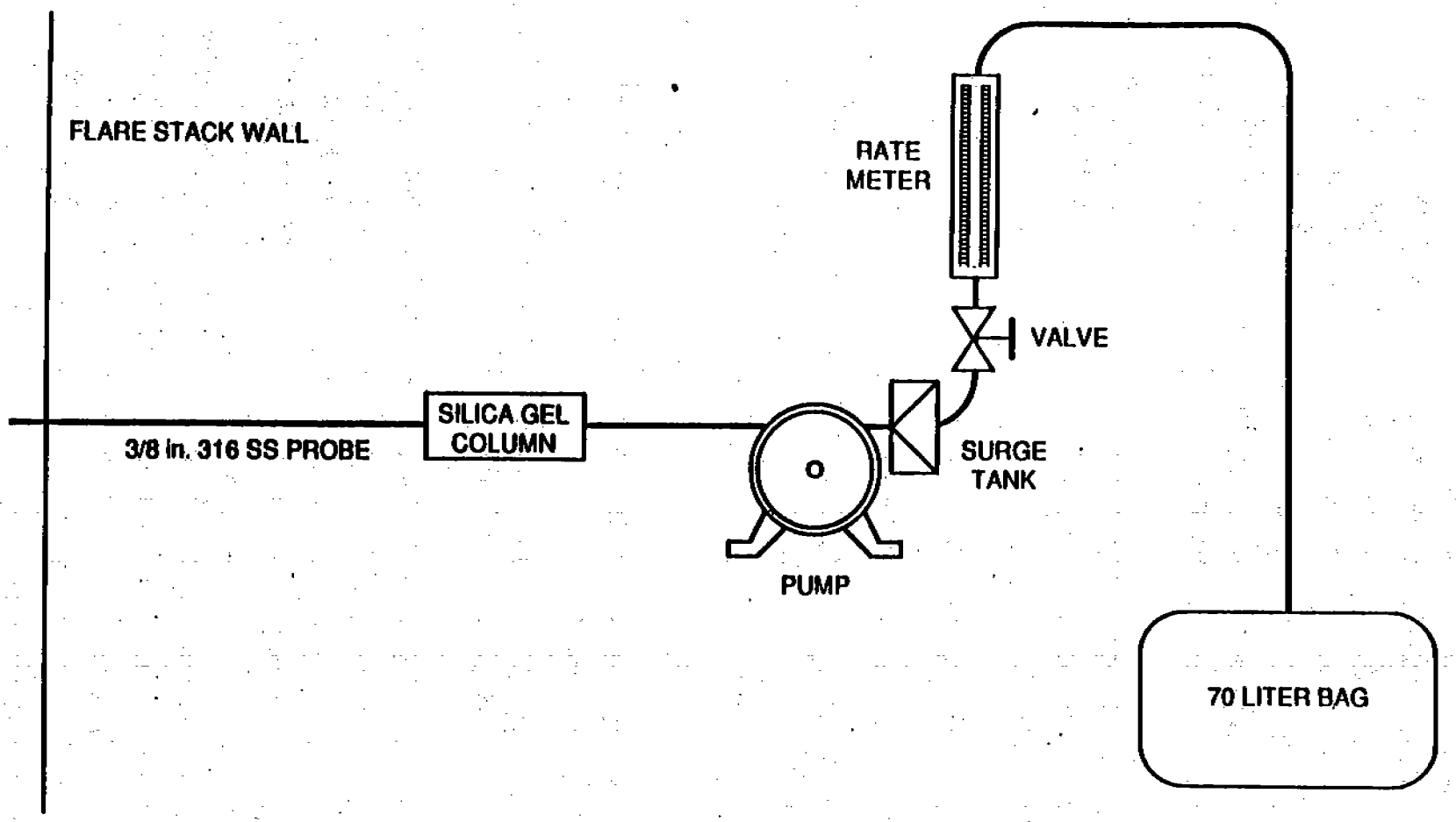

Figure D-5. Carbon monoxide sampling train.

known characteristic absorption spectra in the infrared ranges. The analyzer contains an infrared detector that uses the nondispersive single-beam technique which alternates modulation of the sample and reference cells. The reference cell is filled with a nonabsorbing gas and sealed, and the sample is routed through the sample cell. When CO is present in the sample, some radiation is absorbed by the CO, which causes the detector inputs to be unequal and produces a capacitance change in the detector. This capacitance change in the detector is designed so that the final output is proportional to the concentration of CO.

The instrument has detection ranges of 0 to 50, 0 to 250, 0 to 500, and 0 to 1000 ppm CO and is guaranteed by the manufacturer to meet the following performance specifications:

Minimum detectable sensitivity: 0.5 ppm

Electronic response time: 0.7 seconds to 90% full scale

Zero drift: 0.5 % per hour or ±1% for 24 hours, whichever is lower; ±2% full scale over 3 days

Precision: 1% full scale

Noise: ±0.5% of full scale (maximum)

Linearity: ±0.5% of full scale on 50 ppm range; ±1% full scale on 250, 500, and 1000 ppm ranges

Interference equivalent: CO_2 rejection ration, 40,000 to 1; water vapor rejection ratio, 20,000 to 1; total less than 1 ppm

The analyzer is set up as shown in Figure D-6. The NDIR was allowed to warm up for a minimum of one hour. Zero nitrogen and calibration gases containing CO in nitrogen were introduced at the analyzer to establish the instrument zero and span settings. After the analyzer performance was verified, the calibration gas was introduced through the gas conditioning apparatus. The gas conditioning apparatus consists of two teflon™ columns connected in series with leak-free connections and immersed in an ice water bath. The first column contained approximately 200 grams of drierite and was used to remove moisture from the sample gas. The second impinger contains approximately 500 grams of ascarite absorbent to remove carbon dioxide (CO_2). This

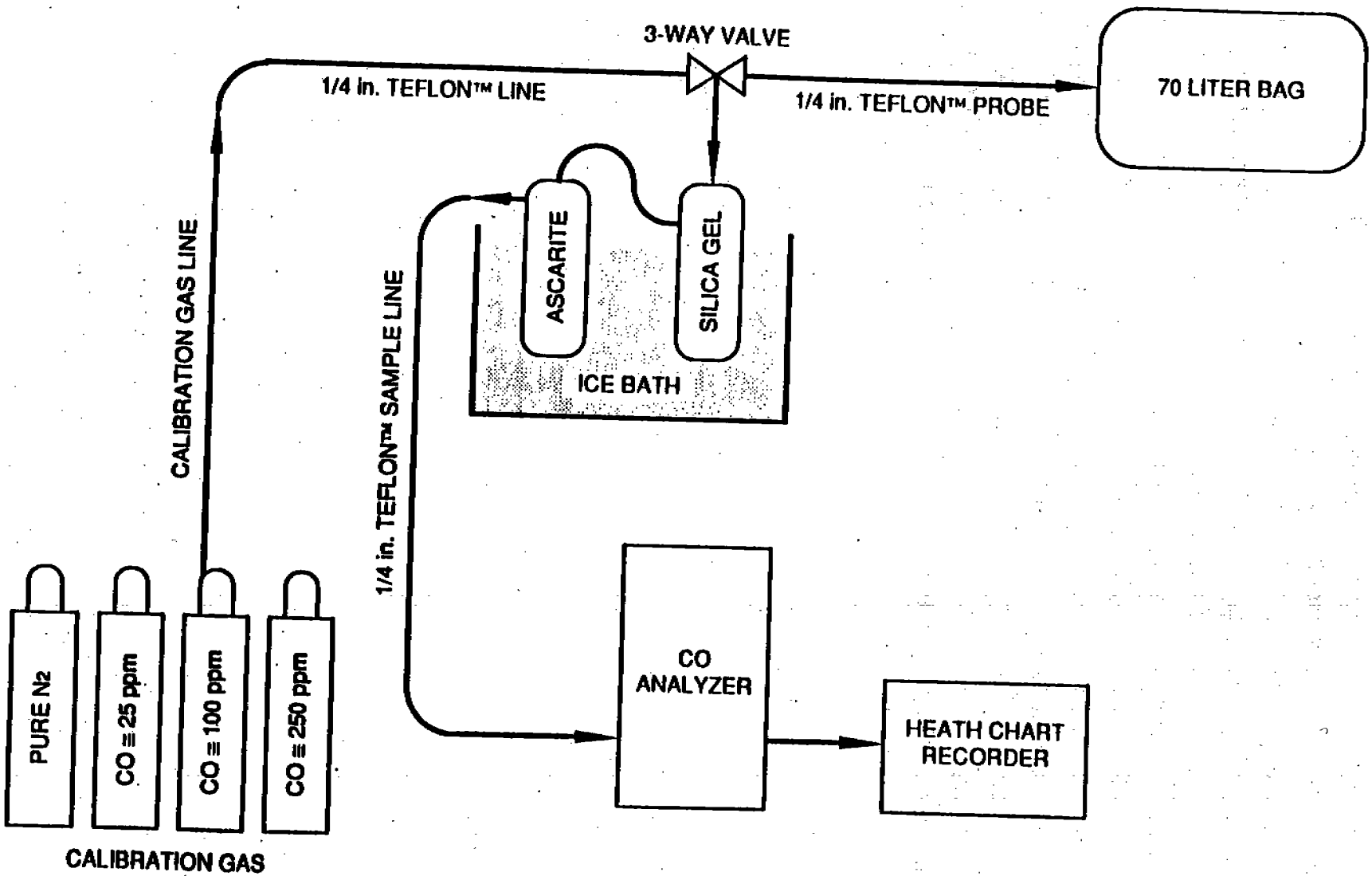

Figure D-6. Carbon monoxide analytical system.

procedure verified that the sampling system is leak-free and free of any contaminants which could interfere with the analysis.

Each bag will be analyzed consecutively by attaching it to the inlet of the conditioning apparatus. Gas will be pulled from the bag and analyzed to a constant response for a 5 minute period.

After completion of the test, the analyzer is again calibrated with the zero gas and the three CO calibration gases. These gases are introduced into the conditioning apparatus. An overall calibration equation is generated by using the pre-test calibration points of chart divisions versus CO concentrations in the calibration gases. The chart divisions recorded during the tests are inserted into the equation to generate the CO concentrations. If the post-test calibrations vary by less than 2 percent from pre-test calibrations, all data are reduced using pre-test calibrations.

DETERMINATION OF HYDROGEN CHLORIDE EMISSIONS

Hydrogen chloride (HCl) emissions are measured with a proposed EPA Method 26. In this method a sample is extracted from the source and passed through a dilute sulfuric acid solution. The HCl gas is dissolved in this solution and forms chloride ions which is subsequently analyzed by ion chromatography.(IC).

SAMPLING APPARATUS

The sampling train used in these tests is assembled by PEI personnel and meets all design specifications established by the Federal EPA. The sampling apparatus consists of:

Probe - 5/8-in Hasteloy (C-276) tube.

Filter Holder - Pyrex glass with heating system capable of preventing moisture condensation.

Filter - Pallflex™ quartz fiber, 3-in diameter.

Impingers - Four Greenburg-Smith design impingers connected in series with glass ball joints. The first and second impingers are of the Greenburg-Smith design. The third and fourth impingers are modified by removing the impinging plate and extending the tube to within 1.3 cm (0.5 in.) of the bottom of the flask.

Metering System - Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5°F, calibrated dry gas meter, and related equipment, to maintain a constant sampling rate and to determine sample volume. The dry gas meter is made by Rockwell and the fiber vane pump is made by Gast.

Barometer - Aneroid tube type to measure atmospheric pressures to ±0.1 in.Hg.

SAMPLING PROCEDURES

Approximately 200 grams of silica gel are placed in the fourth impinger to remove moisture prior to the metering system. One hundred milliliters (ml) of

0.1N sulfuric acid (H_2SO_4) are placed in each of the first two impingers as the absorbing solution for HCl. One hundred ml of 0.1N sodium hydroxide are placed in the third impinger to protect the pump from any chlorine gas (Cl_2) that may be present. The train is set up with the probe as shown in Figure D-7 . The sampling train is leak checked at the sampling site prior to each test run by plugging the inlet to the probe and pulling a 15-in.Hg. vacuum, and at the conclusion of the test by plugging the inlet to the probe and pulling a vacuum equal to the highest vacuum reached during the test run.

Crushed ice is place around the impinger to keep the temperature of the gas leaving the last impinger at 68°F or less. Sampling will be conducted at a single point within the stack and the sampling flow rate will remain constant throughout the sampling period.

RECOVERY PROCEDURES

Upon completion of each sample run, the sampling train is leak-checked and disassembled. The impinger section is sealed and carefully transported to the cleanup area.

The amount of moisture collected is determined by weighing each impinger before and after the sample run. After being weighed, the third and fourth impinger contents are discarded. Sample recovery continues as follows:

Container No. 1 - The contents of the first and second impingers and their respective distilled water rinses are placed in a leak-free polyethylene container which is labeled and sealed with the liquid level marked.

Container. No. 2 - A representative blank of the 0.1 H_2SO_4 absorbing solution will be taken and placed in a leak-free polyethylene container which is labeled and sealed with the liquid level marked.

ANALYTICAL PROCEDURES

Ion chromatography is used to analyze the recovered samples for chloride ion. Analytical procedures will follow those described in EPA Method

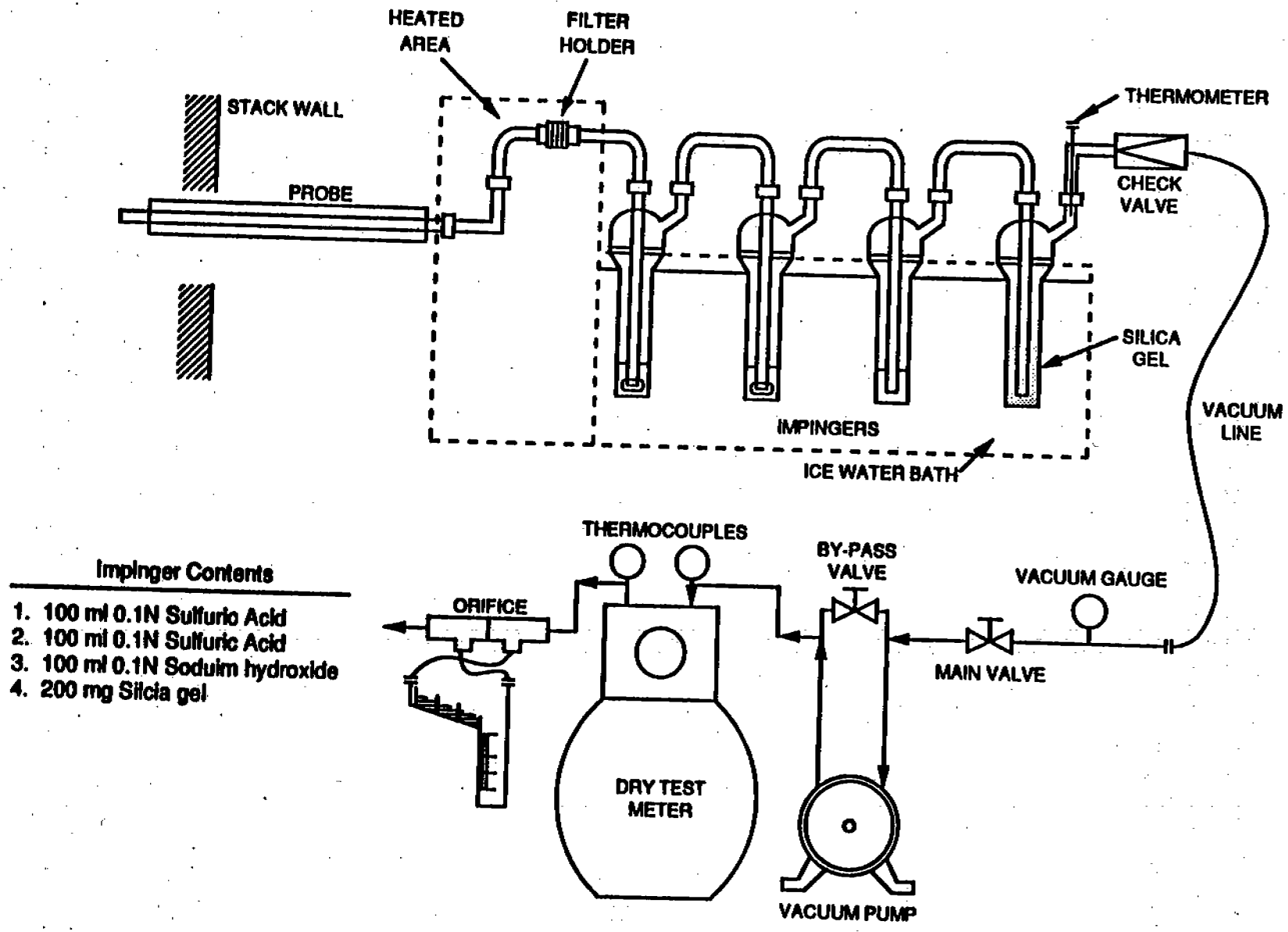

Figure D-7. Hydrogen chloride sampling train.

300.0.* The results will be reported as HCl and the mass emission rate is calculated from the product of the HCl concentration and the volumetric flow rate of the stack gas.

* The Determination of Inorganic Anions in Water by Ion Chromatograhpy, EPA-600/4-84-017, March 1984.

DETERMINATION OF FUEL GAS CONTENTS

Sampling and analysis of the landfill gas will be conducted to determine the concentrations and mass emissions of the following: methane (CH_4), nitrogen (N_2), carbon dioxide (CO_2), hydrogen sulfide (H_2S), and total sulfur.

SAMPLING APPARATUS

A schematic of the sampling apparatus to be used to collect landfill gas samples for the above compounds is presented in Figure D-8. This sampling apparatus will be used at the landfill gas flare inlet sampling site. Assembled by PEI personnel, the train consists of the following:

Sample line - 1/4-in. o.d. teflon™ tube.

Sample pump - Leak-free oil-less piston type compresser with the ability to deliver >50 psi.

Pressure gauge - 0 to 100 psi.

Sample Collection Cylinder - 300cc 316 stainless steel cylinderical container with shut-off valves at both ends.

SAMPLING PROCEDURE

The sampling apparatus will be set-up as shown in Figure A-8. Initially the sample cylinder will be purged with landfill gas by opening both shut-off valves with the sample pump on for 1 minute. After this period, the shut-off valve at the outlet of the sample cylinder will be closed. A sample of the landfill gas will be collected by pressurizing the cylinder to ≥40 psi. After the targeted pressure is reached or exceeded, the inlet shut-off valve will be closed. The cylinder is then removed from the site and shipped overnight to the analytical laboratory.

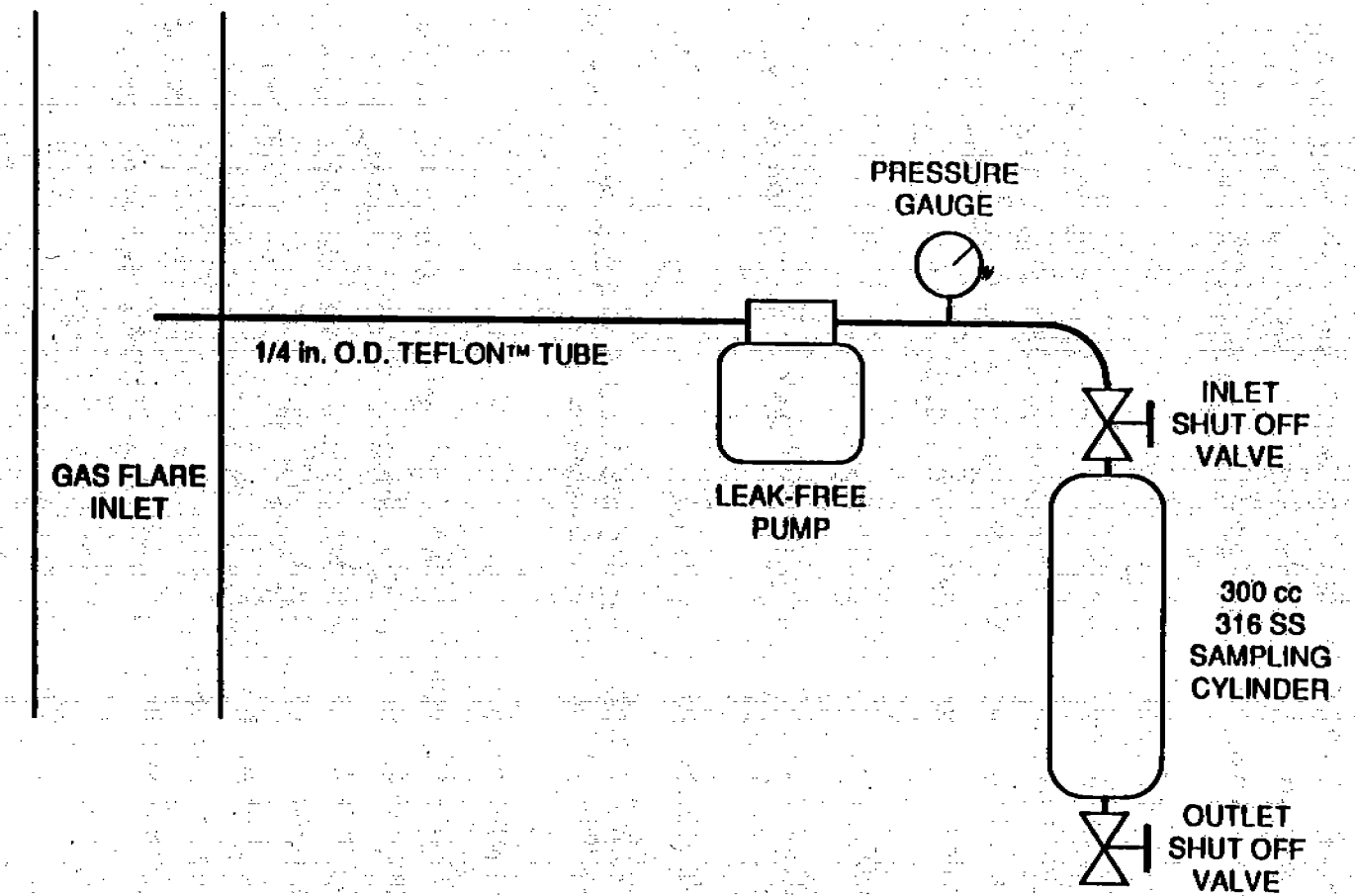

Figure D-8. Fuel gas analysis sampling apparatus.

ANALYSIS

Analysis for CH_4, N_2, and CO_2 will be conducted according to procedures described in ASTM Method D 1945, "Analysis of Natural Gas by Gas Chromatography".* This method uses a gas chromatograph equipped with a thermal conductivity detector (GC-TCD). Analysis for H_2S and total sulfur will be conducted by chemiluminescent detector.

* Annual Book of ASTM Standards, Section 5, Volume 05.05.

APPENDIX E

CALIBRATION PROCEDURES AND RESULTS

CALIBRATION PROCEDURES AND RESULTS

All of the equipment used was calibrated according to the procedures outlined in Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment.*

Pitot Tube Calibration

The pitot tube used in sampling was constructed by PEI Associates, Inc., and met all requirements of EPA Method 2, Section 4.1.** Therefore, a baseline coefficient of 0.84 was assigned to each pitot tube. See Figures E-1 and E-2 for alignment requirements of Method 2, and Figures 3a through 3b for actual inspection data of the pitot tubes used during the test program.

Dry Gas Meter and Orifice Meter

Figure E-4 shows the setup used for the initial and post-test calibrations. A wet-test meter with a 2-cubic-feet-per-minute capacity and ± 1 percent accuracy was used. The pump was run for approximately 15 minutes at an orifice manometer setting of 0.5 in.H_2O to heat up the pump and wet the interior surface of the wet-test meter. The information in Figure E-5 (example calculation sheet) was gathered for the initial calibration, and the ratio of accuracy of the wet-test meter to the dry-test meter and the ΔH@ were then calculated.

Post-Test Meter Calibration Check

A post-test meter calibration check was made on the meter box used during the test to check its accuracy against the last calibration check. This post-test calibration

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* Office of Air Programs Publication No. APTD-0576.

** 40 CFR 60, Appendix A, July 1989.

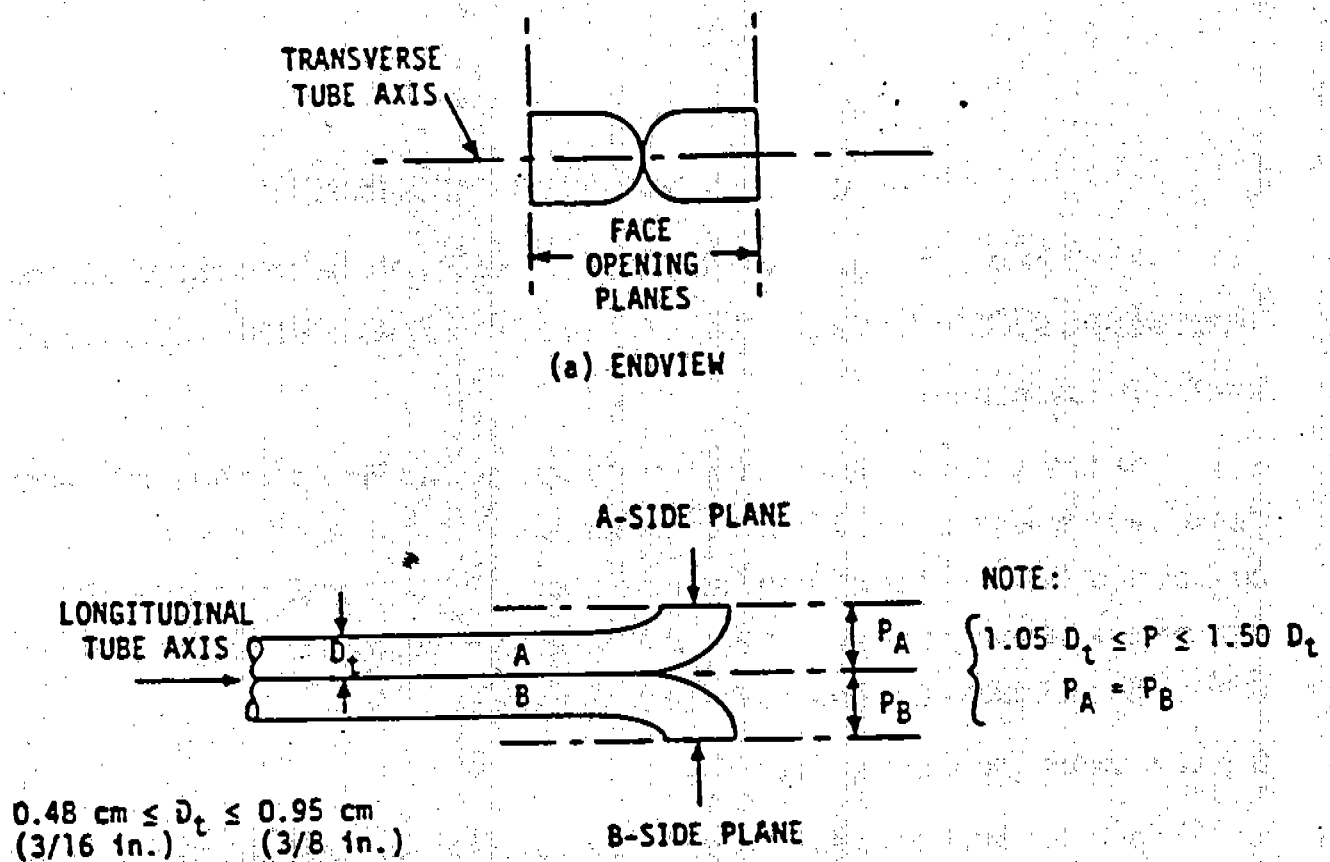

Figure E-1. Properly constructed Type S pitot tube, shown in: (1) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

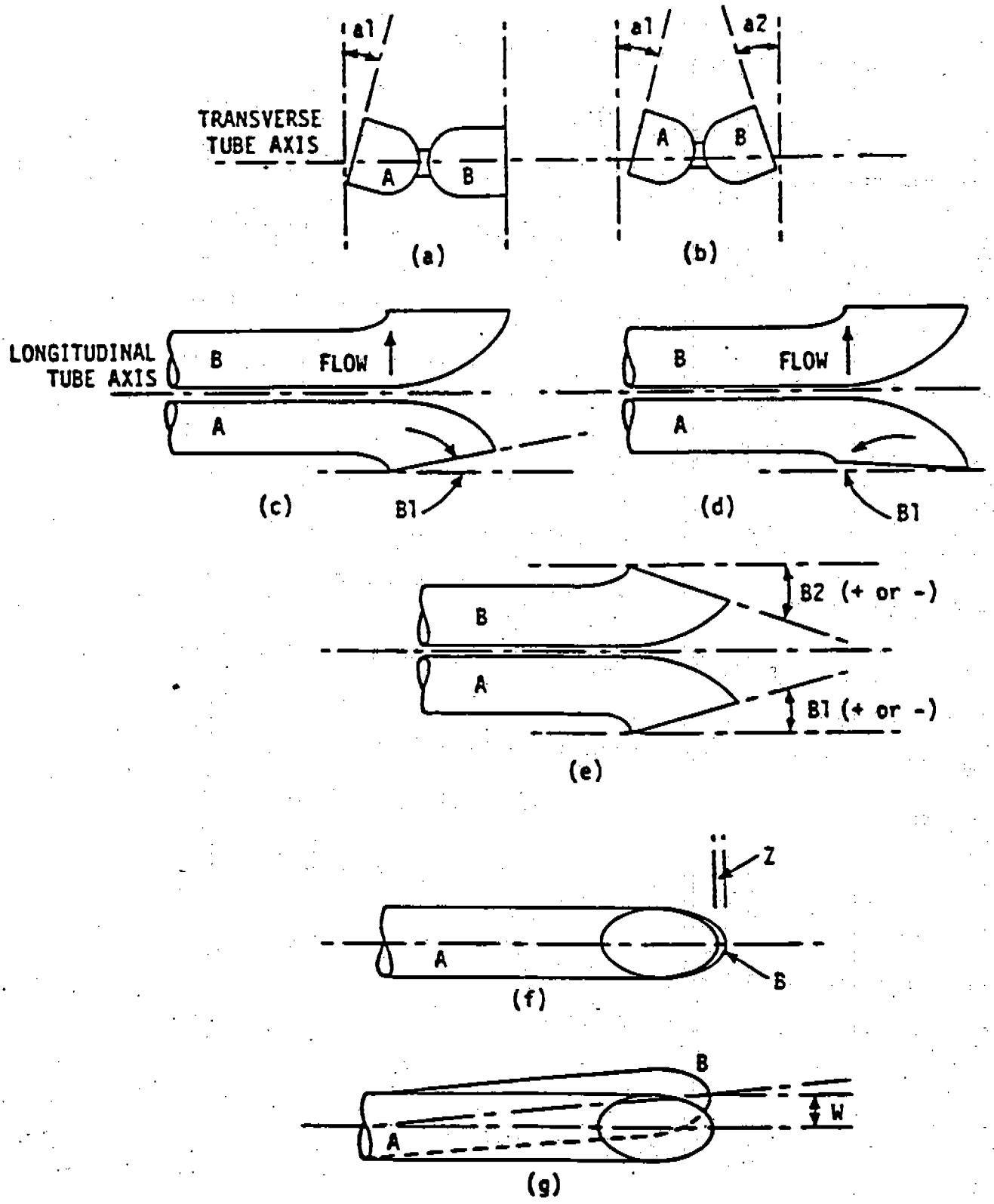

Figure E-2. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect Cp so long s a_1 and a_2 <10°, B_1 and B_2 <5°, z <0.32 (1/8 in.) and w <0.08 cm (1/32 in.).

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 301 Date 12-8-89 Inspector GThress

α_1 Degrees	α_2 Degrees	β_1 Degrees	β_2 Degrees
1°	1°	0°	1°
<10°	<10°	<5°	<5°

D_t Inches	P Inches	1.05 D_t Inches	1.50 D_t Inches
0.375	1.121	.394	.563
0.185 ≤ P_t <0.380	-	-	-

γ Degrees	ϕ Degrees	P_{sin} (γ) Inches	P_{sin} (ϕ) Inches
1°	0°	0.0196	0°
-	-	<0.125	<0.03125

P_1 Inches	P_2 Inches	$\lvert P_1 - P_2 \rvert$ Inches	Meet specifications
.561	.560	.001	✓
1.05 D_t <P_1 <1.50 D_t	1.05 D_t <P_2 <1.50 D_t	≤0.010	

Lower line in each table is limits for meeting specifications.

Figure E-3a. Pitot tube inspection data sheet.

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 523 Date 7/16/90 Inspector M. WILLIAMS

α_1 Degrees	α_2 Degrees	β_1 Degrees	β_2 Degrees
1°	1°	0°	2°
<10°	<10°	<5°	<5°

D_t Inches	P Inches	1.05 D_t Inches	1.50 D_t Inches
0.375	1.10	0.394	.563
$0.185 \leq P_t < 0.380$	-	-	-

γ Degrees	ϕ Degrees	P_{sin} (γ) Inches	P_{sin} (ϕ) Inches
1°	1°	0.0192	0.0192
-	-	<0.125	<0.03125

P_1 Inches	P_2 Inches	$\lvert P_1 - P_2 \rvert$ Inches	Meet specifications
.551	.549	.002	✓
$1.05\ D_t < P_1 < 1.50\ D_t$	$1.05\ D_t < P_2 < 1.50\ D_t$		

Lower line in each table is limits for meeting specifications.

Figure E-3b. Pitot tube inspection data sheet.

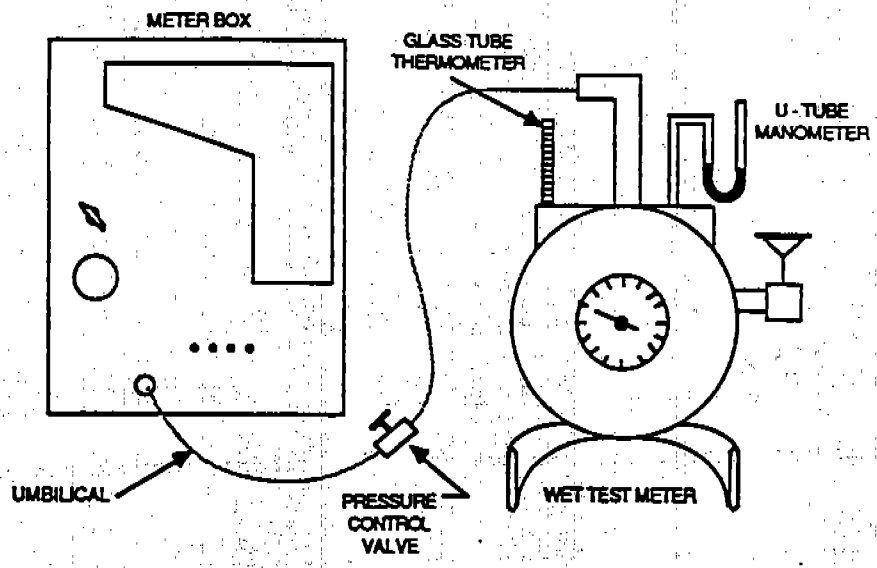

Figure E-4. Calibration setup.

DATE _____ METER BOX NO. _____

BAROMETRIC PRESSURE, P_b = _____ in. Hg. DRY GAS METER NO. _____

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	WET TEST METER T_w, °F	DRY GAS METER			TIME Ø, min.	Y	ΔH@
				INLET t_{di}, °F	OUTLET t_{do}, °F	AVERAGE t_d, °F			
0.5	5								
1.0	5								
1.5	10								
2.0	10								
3.0	10								
4.0	10								

AVERAGE _____

ΔH	$\frac{\Delta H}{13.6}$	Y: $\frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	ΔH@: $\frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\emptyset}{V_w} \right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

Y = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

ΔH@ = Orifice of pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in H_2O). Tolerance = ± 0.15.

Figure E-5. Calibration data sheet.

must be within ± 5 percent of the initial calibration. Both the initial and post-test calibrations were performed as described in APTD-0576. Three calibration runs were made with the average orifice setting obtained during each test run and with the vacuum set at the maximum value obtained during each test run. After the post-test calibration check was made, all three runs were within the ± 5 percent range allowed by EPA Method 5.*

The initial meter box calibration data are presented in Figure E-6. The post-test meter box calibration data are presented in Figure E-7.

Thermocouples

The thermocouples were calibrated by comparing them against an ASTM-3F thermometer at approximately 32°F, ambient temperature, 100°F, and 500°F. The thermocouples read within 1.5 percent of the reference thermometer throughout the entire range when expressed in degrees Rankine. If the thermocouple did not read within 1.5 percent, a correction formula based on a least squares analysis of the data was utilized. The correction formula corrected the data to within 1.5 percent. The thermocouple was checked at ambient temperature at the test site to verify the calibration. Calibration data are presented in Figures E-8a and E-8b.

Digital Indicator for Thermocouple Readout

A digital indicator was calibrated by feeding a series of millivolt signals to the input, and comparing the indicator reading with the reading the signal should have generated. Error did not exceed 0.5 percent when the temperatures were expressed in degrees Rankine. Calibration data for digital indicators used during this sampling program are shown in Figures E-9a and E-9b.

Dry Gas Meter Thermocouple

The inlet and outlet dry gas meter thermocouples were calibrated by comparing them against an ASTM-3F thermometer at approximately 32°F, ambient temperature,

* 40 CFR 60, Appendix A, July 1989.

PARTICULATE SAMPLING METER BOX INITIAL CALIBRATION

DATE: 7/25/90 METER BOX NO. FT-7

CALIBRATOR: R. Kelso BAROMETRIC PRESSURE (P_b) 29.64 in. Hg

Leak Checks:

Positive (minimum 5 in. H_2O): ✓

Negative (within 3 in. Hg of absolute): 0.00 cfm* 29 in. Hg

*Not to exceed 0.005 cfm.

Orifice manometer setting ΔH in H_2O	Volume wet test meter V_w ft^3	Volume dry gas meter V_d ft^3	Temperatures: Wet test meter T_w °F	Dry gas meter: Inlet T_i °F	Dry gas meter: Outlet T_o °F	Dry gas meter: Average T_d °F	Duration of test θ min	Vacuum setting in Hg	Y	ΔHθ in H_2O
0.5	6	312.800	72	78	76	77.75	13.17.39	10	.985	1.38
		318.951	72	80	77	537.75				
1.0	10	319.500	72	80	77	79.75	15.53.26	10	.988	1.42
		329.745	72	83	79	539.75				
1.5	10	330.200	72	83	79	81.5	13.13.03	10	.989	1.47
		340.450	72	85	79	541.5				
2.0	10	340.900	72	85	79	82.5	11.38.46	10	.990	1.51
		351.150	72	86	80	542.5				
3.0	11	351.900	72	86	80	83.5	10.15.00	10	.991	1.45
		363.151	72	87	81	543.5				
4.0	15	363.500	72	87	81	84.75	12.19.72	10	.993	1.50
		378.809	72	84	82	544.75				
								Average	.989	1.46

Y must not deviate by more than ±0.02 Y.
ΔHθ must not deviate by more than 0.15 in H_2O.

ΔH	Y: $\frac{(V_w)(P_b)(T_d + 460)}{(V_d)(P_b + \Delta H/13.6)(T_w + 460)}$	ΔHθ: $\frac{(0.0317)(\Delta H)}{(P_b)(T_d + 460)}\left[\frac{(T_w + 460)(\theta)}{(V_w)}\right]^2$
0.5	$\frac{(6)(29.64)(537.75)}{(6.151)(29.68)(532)}$	$\frac{(0.0317)(0.5)}{(29.64)(537.75)}\left[\frac{(532)(13.29)}{(6)}\right]^2$
1.0	$\frac{(10)(29.64)(539.75)}{(10.245)(29.71)(532)}$	$\frac{(.0317)(1.0)}{(29.64)(539.75)}\left[\frac{(532)(15.87)}{(10)}\right]^2$
1.5	$\frac{(10)(29.64)(541.5)}{(10.250)(29.75)(532)}$	$\frac{(.0317)(1.5)}{(29.64)(541.5)}\left[\frac{(532)(13.22)}{(10)}\right]^2$
2.0	$\frac{(10)(29.64)(542.5)}{(10.250)(29.79)(532)}$	$\frac{(.0317)(2.0)}{(29.64)(542.5)}\left[\frac{(532)(11.64)}{(10)}\right]^2$
3.0	$\frac{(11)(29.64)(543.5)}{(11.251)(29.86)(532)}$	$\frac{(.0317)(3.0)}{(29.64)(543.5)}\left[\frac{(532)(10.25)}{(11)}\right]^2$
4.0	$\frac{(15)(29.64)(544.75)}{(15.309)(29.93)(532)}$	$\frac{(.0317)(4.0)}{(29.64)(544.75)}\left[\frac{(532)(12.73)}{(15)}\right]^2$

Figure E-6. Particulate sampling meter box initial calibration.

PARTICULATE SAMPLING METER BOX
POST-TEST CALIBRATION

DATE: 8/18/90 METER BOX NO. FT-7

BAROMETRIC PRESSURE (P_{bar}): 29.53 in. Hg PRETEST Y: .984 ΔH@: 1.46

PLANT: Disposal Synfuel PROJECT NO. 5016

PROJECT MANAGER: D. Fitzgerald CALIBRATOR: R. Kabbe

Orifice manometer setting * ΔH in. H_2O	Wet test meter volume V_w ft^3	Dry gas meter volume V_d ft^3	Temperatures: Wet test meter T_w °F	Dry gas meter: Inlet T_{di} °F	Dry gas meter: Outlet T_{di} °F	Dry gas meter: Average T_d °F	Vacuum setting ** in. Hg	Duration of run Ø min	Y	ΔH@
1.46	10	405.700	72	79	77	78	15	13.20.50	.993	1.47
		415.850	72	79	77	538				
1.46	11	415.850	72	79	77	78.5	15	14.40.32	.990	1.47
		427.052	72	81	77	538.5				
1.46	13	427.052	72	81	77	79.25	15	17.21.10	.991	1.47
		440.302	72	82	77	539.25				
						Post-test average***			.991	1.47

Y	ΔH@
$\frac{(V_w)(P_{bar})(T_d + 460)}{(V_d)(P_{bar} + \Delta H/13.6)(T_w + 460)}$	$\frac{(0.0317)(\Delta H)}{(P_{bar})(T_d + 460)}\left[\frac{(T_w + 460)(\text{Ø})}{(V_w)}\right]^2$
$\frac{(10)(29.53)(538)}{(10.150)(29.64)(532)}$	$\frac{(.0317)(1.46)}{(29.53)(538)}\left[\frac{(532)(13.34)}{(10)}\right]^2$
$\frac{(11)(29.53)(538.5)}{(11.202)(29.64)(532)}$	$\frac{(.0317)(1.46)}{(29.53)(538.5)}\left[\frac{(532)(14.67)}{(11)}\right]^2$
$\frac{(13)(29.53)(539.25)}{(13.250)(29.64)(532)}$	$\frac{(.0317)(1.46)}{(29.53)(539.25)}\left[\frac{(532)(17.35)}{(13)}\right]^2$

*To be the average ΔH used during the test series.
**To be the highest vacuum used during the test series.
***Post-test Y must be within the range, pre-test Y ±0.05Y
Post-test ΔH@ must be within the range, pre-test ΔH@ ±0.15

Figure E-7. Particulate sampling meter box post-test calibration

THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12-7-89 Thermocouple No.: 646

Calibrator: J. Neese Reference: ASTM-3F

Range:

Reference point No.	Source,*	Reference thermometer temperature, °F	Thermocouple temperature, °F	Difference, %**
1	2	76	77	.19
2	1	35	37	.40
3	3	170	172	.32
4	4	424	426	.23

*Source: 1) Ice Bath
2) Ambient
3) Water Bath
4) Oil Bath

**Percent difference

$$\frac{\text{Reference temp. °R - thermocouple temp. °R}}{\text{(Reference temp. °R)}} \times 100\%$$

where °R = °F + 460

Each percent difference must be less than or equal to 1.5%.

Figure E-8a. Thermocouple calibration data sheet.

THERMOCOUPLE CALIBRATION DATA SHEET

Date: 12/15/89 Thermocouple No.: 734

Calibrator: G. Thress Reference: ASTM 31F

Range:

Reference point No.	Source,*	Reference thermometer temperature, °F	Thermocouple temperature, °F	Difference, %**
1	2	72	72	0
2	1	32	32	0
3	3	210	210	0
4	4	426	426	0

*Source: 1) Ice Bath
2) Ambient
3) Water Bath
4) Oil Bath

**Percent difference

$$\frac{\text{Reference temp. °R - thermocouple temp. °R}}{\text{(Reference temp. °R)}} \times 100\%$$

where °R = °F + 460

Each percent difference must be less than or equal to 1.5%.

Figure E-8b. Thermocouple calibration data sheet.

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 1/3/90 INDICATOR NO: 122

OPERATOR: M. Kuetter SERIAL NO: 501-2

CALIBRATION DEVICE NO: K MANUFACTURER: OMEGA

TEST POINT NO:	MILLIVOLT SIGNAL	EQUIVALENT TEMPERATURE, deg. F	DIGITAL INDICATOR TEMPERATURE READING, deg. F	DIFFERENCE %
1	-0.692	0	000	.00
2	1.520	100	101	.17
3	3.819	200	202	.30
4	6.092	300	301	.13
5	8.314	400	399	.11
6	10.560	500	501	.10
7	22.251	1000	1001	.06
8	29.315	1300	1300	.00
9	36.166	1600	1600	.00
10	42.732	1900	1899	.04

Percent difference must be less than of equal to 0.5%

Percent difference:

$$\frac{\text{(Equivalent temperature, deg. R - Digital indicator temperature, deg. R)(100\%)}}{\text{(Equivalent temperature, deg. R)}}$$

Where, deg. R = deg. F + 460

Figure E-9a. Thermocouple digital indicator calibration data sheet.

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 2/24/90 INDICATOR NO: FT-7

OPERATOR: R. Kahle SERIAL NO:

CALIBRATION DEVICE NO: #7 MANUFACTURER: OMEGA

TEST POINT NO	MILLIVOLT SIGNAL	EQUIVALENT TEMPERATURE, deg. F	DIGITAL INDICATOR TEMPERATURE READING, deg. F	DIFFERENCE %
1	-0.692	0	1	.22
2	1.520	100	100	0
3	3.819	200	201	.15
4	6.052	300	300	0
5	8.314	400	400	0
6	10.560	500	499	.10
7	22.251	1000	997	.21
8	29.315	1300	1295	.28
9	36.166	1600	1594	.29
10	42.732	1900	1890	.42

Percent difference must be less than or equal to 0.5%

Percent difference:

$$\frac{\text{(Equivalent temperature, deg. R - Digital indicator temperature, deg. R)(100\%)}}{\text{(Equivalent temperature, deg. R)}}$$

Where, deg. R = deg. F + 460

Figure E-9b. Thermocouple digital indicator calibration data sheet.

DRY GAS THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 7/24/90 Thermocouple No: FT-7

Calibrator: R. Kolde Reference: ASTM-3F

INLET

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	72	71	1
2	2	34	34	0
3	3	140	140	0

OUTLET

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	72	71	1
2	2	34	35	1
3	3	140	139	1

'Source: 1. Ambient
2. Ice bath
3. Water bath

Figure E-10. Dry gas thermocouple calibration data sheet.

and approximately 110°F. The thermocouples agreed within 5°F of the reference thermometer. The thermocouples were checked at ambient temperature prior to the test series to verify calibration. Calibration data are included in Figure E-10.

Impinger Thermocouple

The impinger thermocouple was calibrated by comparing it against an ASTM-3F thermometer at approximately 32°F and ambient temperature. The thermocouple agreed within 2°F of the reference thermometer. The thermocouple was checked at ambient temperature prior to the test series to verify calibration. Calibration data are included in Figure E-11.

Trip Balance

The trip balance was calibrated by comparing it with Class-S standard weights, and it agreed within 0.5 gram. Calibration data are shown in Figure E-12.

Barometer

The field barometer was calibrated to within 0.1 in.Hg of an NBS-traceable mercury-in-glass barometer before the test series. It was checked against the mercury-in-glass barometer after each series to determine if it read within 0.2 in.Hg. If it did not read within 0.2 in.Hg, a correction factor was determined for the last test series. Calibration data are included in Figure E-13.

Orsat Analyzer

The Orsat analyzer was calibrated before the test series by determining the percentages of oxygen, carbon monoxide, and carbon dioxide in a calibration gas containing known percentages of each. The analyzer read within 0.5 percent of the known value for each gas. Calibration data are shown in Figures E-14a and E-14b.

IMPINGER THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 1/9/90 Thermocouple No: I-22

alibrator: M.K. Reference: ASTM-3F

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	72	71	.18
2	2	32	33	.20

'Source: 1) Ambient
2) Ice bath

''Difference must be less than 2 deg. F at both points

Figure E-11. Impinger thermocouple calibration data sheet.

TRIP BALANCE CALIBRATION DATA SHEET

Balance No.	Date	Calibrator	Mass determined for					
			5 g	Error	50 g	Error	100 g	Error
419	12/7/89	J. Neese	5.0	0.0	50.0	0.0	100.0	0.0
418	12/15/89	D. CAHILL	5.2	0.20	50.1	0.10	100.2	0.20
198	12/15/89	D. CAHILL	5.2	0.20	50.05	0.05	100.0	0.0
199	12/15/89	D. CAHILL	5.1	0.10	50.10	0.10	100.15	0.15
METTLER	12/15/89	D. CAHILL	5.0	0.0	50.00	0.0	99.99	0.01 ←

Error must not exceed 0.5 grams at each point.

Figure E-12. Trip balance calibration data sheet.

BAROMETER CALIBRATION LOG

BAROMETER NO.	408	414		410	408	414	711
	Spanfit	Calgaz		S0020	S0020	50014	50000-1

PRETEST

BAROMETER READING	29.48	29.49	30.20	29.59	29.60	29.52	29.64
REFERENCE BAROMETER READING	29.48	29.50	29.50	29.60	29.60	29.53	29.63
DIFFERENCE*	.00	.00	.00	0.01	0.00	.01	.01
DATE	7/20/90	7/24/90	7/24/90	7/27/90	7/27/90	7/30/90	8/6/90
CALIBRATOR	RH	MK	MK	RHold	RHold	JJ	J.L.K

POST-TEST

BAROMETER READING	29.60				29.65	29.:	
REFERENCE BAROMETER READING	29.60				29.62	29.:0	
DIFFERENCE**	0.00				0.03	.0:	
DATE	7/27/90				8/3/90	8/7/:0	
CALIBRATOR	R. Hold				MK	JJ	

*Barometer is adjusted so that difference does not exceed 0.05 in. Hg.
**Barometer is not adjusted. If difference exceed 0.10 in. Hg, inform project manager immediately.

Figure E-13. Barometer calibration log.

PEI ASSOCIATES, INC.
11499 CHESTER ROAD
CINCINNATI, OHIO 45246
(513) 782-4700

Reference Gas: Matheson Gas Products, Inc.
Cylinder No. 4
Control No.
Analysis: CO_2- 5
O_2- 10
CO- 2.0

ORSAT CALIBRATION DATA SHEET

Orsat No.: 142 Gas: CO_2

Calibrator	Date	PN	Value determined
D. CAHILL	4/30/90	5720	5.0
D. CAHILL	6/5/90	5766	5.0
R. Kolde	6/15/90	5808	5.0
B. Yoder	7/11/90	5001q	5.0
[illegible]	7/[illegible]/90	[illegible]	5.2
R. Kolde	7/31/90	5004 5001q	5.0
R. Kolde	8/17/90	5682	5.0

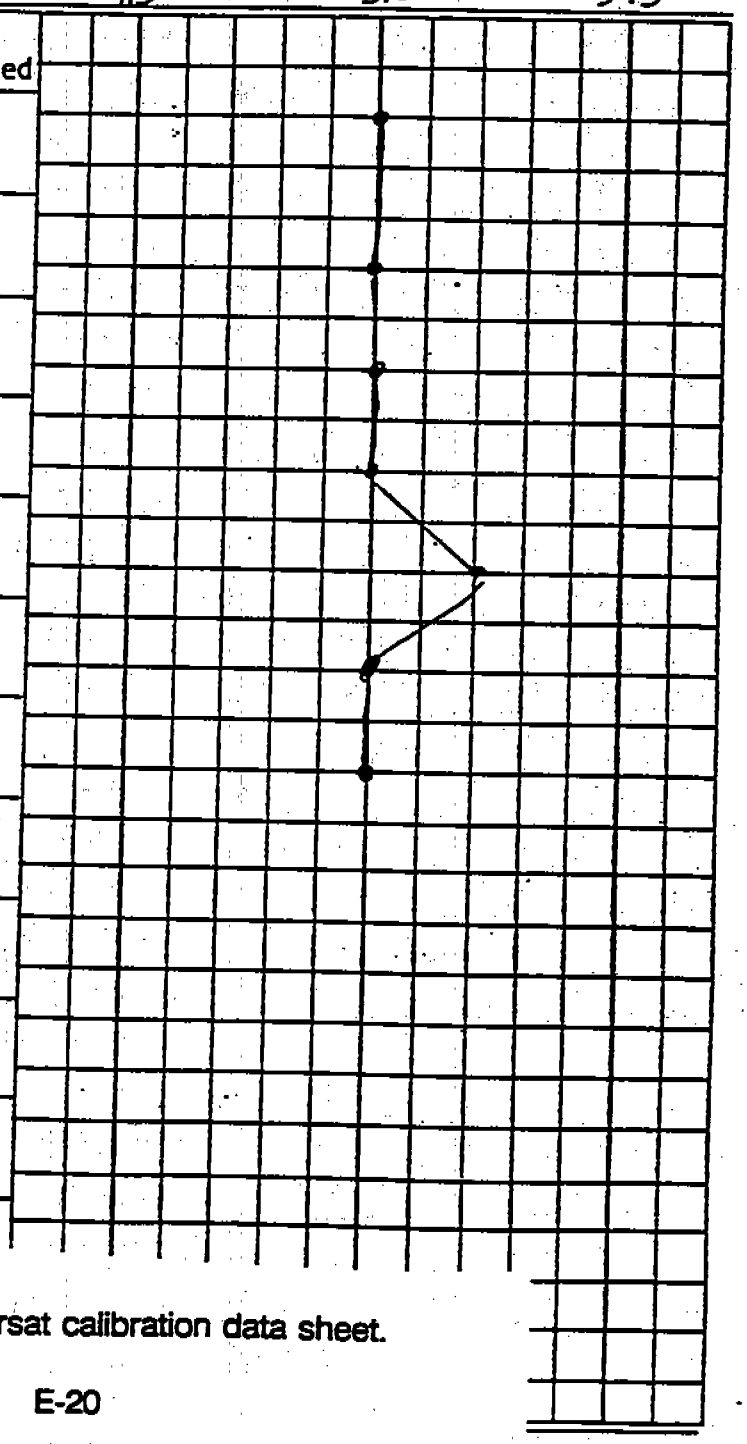

Figure E-14a. Orsat calibration data sheet.

PEI ASSOCIATES, INC.
11499 CHESTER ROAD
CINCINNATI, OHIO 45246
(513) 782-4700

Reference Gas: Matheson Gas Products, Inc.
Cylinder No. 4
Control No.
Analysis: CO_2 - 5
O_2 - 10
CO - 2.0

ORSAT CALIBRATION DATA SHEET

Orsat No.: 142 Gas: O_2

Calibrator	Date	PN	Value determined
D CAHILL	4/30/90	5700	10.0
D CAHILL	6/5/90	5766	10.00
R. Kolde	6/15/90	5808	10.0
B Gaels	7/11/90	5019	9.8
T [illegible]	[illegible]	5003 / 5003	9.8
R. Kolde	7/31/90	5014 / 5016	9.8
R. Kolde	8/15/90	5652	9.8

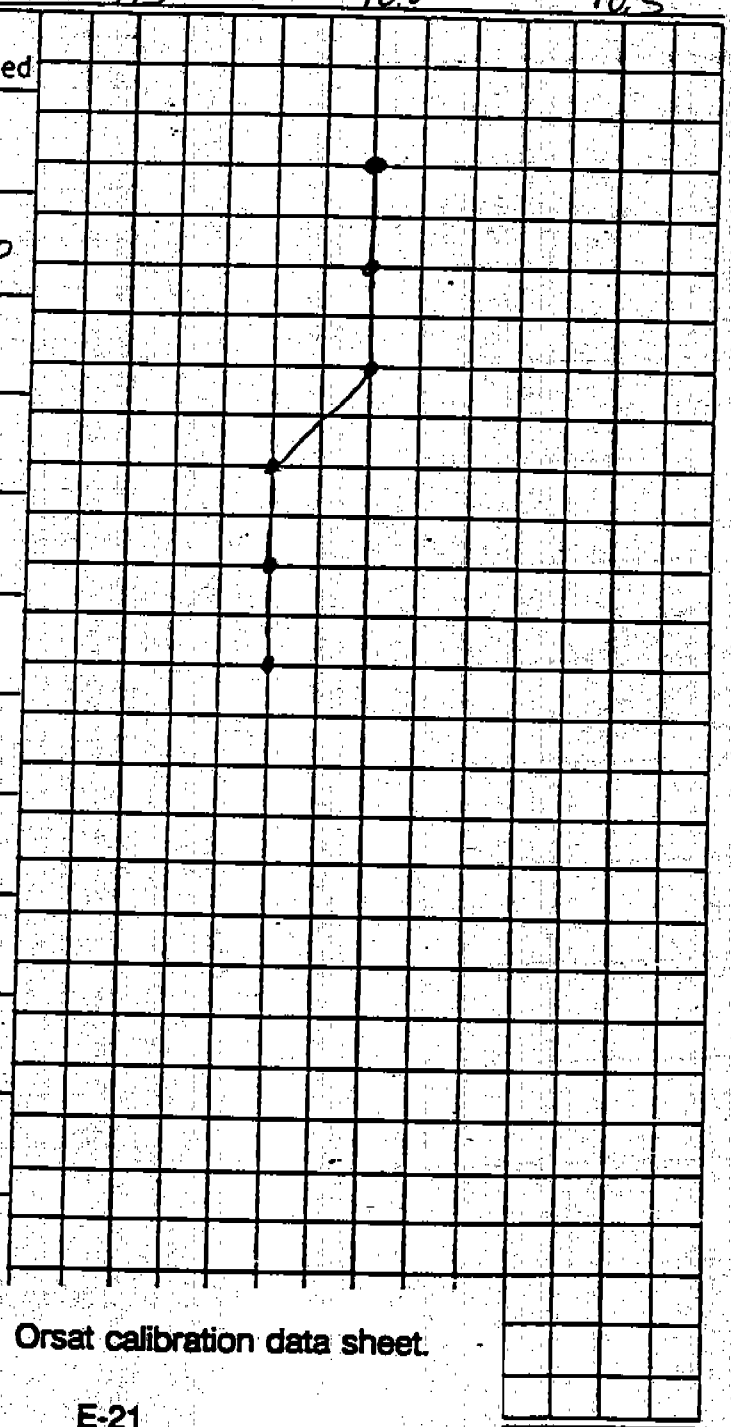

Figure E-14b. Orsat calibration data sheet.