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LFG EFD AP42
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EMISSION TEST REPORT

PERFORMANCE EVALUATION
LANDFILL GAS ENCLOSED FLARE
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

September 1990

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PN: 50016

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PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/139

PLANT :	Disposal Specialists, Inc.		
SAMPLE LOCATION :	Flare Inlet		
RUN NUMBER :	D2-I-4		
DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.64
TIME(24-HR) :	2015	STATIC PRES., in. H2O :	1.12
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	47.17	DRY MOLECULAR WEIGHT:	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1		
2	0.175	105
3	0.200	105
4	0.245	105
5	0.245	105
6	0.245	105
7	0.240	105
8	0.150	105
9	0.180	105
10	0.220	105
11	0.245	105
12	0.260	105
	0.260	105
	0.222	105

✓ 9-18-90 MW

CONTENTS

SECTION 1

INTRODUCTION

On August 9 and 10, 1990, personnel from PEI Associates, Inc. (PEI) conducted atmospheric emission tests on an enclosed flare operated by Disposal Specialists, Inc., in Rockingham, Vermont. 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 to determine the outlet mass emission rates of hydrofluoric acid (HF), hydrochloric acid (HCl), sulfuric acid (H_2SO_4), and selected VOCs were conducted for comparison with the corresponding State of Vermont's 8-hour action levels.

Testing procedures were conducted in the presence of Mr. David Manning, a representative of the Air Pollution Control Division of the State of Vermont. Mr. Kevin Greenwood of Disposal Specialists, Inc., coordinated the process operations throughout the sampling program. Mr. Dan Fitzgerald of PEI coordinated all testing activities during the sampling program.

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 500 dry standard cubic feet per minute (dscfm) [560 actual cubic feet per minute (acfm)]. Temperature averaged 103°F; moisture (H_2O) content, 3.2 percent; carbon dioxide (CO_2) content, 31.8 percent; oxygen (O_2) content, 3.9 percent; and methane (CH_4) content, 43.4 percent.

Flare stack flow rates by EPA Method 2 averaged 5440 dscfm (22,000 acfm), compared with 4450 dscfm determined by carbon balance. Temperature of the flue gas averaged 1583°F; H_2O content, 4.6 percent; CO_2 content, 8.6 percent; and O_2

* 40 CFR 60, Appendix A, July 1989.

TABLE 2-1. SUMMARY OF FLUE GAS CONDITIONS

Run number	Sampling location	Flue gas flow rate, acfm	Flue gas flow rate, dscfm	Temperature, °F	Moisture, %	O_2, %	CO_2, %	CH_4, %	N_2, %
D2-I-1	Inlet	550	510	99	3.2	5.4	31.9	42.3	20.4
D2-O-1	Stack	21,600	5,110	1677	4.3	9.3	8.5		82.2
D2-I-2	Inlet	550	500	104	3.2	3.0	33.5	44.2	19.3
D2-O-2	Stack	25,800	6,140	1686	2.6	9.0	9.2		81.8
D2-I-3	Inlet	570	510	107	3.2	3.2	30.0	43.6	23.2
D2-O-3	Stack	22,200	5,300	1618	a	10.4	9.5		80.1
D2-I-4	Inlet	550	490	105	3.2				
D2-O-4	Stack	21,000	5,630	1495	4.6	9.8	9.0		81.2
D2-I-5	Inlet	550	500	100	3.2				
D2-O-5	Stack	21,700	5,430	1505	6.9	11.5	8.0		80.5
D2-I-6	Inlet	560	510	102	3.2				
D2-O-6	Stack	19,800	5,040	1514	4.5	12.4	7.2		80.4
Average	Inlet	560	500	103	3.2	3.9	31.8	43.4	21.0
	Stack	22,000	5,440 (4,450)[b]	1583	4.6	10.4	8.6		81.0

[a] Sample lost due to broken probe; average used to calculate flow rate.

[b] Measured by carbon balance.

content, 10.4 percent. All flare stack emission rates are calculated using the flow-rate value obtained from the carbon balance, which we believe is 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) and pounds per 8 hours (lb/8 h). The product of the pollutant concentration and the flue gas flow rate yields the mass emission rate.

Table 2-3 presents the HCl and HF emissions data collected from the flare stack. All analytical results were below levels of detection. Results for Run D26-2 are questionable, since the sampling train did not leak-check after the sample run was completed. Since nondetectable levels were found in Runs D26-1 and D26-3, as well as D26-2, the sample volume from D26-2 was used to calculate the average sampling train detection limit.

Table 2-4 presents the data on SO_2 and H_2SO_4 emissions from the flare stack. Analytical results were just above the detection limits of EPA Method 8. Sample Run D8-0-1 resulted in levels below detection, and after review of the amount of moisture captured during this sampling run, this value is considered nonrepresentative as compared with the two other sampling runs. Moisture recovered from Run D8-0-1 was calculated at 0.4 percent, which did not compare well with the testing average of 4.6 percent; therefore, the sample is not considered representative of the flare stack flue gas and is not included in the average emission calculations. SO_2 concentrations averaged 2.52 ppm, which corresponds to a mass emission rate of 0.112 lb/h. H_2SO_4 concentration averaged 1.65 ppm, which corresponds to a mass emission rate of 0.112 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

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* 40 CFR 60, Appendix A, July 1989.

TABLE 2-2. SUMMARY OF POLLUTANT EMISSIONS

Pollutant	Sampling site	Concentration		Emission rate		Vermont action level
		ppm	µg/m³	lb/h	lb/8 h	lb/8 h
HCl	Stack	<0.28	<420	<0.0070	<0.0560	0.87
HF	Stack	<5.1	<4,200	<0.070	<0.560	3.1
H_2SO_4	Stack	1.7	6,700	0.112	0.896	1.2
SO_x	Stack	2.5	6,700	0.112	0.896	
NMO	Inlet	776	387,000	0.729	NA[a]	
	Stack	<2	<1,000	<0.0166	<0.133	
VOCs						
Acetone	Inlet	36.8	88,900	0.1676	NA	
	Stack	<0.28	<680	<0.0114	<0.0912	7,480
Acrylonitrile	Inlet	21.3	47,100	0.0887		
	Stack	<0.076	<170	<0.0028	<0.0223	0.0012
Benzene	Inlet	1.3	4,200	0.0079	NA	
	Stack	<0.024	<77	<0.0013	<0.0103	0.0096
Carbon tetrachloride	Inlet	<0.3	<1,930	<0.0036	NA	
	Stack	<0.012	<77	<0.0013	<0.0103	0.0054
Chlorobenzene	Inlet	<0.4	<1,930	<0.0036	NA	
	Stack	<0.016	<77	<0.0013	<0.0103	69.1
Chloroform	Inlet	<0.4	<1,930	<0.0036	NA	
	Stack	<0.016	<77	<0.0013	<0.0103	0.0034
1,1-Dichloroethane	Inlet	43.7	180,000	0.3392	NA	
	Stack	<0.019	<77	<0.0013	<0.0103	1,004
1,2-Dichloroethene (total)	Inlet	30.6	123,300	0.2324	NA	
	Stack	<0.019	<77	<0.0013	<0.0103	3,320
Ethyl benzene	Inlet	8.0	35,300	0.0666	NA	
	Stack	<0.017	<77	<0.0013	<0.0103	1,830
Methylene chloride	Inlet	24.9	88,000	0.1658	NA	
	Stack	4.3	15,300	0.2551	<2.040	0.020
Methyl ethyl ketone	Inlet	10.8	32,400	0.0610	NA	
	Stack	<0.23	<680	<0.0114	<0.0912	248
1,1,2,2-Tetrachloroethane	Inlet	<0.3	<1,930	<0.0036	NA	
	Stack	<0.011	<77	<0.0013	<0.0103	0.0014
Tetrachloroethene	Inlet	9.0	62,000	0.1168	NA	
	Stack	<0.011	<77	<0.0013	<0.0103	0.033
Toluene	Inlet	99.2	380,000	0.7160	NA	
	Stack	<0.020	<77	<0.0013	<0.0103	464
1,1,1-Trichloroethane	Inlet	7.9	43,700	0.0823	NA	
	Stack	<0.014	<77	<0.0013	<0.0103	7,980
Trichloroethene	Inlet	5.3	28,700	0.0540	NA	
	Stack	<0.014	<77	<0.0013	<0.0103	0.034

Trichloroethylene?

(continued)

TABLE 2-2 (continued)

Pollutant	Sampling site	Concentration		Emission rate		Vermont action level
		ppm	$\mu g/m^3$	lb/h	lb/8 h	lb/8 h
Vinyl chloride	Inlet	22.4	58,300	0.1099	NA	0.016
	Stack	<0.062	<160	<0.0026	<0.0206	
Xylenes (total)	Inlet	24.1	106,300	0.2004	NA	8.63
	Stack	<0.017	<77	<0.0013	<0.0103	

[a] NA = Not applicable.

TABLE 2-3. SUMMARY OF HCl/HF EMISSIONS

Run No.	Pollutant	Date (1990)	Time (24-h)	Concentration ppm	Concentration µg/m³	Emission rate lb/h	Emission rate lb/8 h
D26-1	HCl	8/9	1846-1946	<0.26	<390	<0.0066	<0.0528
	HF			<4.8	<4000	<0.066	<0.528
D26-2	HCl	8/10	0830-0938	<0.31	<470	<0.0079	<0.0632
	HF			<5.7	<4700	<0.079	<0.632
D26-3	HCl	8/10	1001-1101	<0.26	<390	<0.0066	<0.0528
	HF			<4.8	<4000	<0.066	<0.528
Average	HCl			<0.28	<420	<0.0070	<0.0560
	HF			<5.1	<4200	<0.070	<0.560

TABLE 2-4. SUMMARY OF SO_2/H_2SO_4 EMISSIONS

Run No.	Pollutant	Date (1990)	Time (24-h)	Concentration ppm	Concentration µg/m³	Emission rate lb/h	Emission rate lb/8 h
D8-0-1	SO_2	8/9	1845-1945	[a]	[a]	[a]	[a]
	H_2SO_4			[a]	[a]	[a]	[a]
D8-0-2	SO_2	8/10	0839-0939	2.06	5.48	0.092	0.736
	H_2SO_4			1.86	7.59	0.126	1.008
D8-0-3	SO_2	8/10	1000-1100	2.98	7.93	0.132	1.056
	H_2SO_4			1.43	5.83	0.097	0.776
Average	SO_2			2.52	6.71	0.112	0.896
	H_2SO_4			1.65	6.71	0.112	0.892

[a] Levels below detection; value not used in average; see text for explanation.

removal efficiency as a surrogate determination of the methane removal efficiency. However, the analytical detection limits of the Method 25 analyzer restricted the calculated removal efficiencies. The detection limit of the Method 25 analyzer was approximately 2 ppm as carbon (C_1), and all samples taken from the flare stack were less than this. All stack mass 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 higher ranking (lower thermal stability) are theoretically removed also. Toluene has a thermal stability ranking of 35. Benzene and chlorobenzene are the only two GC/MS analyzed compounds with higher rankings, at 3 and 19, respectively. Benzene levels were just above detection limits and chlorobenzene was not detected in the inlet gas, which prevents their use as suitable surrogates in this determination. Acrylonitrile was analyzed from charcoal tubes and has a lower thermal stability index ranking at 20; however, the lower inlet concentration and higher detection limit from the charcoal tube collection method prevent it from being used as a suitable VOC surrogate. Tables 2-5a and 2-5b present the calculated removal efficiency data for both NMOs and toluene. Removal efficiency based on

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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.

NMOs is an average greater than 97.7 percent; whereas, the toluene removal efficiency is greater than 99.8 percent.

Table 2-5a presents the concentration and mass emission rate of NMOs from the flare inlet and stack. Flare inlet concentrations averaged 776 ppm (387,000 $\mu g/m^3$), which corresponds to an average mass emission rate of 0.729 lb/h. Stack NMO levels were below analytical detection of 2 ppm (1000 $\mu g/m^3$). If this value is used to calculate a theoretical stack mass emission rate, a value of <0.0166 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 99.2 ppm (380,000 $\mu g/m^3$), which corresponds to an average mass emission rate of 0.716 lb/h. Stack NMO levels were below analytical detection of 0.02 ppm (77 $\mu g/m^3$). If this value is used to calculate a theoretical stack mass emission rate, a value of <0.0013 lb/h is obtained.

Table 2-6 presents data for the remaining selected VOCs. All selected VOCs that were measured at the inlet were at levels below detection at the stack with the exception of methylene chloride. Analysis of a blank field canister that was pressurized with ultra-pure helium showed methylene chloride as an analytical contaminant. Methylene chloride is a common laboratory solvent that is used in most EPA published extraction procedures. Because of its widespread use, it has become a common contaminant within laboratory organic analysis and in most cases is unavoidable. Flare stack concentrations were comparable with those found in the sample blank. Therefore, levels at the stack may have originated from laboratory contamination and are not representative of true stack emissions. Levels detected at the inlet show possible methylene chloride concentrations above laboratory contamination, but accurate quantitation to the degree of high bias from contamination cannot be determined.

Data presented in Table 2-6 regarding removal efficiency for compounds that were not detected at either the inlet or stack are shown as not applicable (NA). In

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

Run No.	Sampling site	Date (1990)	Time (24-h)	Concentration		Mass emission rate		Removal efficiency, %
				ppm	$\mu g/m^3$	lb/h	lb/8 h	
D25-I-1	Inlet	8/9	0953-1053	840	419,000	0.790	6.32	>97.9
D25-0-1	Stack	8/9	0953-1053	<2	<1,000	<0.0166	<0.133	
D25-I-2	Inlet	8/9	1245-1345	734	366,000	0.690	5.52	>97.6
D25-0-2	Stack	8/9	1245-1345	<2	<1,000	<0.0166	<0.133	
D25-I-3	Inlet	8/9	1543-1643	753	376,000	0.708	5.66	>97.7
D25-0-3	Stack	8/9	1543-1643	<2	<1,000	<0.0166	<0.133	
Average	Inlet			776	387,000	0.729	5.83	>97.7
	Stack			<2	<1,000	<0.0166	<0.133	

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

Run No.	Sampling site	Date (1990)	Time (24-h)	Concentration		Mass emission rate		Removal efficiency, %
				ppm	$\mu g/m^3$	lb/h	lb/8 h	
D25-I-1	Inlet	8/9	0953-1053	101	390,000	0.735	5.88	>99.8
D25-0-1	Stack	8/9	0953-1053	<0.02	<72	<0.0012	<0.0096	
D25-I-2	Inlet	8/9	1245-1345	99.2	380,000	0.716	5.73	>99.8
D25-0-2	Stack	8/9	1245-1345	<0.02	<78	<0.0013	<0.010	
D25-I-3	Inlet	8/9	1543-1643	96.5	370,000	0.697	5.58	>99.8
D25-0-3	Stack	8/9	1543-1643	<0.02	<82	<0.0014	<0.011	
Average	Inlet			99.2	380,000	0.716	5.73	>99.8
	Stack			<0.02	<77	<0.0013	<0.010	

TABLE 2-6. SUMMARY OF SELECTED VOC POLLUTANTS

POLLUTANT	SAMPLING SITE	CONCENTRATION Run 1 ppm	Run 1 µg/m3	Run 2 ppm	Run 2 µg/m3	Run 3 ppm	Run 3 µg/m3	AVERAGE ppm	AVERAGE µg/m3	MASS EMISSION RATE Run 1 lb/h	Run 2 lb/h	Run 3 lb/h	AVERAGE lb/h	AVERAGE lb/8-h	% Removal Efficiency Run 1 µg/m3	Run 2 ppm	Run 3 µg/m3	AVERAGE
acetone [a] acet	inlet	37.7	91,100	36.8	88,400	36.1	87,300	36.8	88,900	0.1717	0.1668	0.1644	0.1678	1.3408	>93.7	>93.8	>92.4	>93.2
	outlet	[illegible]	<650	<0.28	<640	<0.31	<750	<0.28	<680	<0.0109	<0.0107	<0.0125	<0.0114	<0.0912				
acrylonitrile [a] 2v	inlet	[illegible]	81,700	18.6	44,000	20.8	45,500	21.3	47,100	0.0974	0.0830	0.0857	0.0887	0.7096	>96.4	>97.7	>97.7	>96.9
	outlet	[illegible]	<270	<0.08	<110	<0.06	<120	<0.08	<170	<0.0045	<0.0019	<0.0020	<0.0028	<0.0224				
benzene 3v	inlet	[illegible]	4,300	1.2	3,900	1.3	4,300	1.3	4,200	0.0081	0.0073	0.0081	0.0079	0.0632	>85.2	>82.2	>82.7	>83.4
	outlet	[illegible]	<72	<0.02	<78	<0.03	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
carbon tetrachloride 6v	inlet	[illegible]	<1,880	[illegible]	<1,990	<0.3	<1,930	<0.3	<1,930	<0.0035	<0.0037	<0.0038	<0.0036	<0.0288	NA [b]	NA	NA	NA
	outlet	[illegible]	<72	[illegible]	<78	<0.01	<82	<0.01	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
chlorobenzene 7v	inlet	[illegible]	<1,880	<0.4	<1,990	<0.4	<1,930	<0.4	<1,930	<0.0035	<0.0037	<0.0038	<0.0036	<0.0288	NA	NA	NA	NA
	outlet	[illegible]	<72	<0.02	<78	<0.02	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
chloroform 11v	inlet	[illegible]	<1,880	<0.4	<1,990	<0.4	<1,900	<0.4	<1,930	<0.0035	<0.0037	<0.0038	<0.0036	<0.0288	NA	NA	NA	NA
	outlet	[illegible]	<72	<0.02	<78	<0.02	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
1,1-dichloroethane 14v	inlet	[illegible]	170,000	40.1	180,000	43.7	180,000	43.7	180,000	0.3203	0.3580	0.3392	0.3392	2.7136	>99.6	>99.6	>99.6	>99.6
	outlet	[illegible]	<72	<0.02	<78	<0.02	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
1,2-dichlorothene (total) ISVA	inlet	[illegible]	120,000	32.2	130,000	28.7	120,000	30.8	123,000	0.2261	0.2450	0.2261	0.2324	1.8592	>99.5	>99.5	>99.4	>99.4
	outlet	[illegible]	<72	<0.02	<78	<0.02	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
ethyl benzene 19v	inlet	[illegible]	34,000	8.2	36,000	8.2	38,000	8	35,300	0.0641	0.0678	0.0678	0.0666	0.5328	>98.1	>98.1	>97.9	>98.0
	outlet	[illegible]	<72	<0.02	<78	<0.02	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
methylene chloride [c] 22v	inlet	[illegible]	78,000	[illegible]	85,000	28.3	100,000	24.8	88,000	0.1489	0.1602	0.1884	0.1658	1.3264	-10.8	-108.1	-41.8	-53.5
	outlet	[illegible]	9,900	6.7	20,000	4.8	18,000	4.3	15,300	0.1650	0.3334	0.2687	0.2551	2.0408				
methylethyl ketone [a] MEK	inlet	[illegible]	30,400	10.1	32,100	11.6	34,800	10.8	32,400	0.0572	0.0606	0.0652	0.0610	0.488	>80.9	>82.3	>80.8	>81.4
	outlet	[illegible]	<650	[illegible]	<640	<0.28	<780	<0.23	<680	<0.0109	<0.0107	<0.0126	<0.0114	<0.0912				
1,1,2,2-tetrachloroethane 23v	inlet	[illegible]	<1,880	[illegible]	<1,990	<0.3	<1,930	<0.3	<1,930	<0.0035	<0.0037	<0.0038	<0.0036	<0.0288	NA	NA	NA	NA
	outlet	<0.01	<72	<0.01	<78	<0.01	<82	<0.01	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
tetrachloroethene 24va	inlet	8.4	78,000	[illegible]	83,000	8.4	85,000	9	82,000	0.1093	0.1187	0.1225	0.1168	0.9344	>98.9	>98.9	>98.9	>98.9
	outlet	<0.01	<72	<0.01	<78	<0.01	<82	<0.01	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
toluene 25v	inlet	101.8	380,000	98.2	380,000	96.6	370,000	99.2	380,000	0.7349	0.7160	0.6972	0.7160	5.728	>99.8	>99.8	>99.8	>99.8
	outlet	<0.02	<72	<0.02	<78	<0.08	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
1,1,1-trichloroethane 27v	inlet	[illegible]	47,000	7.4	41,000	7.8	43,000	7.8	43,700	0.0866	0.0773	0.0810	0.0823	0.6584	>98.8	>98.3	>98.3	>98.4
	outlet	[illegible]	<72	<0.01	<78	[illegible]	<82	<0.01	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
trichloroethene 29va	inlet	[illegible]	30,000	5.1	28,000	5.1	28,000	5.3	28,700	0.0565	0.0528	0.0528	0.0540	0.432	>97.9	>97.5	>97.3	>97.6
	outlet	<0.01	<72	<0.01	<78	<0.02	<82	<0.01	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				
vinyl chloride 31v	inlet	23.1	60,000	23.1	60,000	21.2	55,000	22.4	58,300	0.1131	0.1131	0.1036	0.1099	0.8792	>97.9	>97.7	>97.4	>97.7
	outlet	<0.06	<72	<0.06	<78	<0.08	<82	<0.06	<77	<0.0024	<0.0026	<0.0027	<0.0026	<0.0208				
xylenes (total) XYL	inlet	22.4	99,000	24.9	110,000	24.8	110,000	24.1	106,300	0.1865	0.2073	0.2073	0.2004	1.6032	>99.4	>99.4	>99.3	>99.4
	outlet	<0.02	<72	<0.02	<78	<0.08	<82	<0.02	<77	<0.0012	<0.0013	<0.0014	<0.0013	<0.0104				

[a] Sample collection by charcoal tube.

[b] NA = Not applicable.

[c] Artifact from laboratory contamination.

addition to the lb/h mass emission rates of each VOC, the mass emission rate is presented as lb/8 h, which is the unit used to represent the action levels set by the State of Vermont.

See Appendix A for example calculations used to develop these emission rates. Appendix B contains the actual field data obtained on site. Appendix C presents the analytical results produced from the respective samples that were collected.

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. Tables 3-2 through 3-4 outline quality assurance results for analysis of field samples.
- Internal and external audits to ensure accuracy in sampling and analysis.

Sampling equipment, reagents, and analytical procedures for this test series met all necessary guidelines set forth for accurate test results. Calibration showed that

TABLE 3-1. FIELD EQUIPMENT CALIBRATION

Equipment	ID No.	Calibrated against	Allowable error	Actual error	Within allowable limits	Comments
Meter box	FT-3	Wet test meter	Y ±0.02	-0.010	X	
			ΔH@ ±0.15	-0.07	X	
			(Y ± 0.05 of Y post-test)	-0.027	X	
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	
Meter box - low flow	VB-1	Electronic bubble meter	Y ± 0.02	-0.006	X	
			(Y ± 0.05 of Y post-test)	-0.010	X	
Meter box - low flow	VB-3	Electronic bubble meter	Y ± 0.02	+0.014	X	
			(Y ± 0.05 of Y post-test)	-0.018	X	
Pitot tubes	301	Geometric specifications	[a]	[a]	OK	Visually inspected on site
	523			[a]	OK	
Digital indicator	FT-3	Millivolt signals	±0.5%	+0.3%	X	
	FT-7			-0.4%	X	
	VB-1			+0.2%	X	
	VB-3			±0.2%	X	
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	±2°F	±1°F	X	
	I-37			0°F	X	
Trip balance	Mettler	Type-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	Post-test
Dry gas thermocouple	FT-3	ASTM-3F	±5°F	+1°F	X	Inlet
	FT-7			+1°F	X	Outlet
	VB-1			-1°F	X	Inlet
	VB-3			±1°F	X	Outlet
				-1°F	X	
				-1°F	X	

[a] See Appendix E.

TABLE 3-2. ANALYTICAL AUDIT RESULTS

Analyte	Theoretical value	Reported value	Percent recovery
SO_2/H_2SO_4 Audit No. 2529, Lot No. 0587	617 mg/dscm	620 mg/dscfm	100.4
Chloride	4 mg/L	NR[a]	93.5, 103, 99.2
Fluoride	4 mg/L	NR	90.5, 99.0, 98.0

[a] NR = Not reported.

TABLE 3-3. CHARCOAL TUBE DESORPTION EFFICIENCIES

Analyte	Level	Theoretical value, µg	Percent recovery
Acetone	Low	11.8	100
	High	212.8	85
Acrylonitrile	Low	18.1	90.6
	High	241.8	93.6
Methylethyl ketone	Low	12.1	122
	High	217.4	94

TABLE 3-4. SAMPLE CANISTER SURROGATE RECOVERY

Run No.	Compound percent recovery		
	d4-1,2-Dichloroethane	d8-Toluene	p-Bromofluorobenzene
D25-I-1	99	113	73
D25-I-2	104	112	77
D25-I-3	101	107	72
D25-0-1	94	102	84
D25-0-2	97	99	97
D25-0-3	101	99	94
Blank - VBLKC4	98	109	70
Blank - VBLKC6	96	101	86

all pollutant sampling equipment was within the limits described in the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III."

Table 3-2 presents data on the quality assurance procedures for SO_2/H_2SO_4 and HCl/HF samples. An EPA-supplied audit vial containing a concentration of sulfate ion (SO_4^-) was analyzed to verify the titration technique of the analyst. The reported value is compared with the theoretical value and reported as percent recovery. For HCl/HF analysis, standard reference solutions (SRS) are prepared in house with known quantities of chloride and fluoride 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 data from desorption efficiency determinations of the compounds collected by charcoal tubes. Blank charcoal tubes were spiked with known quantities of each pollutant at low and high levels within the reported analytical range. Subsequent desorption and analysis of each tube was conducted to determine the percent recovery of the analytical procedures.

Table 3-4 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.

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

SECTION 4

PROCESS DESCRIPTION

Disposal Specialists, Inc., operates an enclosed ground flare to control CH_4 and NMOs contained in the landfill gas collected from their disposal site in Rockingham, Vermont. 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.

Table 4-1 presents data on the flare exhaust gas temperature, which was monitored by strip chart during the testing program. Appendix F contains the strip-chart reduction data and a copy of the chart reading.

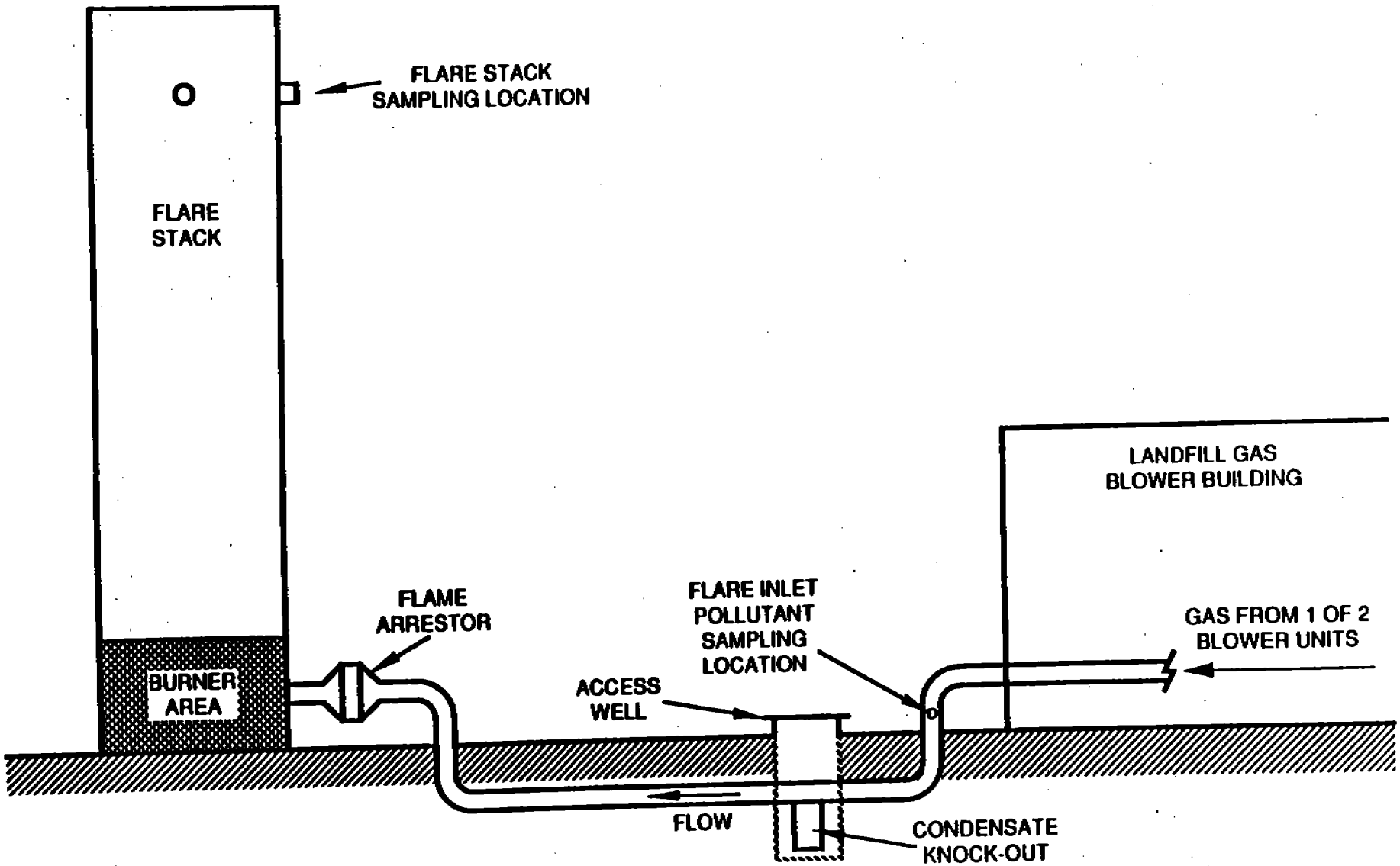

Figure 4-1. Methane control system.

TABLE 4-1. FLARE EXHAUST GAS TEMPERATURE

Test series number	Date (1990)	Corresponding pollutants sampled	Corresponding sample run Nos.	Exhaust gas temperature, °F	Heat input, 10^6 Btu/h[a]
1	8/9	NMOs, VOCs, and acrylonitrile	D25-I-1, D25-O-1, DA-I-1, DA-O-1	1770	13.2
2	8/9	NMOs, VOCs and acrylonitrile	D25-I-2, D25-O-2, DA-I-1, DA-O-1	1760	13.2
3	8/9	NMOs, VOCs, and acrylonitrile	D25-I-3, D25-O-3, DA-I-3, DA-O-3	1690	13.2
4	8/9	MEK/acetone, HCl/HF, and H_2SO_4	D18-I-1, D18-O-1, D18-I-2, D18-O-2, D26-1, D8-O-1	1710	13.2
5	8/10	MEK/acetone, HCl/HF, and H_2SO_4	D18-I-3, D18-O-3, D26-2, D8-O-2	1650	13.2
6	8/10	MEK/acetone, HCl/HF, and H_2SO_4	D26-3, D8-O-3	1680	13.2
Average of 6 Test Series				1710	13.2

[a] 10^6 Btu/h = million Btu per hour, based on 503 dscfm and average calorific value of the inlet flue gas (438.1 Btu/dscf).

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	1-1/8
3	2-1/4
4	5-1/2
5	6-5/8
6	7-1/4

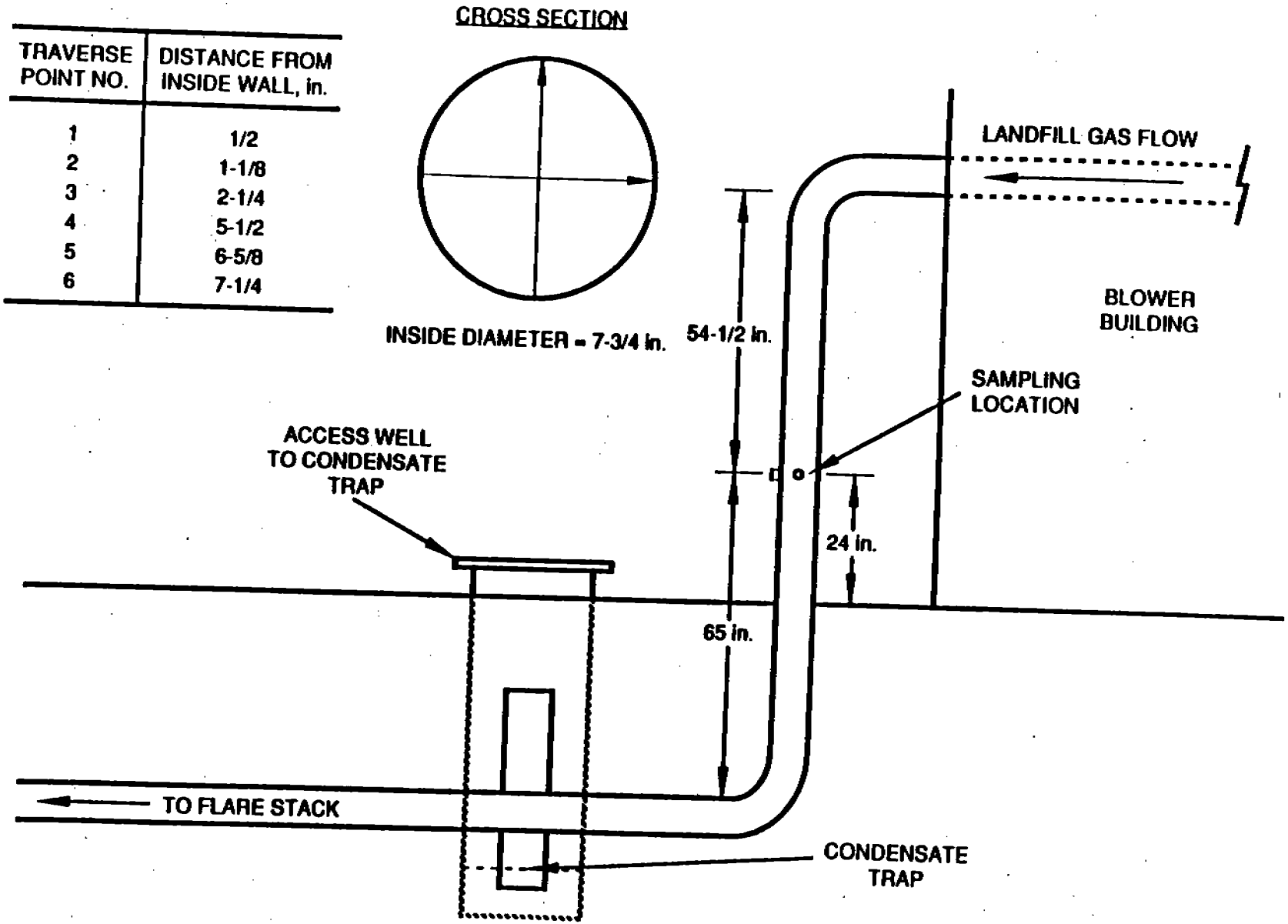


Figure 5-1. Flare inlet sampling location.

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.

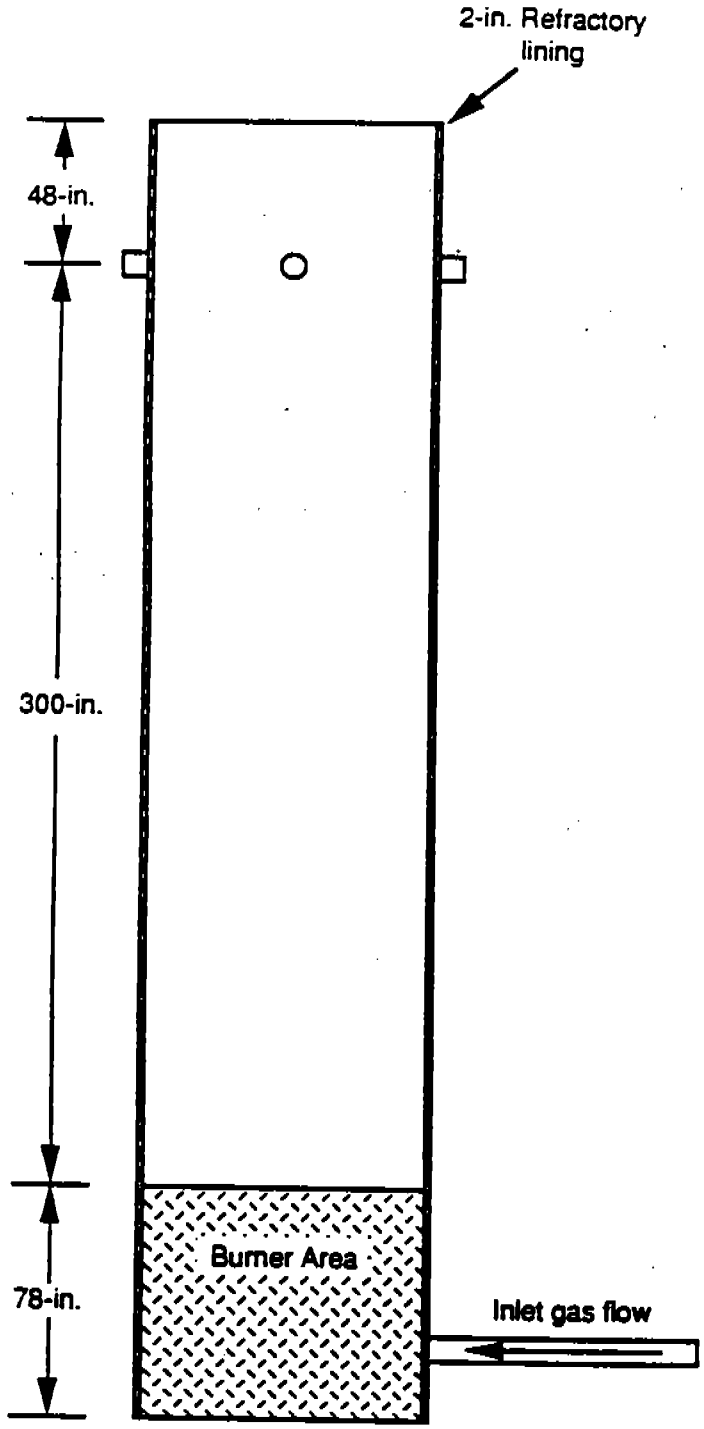
Flare Stack

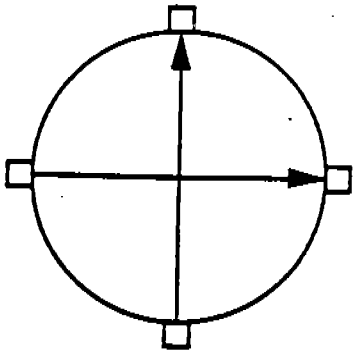
As depicted in Figure 5-2, four sampling ports were located 3.3 stack diameters downstream and 0.5 stack diameter upstream of the nearest flow disturbances. Of the four sampling ports, only two were used to gain access to the exhaust gas stream. A total of 24 sampling points (12 per port) were used to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

* 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

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/.

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	D2-I-1

DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.98
TIME(24-HR) :	930	STATIC PRES., in. H2O :	1
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	47.17	DRY MOLECULAR WEIGHT:	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.165	97
2	0.205	98
3	0.250	99
4	0.250	100
5	0.250	100
6	0.245	100
7	0.170	99
8	0.195	99
9	0.225	100
10	0.260	100
11	0.260	100
12	0.260	100
	0.228	99

VA-1 8-93

validated 3/13/90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	D2-I-2

DATE :	8/9/90	**BAROMETRIC PRES., in. Hg :**	29.75
TIME(24-HR) :	1155	**STATIC PRES., in. H2O :**	1.2
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	47.17	**DRY MOLECULAR WEIGHT:**	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.120	103
2	0.200	104
3	0.245	104
4	0.255	104
5	0.240	104
6	0.240	104
7	0.175	103
8	0.200	104
9	0.240	104
10	0.270	104
11	0.270	104
12	0.270	105
	0.227	104

9-18-90

validated 3/13

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	D2-I-3

DATE :	8/9/90	**BAROMETRIC PRES., in. Hg :**	29.5
TIME(24-HR) :	1443	**STATIC PRES., in. H2O :**	1.2
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	47.17	**DRY MOLECULAR WEIGHT:**	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.205	107
2	0.225	107
3	0.250	107
4	0.250	107
5	0.245	107
6	0.230	107
7	0.170	106
8	0.220	106
9	0.260	106
10	0.270	106
11	0.270	106
12	0.270	107
	0.239	107

✓ 9-18-90 MM

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/13/90

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	D2-I-4

DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.64
TIME(24-HR) :	2015	STATIC PRES., in. H2O :	1.12
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	47.17	DRY MOLECULAR WEIGHT:	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.175	105
2	0.200	105
3	0.245	105
4	0.245	105
5	0.245	105
6	0.240	105
7	0.150	105
8	0.180	105
9	0.220	105
10	0.245	105
11	0.260	105
12	0.260	105
	0.222	105

9-8-90 MW

validated 3/13/9

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT : Disposal Specialists, Inc.
SAMPLE LOCATION : Flare Inlet

Run No:	D2-I-1	D2-I-2	D2-I-3	D2-I-4	AVERAGE
STACK PRESSURE, in Hg :	30.05	29.84	29.59	29.72	29.80
STACK TEMP., deg. F :	99	104	107	105	104
MOLECULAR WEIGHT, DRY :	28.04	28.04	28.04	28.04	28.04
MOLECULAR WEIGHT, STACK :	27.72	27.72	27.72	27.72	27.72
AVG. SQRT. VELOCITY HEAD :	0.48	0.47	0.49	0.47	0.48
VELOCITY, fps :	28.01	28.10	29.11	27.93	28.29
ACTUAL CUBIC FEET/ MINUTE :	551	552	572	549	556
)RY STANDARD CUBIC FEET/ MINUTE :	505	499	510	493	502

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/13/90

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	D2-I-5

DATE :	8/10/90	BAROMETRIC PRES., in. Hg :	29.9
TIME(24-HR) :	806	STATIC PRES., in. H2O :	1.1
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	47.17	DRY MOLECULAR WEIGHT:	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.195	100
2	0.225	100
3	0.240	100
4	0.240	100
5	0.240	100
6	0.240	100
7	0.170	100
8	0.180	100
9	0.205	100
10	0.245	100
11	0.245	100
12	0.255	100
	0.223	100

9-18-90 MW

validated 3/13/9

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Inlet
RUN NUMBER :	D2-I-6

DATE :	8/10/90	**BAROMETRIC PRES., in. Hg :**	29.8
TIME(24-HR) :	1125	**STATIC PRES., in. H2O :**	1.16
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	3.2	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	47.17	**DRY MOLECULAR WEIGHT:**	28.04
NO. OF TRAVERSE PTS. :	12		

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.190	102
2	0.230	102
3	0.250	102
4	0.250	102
5	0.250	102
6	0.245	102
7	0.170	102
8	0.215	102
9	0.240	102
10	0.250	102
11	0.265	102
12	0.265	102
	0.235	102

✓ 9-19-90 MW

PEI ASSOCIATES
VELOCITY DETERMI

PLANT : Disposal Specialists, Inc.
SAMPLE LOCATION : Flare Inlet

Run No:	D2-I-5	D2-I-6
STACK PRESSURE, in Hg :	29.98	29.89
STACK TEMP., deg. F :	100	102
MOLECULAR WEIGHT, DRY :	28.04	28.04
MOLECULAR WEIGHT, STACK :	27.72	27.72
AVG. SQRT. VELOCITY HEAD :	0.47	0.48
VELOCITY, fps :	27.80	28.62
ACTUAL CUBIC FEET/ MINUTE :	546	562
)RY STANDARD CUBIC FEET/ MINUTE :	500	511

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	D2-O-1

DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.98
TIME(24-HR) :	905	STATIC PRES., in. H2O :	-0.05
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	4.3	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.5
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	9.3

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.005	1626
2	0.004	1645
3	0.005	1651
4	0.005	1651
5	0.005	1657
6	0.005	1637
7	0.007	1670
8	0.006	1684
9	0.005	1700
10	0.005	1697
11	0.004	1703
12	0.003	1717
13	0.002	1574
14	0.003	1637
15	0.004	1670
16	0.004	1687
17	0.003	1691
18	0.003	1687
19	0.004	1686
20	0.006	1690
21	0.008	1708
22	0.011	1723
23	0.011	1723
24	0.005	1727
	0.005	1677

9-13-90 MW

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	D2-O-2

DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.75
TIME(24-HR) :	1210	STATIC PRES., in. H2O :	-0.055
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	2.6	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.9
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	9.2

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.004	1520
2	0.005	1572
3	0.005	1640
4	0.007	1679
5	0.008	1704
6	0.007	1704
7	0.008	1700
8	0.008	1721
9	0.010	1729
10	0.010	1729
11	0.010	1718
12	0.002	1717
13	0.005	1586
14	0.006	1620
15	0.004	1614
16	0.007	1669
17	0.007	1707
18	0.006	1708
19	0.008	1720
20	0.007	1722
21	0.009	1740
22	0.010	1753
23	0.010	1753
24	0.010	1746
	0.007	1686

✓ 9-18-90 MW

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	D2-O-3

DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.5
TIME(24-HR) :	1450	STATIC PRES., in. H2O :	-0.05
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	4.6	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	9.4
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	9.7

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.002	1330
2	0.003	1510
3	0.005	1630
4	0.005	1634
5	0.006	1655
6	0.006	1659
7	0.006	1666
8	0.008	1673
9	0.006	1680
10	0.005	1686
11	0.002	1670
12	0.002	1656
13	0.003	1400
14	0.005	1604
15	0.003	1606
16	0.003	1608
17	0.006	1607
18	0.007	1622
19	0.007	1642
20	0.011	1698
21	0.012	1674
22	0.011	1646
23	0.010	1638
24	0.002	1637
	0.006	1618

✓ 9-18-90 MW

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	D2-O-4

DATE :	8/9/90	BAROMETRIC PRES., in. Hg :	29.64
TIME(24-HR) :	2023	STATIC PRES., in. H2O :	-0.05
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	4.6	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	9.0
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	9.8

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.002	1360
2	0.006	1370
3	0.007	1434
4	0.008	1500
5	0.005	1533
6	0.006	1545
7	0.008	1565
8	0.007	1544
9	0.010	1547
10	0.010	1548
11	0.010	1552
12	0.005	1572
13	0.002	1350
14	0.003	1360
15	0.004	1400
16	0.004	1510
17	0.005	1508
18	0.007	1518
19	0.006	1531
20	0.005	1544
21	0.008	1530
22	0.005	1515
23	0.005	1527
24	0.002	1505
	0.006	1495

OK 9-18-90

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT : Disposal Specialists, Inc.
SAMPLE LOCATION : Flare Stack

Run No:	D2-O-1	D2-O-2	D2-O-3	D2-O-4	AVERAGE
STACK PRESSURE, in Hg :	29.98	29.75	29.50	29.64	29.71
STACK TEMP., deg. F :	1677	1686	1618	1495	1619
MOLECULAR WEIGHT, DRY :	29.73	29.78	29.88	29.83	29.81
MOLECULAR WEIGHT, STACK :	29.23	29.48	29.34	29.29	29.33
AVG. SQRT. VELOCITY HEAD :	0.07	0.08	0.07	0.07	0.08
VELOCITY, fps :	7.87	9.41	8.09	8.04	8.35
ACTUAL CUBIC FEET/ MINUTE :	21553	25771	22158	22037	22880
)RY STANDARD CUBIC FEET/ MINUTE :	5107	6139	5295	5626	5542

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

validated 3/15/90

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	D2-O-5

DATE :	8/10/90	BAROMETRIC PRES., in. Hg :	29.9
TIME(24-HR) :	817	STATIC PRES., in. H2O :	-0.045
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	6.9	PITOT TUBE, Cp :	0.84
STACK AREA, SQ. IN. :	6575.54	PERCENT CO2 :	8.0
NO. OF TRAVERSE PTS. :	24	PERCENT O2 :	11.5

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.003	1429
2	0.002	1437
3	0.003	1457
4	0.005	1496
5	0.007	1538
6	0.007	1524
7	0.007	1528
8	0.008	1533
9	0.008	1538
10	0.010	1555
11	0.010	1561
12	0.005	1584
13	0.002	1443
14	0.004	1464
15	0.004	1470
16	0.005	1478
17	0.005	1486
18	0.006	1503
19	0.006	1509
20	0.007	1513
21	0.006	1515
22	0.006	1519
23	0.005	1524
24	0.003	1525
	0.006	1505

✓ 9-18-90 MW

validated 3/15/9

PEI ASSOCIATES INC.
VELOCITY DETERMINATION

PLANT :	Disposal Specialists, Inc.
SAMPLE LOCATION :	Flare Stack
RUN NUMBER :	D2-O-6

DATE :	8/10/90	**BAROMETRIC PRES., in. Hg :**	29.8
TIME(24-HR) :	1135	**STATIC PRES., in. H2O :**	-0.05
OPERATOR(S) :	Fitzgerald/Kolde		
PERCENT MOISTURE :	4.5	**PITOT TUBE, Cp :**	0.84
STACK AREA, SQ. IN. :	6575.54	**PERCENT CO2 :**	7.2
NO. OF TRAVERSE PTS. :	24	**PERCENT O2 :**	12.4

TRAVERSE PT. NO.	VELOCITY HEAD, in. H2O	STACK TEMP., deg. F
1	0.002	1380
2	0.002	1452
3	0.003	1476
4	0.003	1478
5	0.003	1482
6	0.003	1555
7	0.005	1555
8	0.008	1558
9	0.012	1577
10	0.012	1589
11	0.010	1596
12	0.015	1604
13	0.003	1410
14	0.002	1497
15	0.005	1498
16	0.005	1510
17	0.005	1525
18	0.004	1527
19	0.004	1524
20	0.003	1515
21	0.003	1482
22	0.003	1497
23	0.002	1510
24	0.002	1528
	0.005	1514

OK 9-18-90 MW

PEI ASSOCIATES
VELOCITY DETERMI

PLANT : Disposal Specialists, Inc.
SAMPLE LOCATION : Flare Stack

Run No:	D2-O-5	D2-O-6
STACK PRESSURE, in Hg :	29.90	29.80
STACK TEMP., deg. F :	1505	1514
MOLECULAR WEIGHT, DRY :	29.74	29.65
MOLECULAR WEIGHT, STACK :	28.93	29.12
AVG. SQRT. VELOCITY HEAD :	0.07	0.07
VELOCITY, fps :	7.93	7.23
ACTUAL CUBIC FEET/ MINUTE :	21715	19807
)RY STANDARD CUBIC FEET/ MINUTE :	5427	5040

validated 3/13/90

Moisture and Vmstd Calculations

Plant: Disposal Specialists **Date:** 8/9-10/1990

Run No.	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm °F	Vlc ml	Vmstd scf	Moisture %
D8-O-1	46.029	0.989	29.64	1.46	109	3.3	42.005	0.37
D8-O-2	37.654	0.989	29.90	1.00	95	56.0	35.523	6.91
D8-O-3	38.157	0.989	29.90	1.00	102	56.6	35.528	6.98
							37.685	**4.75**

OK 9-18-90 JMW

validated 3/13/90

Moisture and Vmstd Calculations

Plant: Disposal Specialists **Date:** 8/9-10/1990

Run No.	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm ° F	Vlc ml	Vmstd scf	Moisture %
D26-1	47.430	1.013	29.64	1.75	106	45.7	44.627	4.60
D26-2	46.066	1.013	29.90	1.75	94	3.2	44.650	0.34
D26-3	46.640	1.013	29.90	1.75	104	19.8	44.404	2.06
							44.560	**2.33**

OK 9-18-90 MM

validated 3/13/90

Moisture and Vmstd Calculations

Plant: Disposal Specialists **Date:** 8/9/90

Run No.	Vm cu-ft	Y	Pbar in. Hg	ΔH in. H2O	Tm ° F	Vlc ml	Vmstd scf	Moisture %
D4-O-1	35.118	1.013	30.06	1.75	107	31.9	33.407	4.30
D4-O-2	35.635	1.013	29.75	1.75	118	18.5	32.919	2.58
D4-O-3	34.159	1.013	29.50	1.75	128	6.4	30.769	0.97
							32.365	**2.62**

9-18-90

EMISSION CALCULATIONS

lient Disposal Specialists
ocation Rockingham Flare Inlet
oject Molecular Weight Inlet Flue Gas

PN 50016 Sheet No. 1 of 1
Checked By DH Date 9-21-90
Computed By [illegible] Date 9-14-90

Molecular Weight , lb/lb-mole

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

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*

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

RESULTS:

$$D25-I-1 = \left(42.3 \times \frac{16}{100}\right) + \left(20.4 \times \frac{28}{100}\right) + \left(5.4 \times \frac{32}{100}\right) + \left(31.9 \times \frac{44}{100}\right) = 28.24$$

$$D25-I-2 = \left(44.2 \times \frac{16}{100}\right) + \left(19.3 \times \frac{28}{100}\right) + \left(3.0 \times \frac{32}{100}\right) + \left(33.5 \times \frac{44}{100}\right) = 28.18$$

$$D25-I-3 = \left(43.6 \times \frac{16}{100}\right) + \left(23.2 \times \frac{28}{100}\right) + \left(3.2 \times \frac{32}{100}\right) + \left(30.0 \times \frac{44}{100}\right) = 27.70$$

Average = 28.04 lb/lb-mole

EMISSION FLOW RATE CALCULATIONS

Client Disposal Specialists
Location Rockingham Flare Stack
Subject Flow Rate by Carbon Balance

PN 50016 Sheet No. 1 of 1
Checked By DH Date 9/21/90
Computed By [signature] Date 9-14-90

Flare Flow Rate by Carbon Balance

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

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.*

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

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

RESULTS:

$$D3-O-1 = (503)\frac{(318+43.4)}{8.5} = 4,450$$

$$D3-O-2 = (503)\frac{(318+43.4)}{9.2} = 4,110$$

$$D3-O-3 = (503)\frac{(318+43.4)}{9.5} = 3,980$$

Average = 4,450 dcsfm ✓

$$D3-O-4 = (503)\frac{(318+43.4)}{9.0} = 4,200$$

$$D3-O-5 = (503)\frac{(318+43.4)}{8.0} = 4,730$$

$$D3-O-6 = (503)\frac{(318+43.4)}{7.2} = 5,250$$

H2SO4 AND SO2 EMISSIONS CALCULATIONS

Plant: Disposal Specialists, Inc. **Sampling location:** Flare Stack **Date:** 8/9/90

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
D8-O-1	1845-1945	46.029	0.989	29.64	1.46	108.7	42.021	0.00	0.01	250	0.0096	100	0.00	4450	0.000
D8-O-1	1845-1945	46.029	0.989	29.64	1.46	108.7	42.021	0.11	0.01	1000	0.0096	10	0.97	4450	0.043
Average															
D8-O-2	0839-0939	37.654	0.989	29.90	1.00	94.5	35.523	0.19	0.01	250	0.0096	100	1.86	4450	0.126
D8-O-2	0839-0939	37.654	0.989	29.90	1.00	94.5	35.523	0.19	0.01	1000	0.0096	10	2.06	4450	0.092
Average															
D8-O-3	1000-1100	38.157	0.989	29.90	1.00	101.8	36.530	5.00	0.01	250	0.0096	100	1.43	4450	0.097
D8-O-3	1000-1100	38.157	0.989	29.90	1.00	101.8	36.530	0.27	0.01	1000	0.0096	10	2.98	4450	0.132
Average															

3-RUN AVERAGE		
H2SO4		
SO2	1.10	0.074
	2.01	0.089

OK 4-18-90 MW

EMISSION RATE CALCULATIONS

Client Disposal Specialists
Location Rockingham Flare Stack
Subject Acetone & MEK Emissions

PN 50016 Sheet No. 1 of 1
Checked By MW Date
Computed By [signature] Date 9-14-90

Acetone and Methyethyl Ketone (MEK) Mass Emission Rate

$$pmr = \left(\frac{(M_n)(28.32)(Q_{std})(60)}{(V_{m_{std}})(453.6 \times 10^6)} \right)$$

where:

pmr = Pollutant mass emission rate, lb/h.
M_n = Mass of pollutant collected, µg.
28.32 = Conversion factor, liters per cubic foot.
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, liters.
453.6×10^6 = Conversion factor, micrograms per pound.

FLARE INLET RESULTS:

D18-I-1

$$\text{ACETONE} = \frac{(570)(28.32)(503)(60)}{(6.255)(453.6 \times 10^6)} = 0.1717$$

$$\text{MEK} = \frac{(190)(28.32)(503)(60)}{(6.255)(453.6 \times 10^6)} = 0.0572$$

D18-I-2

$$\text{ACETONE} = \frac{(550)(28.32)(503)(60)}{(6.221)(453.6 \times 10^6)} = 0.1666$$

$$\text{MEK} = \frac{(200)(28.32)(503)(60)}{(6.221)(453.6 \times 10^6)} = 0.0606$$

D18-I-3

$$\text{ACETONE} = \frac{(530)(28.32)(503)(60)}{(6.073)(453.6 \times 10^6)} = 0.1644$$

$$\text{MEK} = \frac{(210)(28.32)(503)(60)}{(6.073)(453.6 \times 10^6)} = 0.0652$$

Average

Acetone mass emission rate: 0.1676 lb/h

MEK mass emission rate: 0.0610 lb/h

(continued)

FLARE OUTLET RESULTS:

D18-O-1

$$\text{ACETONE} = \frac{(<3)(28.32)(4450)(60)}{(4.593)(453.6 \times 10^6)} = <0.0109$$

$$\text{MEK} = \frac{(<3)(28.32)(4450)(60)}{(4.593)(453.6 \times 10^6)} = <0.0109$$

D18-O-2

$$\text{ACETONE} = \frac{(<3)(28.32)(4450)(60)}{(4.691)(453.6 \times 10^6)} = <0.0107$$

$$\text{MEK} = \frac{(<3)(28.32)(4450)(60)}{(4.691)(453.6 \times 10^6)} = <0.0107$$

Average

Acetone mass emission rate: <0.0114 lb/h

MEK mass emission rate: <0.0114 lb/h

D18-O-3

$$\text{ACETONE} = \frac{(<3)(28.32)(4450)(60)}{(3.997)(453.6 \times 10^6)} = <0.0125$$

$$\text{MEK} = \frac{(<3)(28.32)(4450)(60)}{(3.997)(453.6 \times 10^6)} = <0.0125$$

Concentration conversion micrograms per cubic meter to parts per million

$$ppm = \left(\frac{M_n}{V_{m_{std}}}\right) \times \left(\frac{24.04}{MW}\right)$$

where:

ppm = Parts per million

M_n = Mass of pollutant collected, µg.

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

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

MW = Molecular weight, µg/µg-mole (Acetone = 58.08, MEK = 72.10)

INLET

D18-I-1

$$\text{ACETONE} = \left(\frac{570}{6.255}\right) \times \left(\frac{24.04}{58.08}\right) = 37.7$$

$$\text{MEK} = \left(\frac{190}{6.255}\right) \times \left(\frac{24.04}{72.10}\right) = 10.1$$

D18-I-2

$$\text{ACETONE} = \left(\frac{550}{6.221}\right) \times \left(\frac{24.04}{58.08}\right) = 36.6$$

$$\text{MEK} = \left(\frac{200}{6.221}\right) \times \left(\frac{24.04}{72.10}\right) = 10.7$$

(continued)

EMISSION RATE CALCULATIONS

D18-I-3

$$\text{ACETONE} = \left(\frac{530}{6.073}\right) \times \left(\frac{24.04}{58.08}\right) = 36.1$$

$$\text{MEK} = \left(\frac{210}{6.073}\right) \times \left(\frac{24.04}{72.10}\right) = 115$$

Average Inlet Acetone ppm = 36.8

Average Inlet MEK ppm = 10.8

Outlet

D18-O-1

$$\text{ACETONE} = \left(\frac{< 3}{4.593}\right) \times \left(\frac{24.04}{58.08}\right) = < 0.27$$

$$\text{MEK} = \left(\frac{< 3}{4.593}\right) \times \left(\frac{24.04}{72.10}\right) = < 0.22$$

D18-O-2

$$\text{ACETONE} = \left(\frac{< 3}{4.691}\right) \times \left(\frac{24.04}{58.08}\right) = < 0.26$$

$$\text{MEK} = \left(\frac{< 3}{4.691}\right) \times \left(\frac{24.04}{72.10}\right) = < 0.21$$

D18-O-3

$$\text{ACETONE} = \left(\frac{< 3}{3.997}\right) \times \left(\frac{24.04}{58.08}\right) = < 0.31$$

$$\text{MEK} = \left(\frac{< 3}{3.997}\right) \times \left(\frac{24.04}{72.10}\right) = < 0.25$$

Average Outlet Acetone ppm = <0.28

Average Outlet MEK ppm = <0.23

EMISSION RATE CALCULATIONS

Client Disposal Specialists
Location Rockingham Flare Stack
Subject Acrylonitrile Emissions

PN 50016 Sheet No. 1 of 2
Checked By ____ Date ____
Computed By [signature] Date 5-17-90

Acrylonitrile Mass Emission Rate

$$pmr = \left(\frac{(M_n)(28.32)(Q_{std})(60)}{(V_{m_{std}})(453.6 \times 10^6)} \right)$$

where:

pmr = Pollutant mass emission rate, lb/h.
M_n = Mass of pollutant collected, µg.
28.32 = Conversion factor, liters per cubic foot.
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, liters.
453.6×10^6 = Conversion factor, micrograms per pound.

FLARE INLET RESULTS:

$$DA-I-1 = \frac{(1300)(28.32)(503)(60)}{(25.143)(453.6 \times 10^6)} = 0.0974$$

$$DA-I-2 = \frac{(2200)(28.32)(503)(60)}{(49.964)(453.6 \times 10^6)} = 0.0830$$

$$DA-I-3 = \frac{(2200)(28.32)(503)(60)}{(48.352)(453.6 \times 10^6)} = 0.0857$$

Average

Mass emission rate: 0.0887 lb/h

FLARE OUTLET RESULTS:

$$DA-O-1 = \frac{(< 5)(28.32)(4450)(60)}{(18.517)(453.6 \times 10^6)} = < 0.00450$$

$$DA-O-2 = \frac{(< 5)(28.32)(4450)(60)}{(43.836)(453.6 \times 10^6)} = < 0.00190$$

(continued)

Average

$$DA-O-3=\frac{(<5)(28.32)(4450)(60)}{(42.132)(453.6\times10^{6})}=<0.00198$$

Mass emission rate= <0.00279

Concentration conversion micrograms per cubic meter to parts per million

$$ppm=\left(\frac{M_n}{V_{m_{std}}}\right)\times\left(\frac{24.04}{MW}\right)$$

where:

ppm = Parts per million

M_n = Mass of pollutant collected, µg.

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

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

MW = Molecular weight of acrylonitrile, 53.06 µg/µg-mole

INLET

$$DA-1-1=\left(\frac{1300}{25.143}\right)\times\left(\frac{24.04}{53.06}\right)=23.4$$

$$DA-1-2=\left(\frac{2200}{49.964}\right)\times\left(\frac{24.04}{53.06}\right)=19.9$$

$$DA-1-3=\left(\frac{2200}{48.352}\right)\times\left(\frac{24.04}{53.06}\right)=20.6$$

Average Inlet ppm = 21.3

OUTLET

$$DA-O-1=\left(\frac{<5}{18.517}\right)\times\left(\frac{24.04}{53.06}\right)=<0.122$$

$$DA-O-2=\left(\frac{<5}{43.836}\right)\times\left(\frac{24.04}{53.06}\right)=<0.0517$$

$$DA-O-3=\left(\frac{<5}{42.132}\right)\times\left(\frac{24.04}{53.06}\right)=<0.0538$$

Average Outlet ppm = <0.0758

EMISSION RATE CALCULATIONS

Client Disposal Specialists
ocation Rockingham Flare Inlet
ubject Method 25 Results - NMO

PN 50016 Sheet No. 1
Checked By Date
Computed By Date 9-12-90

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:

$$D25-I-1 = (503)(60)\frac{(840)(12)}{(385.1\times 10^6)} = 0.790 lb/h$$

$$D25-I-2 = (503)(60)\frac{(734)(12)}{(385.1\times 10^6)} = 0.690 lb/h$$

$$D25-I-3 = (503)(60)\frac{(753)(12)}{(385.1\times 10^6)} = 0.708 lb/h$$

EMISSION RATE CALCULATIONS

Client Disposal Specialists
Location Rockingham Flare Outlet
Subject Method 25 Results - NMO

PN 50016 Sheet No. ___
Checked By ___ Date ___
Computed By ___ Date 8-19-96

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:

$$D25-O-1 = (4,450)(60)\frac{(<2)(12)}{(385.1\times 10^6)} = <0.0166 lb/h$$

$$D25-O-2 = (4,450)(60)\frac{(<2)(12)}{(385.1\times 10^6)} = <0.0166 lb/h$$

$$D25-O-3 = (4,450)(60)\frac{(<2)(12)}{(385.1\times 10^6)} = <0.0166 lb/h$$

Client Disposal Specialists

Location Rockingham Flare

Subject NMO Removal Efficiency as Carbon

PN 50016 Sheet No. 1 of 1

Checked By _____ Date _____

Computed By _____ Date 9-19-90

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:

$$\%DRE(D25-1-1/D25-O-1) = \frac{0.790 - < 0.0166}{0.790} \times 100 = > 97.9$$

$$\%DRE(D25-1-2/D25-O-2) = \frac{0.690 - < 0.0166}{0.690} \times 100 = > 97.6$$

$$\%DRE(D25-1-3/D25-O-3) = \frac{0.708 - < 0.0166}{0.708} \times 100 = > 97.7$$

VOLATILE ORGANIC EMISSIONS CALCULATIONS

PLANT: Disposal Specialists, Inc. **DATE:** 8/9/90

SAMPLE LOCATION: Flare Inlet

POHC	Pollutant Concentration, ug/m3 RUNS D25-I-1	D25-I-2	D25-I-3	AVERAGE	Volumetric Flow, dscfm 503	503	503	Emission Rate, lb/h RUNS D25-I-1	D25-I-2	D25-I-3	AVERAGE
VINYL CHLORIDE	60,000	60,000	55,000	58,333				0.1131	0.1131	0.1036	0.1099
METHYLENE CHLORIDE	79,000	85,000	100,000	88,000				0.1489	0.1602	0.1884	0.1658
1,1-DICHLOROETHANE	170,000	190,000	180,000	180,000				0.3203	0.3580	0.3392	0.3392
1,2-DICHLOROETHENE (TOTAL)	120,000	130,000	120,000	123,333				0.2261	0.2450	0.2261	0.2324
CHLOROFORM	<1,880	<1,990	<1,930	<1,933				<0.0035	<0.0037	<0.0036	<0.0036
1,1,1-TRICHLOROETHANE	47,000	41,000	43,000	43,667				0.0886	0.0773	0.0810	0.0823
CARBON TETRACHLORIDE	<1,880	<1,990	<1,930	<1,933				<0.0035	<0.0037	<0.0036	<0.0036
TRICHLOROETHENE	30,000	28,000	28,000	28,667				0.0565	0.0528	0.0528	0.0540
BENZENE	4,300	3,900	4,300	4,167				0.0081	0.0073	0.0081	0.0079
TETRACHLOROETHENE	58,000	63,000	65,000	62,000				0.1093	0.1187	0.1225	0.1168
1,1,2,2-TETRACHLOROETHANE	<1,880	<1,990	<1,930	<1,933				<0.0035	<0.0037	<0.0036	<0.0036
TOLUENE	390,000	380,000	370,000	380,000				0.7349	0.7160	0.6972	0.7160
CHLOROBENZENE	<1,880	<1,990	<1,930	<1,933				<0.0035	<0.0037	<0.0036	<0.0036
ETHYL BENZENE	34,000	36,000	36,000	35,333				0.0641	0.0678	0.0678	0.0666
TOTAL XYLENES	99,000	110,000	110,000	106,333				0.1865	0.2073	0.2073	0.2004

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

9-18-90 MW

VOLATILE ORGANIC EMISSIONS CALCULATIONS

PLANT: Disposal Specialists, Inc. **DATE:** 8/9/90

SAMPLE LOCATION: Flare Stack

	Pollutant Concentration, µg/m3				Volumetric Flow, dscfm			
					4,450	4,450	4,450	
	RUNS			AVERAGE	Emission Rate, lb/h			
					RUNS			AVERAGE
POHC	D25-O-1	D25-O-2	D25-O-3		D25-O-1	D25-O-2	D25-O-3	
VINYL CHLORIDE	<144	<156	<164	<155	<0.0024	<0.0026	<0.0027	<0.0026
METHYLENE CHLORIDE	9,900	20,000	16,000	15,300	0.1650	0.3334	0.2667	0.2551
1,1-DICHLOROETHANE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
1,2-DICHLOROETHENE (TOTAL)	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
CHLOROFORM	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
1,1,1-TRICHLOROETHANE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
CARBON TETRACHLORIDE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
TRICHLOROETHENE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
BENZENE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
TETRACHLOROETHENE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
1,1,2,2-TETRACHLOROETHANE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
TOLUENE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
CHLOROBENZENE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
ETHYL BENZENE	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013
TOTAL XYLENES	<72	<78	<82	<77	<0.0012	<0.0013	<0.0014	<0.0013

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

OK 9-18-90 MW

Client Disposal Specialists
Location Rockingham Flare
Subject Toluene Removal Efficiency

PN 50016 Sheet No. 1 of 1
Checked By [illegible] Date
Computed By [illegible] Date 5-18-90

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

$$\%DRE(D25-1-1/D25-O-1) = \frac{0.7349 - < 0.0012}{0.7349} \times 100 = > 99.8$$

$$\%DRE(D25-1-2/D25-O-2) = \frac{0.7160 - < 0.0013}{0.7160} \times 100 = > 99.8$$

$$\%DRE(D25-1-3/D25-O-3) = \frac{0.6972 - < 0.0014}{0.6972} \times 100 = > 99.8$$

EMISSION RATE CALCULATIONS

Concentration conversion micrograms per cubic foot to parts per million

$$ppm = \frac{(M_n)(35.315)(24.04)}{(V_{m_{std}})(1000)(MW)}$$

where:

ppm = Parts per million

M_n = Mass of pollutant collected, µg.

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.

1000 = Conversion factor, micrograms per milligram.

MW = Molecular weight, µg/µg-mole (HCl = 36.47, HF = 20.01)

STACK

D26-1

$$HCl = \frac{(<500)(35.315)(24.04)}{(44.627)(1000)(36.47)} = <0.261$$

$$HF = \frac{(<5000)(35.315)(24.04)}{(44.627)(1000)(20.01)} = <4.75$$

D26-2

$$HCl = \frac{(<600)(35.315)(24.04)}{(44.650)(1000)(36.47)} = <0.313$$

$$HF = \frac{(<6000)(35.315)(24.04)}{(44.650)(1000)(20.01)} = <5.70$$

D26-3

$$HCl = \frac{(<500)(35.315)(24.04)}{(44.404)(1000)(36.47)} = <0.262$$

$$HF = \frac{(<5000)(35.315)(24.04)}{(44.404)(1000)(20.01)} = <4.78$$

Average Stack HCl ppm = **<0.279**

Average Inlet HF ppm = **<5.08**

EMISSION RATE CALCULATIONS

Client Disposal Specialists | PN 50016 | Sheet No. 1 of 2
Location Rockingham Flare Stack | Checked By [illegible] | Date 9-22-92
Subject HCl and HF Emissions | Computed By [illegible] | Date 9-17-92

Hydrochloric acid (HCl) and Hydrofluoric acid (HF) Mass Emission Rate

$$pmr = \left(\frac{(M_n)(Q_{std})(60)}{(V_{m_{std}})(453.6 \times 10^6)} \right)$$

where:

pmr = Pollutant mass emission rate, lb/h.
M_n = Mass of pollutant collected, µg.
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.
453.6×10^6 = Conversion factor, micrograms per pound.

FLARE STACK RESULTS:

D26-1

$$HCl = \frac{(< 500)(4450)(60)}{(44.627)(453.6 \times 10^6)} = < 0.0066$$

$$HF = \frac{(< 5000)(4450)(60)}{(44.627)(453.6 \times 10^6)} = < 0.066$$

D26-2

$$HCl = \frac{(< 600)(4450)(60)}{(44.650)(453.6 \times 10^6)} = < 0.0079$$

$$HF = \frac{(< 6000)(4450)(60)}{(44.650)(453.6 \times 10^6)} = < 0.079$$

D26-3

$$HCl = \frac{(< 500)(4450)(60)}{(44.404)(453.6 \times 10^6)} = < 0.0066$$

$$HF = \frac{(< 5000)(4450)(60)}{(44.404)(453.6 \times 10^6)} = < 0.066$$

Average

HCl mass emission rate: **<0.0070 lb/h**

HF mass emission rate: **<0.070 lb/h**

APPENDIX B

FIELD DATA

THERMOCOUPLE DIGITAL INDICATOR
AUDIT DATA SHEET

Date 9/8/90 Indicator No. FT-3 Operator R. Kolde

Test Point No.	Millivolt signal*	Equivalent temperature, °F*	Digital indicator temperature reading, °F	Difference, %
1		0	1	-.22
2		100	101	-.18
3		500	502	-.10
4		1500	1503	-.14

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: 8/8/90 CLIENT: Disposal Specialist

BAROMETRIC PRESSURE (P_{bar}): 29.50 in.Hg METER BOX NO. ET-3

ORIFICE NO. 10 PRETEST Y: 1.013 ΔH@ 1.75 in.H_2O

ORIFICE K FACTOR: 4.715×10^{-4} AUDITOR: R. Kuhl

Orifice manometer reading ΔH, in.H_2O	Dry gas meter reading V_i/V_f, ft³	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.
1.85	058.000	85	85 °F	102	99	100.5	12.93.15
	068.000	85	545	102	99	560.5 °R	

Dry gas meter V_m, ft³	$V_{m_{std}}$, ft³	$V_{m_{act}}$, ft³	Audit, Y	Y deviation, %	Audit ΔH@, in.H_2O	ΔH@ Deviation, in.H_2O
10.000	9.330	9.117	.977	-3.5	1.87	.12

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

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

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

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

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.

THERMOCOUPLE DIGITAL INDICATOR
AUDIT DATA SHEET

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

Test Point No.	Millivolt signal*	Equivalent temperature, °F*	Digital indicator temperature reading, °F	Difference, %
1		0	-1	-.22
2		100	99	.18
3		500	500	0
4		1500	1503	-.14

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: 8/8/90 CLIENT: Disposal Specialists

BAROMETRIC PRESSURE (P_{bar}): 29.50 in.Hg METER BOX NO. FT-7

ORIFICE NO. 10 PRETEST Y: .989 ΔH@ 1.46 in.H_2O

ORIFICE K FACTOR: 4.715 x10-4 AUDITOR: R. Kell

Orifice manometer reading ΔH, in.H_2O	Dry gas meter reading V_i/V_f, ft³	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.
1.55	959.000	82	82	100	100	100	
	969.500	82	542°R	100	100	560°R	13.31.50

Dry gas meter V_m, ft³	$V_{m_{std}}$, ft³	$V_{m_{act}}$, ft³	Audit, Y	Y deviation, %	Audit ΔH@, in.H_2O	ΔH@ Deviation, in.H_2O
10.500	9.801	9.725	.992	.30	1.56	.10

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

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

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

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

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.

LOW FLOW DRY GAS METER AUDIT DATA SHEET

COMPANY: Disposal Specialists

CITY: Rockingham Vt.

DATE: 8/8/90

LOCATION: Flare Outlet

METER NO: UB-1

PRE-TEST Y: .995

ROTOMETER SETTING: 11/28

NOMINAL FLOW RATE: .5 l/min .2 l/min

OPERATOR: R. Kolodi

BUBBLE METER CONDITIONS

temp. (T_{bm}) ~~80~~ 80 °F

bubble meter readings (Q_{bm}) (liters/minute)

1: 188.5 l/min 5: 196.7 l/min

2: 189.3 l/min 6: 190.5 l/min

3: 189.3 l/min 7: 206.9 l/min

4: 189.0 l/min Avg: 152.8 l/min

DRY GAS METER CONDITIONS

volume initial (V_{mi}): 1201 liters

volume final (V_{mf}): 1204 liters

temp. initial (T_{dgmi}): 63 °F

temp. final (T_{dgmf}): 166 °F

temp. avg. (T_{dgm}): 104.5 °F

time$_{dgm}$: 14.18.33 min.

AUDIT Y = .962

% DIFFERENCE = -3.32%

DRY GAS METER FLOW RATE

$$Q_{dgm} = \frac{(V_{mf} - V_{mi})(T_{bm} + 460)}{(\text{avg.}T_{dgm} + 460)(\text{time}_{dgm})}$$

AUDIT Y

$$Y_{AUDIT} = \frac{Q_{bm}}{Q_{dgm}}$$

% DIFFERENCE

$$\%\text{DIFFERENCE} = \left(\frac{Y_{AUDIT} - Y_{PRETEST}}{Y_{PRETEST}}\right) \times 100$$

LOW FLOW DRY GAS METER AUDIT DATA SHEET

COMPANY: Disposal Specialists CITY: Rockingham, Vt.

DATE: 8-8-90 LOCATION: 0.998 Flare Inlet

METER NO: VB-3 PRE-TEST Y: 0.998

ROTOMETER SETTING: 15 NOMINAL FLOW RATE: 0.20 cfm

OPERATOR: D. Fitzgerald

BUBBLE METER CONDITIONS

temp. (T_{bm}) 68 *°F (78)

bubble meter readings (Q_{bm}) (liters/minute)

1: 0.210 l/min 5: 0.214 l/min

2: 0.214 l/min 6: 0.212 l/min

3: 0.214 l/min 7: 0.213 l/min

4: 0.214 l/min Avg: 0.213 l/min

DRY GAS METER CONDITIONS

volume initial (V_{mi}): 63.200 liters

volume final (V_{mf}): 70.900 liters

temp. initial (T_{dgmi}): 139 °F

temp. final (T_{dgmf}): 135 °F

temp. avg. (T_{dgm}): 137 °F

$time_{dgm}$: 33.43 min.

AUDIT Y = 1.060

% DIFFERENCE = 6.2

DRY GAS METER FLOW RATE

$$Q_{dgm} = \frac{(V_{mf} - V_{mi})(T_{bm} + 460)(29.50)}{(avg.T_{dgm} + 460)(time_{dgm})(29.92)} = 0.201$$

AUDIT Y

$$Y_{AUDIT} = \frac{Q_{bm}}{Q_{dgm}}$$

% DIFFERENCE

$$\%\,DIFFERENCE = \left(\frac{Y_{AUDIT} - Y_{PRETEST}}{Y_{PRETEST}}\right) \times 100$$

*Standard Temp.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant Disposal Specialists Rockingham, Vt.

Date 8/8/90

Sampling location Flare Outlet

Inside of far wall to outside of nipple 99"

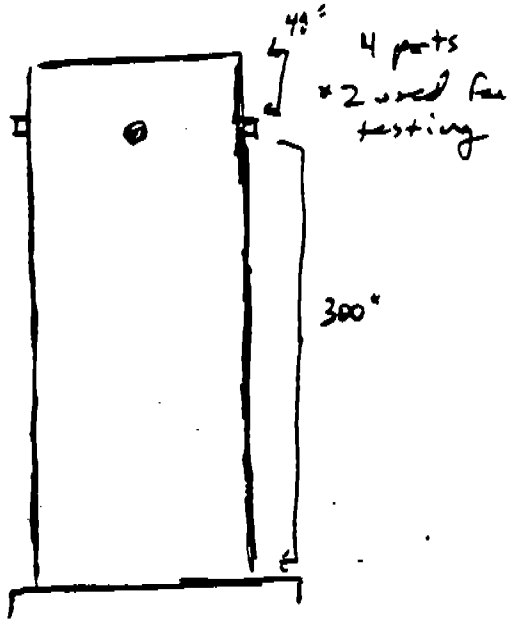
Inside of near wall to outside of nipple (nipple length) 7.5"

Stack I.D. 91.5"

Nearest upstream disturbance 3.3 dd

Nearest downstream disturbance 0.5 dd

Calculated by R. Kobb



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"	7.5"	9 3/8"
2	0.067		6 1/8"		13 5/8"
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 1/8"		92 7/8"
12	0.979		89 5/8"		97 1/8"

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISPOSAL SPECIALIST-ROCKINGHAM, VT. Date 8-9-90

Sampling Location FLARE INLET Clock Time 0930

Run No. D2-I-1 Operator D. FITZGERALD / R KOLBE

Barometric Pressure, in.Hg 29.98 Static Pressure, in.H_2O 10

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 73/4 ~~Side 2~~ →

DRY BULB = 100°F
WET BULB = 82°F

PITOT # 301
~~THERMO # 6416~~
DIGITAC # VB-3

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.165	97
2	0.205	98
3	0.250	99
4	0.250	100
5	0.250	100
6	0.245	100
W-7	0.170	99
8	0.195	99
9	0.225	100
10	0.260	100
11	0.260	100
12	0.260	100

CALCULATIONS

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

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

$M_s =$

$T_s = 99.3\ °F = 559.3\ °R = (°F + 460)$

$P_s = P_b + \frac{s.p.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ in.Hg

$\sqrt{\Delta P} = 0.4760$

$V_s = 85.49 \times Co \times \sqrt{\Delta P} \times \sqrt{\frac{T_s \times \quad}{P_s \times M_s}}$

$V_s = 85.49 \times (\quad) \times (0.4760) \times \sqrt{\frac{\quad}{\quad}}$

$V_s =$ 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

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant DISPOSAL SPECIALISTS - ROCKINGHAM, VT.

Date 8-8-90

Sampling location FLARE INLET

Inside of far wall to outside of nipple 8 1/4"

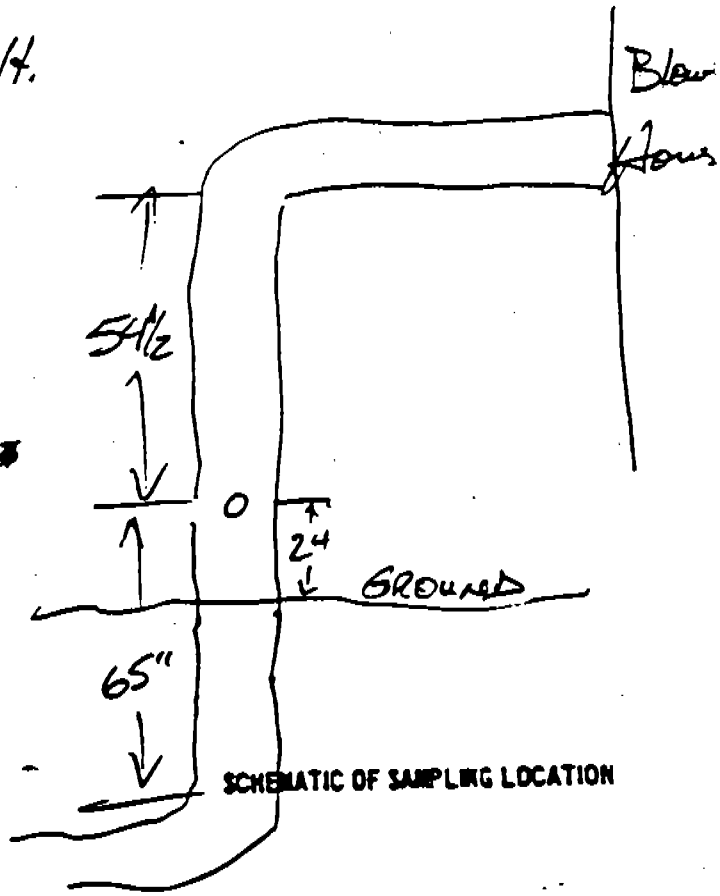
Inside of near wall to outside of nipple (nipple length) 1/2"

Stack I.D. 73/4"

Nearest upstream disturbance 54 1/2 dd 7.0

Nearest downstream disturbance 65" dd 8.4

Calculated by D FITZGERALD



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	0.044	↑	1/2	↑	1
2	0.146		1 1/8		1 5/8
3	0.296	7 3/4	2 1/4	1/2"	2 3/4
4	0.704		5 1/2		6
5	0.854		6 5/8		7 1/8
6	0.956	↓	7 1/4	↓	7 3/4

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISPOSAL SPECIALIST - ROCKINGHAM, VA. Date 8-9-90

Sampling Location FLARE INLET Clock Time 1155

Run No. D2-T-2 Operator D. FITZGERALD / R. KOLBE

Barometric Pressure, in.Hg 29.75 Static Pressure, in.H_2O + 1.2

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 75/4" ~~Side 2~~ ~~5~~

DRY BULB = 103°F

WET BULB = 83°F

PITOT #307

THERM #646

DIGITAL #VB-3

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.120	103
2	0.200	104
3	0.245	104
4	0.255	104
5	0.240	104
6	0.240	104
W-7	0.175	103
8	0.200	104
9	0.240	104
10	0.270	104
11	0.270	104
12	0.270	105

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

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

$Q_s =$ x x 60

$Q_s =$ acfm

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

$Q_{s\,std} =$ 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 DISPOSAL SPECIALISTS - ROCKINGHAM, VA Date 8-9-90

Sampling Location FLARE INLET Clock Time 1443

Run No. D2-I-3 Operator D FITZGERALD / R. KOLDE

Barometric Pressure, in.Hg 29.50 Static Pressure, in.H_2O +1.2

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 7 3/4 ~~Side 2 →~~

PITOT # 301
THERM # 646
DIGITAL # VB-3

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
5-1	0.205	107
2	0.225	107
3	0.250	107
4	0.250	107
5	0.245	107
6	0.230	107
6-7	0.170	106
8	0.220	106
9	0.260	106
10	0.290	106
11	0.270	106
12	0.270	107

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

$\sqrt{\Delta P} =$

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

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

$V_s =$ FT/S

$A_s =$ FT²

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

$Q_s =$ × × 60

$Q_s =$ acfm

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

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

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISPOSAL SPECIALIST - ROCKINGHAM, VA. Date 8-9-90

Sampling Location FLARE INLET Clock Time 2015

Run No. D2-4 Operator D. FITZGERALD / R. KOLBE

Barometric Pressure, in.Hg 29.64 Static Pressure, in.H_2O +1.12

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 73/4 ~~Side 2~~ _____

PITOT # 301

THERM # 646

DIGITAL # VB-3

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.175	105
2	0.200	105
3	0.245	105
4	0.245	105
5	0.245	105
6	0.240	105
W-1	0.150	105
8	0.180	105
9	0.220	105
10	0.245	105
11	0.260	105
12	0.260	105

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 $= (°F + 460)$

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

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

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

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

$V_s =$ ft/s

$A_s =$ ft²

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

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

$Q_s =$ acfm

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

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

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISPOSAL SPECIALIST - ROCKINGHAM VT. Date 8-10-90

Sampling Location FLARE INLET Clock Time 0806

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

Barometric Pressure, in.Hg 29.90 Static Pressure, in.H_2O +1.10

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 73/4 Side 2 ——>

DRY BULB = 101 °F

WET BULB = 85°F

DIGITAL #VB3

PITOT # 301

THERM #646

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
7-1	0.195	100
2	0.225	100
3	0.240	100
4	0.240	100
5	0.240	100
6	0.240	100
6-7	0.170	100
8	0.150	100
9	0.205	100
10	0.245	100
11	0.245	100
12	0.255	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 DISPOSAL SPECIALIST - ROCKINGHAM, VA Date 8-10-90

Sampling Location FLARE INLET

Run No. ~~D3-I-6~~ D3-I-6 Clock Time 1125

Barometric Pressure, in.Hg 29.80 Operator D. FITZGERALD / R. KOLBE

Moisture, % _____ Molecular wt., Dry _____ Static Pressure, in.H_2O -1.16

Stack Dimension, in. Diameter or Side 1 7 3/4 Side 2 _____ Pitot Tube, Cp 0.84

DIGITAL # VB-3

PITOT # 301

THERM # 6446

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
S-1	0.190	102
2	0.230	102
3	0.250	102
4	0.250	102
5	0.250	102
6	0.245	102
W-7	0.170	102
8	0.215	102
9	0.240	102
10	0.250	102
11	0.265	102
12	0.265	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)

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

$P_s =$ in.Hg

$\sqrt{\Delta P} =$

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

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

$V_s =$ 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 DISPOSAL SPECIALIST-ROCKINGHAM Date 8-9-90

Sampling Location FLARE STACK Clock Time 0905-0921

Run No. D2-0-1 Operator D.FITZGERALD/R.KOBE

Barometric Pressure, in.Hg 29.98 Static Pressure, in.H_2O -0.050

Moisture, % 4* Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 91½ ~~Side 2~~

* ASSUMED

PITOT #523
THERM #734
DIGITAL #FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
~~EAST (x)~~ - 1	0.005	1626
2	0.004	1645
3	0.005	1651
4	0.005	1651
5	0.005	1657
6	0.005	1637
7	0.007	1670
8	0.006	1684
9	0.005	1700
10	0.005	1697
11	0.004	1703
12	0.003	1717
5-13	0.002	1574
14	0.003	1637
15	0.004	1670
16	0.004	1697
17	0.003	1661
18	0.003	1657
19	0.004	1686
20	0.006	1690
21	0.008	1708
22	0.011	1723
23	0.011	1723
24	0.005	1727

CALCULATIONS

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

$M_s = (29.73) \times (1 - \frac{4}{100}) + 18 (\frac{4}{100})$

$M_s = 29.26$

$T_s = 1677\ °F = 2137\ °R = (°F + 460)$

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

$P_s = 29.98$ in.Hg

$\sqrt{\Delta P} = \sqrt{0.1403} = 0.0701$

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

$V_s = 85.49 \times (0.84) \times (0.0701) \times \sqrt{\frac{2137}{29.98 \times 29.26}}$

$V_s = 7.863$ ~~15.735~~ ft/s

$A_s = 45.66$ ft²

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

$Q_s = 7.863 \times 45.66 \times 60$

$Q_s = 21,540$ acfm

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

$Q_{s_{std}} = 21,540 \times 17.647 \times \frac{29.98}{2137} \times (1 - \frac{4}{100})$

$Q_{s_{std}} = 5,120$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISPOSAL SPECIALIST ROCKINGHAM VA. Date 8-9-90

Sampling Location FLARE STACK Clock Time 1210

Run No. D2-0-2 Operator D.FITZGERALD/R.KOUBA

Barometric Pressure, in.Hg 29.75 Static Pressure, in.H_2O -0.055

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 91½ Side 2 →

PITOT # 523

THERM # 734

DIGITAL # FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
W-1	0.004	1520
2	0.005	1572
3	0.005	1640
4	0.007	1679
5	0.008	1704
6	0.007	1704
7	0.008	1700
8	0.009	1721
9	0.010	1729
10	0.010	1729
11	0.010	1718
12	0.007	1717
S-13	0.005	1586
14	0.006	1620
15	0.004	1614
16	0.007	1669
17	0.007	1707
18	0.006	1708
19	0.008	1720
20	0.007	1727
21	0.009	1740
22	0.010	1753
23	0.010	1753
24	0.010	1746

CALCULATIONS

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

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

$M_s =$

$T_s = 1686$ °F $= 2146$ °R $= (°F + 460)$

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

$P_s =$ in.Hg

$\sqrt{\Delta P} = 0.0837$

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

$V_s = 85.49 \times (0.84) \times (0.0837) \times \sqrt{\frac{2146}{29.75 \cdot 29.26}}$

$V_s = 9.437$ ft/s

$A_s =$ ft²

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

$Q_s = 9.437 \times 45.66 \times 60$

$Q_s = 25,854$ acfm

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

$Q_{s\,std} = 25,854 \times 17.647 \times \frac{29.75}{2146} \times (1 - \frac{4}{100})$

$Q_{s\,std} = 6,070$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISPOSAL SPECIALISTS - ROCKINGHAM, VA. Date 9-5-90

Sampling Location FLARE STACK Clock Time 1450

Run No. D2-0-3 Operator D. FITZGERALD / R. FOLSE

Barometric Pressure, in.Hg 29.50 Static Pressure, in.H_2O -0.050

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 91/2 Side 2 →

PITOT # 523
THERM # 734
DIGITAL # FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
W-1	0.002	1330
2	0.003	1510
3	0.005	1630
4	0.005	1634
5	0.006	1655
6	0.006	1654
7	0.006	1666
8	0.005	1673
9	0.006	1690
10	0.005	1686
11	0.002	1670
12	0.002	1636
S-13	0.003	1400
14	0.005	1607
15	0.003	1606
16	0.003	1608
17	0.006	1607
18	0.007	1622
19	0.007	1642
20	0.011	1679
21	0.012	1674
22	0.011	1646
23	0.010	1638
24	0.002	1637

CALCULATIONS

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

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

$M_s =$

$T_s = 1618\ °F = 2078\ °R = (°F + 460)$

$P_s = P_b + \frac{5 P_g}{13.6} = (\quad) + \frac{\quad}{13.6}$

$P_s =$ _____ in.Hg

$\overline{\sqrt{\Delta P}} = 0.0722$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s \times 29}{P_s \times M_s}}$

$V_s = 85.49 \times (0.84) \times (0.0727) \times \sqrt{\frac{2078}{29.50 \times 29.26}}$

$V_s = 8.100$ ft/s

$A_s =$ _____ ft²

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

$Q_s = 8.100 \times 45.66 \times 60$

$Q_s = 22,192$ acfm

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

$Q_{s\,std} = 22,192 \times 17.647 \times \frac{29.50}{2078} \times (1 - \frac{4}{100})$

$Q_{s\,std} = 5,340$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City DISTRAL SPECIALTIES - ROCKINGHAM, VT Date 8-9-90

Sampling Location FLARE STACK Clock Time 2023

Run No. DZ-0-4 Operator D. FITZGERALD / R. KOLLE

Barometric Pressure, in.Hg 29.64 Static Pressure, in.H_2O -0.050

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp 0.84

Stack Dimension, in. Diameter or Side 1 41 1/2 ~~Side 2~~ →

DIGITAL #FT-7
PITOT #523
THERM #734

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
1	0.002	1360
2	0.006	1370
3	0.007	1434
4	0.008	1500
5	0.005	1533
6	0.006	1545
7	0.008	1565
8	0.007	1544
9	0.010	1543
10	0.010	1548
11	0.010	1552
12	0.005	1572
13	0.002	1350
14	0.003	1360
15	0.004	1400
16	0.004	1510
17	0.005	1508
18	0.007	1518
19	0.006	1531
20	0.005	1544
21	0.008	1530
22	0.005	1515
23	0.005	1527
24	0.002	1505

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

$\sqrt{\Delta P} =$

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

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

$V_s =$ ft/s

$A_s =$ ft²

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

$Q_s =$ × 60

$Q_s =$ acfm

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

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

$Q_{s_{std}} =$ dscfm

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant and City Disposal Specialists Date 8/10/90

Sampling Location Flare Outlet Clock Time 0817

Run No. D2-05 Operator D.F./R.K.

Barometric Pressure, in.Hg 29.90 Static Pressure, in.H_2O -0.045

Moisture, % _____ Molecular wt., Dry _____ Pitot Tube, Cp .84

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

Therm #734

Pitot #523

Digital #FT-7

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
W-1	0.003	1429
2	0.002	1437
3	0.003	1457
4	0.005	1496
5	0.007	1538
6	0.007	1529
7	0.007	1528
8	0.008	1533
9	0.008	1535
10	0.010	1555
11	0.010	1561
12	0.005	1584
S-1	0.002	1443
2	0.004	1464
3	0.004	1470
4	0.005	1478
5	0.005	1486
6	0.006	1503
7	0.006	1509
8	0.007	1513
9	0.006	1515
10	0.006	1519
11	0.005	1524
12	0.003	1525

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 DISPOSAL SPECIALIST - ROCKINGHAM, VT Date 8-10-90

Sampling Location FLARE STACK

Run No. DZ-0-6 Clock Time 1135

Barometric Pressure, in.Hg 29.80 Operator D. FITZGERALD / R. KOUDE

Moisture, % _____ Molecular wt., Dry _____ Static Pressure, in.H_2O -0.050

Stack Dimension, in. Diameter or Side 1 91/2 Side 2 → Pitot Tube, Cp 0.84

DIGITAL # FT-7

PITOT # 523

THERM # 734

FIELD DATA

TRAVERSE POINT NUMBER	VELOCITY HEAD (ΔP_s), in.H_2O	STACK TEMP., °F
W-1	0.004	1380
2	0.002	1462
3	0.003	1476
4	0.003	1478
5	0.003	1482
6	0.003	1566
7	0.005	1555
8	0.003	1568
9	0.012	1537
10	0.012	1599
11	0.015	1596
12	0.015	1604
S-13	0.003	1410
14	0.002	1497
15	0.005	1498
16	0.005	1510
17	0.005	1525
18	0.004	1527
19	0.004	1524
20	0.003	1515
21	0.003	1487
22	0.003	1497
23	0.002	1510
24	0.002	1528

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

$\sqrt{\Delta P} =$

$V_s = 85.49 \times Cp \times \sqrt{\Delta P} \times \sqrt{\frac{T_s + 460}{P_s \times M_s}}$

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

$V_s =$ 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

DRY MOLECULAR WEIGHT DETERMINATION

402-463-3648

PLANT Disposal Specialist - Rockingham, VT

DATE 8-9-90 TEST NO D-0-1

SAMPLING TIME (24-hr CLOCK) 1010-1110

SAMPLING LOCATION Flare Stack

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) Continuous

ANALYTICAL METHOD ORSAT

AMBIENT TEMPERATURE

OPERATOR D. Fitzgerald

ORSAT LEAK CHECKED ~~No~~ 142

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	8.4	8.4	8.6	8.6			8.5	44/100	3.740
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	17.6	9.2	18.0	9.4			9.3	32/100	2.976
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100	82.4	100	82.0			82.2	28/100	23.016
								TOTAL	29.73

DRY MOLECULAR WEIGHT DETERMINATION

PLANT DISPOSAL SPECIALIST - ROCKINGHAM, VA.
DATE 8-9-90 TEST NO D3-0-3
SAMPLING TIME (24-hr CLOCK) 1547 - 1632
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 76
OPERATOR D. FITZGERALD
ORSAT LEAK CHECKED [signature] #142

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	9.4	9.4	9.6	9.6			9.5	44/100	4.180
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	19.8	10.4	20.0	10.4			10.4	32/100	3.328
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	100.0	80.0			80.1	28/100	22.428
								TOTAL	29.94

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Disposal Specialists - Rockingham, Vt.
DATE 8-9-90 TEST NO D3-0-2
SAMPLING TIME (24-hr CLOCK) 1250 - 1340
SAMPLING LOCATION Flare Stack
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 96°F
OPERATOR D. Fitzgerald
ORSAT LEAK CHECKED ✓ Stef #142

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	9.2	9.2	9.2	9.2			9.2	44/100	4.048
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	18.2	9.0	18.2	9.0			9.0	32/100	2.880
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100	81.8	100	81.8			81.8	28/100	22.904
								TOTAL	29.83

DRY MOLECULAR WEIGHT DETERMINATION

Cyf 8-A-90

PLANT Disposal Specialist - Rockingham, Vt.
DATE ~~8-10-90~~ 8-9-99 TEST NO D3-0-4
SAMPLING TIME (24-hr CLOCK) 1845-1925
SAMPLING LOCATION F-Face Stack
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 74°F
OPERATOR Cyf
ORSAT LEAK CHECKED ~~#142~~ Cyf

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	9.0	9.0	9.0	9.0			9.0	44/100	3.960
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	18.8	9.8	18.8	9.8			9.8	32/100	3.136
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100	81.2	100	81.2			81.2	28/100	22.736
								TOTAL	29.83

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Disposal Specialist - Rockingham, Vt.
DATE 8-10-90 TEST NO D3-0-5
SAMPLING TIME (24-hr CLOCK) 0847-0928
SAMPLING LOCATION Flare Stack
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 74°F
OPERATOR [illegible]
ORSAT LEAK CHECKED ±1/2 [illegible]

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)	19.6	11.6	19.4	11.4			11.5	32/100	3.680
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)	100.0	80.4	100.0	80.6			80.5	28/100	22.540
								TOTAL	29.74

DRY MOLECULAR WEIGHT DETERMINATION

PLANT DISPOSAL TECHNICIANS - ROCKINGHAM, VA.
DATE 8-10-90 TEST NO D3-06
SAMPLING TIME (24-hr CLOCK) 1000-1050
SAMPLING LOCATION FLARE STACK
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 76°F
OPERATOR [illegible]
ORSAT LEAK CHECKED ~~1425~~ D.F

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	7.2	7.2	7.2	7.2			7.2	44/100	3.168
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	19.6	12.4	19.6	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	80.4	100.0	80.4			80.4	28/100	22.512
								TOTAL	29.65

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Disposal Specialists Ashtabula, Ohio	8/9/90	Exit Outlet	Moisture	04-01

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. Gibb	30.06		80	—	96.5	.84	4' Quartz	—	—

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-3	1.75	1.013	734	521	I-22	311	16	.010	13	.006	—	—	—	—	—

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	1016	72.473		1.75	1.75		103	100	12		100
1	10	1026	80.710	—	1.75	1.75		107	102	13	—	102
2	20	1036	87.000	—	1.75	1.75		111	105	12	—	100
3	30	1046	96.500	—	1.75	1.75		114	106	11	—	90
4	40	1056	103.200	—	1.75	1.75		117	108	11	—	94
5	45	1106	107.971	—								

MOISTURE

~~PARTICULATE~~ SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST - ROCKINGHAM, VT. Sample date 8-9-90

Sample location FLARE STACK Recovery date _____

Run number D4-0-1 Recovered by D. FITZGERALD

Filter number(s) N/A

MOISTURE

Impingers

Final volume (wt) 215 ml(g)

Initial volume (wt) 200 ml(g)

Net volume (wt) 15 ml(g)

Description of impinger water Clear

Silica gel

Final wt 715.6 g

Initial wt 698.7 g

Net wt 16.9 g

30 % spent

Total moisture 31.9 g

RECOVERED SAMPLE

Filter container number(s) _____ Sealed _____

Description of particulate on filter _____

Probe rinse container no. _____ Liquid level marked _____

_____ blank container no. _____ Liquid level marked _____

Impinger contents container no. _____ Liquid level marked _____

_____ blank container no. _____ 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
Disposal Specialists Rockingham Vt.	8/9/90	Flare Outlet	Moisture	04-0-2

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	29.75		85°F	—	91.5" + "	.84	4' Quartz	—	—

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
	F-7-2	1.75	1.013	774	523	I-22	311	16	.002	6	.001	—	—	—		

Velocity Traverse

TRAVERSE POINT NUMBER	SAMPLING TIME, min.	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (ΔP), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMP. (T_s), °F	DRY GAS METER TEMPERATURE INLET (T_m in), °F	OUTLET (T_m out), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMP., °F	IMPINGER TEMP., °F
	0	1250	107.715	—	1.75	1.75	1691	116	113	5	—	80
1	10	1300	115.360	—	1.75	1.75	1687	120	115	5	—	81
2	20	1310	123.050	—	1.75	1.75	1680	122	116	5	—	83
3	30	1320	131.400	—	1.75	1.75	1679	122	117	5	—	80
4	40	1330	138.070	—	1.75	1.75	1685	123	118	5	—	82
5	47	1335	143.350	—								
*	47 min [illegible]											

MOISTURE

~~PARTICULATE~~ SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST-ROCKINGHAM Sample date 8-9-90

Sample location FLARE STACK Recovery date 8-9-90

Run number D4-0-2 Recovered by D. FITZGERALD

Filter number(s) N/A

MOISTURE

Impingers

Final volume (wt) 706 ml(g)

Initial volume (wt) 700 ml(g)

Net volume (wt) 6 ml(g)

Description of impinger water Clear

Silica gel

Final wt 853.5 g

Initial wt 841.0 g

Net wt 12.5 g

_____ % spent

Total moisture 18.5 g

RECOVERED SAMPLE

Filter container number(s) _____ Sealed _____

Description of particulate on filter _____

Probe rinse container no. _____ Liquid level marked _____

____ blank container no. _____ Liquid level marked _____

Impinger contents container no. _____ Liquid level marked _____

____ blank container no. _____ 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
Disposal Specialists	819190	Flare Outlet	Moisture	DY-0-3

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. Kolda	29.50		85+	———	91.5"	1	.84	4' Quartz	—	—

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-3	1.75	1.013	731	523	F-22	311	16	.003	5	.001	———	—	—		

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	1547	143.770	—	1.75	1.75	1679	127	126	5	—	75
1	10	1557	151.600	—	1.75	1.75	1681	128	127	5	—	78
2	20	1607	160.990	—	1.75	1.75	1660	129	128	5	—	80
3	30	1617	169.190	—	1.75	1.75	1620	130	128	5	—	81
4	40	1627	177.160	—	1.75	1.75	1610	130	127	5	—	82
5	45	1632	181.929	—								

MOISTURE

~~PARTICULATE~~ SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST - ROCKINGHAM, VA Sample date 8-9-90

Sample location FLARE OUTLET Recovery date 8-9-90

Run number D4-0-3 Recovered by D FITZGERALD

Filter number(s) N/A

MOISTURE

Impingers

Final volume (wt) 204 ml(g)

Initial volume (wt) 200 ml(g)

Net volume (wt) 4 ml(g)

Description of impinger water Clear

Silica gel

Final wt 855.9 g

Initial wt 853.5 g

Net wt 2.4 g

_____ % spent

Total moisture 6.4 g

RECOVERED SAMPLE

Filter container number(s) _____ Sealed _____

Description of particulate on filter _____

Probe rinse container no. _____ Liquid level marked _____

_____ blank container no. _____ Liquid level marked _____

Impinger contents container no. _____ Liquid level marked _____

_____ blank container no. _____ 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
Disposal Specialists Rock. Vt.	8/7/90	Flare Outlet	H_2SO_4	DS-C-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. Kolde	29.64		80°F	—	91.5		.84	4' Quartz	—	—

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	I-37	311	16	.009	1.5	.004	—	—	—	✓	✓

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	1845	970.420	—	1.46	1.46	1623	113	112	15	—	68
1	10	1855	979.100	—	1.46	1.46	1616	110	110	9	—	69
2	20	1905	986.050	—	1.46	1.46	1598	109	109	9	—	68
3	30	1915	992.540	—	1.46	1.46	1680	108	108	9	—	68
4	40	1925	1001.890	—	1.46	1.46	1606	107	107	9	—	67
5	50	1935	1008.900	—	1.46	1.46	1601	106	105	9	—	
6	60	1945	1016.449									

H_2SO_4
~~SO_2~~ TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST-ROCKINGHAM, VA Sample date 8-9-90

Sample location FLARE STACK Recovery date 8-10-90

Run number D8-0-1 Recovered by D. FITZGERALD

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	496.5 g	626.0 g	597.0 g	754.3 g
Initial wt	567.7 g	594.7 g	601.4 g	706.7 g
Net wt	-71.2 g	313 g	-4.4 g	47.6 g

Total moisture 3.3 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15924A Liquid level marked

PA Impinger contents container no. 15935A Liquid level marked

D_2 ~~IMPINGER~~ container no. 15921A Liquid level marked

~~IPA Blank~~ 15926A

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
Disposal Specialists Rock. Ill.	8/10/90	Flare Outlet	H_2SO_4	08-0-2

OPERATOR(S)	BAR. PRESS. (in. Hg)	STATIC PRESS. (in. H_2O)	AMB. TEMP. (°F)	FILTER NUMBER(S)	STACK INSIDE DIA. (in.)	PITOT TUBE C_p	PROBE LENGTH AND TYPE	NOZZLE I.D.	NOZZLE NUMBER
R. Kittle	29.90		75°F	—	7.5	.84	4' Quartz	—	—

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			F-77	311	16	.006	5	.003	—	—	—		

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	0839	017.323	—	1.00	1.00	1500	89	89	3	—	68
1	10	0849	024.050	—	1.00	1.00	1518	92	90	3	—	69
2	20	0859	030.470	—	1.00	1.00	1511	95	92	3	—	72
3	30	0909	037.190	—	1.00	1.00	1515	98	94	3	—	68
4	40	0919	043.840	—	1.00	1.00	1516	100	96	3	—	68
5	50	0929	49.977	—	1.00	1.00	1498	101	98	3	—	72
6	60	0939	56.977									

H_2SO_4

~~SO_2~~ TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALISTS-ROCKINGHAM, VA. Sample date 8-10-90

Sample location FLARE STACK Recovery date 8-10-90

Run number D8-0-2 Recovered by D. FITZGERALD

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	532.2 g	627.1 g	621.8 g	740.4 g
Initial wt	583.0 g	593.7 g	595.0 g	693.8 g
Net wt	-50.8 g	33.4 g	26.8 g	46.6 g

Total moisture 56.0 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15924A Liquid level marked [illegible]

Impinger contents container no. 15927A Liquid level marked [illegible]

H_2O_2 ~~blank~~ Impinger container no. 15437A Liquid level marked [illegible]

~~EPA Blank~~ 15926A [illegible]

Samples stored and locked [illegible]

Remarks

LABORATORY CUSTODY

Received by _____ Date _____

Remarks

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Disposal Specialists	8/10/90	Kiln Outlet	H_2SO_4	DB-0-3

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. Kolb	29.90		80 °F	—	91.5		.84	4' Quartz	—	—

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			I-37	311	16	.006	3	.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	1000	055.171	—	1.00	1.00	1565	100	99	3	—	68
1	10	1010	061.460	—	1.00	1.00	1527	101	100	3	—	68
2	20	1020	067.200	—	1.00	1.00	1459	103	101	3	—	67
3	30	1030	075.160	—	1.00	1.00	1543	104	101	3	—	68
4	40	1040	080.770	—	1.00	1.00	1530	104	102	3	—	67
5	50	1050	087.000	—	1.00	1.00	1520	103	102	3	—	67
6	60	1100	093.328	—								

H_2SO_4

~~SO_2~~ TRAIN SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST-ROCKINGHAM, VT Sample date 8-10-90

Sample location FLARE STACK Recovery date 8-10-90

Run number D8-0-3 Recovered by D. FITZGERALD

MOISTURE

	1st impinger	2nd impinger	3rd impinger	Silica gel
Final wt	534.1 g	643.7 g	635.8 g	717.1 g
Initial wt	581.4 g	603.9 g	608.9 g	679.9 g
Net wt	-47.3 g	39.8 g	26.9 g	37.2 g

Total moisture 56.6 g

RECOVERED SAMPLE

H_2O_2 blank container no. 15924A Liquid level marked

IPA Impinger contents container no. 15438A Liquid level marked

H_2O ~~blank~~ IMPINGER container no. 15439A Liquid level marked

IPA BLANK 15926A

Samples stored and locked

Remarks

LABORATORY CUSTODY

Received by Date

Remarks

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialist CITY: Rockingham, Vt.

DATE: 8-9-90 LOCATION: Flare Inlet

TIME: 1849 - 1909 RUN NO: D18-I-1

METER NO: VB-3 Y-FACTOR: 0.998

BAROMETRIC PRESSURE, in.Hg: 29.64 Operator: D. Fitzgerald

AMBIENT TEMPERATURE, °F: 74

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	15.0	14.6	10
Post-test	6.3	6.3	2

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1849	16.743	17	104	1
5	1854	18.37	17	103	1
10	1859	20.05	17	102	1
15	1904	21.76	17	102	1
20	1909	23.484	17	102	1
		V_m = 6.741		102.6	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \text{ °R}}$$

$$= 6.255$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: DISPOSAL SPECIALIST CITY: ROCKINGHAM, VT.

DATE: 8-10-90 LOCATION: FLARE INLET

TIME: 0857 - 0917 RUN NO: D18-I-3

METER NO: VB-3 Y-FACTOR: 0.998

BAROMETRIC PRESSURE, in.Hg: 29.90 Operator: D FITZGERALD

AMBIENT TEMPERATURE, °F: 66

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	11.6	11.6	3
Post-test	6.5	6.5	1

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	0857	30.195	17	71	1
5	0902	31.6	17	73	1
10	0907	33.2	17	76	1
15	0912	34.7	17	78	1
20	0917	36.364	17	81	1
		V_m = 6.179		75.8	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \text{ °R}}$$

$$= 6.073$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialist CITY: Rockingham, Vt.

DATE: 8-9-90 LOCATION: Flare Inlet

TIME: 1924 - 1944 RUN NO: D18-I-2

METER NO: VB-3 Y-FACTOR: 0.998

BAROMETRIC PRESSURE, in.Hg: 29.64 Operator: D. Fitzgerald

AMBIENT TEMPERATURE, °F: 72

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	10.9	10.9	5
Post-test	6.3	6.3	1

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1924	23.528	17	97	1
5	1929	25.2	17	98	1
10	1934	26.8	17	97	1
15	1939	28.7	17	98	1
20	1944	30.171	17	97	1
		V_m = 6.643		97.4	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \, °R}$$

$$= 6.2218$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialists CITY: Rockingham, Vt

DATE: 8/9/90 LOCATION: Flare Outlet

TIME: 1849-1909 RUN NO: D18-0-1

METER NO: VB-1 Y-FACTOR: 1.003 (.25 l/min)

BAROMETRIC PRESSURE, in.Hg: 29.64 Operator: R. Kolb

AMBIENT TEMPERATURE, °F: 80 °F

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	15	15	5
Post-test	6	6	2

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1849	23.345	14	135	1
5	1854	24.625	14	134	1
10	1859	25.880	14	134	1
15	1904	27.150	14	135	1
20	1909	28.550	14	135	1
		V_m=5.205		134.6	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m\ °R}$$

$$= 4.593$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialists CITY: Rockingham, Vermont

DATE: 8/9/90 LOCATION: Flare Outlet

TIME: 0924-1944 RUN NO: D18-0-2

METER NO: UB-1 Y-FACTOR: 1.003 (.25 l/min)

BAROMETRIC PRESSURE, in.Hg: 29.64 Operator: R. Klee

AMBIENT TEMPERATURE, °F: 75°F

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	15	15	5
Post-test	5	5	2

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1924	28.605	14	132	2
5	1929	29.990	14	131	2
10	1934	31.215	14	131	2
15	1939	32.480	14	131	2
20	1944	33.891	14	131	2
		V_m = 5.286		131.2	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m\ °R}$$

$$= 4.691$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialists CITY: Rockingham, Vt.

DATE: 8/10/90 LOCATION: Flare Outlet

TIME: 0857 - 0917 RUN NO: D18-0-3

METER NO: VB-1 Y-FACTOR: 1.003 (.25 l/min)

BAROMETRIC PRESSURE, in.Hg: 29.90 Operator: R. Kolde

AMBIENT TEMPERATURE, °F: 75°F

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	15	15	5
Post-test	5	5	5

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	0857	34.820	14	94	1
5	0902	35.310	14	97	1
10	0907	36.500	14	98	1
15	0912	37.740	14	101	1
20	0917	39.140	14	104	1
		V_m = 4.220		98.8	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m\ °R}$$

$$= 3.997$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialist CITY: Rockingham, Vermont

DATE: 8-9-90 LOCATION: Flare Inlet

TIME: 0950 - 1120 RUN NO: DA-I-1

METER NO: VB-3 Y-FACTOR: 0.998

BAROMETRIC PRESSURE, in.Hg: ~~30.06~~ 29.88 Operator: D. Fitzgerald

AMBIENT TEMPERATURE, °F: 80

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	11.3	11.3	10.0
Post-test	2.0	2.0	1

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	0950	76.918	15	82	1
15	1005	81.5	15	89	1
30	1020	86.1	15	102	1
45	1035	90.5	15	113	1
60	1050	95.0	15	123	1
75	1106	100.0	15	129	1
90	1120	104.157	15	133	1
		V_m = 27.239		110.1	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \, °R}$$

$$= 25.143$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialist CITY: Rockingham Vt.

DATE: 8-9-90 LOCATION: Flare Inlet

TIME: 1233 - 1403 RUN NO: DA-T-2

METER NO: VB-3 Y-FACTOR: ~~0.998~~ 0.995

BAROMETRIC PRESSURE, in.Hg: 29.75 Operator: D. Fitzgerald

AMBIENT TEMPERATURE, °F: 92

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	12.9	12.0	10
Post-test	2.0	2.0	2

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1233	4.309	29	~~92~~ 116	1
15	1248	14.0	29	~~99~~ 120	1
30	1303	23.2	29	127	1
45	1318	33.0	29	135	1
60	1328	45.2	29	138	1
75	1348	51.4	29	140	1
90	1403	60.837	29	141	1
		V_m = 56.528		131.0	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m\ °R}$$

$$= 49.964$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialists CITY: Rockingham, N.C.

DATE: 8-9-90 LOCATION: Flare Inlet

TIME: 1541 RUN NO: DA-I-3

METER NO: VB-3 Y-FACTOR: 0.995

BAROMETRIC PRESSURE, in.Hg: 29.50 Operator: D. Fitzgerald

AMBIENT TEMPERATURE, °F: 96

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	5.0	5.0	5.
Post-test	3.0		

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1541	60.917	29	127	1
15	1556	70.150	29	132	1
30	1611	79.425	29	137	1
45	1626	88.6	29	140	1
60	1641	98.3	29	143	1
75	1656	107.4	29	144	1
90	1711	116.752	29	144	1
		V_m = 55.835		138.1	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \, °R}$$

$$= 48.352$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialists CITY: Rockingham, Vt.

DATE: 8/9/90 LOCATION: Flue Outlet

TIME: 0950 - 1120 RUN NO: DA-0-1

METER NO: VB-1 Y-FACTOR: 1.007 at .25 l/min

BAROMETRIC PRESSURE, in.Hg: 30.06 Operator: R. Kolde

AMBIENT TEMPERATURE, °F: 80 °F

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	12.5	12.5	5
Post-test	5.0	5.0	5

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	0950	4.278	11	100	2
15	1005	8.309	11	105	2
30	1020	11.410	11	110	2
45	1035	14.515	11	110	2
60	1050	17.755	11	113	2
75	1105	21.980	11	118	2
90	1120	24.145	11	120	2
		V_m = 19.867		110.9	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m, °R}$$

$$= 18.517$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Disposal Specialists CITY: Rockingham, Vt.

DATE: 8/9/90 LOCATION: Flue Outlet

TIME: ~~Pre~~ 1233 - 1403 RUN NO: CA-0-2

METER NO: VB-1 Y-FACTOR: .995 .5 ℓ/min

BAROMETRIC PRESSURE, in.Hg: 29.75 Operator: R. Kalb

AMBIENT TEMPERATURE, °F: 85°F

LEAK CHECK DATA

	Vacuum Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	15	15	5
Post-test	5.0	5.0	5

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1233	24,455	.28	110	2
15	1248	32.320	.28	115	2
30	1303	40,675	.28	120	2
45	1318	49.325	.28	122	2
60	1333	57.125	.28	126	2
75	1348	65.530	.28	132	2
90	1403	73.355	.28	134	2
		V_m = 48.900		122.7	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \,°R}$$

$$= 43.836$$

CHARCOAL TUBE (METHOD 18) SAMPLING DATA

COMPANY: Chemical Specialties CITY: Rockingham, VA

DATE: 8/9/95 LOCATION: Flare Outlet

TIME: 1541 — 1711 RUN NO: DA-O-3

METER NO: VB-1 Y-FACTOR: ~~1.003~~ .995 @ .5 l/min

BAROMETRIC PRESSURE, in.Hg: 29.50 Operator: B Kelly

AMBIENT TEMPERATURE, °F: 85 °F

LEAK CHECK DATA

	Vacuum		
	Initial, in.Hg	Final, in.Hg	Time, min
Pre-test	15.0	14.5	5
Post-test	5	5	5

Sample time, min	Clock time, (24-h)	Meter volume, liter	Rotometer Setting	Dry gas meter temp. °F	Vacuum, in.Hg
0	1541	73.595	28	136	2
15	1556	82.080	28	143	2
30	1611	91.150	28	149	2
45	1626	98.980	28	153	2
60	1641	107.190	28	155	2
75	1656	115.280	28	157	2
90	1711	123.235	28	159	2
		V_m = 49.640		150.3	

$$V_{std} = V_m \text{ liters} \times Y \times 17.647 \times \frac{P_b, \text{in.Hg}}{T_m \, °R}$$

$$= 42.132$$

METHOD 25 FIELD DATA

Plant DISPOSAL SPECIALIST City ROCKINGHAM, VT. Date 8-9-90
Run No. D25-I-1 Sample Location FLARE INLET
Operator D. FITZGERALD
Tank No. 02308 Tank Volume, Liters
Trap No. N/A ~~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	~~737~~ 761	66	737
Post-test	~~742~~ 761	80	112

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0	737	8	721	16	0.2

SAMPLING DATA

Time		Guage vacuum mm Hg	Temperatures, °F		
Clock	Sampling		Probe	Filter inlet	Filter outlet
0953	0	737			
1003	10	610			
1013	20	464			
1023	30	348			
1033	40	254			
1043	50	165			
1053	60	112			

FUEL GAS SAMPLE 22-5

* 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 DISPOSAL SPECIALIST City ROCKINGHAM, IL. Date 8-9-90
Run No. M25-I-2 Sample Location FLARE INLET
Operator D. FITZGERALD
Tank No. 02800 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	761	80	749
Post-test	750	92	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	749	10	709	40	0.5

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
1245	0	749			
1255	10	676			
1305	20	495			
1315	30	368			
1337	52	173			
1345	60	127			

* Leak rate cc/min = $\frac{\Delta P, \text{ cm (volume, cm}^3\text{)}}{Pb, \text{ cm} \times \text{time, min.}}$ FUEL GAS CYLINDER - BS-40

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

METHOD 25 FIELD DATA

Plant DISPOSAL SPECIALIST City ROCKINGHAM, N/T Date 8-9-90
Run No. D25-I-3 Sample Location FLARE INLET
Operator D. FITZGERALD
Tank No. 02319 Tank Volume, Liters
Trap No. N/A ~~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	750	92	747
Post-test	748	98	142

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0	750	10	730	20	

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
1543	0	750			
1553	10	615 (24.2)			
1603	20	467 (18.4)			
1613	30	361 (14.2)			
1623	40	279			
1633	50	203			
1643	60	142			

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

FUEL GAS CYLINDER # 14-5

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

METHOD 25 FIELD DATA

Plant Disposal Specialist City Rockingham Date 8/9/90
Run No. D25 L01 Sample Location Flare Outlet
Operator B. Kelly
Tank No. 02805 Tank Volume, Liters
Trap No. — Rotameter No. Flow Controller #5
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	(30.06) 763.5 (755.65, 29.75	75°F	744
Post-test		80°F	208

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
0805	278	0816	276		

250 ml Flask attached for condensate

SAMPLING DATA

Time		Guage vacuum mm Hg	Temperatures, °F		
Clock	Sampling		Probe	Filter inlet	Filter outlet
0953	0	726	—	—	—
1003	10	630	—	—	—
1013	20	506	—	—	—
1023	30	424	—	—	—
1033	40	352	—	—	—
1043	50	260	—	—	—
1053	60	208	—	—	—

* 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 Disposal Specialists City Rockingham, Vt Date 8/9/90
Run No. M25-0L2 Sample Location Flare outlet
Operator R. Kleb
Tank No. 02317 Tank Volume, Liters
Trap No. — Rotameter No. Flow Controller #5
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	29.75	80°F	750
Post-test			

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
1115	270	1120	266		

Has 250ml knockout flask

SAMPLING DATA

Time		Guage vacuum mm Hg	Temperatures, °F		
Clock	Sampling		Probe	Filter inlet	Filter outlet
1245	0	748	—	—	—
1255	10	654	—	—	—
1305	20	572	—	—	—
1315	30	488	—	—	—
1325	40	400	—	—	—
1335	50	299	—	—	—
1345	60	230	—	—	—

* 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 Diamond Specialties City Parkersburg Ut Date 9/14/
Run No. M25-0-3 Sample Location Flare Outlet
Operator R. Kidd
Tank No. 02703 Tank Volume, Liters
Trap No. — Rotameter No. Flow controller #5
Sampling Rate 6.0 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	29.50	85°F	740
Post-test	29.45	84°F	260

Front-Half - Leak Check Data

Time	Initial vacuum mm Hg	Time	Final vacuum mm Hg.	Δ P mm Hg.	Leak rate* cc/min
1430	290	1605	288		

SAMPLING DATA

Time Clock	Time Sampling	Guage vacuum mm Hg	Temperatures, °F Probe	Filter inlet	Filter outlet
1543	0	748	—	—	—
1553	10	670	—	—	—
1603	20	560	—	—	—
1613	30	454	—	—	—
1623	40	390	—	—	—
1633	50	325	—	—	—
1643	60	260	—	—	—

* 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)

EMISSION TESTING FIELD DATA

PLANT AND CITY	DATE	SAMPLING LOCATION	SAMPLE TYPE	RUN NUMBER
Disposal Specialists	819190	Flare Outlet	HCl / HF	D26-1

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. Kolde	29.64		80°F	—	4.5		.84	4' Quartz	—	—

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
	FT-3	1.75	1.013	734	527	I-22	311	16	.004	5	.002	—	—	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		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	1846	178.202	—	1.75	1.75	1623	109	108	5	250	68
1	10	1856	186.820	—	1.75	1.75	1616	110	107	3	248	71
2	20	1906	194.680	—	1.75	1.75	1590	107	105	2	252	75
3	30	1916	206.500	—	1.75	1.75	1600	106	103	2	251	69
4	40	1926	218.900	—	1.75	1.75	1606	105	101	2	252	68
5	50	1936	218.000	—	1.75	1.75	1601	105	101	2	250	68
6	60	1946	225.632	—								

HCl/HF
SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST - ROCKINGHAM, VT. Sample date 8-9-90
Sample location FLARE STACK Recovery date 8-10-90
Run number D26-1 Recovered by D FITZGERALD

MOISTURE

	1st	2nd	3rd	4th
Impingers	g	g	g	g
Final weight	597.1 g	589.1 g	597.8 g	698.5 g
Initial weight	558.0 g	589.1 g	596.3 g	693.4 g
Net Gain	39.1 g	0.0 g	1.5 g	5.1 g

Description of impinger contents _____

Total moisture 45.7 g

RECOVERED SAMPLE

0.1N H_2SO_4 impinger contents and rinse container no. 1592ZA Liquid level marked [signature]

0.1N H_2SO_4 blank container no. 1592ZA 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
Disposal Specialists	8/10/90	Flare Outlet	HCl/HF	D26[redacted]-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. Hebda	29.90		75°F	—	9.5		.84	4' Quartz	—	—

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-3	1.75	1.013			I-22	311	16	.005	5	.035	—	—	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	0833	226.782	—	1.75	1.75	1500	89	85	2	250	67
1	10	0848	234.600	—	1.75	1.75	1510	93	88	2	250	63
2	20	0858	242.100	—	1.75	1.75	1501	97	90	2	251	65
3	30	0908	249.200	—	1.75	1.75	1515	99	92	2	252	67
4	40	0918	256.000	—	1.75	1.75	1516	101	94	2	250	67
5	50	0928	265.280	—	1.75	1.75	1498	103	95	2	250	74
6	60	0938	272.848	—	1.75	1.75						

HCl/HF
SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST - ROCKINGHAM, VT. Sample date 8-10-90
Sample location FLARE STACK Recovery date 8-10-90
Run number D26-2 Recovered by D. FITZGERALD

MOISTURE

	1st	2nd	3rd	4th
Impingers	____ g	____ g	____ g	____ g
Final weight	591.5 g	590.5 g	597.6 g	700.7 g
Initial weight	591.5 g	590.6 g	596.3 g	698.5 g
Net Gain	0.0 g	-0.1 g	1.1 g	2.2 g

Description of impinger contents Clear

Total moisture 3.2 g

RECOVERED SAMPLE

0.1N H_2SO_4 impinger contents and rinse container no. 15456A Liquid level marked

0.1N H_2SO_4 blank container no. 15923A 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
Disposal Specialists	81/01/06	Flare Quarter	HCl/HF	D26[redacted]-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.	NUMBER
R. Kolb	29.90		80°F	—	91.5		.84	4' Quartz	—	—

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
	F7-3	1.75	1.013			I-22	211	16	.004	5	.002	—	—	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		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	1001	278.926	—	1.75	1.75	1565	103	100	2	250	64
	10	1011	281.530	—	1.75	1.75	1522	105	99	2	252	68
	20	1021	284.310	—	1.75	1.75	1459	106	101	2	253	69
	30	1031	287.200	—	1.75	1.75	1543	109	101	2	250	68
	40	1041	304.960	—	1.75	1.75	1550	108	103	2	250	72
	50	1051	312.680	—	1.75	1.75	1520	109	103	2	251	72
	60	1101	320.466	—								

HCl/HF
SAMPLE RECOVERY AND INTEGRITY SHEET

Plant DISPOSAL SPECIALIST-ROCKINGHAM, VT Sample date 8-10-90
Sample location FLARE STACK Recovery date 8-10-90
Run number D26-3 Recovered by D. FITZGERALD

MOISTURE

	1st	2nd	3rd	4th
Impingers	____ g	____ g	____ g	____ g
Final weight	597.0 g	594.9 g	599.0 g	721.2 g
Initial weight	597.2 g	590.4 g	596.3 g	707.8 g
Net Gain	-0.8 g	4.5 g	2.7 g	13.4 g

Description of impinger contents Clear

Total moisture 19.8 g

RECOVERED SAMPLE

0.1N H_2SO_4 impinger contents and rinse container no. 15440A Liquid level marked [signature]

0.1N H_2SO_4 blank container no. 5973A Liquid level marked [signature]

Samples stored and locked ____
Remarks ____

LABORATORY CUSTODY

Received by ____ Date ____
Remarks ____

APPENDIX C

LABORATORY DATA

MARKWEST HYDROCARBON PARTNERS, LTD.
[illegible]
[illegible]
[illegible]

#1

DFG-I-1

NAME:	[illegible] ASSOCIATES
ADDRESS:	[illegible] CHESTER ROAD
	CINCINNATI, OH [illegible]
WELL NAME/NO:	DISPOSAL SPECIALISTS [illegible]
WELL LOCATION:	[illegible]
GAS ANAL. BY:	[illegible]
SAMPLE DATE:	[illegible]

COMPONENT	MOL%	GPM
METHANE	[illegible]	
ETHANE	[illegible]	[illegible]
PROPANE	[illegible]	[illegible]
ISO-BUTANE	[illegible]	[illegible]
N-BUTANE	[illegible]	[illegible]
ISO-PENTANE	[illegible]	[illegible]
N-PENTANE	[illegible]	[illegible]
HEXANES+	[illegible]	[illegible]
NITROGEN	[illegible]	
[illegible]	[illegible]	
CO2	[illegible]	
HYDROGEN	[illegible]	
	[illegible]	[illegible]

LABORATORY CALCULATIONS	
GROSS BTU/SCF*	[illegible]
DRY BTU/SCF	[illegible]
SPECIFIC GRAVITY	[illegible]
GASOLINE CONTENT (GPM):	
PENTANES & HEAVIER	[illegible]
BUTANES & HEAVIER	[illegible]
PROPANE & HEAVIER	[illegible]
ETHANE & HEAVIER	[illegible]

*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 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.

Rebecca Hobson
LABORATORY TECHNICIAN

[illegible]

#2

DFG-I-2

[illegible]

COMPONENT	[illegible]	[illegible]
METHANE	[illegible]	
ETHANE	[illegible]	[illegible]
PROPANE	[illegible]	[illegible]
ISOBUTANE	[illegible]	[illegible]
N-BUTANE	[illegible]	[illegible]
ISOPENTANE	[illegible]	[illegible]
N-PENTANE	[illegible]	[illegible]
HEXANES+	[illegible]	[illegible]
NITROGEN	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
HYDROGEN	[illegible]	
	[illegible]	[illegible]

LABORATORY CALCULATIONS:

GROSS BTU DRY*	[illegible]
[illegible]	[illegible]
SPECIFIC GRAVITY	[illegible]
GASOLINE CONTENT (GPM):	
PENTANES & HEAVIER	[illegible]
BUTANES & HEAVIER	[illegible]
PROPANE & HEAVIER	[illegible]
ETHANE & HEAVIER	[illegible]

* 60 deg.F, 14.7[illegible] 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 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.

[illegible signature]

LABORATORY TECHNICIAN

#3

DFG-I-3

C-4

METHOD ~~6~~ 8 H_2SO_4 ~~SULFUR DIOXIDE~~ ANALYTICAL DATA

Plant Chemical Spec. Date 8-03-90

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	.00960 N	
Normality of H_2SO_4 Std.	0.01	2 20.75 ml	.00964 N	.0096 N (Avg.)(N_2)
Volume of Std.	20.0	3 20.76 ml	.00963 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 $(NH_4)_2SO_4$	($N_1 \times V_1$) 0.2	3 20.00 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		10 ml	.01	.01		.01
AUDIT NO. 2539	100 ml	20 ml	8.50	8.45		8.48
DA - D8-0-2	250 ml	100 ml	6.50	6.48		6.49
DA - D8-0-3	250 ml	100 ml	5.00	5.00		5.00
PA - D8-0-1	250 ml	100 ml	—	—		*
H_2O_2 - D8-0-2	250 ml	10 ml	0.20	0.18		0.19
H_2O_2 D8-0-3	250 ml	10 ml	0.28	0.25		0.27
H_2O_2 D8-0-1	250 ml	10 ml	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 [signature] Signature of reviewer _____

* Consultant saw titration endpoint due to discoloration from filter.

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Disposal Specialists

Date: August 28, 1990

Attn: Mr. Dan Fitzgerald (PEI)

Job Number PN 50016

This is the Certificate of Analysis for the following samples:

Client Project ID:	Disposal Specialists
Date Received:	August 13, 1990
Work Order:	X0-08-078
Number of Samples:	6
Sample Type:	Charcoal Tubes

I. Introduction

Six charcoal tube samples arrived at ITAS Cincinnati on August 13, 1990. The tubes were sent for analytical work in support of monitoring work for Disposal Specialists. The samples were labeled as follows:

Charcoal # D18-I-1	Charcoal # D18-O-1
Charcoal # D18-I-2	Charcoal # D18-O-2
Charcoal # D18-I-3	Charcoal # D18-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 acetone and methyl ethyl ketone.

The charcoal tubes were desorbed with carbon disulfide and analyzed by Gas Chromatography with Flame Ionization Detection.

Reviewed and Approved by:

C. Craig Crume
Project Manager
008078

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: Disposal Specialists
Work Order: XO-08-078
00807801

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results, ug

Client Sample ID	Lab No.	Acetone Front	Acetone Back	Acetone Total	Methyl Ethyl Ketone Front	Methyl Ethyl Ketone Back	Methyl Ethyl Ketone Total
Charcoal # D18-I-1	01	570	ND	570	190	ND	190
Charcoal # D18-I-2	02	550	ND	550	200	ND	200
Charcoal # D18-I-3	03	530	ND	530	210	ND	210
Charcoal # D18-O-1	04	ND	ND	ND	ND	ND	ND
Charcoal # D18-O-2	05	ND	ND	ND	ND	ND	ND
Charcoal # D18-O-3	06	ND	ND	ND	ND	ND	ND
Method Blank	CBLK001	ND	ND	ND	ND	ND	ND

Detection Limit = 3 ug/Tube

Quality Control
Desorbtion Efficiency

Analyte	Theoretical Value	Percer Recove
Acetone (DE003)	11.8	100
Methyl Ethyl Ketone	12.1	122
Acetone (DE004)	212.8	85
Methyl Ethyl Ketone	217.4	94

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Disposal Specialists

Date: September 14, 1990

Attn: Mr. Dan Fitzgerald (PEI)

Job Number PN 50016

This is the Certificate of Analysis for the following samples:

Client Project ID:	Disposal Specialists
Date Received:	August 10, 1990
Work Order:	X0-08-070
Number of Samples:	6
Sample Type:	Charcoal Tubes

I. Introduction

Six charcoal tube samples arrived at ITAS Cincinnati on August 10, 1990. The tubes were sent for analytical work in support of monitoring work for Disposal Specialists. The samples were labeled as follows:

Charcoal # DA-I-1	Charcoal # DA-O-1
Charcoal # DA-I-2	Charcoal # DA-O-2
Charcoal # DA-I-3	Charcoal # DA-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 analysis requested was acrylonitrile.

Reviewed and Approved by:

C. Craig Crume
Project Manager
008070

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. Comments

On the three inlet samples, the peak identified as acrylonitrile co-eluted with an obvious interference. Several other chromatography columns were utilized in an attempt to eliminate the problem, however, only the original column gave adequate resolution between acrylonitrile and the solvent.

This interference peak may have suppressed the acrylonitrile response and therefore the results should be considered as approximate.

Client: Disposal Specialists
Work Order: XO-08-070
00807001

IT ANALYTICAL SERVICES
CINCINNATI, OH

Analytical Results

Client Sample ID	Lab No.	Acrylontrile Total (1)
Charcoal # DA-I-1	01	1300
Charcoal # DA-I-2	02	2200
Charcoal # DA-I-3	03	2200
Charcoal # DA-O-1	04	ND
Charcoal # DA-O-2	05	ND
Charcoal # DA-O-3	06	ND
Method Blank	ABLK001	ND

Detection Limit = 5ug/Tube

(1) All back halves = ND

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Acrylonitrile (DE004)	241.8	93.6
Acrylonitrile (DE003)	18.1	90.6

LABORATORY ANALYSIS REPORT

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

Page 1
Report Date : 09/05/90
HEG Task # : 90080388
HEG P/N, Acct:

P.O. Number: 5137
Proj #: 50016

Date Received: 08/29/90

HEG Sample # : 9014615 Sample Date: 08/09/90 Sample Priority: Normal
Sample ID : D25-I-1

Parameter	Units	Results	Comments
Non Methane Organics	ppm	447	

HEG Sample # : 9014616 Sample Date: 08/09/90 Sample Priority: Normal
Sample ID : D25-O-1

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 1	

HEG Sample # : 9014617 Sample Date: 08/09/90 Sample Priority: Normal
Sample ID : D25-O-3

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 1	

HEG Sample # : 9014618 Sample Date: 08/09/90 Sample Priority: Normal
Sample ID : D25-I-3

Parameter	Units	Results	Comments
Non Methane Organics	ppm	390	

HAYDEN ENVIRONMENTAL GROUP, INC.

LABORATORY ANALYSIS REPORT

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

Page 2
Report Date : 09/05/90
HEG Task # : 90080388
HEG P/N, Acct:

HEG Sample # : 9014619 Sample Date: 08/09/90 Sample Priority: Normal
Sample ID : D25-I-2

Parameter	Units	Results	Comments
Non Methane Organics	ppm	369	

HEG Sample # : 9014620 Sample Date: 08/09/90 Sample Priority: Normal
Sample ID : D25-O-2

Parameter	Units	Results	Comments
Non Methane Organics	ppm	29	

LABORATORY ANALYSIS REPORT

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

Page 1
Report Date : 09/19/90
HEG Task # : 90090107
HEG P/N, Acct:

P.O. Number:
Proj Name: Disposal Specialist

Date Received: 09/12/90

HEG Sample # : 9015378 Sample Date: 08/09/90 Sample Priority: Emergency
Sample ID : D25-O-2

Parameter	Units	Results	Comments
Non Methane Organics	ppm	< 1	

HAYDEN ENVIRONMENTAL GROUP, INC.

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

PEI Associates, Inc.

Date: September 10, 1990

Attn: Mr. Dan Fitzgerald (PEI)

Job Number PN 50016

This is the Certificate of Analysis for the following samples:

Client Project ID:	Disposal Specialists
Date Received:	August 10, 1990
Work Order:	XO-08-071
Number of Samples:	6
Sample Type:	Canisters

I. Introduction

Six canister samples arrived at ITAS Cincinnati on August 10, 1990. The samples were sent for analytical work in support of monitoring work for Disposal Specialists. The samples were labeled as follows:

Run # D25-I-1 Canister 02308
Run # D25-I-2 Canister 02800
Run # D25-I-3 Canister 02319
Run # D25-O-1 Canister 02805
Run # D25-O-2 Canister 02317
Run # D25-O-3 Canister 02703

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 15 Volatile Organic Compounds in the Table A-1 provided for this project.

Reviewed and Approved by:

C. Craig Crume
Project Manager
008071

II. Analytical Results/Methodology (cont.)

For samples D25-I-1,2 and 3 a 5ml aliquot of gas was loaded onto a blank tenax cartridge. The prepped sample was then thermally desorbed and analyzed by Gas Chromatography/Mass Spectroscopy.

For samples D25-O-1,2 and 3 a 150ml aliquot was used.

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.

Client: Disposal Specialists
Work Order: X0-08-071
00807102

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 5 ml

Level: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:
Run # D25-I-1 Canister 02308
Lab Sample No:
X0-08-071-01
Date Received: 8-10-90
Date Analyzed: 8-23-90

Dilution Factor: 1.88

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
75-01-4	Vinyl Chloride	60000	
75-09-2	Methylene Chloride	79000	B
75-35-3	1,1-Dichloroethane	170000	
540-59-0	1,2-dichloroethene (Total)	120000	
67-66-3	Chloroform	1880	U
71-55-6	1,1,1-trichloroethane	47000	
56-23-5	Carbon Tetrachloride	1880	U
79-01-6	Trichloroethene	30000	
71-43-2	Benzene	4300	
127-18-4	Tetrachloroethene	58000	
79-34-5	1,1,2,2-tetrachloroethane	1880	U
108-88-3	Toluene	390000	
108-90-7	Chlorobenzene	1880	U
100-41-4	Ethylbenzene	34000	
1330-20-7	Total Xylenes	99000	

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 5 ml

Level: (low/med) Med

% Moisture: not dec. N/A

Client Sample ID:
Run # D25-I-2 Canister 02800
Lab Sample No:
XO-08-071-02
Date Received: 8-10-90
Date Analyzed: 8-23-90

Dilution Factor: 1.99

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
75-01-4	Vinyl Chloride	60000	
75-09-2	Methylene Chloride	85000	B
75-35-3	1,1-Dichloroethane	190000	
540-59-0	1,2-dichloroethene (Total)	130000	
67-66-3	Chloroform	1990	U
71-55-6	1,1,1-trichloroethane	41000	
56-23-5	Carbon Tetrachloride	1990	U
79-01-6	Trichloroethene	28000	
71-43-2	Benzene	3900	
127-18-4	Tetrachloroethene	63000	
79-34-5	1,1,2,2-tetrachloroethane	1990	U
108-88-3	Toluene	380000	
108-90-7	Chlorobenzene	1990	U
100-41-4	Ethylbenzene	36000	
1330-20-7	Total Xylenes	110000	

Client: Disposal Specialists
Work Order: XO-08-071
00807104

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Sample Wt/Vol: 5 ml

Level: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:
Run # D25-I-3 Canister 02319
Lab Sample No:
XO-08-071-03
Date Received: 8-10-90
Date Analyzed: 8-23-90

Dilution Factor: 1.93

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
75-01-4	Vinyl Chloride	55000	
75-09-2	Methylene Chloride	100000	B
75-35-3	1,1-Dichloroethane	180000	
540-59-0	1,2-dichloroethene (Total)	120000	
67-66-3	Chloroform	1930	U
71-55-6	1,1,1-trichloroethane	43000	
56-23-5	Carbon Tetrachloride	1930	U
79-01-6	Trichloroethene	28000	
71-43-2	Benzene	4300	
127-18-4	Tetrachloroethene	65000	
79-34-5	1,1,2,2-tetrachloroethane	1930	U
108-88-3	Toluene	370000	
108-90-7	Chlorobenzene	1930	U
100-41-4	Ethylbenzene	36000	
1330-20-7	Total Xylenes	110000	

Client: Disposal Specialists
Work Order: X0-08-071
0807105

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:
Run # D25-O-1 Canister 02805
Lab Sample No:
X0-08-071-04
Date Received: 8-10-90
Date Analyzed: 8-24-90

Dilution Factor: 2.15

CONCENTRATION UNITS:
ug/m3

CAS NO.	COMPOUND		
75-01-4	Vinyl Chloride	144	U
75-09-2	Methylene Chloride	9900	B
75-35-3	1,1-Dichloroethane	72	U
540-59-0	1,2-dichloroethene (Total)	72	U
67-66-3	Chloroform	72	U
71-55-6	1,1,1-trichloroethane	72	U
56-23-5	Carbon Tetrachloride	72	U
79-01-6	Trichloroethene	72	U
71-43-2	Benzene	72	U
127-18-4	Tetrachloroethene	72	U
79-34-5	1,1,2,2-tetrachloroethane	72	U
108-88-3	Toluene	72	U
108-90-7	Chlorobenzene	72	U
100-41-4	Ethylbenzene	72	U
1330-20-7	Total Xylenes	72	U

Client: Disposal Specialists
Work Order: XO-08-071
00807106

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:
Run # D25-O-2 Canister 02317
Lab Sample No:
XO-08-071-05
Date Received: 8-10-90
Date Analyzed: 8-24-90

Dilution Factor: 2.33

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
75-01-4	Vinyl Chloride	156	U
75-09-2	Methylene Chloride	20000	B
75-35-3	1,1-Dichloroethane	78	U
540-59-0	1,2-dichloroethene (Total)	78	U
67-66-3	Chloroform	78	U
71-55-6	1,1,1-trichloroethane	78	U
56-23-5	Carbon Tetrachloride	78	U
79-01-6	Trichloroethene	78	U
71-43-2	Benzene	78	U
127-18-4	Tetrachloroethene	78	U
79-34-5	1,1,2,2tetrachloroethane	78	U
108-88-3	Toluene	78	U
108-90-7	Chlorobenzene	78	U
100-41-4	Ethylbenzene	78	U
1330-20-7	Total Xylenes	78	U

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:
Run # D25-O-3 Canister 02703
Lab Sample No:
X0-08-071-06
Date Received: 8-10-90
Date Analyzed: 8-24-90

Dilution Factor: 2.45

CONCENTRATION UNITS:
ug/m3

CAS NO.	COMPOUND		
75-01-4	Vinyl Chloride	164	U
75-09-2	Methylene Chloride	16000	B
75-35-3	1,1-Dichloroethane	82	U
540-59-0	1,2-dichloroethene (Total)	82	U
67-66-3	Chloroform	82	U
71-55-6	1,1,1-trichloroethane	82	U
56-23-5	Carbon Tetrachloride	82	U
79-01-6	Trichloroethene	82	U
71-43-2	Benzene	82	U
127-18-4	Tetrachloroethene	82	U
79-34-5	1,1,2,2tetrachloroethane	82	U
108-88-3	Toluene	82	U
108-90-7	Chlorobenzene	82	U
100-41-4	Ethylbenzene	82	U
1330-20-7	Total Xylenes	82	U

Client: Disposal Specialists
Work Order: X0-08-071
00807109

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

Matrix: Air

Client Sample ID:

Sample Wt/Vol: 5ml

Lab Sample No:
METHOD BLANK - VBLKC4

Level: (low/med) Med

Date Received: 8-10-90

% Moisture: not dec. N/A

Date Analyzed: 8-23-90

Dilution Factor: 1

CAS NO.	COMPOUND	CONCENTRATION UNITS: ug/m3	
75-01-4	Vinyl Chloride	2000	U
75-09-2	Methylene Chloride	6300	B
75-35-3	1,1-Dichloroethane	1000	U
540-59-0	1,2-dichloroethene (Total)	1000	U
67-66-3	Chloroform	1000	U
71-55-6	1,1,1-trichloroethane	1000	U
56-23-5	Carbon Tetrachloride	1000	U
79-01-6	Trichloroethene	1000	U
71-43-2	Benzene	1000	U
127-18-4	Tetrachloroethene	1000	U
79-34-5	1,1,2,2tetrachloroethane	1000	U
108-88-3	Toluene	1000	U
108-90-7	Chlorobenzene	1000	U
100-41-4	Ethylbenzene	1000	U
1330-20-7	Total Xylenes	1000	U

lient: Disposal Specialists
ork Order: X0-08-071
0807108

IT ANALYTICAL SERVICES
CINCINNATI, OH

VOLATILE ORGANICS ANALYSIS DATA SHEET

strix: Air

ample Wt/Vol: 5ml

evel: (low/med) Med

Moisture: not dec. N/A

Client Sample ID:

Lab Sample No:
METHOD BLANK - VBLKC6
Date Received: 8-10-90
Date Analyzed: 8-24-90

Dilution Factor: 1

CONCENTRATION UNITS:
ug/m3

CAS NO.	COMPOUND		
75-01-4	Vinyl Chloride	2000	U
75-09-2	Methylene Chloride	14000	B
75-35-3	1,1-Dichloroethane	1000	U
540-59-0	1,2-dichloroethene (Total)	1000	U
67-66-3	Chloroform	1000	U
71-55-6	1,1,1-trichloroethane	1000	U
56-23-5	Carbon Tetrachloride	1000	U
79-01-6	Trichloroethene	1000	U
71-43-2	Benzene	1000	U
127-18-4	Tetrachloroethene	1000	U
79-34-5	1,1,2,2tetrachloroethane	1000	U
108-88-3	Toluene	1000	U
108-90-7	Chlorobenzene	1000	U
100-41-4	Ethylbenzene	1000	U
1330-20-7	Total Xylenes	1000	U

Client: Disposal Specialists
Work Order: XO-08-071
00807110

IT ANALYTICAL SERVICES
CINCINNATI, OH

Quality Assurance Data

Surrogate Recovery, Percent

Client Sample ID	Lab No.	d4-1,2-Dichloroethane	d8-Toluene	P-Bromofluorobenzene
Run # D25-I-1 Canister 02308	01	99	113	73
Run # D25-I-2 Canister 02800	02	104	112	77
Run # D25-I-3 Canister 02319	03	101	107	72
Run # D25-O-1 Canister 02805	04	94	102	84
Run # D25-O-2 Canister 02317	05	97	99	97
Run # D25-O-3 Canister 02703	06	101	99	94
Method Blank	VBLKC4	98	109	70
Method Blank	VBLKC6	96	101	86

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

PEI Associates, Inc. Date: September 17, 1990

Attn: Mr. Dan Fitzgerald

Job Number PN 50016

This is the Certificate of Analysis for the following samples:

Client Project ID:	Disposal Specialists
Date Received:	August 17, 1990
Work Order:	XO-08-123
Number of Samples:	4
Sample Type:	Liquid

I. Introduction

Four liquid samples arrived at ITAS Cincinnati on August 17, 1990. The samples were sent for analytical work in support of monitoring work on the Disposal Specialists Project. The samples were labeled as follows:

Liquid Sample # D26-1
Liquid Sample # D26-2
Liquid Sample # D26-3
Liquid Sample # 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 analyses requested included chloride and fluoride by EPA Method 26. The results were converted and are expressed as HCl and HF.

Reviewed and Approved by:

C. Craig Crume
Project Manager
008123

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.

Analytical Results

Client Sample ID	Lab No.	Total Volume, ml	HCl, Total ug	HF, Total ug
Liquid Sample # D26-1	01	317	<500	<5000
Liquid Sample # D26-2	02	395	<600	<6000
Liquid Sample # D26-3	03	334	<500	<5000
Liquid Sample # Blank	04	281	<600	<4000
Detection Limit		NA	1.3mg/L	15mg/L

NA = Not Applicable
ND = Not Detected

Quality Control
Standard Reference Solutions

Analyte	Theoretical Value	Percent Recovery
Chloride	4	93.5, 103, 99.2
Fluoride	4	90.5, 99.0, 98.0

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.

* EPA-600/4-84-041, "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", April 1984.

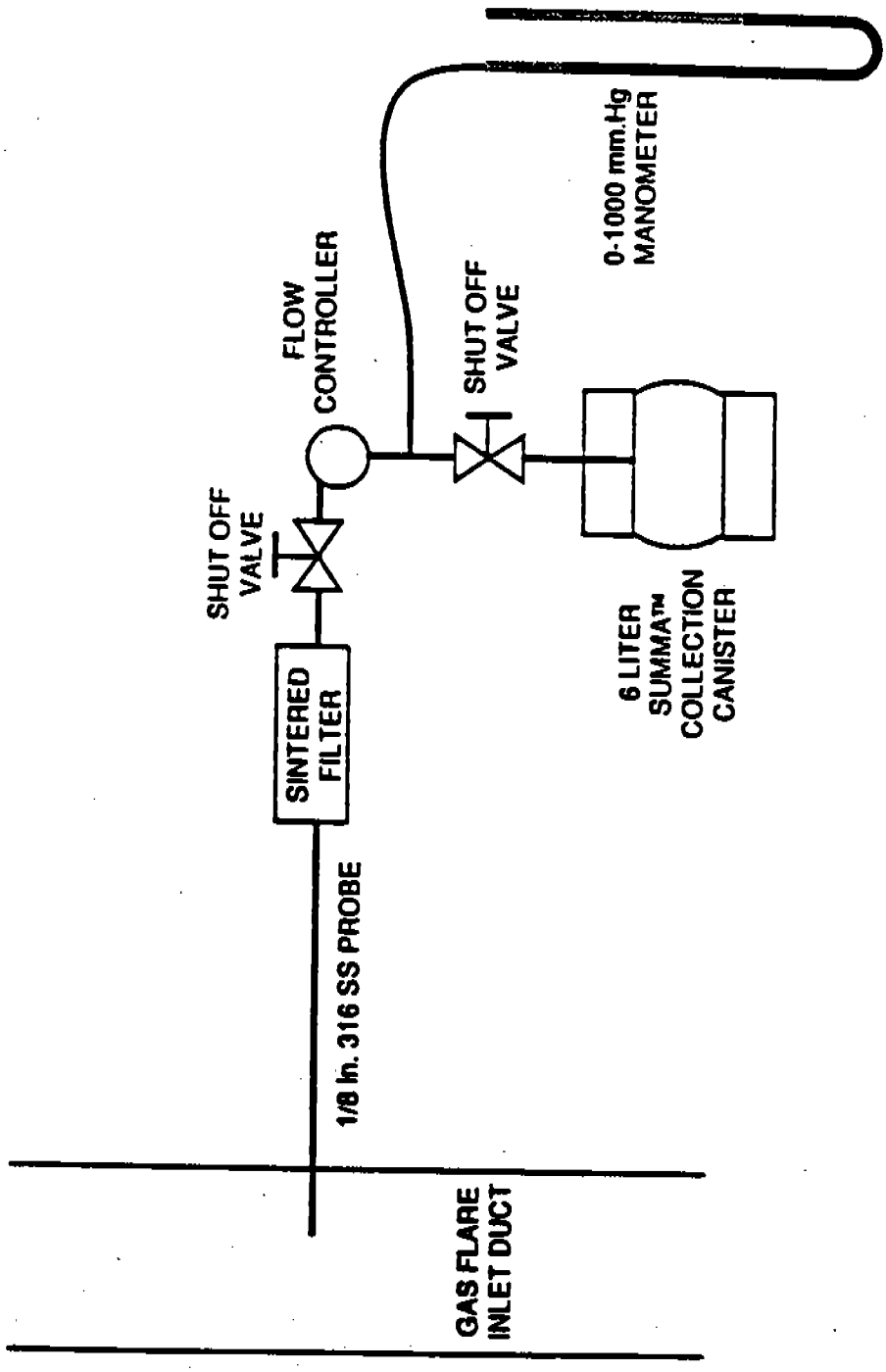


Figure D-1. VOC/NMO sampling train - flare inlet.

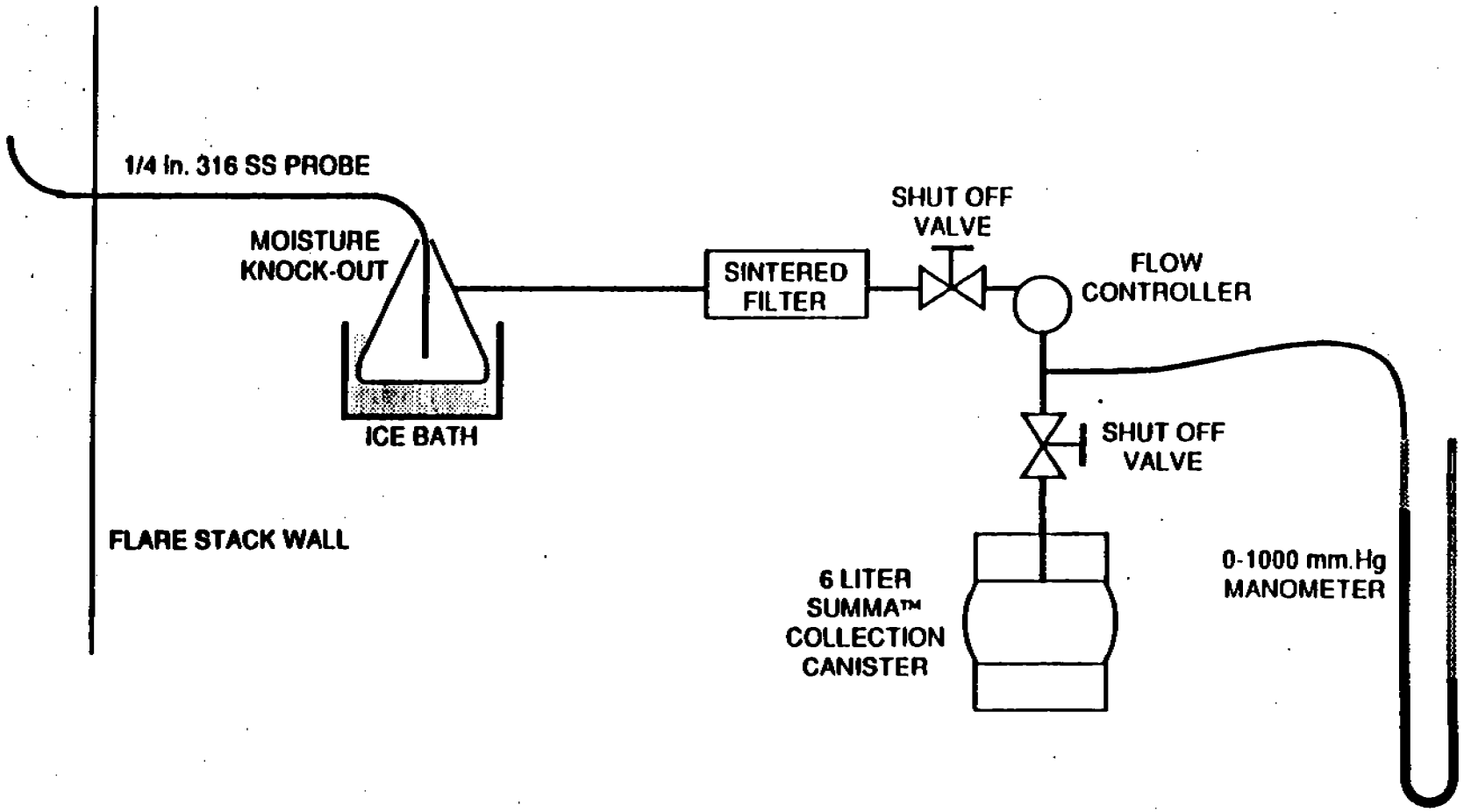


Figure D-2. VOC/NMO sampling train - flare outlet.

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	1,1,2,2-tetrachloroethane
carbon tetrachloride	tetrachloroethylene
chlorobenzene	toluene
chloroform	trichloroethylene
1,1-dichloroethane	1,1,1-trichloroethane
1,2-dichloroethylenes	vinyl chloride
ethyl benzene	xylenes
methylene chloride	

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 SULFURIC ACID MIST AND SULFUR DIOXIDE EMISSIONS

The following method was used in this test program. Sampling procedures followed those described in EPA Method 8.*

SAMPLING APPARATUS

The sulfuric acid (H_2SO_4) mist and sulfur dioxide (SO_2) sampling train used in these tests meets design specifications established by the Federal EPA with the exception of isokinetic sampling. Isokinetic sampling was not performed since gas temperatures were very high and all acid mist existed as a gas. Sampling was conducted at a single point within the flare stack for a 1-hour period. Assembled by PEI personnel, it consists of the following:

Probe - 5/8-in Quartz glass tube.

Filter Holder - Non-heated borosilicate glass with a glass frit filter support and a silicone rubber gasket. The holder design provided a positive seal against leakage from the outside or around the filter. The filter holder was placed between the first and second impingers.

Impingers - Four impingers connected in series with glass ball joints. The first and third are of the Greenburg-Smith design with standard tips. The second and fourth impingers are of the Greenburg-Smith design but modified by replacing the standard tip with a 1/2-in. i.d. glass tube extending to within 1/2-in. of the bottom of the impinger flask.

Metering System - Vacuum gauge, leak-free pump, thermometers or thermocouples capable of measuring temperature to within ±5°F, dry gas meter with 2 % accuracy, and related equipment as required to maintain an isokinetic sampling rate and to determine sample volume.

Barometer - Aneroid type capable of measuring atmospheric pressure to within ±0.1-in.Hg.

* 40 CFR 60, Appendix A, July 1989.

SAMPLING REAGENTS

Water - Deionized and distilled to conform to ASTM Specification D1193-74.

Isopropanol, 80% - 100 ml of isopropanol mixed with 200 ml of deionized, distilled water.

Hydrogen Peroxide, 3% - 100 ml of 30% hydrogen peroxide (H_2O_2) diluted to 1 liter with deionized, distilled water.

ANALYTICAL REAGENTS

Water - Deionized and distilled to conform to ASTM Specification D1193-74.

Isopropanol, 100%

Thorin Indicator

Barium Perchlorate Solution, 0.0100N - 1.95 grams of barium perchlorate trihydrate [$Ba(ClO_4)_2 \cdot H_2O$] dissolved in 200 ml distilled water, diluted to 1 liter with isopropanol and standardized against standard sulfuric acid.

SAMPLING PROCEDURE

Approximately 200 grams of silica gel were weighed in a sealed impinger prior to each test. The first impinger contained 100 ml of 80% isopropanol; this is followed by a 3-inch glass fiber filter.** The second and third impingers each contained 100 ml of 3% H_2O_2, and the fourth impinger contained the silica gel. The sampling train was set up with the probe as shown in Figure D-3. The sampling train was leak checked at the sampling site by plugging the inlet to the probe and pulling a vacuum of 15 in.Hg. Leakage rates of less than than 0.02 ft^3/min at a vacuum of 15 in.Hg. were considered acceptable to begin the sampling. At the completion of the test, the sampling train was leak checked using the same procedure but at the highest vacuum attained during the test run. Ice was placed around the impingers if necessary to keep the temperature of the gases leaving the last impinger at less than 68°F. During sampling, stack gas and sampling train data were recorded at each sampling point.

** Whatman Reeve Angel, 934 AH.

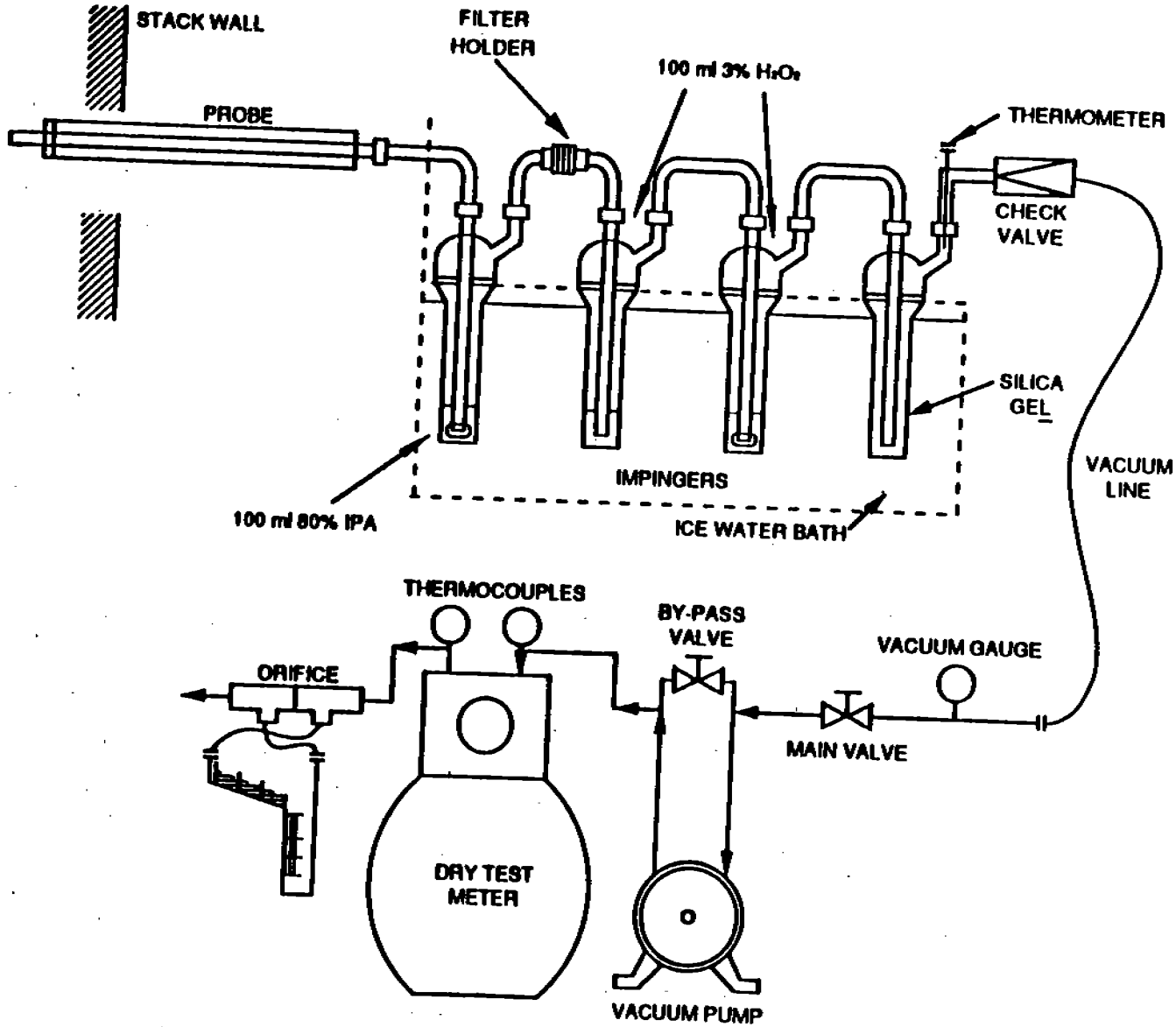


Figure D-3. Sulfuric acid and sulfur dioxide sampling train.

SAMPLE RECOVERY PROCEDURE

At the conclusion of the post test leak check, the probe and first impinger were disconnected from each other and the train is then purged for 15 minutes with ambient air to recover any remaining SO_2 in the isopropanol. After purging, the sampling train was moved carefully from the test site to the cleanup area.

The sampling fractions were recovered as follows:

Container No. 1 - Contents of the first impinger were transferred to a 250-ml graduated cylinder. The probe, first impinger, all connecting glassware before the filter, and the front half of the filter holder were rinsed with 80% isopropanol. This rinse was added to the graduated cylinder with the impinger contents and is diluted to 250 ml with 80% isopropanol. The filter is added to the impinger contents and transferred to a storage container and labeled. The liquid level of the container is marked.

Container No. 2 - Contents of the second and third impingers were transferred to a 1000 ml graduated cylinder. All connecting glassware (including the back half of the filter holder) between the filter and silica gel impinger were rinsed with dionized, distilled water. This rinse is added to the graduated cylinder. The cylinder contents are then diluted to 1000 ml with deionized, distilled water. This solution is transferred to a storage container. The liquid level is marked on the container and the container is labeled.

Container No. 3 - A minimum of 200 ml of 80% isopropanol was taken for blank analysis.

Container No. 4 - A minimum of 200 ml of 3% H_2O_2 was taken for a blank analysis.

ANALYTICAL PROCEDURES

The following procedures were used and followed those described in the method.

Container No. 1 - After shaking the container and allowing the filter fragments to settle, a 10 ml aliquot is pipetted into a 250 ml Erlenmeyer flask. 2 to 4 drops of thorin indicator are added and the solution is titrated to a pink end point using 0.0100 N barium perchlorate. The titration is repeated and the results averaged.

Container No. 2 - A 10 ml aliquot of this solution is pipetted into a 250 ml Erlenmeyer flask. 90 ml of isopropanol and 2 to 4 drops of thorin indicator are added and the solution is titrated as described above.

Containers No. 3 and 4 - Blanks were analyzed using the same procedure as their respective samples.

DETERMINATION OF HYDROGEN CHLORIDE AND HYDROGEN FLUORIDE EMISSIONS

Hydrogen chloride (HCl) and hydrogen fluoride (HF) emissions are measured with a proposed EPA Method 26 sampling train. In this method a sample is extracted from the source and passed through a dilute sulfuric acid solution. The HCl and HF gases were dissolved in this solution and formed ions of chloride (Cl^-) and fluoride (F^-) which were subsequently analyzed by ion chromatography.(IC). Isokinetic sampling was not performed since gas temperatures were very high and all acid mist existed as a gas. Sampling was conducted at a single point within the flare stack for a 1-hour period.

SAMPLING APPARATUS

The sampling train used in these tests was assembled by PEI personnel and met all design specifications established by the Federal EPA. The sampling apparatus consists of:

Probe - 5/8-in Quartz glass tube.

Temperature gauge - Type K thermocouple attached to the pitot tube in an interference-free arrangement with a digital readout to monitor stack gas temperature within 5°F.

Filter Holder - Pyrex glass with heating system capable of preventing moisture condensation.

Filter - Pallflex™ quartz fiber, 3-in diameter.

Draft gauge - An inclined manometer made by Dwyer with a readability of 0.01 in. H_2O in the 0- to 1.00-in. H_2O range and 0.1 in. H_2O in the 1.0- to 10.0-in. H_2O range will be used.

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 and HF. 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-4. 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.

The pitot tube and lines are leak-checked at the test site prior to and at the conclusion of each test run. The check is made by blowing into the impact opening of the pitot tube until 3 or more inches of water is recorded on the manometer and then capping the impact opening and holding it for 15 seconds to assure it is leak-free. The static pressure side of the pitot tube is leak-checked by the same procedure, except suction is used to obtain the 3-in. H_2O manometer reading. Crushed ice is placed around the impingers to keep the temperature of the gas leaving the last impinger at 68°F or less.

During sampling, stack gas and sampling train data are recorded at 10 minute intervals.

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:

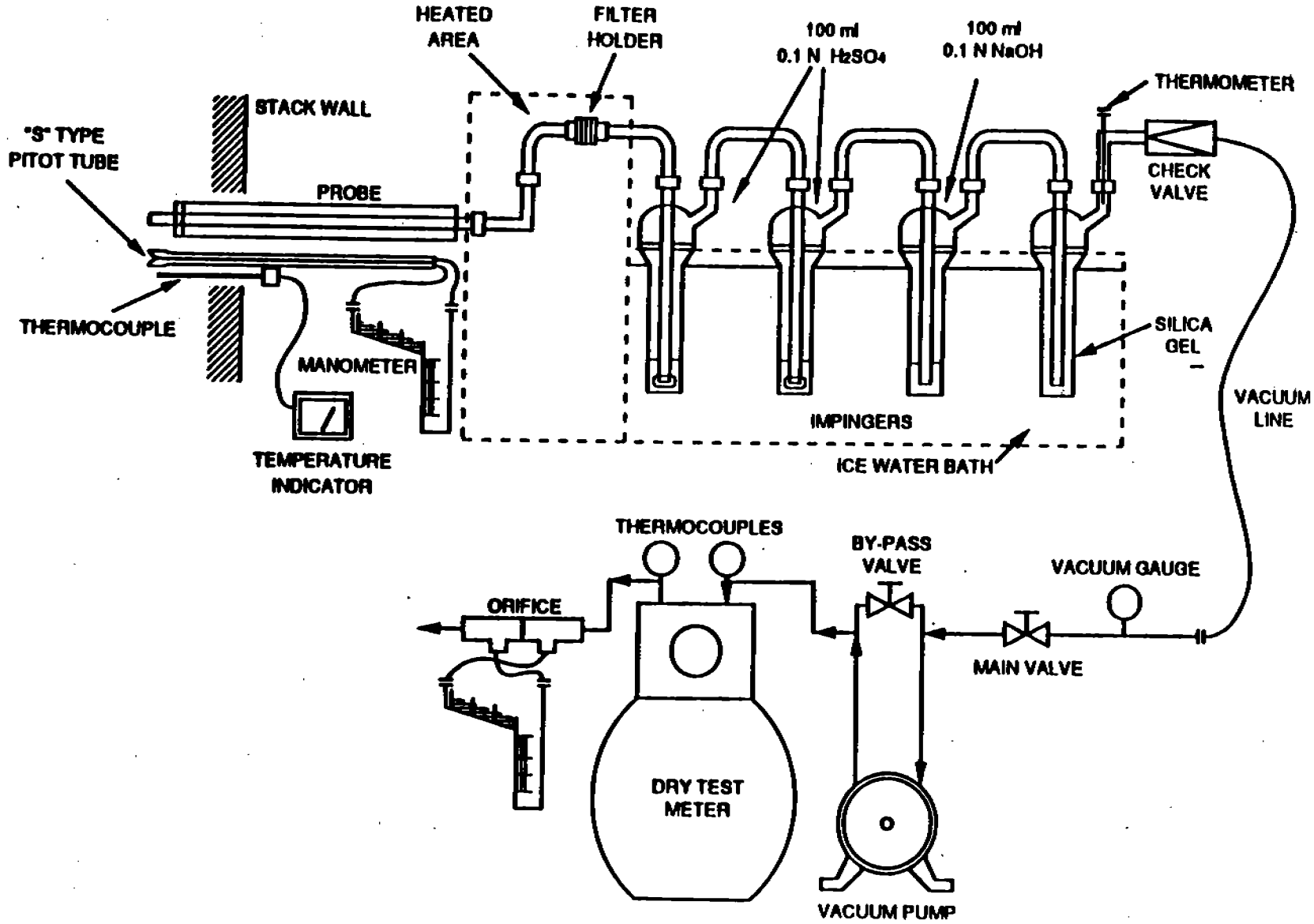


Figure D-4. Hydrogen chloride and hydrogen fluoride sampling train.

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 ions of chloride and fluoride. Analytical procedures will follow those described in EPA Method 300.0.* The results will be reported as HCl and HF. The mass emission rates are calculated from the product of the concentration and the volumetric flow rate of the stack gas.

* The Determination of Inorganic Anions in Water by Ion Chromatography, EPA-600/4-84-017, March 1984.

DETERMINATION OF ACETONE, ACRYLONITRILE, AND METHYL ETHYL KETONE EMISSIONS

Sampling and analysis at the gas flare inlet and outlet were conducted in accordance with procedures in EPA Method 18* for acetone, acrylonitrile, and methyl ethyl ketone (MEK). Analytical procedures will follow those described in NIOSH Methods 1604** for acrylonitrile and the combined procedures of NIOSH Methods 1300** and 2500** for acetone and MEK.

SAMPLING APPARATUS

The sampling train met design specifications established by the U.S. EPA and was assembled by PEI personnel. It consists of:

Probe - At the flare outlet, 1/4-in. o.d. stainless steel (316) tube connected to 1/4-in. o.d. teflon™ tubing with a heating system capable of preventing condensation. At the flare inlet, teflon™ tubing was used instead of the stainless steel probe since temperatures were not above 450°F.

Charcoal tube - Jumbo-sized tube containing 1000 milligrams (mg) of charcoal divided into two sections. The front section contains 800 mg of charcoal and the back section contains 200 mg. Two tubes in series were used for each sample run. The second tube of the series was in place as a backup in case the first tube was overloaded by a target pollutant.

Metering system - Vacuum gauges leak-free diaphragm pump, calibrated rotometer, Singer dry-gas meter measuring 1 liter/revolution with ±2 percent accuracy for flow rates between 0.25 and 1.0 liter/min.

Barometer - Aneroid type to measure atmospheric pressure to ±1 mm.Hg. during sampling and calibration.

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* 40 CFR 60, Appendix A, July 1989.

** NIOSH Manual of Analytical Methods, Third Edition, National Institute for Occupational Safety and Health, Cincinnati, Ohio, February 1984.

Sampling Procedures

The organic sampling train is assembled at the site and is leak checked by pulling a 10-in.Hg. vacuum on the train. The leak check is performed by closing the sample train off from the sample pump, and observing the vacuum on the train for 5 minutes. The leak check is considered acceptable if the vacuum drops by one-half inch or less during the leak check period.

Once the pretest leak check is completed, the probe is inserted into the duct and sampling is initiated by turning on the sample pump and adjusting the flow meter to the sampling. Sample flow rates were set at 0.2 liters/minute for the acetone/MEK samples and at 0.5 liters/minute for the acrylonitrile samples. At the completion of each sampling period, the probe is removed from the stack and the train is leak checked following the same procedures used for the pretest leak check, except that the post-test check is conducted at a vacuum equal to or higher than the maximum vacuum reached during the test. Once the post-test leak check is completed, the charcoal tubes are recovered by capping them on both ends and storing them on ice.

ANALYTICAL PROCEDURE

The front tube from each run is analyzed. Samples were prepared for analysis by scoring the charcoal tubes above the charcoal packing and then breaking the tubes. The glass wool and foam retainers in the tubes are removed and discarded. For the acetone/MEK samples, the charcoal from the front and back halves of the tube is placed in separate vials, and 5 ml of carbon disulfide (CS_2) is added to each vial for desorption. Similarly, the acrylonitrile samples are desorbed, but with a 5 ml solution of 2% v/v acetone in CS_2. The vials are sealed and mechanically shaken for 30 minutes. Approximately 5 minutes is allowed for the charcoal in each vial to settle after shaking is stopped. After settling, the solvent portion of each sample is transferred to another vial of analysis.

A gas chromatograph with a flame ionization detector (GC/FID) is used to analyze the extracts from each sample. Calibration standards are prepared in accordance with the NIOSH methods for the specific compounds.* Three

* NIOSH Manual of Analytical Methods, Third Edition, National Institute for Occupational Safety and Health, Cincinnati, Ohio, February 1984.

standards selected to bracket the expected concentrations in the source samples are used to calibrate the analyzer at the beginning and end of each day's analyses.

QUALITY ASSURANCE

The following quality assurance steps were used during the sampling and analytical program:

- Sampling train leak check. These checks will be performed before and after each test. Procedures for these leak checks are described in the Sampling Procedures section of this attachment.

- Desorption efficiency determination. Desorption efficiencies of specific compounds will be determined from the same lot of charcoal tubes used or sampling. Desorption efficiencies determined for the compounds will be divided into analytical results to calculate equivalent measured source concentrations.

- Determination of sample collection efficiency. The front and back sections of the charcoal tubes will be analyzed separately. If the backup portion contains more than 10 percent of the total material collected, the backup tube from the sample run will be analyzed.

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), oxygen (O_2)and carbon dioxide (CO_2)..

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-5. 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 >100 psi.

Pressure gauge - 0 to 160 psi.

Sample Collection Cylinder - 300cc 316 stainless steel cylinderical container with shut-off valves at both ends.

SAMPLING PROCEDURE

The sampling apparatus was set-up as shown in Figure D-5. Initially the sample cylinder was purged with landfill gas by opening both shut-off valves with the sample pump on for at least 1 minute. After this period, the shut-off valve at the outlet of the sample cylinder was closed. A sample of the landfill gas was collected by pressurizing the cylinder to >100 psi. After the targeted pressure was reached or exceeded, the inlet shut-off valve was closed. The cylinder was then removed from the site and shipped overnight to the analytical laboratory.

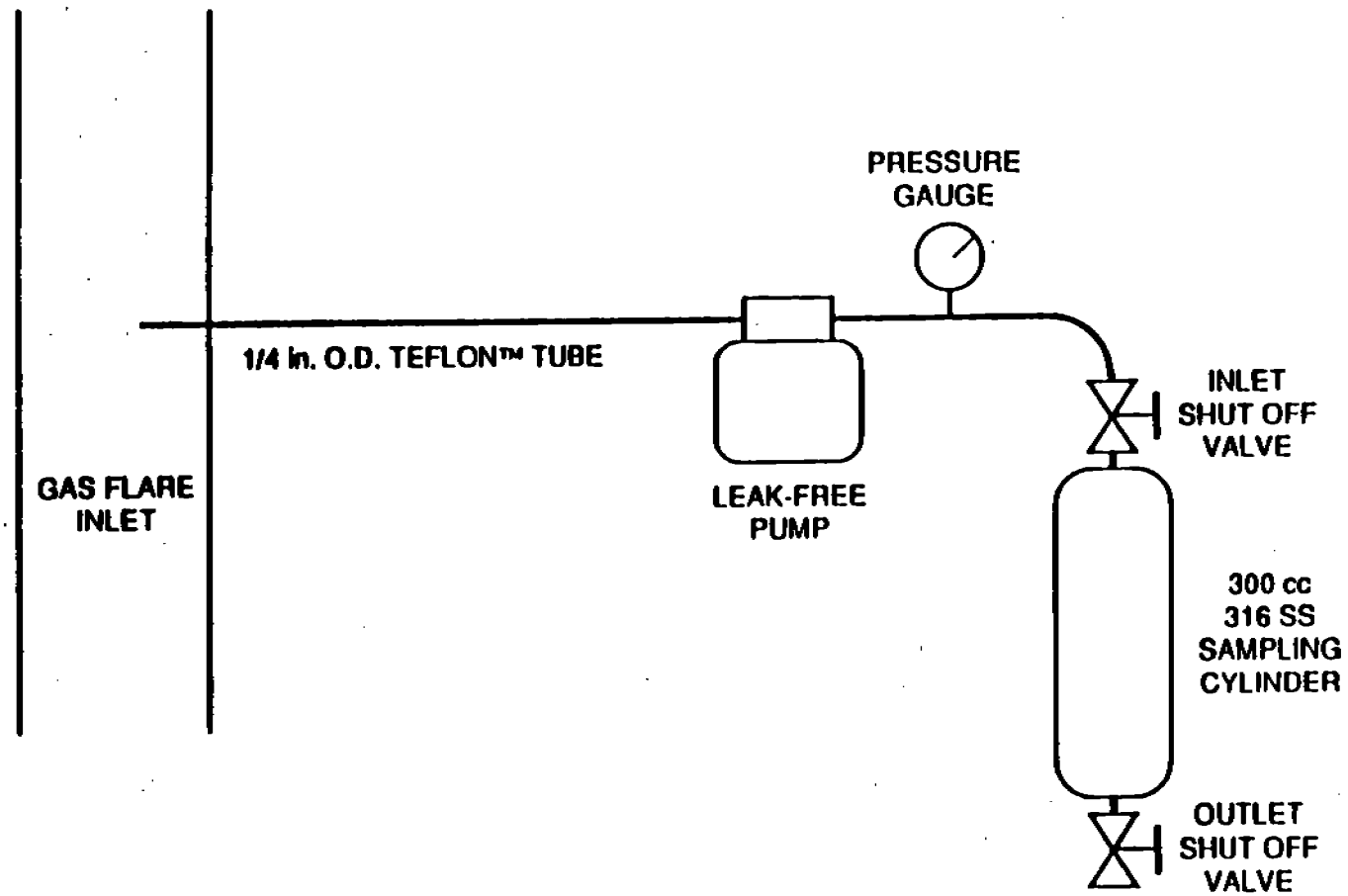
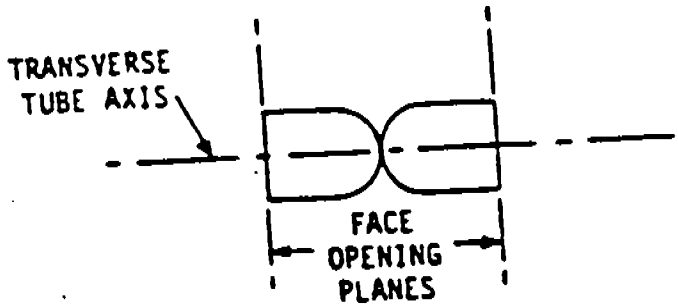


Figure D-5. Fuel gas analysis sampling apparatus.

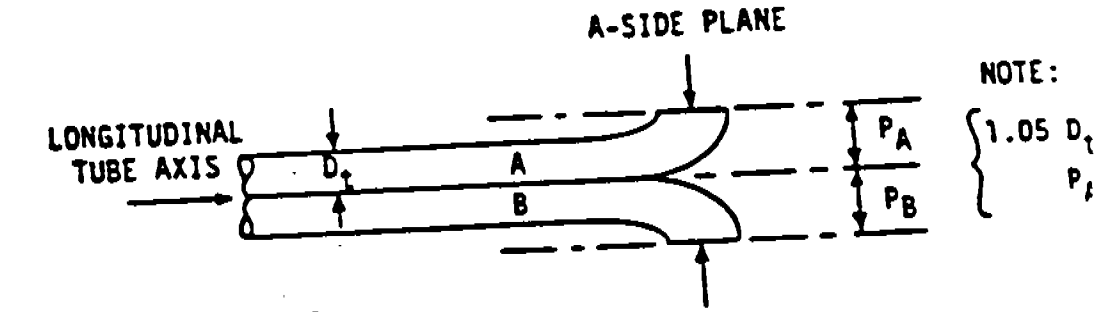
ANALYSIS

Analysis for CH_4, N_2, O_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).

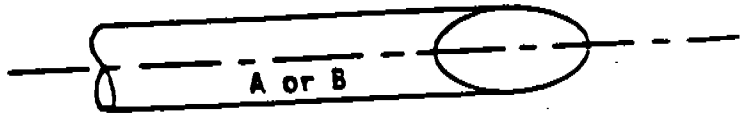
* Annual Book of ASTM Standards, Section 5, Volume 05.05.



(a) ENDVIEW



(b)



(c)

Figure E-1. Properly constructed Type S pitot tube, shown i
face opening planes perpendicular to transverse axis; (b) to
ing planes parallel to longitudinal axis; (c) side view; bo
length and centerlines coincident, when viewed from both si
coefficient values of 0.84 may be assigned to pitot tube

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 and 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 $\Delta H@$ 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.

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 301 Date 12-8-89 Inspector G Thress

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.

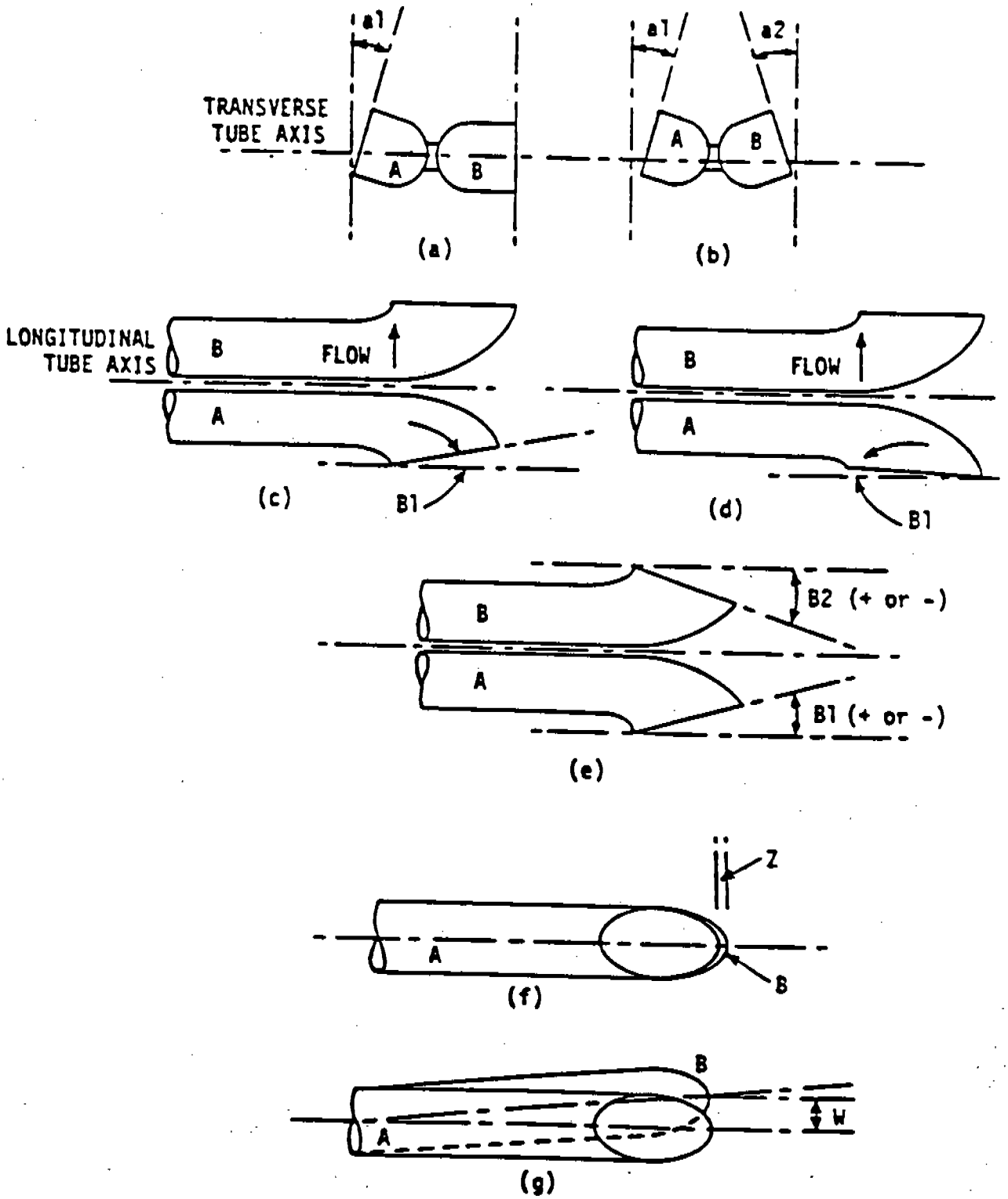


Figure E-2. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect Cp so long as a_1 and a_2 <10°, B_1 and B_2 <5°, z <0.32 (1/8 in.) and w <0.08 cm (1/32 in.).

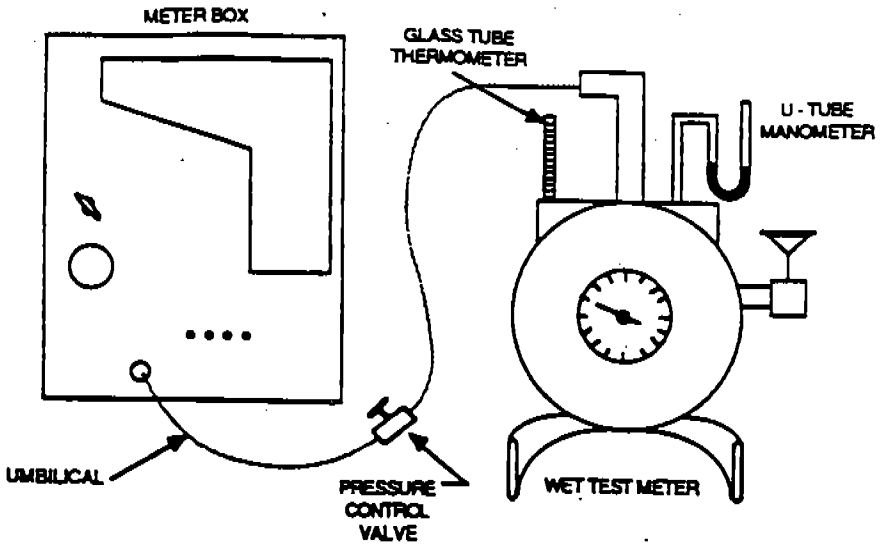


Figure E-4. Calibration setup.

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 ⊘, min.	Y	$\Delta H@$
				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: $\frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@$: $\frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\varnothing}{V_w}\right]^2$
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

$\Delta H@$ = Orifice of pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in H_g). Tolerance = ± 0.15.

Figure E-5. Calibration data sheet.

PITOT TUBE INSPECTION DATA SHEET

Pitot Tube No. 523 Date 7/6/90 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 ≤ 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.

PARTICULATE SAMPLING METER BOX INITIAL CALIBRATION

DATE: 5-11-90 METER BOX NO. FT-3

CALIBRATOR: J. Neese BAROMETRIC PRESSURE (P_b) 29.52 in. Hg

Leak Checks:

Positive (minimum 5 in. H_2O): ✓

Negative (within 3 in. Hg of absolute): 0.001 cfm* 28.0 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	ΔH@ in H_2O
0.5	5.0	956.047	70.5	79	74	76.25	12:14.01	10	1.003	1.69
		961.079	70.5	78	74					
1.0	10.0	961.558	70.5	78	74	76.75	17:37.94	10	1.009	1.75
		971.564	70.5	80	75					
1.5	10.0	972.267	70.5	80	75	77.75	14:05.97	10	1.012	1.68
		982.242	70.5	81	75					
2.0	12.0	982.630	70.5	81	75	78.5	15:05.72	10	1.014	1.78
		994.584	70.5	82	76					
3.0	10.0	995.232	70.5	82	76	79.5	10:17.51	10	1.017	1.78
		1005.154	70.5	84	76					
4.0	10.0	1005.841	70.5	84	76	80.5	8:56.60	10	1.020	1.79
		1015.737	70.5	85	77					
								Average	1.013	1.75

Y must not deviate by more than ±0.02 Y.
ΔH@ must not deviate by more than 0.15 in H_2O.

ΔH	Y: $\frac{(V_w)(P_b)(T_d + 460)}{(V_d)(P_b + \Delta H/13.6)(T_w + 460)}$	ΔH@: $\frac{(0.0317)(\Delta H)}{(P_b)(T_d + 460)}\left[\frac{(T_w + 460)(\theta)}{(V_w)}\right]^2$
0.5	$\frac{(5)(29.52)(536.25)}{(5.032)(29.56)(530.5)}$	$\frac{(.0317)(0.5)}{(29.52)(536.75)}\left[\frac{(530.5)(12.23)}{(5)}\right]^2$
1.0	$\frac{(10)(29.52)(536.75)}{(10.006)(29.59)(530.5)}$	$\frac{(.0317)(1.0)}{(29.52)(536.75)}\left[\frac{(530.5)(17.63)}{(10)}\right]^2$
1.5	$\frac{(10)(29.52)(537.75)}{(9.975)(29.63)(530.5)}$	$\frac{(.0317)(1.5)}{(29.52)(537.75)}\left[\frac{(530.5)(14.10)}{(10)}\right]^2$
2.0	$\frac{(12)(29.52)(538.5)}{(11.954)(29.67)(530.5)}$	$\frac{(.0317)(2.0)}{(29.52)(538.5)}\left[\frac{(530.5)(15.10)}{(12)}\right]^2$
3.0	$\frac{(10)(29.52)(539.5)}{(9.922)(29.74)(530.5)}$	$\frac{(.0317)(3.0)}{(29.52)(539.5)}\left[\frac{(530.5)(10.29)}{(10)}\right]^2$
4.0	$\frac{(10)(29.52)(540.5)}{(9.896)(29.81)(530.5)}$	$\frac{(.0317)(4.0)}{(29.52)(540.5)}\left[\frac{(530.5)(8.94)}{(10)}\right]^2$

Figure E-6a. Particulate sampling meter box initial calibration.

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 Figures E-6a and E-6b. The post-test meter box calibration data are presented in Figures E-7a and E-7b.

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 through 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 Figure E-9a through E-9d.

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 1990.

PARTICULATE SAMPLING METER BOX
POST-TEST CALIBRATION

DATE: 8/15/90
METER BOX NO. FT-3
BAROMETRIC PRESSURE (P_{bar}): 29.53 in. Hg
PRETEST Y: 1.013 ΔH@: 1.75
PLANT: Disposal Specialists
PROJECT NO. 50016
PROJECT MANAGER: D. Fitzgerald
CALIBRATOR: R. Kolb

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	Temperatures: Dry gas meter Inlet T_{di} °F	Temperatures: Dry gas meter Outlet T_{di} °F	Temperatures: Dry gas meter Average T_d °F	Vacuum setting ** in. Hg	Duration of run Ø min	Y	ΔH@
1.75	10	487.900	72	85	76	81	10	13.18.88	.986	1.7
		498.171	72	85	78	541				
1.75	12	498.171	72	85	78	81.5	10	15.59.06	.986	1.74
		510.505	72	85	78	541.5				
1.75	12	510.505	72	85	78	82	10	16.00.79	.987	1.7
		522.842	72	86	79	542				
						Post-test average***			.986	1.74

Y	ΔH@
$\frac{(V_w)(P_{bar})(T_d + 460)}{(V_d)(P_{bar} + \Delta H/13.6)(T_w + 460)}$	$\frac{(0.0317)(\Delta H)}{(P_{bar})(T_d + 460)}\left[\frac{(T_w + 460)(\Ø)}{(V_w)}\right]^2$
$\frac{(10)(29.53)(541)}{(10.271)(29.66)(532)}$	$\frac{(.0317)(1.75)}{(29.53)(541)}\left[\frac{(532)(13.31)}{(10)}\right]^2$
$\frac{(12)(29.53)(541.5)}{(12.334)(29.66)(532)}$	$\frac{(.0317)(1.75)}{(29.53)(541.5)}\left[\frac{(532)(15.98)}{(12)}\right]^2$
$\frac{(12)(29.53)(542)}{(12.337)(29.66)(532)}$	$\frac{(.0317)(1.75)}{(29.53)(542)}\left[\frac{(532)(16.01)}{(12)}\right]^2$

*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-7a. Particulate sampling meter box post-test calibration.

PARTICULATE SAMPLING METER BOX INITIAL CALIBRATION

DATE: 7/25/90 METER BOX NO. FT-7

CALIBRATOR: R. Kolde 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_1 °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	ΔH@ in H_2O
0.5	6	312.800	72	78	76	77.75	15.17.39	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	11.38.16	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	89	82	544.75				
								Average	.989	1.46

Y must not deviate by more than ±0.02 Y.

ΔH@ must not deviate by more than 0.15 in H_2O.

ΔH	Y: $\frac{(V_w)(P_b)(T_d + 460)}{(V_d)(P_b + \Delta H/13.6)(T_w + 460)}$	ΔH@: $\frac{(0.0317)(\Delta H)}{(P_b)(T_d + 460)}\left[\frac{(T_w + 460)(\theta)}{(V_w)}\right]^2$
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	$\frac{(10)(29.64)(537.75)}{(10.245)(29.71)(532)}$	$\frac{(.0317)(1.0)}{(29.64)(539.75)}\left[\frac{(532)(15.89)}{(10)}\right]^2$
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	$\frac{(11)(29.64)(543.5)}{(11.251)(29.86)(532)}$	$\frac{(.0317)(3.0)}{(29.64)(543.5)}\left[\frac{(532)(10.26)}{(11)}\right]^2$
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-6b. Particulate sampling meter box initial 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.

PARTICULATE SAMPLING METER BOX
POST-TEST CALIBRATION

DATE: 8/19/90 METER BOX NO. FT-7

BAROMETRIC PRESSURE (P_{bar}): 29.53 in. Hg PRETEST Y: .984 ΔH@: 1.46

PLANT: Liquid Spaceflight PROJECT NO. 5016

PROJECT MANAGER: D. Fitzgerald CALIBRATOR: R. Kelly

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	Temperatures: Dry gas meter Inlet T_{di} °F	Temperatures: Dry gas meter Outlet T_{di} °F	Temperatures: Dry gas meter Average T_d °F	Vacuum setting ** in. Hg	Duration of run θ 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@
$\frac{(V_w)(P_{bar})(T_d + 460)}{(V_d)(P_{bar} + \Delta H/13.6)(T_w + 460)}$	$\frac{(0.0317)(\Delta H)}{(P_{bar})(T_d + 460)}\left[\frac{(T_w + 460)(\theta)}{(V_w)}\right]^2$
$\frac{(10)(29.53)(538)}{(10.150)(29.64)(532)}$	$\frac{(.0317)(1.46)}{(29.53)(538)}\left[\frac{(532)(13.34)}{(10)}\right]^2$
$\frac{(11)(29.53)(538.5)}{(11.202)(29.64)(532)}$	$\frac{(.0317)(1.46)}{(29.53)(538.5)}\left[\frac{(532)(14.67)}{(11)}\right]^2$
$\frac{(13)(29.53)(539.25)}{(13.252)(29.64)(532)}$	$\frac{(.0317)(1.46)}{(29.53)(539.25)}\left[\frac{(532)(17.35)}{(13)}\right]^2$

*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-7b. Particulate sampling meter box post-test calibration.

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 5-10-90 INDICATOR NO: FT-3

OPERATOR: J. Neese SERIAL NO:

CALIBRATION DEVICE NO: 2 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	202	.30
4	6.092	300	301	.13
5	8.314	400	400	0
6	10.560	500	502	.21
7	22.251	1000	1004	.27
8	29.315	1300	1304	.23
9	36.166	1600	1605	.24
10	42.732	1900	1906	.25

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 CALIBRATION DATA SHEET

Date: 12/15/89 Thermocouple No.: 734

Calibrator: G Thoss Reference: ASTM 3F

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: 9-8-89 INDICATOR NO: VB-1

OPERATOR: J. Neese SERIAL NO:

CALIBRATION DEVICE NO: 2 MANUFACTURER: Omega

TEST POINT NO.	MILLIVOLT SIGNAL	EQUIVALENT TEMPERATURE, deg. F	DIGITAL INDICATOR TEMPERATURE READING, deg. F	DIFFERENCE s
1	-0.692	0	0	0
2	1.520	100	101	.18
3	3.819	200	201	.15
4	6.092	300	301	.13
5	8.314	400	400	0
6	10.560	500	502	.21
7	22.251	1000	1003	.21
8	29.315	1300	1302	.11
9	36.166	1600	1602	.10
10	42.732	1900	1903	.13

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-9c. Thermocouple digital indicator calibration data sheet.

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 7/24/90 INDICATOR NO: FT-7

OPERATOR: R. Kalb 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:

$$\frac{(\text{Equivalent temperature, deg. R} - \text{Digital indicator temperature, deg. R})(100\%)}{(\text{Equivalent temperature, deg. R})}$$

Where, deg. R = deg. F + 460

Figure E-9b. Thermocouple digital indicator calibration data sheet.

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 Figures E-10a through E-10d.

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 Figures E-11a and E-11b.

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.

Low Flow Dry Gas Meter

The low flow dry gas meter for the charcoal sampling train is calibrated against an electronic bubble meter at flow rates of 1, 0.5, and 0.25 liter/min. After the

THERMOCOUPLE DIGITAL INDICATOR
CALIBRATION DATA SHEET

DATE: 12-28-89 INDICATOR NO: VB-3

OPERATOR: J. Nease SERIAL NO:

CALIBRATION DEVICE NO: 2 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	101	.18
3	3.819	200	200	0
4	6.092	300	301	.13
5	8.314	400	399	.12
6	10.560	500	501	.10
7	22.251	1000	1002	.14
8	29.315	1300	1302	.11
9	36.166	1600	1601	.05
10	42.732	1900	1901	.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-9d. 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.

''Difference must be less than 3 deg. F at both points

Figure E-10b. Dry gas thermocouple calibration data sheet.

DRY GAS THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 5/10/90 Thermocouple No.: FT-3

Calibrator: R. Kolodi Reference: ASTM-3F

INLET

Reference point No.	Source*	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F**
1	1	71	72	1
2	2	34	35	1
3	3	150	150	0

OUTLET

Reference point No.	Source*	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F**
1	1	71	71	0
2	2	34	34	0
3	3	150	151	1

*Source: 1 - Ambient
2 - Ice bath
3 - Water bath

**Difference must be less than 5 deg. F at both points

Figure E-10a. Dry gas thermocouple calibration data sheet.

DRY GAS THERMOMETER CALIBRATION DATA SHEET

Date: 12-28-89 Thermometer No.: VB-3

Calibrator: J Neese Reference: ASTM-3F

Reference point No.	Source *	Reference thermometer temperature, °F	Dry gas thermometer temperature, °F	Difference, °F**
1	2	72	71	1
2	1	32	32	0
3	3	158	158	0

*Source: 1) Ice bath
2) Ambient
3) Water bath

**Difference must be less than or equal to ±5°F.

Figure E-10d. Dry gas thermometer calibration data sheet.

DRY GAS THERMOMETER CALIBRATION DATA SHEET

Date: 9-8-89 Thermometer No.: VB-1

Calibrator: J. Neese Reference: ASTM-3F

Reference point No.	Source *	Reference thermometer temperature, °F	Dry gas thermometer temperature, °F	Difference, °F**
1	2	74	73	1
2	1	34	34	0
3	3	198	198	0

*Source: 1) Ice bath
2) Ambient
3) Water bath

**Difference must be less than or equal to ±5°F.

Figure E-10c. Dry gas thermometer calibration data sheet.

IMPINGER THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 12/8/89 Thermocouple No: I-37

Calibrator: M. Koetter Reference: ASTM. THERM.

Reference point No.	Source'	Reference thermometer temperature deg. F	Thermocouple temperature deg. F	Difference deg. F''
1	1	74	74	.00°
2	2	32	32	—

'Source: 1) Ambient
2) Ice bath

''Difference must be less than 2 deg. F at both points

Figure E-11b. Impinger thermocouple calibration data sheet.

IMPINGER THERMOCOUPLE
CALIBRATION DATA SHEET

Date: 1/9/90 Thermocouple No: I-22

Calibrator: M.K. Reference: ASTM-3E

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-11a. Impinger thermocouple calibration data sheet.

BAROMETER CALIBRATION LOG

BAROMETER NO.	408	1/1/4		410	408	414	711
	[illegible]	Cal 9.1		50020	50020	500.4	50000-1

PRETEST

BAROMETER READING	29.48	29.49	30.20	29.54	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	.70	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	[illegible]	MK	MK	[illegible]	[illegible]	[illegible]	[illegible]

POST-TEST

BAROMETER READING	29.60				29.65	29.[illegible]	
REFERENCE BAROMETER READING	29.60				29.62	29.[illegible]0	
DIFFERENCE**	0.00				0.03	.0[illegible]	
DATE	7/27/90				8/8/90	8/7/90	
CALIBRATOR	R. Kilch				MK	[illegible]	

*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.

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.

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
① CAHILL	4/30/90	5700	10.0
① CAHILL	6/5/90	5766	10.00
R. Kolde	6/15/90	5008	10.0
B Gorls	7/11/90	5019	9.8
[illegible]	7/[illegible]	5002 5003	9.8
R. Kolde	7/31/90	5014 5016	9.8
R. Kolde	8/15/90	5652	9.8

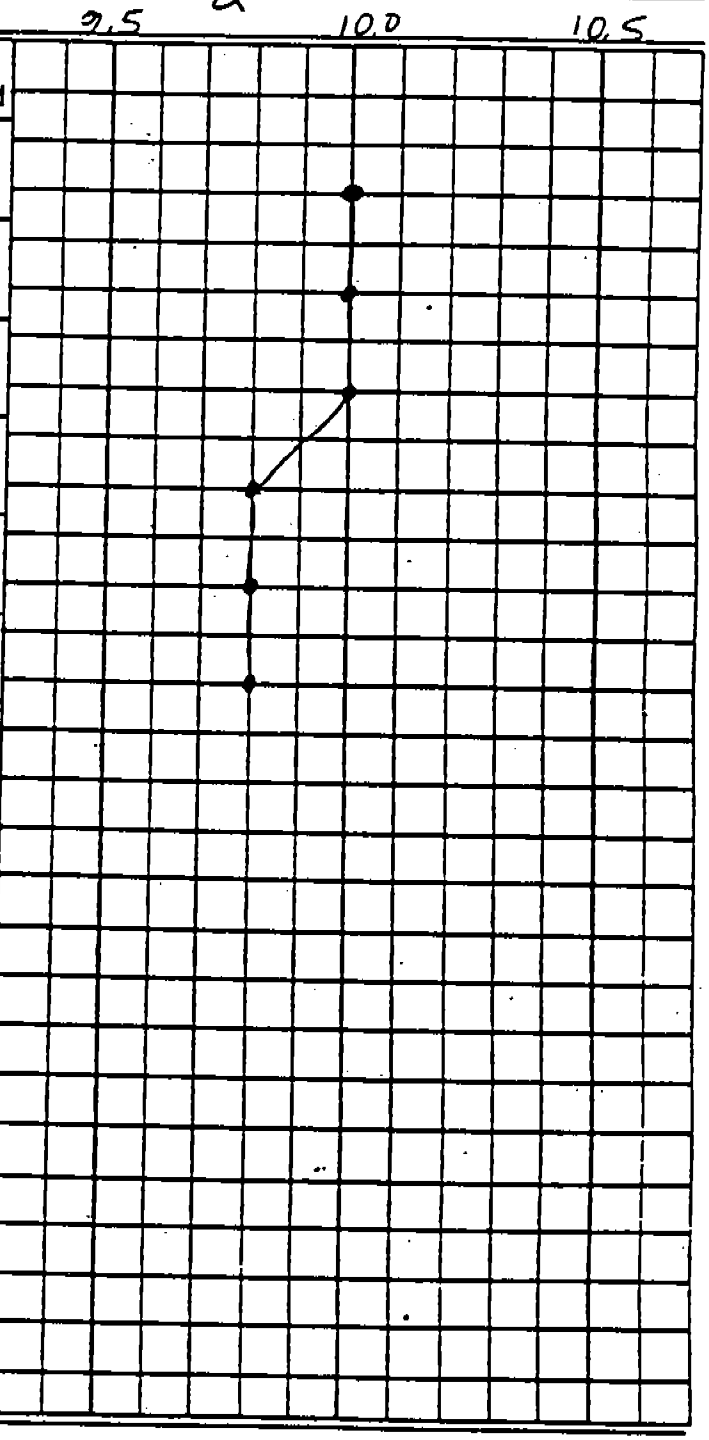


Figure E-14b. Orsat calibration data sheet.

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	5800	5.0
[illegible]	7/11/90	500 19	5.0
[illegible]	[illegible]	[illegible]	[illegible]
R. Kolde	7/31/90	5800 M 5801G	5.0
R. Kolde	8/17/90	5682	5.0

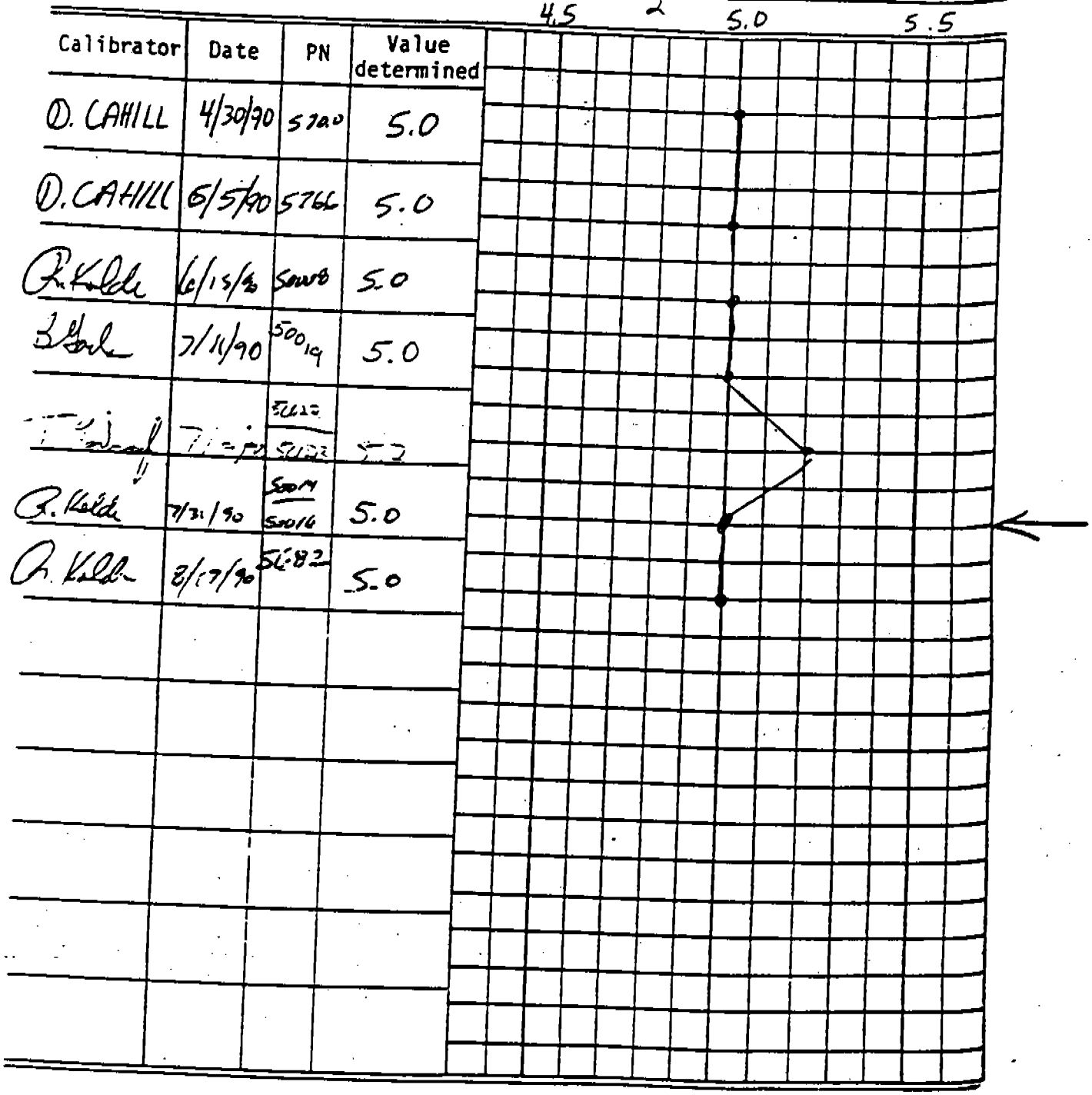


Figure E-14a. Orsat calibration data sheet.

DRY GAS METER PRE-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 9-8-89

CALIBRATION BY: J. Neese

METER CONSOLE NO: VB-1

NOMINAL FLOW RATE: 1.0 LITERS/MINUTE

BUBBLE METER NO: 4765-5 ROTO. SETTING 53

RUN # 1

BUBBLE METER CONDITIONS:

bubble meter times (Qbm) (liters/minute)

1: 991 l/min. 5: 987.8 l/min.
2: 1001 l/min. 6: 1003 l/min.
3: 991 l/min. 7: 1002 l/min.
4: 1003 l/min. Avg: 997.0 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 73.0 liters
volume final (Vmf): 83.0 liters
temp. initial (Tdgmi): 96 deg. F
temp. final (Tdgmf): 97 deg. F
temp. avg. (Tdgm): 96.5 deg. F
time, dgm 9.48 min.
calculated y = .992

RUN # 2

BUBBLE METER CONDITIONS:

temp. (Tbm) 70 deg. F

bubble meter times (Qbm) (liters/minute)

1: 1001 l/min. 5: 1002 l/min.
2: 1002 l/min. 6: 1001 l/min.
3: 1002 l/min. 7: 1002 l/min.
4: 997.4 l/min. Avg: 1001 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 84.0 liters
volume final (Vmf): 94.0 liters
temp. initial (Tdgmi): 97 deg. F
temp. final (Tdgmf): 98 deg. F
temp. avg. (Tdgm): 97.5 deg. F
time, dgm 9.40 min.
calculated y = .990

RUN # 3

BUBBLE METER CONDITIONS:

temp. (Tbm) 70 deg. F

bubble meter times (Qbm) (liters/minute)

1: 1002 l/min. 5: 1002 l/min.
2: 1002 l/min. 6: 987.8 l/min.
3: 1001 l/min. 7: 984.6 l/min.
4: 1001 l/min. Avg: 997.2 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 95.0 liters
volume final (Vmf) 105.0 liters
temp. initial (Tdgmi): 98 deg. F
temp. final (Tdgmf): 99 deg. F
temp. avg. (Tdgm): 98.5 deg. F
time, dgm 9.31 min.
calculated y = .979

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE PRE-TEST Y = .987

Figure E-15a. Dry gas meter pre-test calibration.

bubble meter is connected to the gas meter inlet, the meter is operated for 5 minutes to stabilize flow. After warmup, three separate calibrations are made with a total metered volume of 5 liters and at least seven bubble meter flow rate readings. Bubble meter readings are acceptable if the ratio of the shortest time to the longest time is greater than 0.95. The meter calibration factors for all thrree runs must agree within ±0.02 Y. The pretest calibration data for the meters used in this test are shown in Figures E-15a through E-15f. Post-test calibration data are shown in Figures E-16a through E-16d.

DRY GAS METER PRE-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 9-8-89 METER CONSOLE NO: VB-1

CALIBRATION BY: J. Neese NOMINAL FLOW RATE: .5 LITERS/MINUTE

BUBBLE METER NO: 4765-5 ROTO. SETTING 28

RUN # 1

BUBBLE METER CONDITIONS:

[redacted]

bubble meter times (Qbm): (liters/minute)

1: 503.6 l/min. 5: 504.4 l/min.
2: 507.8 l/min. 6: 501.1 l/min.
3: 504.4 l/min. 7: 504.4 l/min.
4: 502.0 l/min. Avg: 504.0 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 54.0 liters
volume final (Vmf): 59.0 liters
temp. initial (Tdgmi): 91 deg. F
temp. final (Tdgmf): 93 deg. F
temp. avg. (Tdgm): 92 deg. F
time, dgm 9.42 min.
calculated y = .989

RUN # 2

BUBBLE METER CONDITIONS:

temp. (Tbm) 70 deg. F

bubble meter times (Qbm) (liters/minute)

1: 502.0 l/min. 5: 505.3 l/min.
2: 505.3 l/min. 6: 502.0 l/min.
3: 503.6 l/min. 7: 505.3 l/min.
4: 502.0 l/min. Avg: 503.7 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 60.0 liters
volume final (Vmf): 65.0 liters
temp. initial (Tdgmi): 93 deg. F
temp. final (Tdgmf): 94 deg. F
temp. avg. (Tdgm): 93.5 deg. F
time, dgm 9.49 min.
calculated y = .998

RUN # 3

BUBBLE METER CONDITIONS:

temp. (Tbm) 70 deg. F

bubble meter times (Qbm) (liters/minute)

1: 502.9 l/min. 5: 502.0 l/min.
2: 502.8 l/min. 6: 503.6 l/min.
3: 501.1 l/min. 7: 502.8 l/min.
4: 504.4 l/min. Avg: 502.8 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 66.0 liters
volume final (Vmf): 71.0 liters
temp. initial (Tdgmi): 95 deg. F
temp. final (Tdgmf): 96 deg. F
temp. avg. (Tdgm): 95.5 deg. F
time, dgm 9.48 min.
calculated y = .999

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE PRE-TEST Y = .995

Figure E-15c. Dry gas meter pre-test calibration.

DRY GAS METER PRE-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 9-8-89

CALIBRATION BY: J. Neese

METER CONSOLE NO: VB-1

NOMINAL FLOW RATE: .25 LITERS/MINUTE

BUBBLE METER NO: 4765-S ROTO. SETTING 14

RUN # 1

BUBBLE METER CONDITIONS:

temp. (Tbm) 73 deg. F

bubble meter times (Obm) (liters/minute)

1: 247.5 l/min. 5: 246.0 l/min.
2: 247.3 l/min. 6: 246.2 l/min.
3: 247.1 l/min. 7: 252.0 l/min.
4: 247.5 l/min. Avg: 247.7 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 30.0 liters
volume final (Vmf): 33.0 liters
temp. initial (Tdgmi): 80 deg. F
temp. final (Tdgmf): 84 deg. F
temp. avg. (Tdgm): 82 deg. F
time, dgm 11.98 min.
calculated y = 1.006

RUN # 2

BUBBLE METER CONDITIONS:

temp. (Tbm) 73 deg. F

bubble meter times (Obm) (liters/minute)

1: 246.5 l/min. 5: 246.2 l/min.
2: 246.5 l/min. 6: 246.2 l/min.
3: 246.7 l/min. 7: 246.0 l/min.
4: 246.9 l/min. Avg: 246.4 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 33.5 liters
volume final (Vmf): 36.5 liters
temp. initial (Tdgmi): 84 deg. F
temp. final (Tdgmf): 89 deg. F
temp. avg. (Tdgm): 86.5 deg. F
time, dgm 11.90 min.
calculated y = 1.002

RUN # 3

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Obm) (liters/minute)

1: 246.0 l/min. 5: 247.7 l/min.
2: 246.0 l/min. 6: 248.9 l/min.
3: 245.6 l/min. 7: 248.3 l/min.
4: 244.8 l/min. Avg: 246.9 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 37.0 liters
volume final (Vmf): 40.0 liters
temp. initial (Tdgmi): 89 deg. F
temp. final (Tdgmf): 91 deg. F
temp. avg. (Tdgm): 90 deg. F
time, dgm 11.76 min.
calculated y = 1.000

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Obm}{Qdgm}$$

AVERAGE PRE-TEST Y = 1.003

Figure E-15b. Dry gas meter pre-test calibration.

DRY GAS METER PRE-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 12-28-89
CALIBRATION BY: J. Neese
METER CONSOLE NO: VB-3
NOMINAL FLOW RATE: .50 LITERS/MINUTE
BUBBLE METER NO: 4765-S ROTO. SETTING 29

RUN # 1

BUBBLE METER CONDITIONS:
temp. (Tbm) 72 deg. F
bubble meter times (Qbm) (liters/minute)
1: 497.1 l/min. 5: 501.1 l/min.
2: 505.3 l/min. 6: 503.6 l/min.
3: 505.3 l/min. 7: 503.6 l/min.
4: 503.6 l/min. Avg: 502.8 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 58.0 liters
volume final (Vmf): 63.0 liters
temp. initial (Tdgmi): 105 deg. F
temp. final (Tdgmf): 106 deg. F
temp. avg. (Tdgm): 105.5 deg. F
time, dgm 9.28 min.
calculated y = .992

RUN # 2

BUBBLE METER CONDITIONS:
temp. (Tbm) 72 deg. F
bubble meter times (Qbm) (liters/minute)
1: 503.6 l/min. 5: 502.0 l/min.
2: 503.6 l/min. 6: 499.5 l/min.
3: 503.6 l/min. 7: 496.3 l/min.
4: 500.3 l/min. Avg: 501.3 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 63.5 liters
volume final (Vmf): 68.5 liters
temp. initial (Tdgmi): 106 deg. F
temp. final (Tdgmf): 107 deg. F
temp. avg. (Tdgm): 106.5 deg. F
time, dgm 9.36 min.
calculated y = .999

RUN # 3

BUBBLE METER CONDITIONS:
temp. (Tbm) 72 deg. F
bubble meter times (Qbm) (liters/minute)
1: 499.5 l/min. 5: 512.0 l/min.
2: 499.5 l/min. 6: 511.1 l/min.
3: 499.5 l/min. 7: 495.5 l/min.
4: 495.5 l/min. Avg: 501.8 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 69.0 liters
volume final (Vmf): 74.0 liters
temp. initial (Tdgmi): 107 deg. F
temp. final (Tdgmf): 107 deg. F
temp. avg. (Tdgm): 107 deg. F
time, dgm 9.28 min.
calculated y = .993

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE PRE-TEST Y = .995

Figure E-15e. Dry gas meter pre-test calibration.

DRY GAS METER PRE-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 12-28-89

CALIBRATION BY: J. Neese

METER CONSOLE NO: VB-3

NOMINAL FLOW RATE: .25 LITERS/MINUTE

BUBBLE METER NO: 4765-S ROTO. SETTING 17

RUN # 1

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Qbm) (liters/minute)

1: 247.3 l/min. 5: 248.3 l/min.
2: 248.3 l/min. 6: 248.3 l/min.
3: 248.5 l/min. 7: 248.3 l/min.
4: 247.1 l/min. Avg: 248.0 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 46.5 liters
volume final (Vmf): 49.5 liters
temp. initial (Tdgmi): 103 deg. F
temp. final (Tdgmf): 103 deg. F
temp. avg. (Tdgm): 103 deg. F
time, dgm 11.33 min.
calculated y = .991

RUN # 2

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Qbm) (liters/minute)

1: 256.2 l/min. 5: 256.2 l/min.
2: 256.0 l/min. 6: 240.0 l/min.
3: 257.3 l/min. 7: 256.2 l/min.
4: 257.7 l/min. Avg: 255.7 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 520 liters
volume final (Vmf): 530 liters
temp. initial (Tdgmi): 103 deg. F
temp. final (Tdgmf): 104 deg. F
temp. avg. (Tdgm): 103.5 deg. F
time, dgm 11.21 min.
calculated y = 1.012

RUN # 3

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Qbm) (liters/minute)

1: 253.0 l/min. 5: 257.7 l/min.
2: 254.3 l/min. 6: 254.7 l/min.
3: 255.4 l/min. 7: 256.0 l/min.
4: 254.7 l/min. Avg: 255.1 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 53.5 liters
volume final (Vmf): 56.5 liters
temp. initial (Tdgmi): 104 deg. F
temp. final (Tdgmf): 105 deg. F
temp. avg. (Tdgm): 104.5 deg. F
time, dgm 10.99 min.
calculated y = .991

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE PRE-TEST Y = .998

Figure E-15d. Dry gas meter pre-test calibration.

DRY GAS METER POST-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 8/29/90
PLANT: Disposal Specialists
PROJECT MANAGER: D. Fitzgerald
CALIBRATION BY: R. Kelly

METER CONSOLE NO: VB-1 PRE-TEST Y: 1.003
NOMINAL FLOW RATE: .25 LITERS/MINUTE
BUBBLE METER NO: 6:1:6 meter 1379-P ROTO. SETTING 14
PROJECT NO.: 50016

RUN # 1

BUBBLE METER CONDITIONS:
mp. (Tbm) 76 deg. F
bble meter times (Qbm) (liters/minute)
.2500 l/min. 5: .2497 l/min.
.2500 l/min. 6: .2502 l/min.
.2492 l/min. 7: .2502 l/min.
2497 l/min. Avg: .2495 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 96 liters
volume final (Vmf): 99 liters
temp. initial (Tdgmi): 97 deg. F
temp. final (Tdgmf): 99 deg. F
temp. avg. (Tdgm): 98 deg. F
time, dgm 11.09 min.
calculated y = .971

RUN # 2

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Qbm) (liters/minute)
1: .2487 l/min. 5: .2489 l/min.
2: .2502 l/min. 6: .2502 l/min.
3: .2487 l/min. 7: .2502 l/min.
4: .2502 l/min. Avg: .2496 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 99 liters
volume final (Vmf): 102 liters
temp. initial (Tdgmi): 99 deg. F
temp. final (Tdgmf): 100 deg. F
temp. avg. (Tdgm): 99.5 deg. F
time, dgm 11.46 min.
calculated y = 1.006

RUN # 3

BUBBLE METER CONDITIONS:
p. (Tbm) 70 deg. F
ble meter times (Qbm) (liters/minute)
2473 l/min. 5: .2460 l/min.
2473 l/min. 6: .2471 l/min.
2483 l/min. 7: .2471 l/min.
2483 l/min. Avg: .2477 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 102 liters
volume final (Vmf): 105 liters
temp. initial (Tdgmi): 100 deg. F
temp. final (Tdgmf): 101 deg. F
temp. avg. (Tdgm): 100.5 deg. F
time, dgm 11.50 min.
calculated y = 1.003

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE POST-TEST Y = .993

Figure E-16a: Dry gas meter post-test calibration.

DRY GAS METER PRE-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 12-28-89

CALIBRATION BY: J. Neese

METER CONSOLE NO: VB-3

NOMINAL FLOW RATE: 1.0 LITERS/MINUTE

BUBBLE METER NO: 4765-S ROTO. SETTING 54

RUN # 1

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Qbm) (liters/minute)

1: 1007 l/min. 5: 991.0 l/min.
2: 1003 l/min. 6: 1004 l/min.
3: 1003 l/min. 7: 994.2 l/min.
4: 991.0 l/min. Avg: 999.0 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 81.0 liters
volume final (Vmf): 91.0 liters
temp. initial (Tdgmi): 108 deg. F
temp. final (Tdgmf): 108 deg. F
temp. avg. (Tdgm): 108 deg. F
time, dgm 9.15 min.
calculated y = .976

RUN # 2

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Qbm) (liters/minute)

1: 994.2 l/min. 5: 1006 l/min.
2: 997.4 l/min. 6: 1005 l/min.
3: 994.2 l/min. 7: 1002 l/min.
4: 1005 l/min. Avg: 1001 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 92.0 liters
volume final (Vmf): 102.0 liters
temp. initial (Tdgmi): 108 deg. F
temp. final (Tdgmf): 109 deg. F
temp. avg. (Tdgm): 108.5 deg. F
time, dgm 9.23 min.
calculated y = .987

RUN # 3

BUBBLE METER CONDITIONS:

temp. (Tbm) 72 deg. F

bubble meter times (Qbm) (liters/minute)

1: 1002 l/min. 5: 1013 l/min.
2: 1001 l/min. 6: 1012 l/min.
3: 991.0 l/min. 7: 1008 l/min.
4: 991.0 l/min. Avg: 1003 l/min.

DRY GAS METER CONDITIONS:

volume initial (Vmi): 103.0 liters
volume final (Vmf): 113.0 liters
temp. initial (Tdgmi): 109 deg. F
temp. final (Tdgmf): 109 deg. F
temp. avg. (Tdgm): 109 deg. F
time, dgm 9.25 min.
calculated y = .992

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE PRE-TEST Y = .985

Figure E-15f. Dry gas meter pre-test calibration.

DRY GAS METER POST-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 8/30/90
PLANT: Disposal Specialist
PROJECT MANAGER: D. Fitzgerald
CALIBRATION BY: D. Kalb
METER CONSOLE NO: VB-3 PRE-TEST Y: .998
NOMINAL FLOW RATE: .25 (0.16 mm) LITERS/MINUTE
BUBBLE METER NO: 1379-P ROTO. SETTING 17
PROJECT NO.: 50016

RUN # 1

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Qbm) (liters/minute)
.2518 l/min. 5: .2530 l/min.
.2528 l/min. 6: .2518 l/min.
.2518 l/min. 7: .2518 l/min.
.2518 l/min. Avg: .2521 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 100 liters
volume final (Vmf): 103 liters
temp. initial (Tdgmi): 102 deg. F
temp. final (Tdgmf): 103 deg. F
temp. avg. (Tdgm): 102.5 deg. F
time, dgm 10.85 min.
calculated y = .968

RUN # 2

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Qbm) (liters/minute)
1: .2530 l/min. 5: .2530 l/min.
2: .2533 l/min. 6: .2518 l/min.
3: .2533 l/min. 7: .2530 l/min.
4: .2573 l/min. Avg: .2530 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 103 liters
volume final (Vmf): 106 liters
temp. initial (Tdgmi): 103 deg. F
temp. final (Tdgmf): 104 deg. F
temp. avg. (Tdgm): 103.5 deg. F
time, dgm 10.88 min.
calculated y = .976

RUN # 3

BUBBLE METER CONDITIONS:
p. (Tbm) 70 deg. F
ble meter times (Qbm) (liters/minute)
530 l/min. 5: .2533 l/min.
530 l/min. 6: .2533 l/min.
533 l/min. 7: .2533 l/min.
533 l/min. Avg: .2532 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 106 liters
volume final (Vmf): 109 liters
temp. initial (Tdgmi): 104 deg. F
temp. final (Tdgmf): 104 deg. F
temp. avg. (Tdgm): 104 deg. F
time, dgm 11.27 min.
calculated y = 1.012

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Qbm}{Qdgm}$$

AVERAGE POST-TEST Y = .985

Figure E-16c. Dry gas meter post-test calibration.

DRY GAS METER POST-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 8/29/90
PLANT: Disposal Specialist
PROJECT MANAGER: D. Fitzgerald
CALIBRATION BY: R. Hall

METER CONSOLE NO: UB-1 PRE-TEST Y: .995
NOMINAL FLOW RATE: .50 LITERS/MINUTE
BUBBLE METER NO: 0.5 Liter 1379-D ROTO. SETTING 28
PROJECT NO.: 50016

RUN # 1

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Obm) (liters/minute)
.5003 l/min. 5: .5003 l/min.
.5003 l/min. 6: .4955 l/min.
.5003 l/min. 7: .5003 l/min.
.5003 l/min. Avg: .5003 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 80 liters
volume final (Vmf): 85 liters
temp. initial (Tdgmi): 90 deg. F
temp. final (Tdgmf): 93 deg. F
temp. avg. (Tdgm): 91.5 deg. F
time, dgm 7.44 min.
calculated y = .993

RUN # 2

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Obm) (liters/minute)
1: .5003 l/min. 5: .4995 l/min.
2: .4947 l/min. 6: .4947 l/min.
3: .4995 l/min. 7: .5003 l/min.
4: .4992 l/min. Avg: .4969 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 85 liters
volume final (Vmf): 90 liters
temp. initial (Tdgmi): 93 deg. F
temp. final (Tdgmf): 95 deg. F
temp. avg. (Tdgm): 94 deg. F
time, dgm 9.55 min.
calculated y = .992

RUN # 3

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Obm) (liters/minute)
.4947 l/min. 5: .4947 l/min.
.4995 l/min. 6: .4995 l/min.
.4947 l/min. 7: .4955 l/min.
.4955 l/min. Avg: .4969 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 90 liters
volume final (Vmf): 95 liters
temp. initial (Tdgmi): 95 deg. F
temp. final (Tdgmf): 97 deg. F
temp. avg. (Tdgm): 96 deg. F
time, dgm 9.58 min.
calculated y = .991

$$Qdgm = \frac{(Vmf-Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Obm}{Qdgm}$$

AVERAGE POST-TEST Y = .991

Figure E-16b. Dry gas meter post-test calibration.

APPENDIX F

PROCESS DATA

DRY GAS METER POST-TEST CALIBRATION
(LOW FLOW <1 LITER/MINUTE)

DATE: 8/30/90
PLANT: Disposal Specialists
PROJECT MANAGER: D. Fitzgerald
CALIBRATION BY: R. Kalika

METER CONSOLE NO: VB-3 PRE-TEST Y: .995
NOMINAL FLOW RATE: .50 LITERS/MINUTE
BUBBLE METER NO: 6 liter 1379-P ROTO. SETTING 29
PROJECT NO.: 50016

RUN # 1

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Obm) (liters/minute)
1: .503 l/min. 5: .503 l/min.
2: .503 l/min. 6: .503 l/min.
3: .503 l/min. 7: .503 l/min.
4: .503 l/min. Avg: .503 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 84 liters
volume final (Vmf): 89 liters
temp. initial (Tdgmi): 97 deg. F
temp. final (Tdgmf): 100 deg. F
temp. avg. (Tdgm): 98.5 deg. F
time, dgm 9.33 min.
calculated y = .984

RUN # 2

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Obm) (liters/minute)
1: .511 l/min. 5: .511 l/min.
2: .511 l/min. 6: .503 l/min.
3: .503 l/min. 7: .511 l/min.
4: .511 l/min. Avg: .509 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 89 liters
volume final (Vmf): 104 liters
temp. initial (Tdgmi): 100 deg. F
temp. final (Tdgmf): 100 deg. F
temp. avg. (Tdgm): 100 deg. F
time, dgm 9.14 min.
calculated y = .968

RUN # 3

BUBBLE METER CONDITIONS:
temp. (Tbm) 70 deg. F
bubble meter times (Obm) (liters/minute)
1: .503 l/min. 5: .511 l/min.
2: .503 l/min. 6: .511 l/min.
3: .503 l/min. 7: .503 l/min.
4: .511 l/min. Avg: .507 l/min.

DRY GAS METER CONDITIONS:
volume initial (Vmi): 104 liters
volume final (Vmf): 109 liters
temp. initial (Tdgmi): 100 deg. F
temp. final (Tdgmf): 102 deg. F
temp. avg. (Tdgm): 101 deg. F
time, dgm 9.23 min.
calculated y = .978

$$Qdgm = \frac{(Vmf - Vmi)\,(Tbm + 460)}{(avg.\ Tdgm + 460)\,(time,\ dgm)}$$

$$Y = \frac{Obm}{Qdgm}$$

AVERAGE POST-TEST Y = .977

Figure E-16d. Dry gas meter post-test calibration.

CLIENT Disposal Specialists
LOCATION Flare Stack
SUBJECT Flare Temp °F

PN 50016 Sheet No 2 of 2
Checked By _____ Date _____
Computed By [signature] Date 8/31/90

DATE: 8-10-90

TIME	Temp °F	
0806	1660	
0826	1630	
0846	1630	TEST SERIES
0906	1650	#5
0926	1630	AVG = 1650°F
0946	1690	
1006	1700	TEST SERIES
1026	1660	#6
1046	1700	AVG = 1680°F
1106	1670	
1126	1680	
1146	1690	
1206	1680	
AVERAGE	1670	

CLIENT DISPOSAL SPECIALISTS
LOCATION Flare Stack
SUBJECT Flare Temp. °F

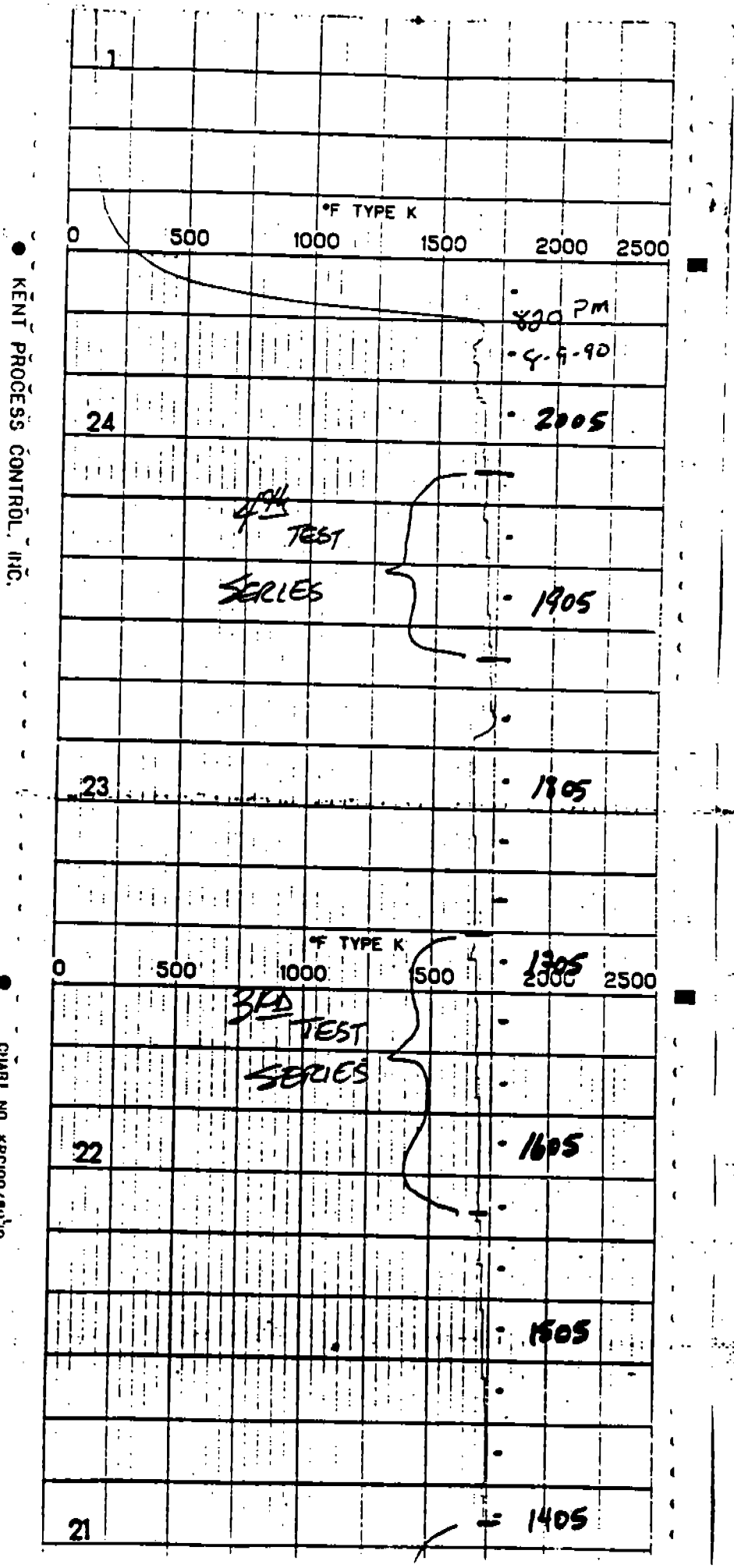
PN 50016 Sheet No. 1 of 2
Checked By _____ Date _____
Computed By [signature] Date 8/31/90

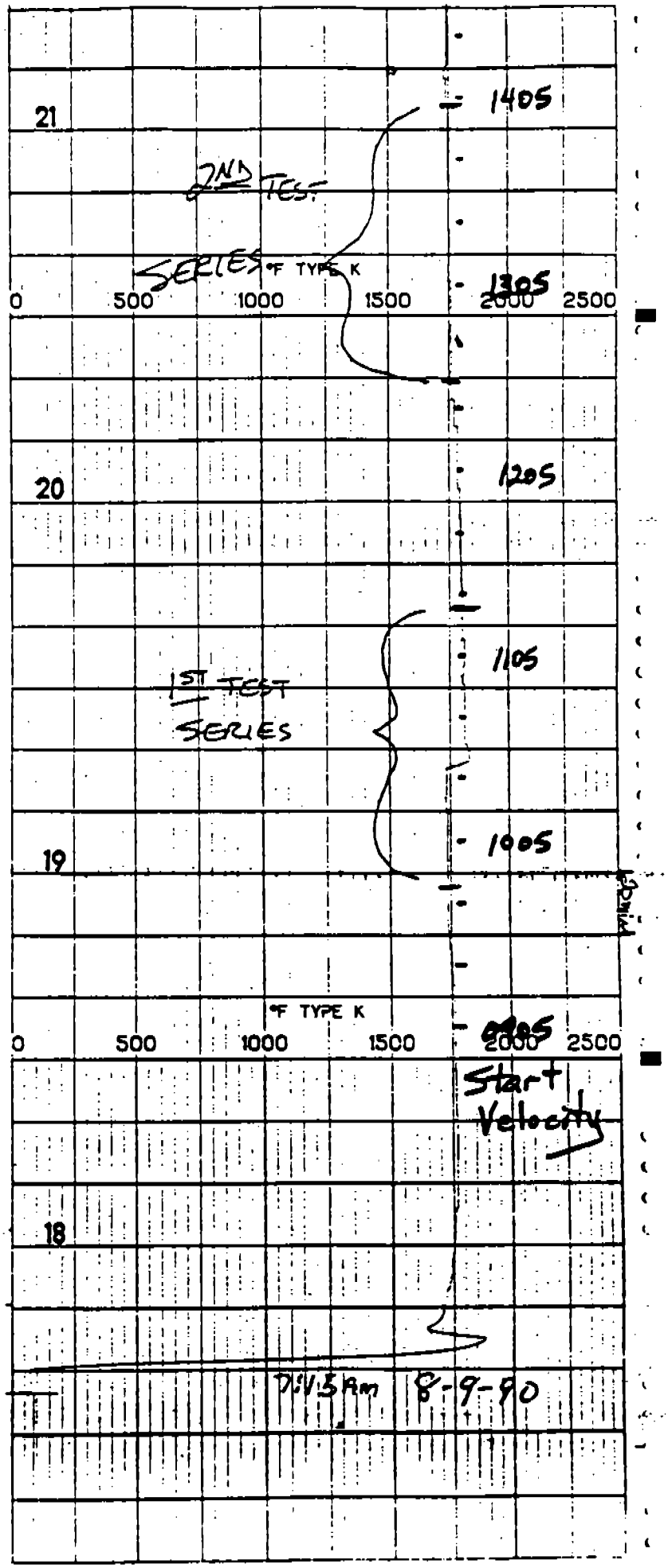
DATE: 8-9-90

TIME	TEMP °F	
0905	1740	
0925	1750	
0945	1740	
1005	1730	TEST SERIES #1
1025	1730	
1045	1820	AVG = 1770°F
1105	1810	
1125	1800	
1145	1800	
1205	1790	
1225	1770	
1245	1760	
1305	1760	TEST SERIES #2 = 1760°F
1325	1750	
1345	1750	
1405	1740	
1425	1740	
1445	1730	
1505	1725	
1525	1720	
1545	1700	
1605	1700	

TIME	TEMP °F	
1625	1690	TEST SERIES #3 = 1690°F
1645	1690	
1705	1660	
1725	1680	
1745	1680	
1805	1660	
1825	1750	
1845	1730	TEST SERIES #4 = 1710°F
1905	1710	
1925	1700	
1945	1700	
2005	1690	
2025	1640	

AVERAGE TEMP. ON 8/9/90 = 1730°F


°F TYPE K
0
500
1000
1500
2000
2500
8:30 PM
4-4-90
24
2005
4TH TEST SERIES
1905
23
1805
°F TYPE K
0
500
1000
1500
2000
2500
1705
3RD TEST SERIES
22
1605
1505
21
1405
KENT PROCESS CONTROL, INC.
CHART NO. KPC100/8070


21
20
19
18
1405
1305
1205
1105
1005
2nd TEST SERIES
1ST TEST SERIES
°F TYPE K
0
500
1000
1500
2000
2500
Start Velocity
Div 1.5 Rm
8-9-90
PRINTED IN U.S.A.
KENT PROCESS CONTROL, INC.
CHART

Send copy to Kathy Farr

State of Louisiana

Department of Environmental Quality

dwin W. Edwards
Governor

Kai David Midboe
Secretary

Mr. Mark A Cobb
Colonial Landfill
Browning-Ferris, Inc.
P.O. Box 605
Sorrento, LA

Dear Mr. Cobb:

RE: Permit request, Colonial Landfill, Browning-Ferris, Inc., Sorrento, Ascension Parish, Louisiana

This is to inform you that the permit request for the above referenced facility has been approved under LAC 33:III.505. The submittal was approved on the basis of the emissions reported and the approval in no way guarantees the design scheme presented will be capable of controlling the emissions as to the types and quantities stated. A new application must be submitted if the reported emissions are exceeded after operations begin. The synopsis, data sheets and conditions are attached herewith.

It will be considered a violation of the permit if all proposed control measures and/or equipment are not installed and properly operated and maintained as specified in the application.

The permit number cited below should be referenced in future correspondence regarding this facility.

Done this 27th day of MAY, 1992.

Permit No.: 2137

Very truly yours,

Gustave Von Bodungen

Gustave A. Von Bodungen, P.E.
Assistant Secretary

GVB:EK:das

c: Capital Regional Office

AIR PERMIT BRIEFING SHEET
AIR QUALITY REGULATORY DIVISION
LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

COLONIAL LANDFILL
BROWNING-FERRIS, INC.
SORRENTO, ASCENSION PARISH, LOUISIANA

I. BACKGROUND

Browning-Ferris, Inc. (BFI) proposes to construct and operate a gas collecting system at the Colonial Landfill near Sorrento, Louisiana. The collected gases will be burned in an enclosed flare system.

II. ORIGIN

A permit application and Emissions Inventory Questionnaire were submitted January 17, 1992.

III. DESCRIPTION

The Colonial Landfill is operated by BFI and serves as a collection and disposal point for municipal and other wastes generated in the area. The decomposing waste encapsulated in the landfill produces gas which is primarily composed of methane, carbon dioxide, and numerous trace organics.

The enclosed flare system will collect gas via a network of extraction wells. The saturated gas will enter a knockout pot where condensate will be removed. The gas is then sent to the enclosed flare for incineration. Design destruction efficiency for hydrocarbons is 98% or better.

Estimated emission rates from the flare are shown below:

EMISSION RATES
(Tons per Year)

Pollutant	Emission Rate
PM_{10}	Negligible
SO_2	11.2
NO_x	20.5
VOC	32.8
CO	178.2
HCl	24.5

AIR PERMIT BRIEFING SHEET
AIR QUALITY REGULATORY DIVISION
LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

COLONIAL LANDFILL
BROWNING-FERRIS, INC.
SORRENTO, ASCENSION PARISH, LOUISIANA

IV. TYPE OF REVIEW

This application was reviewed for compliance with the Louisiana Air Quality Regulations. New Source Performance Standards, PSD and NESHAP do not apply.

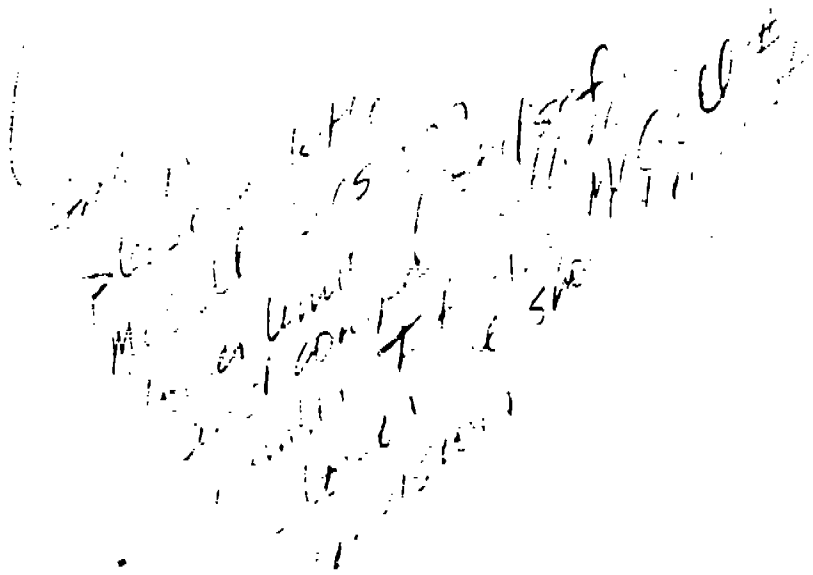
V. PUBLIC NOTICE

A public notice of the proposed facility was published in the Gonzales Weekly News, Gonzales, Louisiana, on February 7, 1992, and the Morning Advocate, Baton Rouge, Louisiana, on February 8, 1992. There were no comments received from the public.

SPECIFIC CONDITION

COLONIAL LANDFILL
BROWNING-FERRIS, INC.
SORRENTO, ASCENSION PARISH, LOUISIANA

1. Permittee shall ensure destruction of emissions to the flare stack by maintaining the heat content of the flare gas above 300 BTU/scf and by installing, maintaining and operating according to the manufacturer's specifications a heat sensor to monitor the presence of a continuous flame.



LOUISIANA AIR EMISSION PERMIT
GENERAL CONDITIONS

I. This permit is issued on the basis of the emissions reported in the application for approval of emissions and in no way guarantees that the design scheme presented will be capable of controlling the emissions to the type and quantities stated. Failure to install, properly operate and/or maintain all proposed control measures and/or equipment as specified in the application and supplemental information shall be considered a violation of the permit and LAC 33:III.505. If the emissions are determined to be greater than those allowed by the permit or if proposed control measures and/or equipment are not installed or do not perform according to design efficiency, an application to modify the permit must be submitted.

II. The permittee is subject to all applicable provisions of the Louisiana Air Quality Regulations. Violation of the terms and conditions of the permit constitutes a violation of these regulations.

III. The permit application and the attached data sheets establish the emission and operating limitations and are a part of the permit. The synopsis and data sheets are based on the application and Emission Inventory Questionnaire submitted January 17, 1992.

IV. This permit shall become invalid, for the sources not constructed, if:

(a) construction is not commenced, or binding agreements or contractual obligations to undertake a program of construction of the project are not entered into, within two (2) years (18 months for PSD permits) after issuance of this permit, or;

(b) if construction is discontinued for a period of two (2) years (18 months for PSD permits) or more.

The administrative authority may extend this time period upon a satisfactory showing that an extension is justified.

This provision does not apply to the time period between construction of the approved phases of a phased construction project. However, each phase must commence construction within two (2) years (18 months for PSD permits) of its projected and approved commencement date.

V. The permittee shall submit semi-annual reports of progress outlining the status of construction, noting any design changes, modifications or alterations in the construction schedule which have or may have an effect on the emission rates or ambient air quality levels. These reports shall continue to be submitted until such time as construction is certified as being complete. Furthermore, for any

significant change in the design, prior approval shall be obtained from the Louisiana Air Quality Division.

VI. The permittee shall notify the Department of Environmental Quality, Air Quality Division within ten (10) calendar days from the date that construction is certified as complete and the estimated date of start-up of operation. The appropriate Regional Office shall also be so notified within the same time frame.

VII. Any emissions testing performed for purposes of demonstrating compliance with the limitations set forth in paragraph III shall be conducted in accordance with the methods described in the Division's test manual or any other methods approved by the U.S. EPA. Any deviation from or modification of the methods used for testing shall have prior approval from the Louisiana Air Quality Division.

VIII. The emission testing described in paragraph VII above, or established in the specific conditions of this permit, shall be conducted within sixty (60) days after achieving normal production rate, but in no event later than 180 days after initial start-up (or restart-up after modification). The Air Quality Division Surveillance Section shall be notified at least (30) days prior to testing and shall be given the opportunity to conduct a pretest meeting and observe the emission testing. The test results shall be submitted to the Air Quality Division within forty-five (45) days after the complete testing. As required by LAC 33:III.913, the permittee shall provide necessary sampling port in stacks or ducts and such other safe and proper sampling and testing facilities for proper determination of the emission limits.

IX. The permittee shall, within 180 days after start-up of each project or unit, report to the Louisiana Air Quality Division any significant difference in operating emission rates as compared to those limitations specified in paragraph III. This report shall also include, but not be limited to , malfunctions and upsets.

X. The permittee shall retain records of all information resulting from monitoring activities and information indicating operating parameters as specified in the specific conditions of this permit for a minimum of at least two (2) years.

XI. If for any reason the permittee does not comply with, or will not be able to comply with, the emission limitations specified in this permit, the permittee shall provide the Air Quality Division with the following information in writing within five (5) days of such conditions:

a. Description of noncomplying emission(s);
b. Cause of noncompliance;
c. Anticipated time the noncompliance is expected to continue, or, if corrected, the duration of the period of noncompliance;
d. Steps taken by the permittee to reduce and eliminate the noncomplying emissions; and
e. Steps taken by the permittee to prevent recurrences of the noncomplying emissions.

XII. Permittee shall allow the authorized officers and employees of the Department of Environmental Quality, at all reasonable times and upon presentation of identification, to:

1) Enter upon the permittee's premises where regulated facilities are located, regulated activities are conducted or where records required under this permit are kept;

2) Have access to and copy any records that are required to be kept under the terms and conditions of this permit, the Louisiana Air Quality Regulations, or the Act;

3) Inspect any facilities, equipment (including monitoring methods and an operation and maintenance inspection), or operations regulated under this permit; and,

4) Sample or monitor, for the purpose of assuring compliance with this permit or as otherwise authorized by the Act or regulations adopted thereunder, any substances or parameters at any location.

XIII. If samples are taken under Section XII. 4) above, the officer or employee obtaining such samples shall give the owner, operator or agent in charge a receipt describing the sample obtained. If requested prior to leaving the premises, a portion of each sample equal in volume or weight to the portion retained shall be given to the owner, operator or agent in charge. If an analysis is made of such samples, a copy of the analysis shall be furnished promptly to the owner, operator or agency in charge.

XIV. The permittee shall allow authorized officers and employees of the Department of Environmental Quality, upon presentation of identification, to enter upon the permittee's premises to investigate potential or alleged violations of the Act or the rules and regulations adopted thereunder. In such investigations, the permittee shall be notified at the time entrance is requested of the nature of the suspected violation. Inspections under this subsection

shall be limited to the aspects of alleged violations. However, this shall not in any way preclude prosecution of all violations found.

XV. The permittee shall comply with the reporting requirements specified under LAC 33:III.918 as well as notification requirements specified under LAC 33:III.927.

XVI. In the event of any change in ownership of the source described in this permit, the permittee and the succeeding owner shall notify the Louisiana Air Quality Division, within ninety (90) days after the event, to amend this permit.

SORRENTO, ASCENSION PARISH, LOUISIANA

Estimated starting date of construction July 1992 Estimated date operation will begin August 1992 Location of plant: 15 UTM: 405.4 Km E 3336.9 Km N

Description of location: Colonial Landfill, Sorrento, La.

Dispersion Model(s) Used: _____ NEW X OR MODIFIED ____ EMISSION SOURCES Flare Stack (Type of source)

EMISSION SOURCES

Emission Point No.	Description	Operating Rate (Max)	Operating Schedule H/D	D/W	W/Y
1-92	Flare	2150 cfm	24	7	52

PERMITTED EMISSIONS IN POUNDS PER HOUR (Max/Avg)

Emission Point No.	PM	SO_2	NO_x	VOC	CO	HCl	Feet Height	°F Temp.	CFM Flow Rat
1-92	Neg /Neg	2.56 /2.56	4.68 /4.68	7.52 /7.52	40.8 /40.8	5.62 /5.62	35	2000	120 ac

PERMITTED EMISSIONS IN TONS PER YEAR

Emission Point No.	PM	SO_2	NO_x	VOC	CO	HCl
1-93	Neg.	11.2	20.5	32.8	178.2	24.5