Hartford, 11/93

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Compliance Test Report
Hartford Landfill Flare
Emissions Test Program
Hartford, Connecticut

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ROJAC Project F93-09

November 19, 1993

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1.0 INTRODUCTION

1.1 Summary of Test Program

ROJAC Environmental Services Inc. (ROJAC) was retained by Connecticut Resources Recovery Authority to conduct an emission measurement test program on a landfill flare located in Hartford, Connecticut. The test program was conducted to comply with State of Connecticut Temporary Permit No. 0120, issued by the Department of Environmental Protection.

Gasses measured at the flare outlet sampling location included oxygen (O_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), total hydrocarbons (THC) including methane and non-methane organic compounds (NMOC). In addition, Tedlar bag samples were taken at the inlet sampling location to determine the NMOC concentration and lower heating values of the landfill gas.

The tests were carried out in conformance with the regulations of the Connecticut Department of Environmental Protection (CTDEP). The objectives were to demonstrate compliance with applicable permit conditions or regulations. The following emission limits applied to this source:

TSP	0.90	pounds per hour
SOx, expressed as SO2	0.26	pounds per hour
NOx, expressed as NO2	3.29	pounds per hour
THC	0.50	pounds per hour
CO	11.35	pounds per hour
Methane	6.14	pounds per hour
Destruction Efficiency of NMOC	98%	
Visible Emissions	not to exceed 5 minutes in any two hour observation period.	

1.2 Key Personnel

The following presents the test program organization and names and phone numbers of responsible individuals:

CRRA	David Martin	203-549-1751
ROJAC Envir. Serv., Inc.	Leigh A. Gammie	203-232-8959
Atlantic Analytical Laboratory	Victor Given	908-534-5600

The ROJAC test team consisted of Messrs. John S. Gammie, Richard A. Kopacz, Thomas E. Conroy, and Ms. Eszter Samodai. Mr. David Martin of CRRA provided onsite assistance, and Mr. Carl Ekroth was the CTDEP observer.

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTIONS

2.1 Process Description

Hartford Landfill, located on 180 East Service Road in Hartford, Connecticut, has installed one LFG Specialties enclosed ground flare for destruction of landfill gas produced onsite. The flare is designed to achieve a minimum NMOC destruction efficiency of 98.0%

The flare is fueled by landfill gas, produced onsite, with a lower heating value (LHV) of 550 Btu per standard cubic foot (Btu/scf). The maximum design fuel flow rate is 1500 standard cubic feet per minute (SCFM), and the maximum fuel firing rate is 49.5 million Btu per hour (MMBtu/hr).

To achieve the minimum destruction efficiency a minimum residence time of 0.6 second is required.

Based on the minimum distance of 25 feet from the stack to the nearest property line, the minimum stack height must be 35.25 feet above grade. The unit is designed to operate 24 hours per day for a total of 8760 hours per year.

The gas collection system, which provides Landfill FG gas to the flare, consists of a series of wells installed in the landfill. The wells are connected to the flare site by a subsurface header system. A centrifugal blower located at the flare site draws LFG through a water knockout and particulate filter and delivers it to the flare where it is combusted.

The flare utilizes an electrically ignited pilot, burning propane, to initiate LFG combustion. Pilot gas is turned off after main flame ignition.

The flare is designed to operate at approximately 1650 degrees Fahrenheit.

The system has been provided with several data gathering and recording features:

A) Continuous combustion temperature chart recorder.

B) Inlet gas flow meter. A differential pressure type flow meter is available for the determination of instantaneous inlet gas flow.

2.2 Control Equipment

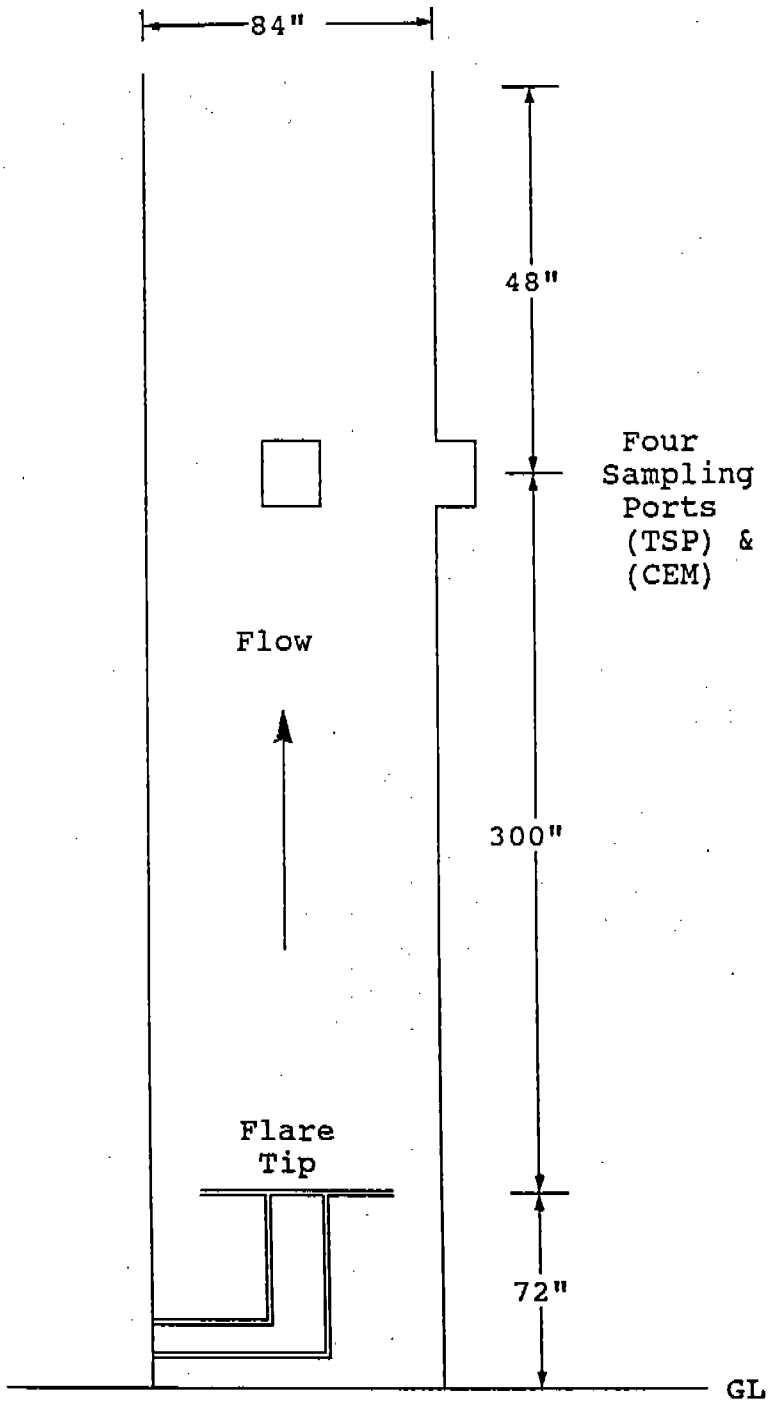
A process description of the flare operation response and a copy of the blue prints of the process can be found in the appendix section.

2.3 Description of Outlet Sampling Location

The landfill gas flare outlet sampling location was located in a circular 84 inch inner diameter (I.D.) section of vertical stack. A schematic of the sampling location is shown in Figure 2-3. Four sampling ports spaced 90° apart on a horizontal plane were located 300 inches (3.6 duct diameters) downstream from the top of the flare tip and 48 inches (.57 duct diameters) upstream from the top of the stack. EPA Method 1 required the use of twenty four (24) sampling points, twelve (12) sampling points per port for isokinetic sampling.

2.4 Description of Inlet Sampling Location

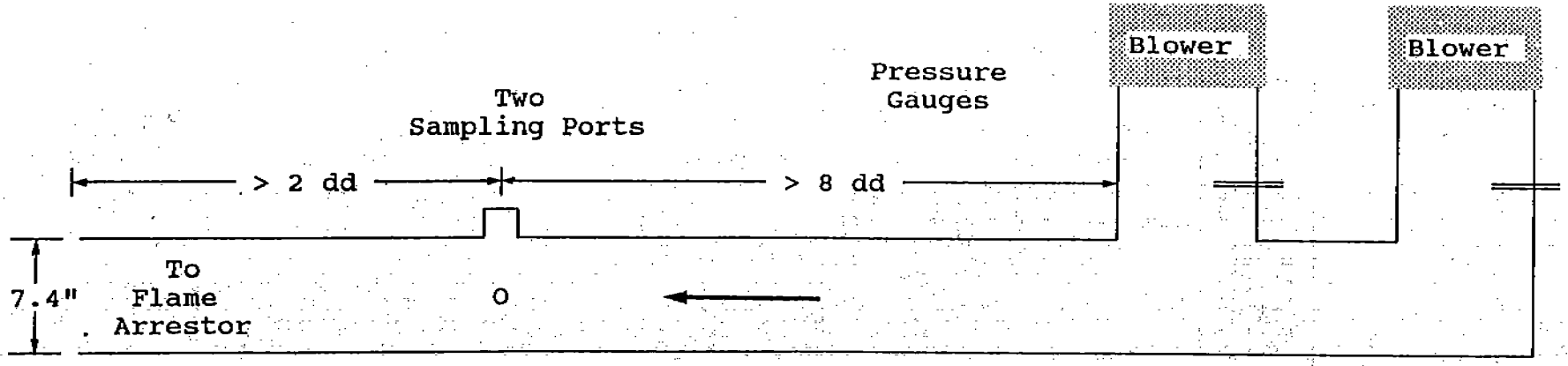
Figure 2-4 shows a schematic diagram of the inlet location. The inlet location was located in a 7.4 inch I.D. section of horizontal PVC duct. Two sampling ports spaced 90° apart on a vertical plane were located at a minimum of two duct diameters upstream from a 90° bend in the duct and eight duct diameters downstream of the flow sensor.



TRAVERSE POINT NUMBER	TRAVERSE POINT LOCATION FROM STACK WALL (IN.)
1	1.8
2	5.6
3	9.9
4	14.9
5	21.0
6	29.9
7	54.1
8	63.0
9	69.1
10	74.1
11	78.4
12	82.2

FIGURE 2-3

Landfill Gas Flare Outlet Sampling Location
Hartford Landfill
Hartford, Connecticut



TRAVERSE POINT NUMBER	TRAVERSE POINT LOCATION FROM STACK WALL (IN.)
1	0.5
2	1.9
3	5.6
4	6.9

FIGURE 2-4

Landfill Gas Flare Inlet Sampling Location
Hartford Landfill
Hartford, Connecticut

3.0 SUMMARY AND DISCUSSION OF RESULTS

3.1 Objectives and Test Matrix

The purpose of the test program was to determine source compliance with applicable permit conditions and/or regulations. The specific objectives in order of priority were:

* Measured continuous outlet stack emissions of O_2, NOx, CO, SO_2 and THC according to EPA Methods 3A, 7E, 10, 6C, and 25A (40CFR60 Appendix A - Reference Methods).

* Sampled outlet stack gas to determine Non-Methane Organic Compounds (NMOC) and Methane stack emissions per EPA Method 18. Volumetric flowrates were performed before and after each integrated bag sample per EPA Method 2. Moisture tests, performed by EPA Method 4, were sampled simultaneously with the NMOC tests (40CFR60 Appendix A - Reference Methods).

* Sampled landfill gas to determine NMOC and lower heating value per EPA Method 18 and ASTM D3588. Volumetric flowrates were performed before and after each integrated bag sample per EPA Method 2. In addition, moisture tests, performed by EPA Method 4, were sampled simultaneously with the NMOC tests (40CFR60 Appendix A - Reference Methods).

* The flare's residence time was expressed as the ratio of the flare's volume to the flare's exit gas actual flowrate.

* Determined visible emissions in accordance with EPA Method 22 (40CFR60 Appendix A - Reference Methods).

Table 3-1 presents the sampling and analytical matrix.

Table 3-1

Emission Measurement Test Matrix
Landfill Gas Flare
Hartford, Connecticut

Sampling Location	No. of Runs	Sample/Type Pollutant	Sampling Method	Sampling Organ.	Sample Run Time (min.)	Analytical Method	Analytical Laboratory
Flare Outlet	3	CEM (NOx, SO2, CO, THC)	M7E, M6C M10, M25A	RES	60	M7E, M6C M10, M25A	RES
	3	CO2, O2	M18	RES	60	Orsat, M3	RES
	3	NMOC & Methane	M18	RES	60	M18	Atlantic
	1	Visible Emissions	M9	RES	120	N/A	N/A
Flare Inlet	3	NMOC	M18	RES	60	M18	Atlantic
	3	LHV	M18	RES	60	M18	Atlantic

RES – ROJAC Environmental Services
Atlantic – Atlantic Analytical Laboratory

3.2 Field Test Changes and Problems

ROJAC Environmental Services, Inc. (ROJAC) performed four (60 minute) Non-Methane Organic Compounds (NMOC) tests as compared to the usual three tests as required by the Connecticut Department of Environmental Protection (CTDEP) agency during the compliance test program. A total of eight gaseous samples were withdrawn from both the inlet and outlet flare sample locations in accordance with EPA Method 18 via Tedlar Bag In A Box sampling apparatus. Since the second inlet bag sample was lost during transport, the fourth inlet bag sample was analyzed in its place, therefore, a total of six bag samples were analyzed by Atlantic Analytical laboratory.

The particulate tests were not performed as scheduled on November 4, 1993 due to ROJAC's equipment failure.

3.3 Emissions Test Results

3.3.1 Continuous Emission Monitoring Summary of Results

Triplicate sixty minute CEM tests were conducted at the Flare outlet location. The following gases were monitored on November 4, 1993: nitrogen oxide, carbon monoxide, total hydrocarbons, sulfur dioxide, and oxygen. The average total hydrocarbons and the average carbon monoxide emissions were the only gases out of compliance with their respective emission limitations.

	Average Emissions	State Limit
Total Hydrocarbons, (lb/hr)	0.56	0.50
Carbon Monoxide, (lb/hr)	12.0	11.35

The results are summarized in Table 3-2.

TABLE 3-2

SUMMARY TABLE OF GASEOUS EMISSION DATA
HARTFORD LANDFILL FLARE
HARTFORD, CONNECTICUT

		Flare Outlet Location			
Method/Component	Units	Run 1	Run 2	Run 3	Avg
	DATE:	11-04-93	11-04-93	11-04-93	
	TIME:	1140-1240	1315-1415	1435-1535	
Method 2 - Flow	dscfm	9870	10993	9817	10227
	acfm	38552	42890	40515	40721
M3 - CO2	%	5.7	5.8	6.0	5.8
M3 - Oxygen	%	13.3	13.2	12.8	13.1
Method 4 - Moisture	%	5.3	7.5	8.6	7.1
Method 18 - NMOC	ppm as Carbon	< 18	< 18	< 18	< 18
Methane	lb/hr as Carbon	< 0.42	< 0.69	< 0.58	< 0.56
Residence Time	seconds	1.8	1.6	1.7	1.7
	TIME:	1048-1148	1220-1320	1335-1455	
Method 25A - THC	ppm as Carbon	22.5	33.6	31.8	29.3
	lb/hr as Carbon	0.42	0.69	0.58	0.56
Method 7E - NOx	ppm	12.3	12.4	12.6	12.4
	lb/hr	0.9	1.0	0.9	0.9
Method 6C - Sulfur Dioxide	ppm	0.6	2.2	2.6	1.8
	lb/hr	0.1	0.2	0.3	0.2
Method 10 - CO	ppm	240	276	287	268
	lb/hr	10.3	13.3	12.3	12.0

		Flare Inlet Location			
Method/Component	Units	Run 1	Run 2	Run 3	Avg
	DATE:	11-04-93	11-04-93	11-04-93	
	TIME:	1140-1240	1315-1415	1435-1535	
Method 2 - Flow	dscfm	687	692	710	696
	acfm	731	742	753	737
M3 - CO2	%	34.2	34.4	35.5	34.7
M3 - Oxygen	%	0.6	1.8	0.6	1.0
Method 4 - Moisture	%	2.7	3.6	2.6	3.0
Method 18 - NMOC	ppm as Carbon	1300	* 1100	1100	1167
Methane	ppm as Carbon	51.8	* 33.5	55.0	46.8
ASTM D3588 - LHV	BTU/cf	513	* 332	545	463

Method/Component	Units	Run 1	Run 2	Run 3	Avg
NMOC Destruction Efficiency	ppm	> 98.62%	> 98.36%	> 98.36%	> 98.46%
Method 22 - Visible Emissions		No visible emissions observed from 1200 hours to 1400 hours			

Note: * (M18-4 Tedlar bag sample was analyzed in place of M18-2 sample due to lost bag through shipment)

Please note, an experimental CEM test (Run No. CEM-4B) was performed on November 4, 1993 from 1559 hours to 1620 hours with the flare operating temperature increased from 1650°F to 1700°F. With the increase in flare operating temperature, the average CO and THC emissions were 2.8 lb/hr and 0.06 lb/hr, respectively.

3.3.2 Residence Time Summary of Results

The average gas residence time in the flare was 1.7 seconds. The results from each test are shown in Table 3-2. Residence time was calculated by the following equation:

$$Rt = Vi / Qi$$

where,
Rt = residence time, seconds.
Qi = actual volumetric flow through flare, cubic feet per second.
Vi = volume of flare, from tip of burner to top of flare, 130 cubic feet.

3.3.3 Non-Methane Organic Compound/Lower Heating Value Summary of Results

The average Non-Methane Organic Compounds (NMOC) destruction efficiency was 98.5 percent which was in compliance with the respective regulation (at least 98 percent NMOC destruction efficiency). A summary of NMOC results and lower heating values from each test are shown in Table 3-2. Please note that the sample from Run 2 was replaced by the sample from Run 4 as explained earlier in Section 3-2.

3.3.4 Methane Summary of Results

The average methane emission rate was in compliance with its respective emission limitation. The methane results from the outlet sampling location were to be determined by substracting the NMOC emissions from the total hydrocarbons emissions. Since the NMOC samples from each

test were not detected, accurate methane emissions could not be calculated. The methane results from Table 3-2 are presented on a worst case scenario and assumed that all the hydrocarbons detected were methane.

3.3.5 Opacity Summary of Results

Visible emissions testing was performed in accordance with EPA Method 22. No visible emissions from the flare were observed during the observation period.

Nomenclature associated with the summary tables is explained as follows.

dscfm	-	dry standard cubic feet per minute.
acfm	-	actual cubic feet per minute.
ppm	-	parts per million.
ppm as carbon	-	parts per million as carbon.
lb/hour	-	pounds per hour.
%	-	percent.
BTU/cf	-	British thermal units per cubic foot.

Standard conditions were 29.92 inches of mercury and 68^{o} F.

3.4 Operational Process Parameters

Flare operating parameters were monitored on a strip chart during the course of the compliance testing. The average flare temperature was 1650^{o}F. ROJAC performed flow measurements at the inlet sampling location and the results are presented in Table 3-2. Copies of all chart recordings and other supplemental data are included in the Appendix section of this report.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Emissions Test Methods

4.1.1 Non-Methane Organic Compounds

Non-Methane Organic Compound (NMOC) determinations were performed in accordance with EPA Method 18.

Samples from both the inlet and outlet locations were collected for NMOC using the "bag-in-a-box" sampling system, shown in Figure 4-1. The Teflon sample line passed through the wall of the rigid container and was connected to the sample bag, which created a vacuum seal. The bags were filled at a constant rate of 0.5 liters per minute (lpm) over a one (1) hour sampling period by slow evacuation of air within the container. The resulting vacuum inflated the bag with the extracted gas sample. Each sample/line bag pair was filled, purged, and filled again to condition the sampling train and minimize any wall absorption effects. Bag samples were collected in conjunction with each CEM test run.

At the end of the field test program, the bag samples were analyzed first for oxygen and carbon dioxide by an Orsat analyzer per EPA Method 3 and then rushed to the laboratory and analyzed within 24 hours by GC/FID. GC conditions, such as column type, carrier flowrate, temperature, and injected sample volume, were determined before the field sample analyses by means of trial runs on a presurvey sample. Conditions were set to maximize peak resolution and separation. Calibration standards were prepared in advance according to EPA Method 18 protocol. Three (3) standards for high, low, and mid concentration ranges were prepared to encompass the expected stack gas concentrations.

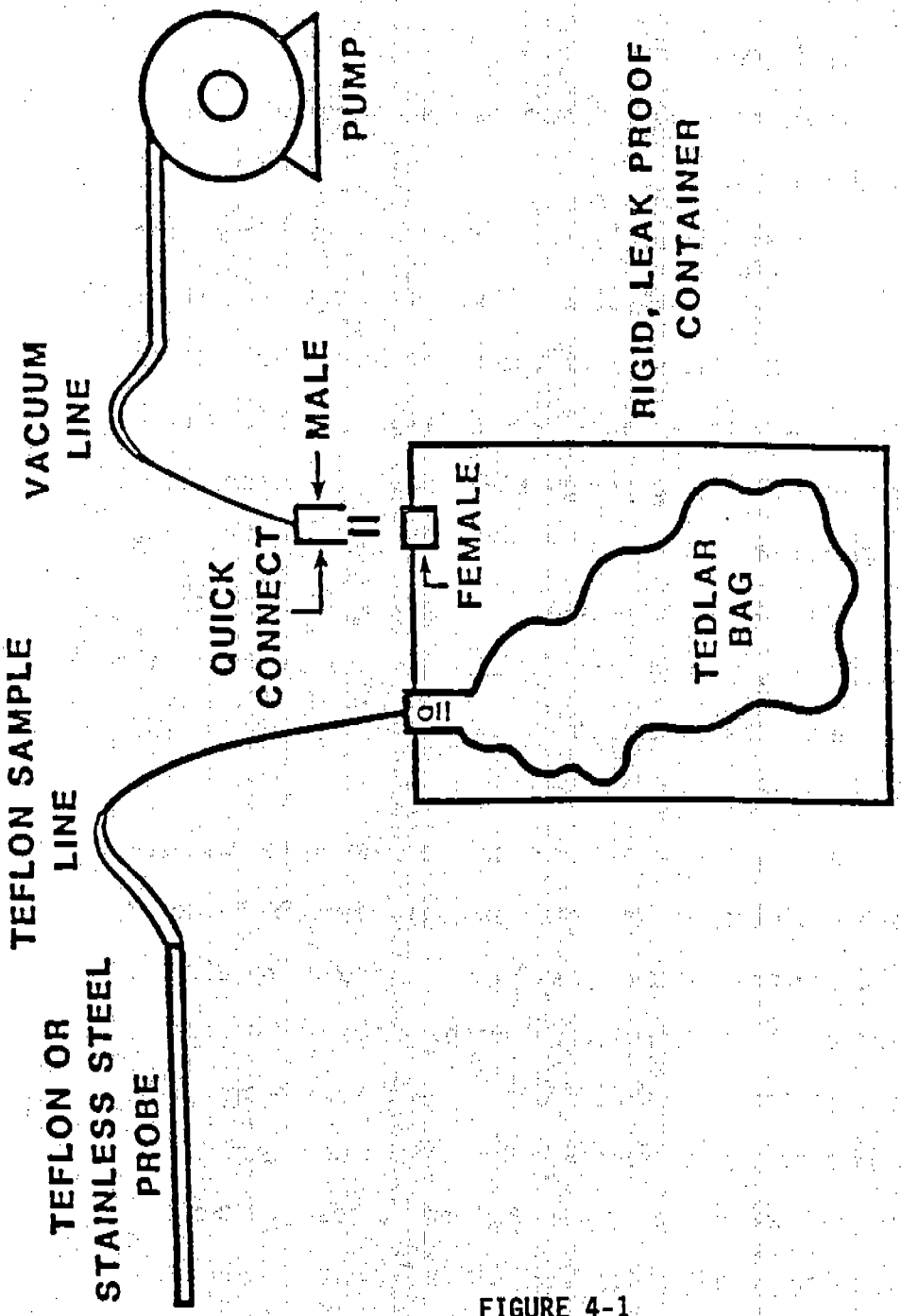


FIGURE 4-1

EPA Method 18
Methane and NMOC Collection Train

The NMOC destruction efficiency was determined through comparison of the inlet and outlet NMOC concentrations using the following equation:

$$\text{Destruction Efficiency} = \frac{\text{NMOC Inlet} - \text{NMOC Outlet}}{\text{NMOC Inlet}} \times 100$$

4.1.2 Visible Emissions

Visible emissions were determined visually in accordance with EPA Method 22. One continuous (two hour) observation period was conducted with three observers alternating between making observations and taking breaks. Observations were recorded on field data sheets which are included in the appendix section of this report.

4.1.3 Continuous Emission Monitoring

ROJAC conducted the outlet flue gas measurements for NO_X, SO_2, CO, THC, and diluent O_2 using EPA Reference Methods 7E, 6C, 10, 25A, and 3A, respectively. Figure 4-2 shows a schematic diagram of the sampling system.

The CEMS draws flue gas in through a 6 foot glass lined stainless steel heated probe with in-stack and/or heated out-of-stack filtration systems. The gas sample was drawn through the probe and filter(s) by a heated Teflon lined diaphragm vacuum pump. From the pump the sample was sent through a heated Teflon sample line. At the end of the sample line the extracted flue gas was split three ways with one part going through a refrigerator-type condenser, into a manifold, and finally to the NO/NO_X, O_2, and CO analyzers. Another part of the sample flue gas was sent directly to the THC analyzer in a heated state with no prior moisture removal. The final portion of the sample was sent through a permeation dryer manufactured by Permapure, Inc. before being introduced to the SO_2 analyzer. Analyzer outputs were recorded by a data acquisition system (DAS) at thirty (30) second intervals.

A total of three (3) sixty (60) minute CEM test runs were performed with a zero and mid-range calibration check between each test run. In addition, a full range calibration and linearity check was performed on each reference method analyzer at the beginning of each test day. Emissions was reported in parts per million and pounds per hour (lb/hr).

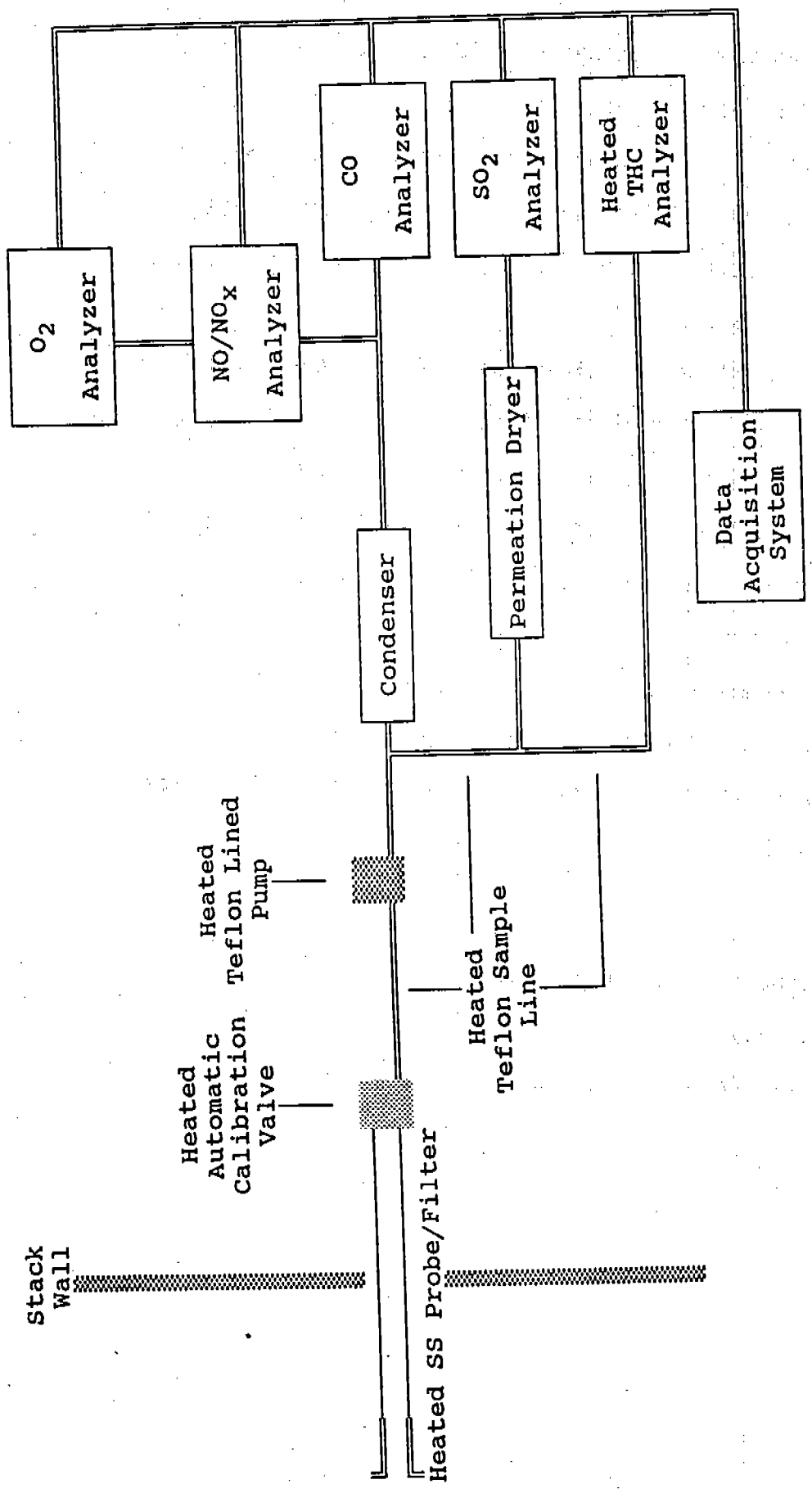


FIGURE 4-2

EPA Methods 3A, 6C, 7E, 10, 25A, Continuous Emission Monitoring System

ROJAC

The CO instrument was an Horiba Model PIR-2000 analyzer which measured CO concentration by means of non-dispersive infrared radiation (NDIR). The infrared radiation was produced by the analyzer and was, in turn, absorbed by the continuous flow of sample gas through the analyzer. The percentage of infrared radiation thus absorbed was proportional to the concentration of CO in the gas stream.

The heated THC instrument was a Beckman Model 402 analyzer which utilized the flame ionization method of detection of total hydrocarbons. The sensor was a burner in which a regulated flow of sample gas passed through a flame sustained by the regulated flow of air and a mixture of 40% hydrogen and 60% nitrogen fuel. Within the flame, a complex ionization of the hydrocarbons in the sample stream occurred which allows for their detection and measurement. Propane (C_3H_8) was used as the calibration standard. Sample concentrations were reported in parts per million by volume (ppmv) as propane, and were adjusted in terms of ppmv as Carbon using Equation 25A-1:

$$C_C = KC_{meas},$$

where C_C = the THC concentration in ppmv as Carbon,

C_{meas} = the THC concentration as measured in ppmv as propane,

K = the response factor for the calibration gas being used (propane = 3).

4.1.5 Analyzer Calibrations

Calibrations were performed using an Environics Series 2020 Computerized Multi-Component Gas Mixer. This system (shown in Figure 4-3) accurately blends NIST (National Institute of Standards and Technology) traceable mixtures from EPA Protocol and other certified gases.

The gas mixer contained five (5) mass flow controllers (MFC's) which have been calibrated and certified NIST traceable with the use of a Sierra Cal-Bench. The Sierra Cal-Bench was a NIST recognized and traceable primary flow measurement standard which contained a sonar detection device sensitive to 0.0005 inches. Using this system, the MFC's were calibrated by the manufacturer at eleven (11) points along their respective ranges from zero to the maximum flow. These data points were stored in the gas mixer's computer as a reference table to be used for interpolating all flow commands.

Required flow rates and target mixtures were entered into the instrument's computer along with the undiluted gas concentrations. The MFC's then accurately mixed the calibration gases with the balance gas to produce the requested dilutions. The Environics Series 2020 NIST Traceability Certification is included in the Appendix.

Certified EPA Protocol 1 compressed span gases of SO_2, NO, O_2, CO, and propane (C_3H_8), supplied by Matheson Gas Products, were used as the calibration standards. High purity nitrogen (N_2) was used as the zero and gas mixer balance gas.

FIGURE 4-3

EPA Conditional Test Method 007
Environics 2020 Computerized Multi-Component Gas Mixer

The gas mixer was used in strict accordance with the EPA's EMTIC (Emission Measurement Technical Information Center) Publication No.CTM-007 Verification of Gas Dilution System For Field Instrument Calibrations (Appendix).

The accuracy of the gas mixer was demonstrated to the onsite observer in accordance with the Performance Specifications Tests outlined in EPA Conditional Test Method 7. Prior to the field testing, a single analyzer was chosen by ROJAC to be calibrated at five (5) points along its measurement range using the gas mixer. These sampling points included the undiluted (100%) calibration gas concentration, as well as 2:1, 5:1, 10:1, and 100:1 dilutions.

The dilutions were introduced to the analyzer one at a time and the responses noted on a field data sheet. The sequence of calibrations were repeated three (3) times and the averages were compared to the predicted responses. These averages did not differ from the predicted concentrations by more than 2% of the predicted value.

Following the dilution sequence tests, a mid-level Protocol 1 gas was introduced directly to the analyzer. The concentration of this mid-level gas did not differ from one of the dilutions by more than 10%. For the gas mixing system to be shown acceptable, the analyzer response to this undiluted gas must be within 2% of the gas concentration.

For the field tests, the analyzers were calibrated and linearized at four (4) points along their measurement ranges at the beginning of each test day. EPA Protocol 1 gases were introduced to each analyzer via the gas mixer to produce calibrations at 90%, 60%, 30%, and 0% of the span values using the N_2 balance/zero gas as the dividing medium.

The system bias and drift tests were conducted with appropriate mid-level dilution gases based on the source emissions. These system calibrations were repeated after each thirty (30) minute test run. The gases passed through all components of the sampling system except the sampling probe. The calibration gas dilutions produced by the gas mixer have the following approximate concentrations:

Constituent	High-level	Mid-level	Low-level	Zero
SO_2	95.6 ppm	47.8 ppm	00.0 ppm	N_2
NOx	95.0 ppm	47.5 ppm	00.0 ppm	N_2
O_2	20.9 %	16.1 %	00.0 %	N_2
CO	1200.0 ppm	720.0 ppm	360.0 ppm	N_2
THC	95.3 ppm	47.7 ppm	28.6 ppm	N_2

4.1.6 Data Reduction

The system calibrations were performed to document any instrument drift. Using Equation 6C-1 (CFR 40, Part 60, Appendix A), the ppm and percent values were corrected to account for the zero and span values and any instrument drift as follows:

$$C_{gas} = (\bar{C} - C_o) \times \frac{C_{ma}}{C_m - C_o},$$

where C_{gas} = emissions concentration (ppm or %)

$\bar{C}$ = average emissions reading (ppm or %)

C_o = average zero reading (ppm or %)

C_m = average span reading (ppm or %)

C_{ma} = span gas concentration (ppm or %).

The corrected ppm and % averages were then used to calculate emission rates in the appropriate standard units.

4.2 Sample Identification and Custody

Sample custody procedures for this program were based on EPA recommended procedures. The project manager was responsible for ensuring that proper custody and documentation procedures were followed for the field sampling and field analytical efforts. The project manager was assisted in this effort by key sampling personnel involved in sample recovery. All sampling data, including information regarding sampling times, locations, and any specific considerations associated with sample acquisition were recorded in ink on pre-formatted data sheets.

Following sample collection, all samples were given a unique alphanumeric sample identification code. The sample volumes were measured and recorded, and the liquid levels on each bottle were marked. Sample labels and integrity seals were completed and affixed to the sample container. Samples were stored in a secure area until shipment.

All samples were packed and shipped according to Department of Transportation (DOT) guidelines. As the samples were packed for shipment to the appropriate laboratories chain-of-custody forms were completed for each shipment box and enclosed therein.

5.0 QA/QC ACTIVITIES

ROJAC maintains specific laboratory facilities dedicated to the maintenance and calibration of source sampling equipment used in performing EPA reference method source tests. These facilities include all equipment and standards necessary for equipment calibration using the procedures outlined in the Quality Assurance Handbook for Air Pollution Measurement Systems Volume III, Stationary Source Specific Methods (EPA 600/4-77-027b).

The checkout and calibration of the source sampling equipment is performed prior to and at the completion of each project. Referenced calibration procedures were strictly followed and the results properly documented and retained. The following calibrated equipment was used during the test program.

* Type-S Pitot Tubes
* Sampling Nozzles
* Type-K Thermocouples
* Dry Gas Meters
* Gas Mixer Mass Flow Controllers
* Continuous Emission Monitors

Calculations for determining flow rates, moisture content, isokinetics, and particulate and gaseous concentrations are made using a computer program developed by the QA/QC Manager at ROJAC. This program utilizes the calculation procedures and equations specified in EPA Methods 2, 4, and 5. The program has been successfully used for numerous test efforts and has been validated by independent sources.

Quality control for the various organic and inorganic analytical procedures is established using field blanks, method blanks, trip blanks, surrogate spiking, and internal standards for quantization. Where applicable, percent recoveries are calculated and determined.

APPENDIX A

Test Results and Calculations

ROJAC ENVIRONMENTAL SERVICES, INC.
EPA METHOD 3 & EPA METHOD 4

HARTFORD LANDFILL
FLARE OUTLET SAMPLING LOCATION
HARTFORD, CONNECTICUT

RUN NO.:	M4-1-Outlet	M4-2-Outlet	M4-3-Outlet	M4-1-Inlet	M4-2-Inlet	M4-3-Inlet
DATE:	11-04-93	11-04-93	11-04-93	11-04-93	11-04-93	11-04-93
TIME:	1140-1240	1315-1415	1435-1535	1140-1240	1315-1415	1435-1535
PBAR, (in. Hg)	30.10	30.10	30.10	30.10	30.10	30.10
STACK AREA, (Sq. Ft.)	38.47	38.47	38.47	0.30	0.30	0.30
NOZZLE DIA., (in.)						
TOTAL TIME, (minutes)	60	60	60	60	60	60
CALIBRATION FACTOR	0.9992	0.9992	0.9992	1.0043	1.0043	1.0043
PITOT COEFFICIENT	0.84	0.84	0.84	0.99	0.99	0.99
SQ.RT.DELTA P, (in. H2O)	0.1546	0.1734	0.1599	0.6487	0.6585	0.6712
DELTA H, (in. H2O)	1.00	1.00	1.00	1.00	1.00	1.00
METER TEMP., (Degree F)	68	72	74	67	72	73
STATIC PRESS., (in. H2O)	-0.06	-0.06	-0.06	2.50	2.50	2.50
STACK TEMP., (Degree F)	1505	1457	1544	93	93	93
METER VOLUME, (cu.ft.)	31.549	31.802	32.115	32.938	33.885	33.049
TOTAL H2O VAPOR, (ml)	37.60	54.70	63.70	19.60	26.70	18.40
CO2 IN STACK GAS, (%)	5.7	5.8	6.0	34.2	34.4	35.5
O2 IN STACK GAS, (%)	13.3	13.2	12.8	0.6	1.8	0.6
CO IN STACK GAS, (%)	0.0	0.0	0.0	0.0	0.0	0.0
N2 IN STACK GAS, (%)	81.0	81.0	81.2	65.2	63.8	63.9
METER VOL. STD, (cu.ft.)	31.79	31.80	32.00	33.42	34.06	33.16
H2O IN STACK GAS, (%)	5.27	7.49	8.57	2.69	3.56	2.55
STACK GAS MOLECULAR WT	28.84	28.60	28.49	33.08	33.02	33.30
EXCESS AIR, (%)	164.5	161.3	148.2	3.6	12.0	3.7
STACK GAS VEL., (FPM)	1002.27	1115.03	1053.30	2447.49	2486.65	2523.84
GAS FLOWRATE, (ACFM)	38552	42890	40515	731	742	753
STP FLOWRATE, (DSCFM)	9870	10993	9817	687	692	710

EXAMPLE CALCULATIONS

1. pounds per hour = lb/dscf x dscfm x 60

$$\text{lb/dscf} = \text{ppm} \times \text{MW} \times \frac{2.205\text{E}-3\ \text{LB/G}}{22.414\ \text{L/G-MOLE} \times 3.531\text{E}-2\ \text{CF/L} \times (528.27^{o}\text{R}/492.27^{o}\text{R})} \times 1\text{E}6$$

where lb/hr = pounds per hour
lb/dscf = pounds per dry standard cubic feet
MW = molecular weight in grams per gram-mole (g/g-mole)
lb/g = pounds per gram
l/g-mole = liters per gram-mole
cf/l = cubic feet per liter
oR = degrees Rankine

lb/dscf = 12.3 x 46.0 x 2.596E-09 = 1.469E-06

lb/hr = 1.469E-06 x 9870 x 60 = 0.9 lb/hr

2. ppm as Carbon = ppm THC x C K-Factor = 7.5 x 3.0 = 22.5 ppmC

where C K-Factor = Carbon equivalent correction factor (propane = 3)

3. pounds per hour as C = ppmC x MW x 2.596E-09 x dscfm x 60

lbC/hr = 22.5 x 12.0 x 2.596E-09 x 9870 x 60

lbC/hr = 0.4 lbC/hr

EQUATIONS 6C-1 - EMISSIONS CONCENTRATIONS

CLIENT: CRRA
LOCATION: HARTFORD LANDFILL FLARE
PROJ. NO: F93-09
DATE: 11/04/93

TIME	RUN NUMBER	ANALYZER AVERAGE	ZERO RESPONSE INITIAL	ZERO RESPONSE FINAL	UPSCALE RESPONSE INITIAL	UPSCALE RESPONSE FINAL	AVERAGE ZERO	AVERAGE SPAN	SPAN GAS VALUE	EMISSIONS CONCENTRATION
1048-1148	NOx-1	12.7	0.3	0.6	48.4	46.8	0.5	47.6	47.5	12.3 ppm
1220-1320	NOx-2	12.7	0.6	0.6	46.8	47.1	0.6	47.0	47.5	12.4 ppm
1355-1455	NOx-3	13.0	0.6	0.6	47.1	47.3	0.6	47.2	47.5	12.6 ppm
	AVERAGE	12.8	0.5	0.6	47.4	47.1	0.6	47.3		12.5 ppm
1048-1148	SO2-1	1.3	0.3	1.1	47.6	48.7	0.7	48.2	47.8	0.6 ppm
1220-1320	SO2-2	3.4	1.1	1.3	48.7	49.1	1.2	48.9	47.8	2.2 ppm
1355-1455	SO2-3	3.9	1.3	1.4	49.1	48.6	1.4	48.9	47.8	2.6 ppm
	AVERAGE	2.9	0.9	1.3	48.5	48.8	1.1	48.6		1.8 ppm
1048-1148	O2-1	13.4	0.0	0.1	16.1	16.1	0.1	16.1	16.1	13.4 %
1220-1320	O2-2	13.5	0.1	0.1	16.1	16.1	0.1	16.1	16.1	13.5 %
1355-1455	O2-3	13.5	0.1	0.1	16.1	16.1	0.1	16.1	16.1	13.5 %
	AVERAGE	13.5	0.1	0.1	16.1	16.1	0.1	16.1		13.5 %
1048-1148	CO-1	240.0	4.7	2.9	712.6	714.3	3.8	713.5	720.0	239.6 ppm
1220-1320	CO-2	275.2	2.9	2.5	714.3	710.7	2.7	712.5	720.0	276.4 ppm
1355-1455	CO-3	284.8	2.5	3.5	710.7	707.0	3.0	708.9	720.0	287.4 ppm
	AVERAGE	266.7	3.4	3.0	712.5	710.7	3.2	711.6		267.8 ppm

EQUATIONS 6C-1 - EMISSIONS CONCENTRATIONS

CLIENT: CRRA
LOCATION: HARTFORD LANDFILL FLARE
PROJ. NO: F93-09
DATE: 11/04/93

TIME	RUN NUMBER	ANALYZER AVERAGE	ZERO RESPONSE INITIAL	ZERO RESPONSE FINAL	UPSCALE RESPONSE INITIAL	UPSCALE RESPONSE FINAL	AVERAGE ZERO	AVERAGE SPAN	SPAN GAS VALUE	EMISSIONS CONCENTRATION
1520-1559	NOx-4A	12.9	0.6	0.3	47.3	47.0	0.5	47.2	47.5	12.7 ppm
1559-1620	NOx-4B	15.9	0.6	0.3	47.3	47.0	0.5	47.2	47.5	15.7 ppm
	AVERAGE	14.4	0.6	0.3	47.3	47.0	0.5	47.2		14.2 ppm
1520-1559	SO2-4A	2.8	1.4	1.1	48.6	48.7	1.3	48.7	47.8	1.6 ppm
1559-1620	SO2-4B	3.0	1.4	1.1	48.6	48.7	1.3	48.7	47.8	1.8 ppm
	AVERAGE	2.9	1.4	1.1	48.6	48.7	1.3	48.7		1.7 ppm
1520-1559	O2-4A	13.4	0.1	0.1	16.1	16.1	0.1	16.1	16.1	13.4 ppm
1559-1620	O2-4B	12.7	0.1	0.1	16.1	16.1	0.1	16.1	16.1	12.7 ppm
	AVERAGE	13.1	0.1	0.1	16.1	16.1	0.1	16.1		13.0 ppm
1520-1559	CO-4A	298.6	3.5	2.6	707.0	708.9	3.1	708.0	720.0	301.9 ppm
1559-1620	CO-4B	66.8	3.5	2.6	707.0	708.9	3.1	708.0	720.0	65.1 ppm
	AVERAGE	182.7	3.5	2.6	707.0	708.9	3.1	708.0		183.5 ppm

EXAMPLE CALCULATIONS

EQUATION 6C-1 - EMISSION CONCENTRATIONS

CLIENT: CRRA
LOCATION: HARTFORD LANDFILL FLARE
PROJ. NO: F93-09
DATE: 11/04/93

RUN NUMBER	ANALYZER AVERAGE	ZERO RESPONSE INITIAL	ZERO RESPONSE FINAL	UPSCALE RESPONSE INITIAL	UPSCALE RESPONSE FINAL	AVERAGE ZERO	AVERAGE SPAN	SPAN GAS VALUE	EMISSIONS CONCENTRATION
NOx-1	12.7	0.3	0.6	48.4	46.8	0.5	47.6	47.5	12.3 ppm

EQUATION 6C-1: $C_{gas} = (\bar{C} - C_o) \times \frac{(C_{ma})}{(C_m - C_o)}$,

WHERE
$\bar{C}$ = ANALYZER RUN AVERAGE
C_o = AVERAGE ZERO RESPONSE
C_m = AVERAGE SPAN RESPONSE
C_{ma} = UPSCALE SPAN GAS CONCENTRATION
C_{gas} = POLLUTANT CONCENTRATION

$$C_{gas} = (12.7 - 0.5) \times \frac{(47.5)}{(47.6) - (0.5)} = 12.3 \text{ ppm}$$

APPENDIX B

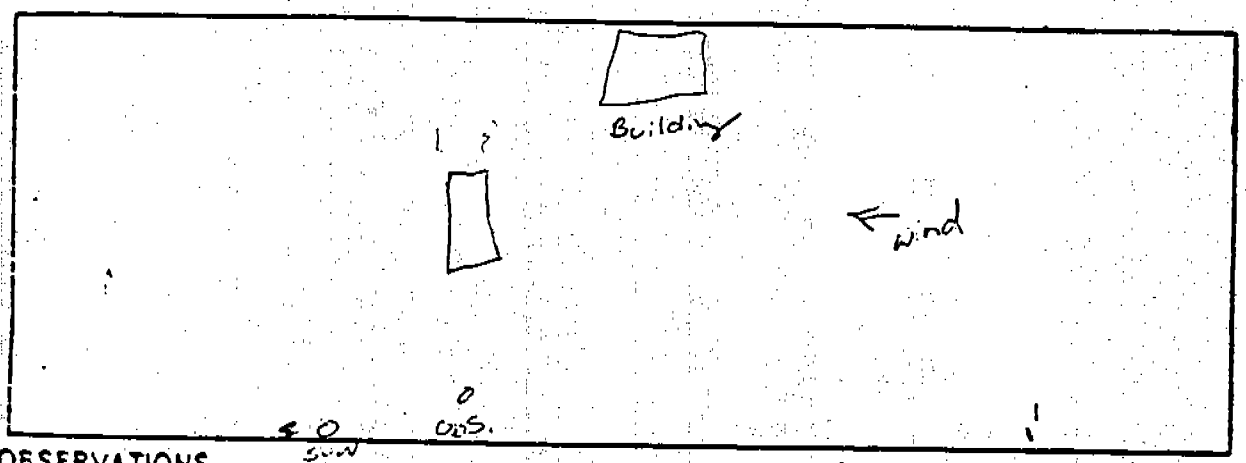
Field Data Sheets

pg 1 of 3

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company Hfd Landfill	Observer RAK / TC / JSG
Location @ Hartford, CT	Affiliation ROSAC
Company representative David Martin	Date 11/4/93
Sky Conditions Cloudy	Wind direction South
Precipitation NONE	Wind speed 5-10 m.p.h.
Industry CRRA	Process unit Flare

Sketch process unit; indicate observer position relative to source and sun; indicate potential emission points and/or actual emission points.



OBSERVATIONS

		Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	RAK	1200	0	0
		1205	0	0
		1210	0	0
		1215	0	0
	TEC	1220	0	0
		1225	0	0
		1230	0	0
	JSG	35	0	0
		40	0	0
End observation		1245		

Figure 22-1

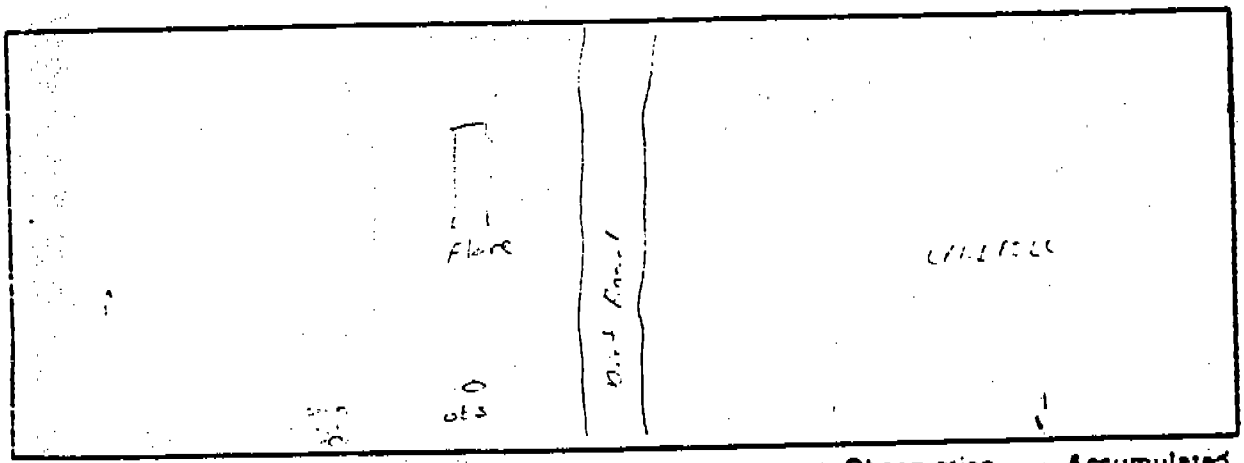
FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company Hartford LANDFILL
Location Hartford, CT
Company representative David Martin
Observer RAK/JSG/TC/ROJAC
Affiliation
Date 11/4/93

Sky Conditions Cloudy 95°
Precipitation 0
Wind direction South
Wind speed 5-10 mph

Industry CRRA
Process unit Landfill flare

Sketch process unit; indicate observer position relative to source and sun; indicate potential emission points and/or actual emission points.



OBSERVATIONS

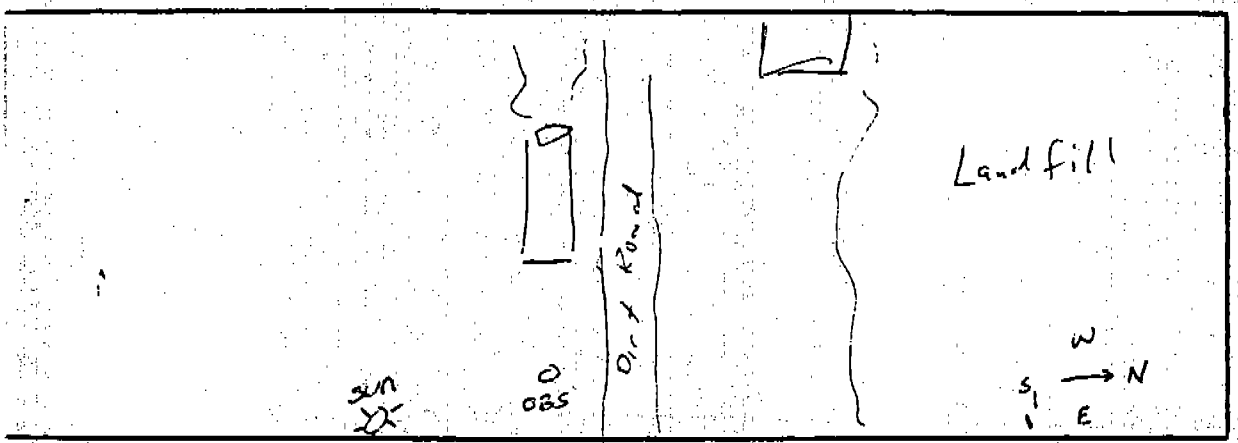
		Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	RAK	1245	0	0
		1250	0	0
		1255	0	0
	RAK	1300	0	0
	TEC	1305	0	0
		1310	0	0
		1315	0	0
	TEC JSG	1320	0	0
		25	0	0
End observation		30		

Figure 22-1

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

ompany Hartford Landfill	Observer RAK/TEC/JSG
ocation Hartford, CT	Affiliation ROSAC
ompany representative David Martin	Date 11/4/93
ky Conditions Cloudy	Wind direction South
recipitation NONE	Wind speed 5-10 mph
ndustry CRRA	Process unit Landfill Flare

ketch process unit; indicate observer position relative to source and sun; indicate potential mission points and/or actual emission points.



BSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
egin Observation	RAK 1330	0	0
	35	0	0
	40	0	0
	RAK 1345	0	0
	50	0	0
	55	0	0
	End 1400		
nd observation			

Figure 22-1

RUN NO. M4-1-Outlet
PROJ. NO. F93-09
DATE 11-4-93
FIRM NAME CIRMA
PLANT LOC. Hartford Landfill
TESTER TEC/JJG

MODULE NO. 1481
DGM, Y .9993
MOD.ΔH@ 1.81
PROBE I.D. 8FT WC
PITOT (Cp) .81
NOZ. DIA. .500
FILTER I.D. ~~CHROMOSORB~~ NA
TARE WT. NA

PITOT LEAK CHECK
INITIAL 7½" OK
FINAL OK
TRAIN LEAK CHECK
INITIAL 0.017 ft³ @ 7" In. Hg.
FINAL 0.002 ft³ @ 6 In. Hg.
SAMPLING TIME ~~120~~ 60 min.
INITIAL 1140
FINAL 1240

STACK COND.
STATIC PRES. -0.065
DUCT DIM. 84"
DUCT AREA 38.48
%H2O 3
AMBIENT COND.
AMB. TEMP 50 °F
BAR. PRES. 30.10 In. Hg.

TRAV. PT	SAMPLE TIME (min)	CLOCK TIME (hours)	VEL. ΔP	ORIFICE ΔH	DGM Tm in °F	DGM Tm out °F	STACK TEMP. Ts °F	GAS SAMPLE VOLUME Vm ft³	COND. OUTLET °F	HEATER BOX °F	PROBE TEMP. °F	FILTER OUTLET °F	PUMP VAC. In. Hg.	OTHER
	18 min	1140		1.0				595.077						
1	10	50		1.0	58	58	1510	600.3	465					
2	20	1200			65	59	1508	605.8	↓					
10	30	10			73	63	1507	610.9						
4	40	20			79	66	1492	616.4						
5	50	30			79	69	1509	621.1						
6	60	40			80	70	1506	626.578	↓					
7														
8														
9														
10														
11														
12														
1														
2														
3														
14														
15														
16														
17														
18														
19														
20														
21														
22														
	AVERAGE	ΔP SQRT (ΔP)			68		1505	TOTAL 31.549						

REMARKS

Rojac Environmental Services, Inc.

SAMPLE IDENT. OUT - M4
DATE TAKEN
PROJECT#
ANALYSIS

POST IMPS. WEIGHT
PRE IMPINGERS TARE
TOTAL IMP'S CONTENTS 30

POST S.G. WEIGHT 7.6
PRE S.G. TARE
TOTAL S.G. CONTENTS 7.6

37.6

ORSAT BAG ANALYSIS

	1	2	3	AVERAGE
CO2	5.8	5.6	5.6	5.6
O2	13.3	13.3	13.3	13.3
CO				
N2				

EPA METHODS FIELD DATA SHEET

RUN NO. MW-2
PROJ. NO. F9307
DATE 11-4-93
PLANT NAME CRRA
PLANT LOC. Hartford Landfill
TESTER TEG/JVC

MODULE NO. 1491
DGM, Y .9992
MOD ΔH@ 1.81
PROBE I.D. 5FT WL
PITOT (Cp) .84
NOZ. DIA. .500
FILTER I.D. NA
TARE WT. NA

PITOT LEAK CHECK
INITIAL ✓
FINAL OK
TRAIN LEAK CHECK
INITIAL ft³ @ in. Hg.
FINAL 0.002 ft³ @ 4 in. Hg.
SAMPLING TIME 60 min.
INITIAL 1315
FINAL 1415

STACK COND.
STATIC PRES. -.06
DUCT DIM. 84"
DUCT AREA 38.47
%H2O 7.5%
AMBIENT COND.
AMB. TEMP 59 °F
BAR. PRES. 30.10 in. Hg.

TRAV. PT	SAMPLE TIME (min)	CLOCK TIME (hours)	VEL. ΔP	ORIFICE ΔH	DGM Tm in °F	DGM Tm out °F	STACK TEMP. Ts °F	GAS SAMPLE VOLUME Vm ft³	COND. OUTLET °F	HEATER BOX °F	PROBE TEMP. °F	FILTER OUTLET °F	PUMP VAC. in. Hg.	OTHER
								636.767						
	10min	1315		1.0	64	64	1508	630.8	65					
		25			70	65	1490	636.7						
		35			75	65	1475	641.8						
		45			78	63	1446	647.6						
		55			80	71	1432	652.6						
		1405			80	72	1456	657.367						
		15												
	AVERAGE	ΔP SQRT (ΔP)			72		1457	TOTAL 31.802						

REMARKS

POST IMPS. WEIGHT
PRE IMPINGERS TARE
TOTAL IMP'S CONTENTS 42

POST S.G. WEIGHT
PRE S.G. TARE
TOTAL S.G. CONTENTS 12.7

Total = 54.7ml

ORSAT BAG ANALYSIS

	1	2	3	AVERAGE
CO2	5.8	5.8	5.8	5.8
O2	13.2	13.2	13.2	13.2
CO				
N2				

I NO. MM-3
. NO. F93-07
DATE 11-4-93
NAME CRRA
T LOC. Hartford Landfill
STER TEC/JSC

MODULE NO. 14581
DGM, Y .9992
MOD.ΔH@ 1.81
PROBE I.D. 6FT
PITOT (Cp) .84
NOZ. DIA. -
FILTER I.D. -
TARE WT. -

PITOT LEAK CHECK
INITIAL ✓
FINAL OK
TRAIN LEAK CHECK
INITIAL ft³ @ In. Hg.
FINAL 0.002 ft³ @ 5 In. Hg.
SAMPLING TIME 60 min.
INITIAL 1435
FINAL 1535

STACK COND.
STATIC PRES. -.06
DUCT DIM. 8"ϕ
DUCT AREA 35.47
%H2O 6.6%
AMBIENT COND.
AMB. TEMP 50s °F
BAR. PRES. 30.10 In. Hg.

AV. PT	SAMPLE TIME (min)	CLOCK TIME (hours)	VEL. ΔP	ORIFICE ΔH	DGM Tm in °F	DGM Tm out °F	STACK TEMP. Ts °F	GAS SAMPLE VOLUME Vm ft³	COND. OUTLET °F	HEATER BOX °F	PROBE TEMP. °F	FILTER OUTLET °F	PUMP VAC. In. Hg.	OTHER
				1.0				657.000						
	10min	1435			67	67	1541	664.6						
		45			77	70	1538	669.3						
		55			79	71	1535	675.0						
		1505			81	73	1545	680.2						
		15			81	72	1561	685.1						
		25			81	71	1543	691.115						
		35												
	AVERAGE	ΔP SQRT (ΔP)			74		1544	TOTAL 32.115						

REMARKS

POST IMPS. WEIGHT
PRE IMPINGERS TARE
TAL IMP'S CONTENTS 51 ml

POST S.G. WEIGHT
PRE S.G. TARE
TAL S.G. CONTENTS 12.7

Total = 63.7ml

ORSAT BAG ANALYSIS

	1	2	3	AVERAGE
CO2	6.0	6.0	6.0	6.0
O2	12.9	12.9	12.9	12.9
CO				
N2				

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11/3/93 Page 1 of 1

Plant Hartford Landfill Pre-test check

Location Flare Outlet Sampling Location

Stack Dimensions 84" ID Area ____ ft²

Barometric Pressure, (Pb) 38.47 in. Hg.

Static Pressure, (Ps) -0.06 in. H2O

Stack Molecular Wt., (Ms) 28.6

Moisture Content 7 %

Pitot No. 5'

Leak Check OK in. H2O

Pitot Coefficient 0.84

Tester CAK/JAG

Point	ΔP in. H2O	Ts (°F)	~~Cyclonic Flow Angle~~	~~Other~~	Other
A 1	.03	1563		.025	1538
2	.03	1553		.03	1594
3	.03	1550		.025	1535
4	.025	1537		.025	1528
5	.025			.03	1520
6	.025	1466		.025	1470
7	.025			.03	1455
8	.025			.025	1434
9	.03			.03	1429
10	.03	1448		.03	1434
11	.03	1452		.03	1431
12	.03			.025	1430
13	.03			.025	1441
14	.025			.025	1424
Average	0.1667	1510			

4/1

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps/13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [Ts + 460 / Pg x Ms] ____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area 41,996 ACFM

Standard Gas Flowrate, Qstd = (Qs) x 528°R/Ts x Pg/29.92 x (100 - %H2O)/100 10,917 DSCFM

0.7" - No

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11-4-93
Plant CRRA - Hartford
Location Flare outlet

Pre-Run 1 Outlet

Stack Dimensions 84" Area 38.47 ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) -0.05 in. H2O
Stack Molecular Wt., (Ms) 28.84
Moisture Content 3 %

Pitot No. 10' Stainless
Leak Check 7.5 in. H2O
Pitot Coefficient .84

Tester TEC/JSG

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
1	0.025	1650			
2	0.027				
3	0.03				
4	0.03				
5	0.027				
6	0.025				
7	0.02				
8	0.015				
9	0.015				
10	0.015				
11	0.015				
12	0.01				
1	0.035				
2	0.04				
3	0.045				
4	0.035				
5	0.03				
6	0.03				
7	0.01				
8	0.01				
9	0.0				
10	0.0				
11	0.0				
12	0.0				
Average	0.1273	1650			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps / 13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [(Ts + 460) / (Pg x Ms)] _____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area _____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x (528°R / Ts) x (Pg / 29.92) x ((100 - %H2O) / 100) _____ DSCFM

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11-4-93
Plant Hartford Landfill
Location Hartford, CT Flare Outlet

Post 1
Pic 2 Flare outlet

Stack Dimensions 84" Area 38.47 ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) -0.06 in. H2O
Stack Molecular Wt., (Ms) 28.7
Moisture Content 7 %

Pitot No. S-10-55
Leak Check OK in. H2O
Pitot Coefficient .84

Tester TEC/JSG

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
1	0.05	1650			
2	0.05				
3	0.05				
4	0.05				
5	0.04				
6	0.04				
7	0.075				
8	0.02				
9	0.02				
10	0.02				
11	0.01				
12	0.01				
1	0.04				
2	0.05				
3	0.05				
4	0.05				
5	0.05				
6	0.04				
7	0.03				
8	0.03				
9	0.03				
10	0.025				
11	0.025				
12	0.025				
Average	0.1819	1650			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps/13.6

Gas Velocity, $Vs = (85.49) \times (Cp) \times (\text{SQRT } \Delta P)avg \times \text{SQRT}\left[\frac{Ts + 460}{Pg \times Ms}\right]$

Actual Gas Flowrate, Qs = (Vs) x 60 x Area

Standard Gas Flowrate, $Qstd = (Qs) \times \frac{528\ °R}{Ts} \times \frac{Pg}{29.92} \times \frac{100 - \%H2O}{100}$

Run 1 Average $\sqrt{\Delta P}$ avg

_____ ft/sec

_____ ACFM

_____ DSCFM

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11-4-93
Plant CRRA - Hartford
Location Hartford, CT

Post 2
Pre 3 Outlet Flare

Stack Dimensions 84" Area ____ ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) -0.061 in. H2O
Stack Molecular Wt., (Ms) 28.6
Moisture Content 7.5 %

Pitot No. 10'-SS
Leak Check OK in. H2O
Pitot Coefficient .84

Tester TEC/JJG

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
1	0.05	1650			
2	0.04				
3	0.05				
4	0.05				
5	0.05				
6	0.035				
7	0.03				
8	0.03				
9	0.03				
10	0.025				
11	0.02				
12	0.025				
1	0.04				
2	0.045				
3	0.05				
4	0.05				
5	0.04				
6	0.03				
7	0.02				
8	0.01				
9	0.015				
10	0.01				
11	0				
12	0				
Average	0.1648	1650			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps / 13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [$\frac{Ts + 460}{Pg \times Ms}$] ____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area ____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x $\frac{528\,°R}{Ts}$ x $\frac{Pg}{29.92}$ x $\frac{100 - \%H2O}{100}$ ____ DSCFM

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11-4-93
Plant Hartford Landfill
Location Hartford, CT

Post Run 3 Flare outlet

Stack Dimensions 84" Area 38.47 ft²
Barometric Pressure, (Pb) 30.1 in. Hg.
Static Pressure, (Ps) -0.065 in. H2O
Stack Molecular Wt., (Ms) 28.5
Moisture Content 8.6 %

Pitot No. 10-55
Leak Check OK in. H2O
Pitot Coefficient .84

Tester JSG/TEC

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
1	0.03	1650			
2	0.035				
3	0.04				
4	0.03				
5	0.03				
6	0.03				
7	0.01				
8	0.01				
9	0.01				
10	0.0				
11	0.0				
12	0.0				
1	0.055				
2	0.06				
3	0.05				
4	0.04				
5	0.05				
6	0.035				
7	0.03				
8	0.03				
9	0.03				
10	0.03				
11	0.03				
12	0.025				
		↓			
Average	0.1549	1650			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps/13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [(Ts + 460) / (Pg x Ms)] _____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area _____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x (528 °R / Ts) x (Pg / 29.92) x ((100 - %H2O) / 100) _____ DSCFM

EPA METHODS FIELD DATA SHEET

RUN NO. M4-1-Inlet
PROJ. NO. F93-C7
DATE 11/4/93
FIRM NAME Hartford Landfill
PLANT LOC. Hartford, CT
TESTER RAL/[illegible]

MODULE NO. 1748
DGM, Y 1.0013
MOD.ΔH@ 1.60
PROBE I.D. Std 16
PITOT (Cp) .99
NOZ. DIA. NA
FILTER I.D. NA
TARE WT. NA

PITOT LEAK CHECK
INITIAL OK
FINAL OK
TRAIN LEAK CHECK
INITIAL 0.00 ft³ @ 8 in. Hg.
FINAL 0.00 ft³ @ 3 in. Hg.
SAMPLING TIME 60 min.
INITIAL 1140
FINAL 1240

STACK COND.
STATIC PRES. +2.5
DUCT DIM. 7.4"
DUCT AREA 0.30
%H2O ~ 2.7
AMBIENT COND.
AMB. TEMP 50 °F
BAR. PRES. 30.10 in. Hg.

TRAV. PT	SAMPLE TIME (min)	CLOCK TIME (hours)	VEL. ΔP	ORIFICE ΔH	DGM Tm in °F	DGM Tm out °F	STACK TEMP. Ts °F	GAS SAMPLE VOLUME Vm ft³	COND. OUTLET °F	HEATER BOX °F	PROBE TEMP. °F	FILTER OUTLET °F	PUMP VAC. in. Hg.	OTHER
	0	1140		1.0				803.174						
	5	45			58	59	93	807.8	68				7"	
	10	50			62	59	93	501						
	15	55			66	60	93	812.						
	20	1200			70	61	93	816.6						
	25	05			71	62	93	816.5						
	30	10			71	63	93	821.7						
	35	15			75	63	93	822.6						
	40	20			75	63	93	823.						
	45	25			76	65	93	829.						
	50	30			77	67	93	831.0						
	55	35			76	67	93	833.4						
	60	1240		↓	77	69	93	836.112						
	AVERAGE	ΔP SQRT (ΔP)			67		93	TOTAL 32.935						

REMARKS
Purge 1101 to 1115
MIE Bag Start 1125
1148

Impingers H2O Gain 8 ml
Silica Gel H2O Gain 11.6
Total Moisture Gain 19.6

ORSAT BAG ANALYSIS

	1	2	3	AVERAGE
CO2	34.2	34.2	34.2	34.2
O2	0.6	0.6	0.6	0.6
CO				
N2				

EPA METHODS FIL. DATA SHEET

RUN NO. MW-2-Inlet
PROJ. NO. F93-09
DATE 11/4/93
FIRM NAME Hartford Landfill
PLANT LOC. Hartford, CT
TESTER RNK

MODULE NO. 1748
DGM, Y 1.0043
MOD.ΔH@ 1.86
PROBE I.D. ~~SS~~ Teflon
PITOT (Cp) NA
NOZ. DIA. NA
FILTER I.D. NA
TARE WT. NA

PITOT LEAK CHECK
INITIAL OK
FINAL OK
TRAIN LEAK CHECK
INITIAL .002 ft³ @ 11 in. Hg.
FINAL 0.002 ft³ @ 10 in. Hg.
SAMPLING TIME 60 min.
INITIAL 1315
FINAL 1415

STACK COND.
STATIC PRES. +2.5
DUCT DIM. 7.4" ED
DUCT AREA 0.3
%H2O 3.6%
AMBIENT COND.
AMB. TEMP 50 F
BAR. PRES. 30.10 in. Hg.

TRAV. PT	SAMPLE TIME (min)	CLOCK TIME (hours)	VEL. ΔP	ORIFICE ΔH	DGM Tm in °F	DGM Tm out °F	STACK TEMP. Ts °F	GAS SAMPLE VOLUME Vm ft³	COND. OUTLET °F	HEATER BOX °F	PROBE TEMP. °F	FILTER OUTLET °F	PUMP VAC. in. Hg.	OTHER
	0	1315	NA	1.0				836.462						
1	5	20			68	64	93	840.4	<68					
	10	25			70	64	93	844.2						
	15	30			74	67	93	847.5						
	20	35			74	67	93	849.9						
	25	40			76	67	93	851.6						
	30	45			77	67	93	852.8						
	35	50			78	67	93	856						
	40	55			78	70	93	857.1						
	45	1400			78	70	93	861.7					7"	
	50	05			79	70	94	866					7"	
	55	10			79	71	94	869					7	
	60	1415			81	72	94	870.347					7"	
	AVERAGE	ΔP SQRT (ΔP)			72		93	TOTAL 33.885						

REMARKS
Purge 1317 - 1320
MW Bag Start 1327
Stop 1340

ml
Impingers H2O Gain 16 ml
Silica Gel H2O Gain 10.7
Total Moisture Gain 26.7

ORSAT BAG ANALYSIS

	1	2	3	AVERAGE
CO2	34.4	34.4	34.4	34.4
O2	1.8	1.8	1.8	1.8
CO				
N2				

RUN NO. M4-3-Inlet
PROJ. NO. F93-29
DATE 11/4/93
FIRM NAME Hartford Landfill
PLANT LOC. Hartford, CT
TESTER RAK

MODULE NO. 1746
DGM, Y 1.0043
MOD. ΔH@ 1.86
PROBE I.D. Te Flon
PITOT (Cp) NA
NOZ. DIA. NA
FILTER I.D. NA
TARE WT. NA

PITOT LEAK CHECK
INITIAL NA
FINAL NA
TRAIN LEAK CHECK
INITIAL 0.00 ft³ @ 10 in. Hg.
FINAL 0.00 ft³ @ 10 in. Hg.
SAMPLING TIME 60 min.
INITIAL 1435
FINAL 1535

STACK COND.
STATIC PRES. +2.5
DUCT DIM. 7.4" ID
DUCT AREA 0.3 ft²
%H2O 2.6%
AMBIENT COND.
AMB. TEMP 50 °F
BAR. PRES. 30.10 in. Hg.

TRAV. PT	SAMPLE TIME (min)	CLOCK TIME (hours)	VEL. ΔP	ORIFICE ΔH	DGM Tm in °F	DGM Tm out °F	STACK TEMP. Ts °F	GAS SAMPLE VOLUME Vm ft³	COND. OUTLET °F	HEATER BOX °F	PROBE TEMP. °F	FILTER OUTLET °F	PUMP VAC. in. Hg.	OTHER
	0	1435		1.0				871.057						
A1	5	40			67	66	94	873.	<68					
	10	45			76	67	94	877.						
	15	50			76	66	94	880						
	20	55			76	67	93	883.1						
	25	1500			76	67	93	886.						
	30	05			76	70	93	889.6						
	35	10			78	70	93	891.6					7"	
	40	15			76	70	93	894.6					7"	
	45	20			77	70	93	895.6						
	50	25			78	70	93	899.					6 1/2"	
	55	30			78	70	93	901.8					6 1/2"	
	60	1535			77	70	93	904.108						
	AVERAGE	ΔP SQRT (ΔP)			73		93	TOTAL 33.047						

ORSAT BAG ANALYSIS

	1	2	3	AVERAGE
CO2	35.5	35.5	35.5	35.5
O2	0.6	0.6	0.6	0.6
CO				
N2				

Impingers H2O Gain 9
Silica Gel H2O Gain 9.4
Total Moisture Gain 18.4

REMARKS
Purge 1400
MIE BAG start
1405
1500 stop

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11/4/93
Plant Hartford Landfill
Location [illegible]

Stack Dimensions 7.4" ID Area 0.30 ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) +2.5 in. H2O
Stack Molecular Wt., (Ms) 33.1
Moisture Content 2.7 %

Pitot No. Std-18
Leak Check o.k. in. H2O
Pitot Coefficient .99
Tester RAK/JSG

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
A 1	.40	93			
2	.42	93			
3	.43	92			
4	.44	92			
B 1	.39	93			
2	.43	93			
3	.415	93			
4	.42	93			
Average	0.6465	93			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps / 13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [(Ts + 460) / (Pg x Ms)] _____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area _____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x (528 °R / Ts) x (Pg / 29.92) x ((100 − %H2O) / 100) _____ DSCFM

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11/4/93
Plant Hartford Landfill
Location Hartford, CT Flare Inlet

Stack Dimensions 7.4"ID Area 0.30 ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) -2.5 in. H2O
Stack Molecular Wt., (Ms) 33.0
Moisture Content 3.6 %

Pitot No. STD-18"
Leak Check OK in. H2O
Pitot Coefficient .99
Tester RAK/JSG

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
A 1	.42	93			
2	.44	93			
3	.42	93			
4	.42	93			
B 1	.42	93			
2	.44	93			
3	.42	~~95~~ 93			
4	.41	93			
Average	0.6509	93			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps / 13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [$\frac{Ts + 460}{Pg \times Ms}$] _____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area _____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x 528 °R x Pg x 100 − %H2O DSCFM

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 11/4/93 Run-1430 Page 3 of 4
Plant Hartford Landf. II
Location Flare 2

Stack Dimensions 7.4" ID Area 0.30 ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) +2.5 in. H2O
Stack Molecular Wt., (Ms) 33.0
Moisture Content 3.6 %

Pitot No. 18" STD
Leak Check ok in. H2O
Pitot Coefficient .99
Tester RAK/JSG

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
A 1	.42	94			
2	.46				
3	.44				
4	.44				
B 1	.43				
2	.45				
3	.46				
4	.45				
Average	0.6661	94			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps / 13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [(Ts + 460) / (Pg x Ms)] _____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area _____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x (528 °R / Ts) x (Pg / 29.92) x ((100 − %H2O) / 100) _____ DSCFM

EPA METHOD 2
VELOCITY TRAVERSE AND FLOWRATE DETERMINATION

Date 4/4/93
Plant Hartford Landfill
Location Hartford, CT Flow Inlet

Stack Dimensions 7.4" ID Area 0.30 ft²
Barometric Pressure, (Pb) 30.10 in. Hg.
Static Pressure, (Ps) +2.5 in. H2O
Stack Molecular Wt., (Ms) 33.3
Moisture Content 2.6 %

Pitot No. Std -18"
Leak Check ok in. H2O
Pitot Coefficient 0.99
Tester RDK/JSG

3:45 pm

Point	ΔP in. H2O	Ts (°F)	Cyclonic Flow Angle	Other	Other
A 1	.43	93			
2	.47				
3	.46				
4	.45				
B 1	.46				
2	.465				
3	.465				
4	.46				
Average	0.6763	93			

Absolute Gas Temperature = Ts + 460°R

Absolute Gas Pressure, Pg = Pb + Ps / 13.6

Gas Velocity, Vs = (85.49) x (Cp) x (SQRT ΔP)avg x SQRT [(Ts + 460) / (Pg x Ms)] _____ ft/sec

Actual Gas Flowrate, Qs = (Vs) x 60 x Area _____ ACFM

Standard Gas Flowrate, Qstd = (Qs) x (528 °R / Ts) x (Pg / 29.92) x ((100 − %H2O) / 100) _____ DSCFM

	CO_2	5.8	5.6 5.4
	O_2	13.3	
	CO_2	34.2	34.2
	O_2	0.6	0.6
	CO_2	5.8	5.7
	O_2	13.2	13.2
	CO_2	34.4	34.4
	O_2	1.8	1.8
	CO_2	6.0	6.0
	O_2	12.9	12.8
	CO_2	35.5	35.5
	O_2	0.6	0.6
	CO_2	7.0	7.0
	O_2	12.3	12.3
	CO_2	35.0	35.0
	O_2	0.6	0.8

APPENDIX C

CEM Results and Calibration Data Sheets

CLIENT: CRRA
PROJ. NO.: F93-09
LOCATION: HARTFORD LANDFILL FLARE

RUN NO.:	CEM-1	CEM-2	CEM-3	AVERAGE
DATE:	11/04/93	11/04/93	11/04/93	
TIME:	1048-1148	1220-1320	1355-1455	
INPUTS				
O2 Concentration (%)	13.4	13.5	13.5	13.5
CO2 Concentration (%)	5.7	5.8	6.0	5.8
NOx Concentration (ppm)	12.3	12.4	12.6	12.4
SO2 Concentration (ppm)	0.6	2.2	2.6	1.8
CO Concentration (ppm)	239.6	276.4	287.4	267.8
THC-Out Concentration (ppm)	7.5	11.2	10.6	9.8
Ambient Temp (DegreeF)	50	56	58	54.7
Ambient Barometric Press (in.Hg)	30.10	30.05	30.01	30.05
Volumetric Flowrate (dscfm)	9870	10993	9817	10227
OUTPUTS				
NOx (lb/hr)	0.9	1.0	0.9	0.9
SO2 (lb/hr)	0.1	0.2	0.3	0.2
CO (lb/hr)	10.3	13.3	12.3	12.0
THC-out (ppm as Carbon)	22.5	33.6	31.8	29.3
THC-out (lb/hr as Carbon)	0.42	0.69	0.58	0.56

CLIENT: CRRA
PROJ. NO.: F93-09
LOCATION: HARTFORD LANDFILL FLARE

RUN NO.:	CEM-4A	CEM-4B	AVERAGE
DATE:	11/04/93	11/04/93	
TIME:	1520-1559	1559-1620	
INPUTS			
O2 Concentration (%)	13.4	12.7	13.1
CO2 Concentration (%)	7.0	7.0	7.0
NOx Concentration (ppm)	12.7	15.7	14.2
SO2 Concentration (ppm)	1.6	1.8	1.7
CO Concentration (ppm)	301.9	65.1	183.5
THC-Out Concentration (ppm)	11.5	1.0	6.3
Ambient Temp (DegreeF)	52	50	51.0
Ambient Barometric Press (in.Hg)	30.05	30.05	30.05
Volumetric Flowrate (dscfm)	9817	9817	9817
OUTPUTS			
NOx (lb/hr)	0.9	1.1	1.0
SO2 (lb/hr)	0.2	0.2	0.2
CO (lb/hr)	12.9	2.8	7.9
THC-out (ppm as Carbon)	34.5	3.0	18.8
THC-out (lb/hr as Carbon)	0.63	0.06	0.34

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Land Fill
Project No:
Location: Flare outlet
Pollutant: NO_x

Date: 11/4/93
Run No: 1
Run Time: 1048 - 1148
Span Value: 0 - 100 ppm

PRE-TEST Calibration Data And Linearity Check: 9.31 - 12.3

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:	0.0	—	47.5	95.0	
Cal Response:	0.3	—	49.4	95.9	
Absolute Difference:	0.3	—	1.9	0.9	
Cal Error (<2%):	0.3%	—	1.9%	0.9%	

System Cal Bias and Drift Check:
Cal Gas: 47.5 (9.31%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.3	0.3	0.0%	0.6	0.3%	0.3%
Upscale 1:	49.4	48.4	1.0%	46.8	2.6%	1.6%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 12.7 (Run Average)
Co = 0.5 (Average Zero)
Cm = 47.6 (Average Upscale)
Cma = 47.5 (Cal Gas Conc)
Cgas = 12.3 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare outlet
Pollutant: NOx

Date: 1/24/13
Run No: 2
Run Time: 1220 - 1320
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 47.5 (93.7%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.3	0.6	0.3%	0.6	0.3%	0.0%
Upscale 1:	49.4	46.8	2.6%	47.1	2.3%	0.3%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 12.7 (Run Average)
Co = 0.6 (Average Zero)
Cm = 47.0 (Average Upscale)
Cma = 47.5 (Cal Gas Conc)
Cgas = 12.4 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare outlet
Pollutant: NOx

Date: 11/4/93
Run No: 3
Run Time: 1355 - 1455
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 47.5 (93%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.3	0.6	0.3%	0.6	0.3%	0.0%
Upscale 1:	49.4	47.1	2.3%	47.3	2.1%	0.2%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 13.0 (Run Average)
Co = 0.6 (Average Zero)
Cm = 47.2 (Average Upscale)
Cma = 47.5 (Cal Gas Conc)
Cgas = 12.6 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare outlet
Pollutant: SO_2

Date: 11/4/93
Run No: 1
Run Time: 1048 - 1145
Span Value: 0 - 100 ppm

PRE–TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:	0.0	—	47.8	95.6	
Cal Response:	0.5	—	47.2	95.0	
Absolute Difference:	0.5	—	0.6	0.6	
Cal Error (<2%):	0.5%	—	0.6%	0.6%	

System Cal Bias and Drift Check:

Cal Gas: 47.8 ppm (50%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.5	0.3	0.2%	1.1	0.6%	0.8%
Upscale 1:	47.2	47.6	0.4%	48.7	1.5%	0.9%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 1.3 (Run Average)
Co = 0.7 (Average Zero)
Cm = 48.2 (Average Upscale)
Cma = 47.8 (Cal Gas Conc)
Cgas = 0.6 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare outlet
Pollutant: SO_2

Date: 11/10/93
Run No: 2
Run Time: 1220-1320
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 47.8 ppm (50%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.5	1.1	0.6%	1.3	0.8%	0.2%
Upscale 1:	47.2	48.7	1.5%	49.1	1.9%	0.4%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 3.4 (Run Average)
Co = 1.2 (Average Zero)
Cm = 48.9 (Average Upscale)
Cma = 47.8 (Cal Gas Conc)
Cgas = 2.2 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Hammonton
Pollutant: SO_2

Date: 1/14/93
Run No: 3
Run Time: 1355 - 1455
Span Value: 0 - 100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:
Cal Gas: 47.8 ppm (50%)

	Pre Cal		Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.5	1.3	0.8%	1.4	0.9%	0.1%
Upscale 1:	47.2	49.1	1.9%	48.6	1.4%	0.5%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 3.9 (Run Average)
Co = 1.4 (Average Zero)
Cm = 48.9 (Average Upscale)
Cma = 47.8 (Cal Gas Conc)
Cgas = 2.6 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Newfield Landfill
Project No:
Location: Flare outlet
Pollutant: O_2

Date: 11/4/93
Run No: 1
Run Time: 1048 - 1148
Span Value: 0 - 25%

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:	0.0	—	16.1%	20.9%	
Cal Response:	0.0	—	16.2	20.9	
Absolute Difference:	0.0	—	0.1	0.0	
Cal Error (<2%):	0.0%	—	0.4%	0.0%	

System Cal Bias and Drift Check:

Cal Gas:

	Pre Cal		Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.0	0.0	0.0%	0.1	0.4%	0.4%
Upscale 1:	16.2	16.1	0.4%	16.1	0.4%	0.0%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 13.4 (Run Average)
Co = 0.1 (Average Zero)
Cm = 16.1 (Average Upscale)
Cma = 16.1 (Cal Gas Conc)
Cgas = 13.4 % (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare outlet
Pollutant: O_2

Date: 1/[illegible]/93
Run No: 2
Run Time: 1220 - 1320
Span Value: 0-25%

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 16.1%

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.0	0.1	0.4%	0.1	0.4%	0.0%
Upscale 1:	16.2	16.1	0.4%	16.1	0.4%	0.0%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 13.5 (Run Average)
Co = 0.1 (Average Zero)
Cm = 16.1 (Average Upscale)
Cma = 16.1 (Cal Gas Conc)
Cgas = 13.5% (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Plant exhaust
Pollutant: O_2

Date: 11/4/93
Run No: 3
Run Time: 1355 - 1455
Span Value: 0-25%

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 16.1 %

		Pre Cal		Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.0	0.1	0.4%	0.1	0.4%	0.0%
Upscale 1:	16.2	16.1	0.4%	16.1	0.4%	0.0%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 13.5 (Run Average)
Co = 0.1 (Average Zero)
Cm = 16.1 (Average Upscale)
Cma = 16.1 (Cal Gas Conc)
Cgas = 13.5% (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare Outlet
Pollutant: CO

Date: 11/4/95
Run No: 1
Run Time: 1045 - 1145
Span Value: 0 - 1200 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:	0.0	360.0	720.0	1200.0	
Cal Response:	1.1	373.3	707.5	1206.0	
Absolute Difference:	1.1	13.3	12.5	6.0	
Cal Error (<2%):	0.1%	1.0%	1.0%	0.5%	

System Cal Bias and Drift Check:

Cal Gas: 720.0 (30.74%)

	Pre Cal		Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	1.1	4.7	0.3%	2.9	0.1%	0.1%
Upscale 1:	707.5	712.6	0.4%	714.3	0.5%	0.1%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 240.0 (Run Average)
Co = 3.8 (Average Zero)
Cm = 713.5 (Average Upscale)
Cma = 720.0 (Cal Gas Conc)
Cgas = 239.6 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare Outlet
Pollutant: CO

Date: 11/4/93
Run No: 2
Run Time: 1220 - 1320
Span Value: 0-1300 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 720.0 (32.74%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	1.1	2.9	0.1%	2.5	0.1%	0.0%
Upscale 1:	707.5	714.3	0.5%	710.7	0.2%	0.3%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 275.2 (Run Average)
Co = 2.7 (Average Zero)
Cm = 712.5 (Average Upscale)
Cma = 720.0 (Cal Gas Conc)
Cgas = 276.4 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare 6 of 1 & 4
Pollutant: CO

Date: 11/4/13
Run No: 3
Run Time: 1355 - 1455
Span Value: 0 - 1300 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 720.0 (30.74%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	1.1	2.5	0.1%	3.5	0.2%	0.1%
Upscale 1:	707.5	710.7	0.2%	707.0	0.0%	0.3%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 284.8 (Run Average)
Co = 3.0 (Average Zero)
Cm = 708.9 (Average Upscale)
Cma = 720.0 (Cal Gas Conc)
Cgas = 287.4 ppm (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 25A – THC

Source ID: Hartford Landfill
Project No: F93-09
Location: Flare outlet

Date: 11/4/93
Run No: 1
Run Time: 1048 — 1148
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range
Cal Gas Conc:	0.0	28.6	47.7	95.3
Cal Response:	0.3	28.4	48.0	95.4
Cal Rspnse – Zero:		28.1	47.7	95.1
Multiplication Factor:		1.0021	1.0021	1.0021
Corrected Conc (ppm):		28.2	47.8	95.3
Cal Error (<5%):		1.4%	0.2%	0.0%

Multiplication Factor Calculation, Mf:

$$Mf = \frac{Cma}{Cm - Co}$$

Cma = 95.3 (Span Gas Conc)
Cm = 95.4 (Cal response)
Co = 0.3 (Zero response)
Mf = 1.0021

Calibration Error Calculation, Cerr:

$$Cerr = \frac{[\text{Corrected Conc (ppm)} - \text{Cal Gas Conc (ppm)}]}{\text{Cal Gas Conc (ppm)}} \times 100$$

Calibration Drift, Cd:

	Pre Cal		Post Cal		
	Gas Conc	Calibration Response	Calibration Response		Drift (<3%)
Zero:	0.0	0.8	3.1		2.3%
Upscale 1:	47.7	47.3	47.4		0.1%
Upscale 2:					

$$Cd = \frac{\text{Pre Cal Response} - \text{Post Cal Response}}{\text{Span}} \times 100$$

Emissions Conc = (Avg analyzer reading – Zero) x Mf:

Avg Reading = 9.5

Emissions Conc =	7.5	ppm
Emissions as Carbon =	22.5	ppmC

M18 Bag (1120—1148)
12.0
10.0 ppm
30.1 ppmC

CEM CALIBRATION DATA
EPA Method 25A – THC

Source ID: Hartford Landfill
Project No: F93-09
Location: Flare outlet

Date: 11/4/93
Run No: 2
Run Time: 1220-1320
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range
Cal Gas Conc:				
Cal Response:				
Cal Rspnse – Zero:				
Multiplication Factor:				
Corrected Conc (ppm):				
Cal Error (<5%):				

Multiplication Factor Calculation, Mf:

$$Mf = \frac{Cma}{Cm - Co}$$

Cma = (Span Gas Conc)
Cm = (Cal response)
Co = (Zero response)
Mf = 1.0021

Calibration Error Calculation, Cerr:

$$Cerr = \frac{[\text{Corrected Conc (ppm)} - \text{Cal Gas Conc (ppm)}]}{\text{Cal Gas Conc (ppm)}} \times 100$$

Calibration Drift, Cd:

	Pre Cal		Post Cal		
	Gas Conc	Calibration Response	Calibration Response		Drift (<3%)
Zero:	0.0	3.1	2.1		1.0%
Upscale 1:	47.7	47.4	47.4		0.0%
Upscale 2:					

$$Cd = \frac{\text{Pre Cal Response} - \text{Post Cal Response}}{\text{Span}} \times 100$$

Emissions Conc = (Avg analyzer reading – Zero) x Mf:

M18 Bag (1223-1320

Avg Reading = 13.8

Emissions Conc =	11.2	ppm
Emissions as Carbon =	33.7	ppmC

13.8
11.2 ppm
33.7 ppmC

CEM CALIBRATION DATA
EPA Method 25A – THC

Source ID: Hartford Landfill
Project No: F93-09
Location: Flare outlet

Date: 11/4/93
Run No: 3
Run Time: 1355-1455
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range
Cal Gas Conc:				
Cal Response:				
Cal Rspnse – Zero:				
Multiplication Factor:				
Corrected Conc (ppm):				
Cal Error (<5%):				

Multiplication Factor Calculation, Mf:

$$Mf = \frac{Cma}{Cm - Co}$$

Cma = (Span Gas Conc)
Cm = (Cal response)
Co = (Zero response)
Mf = 1.0021

Calibration Error Calculation, Cerr:

$$Cerr = \frac{[\text{Corrected Conc (ppm)} - \text{Cal Gas Conc (ppm)}]}{\text{Cal Gas Conc (ppm)}} \times 100$$

Calibration Drift, Cd:

	Pre Cal		Post Cal		
	Gas Conc	Calibration Response	Calibration Response		Drift (<3%)
Zero:	0.0	2.1	2.0		0.1%
Upscale 1:	47.7	47.4	49.6		2.2%
Upscale 2:					

$$Cd = \frac{\text{Pre Cal Response} - \text{Post Cal Response}}{\text{Span}} \times 100$$

Emissions Conc = (Avg analyzer reading – Zero) x Mf: M18 Bag (1402-1455

Avg Reading = 12.7

Emissions Conc =	10.6	ppm
Emissions as Carbon =	31.9	ppmC

11.4
9.3 ppm
28.0 ppm C

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hart + Field Landfill
Project No:
Location: Plant 0, Unit 4
Pollutant: NOx

Date: 1/10/13
Run No: 4
Run Time: 1520-1620
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 47.5 (9.31%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.3	0.6	0.3%	0.3	0.0%	0.3%
Upscale 1:	49.4	47.3	2.1%	47.0	2.4%	0.3%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 4A / 4B = 12.9 / 15.9 (Run Average)
Co = 0.5 (Average Zero)
Cm = 47.2 (Average Upscale)
Cma = 47.5 (Cal Gas Conc)
Cgas = 12.7 / 15.7 (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hunter Unit 1&2
Project No:
Location: Flare outlet
Pollutant: SO_2

Date: 11/2/13
Run No: 2
Run Time: 1520-1620
Span Value: 0-100 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 47.8 ppm (50%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.5	1.4	0.9%	1.1	0.6%	0.3%
Upscale 1:	47.2	48.1	1.4%	48.7	1.5%	0.1%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

	4A / 4B	
C =	2.8 3.0	(Run Average)
Co =	1.3	(Average Zero)
Cm =	48.7	(Average Upscale)
Cma =	47.8	(Cal Gas Conc)
Cgas =	1.6 / 1.8	(Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 =		(%CO2 from M3/3A)
Cco =		(CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Norfolk Landfill
Project No:
Location: Flare outlet
Pollutant: O_2

Date: 11/2/93
Run No: 4
Run Time: 1520-1620
Span Value: 0-25%

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 16.1%

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	0.0	0.1	0.4%	0.1	0.4%	0.0%
Upscale 1:	16.2	16.1	0.4%	16.1	0.4%	0.0%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

C = 13.4 / 12.7 (Run Average) (4A/4B)
Co = 0.1 (Average Zero)
Cm = 16.1 (Average Upscale)
Cma = 16.1 (Cal Gas Conc)
Cgas = 13.4 / 12.7 (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 6C Guidelines

Source ID: Hartford Landfill
Project No:
Location: Flare outlet
Pollutant: CO

Date: 11/4/03
Run No: 4
Run Time: 1520 - 1620
Span Value: 0 - 1300 ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range	
Cal Gas Conc:					
Cal Response:					
Absolute Difference:					
Cal Error (<2%):					

System Cal Bias and Drift Check:

Cal Gas: 720.0 (39.74%)

	Pre Cal			Post Cal		
	Analyzer Cal Rspnse	System Cal Rspnse	Syst Bias (<5%)	System Cal Rspnse	Syst Bias (<5%)	Drift (<3%)
Zero:	1.1	3.5	0.2%	2.6	0.1%	0.1%
Upscale 1:	707.5	707.0	0.0%	708.9	0.1%	0.1%
Upscale 2:						

Calibration Error Calculation, Cerr:

$$Cerr = \frac{\text{Calibration Response} - \text{Cal Gas Concentration}}{\text{Span}} \times 100$$

Calibration Drift Calculation, Cd:

$$Cd = \frac{\text{Pre Cal System Response} - \text{Post Cal System Response}}{\text{Span}} \times 100$$

Emissions Concentration, Cgas:

$$Cgas = (C - Co) \times \frac{Cma}{Cm - Co}$$

4A / 4B

C = 298.6 66.8 (Run Average)
Co = 3.1 (Average Zero)
Cm = 708.0 (Average Upscale)
Cma = 720.0 (Cal Gas Conc)
Cgas = 301.9 / 65.1 (Emissions Conc)

$$Cco = C \times (1 - (\%CO2/100))$$

%CO2 = (%CO2 from M3/3A)
Cco = (CO Conc)

CEM CALIBRATION DATA
EPA Method 25A – THC

Source ID: Hartford Landfill
Project No: F93-09
Location: Flare Out Het

Date: 11/4/93
Run No: 4A + 4B
Run Time: 1520-1620
Span Value: 0-100ppm

PRE-TEST Calibration Data And Linearity Check:

	Zero	Low Range	Mid Range	High Range
Cal Gas Conc:				
Cal Response:				
Cal Rspnse – Zero:				
Multiplication Factor:				
Corrected Conc (ppm):				
Cal Error (<5%):				

Multiplication Factor Calculation, Mf:

$$Mf = \frac{Cma}{Cm - Co}$$

Cma = (Span Gas Conc)
Cm = (Cal response)
Co = (Zero response)
Mf = 1.0021

Calibration Error Calculation, Cerr:

$$Cerr = \frac{[\text{Corrected Conc (ppm)} - \text{Cal Gas Conc (ppm)}]}{\text{Cal Gas Conc (ppm)}} \times 100$$

Calibration Drift, Cd:

		Pre Cal	Post Cal	
	Gas Conc	Calibration Response	Calibration Response	Drift (<3%)
Zero:	0.0	2.0	2.0	0.0%
Upscale 1:	47.7	49.6	47.4	2.2%
Upscale 2:				

$$Cd = \frac{\text{Pre Cal Response} - \text{Post Cal Response}}{\text{Span}} \times 100$$

Emissions Conc = (Avg analyzer reading – Zero) x Mf: M18 Bag (1528-1620

	4A	4B
Avg Reading =	13.5	3.0
Emissions Conc =	11.5	1.0 ppm
Emissions as Carbon =	34.6	3.0 ppmC

9.8
7.8 ppm
23.4 ppmC

GAS DILUTION PERFORMANCE SPECIFICATIONS TESTS

Thermo Environmental Model 43A-HT SO2 analyzer

MONITOR: Environics Series 2020 Gas Mixer S/N: 1771	DATE OF TEST: 11/4/93

TEST NO.	TIME	100% SUPPLY GAS: 240.0 ppm SO2 PREDICTED VALUE	ANALYZER RESPONSE	RESP DEV FROM MEAN (<=2%)	ABSOLUTE DIFFERENCE	RESPONSE ERROR (<=2%)
1	0752	240.0	240.8	0.3%	0.8	0.3%
2	0815	240.0	239.7	0.2%	0.3	0.1%
3	0830	240.0	239.8	0.1%	0.2	0.1%
		MEAN VALUES:	240.1	0.2%	0.4	0.2%

TEST NO.	TIME	DILUTION 1: 192.0 ppm (80%) PREDICTED VALUE	ANALYZER RESPONSE	RESP DEV FROM MEAN (<=2%)	ABSOLUTE DIFFERENCE	RESPONSE ERROR (<=2%)
1	0800	192.0	193.4	0.3%	1.4	0.7%
2	0818	192.0	193.9	0.1%	1.9	1.0%
3	0832	192.0	194.8	0.4%	2.8	1.5%
		MEAN VALUES:	194.0	0.3%	2.0	1.1%

TEST NO.	TIME	DILUTION 2: 144.0 ppm (60%) PREDICTED VALUE	ANALYZER RESPONSE	RESP DEV FROM MEAN (<=2%)	ABSOLUTE DIFFERENCE	RESPONSE ERROR (<=2%)
1	0803	144.0	143.4	0.6%	0.6	0.4%
2	0820	144.0	144.6	0.3%	0.6	0.4%
3	0836	144.0	144.6	0.3%	0.6	0.4%
		MEAN VALUES:	144.2	0.4%	0.6	0.4%

TEST NO.	TIME	DILUTION 3: 96.0 ppm (40%) PREDICTED VALUE	ANALYZER RESPONSE	RESP DEV FROM MEAN (<=2%)	ABSOLUTE DIFFERENCE	RESPONSE ERROR (<=2%)
1	0807	96.0	97.5	1.4%	1.5	1.6%
2	0823	96.0	95.6	0.6%	0.4	0.4%
3	0839	96.0	95.3	0.9%	0.7	0.6%
		MEAN VALUES:	96.1	1.0%	0.9	0.9%

TEST NO.	TIME	DILUTION 4: 48.0 ppm (20%) PREDICTED VALUE	ANALYZER RESPONSE	RESP DEV FROM MEAN (<=2%)	ABSOLUTE DIFFERENCE	RESPONSE ERROR (<=2%)
1	0811	48.0	48.6	0.1%	0.6	1.3%
2	0826	48.0	48.7	0.0%	0.7	1.5%
3	0842	48.0	48.7	0.0%	0.7	1.5%
		MEAN VALUES:	48.7	0.0%	0.7	1.4%

INDEPENDENT CHECK:

MID-LEVEL DILUTION	MID-LEVEL CAL GAS	DEV OF CAL GAS VALUE FROM DIL VALUE (<=10%)	ANALYZER RESPONSE	RESP ERROR (<=2%)
96.0 ppm	95.6 ppm	0.4%	94.8	0.8%

APPENDIX D

Equipment Calibrations
and
EPA Protocol 1 Certification Sheets

S-TYPE PITOT GEOMETRIC CALIBRATION

PART 2 - PITOT ALIGNMENT

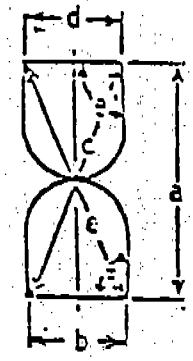
Probe Identification 1001 Pitot Identification 1001

Technical Specialist TEC

Date 10/20/1992

A.

Transverse Tube Axis



a 1.120
b .235
c 1.195
d .237
e 1.185
θ 99
θ' 99

$\frac{a^2 + b^2 - c^2}{2ab} = \cos\theta$

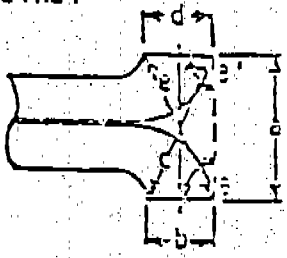
$\frac{a^2 + d^2 - e^2}{2ad} = \cos\theta'$

$(80^\circ < \theta < 100^\circ)$

$(80^\circ < \theta' < 100^\circ)$

B.

Longitudinal Tube Axis



a 1.120
b .249
c 1.195
d .250
e 1.185
θ 96
θ' 89

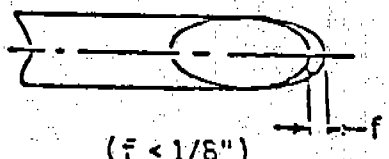
$\frac{a^2 + b^2 - c^2}{2ab} = \cos\theta$

$\frac{a^2 + d^2 - e^2}{2ad} = \cos\theta'$

$(85^\circ < \theta < 95^\circ)$

$(85^\circ < \theta' < 95^\circ)$

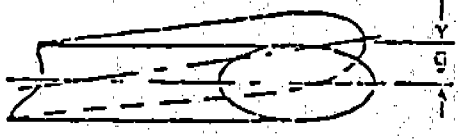
C.



f ____

$(f < 1/8")$

D.



g ____

$(g < 1/32")$

NOTE: values in parentheses are EPA Method 2 specifications.

PROBE THERMOCOUPLE CALIBRATION

		Tolerances
Expected Stack Temperature (T_s)	____ °R	
Mercury Thermometer (T_{ref})	____ °R	($T_s \pm 10\%$)
Thermocouple Readout	____ °R	($T_{ref} \pm 1.5\%$)

Probe Identification ____

Technician ____ Date ____

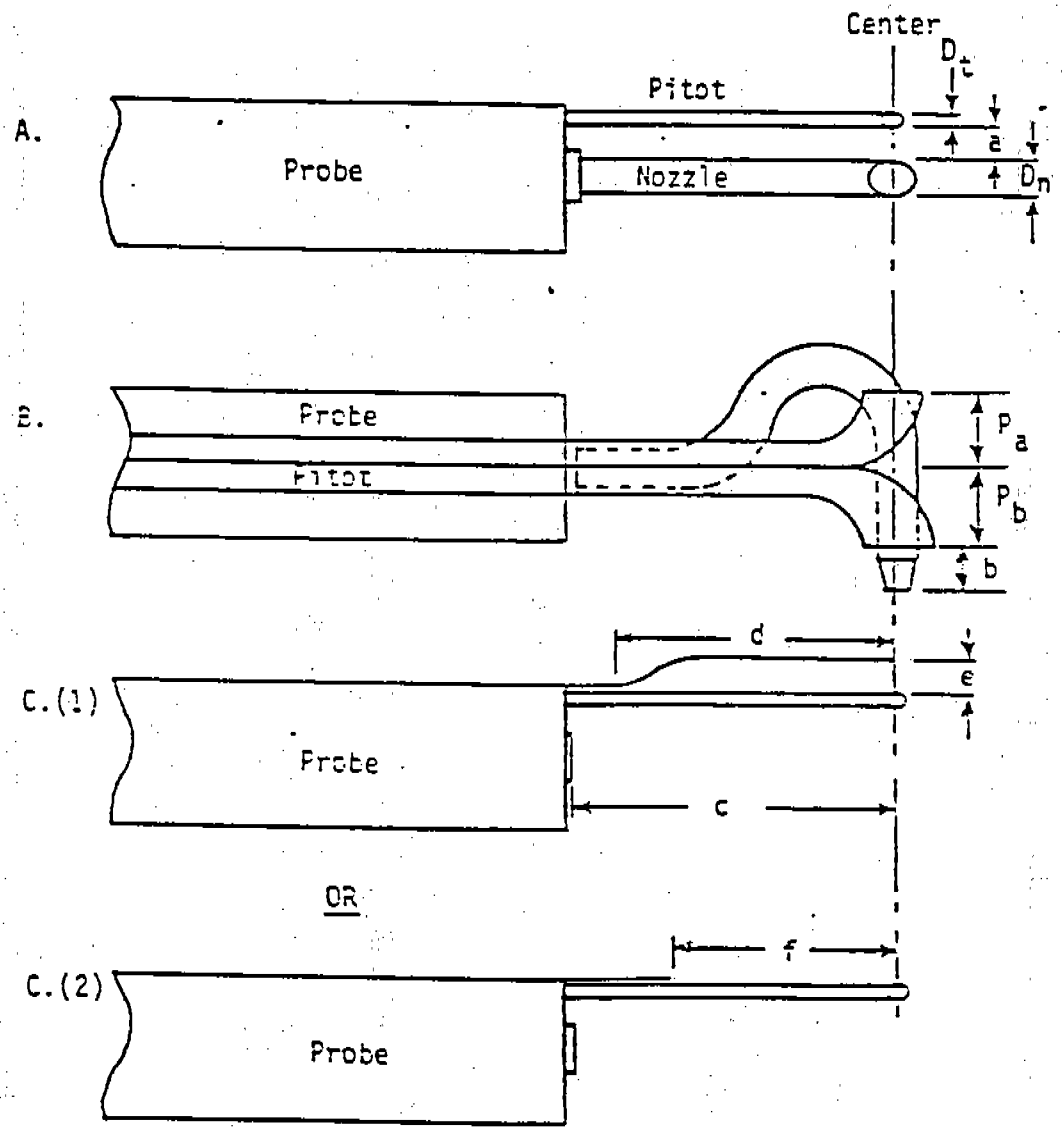
S-TYPE PITOT GEOMETRIC CALIBRATION

PART 1 - PROBE CONFIGURATION

Probe Identification 1001 Pitot Identification 1001

Technical Specialist TEC

Date 10/21/92



D_t .375

D_n .505

a .612

P_a .513

P_b .513

b .424

c ____

d ____

e ____

OR

c 5.080

f 1.980

Specifications (EPA Method 2)

D_t = 3/16" to 3/8"
D_n = 1/2"
a ≥ 3/4"
b ≥ 0

c ≥ 3"
d ≥ 3"
e ≥ 3/4"
f ≥ 2"

$P_a = P_b$

$1.05\ D_t \leq P \leq 1.50\ D_t$

If these specifications are met, proceed with Part 2 Pitot alignment

Method 5 Module Calibration

Date: 11/5/13
Bar. Ps., (Pb): 30.12 in. Hg

Module #: 5-1215
Std. Meter: 5277

Pre-test / Post-test

Module Orifice Setting (in. H2O)	Standard Meter: Volume Vs (ft³)	Factor Ys	Temp. ts (°F)	Pressure Ps (in. H20)	Module Meter: Volume Vm (ft³)	Temperatures tmi (°F)	tmo (°F)	Time @ (min)	Y	ΔHa (in. H2O)	Module Flowrate Q (SCFM)	OF
0.5	5.003	1.0001	62	-0.10	5.112	71	75	13.71	.9918	2.00	.3532	
1	5.004	1.0001	63	-0.10	5.106	74	75	9.61	1.0056	1.92	.5462	
1.5	10.003	1.0001	62	-0.15	10.235	73	76	15.31	1.0053	1.83	.6485	
2	10.005	1.0001	64	-0.15	10.206	73	75	13.61	1.0012	2.00	.7612	
3	10.003	1.0001	66	-0.15	10.192	74	76	10.21	1.0032	1.91	.9632	
								Averages	1.0016	1.92		

Check				

calc		
avg		

For check, use the average ΔHa for ΔH

$$Y = \frac{Vs\left(Pb + \frac{Ps}{13.6}\right)(Tm + 460)\,Ys}{Vm\left(Pb + \frac{\Delta H}{13.6}\right)(Ts + 460)}$$

$$\Delta Ha = \frac{(0.0317)\,\Delta H}{Pb\,(tm + 460)}\left[\frac{(ts + 460)\,@}{Vs\;\;Ys}\right]^2$$

$$Q = Y\,(17.64)\,Vm\,\sqrt{\frac{\left(Pb + \frac{\Delta H}{13.6}\right)}{(tm + 460)\;\;@}}$$

$$\text{fice factor} = \left[\frac{(Ts + 460)\;\;\Delta H}{Pb}\right]^{1/2}$$

Correlation Line Equation
Q = m (OF) + b

Acceptance Criteria:
Each Y must be 1.00 ± 0.01
Average ΔHa must be 1.84 ± 0.25
Each ΔHa must be within 0.15 of the average ΔHa

tmi °F	tmo °F	Reference thermometer °F	Module Leak Check ft³	In. Hg.
62	62	62	0.00	14

Heater Box Love Control OK: ✓
Probe Heater Love Control OK: ✓
Module Cleaned: ✓
Pitot Tube Manometer Leak Check: ✓

Calibrated and Checked by: TEC Date: 11/5/13

Reviewed by: TEC Date: 11/5/13

Method 5 Module Calibration

Date: 9/7/93
Bar. Ps., (Pb): 30.55 in. Hg

Module #: 570415
Std. Meter: 1248

Pre-test / Post-test

Module Orifice Setting (in. H2O)	Standard Meter: Volume Vs (ft³)	Factor Ys	Temp. ts (°F)	Pressure Ps (in. H20)	Module Meter: Volume Vm (ft³)	Temperatures tmi (°F)	tmo (°F)	Time @ (min)	Y	ΔHa (in. H2O)	Module Flowrate Q (SCFM)	OF
0.5	5.001	1.0001	70	-0.10	5.105	85	75	13.41	.9962	1.78	.3869	
1	5.003	1.0001	70	-0.10	5.036	86	78	9.07	1.0055	1.50	.5685	
1.5	10.001	1.0001	70	-0.15	10.155	87	79	15.15	1.0056	1.53	.6815	
2	10.003	1.0001	70	-0.15	10.131	89	80	13.06	1.0101	1.64	.7915	
3	10.003	1.0001	73	-0.15	10.125	91	81	10.71	1.0044	1.89	.9617	
								Averages	1.0043	1.88		

calc		
avg		

Check

For check, use the average ΔHa for ΔH

$$Y = \frac{Vs\left(Pb + \frac{Ps}{13.6}\right)(Tm + 460)\,Ys}{Vm\left(Pb + \frac{\Delta H}{13.6}\right)(Ts + 460)}$$

$$\Delta Ha = \frac{(0.0317)\,\Delta H}{Pb\,(tm + 460)} \cdot \frac{[(ts + 460)\,@\,]^2}{[\,Vs\;\;Ys\,]^2}$$

$$Q = Y\,(17.64)\,Vm\,\frac{\left(Pb + \frac{\Delta H}{13.6}\right)}{(tm + 460)\;\;@}$$

$$\text{Orifice factor} = \frac{[(Ts + 460)\;\;\Delta H\;\;]^{1/2}}{[\;\;\;\;Pb\;\;\;\;\;\;\;\;]^{1/2}}$$

Correlation Line Equation
Q = m (OF) + b

Acceptance Criteria:
Each Y must be 1.00 ± 0.01
Average ΔHa must be 1.84 ± 0.25
Each ΔHa must be within 0.15 of the average ΔHa

tmi °F	tmo °F	Reference thermometer °F	Module Leak Check ft³	in. Hg.
71	71	71	0.00	13

Heater Box Love Control OK: ✓
Probe Heater Love Control OK: ✓
Module Cleaned: ✓
Pitot Tube Manometer Leak Check: ✓

Calibrated and Checked by: TEC Date: 9/10/93

Reviewed by: [signature] Date: 9/10/93

Method 5 Module Calibration

Date: 11/12/93
Bar. Ps., (Pb): 30.00 in. Hg

Module #: S-14F1
Std. Meter: 507797

Pre-test / Post-test

Module Orifice Setting (in. H2O)	Standard Meter: Volume Vs (ft³)	Factor Ys	Temp. ts (°F)	Pressure Ps (in. H20)	Module Meter: Volume Vm (ft³)	Temperatures tmi (°F)	tmo (°F)	Time @ (min)	Y	ΔHa (in. H2O)	Module Flowrate Q (SCFM)	OF
0.5	5.001	1.0001	72.	-0.10	5.062	85	77	13.62	1.0033	2.05	.3787	
1	5.003	1.0001	72	-0.10	5.045	85	79	9.51	1.0077	1.99	.5392	
1.5	10.001	1.0001	74	-0.15	10.142	86	80	15.51	1.0006	2.00	.6674	
2	10.003	1.0001	74	-0.15	10.120	90	82	12.81	1.0035	1.91	.8078	
3	10.002	1.0001	74	-0.15	10.109	91	82	10.91	1.0077	1.94	.9546	
								Averages	1.0050	1.96		

Check

calc			
avg			

For check, use the average ΔHa for ΔH

$$Y = \frac{Vs\left(Pb + \frac{Ps}{13.6}\right)(Tm + 460)\,Ys}{Vm\left(Pb + \frac{\Delta H}{13.6}\right)(Ts + 460)}$$

$$\Delta Ha = \frac{(0.0317)\,\Delta H}{Pb\,(tm + 460)} \cdot \frac{[(ts + 460)\,@\,]^2}{[\,Vs\;\;Ys\,]^2}$$

$$Q = Y\,(17.64)\,Vm\,\frac{\left(Pb + \frac{\Delta H}{13.6}\right)}{(tm + 460)\;\;@}$$

$$\text{Orifice factor} = \frac{[(Ts + 460)\;\;\Delta H]^{1/2}}{[\;\;\;\;Pb\;\;\;\;]^{1/2}}$$

Correlation Line Equation
Q = m (OF) + b

Acceptance Criteria:
Each Y must be 1.00 ± 0.01
Average ΔHa must be 1.84 ± 0.25
Each ΔHa must be within 0.15 of the average ΔHa

tmi °F	tmo °F	Reference thermometer °F	Module Leak Check ft³	Module Leak Check in. Hg.
72	72	72	0.00	13

Heater Box Love Control OK: ✓
Probe Heater Love Control OK: ✓
Module Cleaned: ✓
Pitot Tube Manometer Leak Check: ✓

Calibrated and Checked by: TEC Date: 11/12/93

Reviewed by: TEC Date: 11/12/93

Method 5 Module Calibration

Date: 10/15/93
Bar. Ps., (Pb): 30.22 in. Hg

Module #: 5-14F1
Std. Meter: _____

Pre-test / Post-test

Module Orifice Setting (in. H2O)	Standard Meter: Volume Vs (ft³)	Factor Ys	Temp. ts (°F)	Pressure Ps (in. H20)	Module Meter: Volume Vm (ft³)	Temperatures tmi (°F)	tmo (°F)	Time @ (min)	Y	ΔHa (in. H2O)	Module Flowrate Q (SCFM)	OF
0.5	5.002	1.0001	54	-0.10	5.150	70	60	13.13	.9907	1.81	.4043	
1	5.003	1.0001	54	-0.10	5.156	72	60	9.41	.9923	1.86	.5634	
1.5	10.003	1.0001	54	-0.10	10.331	76	64	15.25	1.0042	1.80	.6957	
2	10.004	1.0001	54	-0.15	10.345	76	66	12.76	1.0066	1.75	.8152	
3	10.001	1.0001	56	-0.15	10.210	78	68	10.72	1.0023	1.81	.9873	
								Averages	.9992	1.81		

calc		
avg		

heck

or check, use the average ΔHa for ΔH

$$Y = \frac{Vs\left(Pb + \frac{Ps}{13.6}\right)(Tm + 460)\,Ys}{Vm\left(Pb + \frac{\Delta H}{13.6}\right)(Ts + 460)}$$

$$\Delta Ha = \frac{(0.0317)\,\Delta H}{Pb\,(tm + 460)} \left[\frac{(ts + 460)\,@}{Vs\;Ys}\right]^2$$

$$Q = Y\,(17.64)\,Vm\,\frac{\left(Pb + \frac{\Delta H}{13.6}\right)}{(tm + 460)\;@}$$

$$\text{ifice factor} = \left[\frac{(Ts + 460)}{Pb}\,\Delta H\right]^{1/2}$$

Correlation Line Equation
Q = m (OF) + b

Acceptance Criteria:
Each Y must be 1.00 ± 0.01
Average ΔHa must be 1.84 ± 0.25
Each ΔHa must be within 0.15 of the average ΔHa

tmi °F	tmo °F	Reference thermometer °F	Module Leak Check ft³	In. Hg.
54	54	54	0.00	12

Heater Box Love Control OK: ✓
Probe Heater Love Control OK: ✓
Module Cleaned: ✓
Pitot Tube Manometer Leak Check: ✓

Calibrated and Checked by: TEC Date: 10/15/93

Reviewed by: TEC Date: 10/15/93

Matheson
P.O. Box 136
6874 South Main Street
Morrow, Georgia 30260
Phone: (404) 961-7891

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

CUSTOMER: ABCO Welding & Ind. Supply REFERENCE #: 105-94941

CYLINDER #: SX-11721 PROTOCOL: G1

CYLINDER PRESSURE: 2000

LAST ANALYSIS DATE: 09/25/92

EXPIRATION DATE: 03/25/94

REPLICATE CONCENTRATIONS

COMPONENT : Propane	DATE: 09/25/92	DATE: / /
MEAN CONC : 95.3 PPM	95.3 PPM 95.2 PPM 95.4 PPM	
COMPONENT :	DATE: / /	DATE: / /
MEAN CONC :		
COMPONENT :	DATE: / /	DATE: / /
MEAN CONC :		

BALANCE GAS: Nitrogen

REFERENCE STANDARDS

SRM # : 2643

CYLINDER # : CAL5086

CONCENTRATION: 100 PPM

CERTIFICATION INSTRUMENTS

COMPONENT Propane

MAKE/MODEL Beckman THC

SERIAL NUMBER 1003052

MEASUREMENT PRINC. FID

LAST CALIBRATION 07/01/92

REPLICATE DATA COMPONENT: Propane

DATE 09/25/92

1. Z =0 R =413.5 C =394.1
2. R =412.5 Z =0 C =392.7
3. Z =0 C =393.8 R =412.8

DATE / /

Z = R = C =
R = Z = C =
Z = C = R =

REPLICATE DATA COMPONENT:

DATE / /

1. Z = R = C =
2. R = Z = C =
3. Z = C = R =

DATE / /

Z = R = C =
R = Z = C =
Z = C = R =

REPLICATE DATA COMPONENT:

DATE / /

1. Z = R = C =
2. R = Z = C =
3. Z = C = R =

DATE / /

Z = R = C =
R = Z = C =
Z = C = R =

R = Reference Gas, C = Candidate Gas, Z = Zero Gas

This certification was performed according to EPA Protocol method (s) described in section 2.0.7.G1, and/or section 2.0.7.G2.

ANALYST _____ DATE 10/2/92

Matheson
P.O. Box 351
1650 Enterprise Parkway
Twinsburg, Ohio 44087
Phone: (216) 425-4406

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

CUSTOMER: ABCO WELDING & IND SUPPLY

REFERENCE #: 109-21151

CYLINDER #: SX-26562

PROTOCOL: 1

CYLINDER PRESSURE: 2000

LAST ANALYSIS DATE: 05/26/93

EXPIRATION DATE: 05/26/96

REPLICATE CONCENTRATIONS

COMPONENT : CARBON MONOXIDE

MEAN CONC : 84.9 PPM

DATE: 05/19/93

85.1 PPM
84.7 PPM
84.6 PPM

DATE: 05/26/93

85.1 PPM
84.9 PPM
84.8 PPM

COMPONENT :

MEAN CONC :

DATE: / /

DATE: / /

COMPONENT :

MEAN CONC :

DATE: / /

DATE: / /

BALANCE GAS: NITROGEN

REFERENCE STANDARDS

SRM # : GMIS 1679G

CYLINDER # : SX-23294

CONCENTRATION: 97.2 PPM

CERTIFICATION INSTRUMENTS

COMPONENT CARBON MONOXIDE

MAKE/MODEL TECO 48H

SERIAL NUMBER 48H-37040-255

MEASUREMENT PRINC. INFRARED

LAST CALIBRATION 03/23/93

REPLICATE DATA COMPONENT: CARBON MONOXIDE

	DATE 05/19/93			DATE 05/26/93		
1.	Z =0	C =474.5	R =542	Z = 0	C =235	R =268.5
2.	C =476	R =546	Z =0	C = 235	R =269	Z =0
3.	R =542	Z =0	C =472	R = 269	Z =0	C =235

REPLICATE DATA COMPONENT:

	DATE / /			DATE / /		
1.	Z =	C =	R =	Z =	C =	R =
2.	C =	R =	Z =	C =	R =	Z =
3.	R =	Z =	C =	R =	Z =	C =

REPLICATE DATA COMPONENT:

	DATE / /			DATE / /		
1.	Z =	C =	R =	Z =	C =	R =
2.	C =	R =	Z =	C =	R =	Z =
3.	R =	Z =	C =	R =	Z =	C =

R = Reference Gas, C = Candidate Gas, Z = Zero Gas

This certification was performed according to EPA Protocol method (s) described in section 3.0.4.G1, and/or section 3.0.4.G2.

ANALYST [signature] DATE 6.2.93

Matheson
P.O. Box 358
1650 Enterprise Parkway
Twinsburg, Ohio 44087
Phone: (216) 425-4406

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

CUSTOMER: ABCO WELDING & IND SUPPLY

REFERENCE #: 109-21151

CYLINDER #: SX-26160

PROTOCOL: 1

CYLINDER PRESSURE: 1800

LAST ANALYSIS DATE: 05/25/93

EXPIRATION DATE: 05/25/95

REPLICATE CONCENTRATIONS

COMPONENT : NITRIC OXIDE	DATE: 05/10/93	DATE: 05/25/93	
MEAN CONC : 93.8 PPM	95.2 PPM	92.6 PPM	
	94.8 PPM	94.0 PPM	
	93.5 PPM	91.8 PPM	
		93	
COMPONENT :	DATE: / /	DATE: / /	
MEAN CONC :			
COMPONENT :	DATE: / /	DATE: / /	
MEAN CONC :			

BALANCE GAS: NITROGEN

REFERENCE STANDARDS

SRM # : 1684b

CYLINDER # : CLM-2235

CERTIFICATION INSTRUMENTS

COMPONENT NITRIC OXIDE

MAKE/MODEL TECO 14A

SERIAL NUMBER 14A-13108-134

MEASUREMENT PRINC. CHEMILUMINESCENCE

LAST CALIBRATION 05/17/93

REPLICATE DATA COMPONENT: NITRIC OXIDE

DATE 05/10/93			DATE 05/25/93		
1. Z =0	C =499	R =499	Z = 0	C =459	R =472
2. C =497	R =499	Z =0	C = 464	R =470	Z =0
3. R =496	Z =0	C =487	R = 475	Z =0	C =463

REPLICATE DATA COMPONENT:

DATE / /			DATE / /		
1. Z =	C =	R =	Z =	C =	R =
2. C =	R =	Z =	C =	R =	Z =
3. R =	Z =	C =	R =	Z =	C =

REPLICATE DATA COMPONENT:

DATE / /			DATE / /		
1. Z =	C =	R =	Z =	C =	R =
2. C =	R =	Z =	C =	R =	Z =
3. R =	Z =	C =	R =	Z =	C =

R = Reference Gas, C = Candidate Gas, Z = Zero Gas

This certification was performed according to EPA Protocol method (s) described in section 3.0.4.G1, and/or section 3.0.4.G2.

ANALYST [signature] DATE 6.2.93

Matheson

World Leader in Specialty Gases & Equipment

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

CUSTOMER: ABCO WELDING

REFERENCE #: 109-23706

CYLINDER #: SX-26553

PROTOCOL: 1

CYLINDER PRESSURE: 2000

LAST ANALYSIS DATE: 09/03/93

EXPIRATION DATE: 09/03/95

		REPLICATE CONCENTRATIONS	
COMPONENT : NITRIC OXIDE	DATE: 08/27/93	DATE: 09/03/93
MEAN CONC : 228 PPM	227 PPM	228 PPM
	228 PPM	228 PPM
	229 PPM	228 PPM
COMPONENT : NITROGEN DIOXIDE	DATE: / /	DATE: / /
MEAN CONC : 1 PPM		
COMPONENT :	DATE: / /	DATE: / /
MEAN CONC :		

BALANCE GAS: NITROGEN

REFERENCE STANDARDS

SRM # : 1686B

CYLINDER # : CLM-4883

CONCENTRATION: 492 PPM

Matheson
P.O. Box 358
1650 Enterprise Parkway
Twinsburg, Ohio 44087
Phone: (216) 425-4406

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

CUSTOMER: ABCO WELDING & IND SUPPLY

REFERENCE #: 109-21151

CYLINDER #: SX-16485

PROTOCOL: 1

CYLINDER PRESSURE: 2000

LAST ANALYSIS DATE: 06/01/93

EXPIRATION DATE: 06/01/95

REPLICATE CONCENTRATIONS

COMPONENT : SULFUR DIOXIDE	DATE: 05/23/93	DATE: 06/01/93
MEAN CONC : 95.6 PPM	95.9 PPM	95.1 PPM
	95.5 PPM	95.1 PPM
	96.1 PPM	95.9 PPM
COMPONENT :	DATE: / /	DATE: / /
MEAN CONC :		
COMPONENT :	DATE: / /	DATE: / /
MEAN CONC :		

BALANCE GAS: NITROGEN

REFERENCE STANDARDS

SRM # : 1694A

CYLINDER # : CLM-4753

CONCENTRATION: 97.0 PPM

CERTIFICATION INSTRUMENTS

COMPONENT SULFUR DIOXIDE

MAKE/MODEL TECO 40

SERIAL NUMBER 40-37461-255

MEASUREMENT PRINC. FLUORESCENCE

LAST CALIBRATION 04/20/93

REPLICATE DATA COMPONENT: SULFUR DIOXIDE

	DATE 05/23/93			DATE 06/01/93		
1.	Z =0	C =256	R =259	Z = 0	C =254	R =259
2.	C =257	R =261	Z =0	C = 254	R =259	Z =0
3.	R =259.5	Z =0	C =257	R = 259	Z =0	C =256

REPLICATE DATA COMPONENT:

	DATE / /			DATE / /		
1.	Z =	C =	R =	Z =	C =	R =
2.	C =	R =	Z =	C =	R =	Z =
3.	R =	Z =	C =	R =	Z =	C =

REPLICATE DATA COMPONENT:

	DATE / /			DATE / /		
1.	Z =	C =	R =	Z =	C =	R =
2.	C =	R =	Z =	C =	R =	Z =
3.	R =	Z =	C =	R =	Z =	C =

R = Reference Gas, C = Candidate Gas, Z = Zero Gas

This certification was performed according to EPA Protocol method (s) described in section 3.0.9.G1, and/or section 3.0.9.G2.

ANALYST _____ DATE 6.2.93

ABCO WELDING & INDUSTRIAL SUPPLY, INC.

130 CROSS ROAD
P.O. BOX 296
WATERFORD, CT 06385
(203) 442-0363 • 800-962-0285
FAX: (203) 447-3347

OUR 70TH YEAR
1921-1991

BRANCH STORES

ABCO RI
83 GILBANE ST.
WARWICK, RI 02886
(401) 732-2920

CHESHIRE COMPRESSED GAS
140 COMMERCE CT.
CHESHIRE, CT 06410
(203) 272-0389

Technical Data
Typical Purity Specifications

Nitrogen	Zero Grade
Chemical Symbol:	N_2
Minimum Purity:	99.998%
Water:	< 3 ppm
Oxygen	< 5 ppm
THC	< 0.5 ppm
CGA Valve Connection:	CGA580
DOT Shipping Name:	Nitrogen
DOT Hazard Class:	Nonflammable Gas
I.D. Number	UN1066
Specification:	Matheson Zero Grade Specs

Date: ____/____/____

Delivery ticket #_____

Customer Name:__ _____

Cylinder Serial Number:_____

APPENDIX E

Laboratory Analysis Reports
and
Analytical Data Sheets

CHAIN OF CUSTODY FORM
PLEASE COMPLETE AND RETURN

Project No: F93-09
Client: CRRA
Project Mgr: Richard Kopacz

Date Sampled: 11/4/93
Location: Landfill Flare

SAMPLE RECOVERY

CONTAINER CODE	DESCRIPTION
M18-0-1	
M18-0-2	
M18-0-3	
M18-0-4	
M18-1-Inlet	← Not received
M18-2-Inlet	
M18-3-Inlet	
M18-4-Inlet	

PERSON ENGAGED IN SAMPLE RECOVERY
Signature: [signature]
Title: Project Manager
Recovery Location: Hartford Landfill
Date and time of recovery: 11/4/93 p.m.

SAMPLE(S) RECIPIENT, UPON RECOVERY, IF NOT RECOVERY PERSON
Signature:
Title:
Date and time of receipt:
Sample storage:

LABORATORY PERSON RECEIVING SAMPLE(S)
Signature: [signature]
Title: Vice President
Date and time of receipt: 8:45 AM, NOV. 5, 1993
Sample storage: Cooler

ANALYSIS

CONTAINER CODE	METHOD OF ANALYSIS	DATE AND TIME OF ANALYSIS	SIGNATURE OF ANALYST

CHNCSTDY

ROJAC Environmental Services, Inc.

ATLANTIC
ANALYTICAL
LABORATORY

Mr. Richard Kopacz
ROJAC Environmental Services, Inc.
30 Arbor Street
Hartford, CT 06106

Report No. AAL-1272
Date Received 11-05-93
Date Reported 11-11-93
P.O. No. 27244

Material Submitted: Seven Gas Samples in Tedlar Bags;
Rojac Project No. F93-09

Information Requested: Gas Chromatographic and
Mass Spectrometric Analysis

Notebook: YP110,p85-88;MS115,p2

Subject samples were analyzed for Total Non-Methane Hydrocarbons following EPA Method 18 protocol.

Results are attached.

Don Pachuta, Ph.D.

p1111

FAX: 203-232-5378

TELEPHONE: 203-232-8959

Enclosures: Chain of Custody
Chromatograms
Notebook pages

Results of Analysis

Gas Samples

Sample Identification	Concentration % v/v Dry Basis M18-1	M18-3	M18-4
Nitrogen	12.0	8.5	33.6
Oxygen	1.3	0.49	8.0
Argon	0.14	0.11	0.40
Carbon Dioxide	34.7	35.9	24.5
Hydrogen	ND 0.01	ND 0.01	ND 0.01
Helium	ND 0.01	ND 0.01	ND 0.01
Methane	51.8	55.0	33.5
Total Non-Methane Hydrocarbons, as hexane equivalent	0.021	0.019	0.019
Hydrocarbons, as methane equivalent	0.13	0.11	0.11
Lower Heating Value, BTU/CuFt	513	545	332
Higher Heating Value, BTU/CuFt	524	557	339

ND = None detected, followed by the limit of detection.

Results of Analysis

Gas Samples

Concentration % v/v Dry Basis

Sample Identification	M18-0-1	M18-0-2	M18-0-3
Nitrogen	-	-	-
Oxygen	-	-	-
Argon	-	-	-
Carbon Dioxide	-	-	-
Hydrogen	-	-	-
Helium	-	-	-
Methane	-	-	-
Total Non-Methane Hydrocarbons, as hexane equivalent	ND 0.001	ND 0.001	ND 0.001
Hydrocarbons, as methane equivalent	ND 0.006	ND 0.006	ND 0.006
Lower Heating Value, BTU/CuFt	-	-	-
Higher Heating Value, BTU/CuFt	-	-	-

ND = None detected, followed by the limit of detection.

APPENDIX F

Operational/Process Data

OPERATION

The LFG Specialties enclosed flare system is designed for fully automatic, unattended operation. To familiarize yourself with the features and flexibility of the complete system, please review this operation and maintenance manual prior to proceeding with the start-up or adjustment of the control system.

To assure both personal and equipment safety, a qualified LFG Specialties factory representative should have completed the initial start-up and commissioning of the enclosed flare station before standard operation is commenced. The qualified representative will also conduct an on-site training session with the customer's operating personnel to assure safe and efficient operation of the enclosed flare station.

Under standard operating conditions, all that is required to start the enclosed flare is to turn the operation mode switch in the Flame-Trol II controller to "Auto". The controller will then automatically start the system proceeding through the following logic sequence:

1) Placing the operation mode switch to "Auto", will activate the purge timer and start the purge blower.
   Permissive: Main header valve must be in closed position

2) When purging is complete the pilot and igniter timers are activated, powering the pilot gas solenoid valve and the ignition system.
   Permissive: Flare stack temperature reading must be below the set point in the temperature controller.

   Purge pressure switch must sense the purge air flow to confirm that the flare stack is being purged.

   Header valve must be in the closed position.

3) The pilot will ignite and raise the pilot thermocouple temperature to the blower-on set point.

4) At the blower-on set point the controller will start the blower and open the landfill gas main header valve.
Permissive: The pilot must achieve the pilot off temperature within the time set in the pilot timer or the system will shutdown indicating "pilot failure".

The ultraviolet scanner must confirm the pilot flame.

5) The pilot will ignite the landfill gas and raise the thermocouple temperature to the pilot-off setting, which is the High Alarm setting on the pilot temperature controller.
Permissive: Header valve must be in the open position, otherwise the blower would shutdown.

6) At the pilot-off temperature (High Alarm setting on the pilot temperature controller), the controller will close the pilot gas solenoid valve

7) The flare will continue to operate if and only if all of the following conditions are met:

A - Header valve is maintained in the open position.

B - Flame is confirmed by the ultraviolet scanner.

C - Flare chamber temperature is maintained above the low temperature shutdown (HL, High Alarm) on the flare chamber temperature controller.

D - Flare chamber temperature is maintained below the high temperature shutdown (SV, Set Value) on the flare chamber temperature controller.

8) The flare will shutdown, activate the down timer and go into the automatic restart sequence if:

A - Flame is not confirmed by the ultraviolet scanner for more than 4 seconds.

B - Flare chamber temperature falls below the low temperature shutdown (High Alarm) on the flare chamber temperature controller. The low temperature shutdown is locked out for 15 minutes on start-up.

9) The flare will shutdown and will not go to down time or try to reignite automatically if:

A - Purge pressure switch does not confirm the purge air flow prior to ignition cycle on start-up.

B - Pilot does not achieve the pilot off temperature (High Alarm) on the pilot temperature controller within the time set in the pilot timer.

C - Header valve does not make the open position contact (Delay: 30 seconds on start-up).

D - Low temperature shutdown is not reached within 15 minutes from start-up.

E - Flare chamber temperature rises above the high temperature shutdown (Set Value) on the flare chamber temperature controller.

Note: To reinstate the automatic controls, the system must be manually reset by pushing the reset button on the face panel of the Flare-Trol II controller.