HORIZON
AIR MEASUREMENT SERVICES, INC.

Horizon Test #: W07-056-FR
Date Tested: January 14, 2008
Report Date: February 15, 2008
Revision Number: 0

EMISSION COMPLIANCE TEST ON A LANDFILL GAS FLARE

Permit to Operate No. 01395

Facility:

Simi Valley Landfill and Recycling Center
2801 Madera Road
Simi Valley, California 93065

Prepared for:

Simi Valley Landfill and Recycling Center
2801 Madera Road
Simi Valley, California 93065

Prepared by:

Horizon Air Measurement Services, Inc.
996 Lawrence Drive, Suite 108
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Regulatory Agency:

Ventura County Air Pollution Control District
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Ventura, California 93003

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HORIZON
AIR MEASUREMENT SERVICES, INC.

February 15, 2008

Mr. Bruce Matlock
Simi Valley Landfill and Recycling Center
2801 Madera Road
Simi Valley, California 93065

Dear Mr. Matlock:

Please find enclosed three copies of the final report entitled "Emissions Compliance Test on A Landfill Gas Flare".

If you have any questions, please call me at (805) 498-8781.

Sincerely,

HORIZON AIR MEASUREMENT SERVICES, INC.

Edward S. Swede
Project Manager

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1. INTRODUCTION

Under the requirements of Ventura County Air Pollution Control District (VCAPCD) Permit to Operate #01395, Simi Valley Landfill and Recycling Center (SVLRC) is required to conduct a biennial source test on the subject landfill gas flare (John Zinc) located at the landfill to determine emissions of criteria pollutants. Horizon Air Measurement Services, Inc. (Horizon) had been retained for this purpose. The compounds of interest quantified and the associated test methods utilized are provided in Table 1-1.

The emission testing was completed on January 14, 2008 by Horizon is accordance with Horizon Test Plan No. W07-051-TP which had been formally approved by VCAPCD. Flare operation was the responsibility of the Simi Valley Landfill and Recycling Center. A VCAPCD representative, Mr. Stan Cowen, was present during the test program.

The summary of results is presented in Section 2. A brief description of the flare and flare operating conditions during testing are provided in Section 3. Sampling/analytical procedures are provided in Section 4.

Table 1-1
Compounds of Interest
Simi Valley Landfill and Recycling Center
Permit to Operate No. 01395

Parameter	Location	Method	No. of Samples Per Source
Oxides of Nitrogen	Outlet	EPA 7E	3
Carbon Monoxide	Outlet	EPA 10	3
Nitrogen	Outlet	EPA 3A	3
Oxygen	Outlet	EPA 3A	3
Carbon Dioxide	Outlet	EPA 3A	3
Flow Rate	Inlet	Fuel Gas Meter	3
	Outlet	CARB Method 2	3
Moisture	Outlet	EPA 4	3
	Inlet	Wet Bulb/Dry Bulb	3
Sulfur Content	Inlet	GC/Hall & GC/MS Analyses	3
Higher Heating Value	Inlet	ASTM D-3588-91	1
Reactive Organic Compounds, as Non-Methane Hydrocarbons	Inlet	EPA 25C	3
	Outlet	EPA 25C	3

2. SUMMARY OF RESULTS

The results of the testing program on the John Zinc Flare is provided in Table 2-1. Three test runs were conducted under normal, as-found operating conditions. Emission rates of oxides of nitrogen (lb/hr, lb/MMBtu), carbon monoxide (lb/hr, lb/MMBtu) and reactive organic compounds (lb/hr, ppm C_6 @ 3% O_2) were within Permit limits as reported in Table 2-1.

Table 2-1

Summary of Results
Simi Valley Landfill
John Zink Flare
January 14,2008

Run	1	2	3	**Average**	Emission Limit
Oxygen, %	12.94	12.78	12.97	**12.90**	
Carbon Dioxide, %	7.09	7.28	7.37	**7.25**	
Flow Rate, dscfm	18559	18566	17964	**18363**	
Oxides of Nitrogen,					
ppm	11.9	11.4	11.0	**11.4**	
ppm @ 3 % O2	26.7	25.1	24.8	**25.5**	
lb/hr	1.576	1.513	1.410	**1.500**	
lbs/MMBtu	0.0355	0.0335	0.0330	**0.0340**	0.05
Carbon Monoxide,					
ppm	< 1.0	2.3	< 1.0	< **1.4**	
ppm @ 3 % O2	< 2.2	5.0	< 2.3	< **3.2**	
lb/hr	< 0.081	0.185	< 0.078	< **0.115**	
lbs/MMBtu	< 0.0018	0.0041	< 0.0018	< **0.0026**	0.20
Oxides of Sulfur,					
lbs/MMBtu	0.022	0.022	0.023	**0.022**	0.02
lb/hr	1.014	1.047	1.094	**1.052**	1.50
Outlet - Total Non-Methane Hydrocarbon,					
ppm	1.9	2.0	< 1.0	**1.7**	
ppm, as hexane, @ 3 % O2	0.7	0.7	< 0.4	**0.6**	20
lb/hr	0.0892	0.0939	< 0.0448	**0.0760**	1.09
lbs/MMBtu	0.00201	0.00208	< 0.00105	**0.00171**	
Inlet - Total Non-Methane Hydrocarbon,					
ppm	6230	5580	6160	**5990**	
lb/hr	24.736	22.379	25.215	**24.110**	
Total Non-Methane Hydrocarbon, Destruction Efficiency %	99.6	99.6	> 99.8	**99.7**	98
Fuel Sulfur					
ppm, as H_2S	64.9	66.3	67.9	**66.4**	

3. FLARE DESCRIPTION AND OPERATION

3.1 Process Description

The landfill gas collection system consists of a series of landfill gas collection wells, a gas collection manifold, a pumping system and two landfill gas flares. Landfill gas, collected from various wells located throughout the landfill, is manifolded to a common duct. The landfill gas then passes through a condensation collection system, a blower, then to the flares.

3.2 Flare Descriptions

3.2.2 John Zink Flare

The John Zink flare is rated at 75 MMBtu/hr and consists of an insulated steel cylinder approximately 11 feet in diameter and 50 feet above ground level. The four sample ports to be utilized are located 45 feet from ground level and five feet from the top of the flare. Landfill gas flow rate is continuously monitored and recorded on a strip chart recorder. Flare combustion temperature is maintained above 1600 °F to ensure complete combustion and is monitored by a thermocouple, recording temperature on a strip chart. The flare is equipped with automatic air control louvers and a temperature controller to maintain the pre-set flare temperature. A flame failure detector automatically shuts off the blower in the event of a flame out.

3.3 Operating Conditions

The flare temperature set point was 1640 ^{0} F. Following is a summary of the average operating condition during each test run:

Run#	Average Flare Temp (F)	Landfill Gas Flow Rate (scfm)
1	1639	1594
2	1639	1610
3	1638	1643

Flare operating data (two-minute intervals) is provided in Appendix F.

4. SAMPLING/ANALYTICAL PROCEDURES

The sampling/analytical program had been designed to quantify the parameters of interest outlined in Table 1-1. Three, 60-minute test runs were conducted on the John Zinc Flare for NO_x, CO, ROC and O_2 concentration and emission rate determination. Sulfur content of the landfill gas was determined from three replicate samples. One higher heating valve determination was conducted for the flare.

4.1 Sample Location

4.1.1 Flare Exhaust

At the flare exhaust 24 sample points (12 per diameter), determined in accordance with Method 1.1, were utilized for the determination of the following parameters:

- NO_X
- CO
- O_2/CO_2
- flow rate

A single sample point was utilized for the determination of the following parameter:

- moisture content
- reactive organic compounds

4.1.2 Landfill Gas Supply Line

Landfill gas flow rate was determined using the existing landfill gas flow meter. A single sample port was utilized for the collection of the following compounds:

- total sulfur content
- higher heating value
- reactive organic compounds
- fixed gases

4.2 Moisture

Moisture content of the stack gas was determined using US EPA Method 4, as described in Appendix A.

4.3 Flow Rate

4.3.1 Inlet

Inlet flow rate for the flare was determined using the facilities calibrated on-line flow meters and recorders.

4.3.2 Outlet

The exhaust flow rate was sampled using EPA Method 2 as described in Appendix A.

4.4 Oxides of Nitrogen, Carbon Monoxide, Carbon Dioxide, Oxygen (Continuous Emissions Monitoring)

Three , 60-minute test runs were conducted at the flare exhaust. Twenty-four sample points were utilized. All sampling was performed using Horizon's mobile CEMS under the guidelines of EPA Method 3A, 7E and 10, as detailed in Appendix A.

4.5 Total Sulfur Content of Landfill Gas

The total sulfur content of the landfill gas was determined using GC Hall and GC/MS analyses for each test run.

4.6 Higher Heating Value

The higher heating value of the landfill gas was determined using ASTM D-3588-91.

4.7 Reactive Organic Carbon (ROC), as Total Non-Methane Hydrocarbons (TNMHC)

Three, 60-minute test runs were conducted at the flare exhaust and inlets in accordance with EPA Method 25C, as described in Appendix A, to determine ROC concentration, as TNMHC.

APPENDIX A - Sampling and Analytical Methods

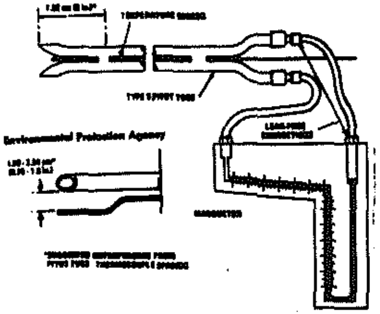
Method:	**Sample Velocity Traverses for Stationary Sources**
Applicable for Methods:	EPA Method 1, SCAQMD Method 1.1, CARB Method 1
Principle:	To aid in the representative measurements of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross section of the stack is divided into a number of equal areas. A traverse point is then located within these equal areas. The method cannot be used when, 1) flow is cyclonic or swirling, 2) stack is small than about 0.30 meter (12 inches) in diameter or 3) the measurement of the site is less than two stack or duct diameters downstream or less than a half diameter upstream from the flow disturbance.

Method: **Stack Gas Velocity and Volumetric Flow Rate**

Applicable for Methods: EPA Method 2, CARB 2, SCAQMD Method 2.1

Principle: The average gas velocity in a stack gas is determined from the gas density and from measurement of the average velocity head with a type S or standard pitot tube.

Sampling Procedure: Set up the apparatus as shown in the figure. Measure the velocity head and temperature at the traverse points specified by EPA Method 2, CARB Method 2 or SCAQMD Method 2.1. Measure the static pressure in the stack and determine the atmospheric pressure. The stack gas molecular weight is determined from independent measurements of O_2, CO_2 and H_2O concentrations.



Sample Recovery: and Analyses: The stack gas velocity is determined from the measured average velocity head, the measured dry concentrations of O_2 and CO_2 and the measured concentration of H_2O. The velocity is determined from the following set of equations:

Where,

ΔP = velocity head, inches in H_2O
Ts = gas/temperature, degrees R
Ps = absolute static pressure
Mwd = dry molecular weight
Mw = molecular weight
Cp = pitot flow coefficient

Dry molecular weight of stack gas

$$Mwd = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

Molecular weight of stack gas, wet basis

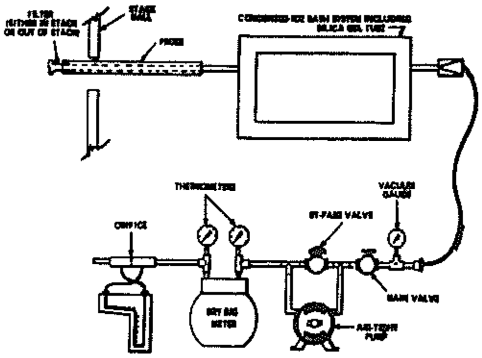
$$M_w = (M_{wd}\ x\ M_d) + 18\ (1 - M_d)$$

$$Where,\ M_d = \frac{100 - Bws}{100}$$

Stack gas velocity

$$(V_s)\ avg. = (5130)\ C_p\ x\ \sqrt{\Delta P}\ avg.\ x\ \sqrt{T_s}\ x\ (\frac{1}{P_s\ x\ M_w})^{1/2}$$

Method:	**Determination of Moisture in Stack Gases**
Applicable for Methods:	EPA Method 4, CARB Method 4, SCAQMD Method 4.1
Principle:	A gas sample is extracted at a constant rate from the source; moisture is removed from the stream and determined either volumetrically or gravimetrically.
Sampling Procedure:	Set up train as shown in the following figure. Sample is drawn at a constant rate through a sufficiently heated probe. The probe is connected to the impinger train by Teflon or glass tubing. The train consists of two greenburg smith impinger (SCAQMD 4.1) or one modified and 1 greenburg smith impinger (CARB & EPA) each containing 100 ml of water, an empty impinger as a knock-out and an impinger containing silica gel to protect the pump from moisture.



Sample Recovery: and Analyses:	Following testing, moisture content is determined gravimetrically or volumetrically from initial and final impinger contents weights or volume.

Method:	**Methane and Total Non-Methane Hydrocarbons by Total Carbon Analyses**
Reference:	EPA Method 25C
Principle:	Gaseous samples are collected in stainless steel canisters. The canisters are then pressurized with nitrogen and analyzed for methane and total non methane hydrocarbons (TNMHC) using a TCA/FID.
Sampling Procedure:	Samples are collected, in duplicate, using stainless steel canisters which are evacuated to less than 10 mm Hg absolute. The tanks are pressurized and evacuated three times with ultrapure nitrogen and leak checked prior to use. A gas flow metering device and stainless steel shutoff valve is located just upstream of the canister. Representative, integrated samples are collected through a heat conditioned 1/4" stainless steel probe. The gas samples are metered into the canisters through the vacuum regulator maintaining a constant flow rate throughout each sampling period. The sampling apparatus is checked for leaks prior to the sampling program by attaching the probe end to an absolute pressure gauge and vacuum pump in series. The sample lines were evacuated to less than 10 mm Hg and the gauge shutoff valve is then closed. The sample lines are deemed to be leak-free if no loss of vacuum occurs as indicated by the vacuum gauge. During sampling the tank pressures are monitored with a 0-30 inch vacuum gauge to ensure integrated sampling.
Analytical Procedure:	Samples are analyzed for methane and total non methane hydrocarbons (TNMHC) by total combustion analyses (TCA)/flame ionization detection (FID).

CONTINUOUS EMISSIONS MONITORING SYSTEM - TRUCK

EPA Methods 3A, 6C, 7E, 10

The continuous emissions monitoring system consists of a Thermo Electron Model 10AR chemiluminescence NO/NO_x analyzer, a Teledyne electro chemical O_2 analyzer, a Thermo Electron Model 48H CO gas filter correlation analyzer, a TECO Model 43C-HL pulsed flourescent SO_2 analyzer and a Fuji PIR 2000 non dispersive infrared CO_2 analyzer. All analyzer specifications are provided in Table 1. All concentrations are determined on a dry basis. Concentrations of NO_X, CO, SO_2 and CO_2 are continuously recorded on a Linseis 10-inch strip chart recorder and a Strawberry Tree Data Acquisition System (DAS). The extractive monitoring system conforms with the requirements of SCAQMD Method 100.1.

The sampling probe (heated to 250°F), constructed of 1/2 inch-diameter 316 stainless steel, is connected to a condenser with a six foot length of 3/8 inch Teflon line (heated to 250°F). A Nupro stainless steel filter (10 micron) is connected at the tip of the probe and maintained at stack temperature.

The condenser consists of a series of two stainless steel moisture knock-out bottles immersed in an ethylene glycol/dry ice bath. The system is designed to minimize contact between the sample and the condensate. Condensate is continuously removed from the knock-out bottles via a peristaltic pump. The condenser outlet temperature is monitored either manually at 10-minute intervals or on a strip chart recorder/DAS system. The sample exiting the condenser is then transported through a filter, housed in a stainless steel holder, followed by 3/8 inch O.D. Teflon tubing and a Teflon coated (or stainless steel/viton) diaphragm pump to the sample manifold. The sample manifold is constructed of stainless steel tubing and directs the sample through each of five rotameters to the NO_X monitor, O_2 monitor, CO monitor, SO_2 monitor and CO_2 monitor and excess sample exhaust line, respectively. Sample flow through each channel is controlled by a back pressure regulator and by stainless steel needle valves on each rotameter. All components of the sampling system that contact the sample are composed of stainless steel, Teflon or glass.

The calibration system is comprised of two parts: the analyzer calibration and the system bias check. The calibration gases are, at a minimum, certified to ± 1% by the manufacturer. Where necessary to comply with the reference method requirements, EPA Protocol 1 gases are used. The cylinders are equipped with pressure regulators which supply the calibration gas to the analyzers at the same pressure and flow rate as the sample. The selection of zero, span or sample gas directed to each analyzer is accomplished by operation of the zero, calibration or sample selector knobs located on the main flow control panel.

For EPA Methods 3A/6C/7E/10 the following procedures are conducted before and after each series of test runs:

Leak Check:

The leak check is performed by plugging the end of the sampling probe, evacuating the system to at least 20 inches of Hg. The leak check is deemed satisfactory if the system holds 20 inches of Hg vacuum for five minutes with less than one inch Hg loss.

Alternately the leak check is accomplished by plugging the probe at the tip and operating the system in the "sample" position. The excess sample vent is closed and the flow observed on the low-flow (0-140 cc/min) sample delivery system. If no flow is observed the system is deemed leak tight.

Linearity Check:

NO_X, CO, O_2, SO_2 and CO analyzer linearity check is performed by introducing, at a minimum, zero gas, mid range calibration gas (40-60% scale) and high range calibration gas (80-100% scale). Instrument span value is set on each instrument with the mid range gas. Linearity is confirmed, if all values agree with the calibration gas value to within 2% of the range.

Stratification Check:

A stack stratification check is performed (pre-test only) by traversing the stack (6 points per traverse). If the gas composition is homogenous, <10% variation between any two points in the gas stream throughout the cross sectional diameter of the stacks, single point gas sampling is performed at an average point. If stratification exceeds the 10% criteria, then the stack cross section is traversed during sampling.

System Bias Check:

The system bias check is accomplished by transporting the same gases used to zero and span the analyzers to the sample system as close as practical to the probe inlet. This is accomplished by opening a valve located on the probe, allowing the gas to flow to the probe and back through the moisture knockout and sample line to the analyzers. During this check the system is operated at the normal sampling rate with no adjustments. The system bias check is considered valid if the difference between the gas concentration exhibited by the measurement system which a known concentration gas is introduced at the sampling probe tip and when the sample gas is introduced directly to the analyzer, does not exceed ± 5% of the analyzer range.

Response Time:

Response time (upscale and downscale) for each analyzer is recorded during the system bias check. Upscale response time is defined as the time it takes the subject analyzer gas to reach 95% of the calibration gas value after introducing the upscale gas to the sample bias calibration system. Downscale response time is defined as the time it takes the subject analyzer to return to zero after the zero gas is introduced into the sample system bias calibration system.

NO_x Conversion Efficiency

The NO_x analyzer NO_2 conversion efficiency is determined by injecting a NO_2 gas standard directly into the NO_x analyzer (after initial calibration). The analyzer response must be a least 90% of the NO_2 standard gas value.

NO_2 Converter Efficiency (alternate method)

The mid level NO gas standard is directly injected into a clean leak-free Tedlar bag. The bag is then diluted 1:1 with air (20.9 % O_2). The bag is immediately attached to the NO_x sample line. The initial NO_x concentration is recorded on the strip chart. After at least 30 minutes the Tedlar bag is reattached to the NO_x sample line. Analyzer response must be at 98% of the initial Tedlar bag NO_x value to be acceptable.

In between each sampling run the following procedures are conducted:

Zero and Calibration Drift Check:

Upon the completion of each test run, the zero and calibration drift check is performed by introducing zero and mid range calibration gases to the instruments, with no adjustments (with the exception of flow to instruments) after each test run. The analyzer response must be within ± 3% of the actual calibration gas value.

Analyzer Calibration:

Upon completion of the drift test, the analyzer calibration is performed by introducing the zero and mid range gases to each analyzer prior to the upcoming test run and adjusting the instrument calibration as necessary.

System Bias Check

(same as above)

A schematic of the sample system and specific information of the analytical equipment is provided in the following pages.

TABLE 1

CONTINUOUS EMISSIONS MONITORING LABORATORY - TRUCK

NO_X CHEMILUMINESCENT ANALYZER -- THERMO ELECTRON MODEL 10 A

Response Time (0-90%)	1.5 sec -- NO mode/1.7 sec -- NO_x mode
Zero Drift	Negligible after 1/2 hour warmup
Linearity	± 1% of full scale
Accuracy	Derived from the NO or NO_2 calibration gas, ± 1% of full scale
Operating Ranges (ppm)	2.5, 10, 25, 100, 250, 1000, 2500, 10000
Output	0-1 volt

O_2 ANALYZER, FUEL TYPE -- TELEDYNE MODEL 326RA

Response Time (0-90%)	60 seconds
Accuracy	± 1% of scale at constant temperature ± 1% of scale of ± 5% of reading, whichever is greater, over the operation temperature range.
Operating Ranges (%)	0-5, 0-25
Output	0-1 volt

O_2 ANALYZER, PARAMAGNETIC -- SERVOMEX MODEL 1400B

Response Time (0-90%)	15 seconds
Accuracy	0.1% oxygen
Linearity	± 1% scale
Operating Ranges (%)	0-25, 0-100
Output	0-1 volt

CO GAS FILTER CORRELATION -- THERMO ELECTRON MODEL 48H

Response Time (0-95%)	1 minute
Zero Drift	± 0.2 ppm CO
Span Drift	Less than 1% full scale in 24 hours
Linearity	± 1% full scale, all ranges
Accuracy	± 0.1 ppm CO
Operating Ranges (ppm)	50, 100, 250, 500, 1000, 2500, 5000, 10,000, 25,000, 50,000
Output	0-1 volt

TABLE 1 (Cont.)

CO_2 INFRARED GAS ANALYZER -- HORIBA - MODEL PIR 2000

Response Time (0-90%)	5 seconds
Zero Drift	± 1% of full scale in 24 hours
Span Drift	± 1% of full scale in 24 hours
Linearity	± 2% of full scale
Resolution	Less than 1% of full scale
Operating Ranges (%)	0-5, 0-15, 0-25
Output	0-1 volt

SO_2 PULSED FLOURESCENT ANALYZER - TECO MODEL 43C-HL

Response Time	80 seconds
Zero Drift	± 1% of full scale in 24 hours
Span Drift	± 1% of full scale in 24 hours
Linearity	± 2% of full scale
Resolution	less than 1% of full scale
Operating Ranges	5, 10, 20, 50, 100, 200 ppm and customized
Output	0-10 volt

RATFISCH FID TOTAL HYDROCARBON ANALYZER -- MODEL 55CA

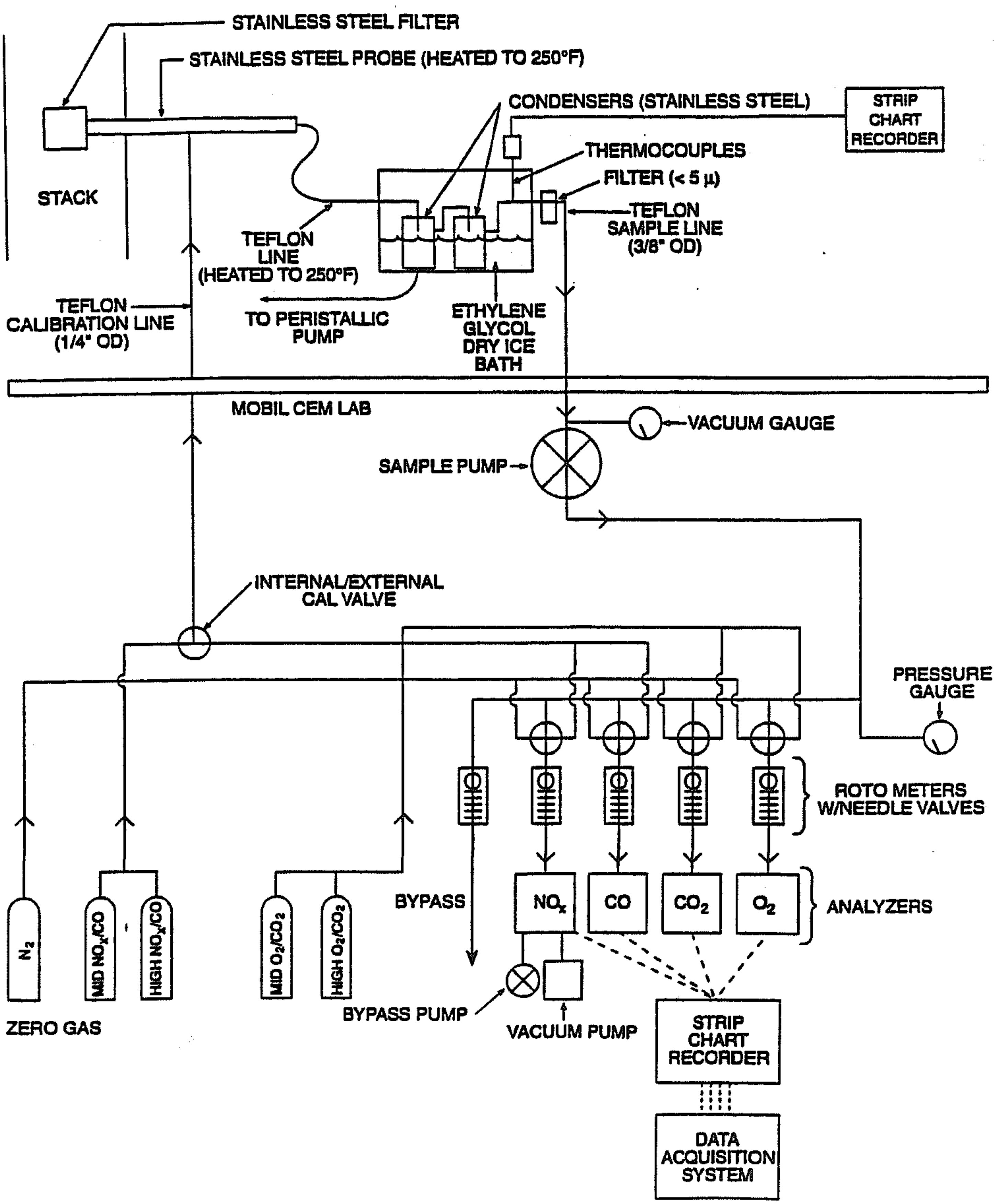
Response Time (0-90%)	5 seconds
Zero Drift	± 1% full scale in 24 hours
Span Drift	± 1% full scale in 24 hours
Linearity	± 1% full scale - constant
Accuracy	± 1% full scale at constant temp.
Operating Ranges (ppm)	10, 100, 1000, 10,000
Output	0 - 10 volts

LINSEIS MODEL L2045 FOUR PEN STRIP CHART RECORDER

Pen Speed	up to 120 cm/min
Measuring Response	0-20 volts
Linearity Error	0.25%
Accuracy	0.3%
Zero Suppression	Manual (from 1 to 10X full scale)

LINEAR 3 PEN CONTINUOUS -- MODEL 595 STRIP CHART

Pen Response	20 inches/second
Measuring Response	1 Mv through 5V
Zero Set	Electronically adjustable full scale with 1 full scale of zero suppression
Accuracy	Total limit of error ± 0.5%



CEM System Schematic

Method:	**NO/NO_X by Continuous Analyzer**
Applicable Reference Methods:	EPA 7E, EPA 20; CARB 100, BAAQMD ST-13A, SCAQMD 100.1
Principle:	A sample is continuously withdrawn from the flue gas stream, conditioned and conveyed to the instrument for direct readout of NO or NO_X.
Analyzer:	TECO Model 10AR
Measurement Principle:	Chemiluminescence
Accuracy:	1% of full scale
Ranges:	0-2.5, 0-10, 0-25, 0-250, 0-1000, 0-2500, 0-10,000 ppm
Output:	0-10 V
Inferences:	Compounds containing nitrogen (other than ammonia) may cause interference.
Response Time:	90%, 1.5 seconds (NO mode) and 1.7 seconds (NO_X mode)
Sampling Procedure:	A representative flue gas sample is collected and conditioned using the CEM system described previously. If EPA Method 20 is used, that method's specific procedures for selecting sample points are used.
Analytical Procedure:	The oxides of nitrogen monitoring instrument is a chemiluminescent nitric oxide analyzer. the operational basis of the instrument is the chemiluminescent reaction of NO and ozone (O_3) to form NO_2 in an excited state. Light emission results chemiluminescence is monitored through an optical filter by a high sensitivity photomultiplier tube, the output of which is electronically processed so it is linearly proportional to the NO concentration. The output of the instrument is in ppmV. When NO_2 is expected to be present in the flue gas, a supercooled water dropout flask will be placed in the sample line to avoid loss of NO_2. Since NO_2 is highly soluble in water, "freezing out" the water will allow the NO_2 to reach the analyzers for analysis. The analyzer measures NO only. In the NO_X mode, the gas is passed through a moly converter which converts NO_2 to NO and a total NO_X measurement is obtained. NO_2 is determined as the difference between NO and NO_X. Use of a moly converter instead of a stainless steel converter eliminates NH_3 interference; NH_3 is converted to NO with a stainless converter, but not with a moly converter.

Method: **Oxygen (O_2) by Continuous Analyzer**

Applicable Reference Methods: EPA 3A, EPA 20, CARB 100, BAAQMD ST-14, SCAQMD 100.1

Principle: A sample is continuously withdrawn from the flue gas stream, conditioned and conveyed to the instrument for direct readout of O_2 concentration.

Analyzer: Teledyne Model 326R

Measurement Principle: Electrochemical cell

Ranges: 0-5, 0-25% 0-100%

Accuracy: 1% of full scale

Output: 0-1 V

Interferences: Halogens and halogenated compounds will cause a positive interference. Acid gases will consume the fuel cell and cause a slow calibration drift.

Response Time: 90% <60 seconds

Sampling Procedure: A representative flue gas sample is collected and conditioned using the CEM system described previously. If Method 20 is used, that method's specific procedures for selecting sample points are used. Otherwise, stratification checks are performed at the start of a test program to select single or multiple-point sample locations.

Analytical Procedure: An electrochemical cell is used to measure O_2 concentration. Oxygen in the flue gas diffuses through a Teflon membrane and is reduced on the surface of the cathode. A corresponding oxidation occurs at the anode internally and an electric current is produced that is proportional to the concentration of oxygen. This current is measured and conditioned by the instrument's electronic circuitry to give an output in percent O_2 by volume.

Method: **Carbon Dioxide (CO_2) by Continuous Analyzer**

Applicable Reference EPA 3A, CARB 100, BAAQMD ST-5, SCAQMD 100.1

Principle: A sample is continuously drawn from the flue gas stream, conditioned and conveyed to the instrument for direct readout of CO_2 concentration.

Analyzer: PIR 2000

Measurement Principle: Non-dispersive infrared (NDIR)

Accuracy: 1% of full scale

Ranges: 0-5, 0-15%

Output: 0-1 V

Interferences: A possible interference includes water. Since the instrument receives dried sample gas, this interference is not significant.

Response Time: 5 seconds

Sampling Procedure: A representative flue gas sample is collected and conditioned using the CEM system described previously.

Analytical Procedure: Carbon dioxide concentrations are measured by short path length non-dispersive infrared analyzers. These instruments measure the differential in infrared energy absorbed from energy beams passed through a reference cell (containing a gas selected to have minimal absorption of infrared energy in the wavelength absorbed by the gas component of interest) and a sample cell through which the sample gas flows continuously. The differential absorption appears as a reading on a scale of 0-100%.

Method: **Carbon Monoxide (CO) by NDIR/Gas Filter Correlation**

Applicable Reference Methods: EPA 10; CARB 1-100; BAAQMD ST-6, SCAQMD 100.1

Principle: A sample is continuously drawn from the flue gas stream, conditioned and conveyed to the instrument for direct readout of CO concentration.

Analyzer: TECO, Model 48H

Measurement Principle: NDIR/Gas Filter Correlation

Precision: 0.1% ppm

Ranges: ppm 0-50, 0-100, 0-250, 0-500, 0-1000, 0-2500, 0-5000, 0-10000, 0-2500, 0-3,000

Output: 0-1 V

Interferences: Negligible interference from water and CO_2

Rise/Fall times (0-95%) 1 minute @ 1 lpm flow, 30 second integration time

Sampling Procedure: A representative flue gas sample is collected and conditioned using the CEM system described previously. Sample point selection has been described previously.

Analytical Procedure: Radiation from an infrared source is chopped and then passed through a gas filter which alternates between CO and N_2 due to rotation of a filter wheel. The radiation then passes through a narrow band-pass filter and a multiple optical pass sample cell where absorption by the sample gas occurs. The IR radiation exits the sample cell and falls on a solid state IR detector.

Method: **Sulfur Dioxide (SO_2) by Pulsed Flourescent**

Applicable Reference Methods: EPA 6C; CARB 1-100; BAAQMD ST-6, SCAQMD 100.1

Principle: A sample is continuously drawn from the flue gas stream, conditioned and conveyed to the instrument for direct readout of SO_2 concentration.

Analyzer: TECO, Model 43C-HL

Measurement Principle: Pulsed flourescense SO_2 analyzer

Precision: 0.1% ppm

Ranges: 5, 10, 20, 50, 100, 200 ppm

Output: 0-10 V

Interferences: Less than lower detectable limit except for the following: NO <3 ppb, m-xylene <2 ppm, H_2O <2% of reading.

Response Time: 80 seconds

Sampling Procedure: A representative flue gas sample is collected and conditioned using the CEM system described previously. Sample point selection has been described previously.

Analytical Procedure: The sample flows into the flourescent chamber, where pulsating UV light excites the SO_2 molecules. The condensing lens focuses the pulsating UV light into the mirror assembly. The mirror assembly contains four selecting mirrors that reflect only the wavelengths which excite SO_2 molecules. As excited SO_2 molecules decay to lower energy states they emit UV light that is proportional to the SO_2 concentration. The PMT (photomultiplier tube) detects UV light emission from decaying SO_2 molecules. The PMT continuously monitors pulsating UV light source and is connected to a circuit that compensates for fluctuating in the light.

Designation: D 3588 – 98 (Reapproved 2003)

Standard Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels[1]

This standard is issued under the fixed designation D 3588; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers procedures for calculating heating value, relative density, and compressibility factor at base conditions (14.696 psia and 60°F (15.6°C)) for natural gas mixtures from compositional analysis.[2] It applies to all common types of utility gaseous fuels, for example, dry natural gas, reformed gas, oil gas (both high and low Btu), propane-air, carbureted water gas, coke oven gas, and retort coal gas, for which suitable methods of analysis as described in Section 6 are available. Calculation procedures for other base conditions are given.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1717 Method for Analysis of Commercial Butane-Butene Mixtures and Isobutylene by Gas Chromatography[3]

D 1945 Test Method for Analysis of Natural Gas by Gas Chromatography[4]

D 1946 Practice for Analysis of Reformed Gas by Gas Chromatography[4]

D 2163 Test Method for Analysis of Liquefied Petroleum (LP) Gases and Propane Concentrates by Gas Chromatography[5]

D 2650 Test Method for Chemical Composition of Gases by Mass Spectrometry[5]

2.2 *GPA Standards:*

GPA 2145 Physical Constants for the Paraffin Hydrocarbons and Other Components in Natural Gas[6]

GPA Standard 2166 Methods of Obtaining Natural Gas Samples for Analysis by Gas Chromatography[6]

GPA 2172 Calculation of Gross Heating Value, Relative Density, and Compressibility Factor for Natural Gas Mixtures from Compositional Analysis[6,7]

GPA Standard 2261 Method of Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography[6]

GPA Technical Publication TP-17 Table of Physical Properties of Hydrocarbons for Extended Analysis of Natural Gases[6]

GPSA Data Book, Fig. 23-2, Physical Constants[6]

2.3 *TRC Document:*

TRC Thermodynamic Tables—Hydrocarbons[8]

2.4 *ANSI Standard:*

ANSI Z 132.1-1969: Base Conditions of Pressure and Temperature for the Volumetric Measurement of Natural Gas[9,10]

3. Terminology

3.1 *Definitions:*

3.1.1 *British thermal unit*—the defined International Tables British thermal unit (Btu).

3.1.1.1 *Discussion*—The defining relationships are:

$$1\ \text{Btu}\cdot\text{lb}^{-1} = 2.326\ \text{J}\cdot\text{g}^{-1}\ \text{(exact)}$$

$$1\ \text{lb} = 453.592\ 37\ \text{g (exact)}$$

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[1] This practice is under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.03 on Determination of Heating Value and Relative Density of Gaseous Fuels.

Current edition approved May 10, 2003. Published May 2003. Originally approved in 1998. Last previous edition approved in 1998 as D 3588 – 98.

[2] A more rigorous calculation of $Z(T,P)$ at both base conditions and higher pressures can be made using the calculation procedures in "Compressibility and Super Compressibility for Natural Gas and Other Hydrocarbon Gases," American Gas Association Transmission Measurement Committee Report 8, AGA Cat. No. XQ1285, 1985, AGA, 1515 Wilson Blvd., Arlington, VA 22209.

[3] Discontinued. See 1981 *Annual Book of ASTM Standards*, Vol 05.01.

[4] *Annual Book of ASTM Standards*, Vol 05.06.

[5] *Annual Book of ASTM Standards*, Vol 05.01.

[6] Available from Gas Processors Association, 6526 E. 60th, Tulsa, OK 74145.

[7] The sole source of supply of the program in either BASIC or FORTRAN suitable for running on computers known to the committee at this time is the Gas Processors Association. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee [1], which you may attend.

[8] Available from Thermodynamics Research Center, The Texas A&M University, College Station, TX 77843-3111.

[9] Available from the American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

[10] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: D03–1007.

By these relationships, 1 Btu = 1 055.055 852 62 J (exact). For most purposes, the value (rounded) 1 Btu = 1055.056 J is adequate.

3.1.2 *compressibility factor (z)*—the ratio of the actual volume of a given mass of gas at a specified temperature and pressure to its volume calculated from the ideal gas law under the same conditions.

3.1.3 *gross heating value*—the amount of energy transferred as heat from the complete, ideal combustion of the gas with air, at standard temperature, in which all the water formed by the reaction condenses to liquid. The values for the pure gases appear in GPA Standard 2145, which is revised annually. If the gross heating value has a volumetric rather than a mass or molar basis, a base pressure must also be specified.

3.1.4 *net heating value*—the amount of energy transferred as heat from the total, ideal combustion of the gas at standard temperature in which all the water formed by the reaction remains in the vapor state. Condensation of any "spectator" water does not contribute to the net heating value. If the net heating value has a volumetric rather than a mass or molar basis, a base pressure must also be specified.

3.1.5 *relative density*—the ratio of the density of the gaseous fuel, under observed conditions of temperature and pressure, to the density of dry air (of normal carbon dioxide content) at the same temperature and pressure.

3.1.6 *standard cubic foot of gas*—the amount of gas that occupies 1 ft^3 (0.028 m^3) at a temperature of 60°F (15.6°C) under a given base pressure and either saturated with water vapor (wet) or free of water vapor (dry) as specified (see ANSI Z 132.1). In this practice, calculations have been made at 14.696 psia and 60°F (15.6°C), because the yearly update of GPA 2145 by the Thermodynamics Research Center, on which these calculations are based, are given for this base pressure. Conversions to other base conditions should be made at the end of the calculation to reduce roundoff errors.

3.1.7 *standard temperature (USA)*—60°F (15.6°C).

3.2 *Symbols*:

3.2.1 *Nomenclature*:

3.2.1.1 B—second virial coefficient for gas mixture

3.2.1.2 $\sqrt{\beta_{ij}}$ —summation factor for calculating real gas correction (alternate method)

3.2.1.3 (cor)—corrected for water content

3.2.1.4 (dry)—value on water-free basis

3.2.1.5 d—density for gas relative to the density of air.

3.2.1.6 d^{id}—ideal relative density or relative molar mass, that is, molar mass of gas relative to molar mass of air

3.2.1.7 G^{id}—molar mass ratio

3.2.1.8 H_m^{id} —gross heating value per unit mass

3.2.1.9 H_v^{id} —gross heating value per unit volume

3.2.1.10 H_n^{id} —gross heating value per unit mole

3.2.1.11 h_m^{id} —net heating value per unit mass

3.2.1.12 h_v^{id} —net heating value per unit volume

3.2.1.13 h_n^{id} —net heating value per unit mole

3.2.1.14 a, b, c—in Eq 1, integers required to balance the equation: C, carbon; H, hydrogen; S, sulfur; O, oxygen

3.2.1.15 *(id)*—ideal gas state

3.2.1.16 *(l)*—liquid phase

3.2.1.17 M—molar mass

3.2.1.18 m—mass flow rate

3.2.1.19 n—number of components

3.2.1.20 P—pressure in absolute units (psia)

3.2.1.21 Q^{id}—ideal energy per unit time released as heat upon combustion

3.2.1.22 R—gas constant, 10.7316 psia.ft³/(lb mol•R) in this practice (based upon R = 8.314 48 J/(mol•K))

3.2.1.23 (sat)—denotes saturation value

3.2.1.24 T—absolute temperature, °R = °F + 459.67 or K = °C + 273.15

3.2.1.25 *(T, P)*—value dependent upon temperature and pressure

3.2.1.26 V—gas volumetric flow rate

3.2.1.27 x—mole fraction

3.2.1.28 Z—gas compressibility factor repeatability of property

3.2.1.29 δ—repeatability of property

3.2.1.30 ρ—density in mass per unit volume

3.2.1.31 $\sum_{j=1}^{n}$ —property summed for Components 1 through n, where n represents the total number of components in the mixture

3.2.2 *Superscripts*:

3.2.2.1 *id*—ideal gas value

3.2.2.2 *l*—liquid

3.2.2.3 σ—value at saturation (vapor pressure)

3.2.2.4 ′—reproducibility

3.2.3 *Subscripts*:

3.2.3.1 *a*—value for air

3.2.3.2 *a*—relative number of atoms of carbon in Eq 1

3.2.3.3 *b*—relative number of atoms of hydrogen in Eq 1

3.2.3.4 *c*—relative number of atoms of sulfur in Eq 1

3.2.3.5 *j*—property for component *j*

3.2.3.6 *ii*—non-ideal gas property for component *i*

3.2.3.7 *ij*—non-ideal gas property for mixture of *i* and *j*

3.2.3.8 *jj*—non-ideal gas property for component *j*

3.2.3.9 *w*—value for water

3.2.3.10 1—property for Component 1

3.2.3.11 2—property for Component 2

4. Summary of Practice

4.1 The ideal gas heating value and ideal gas relative density at base conditions (14.696 psia and 60°F (5.6°C)) are calculated from the molar composition and the respective ideal gas values for the components; these values are then adjusted by means of a calculated compressibility factor.

5. Significance and Use

5.1 The heating value is a measure of the suitability of a pure gas or a gas mixture for use as a fuel; it indicates the amount of energy that can be obtained as heat by burning a unit of gas. For use as heating agents, the relative merits of gases from different sources and having different compositions can be compared readily on the basis of their heating values. Therefore, the heating value is used as a parameter for determining the price of gas in custody transfer. It is also an essential factor in calculating the efficiencies of energy conversion devices such as gas-fired turbines. The heating values of a gas depend not only upon the temperature and pressure, but also upon the degree of saturation with water vapor.

However, some calorimetric methods for measuring heating values are based upon the gas being saturated with water at the specified conditions.

5.2 The relative density (specific gravity) of a gas quantifies the density of the gas as compared with that of air under the same conditions.

6. Methods of Analysis

6.1 Determine the molar composition of the gas in accordance with any ASTM or GPA method that yields the complete composition, exclusive of water, but including all other components present in amounts of 0.1 % or more, in terms of components or groups of components listed in Table 1. At least 98 % of the sample must be reported as individual components (that is, not more than a total of 2 % reported as groups of components such as butanes, pentanes, hexanes, butenes, and so forth). Any group used must be one of those listed in Table 1 for which average values appear. The following test methods are applicable to this practice when appropriate for the sample under test: Test Methods D 1717, D 1945, D 2163, and D 2650.

7. Calculation—Ideal Gas Values; Ideal Heating Value

7.1 An ideal combustion reaction in general terms for fuel and air in the ideal gas state is:

$$C_aH_bS_c\,(id) + (a + b/4 + c)O_2(id) = aCO_2(id) + (b/2)H_2O\ (id \text{ or } l) + cSO_2(id) \qquad (1)$$

where *id* denotes the ideal gas state and *l* denotes liquid phase. The ideal net heating value results when all the water remains in the ideal gas state. The ideal gross heating value results when all the water formed by the reaction condenses to liquid. For water, the reduction from $H_2O(id)$ to $H_2O(l)$ is H_w^{id}

TABLE 1 Properties of Natural Gas Components at 60°F and 14.696 psia[A]

Compound	Formula	Molar Mass, lb·lbmol⁻¹ [B]	Molar Mass, Ratio, G^{id} [C]	Ideal Gross Heating Value[D] H_n^{id}, kJ · mol⁻¹			Ideal Net Heating Value H_n^{id}, kJ · mol⁻¹			Summation Factor, b_i, psia⁻¹
				H_n^{id}, kJ · mol⁻¹	H_m^{id}, Btu · lbm⁻¹	H_v^{id}, Btu · ft⁻³	H_n^{id}, kJ · mol⁻¹	H_m^{id}, Btu · lbm⁻¹	h_v^{id}, Btu · ft⁻³	
Hydrogen	H_2	2.0159	0.069 60	286.20	6 1022	324.2	241.79	51 566	273.93	0
Helium	He	4.0026	0.138 20	0	0	0	0	0	0	0
Water	H_2O	18.0153	0.622 02	44.409	1059.8	50.312	0	0	0	0.0623
Carbon monoxide	CO	28.010	0.967 11	282.9	4342	320.5	282.9	4 342	320.5	0.0053
Nitrogen	N_2	28.0134	0.967 23	0	0	0	0	0	0	0.0044
Oxygen	O_2	31.9988	1.104 8	0	0	0	0	0	0	0.0073
Hydrogen sulfide	H_2S	34.08	1.176 7	562.4	7 094.2	637.1	517.99	6 534	586.8	0.0253
Argon	Ar	39.948	1.379 3	0	0	0	0	0	0	0.0071
Carbon dioxide	CO_2	44.010	1.519 6	0	0	0	0	0	0	0.0197
Air	[E]	28.9625	1.000 0	0	0	0	0	0	0	0.0050
Methane	CH_4	16.043	0.553 92	891.63	23 891	1010.0	802.71	21 511	909.4	0.0116
Ethane	C_2H_6	30.070	1.038 2	1562.06	22 333	1769.7	1428.83	20 429	1618.7	0.0239
Propane	C_3H_8	44.097	1.522 6	2220.99	21 653	2516.1	2043.3	19 922	2314.9	0.0344
i-Butane	C_4H_{10}	58.123	2.006 8	2870.45	21 232	3251.9	2648.4	19 590	3000.4	0.0458
n-Butane	C_4H_{10}	58.123	2.006 8	2879.63	21 300	3262.3	2657.6	19 658	3010.8	0.0478
i-Pentane	C_5H_{12}	72.150	2.491 2	3531.5	21 043	4000.9	3265.0	19 456	3699.0	0.0581
n-Pentane	C_5H_{12}	72.150	2.491 2	3535.8	21 085	4008.9	3269.3	19 481	3703.9	0.0631
n-Hexane	C_6H_{14}	86.177	2.975 5	4198.1	20 943	4755.9	3887.2	19 393	4403.9	0.0802
n-Heptane	C_7H_{16}	100.204	3.459 8	4857.2	20 839	5502.5	4501.9	19 315	5100.3	0.0944
n-Octane	C_8H_{18}	114.231	3.944 1	5515.9	20 759	6248.9	5116.2	19 256	5796.2	0.1137
n-Nonane	C_9H_{20}	128.258	4.428 4	6175.9	20 701	6996.5	5731.8	19 213	6493.6	0.1331
n-Decane	$C_{10}H_{22}$	142.285	4.912 7	6834.9	20 651	7742.9	6346.4	19 176	7189.9	0.1538
Neopentane	C_5H_{12}	72.015	2.491 2	3517.27	20 958	3985	3250.8	19 371	3683	
2-Methylpentane	C_6H_{14}	86.177	2.975 5	4190.43	20 905	4747	3879.6	19 355	4395	0.080
3-Methylpentane	C_6H_{14}	86.177	2.975 5	4193.03	20 918	4750	3882.2	19 367	4398	0.080
2,2-Dimethylbutane	C_6H_{14}	86.177	2.975 5	4180.63	20 856	4736	3869.8	19 306	4384	0.080
2,3-Dimethylbutane	C_6H_{14}	86.177	2.975 5	4188.41	20 895	4745	3877.5	19 344	4393	0.080
Cyclopropane	C_3H_6	42.081	1.452 9	2092.78	21 381	2371	1959.6	20 020	2220	. . .
Cyclobutane	C_4H_8	56.108	1.937 3	2747.08	21 049	2747	2569.4	19 688	2911	. . .
Cyclopentane	C_5H_{10}	70.134	2.421 5	3322.04	20 364	3764	3100.0	19 003	3512	. . .
Cyclohexane	C_6H_{12}	84.161	2.905 9	3955.84	20 208	4482	3689.4	18 847	4180	. . .
Ethyne (acetylene)	C_2H_2	26.038	0.899 0	1301.32	21 487	1474	1256.9	20 753	1424	0.021
Ethene (ethylene)	C_2H_4	28.054	0.968 6	1412.06	21 640	1600	1323.2	20 278	1499	0.020
Propene (propylene)	C_3H_6	42.081	1.452 9	2059.35	21 039	2333	1926.1	19 678	2182	0.033
Benzene	C_6H_6	78.114	2.697 1	3202.74	18 177	3742	3169.5	17 444	3591	0.069
Butanes (ave)	C_4H_{10}	58.123	2.006 8	2875	21 266	3257	2653	19 623	3006	0.046
Pentanes (ave)	C_5H_{12}	72.150	2.491 2	3534	21 056	4003	3267	19 469	3702	0.062
Hexanes (ave)	C_6H_{14}	86.177	2.975 5	4190	20 904	4747	3879	19 353	4395	0.080
Butenes (ave)	C_4H_8	56.108	1.937 2	2716	20 811	3077	2538	19 450	2876	0.046
Pentenes (ave)	C_5H_{10}	70.134	2.421 5	3375	20 691	3824	3153	19 328	3572	0.060

[A] This table is consistent with GPA 2145-89, but it is necessary to use the values from the most recent edition of GPA 2145 for custody transfer calculations.

[B] 1984 Atomic Weights: C = 12.011, H = 1.00794, O = 15.9994, N = 14.0067, S = 32.06.

[C] Molar mass ratio is the ratio of the molar mass of the gas to that of air.

[D] Based upon ideal reaction; the entry for water represents the total enthalpy of vaporization.

[E] Composition from: F. E. Jones, *J. Res. Nat. Bur. Stand.*, Vol. 83, 419, 1978.

– H^l_w , the ideal enthalpy of vaporization, which is somewhat larger than the enthalpy of vaporization $H^v_w - H^{l\prime}_w$.

7.1.1 Because the gross heating value results from an ideal combustion reaction, ideal gas relationships apply. The ideal gross heating value per unit mass for a mixture, H^{id}_m , is:

$$H^{id}_m = \sum_{j=1}^{n} x_j M_j H^{id}_{m,j} / \sum_{j=1}^{n} x_j M_j \tag{2}$$

where: x_j is the mole fraction of Component j, M_j *is the molar mass of Component j from Table 1, and n is the total number of components.*

7.1.2 $H^{id}_{m,j}$ is the pure component, ideal gross heating value per unit mass for Component j (at 60°F (15.6°C) in Table 1). Values of H^{id}_m are independent of pressure, but they vary with temperature.

7.2 *Ideal Gas Density*

7.2.1 The ideal gas density, ρ^{id}, is:

$$\rho^{id} = (P/RT) \sum_{j=1}^{n} x_j M_j = MP/RT \tag{3}$$

where: M is the molar mass of the mixture,

$$M = \sum_{j=1}^{n} x_j M_j \tag{4}$$

P is the base pressure in absolute units (psia), R is the gas constant, 10.7316 psia.ft³/(lb mol•°R) in this practice, based upon R = 8.314 48 J/(mol•K), T is the base temperature in absolute units (°R = °F + 459.67). Values of the ideal gas density at 60°F (15.6°C) and 14.696 psia are in GPA Standard 2145.

7.3 *Ideal Relative Density*:

7.3.1 The ideal relative density d^{id} is:

$$d^{id} = \sum_{j=1}^{n} x_j d_j = \Sigma x_j M_j / M_a = M/M_a \tag{5}$$

where: M_a is the molar mass of air. The ideal relative density is the molar mass ratio.

7.4 *Gross Heating Value per Unit Volume*:

7.4.1 Multiplication of the gross heating value per unit mass by the ideal gas density provides the gross heating value per unit volume, H^{id}_v :

$$H^{id}_v = \rho^{id} H^{id}_m = \sum_{j=1}^{n} x_j H^{id}_{v,j} \tag{6}$$

$H^{id}_{v,j}$ is the pure component gross heating value per unit volume for Component j at specified temperature and pressure (60°F (15.6°C) and 14.696 psia in Table 1, ideal gas values).

7.4.2 Conversion of values in Table 1 to different pressure bases results from multiplying by the pressure ratio:

$$H^{id}_v(P) = H^{id}_v(P = 14.696) \times P/14.696 \tag{7}$$

7.5 *Real Gas Values—Compressibility Factor*:

7.5.1 The compressibility factor is:

$$Z(T,P) = \rho^{id}/\rho = (MP/RT)/\rho \tag{8}$$

where ρ is the real gas density in mass per unit volume. At conditions near ambient, the truncated virial equation of state satisfactorily represents the volumetric behavior of natural gas:

$$Z(T,P) = 1 + BP/RT \tag{9}$$

where B is the second virial coefficient for the gas mixture. The second virial coefficient for a mixture is:

$$B = x_1^2 B_{11} + x_2^2 B_{22} + \cdots + x_n^2 B_{nn} + 2x_1x_2B_{12} + \cdots + 2x_{n-1}x_nB_{n-i,n}$$

$$= \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j B_{ij} \tag{10}$$

where B_{jj} is the second virial coefficient for Component j and B_{ij} is the second cross virial coefficient for Components i and j. The second virial coefficients are functions of temperature. Eq 9 can be used with Eq 10 for calculation of the compressibility factor for the various pressure bases, but it is not accurate at pressures greater than two atmospheres. Special treatment is not required for H_2 and He at mole fractions up to 0.01. Calculations can be made with $B_{jj} = 0$ for hydrogen and helium.

7.5.2 Eq 9 and Eq 10 for calculation of *Z(T,P)* for a gas mixture are rigorous but require considerable calculations and information that is not always available. An alternative, approximate expression for *Z(T,P)* that is more convenient for hand calculations is:

$$Z(T,P) = 1 - P[\sum_{j=1}^{n} x_j \sqrt{\beta_{jj}}]^2 \tag{11}$$

where $\beta_{jj} = B_{jj}/RT$ and $\sqrt{\beta_{jj}}$ is the summation factor for Component j. Values of $\sqrt{\beta_{jj}}$ at 60°F (15.6°C) appear in Table 2. The method based upon Eq 11 has been adopted for this practice.

7.6 *Real Gas Density*:

7.6.1 The real gas density ρ at a specific temperature and pressure is:

$$\rho = \rho^{id}/Z \tag{12}$$

where: ρ^{id} and Z are evaluated at the same temperature and pressure.

7.7 *Real Relative Density*:

7.7.1 The real relative density d is:

$$d = \rho/\rho_a = MZ_a/M_aZ \tag{13}$$

7.8 *Real Heating Value*—The real heating value is not given by division of the ideal heating value by the compressibility factor. Real gas heating values differ from the ideal gas values by less than one part in 10^4 at 14.696 psia, which is of the order of the accuracy of the heating values.

7.9 *Gross Heating Value of Water Wet Gas*:

7.9.1 If the gas contains water as a component but the compositional analysis is on a dry basis, it is necessary to adjust the mole fractions to reflect the presence of water. The corrected mole fractions are:

$$x_j(\mathrm{cor}) = x_j(1 - x_w) \tag{14}$$

The mole fraction of water can range from zero up to the saturated value. The saturated value for x_w is, assuming Raoult's Law:

$$x_w(\mathrm{sat}) = P^v_w/P \tag{15}$$

where: P^v_w is the vapor pressure of water (0.256 36 psia at 60°F (15.6°C)).

7.9.2 Technically, water has a gross heating value, the ideal enthalpy of condensation. If only the water that is formed

TABLE 2 Example Calculations of Gas Properties at 60°F and 14.696 psia (Gas Analysis on Dry Basis)[A]

NOTE—Division of Hv^{id} by Z does not give a real gas heating value but rather an ideal gas heating value per real cubic feet. Any digits carried beyond 1 part in 1000 are not significant but only allieviate roundoff error. Although CO_2 has a carbon atom, its $\alpha = 0$ because it is not part of the fuel formula $C_{\alpha}H_{\beta}S_{\gamma}$.

Compound	x_i	α_i	β_i	γ_i	Hv_i^{id}	G_i^{id}	b_i	$x\alpha_i$	$x\beta_i$	$x\gamma_i$	$x_i\,Hv_i^{id}$	$x_i\,G_i^{id}$	xb_i
Methane	0.8302	1	4	0	1010.0	0.553 92	0.0116	0.8302	3.3208	0	838.5	0.4599	0.009 63
Ethane	0.0745	2	6	0	1769.7	1.038 20	0.0239	0.1490	0.4470	0	131.8	0.0773	0.001 78
Propane	0.0439	3	8	0	2516.1	1.522 60	0.0344	0.1317	0.3512	0	110.5	0.0668	0.001 51
i-Butane	0.0083	4	10	0	3251.9	2.006 80	0.0458	0.0332	0.0830	0	27.0	0.0167	0.000 38
n-Butane	0.0108	4	10	0	3262.3	2.006 80	0.0478	0.0432	0.1080	0	35.2	0.0217	0.000 52
i-Pentane	0.0031	5	12	0	4000.9	2.491 20	0.0581	0.0155	0.0372	0	12.4	0.0077	0.000 18
n-Pentane	0.0025	5	12	0	4008.9	2.491 20	0.0631	0.0125	0.03	0	10.0	0.0062	0.000 16
Hexane	0.0030	6	14	0	4755.9	2.975 50	0.0802	0.0180	0.0420	0	14.3	0.0089	0.000 24
Helium	0.0003	0	0	0	0	0.138 20	0	0	0	0	0	0.0000	0.000 00
Nitrogen	0.0032	0	0	0	0	0.967 23	0.0044	0	0	0	0	0.0031	0.000 01
Carbon dioxide	0.0202	0	0	0	0	1.519 60	0.0197	0	0	0	0	0.0307	0.000 40
Summation	1.0000	. . .	. . .	. . .	. . .	. . .	. . .	1.2333	4.4192	0	1179.7	0.6991	0.014 81

[A] $x_w = (0.256\,36)/14.696 = 0.0174$

G^{id} (dry gas) $= 0.6991$

Z (dry gas) $= 1 - [0.014\,81]^2(14.696) = 0.9968$

Z (dry air) $= 1 - [0.0050]^2(14.696) = 0.9996$

G (dry gas, dry air) $= 0.6991(0.9996)/0.9968 = 0.7011$

G (dry gas, sat air) $= 0.6991(0.9995)/0.9968 = 0.7010$

Hv^{id} (dry gas, dry air) $= 1179.7$ Btu·ft^{-3}

Hv^{id} (sat gas, dry air) $= 1179.7(0.9826) = 1159.1$ Btu·ft^{-3}

$1 - x_w = 0.9826$

G^{id} (sat gas) $= 0.6991(0.9826) + 0.0174(0.622\,02) = 0.6978$

Z (sat gas) $= 1 - [0.9826(0.014\,81) + 0.0174(0.0623)]^2(14.696) = 0.9964$

Z (sat air) $= 1 - [0.9826(0.0050) + 0.0174(0.0623)]^2(14.696) = 0.9995$

G (sat gas, dry air) $= 0.6978(0.9996)/0.9964 = 0.7001$

G (sat gas, sat air) $= 0.6978(0.9995)/0.9964 = 0.7000$

(Hv^{id}/Z)(dry gas, dry air) $= 1179.7/0.9968 = 1183.5$ Btu·ft^{-3}

(Hv^{id}/Z) (sat gas, dry air) $= 1159.1/(0.9964) = 1163.3$ Btu·ft^{-3}

during the combustion condenses, then the heat released upon combustion of a wet gas with dry air becomes:

$$H_v^{id}\,(\text{wet gas}) = (1 - x_w)H_v^{id}\,(\text{dry gas}) \tag{16}$$

For water-saturated gas, x_w at 60° F (15.6° C) is $0.256\,36/P_b$ where P_b is the base pressure. Eq 16 is adequate for custody transfer applications as a matter of definition. However, this equation does not accurately describe the effect of water upon the heating value. Appendix X1 contains a rigorous examination of the effect of water.

7.10 *Calculation of the Ideal Energy Released as Heat*:

7.10.1 When multiplied by the gas flow rate, the ideal gross heating value provides the ideal energy released as heat upon combustion, $\dot{Q}^{id}$, an ideal gas property:

$$\dot{Q}^{id} = \dot{m}H_m^{id} \tag{17}$$

where $\dot{m}$is the mass flow rate. For an ideal gas, the mass flow rate is related to the volumetric flow rate, $\dot{V}^{id}$, by:

$$\dot{m} = \dot{V}^{id}\,\rho^{id} \tag{18}$$

and

$$\dot{Q}^{id} = \dot{V}^{id}H_v^{id} \tag{19}$$

7.10.2 The ideal gas flow rate is related to the real gas flow rate by:

$$\dot{V}^{id} = \dot{V}/Z \tag{20}$$

where $\dot{V}$ is the real gas volumetric flow rate and $Z(T,P)$ is the real gas compressibility factor at the same T and P. Hence, combining Eq 19 and Eq 20 gives:

$$\dot{Q}^{id} = H_v^{id}\,\dot{V}/Z\,(T,P) \tag{21}$$

NOTE 1—The ideal energy released per unit time as heat upon combustion, $\dot{Q}^{id}$, can be calculated using the mass flow rate (Eq 17), the ideal gas flow rate (Eq 19), or the real gas flow rate (Eq 21), but is always an ideal gas property. Division of H_v^{id} by the gas compressibility factor $Z(T,P)$ does not produce a real gas heating value but only allows calculation of $\dot{Q}^{id}$ using the real gas flow rate rather than the ideal gas flow rate.

8. Precision

8.1 The properties reported in this practice derive from experimental enthalpy of combustion measurements which, in general, are accurate to 1 part in 1000. The extra digits that appear in the accompanying tables alleviate problems associated with roundoff errors and internal consistency, but they are not significant.Table 3

8.2 The values of properties in this practice are those that appear in GPA Standard 2172-97, Fig. 23-2 of the GPSA Engineering Data Book, GPA TP-17, and the TRC Thermodynamic Tables—Hydrocarbons. GPA Standard 2145 is updated annually and the values in that standard should be used in all calculations.

NOTE 2—Three sources of error must be considered: errors in heating values of the components, errors in the calculated compressibility factor, and errors in the composition. The uncertainty (twice the standard deviation) of the ideal gas heating values for components should be 0.03 %. Such errors affect the bias and the agreement between calculated and measured heating values, but they do not affect the precision. Error in the calculated compressibility factor varies with the composition of the gas, but for natural gas, this error should be less than 0.03 % and

TABLE 3 Example Calculations of Gas Properties at 60°F and 14.696 psia (Gas Analysis on Wet Basis)^A

NOTE—Division of Hv^{id} by Z does not give a real gas heating value but rather an ideal gas heating value per real cubic feet. Any digits carried beyond 1 part in 1000 are not significant but only allieviate roundoff error. Although CO_2 has a carbon atom, its $\alpha = 0$ because it is not part of the fuel formula $C_\alpha H_\beta S_\gamma$.

Compound	x_i	α_i	β_i	γ_i	Hv_i^{id}	G_i^{id}	b_i	$x_i\alpha_i$	$x_i\beta_i$	$x_i\gamma_i$	$x_i\,Hv_i^{id}$	$x_i\,G_i^{id}$	x_ib_i
Methane	0.8157	1	4	0	1010.0	0.553 92	0.0116	0.8157	3.2629	0	823.9	0.4518	0.009 46
Ethane	0.0732	2	6	0	1769.7	1.038 20	0.0239	0.1464	0.4392	0	129.5	0.0760	0.001 75
Propane	0.0431	3	8	0	2516.1	1.522 60	0.0344	0.1294	0.3451	0	108.5	0.0657	0.001 48
i-Butane	0.0082	4	10	0	3251.9	2.006 80	0.0458	0.0326	0.0816	0	26.5	0.0164	0.000 37
n-Butane	0.0106	4	10	0	3262.3	2.006 80	0.0478	0.0424	0.1061	0	34.6	0.0213	0.000 51
i-Pentane	0.0030	5	12	0	4000.9	2.491 20	0.0581	0.0152	0.0366	0	12.2	0.0076	0.000 18
n-Pentane	0.0025	5	12	0	4008.9	2.491 20	0.0631	0.0123	0.0295	0	9.8	0.0061	0.000 15
Hexane	0.0029	6	14	0	4755.9	2.975 50	0.0802	0.0177	0.0413	0	14.0	0.0088	0.000 24
Helium	0.0003	0	0	0	0	0.138 20	0	0	0	0	0	0	0
Nitrogen	0.0031	0	0	0	0	0.967 23	0.0044	0	0	0	0	0.0030	0
Carbon dioxide	0.0198	0	0	0	0	1.519 60	0.0197	0	0	0	0	0.0302	0.000 39
Water	0.0174	0	0	0	50.3	0.622 02	0.0623	0	0	0	0.9	0.0108	0.001 09
Summation	1.0000	. . .	. . .	. . .	. . .	. . .	. . .	1.2118	4.3421	0	1160.0	0.6977	0.015 64

^{A} G^{id} (sat gas) = 0.6977

Z (sat gas) = 1 – $[0.015\,64]^2(14.696)$ = 0.9964

Z (dry air) = 1 – $[0.0050]^2(14.696)$ = 0.9996

G (sat gas, dry air) = 0.6977(0.9996)/0.9964 = 0.6999

Hv^{id} (sat gas, dry air) = 1160.0 – 0.9 = 1159.1 Btu·ft^{-3}

Z (sat air) = 1 – $[0.9826(0.050) + 0.0174(0.0623)]^2(14.696)$ = 0.9995

G (sat gas, sat air) = 0.6977(0.9995)/0.9964 = 0.6999

(Hv^{id}/Z)(sat gas, dry air) = 1159.1/(0.9964) = 1163.3 Btu·ft^{-3}

negligible compared to errors arising from uncertainty in composition. In this practice, the errors in the heating values of the components and the calculated compressibility factor, Z, are neglected. The precision of the method is related to the repeatability and reproducibility of the analysis. An example appears in .

NOTE 3—It is essential to include all components in the gas sample that appear with mole fractions greater than or equal to 0.001 in the analysis. Some routine analyses do not determine compounds such as He and H_2S, but these compounds are important to the calculations.

8.3 *Repeatability*:

8.3.1 If all the components are analyzed and the results are normalized, then the repeatability of the heating value, δH is:

$$\frac{\delta H}{H^{id}} = \sqrt{\frac{1}{(H^{id})^2}\sum_{j=1}^{n}[(H^{id} - H_j^{id})\delta x_j]^2} \tag{22}$$

8.3.2 If the results of the analysis are made to sum to 1.0 by calculating the methane mole fraction as the difference between 1.0 and the sum of the mole fractions of the other components, then

$$\frac{\delta H}{H^{id}} = \sqrt{\frac{1}{(H^{id})^2}\sum_{j=1}^{n}[H_j^{id}\delta x_j]^2} \tag{23}$$

where δx_j is the repeatability of the method of analysis for Component j. The differences between heating values calculated from successive pairs of analysis performed by the same operator using the same sample of gas and the same instrument should exceed $2\delta H$ in only 5 % of the tests when δH is taken as one standard deviation.

8.4 *Reproducibility*—The reproducibility $\delta H'$ is calculated from Eq 22 and Eq 23 using $\delta x'_j$, the reproducibility of the method of analysis for Compound j. The difference between heating values calculated from analysis obtained in different laboratories is expected to exceed $\delta H'$ for only 5 % of the analyses.

APPENDIXES

(Nonmandatory Information)

X1. EFFECT OF WATER UPON THE HEATING VALUE

X1.1 Custody transfer of natural gas uses a simple pricing equation that states that the cost of gas is the rate of energy released upon combustion multiplied by the price of gas per energy unit multiplied by the time or accounting period. The rate of energy released upon combustion is the product of the heating value of the gas and the flow rate of the gas. The flow rate of the gas requires knowledge of the compressibility factor and the relative density of the gas. All three custody transfer properties (heating value, compressibility factor, and relative density) can be calculated from the composition given pure component property tables. The equations for calculating the properties of dry natural gas are well known, but this appendix also presents an account of the effects of water contained in the gas and in the air used to burn the gas.

X1.2 The heating value of a natural gas is the absolute value of its enthalpy of combustion in an ideal combustion reaction. The heating value is, therefore, an ideal gas property that can be calculated unambiguously from tables of pure component values and it has no pressure dependence.

X1.3 An ideal combustion reaction with fuel and air in the ideal gas state and the possibility of water in the fuel and air is:

$$\begin{aligned}
&C_\alpha H_\beta S_\gamma(id) + (\alpha + \beta/4 + \gamma)(1 + \epsilon)O_2(id) \\
&+ 0.043\,83(\alpha + \beta/4 + \gamma)(1 + \epsilon)Ar\,(id) \qquad (X1.1) \\
&+ [0.001\,62(\alpha + \beta/4 + \gamma)(1 + \epsilon) + x_c/(1 - x_N - x_C)]CO_2(id) \\
&+ [3.728\,73(\alpha + \beta/4 + \gamma)(1 + \epsilon) + x_N / (1 - x_N - x_C)]N_2(id) + (n_w^g \\
&+ n_w^a)H_2O\,(id) \\
&= [\alpha + 0.001\,62(\alpha + \beta/4 + \gamma)(1 + \epsilon) + x_C/(1 - x_N - x_C)]CO_2(id) \\
&+ n_w^v H_2O\,(id) + n_w^l H_2O\,(l) + \gamma SO_2(id) \\
&+ [3.728\,73(\alpha + \beta/4 + \gamma)(1 + \epsilon) \\
&+ x_N/(1 - x_N - x_C)]N_2(id) \\
&+ 0.043\,83(\alpha + \beta/4 + \gamma)(1 + \epsilon)Ar\,(id) + (\alpha + \beta/4 + \gamma)\epsilon O_2(id)
\end{aligned}$$

where: α, β, and γ are stoichiometric coefficients, ϵ is the fraction excess air, the composition of air is assumed to be that of Table X1.1, n_w^g and the moles of water contained in the gas, n_w^a are the moles of water contained in the air, n_w^v are the moles of water contained in the product gas mixture, n_w^l are the moles of gas that actually condense, X_c is the mole fraction of CO_2 in the gas, and x_N is the mole fraction of N_2 in the gas. If air has been injected into the gas, it is assumed that the effect is accounted for in the excess fraction ϵ. Fuel gas mixtures would have non-integer values of α, β and γ.

X1.4 It is customary to define hypothetical reference states for the water formed by the reaction denoted by Eq 1 (as opposed to "spectator" water that enters the reaction carried by the gas or air). If we assume that the water formed in the reaction remains in the ideal gas state, the heating value is termed "net." If we assume that the water formed in the reaction condenses totally to the liquid state, the heating value is termed "gross." The gross heating value is greater than the net heating value by the ideal enthalpy of vaporization for water:

$$\text{heating value (gross)} - \text{heating value (net)} = H_w(id) - H_w(l) \qquad (X1.2)$$

where:

H = enthalpy,
l = liquid state, and
w = water.

The quantity $H_w\ (id) - H_w(l)$ is the ideal enthalpy of vaporization for water.

X1.5 It is possible to calculate a real gas heating value rather than using a hypothetical state, but the calculations are tedious, the numerical values are negligibly different, and the mathematical simplicity of the defining equation is lost. It is customary in the gas industry to use gross heating value for most calculations, so for the remainder of this appendix, the term "heating value" refers to the gross value.

X1.6 Eq 7 in Section 7 provides the recipe to convert the heating value from one base pressure to another. Note that when using Eq 7, H_v^{id} should be calculated using the values from Table 1 before converting the pressure; the individual values in Table 1 should not be converted. Conversion to another temperature is more complicated. Heating value data exist at 25°C based upon the reaction:

$$C_\alpha H_\beta S_\gamma(id) + (\alpha + \beta/4 + \gamma)O_2(id) = \alpha CO_2(id) + (\beta/2)H_2O\,(l) + \gamma SO_2(id) \qquad (X1.3)$$

X1.7 The experiments use pure oxygen and are corrected to stoichiometric proportions. It is necessary to correct the sensible heat effects to arrive at a different temperature:

$$Hn^{id}(T) = Hn^{id}(25) + \int_{25}^{T}[\sum_{r'} C_p^{id} - \sum_{r} C_p^{id}]dT \qquad (X1.4)$$

where:

$$\sum_{r'} C_p^{id} = \alpha C_{p,CO_2}^{id} + (\beta/2)C_{p,H_2O}^{id} + \gamma C_{p,SO_2}^{id} \qquad (X1.5)$$

$$\sum_{r} C_p^{id} = C_{p,C\alpha H_\beta S_\gamma}^{id} + (\alpha + \beta/4 + \gamma)C_{p,O_2}^{id} \qquad (X1.6)$$

and: C_p^{id} is the ideal specific heat at constant pressure, r denotes reactants and r' denotes products.

TABLE X1.1 Example Calculation of Precision

Compound	Composition, x_j	$H_v^{id} - H_{vi}^{id}$ Btu•ft^{-3}	Repeatability		Reproducibility	
			δx_j	$[(H_v^{id} - H_{vi}^{id})\delta x_j]^2$ (Btu•ft^{-3})^2	$\delta x'_j$	$[(H_v^{id} - H_{vi}^{id})\delta x'_j]^2$ (Btu•ft^{-3})^2
Methane	0.8302	169.7	0.0010	0.029	0.0020	0.115
Ethane	0.0745	–590.0	0.0002	0.014	0.0004	0.056
Propane	0.0439	–1336.4	0.0002	0.071	0.0004	0.286
Isobutane	0.0083	–2072.2	0.0001	0.043	0.0002	0.171
Butane	0.0108	–2082.6	0.0002	0.173	0.0004	0.694
Isopentane	0.0031	–2821.2	0.0001	0.080	0.0002	0.318
Pentane	0.0025	–2829.2	0.0001	0.080	0.0002	0.320
Hexane	0.0030	–3576.2	0.0001	0.128	0.0002	0.512
Helium	0.0003	1179.7	0.0001	0.014	0.0002	0.056
Nitrogen	0.0032	1179.7	0.0001	0.014	0.0002	0.056
Carbon dioxide	0.0202	1179.7	0.0002	0.056	0.0004	0.223
Total	1.0000			0.702		2.807

X2. ACCOUNTING FOR WATER

X2.1 If the gas contains water (or must be assumed to be saturated) but the compositional analysis is on a dry basis, it is necessary to adjust the mole fractions to account for the fact that water has displaced some gas, thus lowering the heating value. The mole fraction of water in the gas results from the definition of relative humidity:

$$x_w = h^g P_w^v / P = n_w / (1 + n_w) \qquad \text{(X2.1)}$$

(Based upon one mole of the fuel $C_\alpha H_\beta S_\gamma$) where h^g is the relative humidity of the gas, P_w^v is the vapor pressure of water, and n_w denotes moles of water. For saturated gas h^g is unity. Rearranging Eq X2.1 gives the moles of water:

$$n_w = x_w/(1 - x_w) \qquad \text{(X2.2)}$$

The corrected mole fractions then become:

$$x_i(\text{cor}) = x_i\left[\frac{1}{1 + n_w}\right] = x_i\left[\frac{1}{1 + x_w/(1 - x_w)}\right] = (1 - x_w)x_i \qquad \text{(X2.3)}$$

and the heating value becomes:

$$Hv^{id} = (1 - x_w)\sum_{j=1}^{N} x_j^{dry}\, Hv_j^{id} \qquad \text{(X2.4)}$$

where water is not included in the N components of the summation. If the compositional analysis determines x_w and water is included in the N components of the summation:

$$Hv^{id} = \sum_{j=1}^{N} x_j^{wet}\, Hv_j^{id} - x_w Hv_w^{id} \qquad \text{(X2.5)}$$

X2.2 It is necessary to remove the effect of water because, although water has a heating value, it is only a condensation effect. Water carried by wet gas (spectator water) does not actually condense, and only water formed in the reaction contributes to heating value.

X2.3 Accounting for water in the above manner is sufficient for defined custody transfer conditions, but when trying to model actual situations, the question becomes much more complicated. It is obvious that all of the reaction water actually cannot condense because in a situation in which both gas and air are dry some of the reaction water saturates the product gases and the remainder condenses. It is possible to account for these effects in a general manner. To do so, it is necessary to calculate n_w^g, n_w^a, n_w^v, and n_w^l.

$$n_w^g/[1 + (x_N + x_C)/(1 - x_N - x_C) + n_w^g] = h^g P_w^v/P \qquad \text{(X2.6)}$$

$$n_w^g = (h^g P_w^v/P)/[(1 - x_N - x_C)(1 - h^g P_w^v/P)$$

$$n_w^a/[4.774\,18(\alpha + \beta/4 + \gamma)(1 + \epsilon) + n_w^a] = h^a P_w^v/P \qquad \text{(X2.7)}$$

$$n_w^a = 4.774\,18(\alpha + \beta/4 + \gamma)(1 + \epsilon)(h^a P_w^v/P)/(1 - h^a P_w^v/P)$$

$$n_w^v / \{\alpha + \gamma + (x_N + x_C)/(1 - x_N - x_C) + (\alpha + \beta/4 + \gamma)[0.001\,62(1 + \epsilon) \qquad \text{(X2.8)}$$

$$+3.728\,73(1 + \epsilon) + 0.043\,83(1 + \epsilon) + \epsilon] + n_w^v\} = P_w^v/P$$

$$n_w^v = \{\alpha + \gamma + (x_N + x_C)/(1 - x_N - x_C) + (\alpha + \beta/4 + \gamma)[0.001\,62(1 + \epsilon)$$

$$+3.728\,73(1 + \epsilon) + 0.043\,83(1 + \epsilon) + \epsilon]\}(P_w^v/P)/(1 - P_w^v/P)$$

$$n_w^l = \beta/2 + n_w^g + n_w^a - n_w^v \qquad \text{(X2.9)}$$

where: h_a is the relative humidity of the air. Eq X2.6 and Eq X2.7 are reformulations of Eq X2.1 to reflect inlet conditions. Eq X2.8 reflects Eq X2.1 for the saturated product gas (it must be saturated before any water can condense). Eq X2.9 is a water balance: $\beta/2$ are the moles of water formed by the reaction, $n_w^g + n_w^a$ are the moles of water that enter with the gas and air, n_w^v are the moles of water that saturate the product gas, and n_w^l are the moles of water that condense. Therefore, the complete correction for the effect of water on heating value is:

$$H_v^{id} = H_v^{id}\,(\text{Eq X2.4 or Eq X2.5}) + (h^g P_w^v/P)/(1 - x_n - x_c)(1 - h^g P_w^v/P) \qquad \text{(X2.10)}$$

$$+ 4.774\,18(\alpha + \beta/4 + \gamma)(1 + \epsilon)(h^a P_w^v/P)/(1 - h^a P_w^v/P) - [\alpha + \gamma + (x_n - x_c)$$

$$(1 - x_n - x_c) + (\alpha + \beta/4 + \gamma)(3.774\,18 + 4.774\,18\,\epsilon)]$$

$$\times (P_w^v/P)/(1 - P_w^v)\}H_w^{id}]$$

X2.4 Depending upon the relative humidities of the gas and air, the observed heating value can be greater or smaller than that calculated using Eq X2.4 or Eq X2.5. A humidity of air exists for each gas above which Hv^{id} is greater than that calculated by Eq X2.4 or Eq X2.5. That critical value depends upon the gas composition, the humidity of the gas, and the amount of excess air. For pure, dry methane with no excess air, $h_a = 0.793\,45$.

X3. REAL GAS PROPERTIES

X3.1 In principal, we have enough information to convert the heating value to a real gas property (it is not necessary to do so for relative density because the molar mass ratio, G^{id}, is the desired property). This is simply a matter of evaluating the integral:

$$Hn - Hn^{id} = \int_{0}^{P} \left\{ \left[\left(\frac{\partial H}{\partial P} \right)_{T} \right]_{p} - \left[\left(\frac{\partial H}{\partial P} \right)_{T} \right]_{r} \right\} dP \qquad \text{(X3.1)}$$

where:

$$\left(\frac{\partial H}{\partial V} \right)_{T} = V - T \left(\frac{\partial V}{\partial T} \right)_{P} = B - T \frac{dB}{dT} = 2\, RT^{2} b \frac{dB}{dT} \qquad \text{(X3.2)}$$

where V is the molar volume. The temperature dependence of b must be defined, but in the custody transfer region it is easy to do so. The products and reactants again correspond to Eq X1.3.

X3.2 While it is obviously possible to make the required calculations to convert the heating value into a real gas property, it serves no custody transfer purpose to do so. As we have seen, the cost equation is unchanged; the calculations while obvious are tedious. Hv is slightly different from Hv^{id} because the base pressure is low; the likelihood of having all the information required to use Eq X3.1 is remote. The heating value is defined in a hypothetical state. It is not possible, at base conditions, to have all the water formed in the reaction be either all gas or all liquid; some of the water formed is in each state. Thus, if the definition is of a hypothetical state, using a hypothetical real gas rather than an ideal gas state adds nothing but complexity.

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APPENDIX B - Computer Printout of Results

Facility: Simi Valley Landfill
Source: Zink Flare
Job No.: W07-056
Test Date: 01/14/08

CARB Methods 1-4 Flowrate Determination

	STD TEMP:	68		
		RUN	RUN	RUN
RUN NUMBER	******	1	2	3
DATE OF RUN	******	01/14/08	01/14/08	01/14/08
CLOCK TIME: INITIAL	******	930	1156	1328
CLOCK TIME: FINAL	******	1045	1304	1440
AVG. STACK TEMPERATURE	Degrees F	1571	1570	1570
AVG. SQUARE DELTA P	Inches H20	0.1319	0.1327	0.1280
BAROMETRIC PRESSURE	Inches HG	29.27	29.27	29.27
SAMPLING TIME	Minutes	60	60	60
SAMPLE VOLUME	Cubic Feet	45.997	44.353	45.885
AVG. METER TEMP.	Degrees F	77	76	78
AVG. DELTA H	Inches H20	1.80	1.80	1.80
DGM CALIB. FACTOR [Y]	******	0.9850	0.9850	0.9850
WATER COLLECTED	Milliliters	75	79	77
CO 2	Percent	7.1	7.3	7.4
O 2	Percent	12.9	12.8	13.0
CO	Percent	0.0	0.0	0.0
CH4	Percent	0.0	0.0	0.0
N 2	Percent	80.0	79.9	79.7
STACK AREA	Square Inches	12868.0	12868.0	12868.0
STATIC PRESSURE	Inches WG	-0.030	-0.040	-0.040
PITOT COEFFICIENT	******	0.84	0.84	0.84
SAMPLE VOLUME DRY	DSCF	43.77	42.31	43.60
WATER AT STD.	SCF	3.5	3.7	3.6
MOISTURE	Percent	7.5	8.1	7.7
MOLE FRACTION DRY GAS	******	0.93	0.92	0.92
MOLECULAR WT.DRY	lb/lb Mole	29.65	29.68	29.70
EXCESS AIR	Percent	158	154	161
MOLECULAR WT. WET	lb/lb Mole	28.78	28.73	28.80
STACK GAS PRESSURE	Inches HG	29.27	29.27	29.27
STACK VELOCITY	AFPM	882	888	856
VOLUMETRIC FLOWRATE, DRY STD.	DSCFM	18559	18566	17964
VOLUMETRIC FLOWRATE, ACTUAL	ACFM	78858	79396	76501

SCAQMD Method 307.91

Facility: Simi Valley Landfill
Source: Zink Flare Inlet
Job No.: W07-056
Date: 01/14/08

Run 1

Sulfur Compounds

Speciated Compound		Concentration ppm, as H2S	No. of S molecules in Compound	Total S ppm, as H2S	SO2 Conc. mg/dscf	Avg. Inlet Flow Rate dscfm	SO2 Rate lb/hr
Hydrogen Sulfide		46.60	1	46.60	3.52	1594	0.742
Carbonyl Sulfide		0.30	1	0.30	0.02	1594	0.005
Methyl mercaptan		4.82	1	4.82	0.36	1594	0.077
Ethyl mercaptan	<	0.20	1		0.00	1594	0.000
Dimethyl sulfide		11.50	1	11.50	0.87	1594	0.183
Carbon disulfide	<	0.20	2		0.00	1594	0.000
Dimethyl disulfide	<	0.20	2		0.00	1594	0.000
iso-propyl mercaptan		0.48	1	0.48	0.04	1594	0.008
n-propyl mercaptan	<	0.20	1		0.00	1594	0.000
Total				63.70			1.014

Run 2 Zink

Sulfur Compounds

Speciated Compound		Concentration ppm, as H2S	No. of S molecules in Compound	Total S ppm, as H2S	SO2 Conc. mg/dscf	Avg. Inlet Flow Rate dscfm	SO2 Rate lb/hr
Hydrogen Sulfide		46.00	1	46.00	3.47	1610	0.739
Carbonyl Sulfide		0.32	1	0.32	0.02	1610	0.005
Methyl mercaptan		6.67	1	6.67	0.50	1610	0.107
Ethyl mercaptan	<	0.20	1		0.00	1610	0.000
Dimethyl sulfide		11.50	1	11.50	0.87	1610	0.185
Carbon disulfide	<	0.20	2		0.00	1610	0.000
Dimethyl disulfide	<	0.20	2		0.00	1610	0.000
iso-propyl mercaptan		0.65	1	0.65	0.05	1610	0.010
n-propyl mercaptan	<	0.20	1		0.00	1610	0.000
Total				65.14			1.047

Run 3 Zink

Sulfur Compounds

Speciated Compound		Concentration ppm, as H2S	No. of S molecules in Compound	Total S ppm, as H2S	SO2 Conc. mg/dscf	Avg. Inlet Flow Rate dscfm	SO2 Rate lb/hr
Hydrogen Sulfide		49.30	1	49.30	3.72	1643	0.809
Carbonyl Sulfide		0.32	1	0.32	0.02	1643	0.005
Methyl mercaptan		4.90	1	4.90	0.37	1643	0.080
Ethyl mercaptan	<	0.20	1		0.00	1643	0.000
Dimethyl sulfide		11.70	1	11.70	0.88	1643	0.192
Carbon disulfide	<	0.20	2		0.00	1643	0.000
Dimethyl disulfide	<	0.20	2		0.00	1643	0.000
iso-propyl mercaptan		0.48	1	0.48	0.04	1643	0.008
n-propyl mercaptan	<	0.20	1		0.00	1643	0.000
Total				66.70			1.094

EXPANSION AND F-FACTOR CALC. METHOD

Client:	Simi Valley Landfill	Date:	1/14/2008
Location:	Simi Valley, CA	Job #:	W07-056
Unit:	Flare John Zink	Run#:	1

Fuel temperature		deg F	Std. Temp.	68	
Fuel Pressure		psi			
Fuel Flow Rate		cfm	Fuel Flow	1594	scfm
Exhaust Outlet O2	12.94	%			
Barometric Pressure					

COMPONENTS		**MOLE %**	**HHV btu/ft3**	**LLV btu/ft3**	**Exp Factor dscf/scf fuel**
Oxygen		**1.12**			0.011
Nitrogen		**14.44**			0.144
Carbon Dioxide		**37.04**			0.370
Methane		**46.88**	473.49	426.33	4.018
Ethane	C2	**0.51**	9.03	8.26	0.078
Propane	C3	**0**	0.00	0.00	0.000
Iso-Butane	C4	**0**	0.00	0.00	0.000
N-Butane		**0**	0.00	0.00	0.000
Iso-Pentane	C5	**0**	0.00	0.00	0.000
N-Pentane		**0**	0.00	0.00	0.000
Hexane	C6	**0**	0.00	0.00	0.000
Heptane	C7	**0**	0.00	0.00	0.000
Octane	C8	**0**	0.00	0.00	0.000
Nonane	C9	**0**	0.00	0.00	
Total		**100.0**	**482.51**	**434.58**	**4.62**

CALCULATIONS

EXHAUST FLOW RATE, Q = (scfm*Exp Fac)*(20.92(20.92-%O2)

19308.4 DSCFM

F - FACTOR **9569 scf/MMBtu**

EXPANSION AND F-FACTOR CALC. METHOD

Client:	Simi Valley Landfill	Date:	1/14/2008
Location:	Simi Valley, CA	Job #:	W07-056
Unit:	Flare John Zink	Run#:	2

Fuel temperature		deg F	Std. Temp.	68	
Fuel Pressure		psi			
Fuel Flow Rate		cfm	Fuel Flow	1610	scfm
Exhaust Outlet O2	12.78	%			
Barometric Pressure					

COMPONENTS		MOLE %	HHV btu/ft3	LLV btu/ft3	Exp Factor dscf/scf fuel
Oxygen		1.12			0.011
Nitrogen		14.44			0.144
Carbon Dioxide		37.04			0.370
Methane		46.88	473.49	426.33	4.018
Ethane	C2	0.51	9.03	8.26	0.078
Propane	C3	0	0.00	0.00	0.000
Iso-Butane	C4	0	0.00	0.00	0.000
N-Butane		0	0.00	0.00	0.000
Iso-Pentane	C5	0	0.00	0.00	0.000
N-Pentane		0	0.00	0.00	0.000
Hexane	C6	0	0.00	0.00	0.000
Heptane	C7	0	0.00	0.00	0.000
Octane	C8	0	0.00	0.00	0.000
Nonane	C9	0	0.00	0.00	
Total		**100.0**	**482.51**	**434.58**	**4.62**

CALCULATIONS

EXHAUST FLOW RATE, Q = (scfm*Exp Fac)*(20.92(20.92-%O2)

19110.5 DSCFM

F - FACTOR 9576 scf/MMBtu

EXPANSION AND F-FACTOR CALC. METHOD

Client:	Simi Valley Landfill	Date:	1/14/2008
Location:	Simi Valley, CA	Job #:	W07-056
Unit:	Flare John Zink	Run#:	3

Fuel temperature		deg F	Std. Temp.	68	
Fuel Pressure		psi			
Fuel Flow Rate		cfm	Fuel Flow	1643	scfm
Exhaust Outlet O2	12.97	%			
Barometric Pressure					

COMPONENTS		MOLE %	HHV btu/ft3	LLV btu/ft3	Exp Factor dscf/scf fuel
Oxygen		1.12			0.011
Nitrogen		14.44			0.144
Carbon Dioxide		37.04			0.370
Methane		46.88	473.49	426.33	4.018
Ethane	C2	0.51	9.03	8.26	0.078
Propane	C3	0	0.00	0.00	0.000
Iso-Butane	C4	0	0.00	0.00	0.000
N-Butane		0	0.00	0.00	0.000
Iso-Pentane	C5	0	0.00	0.00	0.000
N-Pentane		0	0.00	0.00	0.000
Hexane	C6	0	0.00	0.00	0.000
Heptane	C7	0	0.00	0.00	0.000
Octane	C8	0	0.00	0.00	0.000
Nonane	C9	0	0.00	0.00	
Total		**100.0**	**482.51**	**434.58**	**4.62**

CALCULATIONS

EXHAUST FLOW RATE, Q = (scfm*Exp Fac)*(20.92(20.92-%O2)

19988.7 DSCFM

F - FACTOR **9563 scf/MMBtu**

Facility:	**Simi Valley Landfill**	**Run No.:**	**1**
Source:	**Flare John Zink**	**Fuel:**	**LFG**
Job No.:	**W07-056**	**Std. O2:**	**3**
Date:	**01/14/08**		

	O2 %	CO2 %	NOx ppm	CO ppm
Range:	25	15	25	100
Span:	12.02	7.00	12.50	50.90
Low:				
High:	20.05	11.97	23.70	79.60

** POST-TEST DRIFT (DIRECT)**

Values				
Zero:	0.05	0.03	-0.05	0.00
Span:	12.03	6.98	12.53	50.00

Percent Drift				
Zero:	0.20	0.20	-0.20	0.00
Span:	0.02	-0.15	0.12	-0.90

** PRE-TEST BIAS **

Values				
Zero:	0.12	0.08	0.08	0.00
Span:	11.95	6.93	12.48	50.20

** POST-TEST BIAS **

Values				
Zero:	0.08	0.11	0.10	0.00
Span:	12.50	6.95	12.53	50.00

** BIAS CORRECTION **

Zero Average	0.10	0.09	0.09	0.00
Span Average	12.23	6.94	12.51	50.10

** POST-TEST DRIFT (BIAS)**

Percent Drift				
Zero:	0.18	-0.20	-0.10	0.00
Span:	-2.20	-0.13	-0.20	0.20

Bias-Corrected Concentration	**12.94**	**7.09**	**11.85**	**0.44**
Bias-Corrected Conc.(O2 adjusted)			**26.65**	**1.00**

** RAW AVERAGE CONCENTRATION **

Average:		13.15	7.03	11.86	0.44
O2 adjust:	3.0			27.40	1.01
Date	Time	O2	CO2	NOx	CO
14-Jan-08	930	13.21	6.91	11.48	0.10
14-Jan-08	931	13.24	6.93	11.52	0.10
14-Jan-08	932	13.49	6.67	11.15	0.10
14-Jan-08	933	13.33	6.86	11.50	0.10
14-Jan-08	934	13.31	6.85	11.52	0.10
14-Jan-08	935	13.42	6.75	11.27	0.10
14-Jan-08	936	13.26	6.90	11.45	0.10
14-Jan-08	937	13.25	6.93	11.60	0.10
14-Jan-08	938	13.38	6.80	11.50	0.10
14-Jan-08	939	13.13	7.05	11.65	0.10

14-Jan-08	940	13.21	6.97	11.60	0.10	
14-Jan-08	941	13.29	6.86	11.57	0.10	
14-Jan-08	942	13.23	6.96	11.70	0.10	
14-Jan-08	943	12.76	7.39	12.56	0.10	
14-Jan-08	944	13.26	6.89	11.63	0.10	
14-Jan-08	945	13.05	7.11	11.91	0.10	
14-Jan-08	946	13.24	6.93	11.84	0.10	
14-Jan-08	947	13.29	6.91	11.81	0.10	
14-Jan-08	948	13.52	6.67	11.21	0.10	
14-Jan-08	949	13.32	6.88	11.89	0.10	
14-Jan-08	950	13.37	6.86	11.72	0.10	
14-Jan-08	951	13.07	7.07	12.30	0.10	
14-Jan-08	952	13.17	7.03	12.56	0.10	
14-Jan-08	953	13.06	7.11	12.64	0.10	
14-Jan-08	954	13.14	7.04	12.60	0.10	
14-Jan-08	955	13.03	7.16	12.78	0.10	
14-Jan-08	956	12.90	7.24	13.15	0.10	
14-Jan-08	957	12.76	7.39	13.70	0.10	
14-Jan-08	958	12.86	7.31	13.40	0.10	
14-Jan-08	959	12.87	7.23	13.10	0.10	
14-Jan-08						Port Change
14-Jan-08	1015	13.36	6.73	11.34	1.79	
14-Jan-08	1016	13.25	6.96	11.53	2.36	
14-Jan-08	1017	13.34	6.88	11.43	0.93	
14-Jan-08	1018	13.16	7.05	11.89	0.58	
14-Jan-08	1019	12.81	7.27	12.37	1.67	
14-Jan-08	1020	13.47	6.70	10.60	0.99	
14-Jan-08	1021	13.56	6.65	10.43	0.95	
14-Jan-08	1022	13.47	6.73	10.62	0.95	
14-Jan-08	1023	13.56	6.68	10.37	1.05	
14-Jan-08	1024	13.59	6.67	10.32	1.72	
14-Jan-08	1025	13.18	7.03	11.17	0.56	
14-Jan-08	1026	13.37	6.79	10.77	0.88	
14-Jan-08	1027	13.55	6.68	10.45	0.91	
14-Jan-08	1028	13.40	6.82	10.48	0.94	
14-Jan-08	1029	13.08	7.10	11.29	1.10	
14-Jan-08	1030	13.21	6.96	11.09	1.47	
14-Jan-08	1031	13.35	6.85	10.46	1.12	
14-Jan-08	1032	13.18	7.04	11.00	0.81	
14-Jan-08	1033	13.05	7.10	11.21	1.10	
14-Jan-08	1034	13.24	6.97	10.79	0.51	
14-Jan-08	1035	12.93	7.34	12.12	0.33	
14-Jan-08	1036	12.62	7.48	13.06	0.10	
14-Jan-08	1037	12.60	7.59	13.54	0.10	
14-Jan-08	1038	12.79	7.39	13.09	0.10	
14-Jan-08	1039	12.88	7.28	12.94	0.10	
14-Jan-08	1040	12.77	7.39	13.19	0.10	
14-Jan-08	1041	12.64	7.54	13.65	0.10	
14-Jan-08	1042	12.82	7.30	13.16	0.10	
14-Jan-08	1043	13.05	7.15	12.44	0.10	
14-Jan-08	1044	12.97	7.29	12.64	0.10	
14-Jan-08	1045	12.60	7.50	13.86	0.10	

Facility:	**Simi Valley Landfill**	**Run No.:**	**2**
Source:	**Flare John Zink**	**Fuel:**	**LFG**
Job No.:	**W07-056**	**Std. O2:**	**3**
Date:	**01/14/08**		

	O2 %	CO2 %	NOx ppm	CO ppm
Range:	25	15	25	100
Span:	12.02	7.00	12.50	50.90
Low:				
High:	20.05	11.97	23.70	79.60

** POST-TEST DRIFT (DIRECT)**

Values				
Zero:	0.05	0.03	-0.08	0.00
Span:	12.00	6.98	12.48	50.50

Percent Drift				
Zero:	0.20	0.20	-0.30	0.00
Span:	-0.08	-0.13	-0.08	-0.40

** PRE-TEST BIAS **

Values				
Zero:	0.08	0.11	0.10	0.00
Span:	12.50	6.95	12.53	50.00

** POST-TEST BIAS **

Values				
Zero:	0.10	0.03	0.13	0.00
Span:	12.00	6.90	12.53	50.20

** BIAS CORRECTION **

Zero Average	0.09	0.07	0.11	0.00
Span Average	12.25	6.93	12.53	50.10

** POST-TEST DRIFT (BIAS)**

Percent Drift				
Zero:	-0.10	0.50	-0.10	0.00
Span:	2.00	0.33	0.00	-0.20

Bias-Corrected Concentration	**12.78**	**7.28**	**11.38**	**2.28**
Bias-Corrected Conc.(O2 adjusted)			**25.06**	**5.02**

** RAW AVERAGE CONCENTRATION **

Average:		13.01	7.20	11.41	2.24
O2 adjust:	3.0			25.91	5.10
Date	Time	O2	CO2	NOx	CO
14-Jan-08	1156	13.12	7.05	11.14	2.42
14-Jan-08	1157	13.40	6.84	10.97	2.70
14-Jan-08	1158	13.11	7.12	11.54	1.92
14-Jan-08	1159	13.00	7.28	11.93	1.19
14-Jan-08	1200	13.07	7.19	11.47	1.32
14-Jan-08	1201	12.60	7.56	11.96	1.36
14-Jan-08	1202	12.75	7.46	11.80	1.97
14-Jan-08	1203	12.90	7.30	11.43	1.97
14-Jan-08	1204	12.82	7.35	11.56	1.89
14-Jan-08	1205	13.35	6.88	10.26	4.72

14-Jan-08	1206	13.35	6.93	10.46	19.29	
14-Jan-08	1207	13.37	6.91	10.45	2.65	
14-Jan-08	1208	13.08	7.24	11.16	1.40	
14-Jan-08	1209	12.98	7.19	11.73	1.65	
14-Jan-08	1210	12.95	7.23	11.76	1.79	
14-Jan-08	1211	13.02	7.22	11.41	1.81	
14-Jan-08	1212	12.98	7.28	11.34	1.87	
14-Jan-08	1213	12.94	7.22	11.24	1.92	
14-Jan-08	1214	13.24	7.01	10.83	1.84	
14-Jan-08	1215	13.20	7.07	10.90	1.49	
14-Jan-08	1216	13.10	7.13	11.05	1.51	
14-Jan-08	1217	12.96	7.21	11.24	1.59	
14-Jan-08	1218	13.28	6.96	10.76	1.40	
14-Jan-08	1219	12.98	7.29	11.46	1.48	
14-Jan-08	1220	13.09	7.13	11.06	1.19	
14-Jan-08	1221	13.00	7.17	11.29	1.45	
14-Jan-08	1222	13.57	6.75	10.40	8.07	
14-Jan-08	1223	13.22	7.02	10.95	1.35	
14-Jan-08	1224	13.01	7.28	11.52	1.36	
14-Jan-08	1225	12.55	7.60	12.27	1.40	
14-Jan-08						Port Change
14-Jan-08	1232	12.96	7.16	11.55	1.44	
14-Jan-08	1233	13.30	7.02	11.19	1.34	
14-Jan-08	1234	13.00	7.15	11.66	1.09	
14-Jan-08	1235	13.67	6.68	10.42	6.27	
14-Jan-08	1236	13.09	7.12	11.36	2.18	
14-Jan-08	1237	12.88	7.36	11.72	1.05	
14-Jan-08	1238	13.02	7.24	11.12	3.88	
14-Jan-08	1239	12.61	7.49	12.10	4.42	
14-Jan-08	1240	13.02	7.17	11.60	4.37	
14-Jan-08	1241	13.01	7.29	11.78	2.81	
14-Jan-08	1242	13.00	7.16	11.41	2.26	
14-Jan-08	1243	13.10	7.06	11.11	2.64	
14-Jan-08	1244	13.08	7.16	11.32	3.78	
14-Jan-08	1245	12.99	7.27	11.54	3.00	
14-Jan-08	1246	13.09	7.12	11.25	2.87	
14-Jan-08	1247	12.80	7.38	11.82	2.09	
14-Jan-08	1248	13.39	6.85	10.68	2.71	
14-Jan-08	1249	13.01	7.20	11.50	1.76	
14-Jan-08	1250	12.79	7.41	11.90	0.91	
14-Jan-08	1251	12.56	7.62	12.29	0.77	
14-Jan-08	1252	12.87	7.29	11.70	0.58	
14-Jan-08	1253	13.02	7.20	11.44	0.73	
14-Jan-08	1254	13.03	7.17	11.40	0.60	
14-Jan-08	1255	12.93	7.30	11.75	0.48	
14-Jan-08	1256	12.71	7.48	12.04	0.46	
14-Jan-08	1257	12.90	7.23	11.59	0.47	
14-Jan-08	1258	12.97	7.25	11.61	0.22	
14-Jan-08	1259	12.66	7.53	12.22	0.40	
14-Jan-08	1300	12.89	7.26	11.84	0.48	
14-Jan-08	1301	12.51	7.69	12.62	0.68	

Facility:	**Simi Valley Landfill**	**Run No.:**	**3**
Source:	**Flare John Zink**	**Fuel:**	**LFG**
Job No.:	**W07-056**	**Std. O2:**	**3**
Date:	**01/14/08**		

	O2 %	CO2 %	NOx ppm	CO ppm
Range:	25	15	25	100
Span:	12.02	7.00	12.50	50.90
Low:				
High:	20.05	11.97	23.70	79.60
	** POST-TEST DRIFT (DIRECT)**			
Values				
Zero:	0.00	0.03	0.10	0.00
Span:	12.00	7.01	12.60	50.30
Percent Drift				
Zero:	0.00	0.20	0.40	0.00
Span:	-0.08	0.07	0.40	-0.60
	** PRE-TEST BIAS **			
Values				
Zero:	0.10	0.03	0.13	0.00
Span:	12.00	6.90	12.53	50.20
	** POST-TEST BIAS **			
Values				
Zero:	0.18	0.06	0.03	0.20
Span:	12.00	6.90	12.60	50.10
	** BIAS CORRECTION **			
Zero Average	0.14	0.05	0.08	0.10
Span Average	12.00	6.90	12.57	50.15
	** POST-TEST DRIFT (BIAS)**			
Percent Drift				
Zero:	-0.30	-0.20	0.40	-0.20
Span:	0.00	0.00	-0.28	0.10
Bias-Corrected Concentration	**12.97**	**7.37**	**10.96**	**0.37**
Bias-Corrected Conc.(O2 adjusted)			**24.76**	**0.82**

** RAW AVERAGE CONCENTRATION **

Average:		12.94	7.26	11.03	0.46
O2 adjust:	3.0			24.80	1.03
Date	Time	O2	CO2	NOx	CO
14-Jan-08	1328	12.62	7.42	11.45	0.10
14-Jan-08	1329	12.97	7.17	11.08	0.10
14-Jan-08	1330	13.00	7.19	11.00	0.10

14-Jan-08	1331	13.10	7.07	10.83	0.10	
14-Jan-08	1332	13.15	7.06	10.71	1.41	
14-Jan-08	1333	12.82	7.40	11.49	0.10	
14-Jan-08	1334	13.11	7.03	10.77	0.10	
14-Jan-08	1335	12.83	7.39	11.65	0.10	
14-Jan-08	1336	12.39	7.71	12.20	0.10	
14-Jan-08	1337	12.69	7.48	11.76	0.10	
14-Jan-08	1338	12.71	7.41	11.54	0.10	
14-Jan-08	1339	12.84	7.33	11.32	0.10	
14-Jan-08	1340	12.94	7.26	11.07	0.10	
14-Jan-08	1341	13.16	7.02	10.34	0.98	
14-Jan-08	1342	13.21	7.06	10.50	11.14	
14-Jan-08	1343	12.82	7.33	11.00	1.00	
14-Jan-08	1344	13.06	7.11	10.67	1.11	
14-Jan-08	1345	12.66	7.54	11.36	0.46	
14-Jan-08	1346	12.92	7.23	10.94	0.10	
14-Jan-08	1347	12.51	7.72	11.72	0.10	
14-Jan-08	1348	12.58	7.54	11.44	0.09	
14-Jan-08	1349	12.96	7.22	11.00	0.25	
14-Jan-08	1350	12.81	7.39	11.24	0.10	
14-Jan-08	1351	12.98	7.17	10.78	0.17	
14-Jan-08	1352	13.33	6.93	10.27	1.25	
14-Jan-08	1353	12.84	7.31	11.03	0.23	
14-Jan-08	1354	13.18	7.04	10.66	0.15	
14-Jan-08	1355	12.66	7.54	11.50	0.10	
14-Jan-08	1356	12.60	7.53	11.44	0.10	
14-Jan-08	1357	12.76	7.49	11.41	0.03	
14-Jan-08						Port Change
14-Jan-08	1406	12.87	7.34	11.29	0.21	
14-Jan-08	1407	12.88	7.36	11.20	0.03	
14-Jan-08	1408	13.00	7.19	10.90	0.10	
14-Jan-08	1409	12.91	7.21	11.09	0.10	
14-Jan-08	1410	13.35	6.94	10.36	1.92	
14-Jan-08	1411	13.00	7.19	10.90	0.10	
14-Jan-08	1412	13.03	7.21	10.97	0.10	
14-Jan-08	1413	12.56	7.60	11.78	0.10	
14-Jan-08	1414	12.90	7.33	11.27	0.10	
14-Jan-08	1415	12.83	7.35	11.28	0.10	
14-Jan-08	1416	13.06	7.16	10.90	0.10	
14-Jan-08	1417	12.82	7.38	11.26	0.10	
14-Jan-08	1418	13.07	7.17	10.79	0.10	
14-Jan-08	1419	13.18	7.05	10.68	0.10	
14-Jan-08	1420	13.12	7.09	10.81	0.10	
14-Jan-08	1421	13.11	7.12	10.69	0.10	
14-Jan-08	1422	12.83	7.41	10.95	0.10	
14-Jan-08	1423	13.31	6.97	10.44	0.10	
14-Jan-08	1424	12.83	7.36	11.19	0.10	
14-Jan-08	1425	12.90	7.33	11.14	0.10	
14-Jan-08	1426	13.20	7.04	10.55	0.10	
14-Jan-08	1427	12.91	7.34	11.24	0.10	
14-Jan-08	1428	12.89	7.30	11.16	0.10	
14-Jan-08	1429	12.83	7.44	11.31	0.10	

14-Jan-08	1430	12.94	7.25	11.01	0.04
14-Jan-08	1431	12.93	7.27	11.13	0.02
14-Jan-08	1432	13.19	7.03	10.46	0.10
14-Jan-08	1433	13.55	6.74	9.83	1.31
14-Jan-08	1434	13.22	7.06	10.23	1.74
14-Jan-08	1435	13.00	7.22	10.80	0.10

Method 100.1 Performance Data

Facility: **Simi Valley Landfill**
Source: **Flare John Zink**
Job No.: **W07-056**
Date: **01/14/08**

PRETEST	**CALIBRATION ERROR**			
LEAK CHECK				
RANGE :	25	15	25	100
	O2	CO2	NOx	CO
ZERO				
Instrument	0.00	0.00	0.00	0.00
Cylinder	0.00	0.00	0.00	0.00
Difference (%)	0.00	0.00	0.00	0.00
LOW LEVEL				
Instrument				
Cylinder				
Difference (%)				
MID LEVEL				
Instrument	12.00	6.98	12.48	50.60
Cylinder	12.02	7.00	12.50	50.90
Difference (%)	-0.08	-0.13	-0.08	-0.30
HIGH LEVEL				
Instrument	19.95	11.90	23.75	79.80
Cylinder	20.05	11.97	23.70	79.60
Difference (%)	-0.40	-0.50	0.20	0.20

PRETEST	**LINEARITY**	
	Cylinder	Instrument
	O2	
Zero	0.00	0.00
High Level	20.05	19.95
Slope	1.01	
Intercept	0.00	Status
Predicted Value	11.96	<1
Linearity (%)	0.16	PASS
	CO2	
Zero	0.00	0.00
High Level	11.97	11.90
Slope	1.01	
Intercept	0.00	Status
Predicted Value	6.96	<1
Linearity (%)	0.16	PASS
	NOx	
Zero	0.00	0.00
High Level	23.70	23.75
Slope	1.00	
Intercept	0.00	Status
Predicted Value	12.53	<1
Linearity (%)	-0.19	PASS
	CO	
Zero	0.00	0.00
High Level	79.60	79.80
Slope	1.00	
Intercept	0.00	Status
Predicted Value	51.03	<1
Linearity (%)	-0.43	PASS

SYSTEM RESPONSE TIME			
	#1	#2	#3
Upscale			
CO	53	57	57
NOx	28	28	24
O2	23	23	23
CO2	21	22	22
Downscale			
CO	56	54	54
NOx	26	26	26
O2	25	21	25
CO2	23	21	20

NO2 CONVERTER EFFICIENCY			
	ppm	%	status
Cylinder(C0)	17.90		
NO Mode(C1)	0.53		
NOx Mode(C2)	17.00		
D1	17.37		
D2	16.47		
D3	0.90		
CE		94.82	
CE > 90 %			PASS
D3 <1.0 ppm	0.90		PASS

POST TEST	**CALIBRATION ERROR**			
LEAK CHECK				
	O2	CO2	NOx	CO
ZERO				
Instrument	0.00	0.03	0.10	0.00
Cylinder	0.00	0.00	0.00	0.00
Difference (%)	0.00	0.20	0.40	0.00
LOW LEVEL				
Instrument				
Cylinder				
Difference (%)				
MID LEVEL				
Instrument	12.00	7.01	12.60	50.30
Cylinder	12.02	7.00	12.50	50.90
Difference (%)	-0.08	0.07	0.40	-0.60
HIGH LEVEL				
Instrument	20.00	11.93	23.70	79.80
Cylinder	20.05	11.97	23.70	79.60
Difference (%)	-0.20	-0.27	0.00	0.20

POST TEST	**LINEARITY**	
	Cylinder	Instrument
	O2	
Zero	0.00	0.00
High Level	20.05	20.00
Slope	1.00	
Intercept	0.00	Status
Predicted Value	11.99	<1
Linearity (%)	0.04	PASS
	CO2	
Zero	0.00	0.03
High Level	11.97	11.93
Slope	1.01	
Intercept	-0.03	Status
Predicted Value	6.99	<1
Linearity (%)	0.14	PASS
	NOx	
Zero	0.00	0.10
High Level	23.70	23.70
Slope	1.00	
Intercept	-0.10	Status
Predicted Value	12.55	<1
Linearity (%)	0.21	PASS
	CO	
Zero	0.00	0.00
High Level	79.60	79.80
Slope	1.00	
Intercept	0.00	Status
Predicted Value	51.03	<1
Linearity (%)	-0.73	PASS

APPENDIX C - Laboratory Results

AtmAA Inc.
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LABORATORY ANALYSIS REPORT

Hydrogen Sulfide and Reduced Sulfur Compounds
Analysis in Tedlar Bag Samples

Report Date: January 21, 2008
Client: Horizon Air Measurement Services, Inc.
Project Location: Simi Valley Landfill
Client Project No.: W07-056
Date Received: January 15, 2008
Date Analyzed: January 15, 2008

ANALYSIS DESCRIPTION

Hydrogen sulfide was analyzed by gas chromatography with a Hall electrolytic conductivity detector operated in the oxidative sulfur mode. All other components were measured by GC/ Mass Spec.

AtmAA Lab No.:	00158-1	00158-2	00158-3
Sample I.D.:	W7-56-TB-1	W7-56-TB-2	W7-56-TB-3
Components	*(Concentration in ppmv)*		
Hydrogen sulfide	46.6	46.0	49.3
Carbonyl sulfide	0.30	0.32	0.32
Methyl mercaptan	4.82	6.67	4.90
Ethyl mercaptan	<0.2	<0.2	<0.2
Dimethyl sulfide	11.5	11.5	11.7
Carbon disulfide	<0.2	<0.2	<0.2
isopropyl mercaptan	0.48	0.65	0.48
n-propyl mercaptan	<0.2	<0.2	<0.2
Dimethyl disulfide	<0.2	<0.2	<0.2
TRS	63.7	65.1	66.7

TRS - total reduced sulfur

Michael L. Porter
Laboratory Director

QUALITY ASSURANCE SUMMARY
(Repeat Analyses)

Project Location: Simi Valley Landfill
Date Received: January 15, 2008
Date Analyzed: January 15, 2008

Components	Sample ID	Repeat Analysis		Mean Conc.	% Diff. From Mean
		Run #1	Run #2		
		(Concentration in ppmv)			
Hydrogen sulfide	W7-56-TB-1	46.1	47.2	46.6	1.2
	W7-56-TB-2	46.0	46.1	46.0	0.11
	W7-56-TB-3	49.2	49.4	49.3	0.20
Carbonyl sulfide	W7-56-TB-2	0.32	0.32	0.32	0.0
	W7-56-TB-3	0.32	0.33	0.32	1.5
Methyl mercaptan	W7-56-TB-2	6.48	6.86	6.67	2.8
	W7-56-TB-3	4.81	4.99	4.90	1.8
Ethyl mercaptan	W7-56-TB-2	<0.2	<0.2	---	---
	W7-56-TB-3	<0.2	<0.2	---	---
Dimethyl sulfide	W7-56-TB-2	11.1	11.9	11.5	3.5
	W7-56-TB-3	11.4	12.0	11.7	2.6
Carbon disulfide	W7-56-TB-2	<0.2	<0.2	---	---
	W7-56-TB-3	<0.2	<0.2	---	---
iso-propyl mercaptan	W7-56-TB-2	0.62	0.68	0.65	4.6
	W7-56-TB-3	0.47	0.50	0.48	3.1
n-propyl mercaptan	W7-56-TB-2	<0.2	<0.2	---	---
	W7-56-TB-3	<0.2	<0.2	---	---
Dimethyl disulfide	W7-56-TB-2	<0.2	<0.2	---	---
	W7-56-TB-3	<0.2	<0.2	---	---

Three Tedlar bag samples, laboratory numbers 00158-(1-3), were analyzed for hydrogen sulfide and reduced sulfur compounds. Agreement between repeat analyses is a measure of precision and is shown above in the column "% Difference from Mean". Repeat analyses are an important part of AtmAA's quality assurance program. The average % Difference from Mean for 11 repeat measurements from the three Tedlar bag samples is 1.9%.

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LABORATORY ANALYSIS REPORT

Speciated Hydrocarbons Analysis in Tedlar Bag Samples

Report Date: January 21, 2008
Client: Horizon Air Measurement Services
Site: Simi Valley Landfill
Project No.: W07-056

Date Received: January 15, 2008
Date Analyzed: January 16, & 21, 2008

ANALYSIS DESCRIPTION

Hydrocarbon Speciation analysis was performed by flame ionization detection/gas chromatography (FID/GC), modified EPA-18.

AtmAA Lab No.:		00158-3	(repeat)			
Sample ID:		TB 3	TB 3			
			(Concentration in ppmv, component)			
Methane		454000	459000			
non-methane hydrocarbons analysis by carbon number grouping						
C2		13.98	14.35			
C3		52.06	51.09			
C4		41.18	41.83			
C5		140.75	140.95			
C6		117.12	117.28			
C7		91.95	91.68			
C8		91.25	91.66			
C9		120.62	120.08			
C10		76.39	74.56			
C11		7.58	7.36			
C12		2.05	1.97			
C13		0.46	0.38			
TNMHC		5092	5069			

TNMHC - total non-methane hydrocarbons as ppmv methane.

*Michael L. Porter
Laboratory Director*

Calculated values for Specific Volume, BTU and F (factor)

Report Date:	January 21, 2008
Client:	Horizon Air Measurement Services
Project Location:	Simi Valley Landfill
Date Received:	January 15, 2008
Date Analyzed:	January 16, & 21, 2008
AtmAA Lab No.:	00158-3 TB 3

Specific volume, BTU, and F factor are calculated using labortatory analysis results for methane, carbon dioxide, nitrogen, oxygen, TGNMO, and sulfur compounds in equations that include assumed values for the specific volume of gases (CH4, CO2, N2, O2, Ar, and (CH2)n). The specific volume of gases were taken from the Scott Speciality Gases catalogue, 2001, and represents as is gas at 60° F and 1 atm. The F factor is calculated according to the equation in ASTM D-3588.B89

Component	Mole %	Wt %	C,H,O,N,S, Wt.%	
Methane	45.63	26.51	Carbon	35.81
Carbon dioxide	36.06	57.61	Hydrogen	6.66
Nitrogen	14.06	14.29	Oxygen	43.16
Oxygen	1.09	1.26	Nitrogen	14.29
Argon	0.048	0.070	Argon	0.07
$(CH_2)_n$	0.508	0.258	Sulfur	0.00

Specific Volume	13.287
BTU/ft^3	465
BTU/ lb.	6178
F (factor)	9906

"as is" gas at 60° F, 1 atm, where CH4-1010, TGNMO-804 BTU/cu.ft.

Component	Specific volume reference values *	
Methane	23.35	(ft^3/lb)
Carbon dioxide	8.59	
Nitrogen	13.54	
Oxygen	11.87	
Argon	9.52	
(CH2)n	21	

* reference, Scott Specialty Gases Catalogue, 2001 adjusted to 60°F

CHAIN OF CUSTODY RECORD

Client/Project Name: Simi landfill

Project Location: Simi Valley

Project No.: W07-056

Field Logbook No.:

Sampler: (Signature)

Chain of Custody Tape No.:

ANALYSES

Sample No./ Identification	Date	Time	Lab Sample Number	Type of Sample	SCAQMD 307.91	ASTM 3588-91 HHV					REMARKS
W7-56-TB-1	1/14/08		00158-1		×						Flare inlet
W7-56-TB-2			2		×						
W7-53-TB-3			3		×	×					

Relinquished by: (Signature)	Date 1/14/08	Time 0700	Received by: (Signature)	Date 01.14.08	Time 0700
Relinquished by: (Signature)	Date 01.14.08	Time 0920	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received for Laboratory: (Signature)	Date 01.~~14~~ 15 08	Time 0920
Sample Disposal Method:			Disposed of by: (Signature)	Date	Time

SAMPLE COLLECTOR

HORIZON AIR MEASUREMENT SERVICES, INC
996 Lawrence Drive, Suite 108
Newbury Park, CA 91320
(805) 498-8781 Fax (805) 498-3173

ANALYTICAL LABORATORY

Atm A.A.
Calabasas Ca

№ 09692

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LABORATORY ANALYSIS REPORT

Methane, Total Gaseous Non-Methane Organics (TGNMO), & Ethane Analysis in Steel Tank Samples

Report Date: January 21, 2008
Client: Horizon Air Measurement Services, Inc.
Client Project No.: W07 - 056
Source Location : Simi Valley Landfill
Source ID: Flare inlet

Date Received: January 15, 2008
Date Analyzed: January 17, 2008

ANALYSIS DESCRIPTION

Total gaseous non-methane organics (TGNMO), and ethane were measured by flame ionization detection/total combustion analysis (FID/TCA), M25. Methane, CO2, and O2 were measured by thermal conductivity detection/gas chromatogrqaphy (TCD/GC).

AtmAA Lab No.	Sample ID	Canister Methane	Canister Ethane	Canister TGNMO	Canister Carbon Dioxide	Canister Oxygen
			(ppmv)		(%v)	(%v)
00158-4	Tank C Inlet 1	437000	9.14	6230	36.1	1.59
		---	---	---	---	---
00158-5	Tank I Inlet 2	437000	13.6	5580	35.6	1.23
		---	---	---	---	---
00158-6	Tank A Inlet 3	450000	10.3	6160	36.0	0.95
		---	---	---	---	---

TGNMO is total gaseous non-methane organics (excluding ethane), reported as ppmvC.
Ethane is reported as ppmvC.

Michael L. Porter
Laboratory Director

QUALITY ASSURANCE SUMMARY

(Repeat Analysis)

Source Location : Simi Valley Landfill
Date Received: January 15, 2008
Date Analyzed: January 17, 2008

Components	Sample ID	Repeat Analysis		Mean	% Diff.
		Run #1	Run #2	Conc.	From Mean
		(Concentration in ppmv)			
Methane	Tank C Inlet 1	438000	436000	437000	0.23
Ethane	Tank C Inlet 1	9.01	9.26	9.14	1.4
	Tank I Inlet 2	13.8	13.3	13.6	1.8
	Tank A Inlet 3	10.2	10.4	10.3	0.97
TGNMO	Tank C Inlet 1	6150	6310	6230	1.3
	Tank I Inlet 2	5330	5820	5580	4.4
	Tank A Inlet 3	6220	6100	6160	0.97
		(Concentration in %v)			
Carbon Dioxide	Tank C Inlet 1	36.7	35.5	36.1	1.7
Oxygen	Tank C Inlet 1	1.73	1.44	1.59	9.1

A set of 3 tank samples, laboratory number 00158-(4 - 6), was analyzed for methane, ethane, and total gaseous non-methane organics (TGNMO). Agreement between repeat analysis is a measure of precision and is shown in the column "% Difference from Mean". The average % Difference from Mean for 9 repeat measurements from the sample set of 3 tank samples is 2.4%.

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LABORATORY ANALYSIS REPORT

Methane, Total Gaseous Non-Methane Organics (TGNMO), & Ethane Analysis in SUMMA Canister Samples

Report Date: January 21, 2008
Client: Horizon Air Measurement Services, Inc.
Client Project No.: W07 - 056
Source Location : Simi Valley Landfill
Source ID: Flare inlet

Date Received: January 15, 2008
Date Analyzed: January 17, 2008

ANALYSIS DESCRIPTION

Total gaseous non-methane organics (TGNMO), and methane were measured by flame ionization detection/total combustion analysis (FID/TCA) M25.

AtmAA Lab No.	Sample ID	Canister Methane	Canister Ethane	Canister TGNMO
00158-7	S9 Outlet 1	<1	<1	1.93
		---	---	---
00158-8	S6 Outlet 2	<1	<1	2.03
		---	---	---
00158-9	S3 Outlet 3	<1	<1	<1
		---	---	---

TGNMO is total gaseous non-methane organics (excluding ethane), reported as ppmvC.
Ethane is reported as ppmvC.

Michael L. Porter
Laboratory Director

QUALITY ASSURANCE SUMMARY
(Repeat Analysis)

Source Location : Simi Valley Landfill
Date Received: January 15, 2008
Date Analyzed: January 17, 2008

Components	Sample ID	Repeat Analysis Run #1	Repeat Analysis Run #2	Mean Conc.	% Diff. From Mean
		(Concentration in ppmv)			
Methane	S9 Outlet 1	<1	<1	---	---
	S6 Outlet 2	<1	<1	---	---
	S3 Outlet 3	<1	<1	---	---
Ethane	S9 Outlet 1	<1	<1	---	---
	S6 Outlet 2	<1	<1	---	---
	S3 Outlet 3	<1	<1	---	---
TGNMO	S9 Outlet 1	1.93	1.93	1.93	0.0
	S6 Outlet 2	2.11	1.95	2.03	3.9
	S3 Outlet 3	<1	<1	---	---

A set of 3 SUMMA canister samples, laboratory numbers 00158-(7 - 9), was analyzed for methane, ethane, and total gaseous non-methane organics (TGNMO). Agreement between repeat analysis isa measure of precision and is shown in the column "% Difference from Mean". The average % Difference from Mean for 2 repeat measurements from the sample set of 3 SUMMA canister samples is 2.0%.

CHAIN OF CUSTODY RECORD

Client/Project Name Simi landfill	Project Location Simi Valley Ca
Project No. W07-056	Field Logbook No.
Sampler: (*Signature*)	Chain of Custody Tape No.

ANALYSES

Sample No./ Identification	Date	Time	Lab Sample Number	Type of Sample	EPA 25C TGNMO CH4	O2/CO2					REMARKS
Tank C	1/14/08		00158-4		X	X					R-1 inlet
" I			5		X	X					2 "
" A			6		X	X					3 "
Summa 9			7		X						R-1 outlet
" 6			8		X						2 "
" 3			9		X						3 "

	Date	Time		Date	Time
Relinquished by: (*Signature*)	1/14/08	0700	Received by: (*Signature*)	01.14.08	0700
Relinquished by: (*Signature*)	01.14.08	0920	Received by: (*Signature*)		
Relinquished by: (*Signature*)			Received for Laboratory: (*Signature*)	15 01.~~14~~.08	0920
Sample Disposal Method:			Disposed of by: (*Signature*)		

SAMPLE COLLECTOR

HORIZON AIR MEASUREMENT SERVICES, INC
996 Lawrence Drive, Suite 108
Newbury Park, CA 91320
(805) 498-8781 Fax (805) 498-3173

ANALYTICAL LABORATORY

Atm A.A.
Calabasas Ca

№ 09691

APPENDIX D - Field Data Sheets

VELOCITY DATA SHEET - METHOD 2

Facility: Simi valley L.F.
Source: Flare #2 - John Zinc
Job #: W07-056
Date: 1-14-08
Operator: CSM

Baro. Press: 29.27
Static Press: -0.03
Pitot Tube #: 10 FT
Pitot Tube Type: S
Magnahelic: # 1

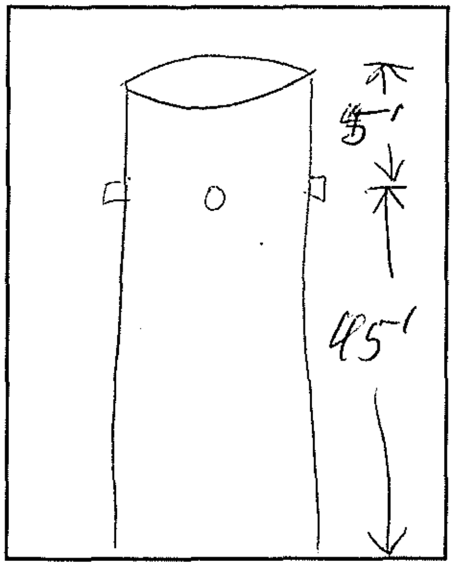
D_1 upstream: 0.46
D_1 downstream: 4.1
Stack Diameter: 128"

Leak Check
Initial: ✓
Final: ✓

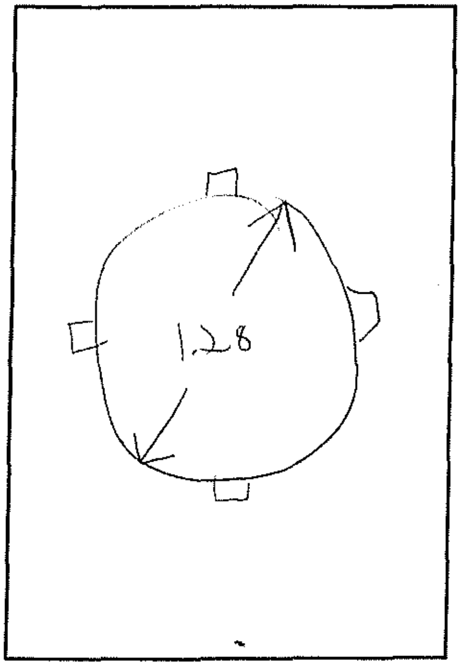
Run #: 1

Point #	Position in.	Velocity Head in. H_2O	Stack Temp °F	Cyclonic Flow Angle
A 12	125.3	0.015	1565	
11	119.4	0.015	1568	
10	112.9	0.015	1570	
9	105.3	0.020	1571	
8	96	0.020	1573	
7	82.4	0.020	1573	
6	45.6	0.020	1573	
5	32	0.020	1574	
4	22.7	0.020	1572	
3	15.1	0.020	1569	
2	8.6	0.015	1570	
1	2.7	0.015	1568	
B 12		0.015	1566	
11		0.015	1568	
10		0.015	1569	
9		0.015	1571	
8		0.015	1573	
7		0.020	1574	
6		0.020	1574	
5		0.020	1572	
4		0.020	1573	
3		0.020	1570	
2		0.015	1568	
1		0.015	1567	
Average		$\sqrt{\Delta P}$= 0.1319	T_s= 1570.5	∠=

Side View



Top View



PARTICULATE FIELD DATA

PLANT Simi Valley Landfill
DATE 1/14/08
LOCATION Simi Valley
OPERATOR CL
SOURCE John Zinc Flare
RUN NO. 1
SAMPLE BOX NO. C-10

TIME START 0930

METER BOX NO. 7
METER ΔH @ 1.750
Y= 0.985
PROBE I.D. NO. –
NOZZLE DIAMETER, in. –
STACK DIAMETER, in.
PROBE HEATER SETTING –
HEATER BOX SETTING –
Δ Cp FACTOR –
FILTER NO. –

ASSUMED MOISTURE, % –
AMBIENT TEMPERATURE 65
BARO. PRESS. 29.27
STATIC PRESS. –
NOMAGRAPH INDEX –

PRE TEST LEAK CHECKS
METER 0.004 @ 15 in. Hg
PITOTS 0 @ – in. Hg
ORSAT

P#	TIME	T_s °F	ΔP in H_2O	√ΔP	ΔH in H_2O	Vm ft³	$T_{m\,IN}$ °F	T_m OUT °F	OVEN °F	IMP. OUT °F	VAC. (in Hg)
Single	0				1.8	928.113	66	64	–	57	3
	10				1.8	935.3	79	70		56	3
	20				1.8	942.6	83	76		57	3
	30				1.8	949.855	84	77		56	3
	40				1.8	958.1	85	78		57	3
	50				1.8	966.3	85	78		56	3
	60					974.110					
Avg.					1.8	45.997		77.1			

TIME END = 1045

Volume of Liquid Water Collected	Impinger Volume 1	2	3	4	Silica Gel Wght. 5
Final	151	111	2		261
Initial	100	100			250
Liquid Collected	51	11	2		11
Total Vol. Collected					75

POST TEST LEAK CHECKS
Meter 0.002 @ 15 in. Hg
Pitots @ in. Hg
Orsat

Orsat Meas.	Time	CO_2	O_2	CO	N_2
1					
2					
3					

Nozzle Cal	D_1	D_2	D_3	Average
				54

VELOCITY DATA SHEET - METHOD 2

Facility: Simi Valley LF
Source: Flare #2- John Zinc
Job #: W07-056
Date: 1-14-08
Operator: CS

Baro. Press: 29.27
Static Press: -0.04
Pitot Tube #: 10 FT
Pitot Tube Type: S
Magnahelic: #1

D₁ upstream: 0.46
D₁ downstream: 4.1
Stack Diameter: 128"

Leak Check
Initial: ✓
Final: ✓

Run #: 2

Point #	Position in.	Velocity Head in. H_2O	Stack Temp °F	Cyclonic Flow Angle
A 12	125.3	0.015	1557	
11	119.4	0.015	1557	
10	112.9	0.020	1563	
9	105.3	0.020	1569	
8	96	0.020	1573	
7	82.4	0.020	1577	
6	45.6	0.020	1577	
5	32	0.020	1575	
4	22.7	0.020	1576	
3	15.1	0.015	1574	
2	8.6	0.015	1570	
1	2.7	0.015	1569	
B 12		0.015	1559	
11		0.015	1565	
10		0.015	1569	
9		0.015	1573	
8		0.020	1576	
7		0.020	1578	
6		0.020	1577	
5		0.020	1575	
4		0.020	1573	
3		0.020	1574	
2		0.015	1571	
1		0.015	1560	
Average		√ΔP= 0.1327	T_s= 1570.0	∠=

Side View

Top View

PARTICULATE FIELD DATA

PLANT Simi Valley Landfill
DATE 1/14/08
LOCATION Simi Valley
OPERATOR M
SOURCE John Zinc, Flare out
RUN NO. 2
SAMPLE BOX NO. C-10

TIME START 1156

METER BOX NO. 7
METER ΔH @ 1.750
Y= 0.985
PROBE I.D. NO. –
NOZZLE DIAMETER, in. –
STACK DIAMETER, in. –
PROBE HEATER SETTING –
HEATER BOX SETTING –
Δ Cp FACTOR –
FILTER NO. –

ASSUMED MOISTURE, % –
AMBIENT TEMPERATURE 65
BARO. PRESS. 29.27
STATIC PRESS. –
NOMAGRAPH INDEX –

PRE TEST LEAK CHECKS
METER 0.005 @ 15 in. Hg
PITOTS – @ – in. Hg
ORSAT

P#	TIME	T_s °F	ΔP in H_2O	√ΔP	ΔH in H_2O	Vm ft^3	$T_{m IN}$ °F	T_m OUT °F	OVEN °F	IMP. OUT °F	VAC. (in Hg)
Single	0				1.8	974.877	74	72		57	1
	10				1.8	982.3	80	73		56	1
	20				1.8	989.7	81	73		56	1
	30				1.8	997.123	78	72		55	1
	40				1.8	1004.5	80	74		56	1
	50				1.8	1011.9	80	73		57	1
	60				–	1019.230	–	–		–	–
Avg.					1.8	44.353		75.8			

TIME END = 1304

Volume of Liquid Water Collected	Impinger Volume				Silica Gel Wght.
	1	2	3	4	5
Final	165	102	2		260
Initial	100	100	0		250
Liquid Collected	65	2	2		10
Total Vol. Collected					79

POST TEST LEAK CHECKS
Meter 0.004 @ 15 in. Hg
Pitots @ in. Hg
Orsat

Orsat Meas.	Time	CO_2	O_2	CO	N_2
1					
2					
3					

Nozzle Cal	D_1	D_2	D_3	Average

VELOCITY DATA SHEET - METHOD 2

Facility: Simi Valley LF.
Source: Flare #2 - John Zink
Job #: W07-056
Date: 1-14-08
Operator: GM

Run #: 3

Baro. Press: 29.27
Static Press: -0.04
Pitot Tube #: 10 FT
Pitot Tube Type: S
Magnahelic: #1

D₁ upstream: 0.46
D₁ downstream: 4.1
Stack Diameter: 128"

Leak Check
Initial: ✓
Final: ✓

Point #	Position in.	Velocity Head in. H_2O	Stack Temp °F	Cyclonic Flow Angle
A 12	125.3	0.015	1549	
11	119.4	0.015	1555	
10	112.9	0.015	1559	
9	105.3	0.015	1566	
8	96	0.020	1570	
7	82.4	0.020	1574	
6	45.6	0.020	1573	
5	32	0.015	1575	
4	22.7	0.015	1571	
3	15.1	0.015	1573	
2	8.6	0.015	1569	
1	2.7	0.015	1568	
B 12		0.015	1559	
11		0.015	1564	
10		0.015	1569	
9		0.015	1573	
8		0.020	1575	
7		0.020	1577	
6		0.020	1577	
5		0.020	1575	
4		0.015	1576	
3		0.015	1572	
2		0.015	1571	
1		0.015	1570	
Average		√ΔP= 0.1280	T_s= 1570.4	∠=

Side View

Top View

PARTICULATE FIELD DATA

PLANT Simi Valley Landfill
DATE 1/17/08
LOCATION Simi Valley
OPERATOR U
SOURCE John Zink Flare
RUN NO. 3
SAMPLE BOX NO. C-10

TIME START 1328

METER BOX NO. 7
METER ΔH @ 1.750
Y= 0.985
PROBE I.D. NO. -
NOZZLE DIAMETER, in. -
STACK DIAMETER, in. -
PROBE HEATER SETTING -
HEATER BOX SETTING -
Δ Cp FACTOR -
FILTER NO. -

ASSUMED MOISTURE, % -
AMBIENT TEMPERATURE 64
BARO. PRESS. 29.27
STATIC PRESS. -
NOMAGRAPH INDEX -

PRE TEST LEAK CHECKS
METER 0.008 @ 15 in. Hg
PITOTS ____ @ ____ in. Hg
ORSAT ____

P#	TIME	T_s °F	ΔP in H_2O	√ΔP	ΔH in H_2O	Vm ft^3	$T_{m IN}$ °F	T_m OUT °F	OVEN °F	IMP. OUT °F	VAC. (in Hg)
Singl	0				1.8	19.520	73	72		56	1
	10				1.8	027.3	82	73		56	2
	20				1.8	34.8	82	73		57	2
	30				1.8	042.4	82	74		56	2
	40				1.8	50.0	85	76		55	2
	50				1.8	57.6	86	77		56	2
	60				-	65.405	-	-		-	-
Avg.					1.8	45.885		77.9			

TIME END = 1440

Volume of Liquid Water Collected	Impinger Volume 1	2	3	4	Silica Gel Wght. 5
Final	165	101	1		260
Initial	100	100			250
Liquid Collected	65	1	1		10
Total Vol. Collected					77

POST TEST LEAK CHECKS
Meter 0.004 @ 15 in. Hg
Pitots ____ @ ____ in. Hg
Orsat ____

Orsat Meas.	Time	CO_2	O_2	CO	N_2
1					
2					
3					

Nozzle Cal	D_1	D_2	D_3	Average
				58

TOTAL COMBUSTION ANALYSIS
SCAQMD METHOD 25
FIELD SAMPLING DATA SHEET

b #: W07-056
Facility: Simi Valley L.F.
Location: Simi Valley CA
Date: 1/14/07
Operator: JB

Control Device: Flare Outlet
Sample Location: Outlet
Ambient Temp.: 70°F
Baro. Pressure: 29.27

R-1

SAMPLE A

Tank #: S-9
Trap #: –
Roto # 25C-1
Probe # 25C-1
Initial Vacuum: 30
Final Vacuum: 10 in/Hg
Start Time: 9:30) 11:59

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00	30	
05	29	
10	28	
15	27	
20	26	
25	24	
30	22	
35	20	
40	18	
45	16	
50	14	
55	12	
60	10	

R-2

SAMPLE B

Tank #: S6
Trap #: –
Roto # 25C-1
Probe # 25C-1
Initial Vacuum: 1.00 Torr
Final Vacuum: 10 in/Hg
End Time: 10:43) 13:02

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00	30	
05	29	
10	28	
15	27	
20	26	
25	24	
30	22	
35	20	
40	18	
45	16	
50	14	
55	12	
60	10	

LEAK RATE

Pre Test : ✓
Post Test: ✓

Pre Test : ✓
Post Test: ✓

TOTAL COMBUSTION ANALYSIS
SCAQMD METHOD 25
FIELD SAMPLING DATA SHEET

b #: W07-056
Facility: Simi Valley LF.
Location: Simi Valley, CA
Date: 1-14-07
Operator: CSM

Control Device: FLARE #2 - John Zinc
Sample Location: OUTLET
Ambient Temp.: 72
Baro. Pressure: 29.27

R-3

SAMPLE A

Tank #: S3 **Trap #:** —
Roto # 25C-1 **Probe #** 25C-1
Initial Vacuum: 100 Torr
Final Vacuum: 10 in/Hg
Start Time: 13:28

SAMPLE B

Tank #: **Trap #:**
Roto # **Probe #**
Initial Vacuum:
Final Vacuum:
End Time: 14:32

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00	30	
05	29	
10	28	
15	27	
20	26	
25	24	
30	22	
35	20	
40	18	
45	16	
50	14	
55	12	
60	10	

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00		
05		
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		

LEAK RATE

Pre Test : ✓
Post Test: ✓

Pre Test :
Post Test:

HORIZON AIR MEASUREMENT SERVICES, INC.
WPDOCS\FORMS\Field Data Sheets\Method 25 Total Combustion

TOTAL COMBUSTION ANALYSIS
SCAQMD METHOD 25
FIELD SAMPLING DATA SHEET

Job #: W07-056

Facility: Simi landfill

Location: 1 Simi Valley

Date: 1/14/08

Operator: El

Control Device: Flare inlet Zinc

Sample Location: inlet

Ambient Temp.: 65

Baro. Pressure: 29.27

R-1

SAMPLE A

Tank #: C

Trap #: -

Roto # 1n 2B

Probe # -

Initial Vacuum: 1.5

Final Vacuum:

Start Time: 0930 - 1030

R-2

SAMPLE B

Tank #: I

Trap #: -

Roto # 1n 2a

Probe # -

Initial Vacuum: 1.5

Final Vacuum:

End Time: 1156 - 1256

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00	29	
05	27.5	
10	26	
15	24.5	
20	23	
25	21.5	
30	20	
35	18.5	
40	17	
45	15.5	
50	14	
55	13	
60	12	

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00	29	
05	27.5	
10	26	
15	25	
20	23.5	
25	21	
30	20	
35	18.5	
40	17	
45	16	
50	14.5	
55	13	
60	12	

LEAK RATE

Pre Test : ✓

Post Test: ✓

Pre Test : ✓

Post Test: ✓

TOTAL COMBUSTION ANALYSIS
SCAQMD METHOD 25
FIELD SAMPLING DATA SHEET

Job #: W07-056

Facility: Simi Valley Landfill

Location: Simi Valley

Date: 1/14/08

Operator: El

R-3

Control Device: Flare Zink

Sample Location: Inlet

Ambient Temp.: 65

Baro. Pressure: 29.27

SAMPLE A

Tank #: A
Trap #:
Roto # in 2B
Probe #
Initial Vacuum: 1.5
Final Vacuum:
Start Time: 1328 - 1428

TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00	29	
05	27.5	
10	26	
15	25	
20	23.5	
25	22	
30	21	
35	19.5	
40	18	
45	16.5	
50	15	
55	13.5	
60	12	

SAMPLE B

Tank #:
Trap #:
Roto #
Probe #
Initial Vacuum:
Final Vacuum:
End Time:

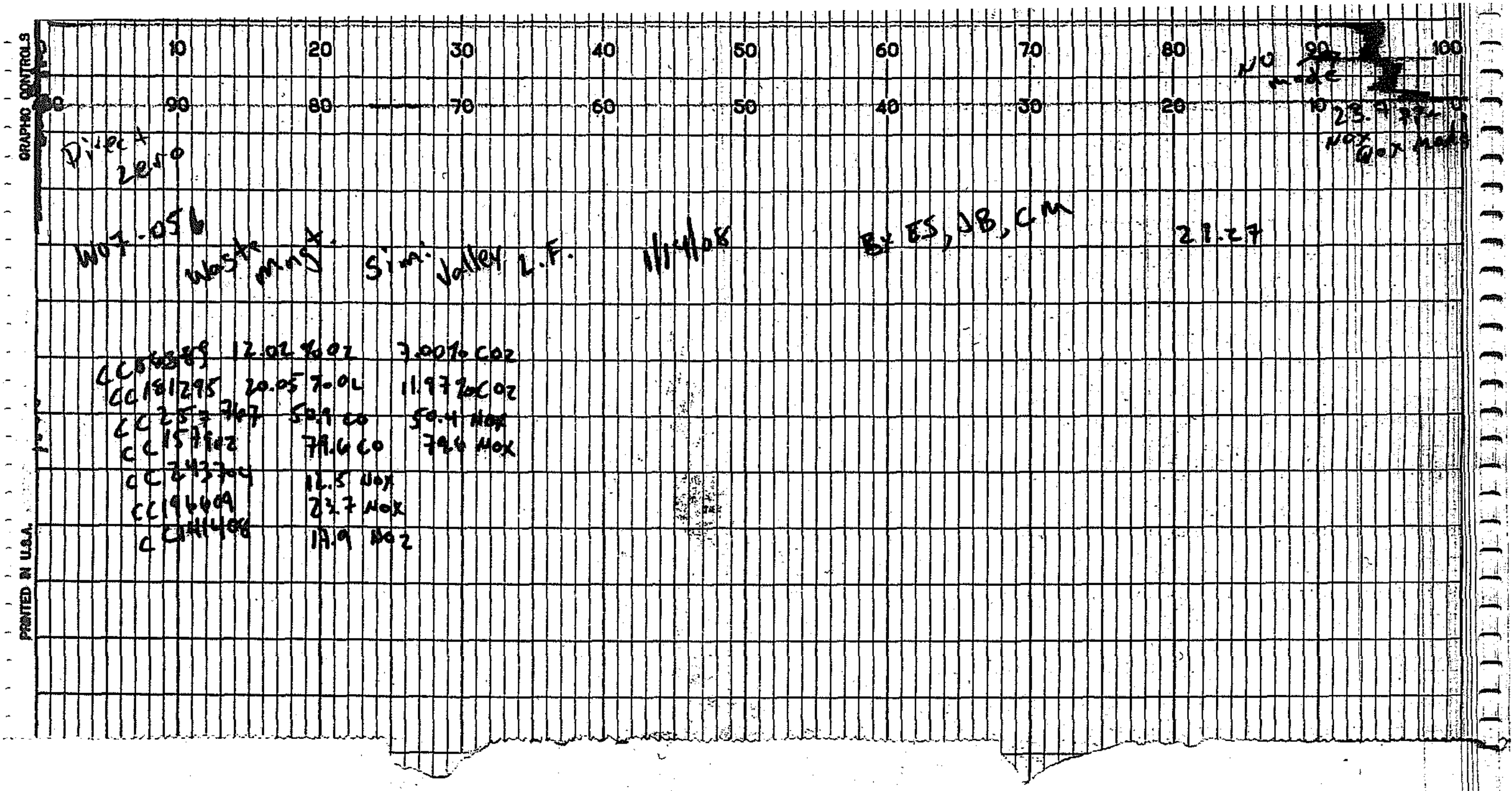
TIME (min.)	VACUUM ("Hg)	FLOW (cc/min)
00		
05		
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		

LEAK RATE

Pre Test : ✓
Post Test: ✓

Pre Test :
Post Test:

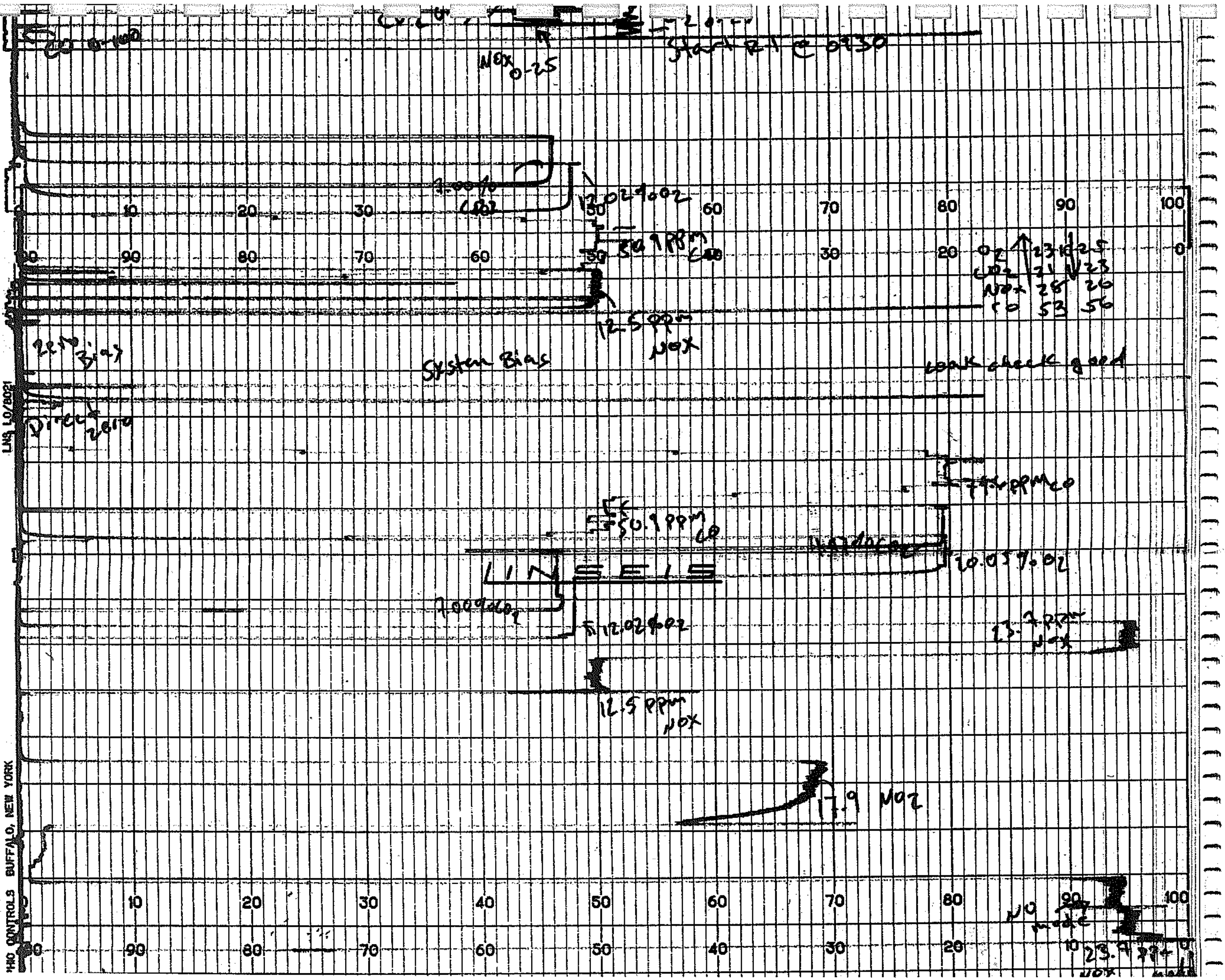
APPENDIX E - Strip Chart Data

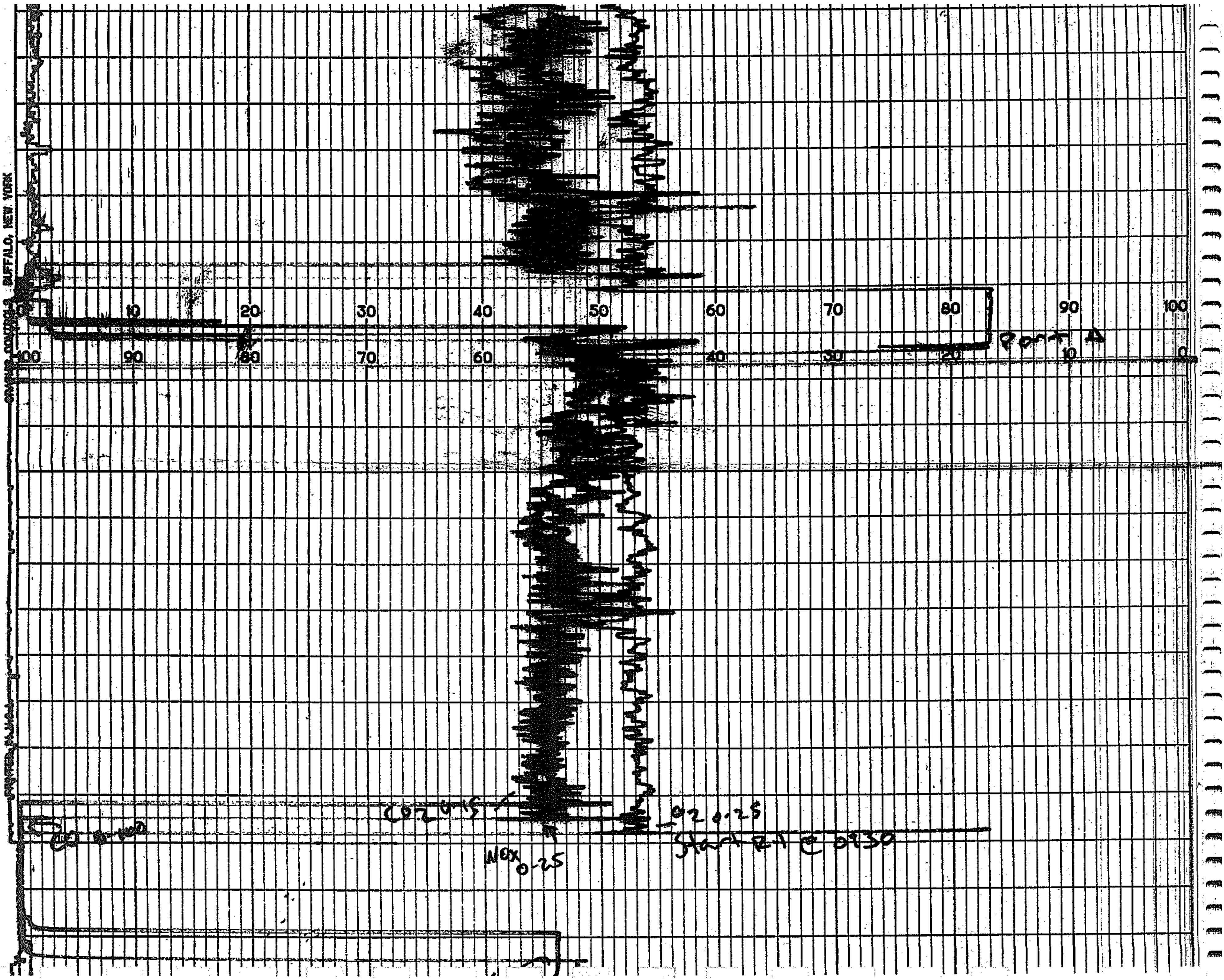


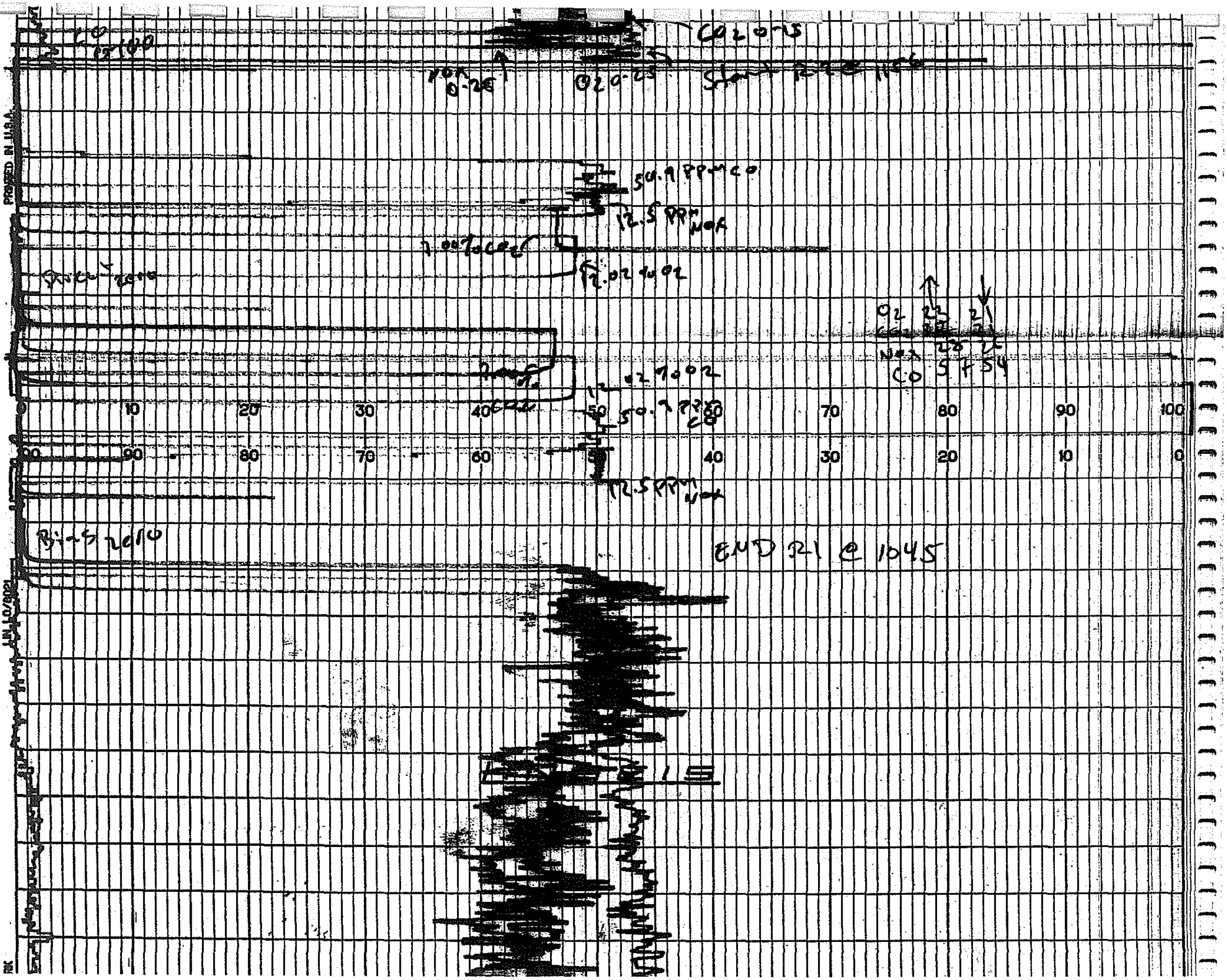
Direct Zero

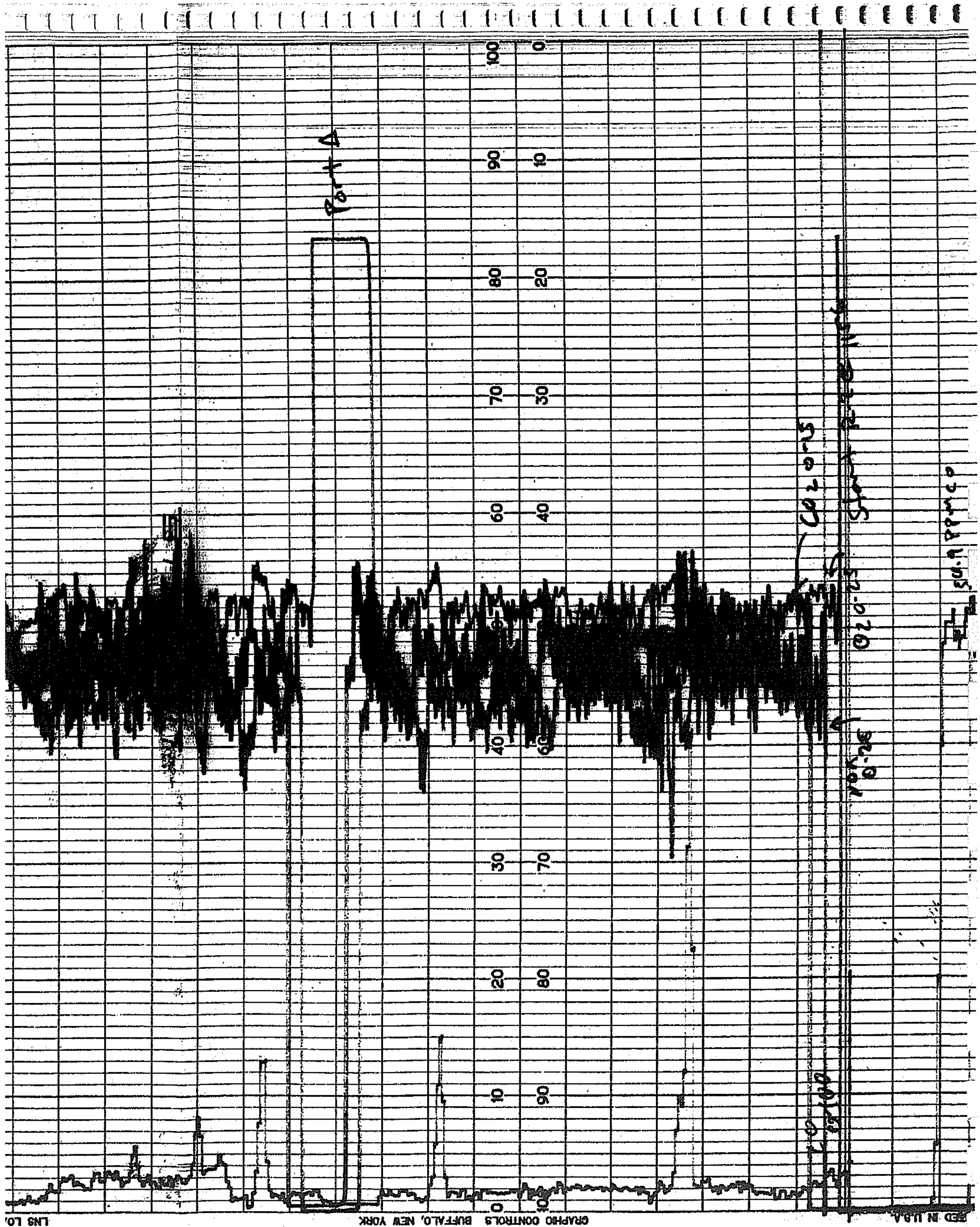
W07-056 Waste mngt. Simi Valley L.F. 11/14/08 By ES, JB, CM 21.27

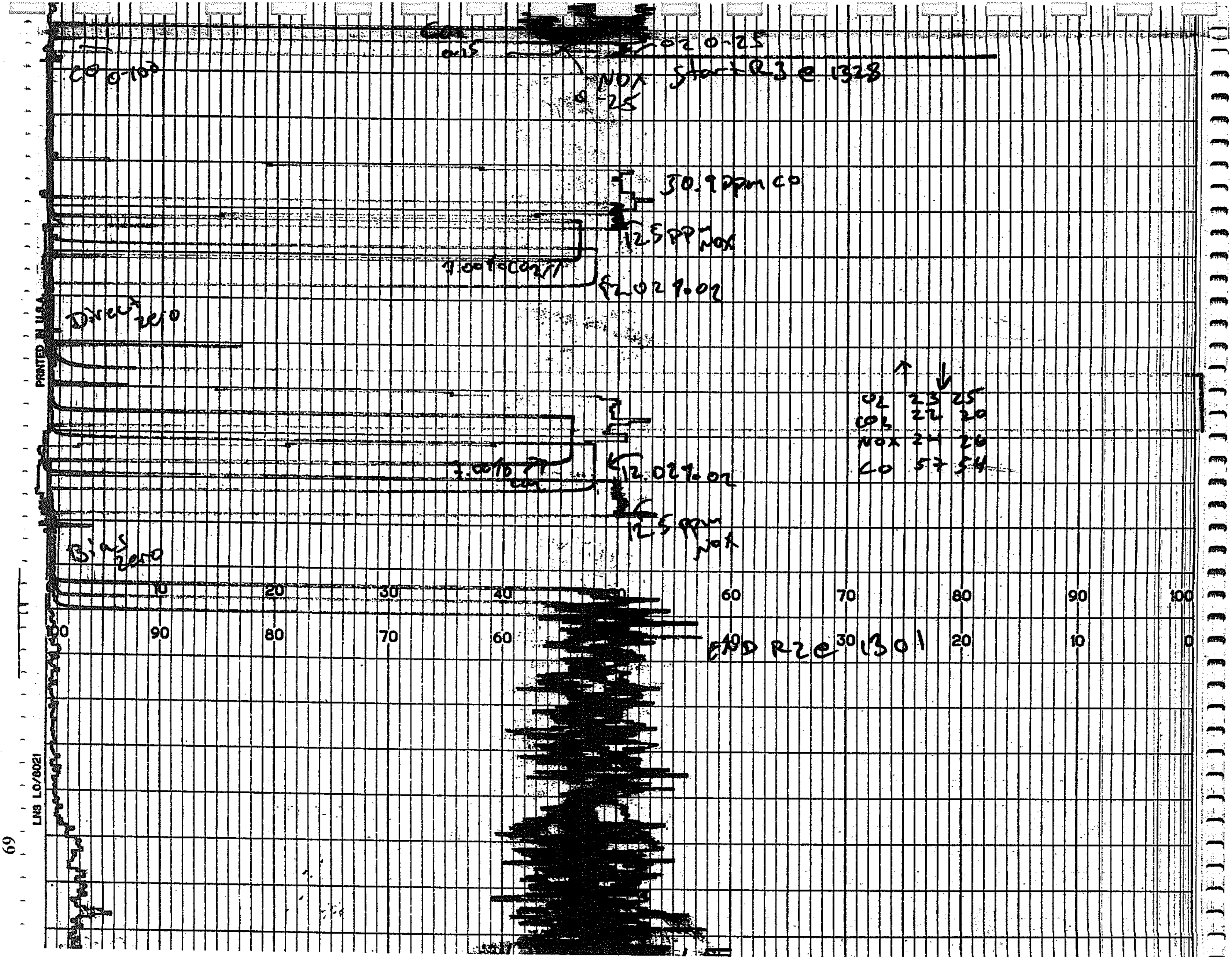
CC63889	12.02 % O2	7.00% CO2
CC181295	20.05 % O2	11.97 % CO2
CC257767	50.9 CO	50.4 NOx
CC157102	79.6 CO	79.6 NOx
CC243709	11.5 NOx	
CC196609	23.7 NOx	
CC141406	17.9 NO2	

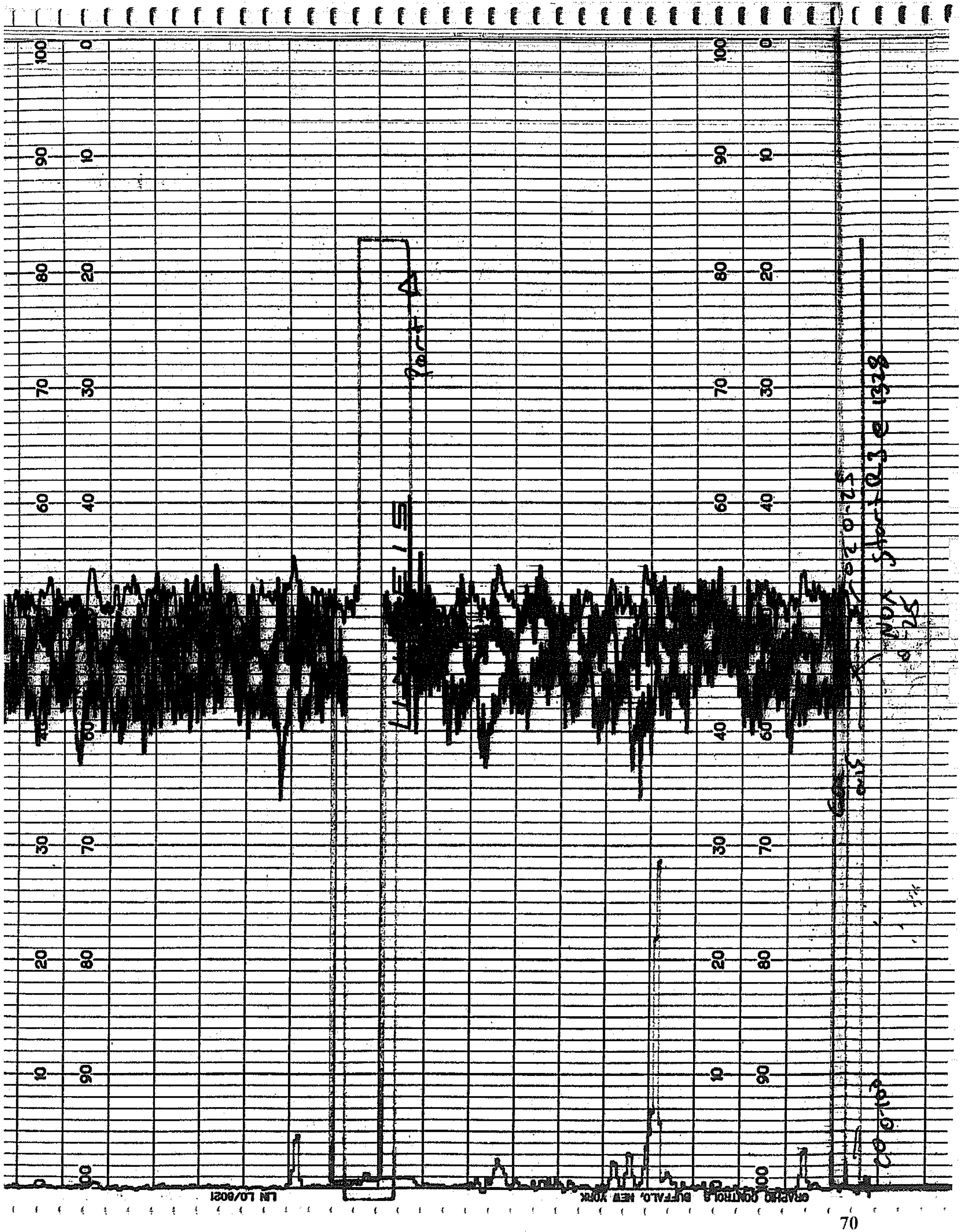

CO 0-100
NOX 0-25
Start R-1 @ 0930
7.00% CO2
13.02% O2
50.9 PPM CO
12.5 PPM NOX
O2 23 25
CO2 21 23
NOX 28 26
CO 53 56
Zero Bias
System Bias
Direct zero
Leak check good
7.4 PPM CO
50.9 PPM CO
10.03% O2
7.00% CO2
12.02% O2
LINSEIS
13.7 PPM NOX
12.5 PPM NOX
17.9 NO2
NO mode
23.9 PPM NOX
LNS L0/8021
HIO CONTROLS BUFFALO, NEW YORK
0
10
20
30
40
50
60
70
80
90
100

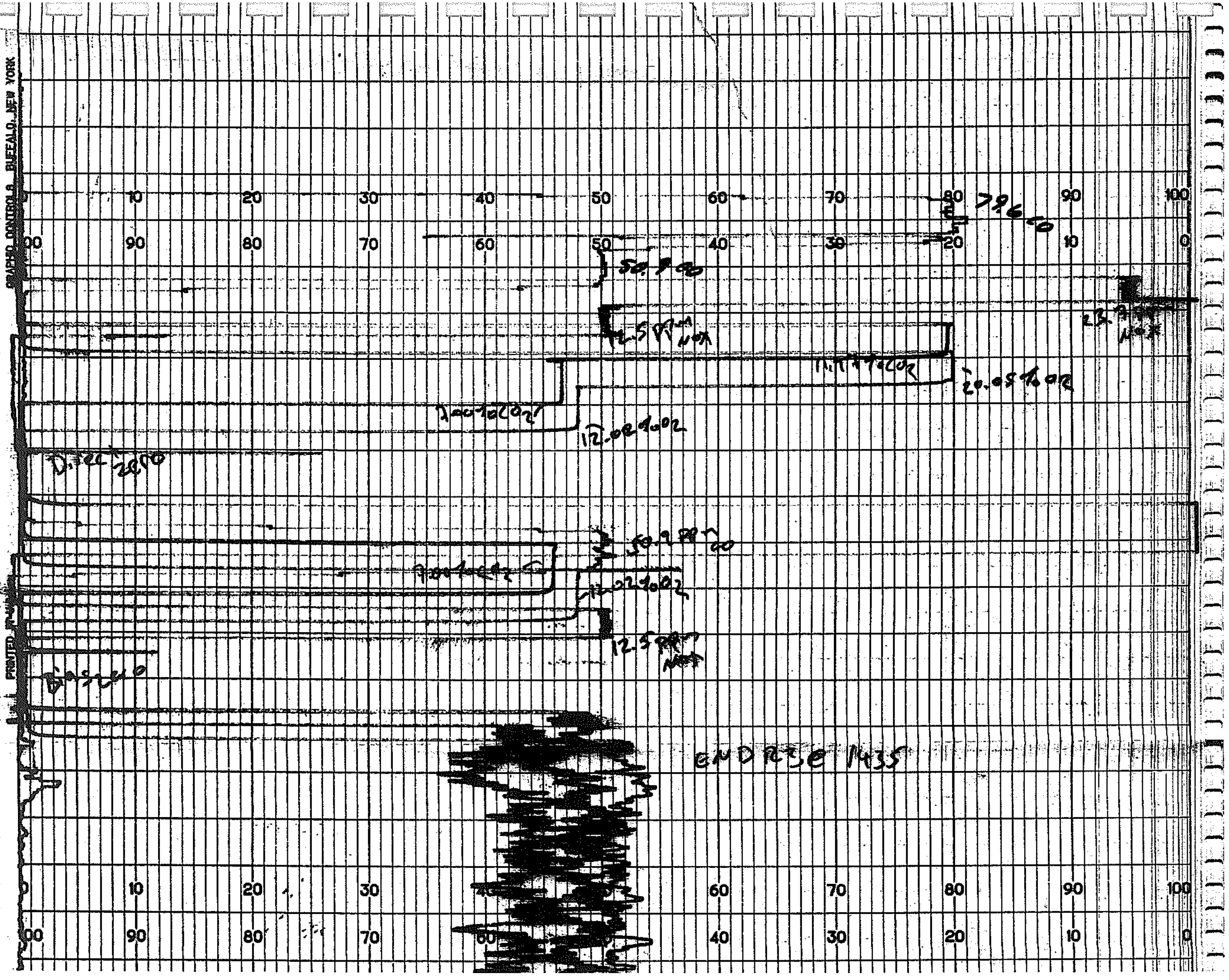

Port A
CO2 0-15
O2 0-25
NOx 0-25
Start R-1 @ 0930
CO 0-100
0
10
20
30
40
50
60
70
80
90
100
GRAPHIC CONTROLS · BUFFALO, NEW YORK
PRINTED IN U.S.A.


CO 0-15
CO 1/100
NOx 0-25
O2 0-25
Start R1 @ 1106
50.9 PPM CO
12.5 PPM NOx
7.00% CO2
12.02% O2
Bias zero
O2 23 21
NOx 28 26
CO 5 + 54
12.02% O2
50.9 PPM CO
40 CO2
12.5 PPM NOx
Bias zero
END R1 @ 1045
1.5
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40
50
60
70
80
90
100
PRINTED IN U.S.A.


GRAPHIC CONTROLS BUFFALO, NEW YORK
0
10
20
30
40
60
70
80
90
100
Port A
CO 0-100
NOx 0-25
O2 0-25
CO2 0-25
Start REF @ 11:06
50.9 ppm CO
LNS LO.
RED IN U.S.A.

CO2 0-15
O2 0-25
NOx 0-25
Start R3 @ 1328
CO 0-100
30.9ppm CO
125ppm NOx
7.00% CO2
12.02% O2
Direct zero
↑ ↓
O2 23 25
CO2 22 20
NOx 24 26
CO 57 54
7.00% CO2
12.02% O2
125ppm NOx
Bias zero
END R2 @ 1301
10 20 30 40 50 60 70 80 90 100
90 80 70 60 40 30 20 10 0
PRINTED IN U.S.A.
LNS LO/6021


100
90
80
70
60
40
30
20
10
0
Port 4
Nov. 25-2023
Start Q3 @ 1328
CO-010
GRAPHIC CONTROLS BUFFALO, NEW YORK
LIN LO/6021


GRAPHIC CONTROLS BUFFALO, NEW YORK
PRINTED IN
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0
79.6 CO
50.9 CO
23.9 PPM NOx
4.5 PPM NOx
Initial 7% CO2
20.05 % O2
7.00 % CO2
12.08 % O2
Diesel 2200
50.9 PPM CO
7.00 % CO2
12.02 % O2
12.5 PPM NOx
Diesel 240
END R3 @ 1435

APPENDIX F - Process Data

OPERATING DATA
FOR LANDFILL FLARES

Facility: W07-056

Date: 1/14/08

Job No.: Simi Valley L.F.

Run #: 1

Source: Flare

Set Point = 1640

	Time	Landfill Gas Flow (scfm)	Condensate Injection ( )	Flare Temerature (°F)	Fuel Pressure ( )	Fuel Temp (°F)
R-1	0930	1575		1643		
WB 125°	1015	1576		1634		
DB 134°						
R2	1156	1630		1650		
WB 125°		1634		1652		
DB 137°						
	1328	~~1650~~ 1700		1610		
R-3		1648		1656		
WB 125						
DB 137						

Horizon Air Measurement Services, Inc.
H:\WPDOCS\FORMS\Fuel Gas Flow Rate For Landfill Flares

Date	Time	Ch. Tag sec	CH03 FLARE#2 TEMP F	CH31 FLARE#2 FLOW SCFM
2008/01/14	09:30:00	0.000	1638.8	1569
2008/01/14	09:32:00	0.000	1634.7	1582
2008/01/14	09:34:00	0.000	1633.6	1574
2008/01/14	09:36:00	0.000	1645.5	1599
2008/01/14	09:38:00	0.000	1644.6	1578
2008/01/14	09:40:00	0.000	1641.5	1589
2008/01/14	09:42:00	0.000	1645.6	1597
2008/01/14	09:44:00	0.000	1632.6	1591
2008/01/14	09:46:00	0.000	1623.7	1625
2008/01/14	09:48:00	0.000	1642.7	1583
2008/01/14	09:50:00	0.000	1646.7	1551
2008/01/14	09:52:00	0.000	1641.7	1625
2008/01/14	09:54:00	0.000	1644.6	1595
2008/01/14	09:56:00	0.000	1642.5	1608
2008/01/14	09:58:00	0.000	1637.7	1599
2008/01/14	10:00:00	0.000	1637.7	1602
2008/01/14	10:02:00	0.000	1629.5	1596
2008/01/14	10:04:00	0.000	1626.6	1620
2008/01/14	10:06:00	0.000	1646.7	1633
2008/01/14	10:08:00	0.000	1648.7	1616
2008/01/14	10:10:00	0.000	1621.8	1561
2008/01/14	10:12:00	0.000	1636.7	1518
2008/01/14	10:14:00	0.000	1644.8	1552
2008/01/14	10:16:00	0.000	1635.7	1574
2008/01/14	10:18:00	0.000	1618.7	1599
2008/01/14	10:20:00	0.000	1643.6	1597
2008/01/14	10:22:00	0.000	1670.5	1581
2008/01/14	10:24:00	0.000	1634.7	1577
2008/01/14	10:26:00	0.000	1634.7	1605
2008/01/14	10:28:00	0.000	1647.9	1644
2008/01/14	10:30:00	0.000	1653.9	1630
2008/01/14	10:32:00	0.000	1621.0	1630
2008/01/14	10:34:00	0.000	1613.6	1601
2008/01/14	10:36:00	0.000	1628.8	1594
2008/01/14	10:38:00	0.000	1631.6	1608
2008/01/14	10:40:00	0.000	1657.6	1575
2008/01/14	10:42:00	0.000	1655.7	1601
2008/01/14	10:44:00	0.000	1652.7	1586
Average Run 1			1639.2	1593.8
2008/01/14	11:56:00	0.000	1651.8	1580
2008/01/14	11:58:00	0.000	1651.6	1611
2008/01/14	12:00:00	0.000	1583.8	1596
2008/01/14	12:02:00	0.000	1656.6	1607
2008/01/14	12:04:00	0.000	1642.9	1625
2008/01/14	12:06:00	0.000	1620.8	1636
2008/01/14	12:08:00	0.000	1635.7	1601

2008/01/14	12:10:00	0.000	1667.9	1631
2008/01/14	12:12:00	0.000	1646.7	1631
2008/01/14	12:14:00	0.000	1644.8	1528
2008/01/14	12:16:00	0.000	1604.8	1619
2008/01/14	12:18:00	0.000	1635.9	1621
2008/01/14	12:20:00	0.000	1648.7	1613
2008/01/14	12:22:00	0.000	1647.7	1586
2008/01/14	12:24:00	0.000	1628.8	1637
2008/01/14	12:26:00	0.000	1651.8	1625
2008/01/14	12:28:00	0.000	1636.5	1613
2008/01/14	12:30:00	0.000	1657.8	1559
2008/01/14	12:32:00	0.000	1621.8	1595
2008/01/14	12:34:00	0.000	1655.7	1606
2008/01/14	12:36:00	0.000	1653.7	1646
2008/01/14	12:38:00	0.000	1624.7	1672
2008/01/14	12:40:00	0.000	1618.7	1653
2008/01/14	12:42:00	0.000	1648.7	1561
2008/01/14	12:44:00	0.000	1658.8	1606
2008/01/14	12:46:00	0.000	1646.8	1602
2008/01/14	12:48:00	0.000	1638.8	1616
2008/01/14	12:50:00	0.000	1623.7	1598
2008/01/14	12:52:00	0.000	1632.8	1580
2008/01/14	12:54:00	0.000	1642.7	1620
2008/01/14	12:56:00	0.000	1650.6	1588
2008/01/14	12:58:00	0.000	1630.7	1652
2008/01/14	13:00:00	0.000	1625.8	1610
2008/01/14	13:02:00	0.000	1641.7	1612
Average Run 2			1639.1	1609.9

2008/01/14	13:28:00	0.000	1630.7	1631
2008/01/14	13:30:00	0.000	1622.8	1612
2008/01/14	13:32:00	0.000	1634.7	1653
2008/01/14	13:34:00	0.000	1635.9	1668
2008/01/14	13:36:00	0.000	1638.8	1641
2008/01/14	13:38:00	0.000	1662.8	1624
2008/01/14	13:40:00	0.000	1628.7	1655
2008/01/14	13:42:00	0.000	1620.8	1680
2008/01/14	13:44:00	0.000	1623.7	1701
2008/01/14	13:46:00	0.000	1658.8	1638
2008/01/14	13:48:00	0.000	1652.7	1610
2008/01/14	13:50:00	0.000	1640.7	1628
2008/01/14	13:52:00	0.000	1617.9	1664
2008/01/14	13:54:00	0.000	1621.8	1720
2008/01/14	13:56:00	0.000	1641.7	1663
2008/01/14	13:58:00	0.000	1658.7	1641
2008/01/14	14:00:00	0.000	1640.8	1645
2008/01/14	14:02:00	0.000	1622.7	1642
2008/01/14	14:04:00	0.000	1627.8	1651
2008/01/14	14:06:00	0.000	1660.7	1632
2008/01/14	14:08:00	0.000	1647.9	1642

2008/01/14	14:10:00	0.000	1635.9	1620
2008/01/14	14:12:00	0.000	1599.7	1579
2008/01/14	14:14:00	0.000	1621.6	1588
2008/01/14	14:16:00	0.000	1650.8	1626
2008/01/14	14:18:00	0.000	1648.7	1622
2008/01/14	14:20:00	0.000	1640.7	1602
2008/01/14	14:22:00	0.000	1634.7	1639
2008/01/14	14:24:00	0.000	1642.7	1651
2008/01/14	14:26:00	0.000	1646.7	1704
2008/01/14	14:28:00	0.000	1642.9	1643
2008/01/14	14:30:00	0.000	1643.7	1648
2008/01/14	14:32:00	0.000	1661.1	1648
2008/01/14	14:34:00	0.000	1648.7	1656
Average Run 3			1638.5	1643.1

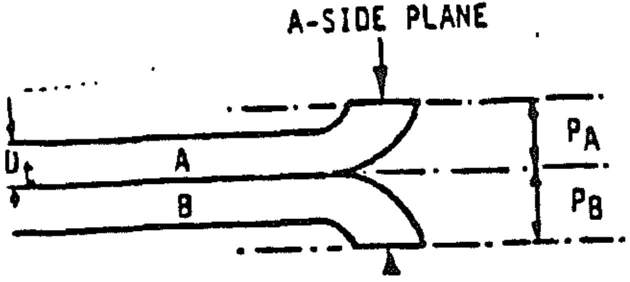
APPENDIX G - Calibration Data

TYPE S PITOT TUBE INSPECTION DATA FORM   Inconel 10-2

Tubing diameter, D_t 0.394 in.

Pitot Tube Assembly Level? [✓ Yes] / No

Pitot Tube Openings Damaged? Yes / [✓ No]



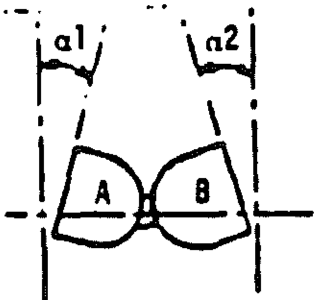
NOTE: 0.848

P_A = 0.424 in.

P_B = 0.424 in.

$$\left\{\begin{array}{l} 1.05\ D_t < P < 1.50\ D_t \\ P_A = P_B \end{array}\right.$$

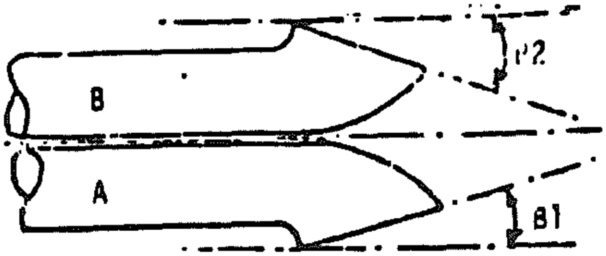
0.4137=0.5910



α_1 = 1.2°

α_2 = 1.0°

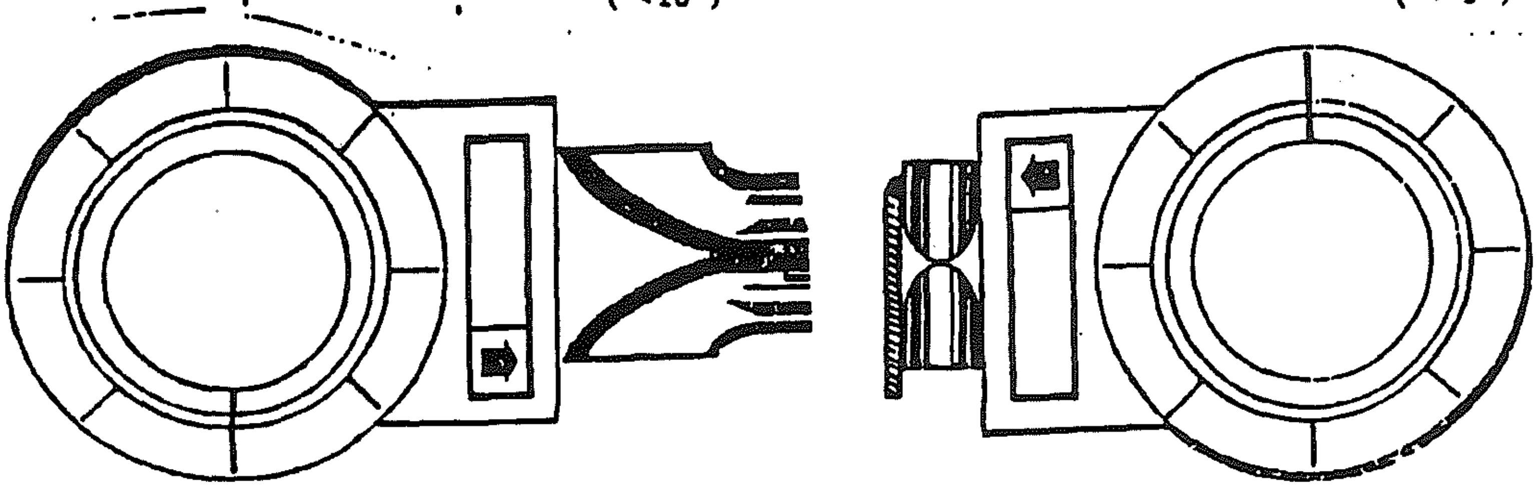
(<10°)



β_1 1.0

β_2 1.0

(< 5°)



Level Position to Find γ = 1.0

Z = A sin γ 0.0148 in. (< 1/8 in.)

Level Position to find θ 1.0

W = A sin θ 0.0148 in. (< 1/32 i

Comments

Checked by:

Date: 1-11-08

Calibration Required? NO

STACK TEMPERATURE SENSOR CALIBRATION DATA- APEX PROBE ASSEMBLIES

Date: 07/25/07
Calibrated by: BJ

THERMOCOUPLE ID:

	ICE WATER						ABSOLUTE T DIFF., %			BOILING WATER						ABSOLUTE T DIFF., %			BOILING OIL						ABSOLUTE T DIFF., %		
	REF			TC						REF			TC						REF			TC					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Stainless Steel Probes																											
3-1	32	32	32	32	31	31	0.0	0.2	0.2	212	212	212	213	212	212	-0.1	0.0	0.0	538	538	536	532	535	534	0.6	0.3	0.2
4-2	32	32	32	30	32	32	0.4	0.0	0.0	212	212	212	210	210	210	0.3	0.3	0.3	534	536	534	531	531	531	0.3	0.5	0.3
4-3	32	32	32	32	30	31	0 0	0.4	0.2	212	212	212	208	209	210	0.6	0.4	0.3	546	545	544	540	542	542	0.6	0.3	0.2
4-4	32	32	32	32	30	31	0.0	0.4	0.2	212	212	212	208	209	210	0.6	0.4	0.3	546	545	544	540	542	542	0.6	0.3	0.2
4-5	32	32	32	32	30	31	0.0	0.4	0.2	212	212	212	208	209	210	0.6	0.4	0.3	546	545	544	540	542	542	0.6	0.3	0.2
6-2	32	32	32	30	29	30	0.4	0.6	0.4	212	212	212	208	209	209	0.6	0.4	0.4	540	540	543	536	537	544	0.4	0.3	-0.1
6-3	32	32	32	31	30	30	0.2	0.4	0.4	212	212	212	211	212	210	0.1	0.0	0.3	539	538	538	537	535	534	0.2	0.3	0.4
6-4	32	32	32	29	30	31	0.6	0.4	0.2	212	212	212	210	210	210	0.2	0.3	0.3	539	539	539	533	533	535	0.6	0.6	0.4
A6-5	32	32	32	30	31	31	0.4	0.2	0.2	212	212	212	213	213	212	-0.1	-0.1	0.0	538	539	539	535	535	535	0.3	0.4	0.4
A8-1	31	32	32	30	30	31	0.2	0.4	0.2	212	212	212	209	208	209	0.4	0.6	0.4	546	548	550	540	547	550	0.6	0.1	0.0
A8-2	32	32	32	31	31	31	0.2	0.2	0.2	212	212	212	211	212	210	0.1	0.0	0.3	540	539	540	536	536	536	0.4	0.3	0.4
A8-3	32	32	32	31	30	31	0.2	0.4	0.2	212	212	212	210	210	211	0.3	0.3	0.1	537	537	537	531	532	540	0.6	0.5	-0.3
10-1	32	32	32	32	31	31	0.0	0.2	0.2	212	212	212	211	212	209	0.1	0.0	0.4	537	535	536	534	535	534	0.3	0.0	0.2
M17-1	32	32	32	31	31	32	0.2	0.2	0.0	212	212	212	211	211	211	0.1	0.1	0.1	540	540	541	542	542	541	-0.2	-0.2	0.0
M17-2	32	32	32	32	33	33	0.0	-0.2	-0.2	212	212	212	212	211	210	0.0	0.1	0.3	541	539	539	539	539	540	0.2	0.0	-0.1
M17-3	32	32	32	31	32	31	0.2	0.0	0.2	212	212	212	211	211	212	0.1	0.1	0.0	543	545	545	544	546	547	-0.1	-0.1	-0.2
Inconel																											
10-2 Inc	32	32	32	34	34	34	-0.4	-0.4	-0.4	212	212	212	213	213	213	-0.1	-0.1	-0.1	540	539	538	539	537	538	0.1	0.2	0.0
6-1 Inc	32	32	32	36	36	36	-0.8	-0.8	-0.8	212	212	212	210	210	208	0.3	0.3	0.6	549	550	549	543	540	540	0.6	1.0	0.9
Loose Thermocouple																											
6-5	32	32	32	34	35	34	-0.4	-0.6	-0.4	212	212	212	210	211	211	0.3	0.1	0.1	537	540	536	537	538	537	0.0	0.2	-0.1
6-8	32	32	32	32	32	32	0.0	0.0	0.0	212	212	212	212	210	210	0.0	0.3	0.3	538	539	541	539	539	539	-0.1	0.0	0.2
7-1	32	32	32	34	35	35	-0.4	-0.6	-0.6	212	212	212	210	210	210	0.3	0.3	0.3	543	544	544	546	547	548	-0.3	-0.3	-0.4
6-5	32	32	32	32	33	32	0.0	-0.2	0.0	212	212	212	210	212	213	0.3	0.0	-0.1	548	546	545	543	544	543	0.5	0.2	0.2

Note: If absolute temperature values of the reference thermometer being calibrated and the stack temperature sensors agree within 1.5 percent at each of the three calibration points, no correction is needed.

STACK TEMPERATURE SENSOR CALIBRATION DATA- APEX PROBE ASSEMBLIES

Date: 01/16/08
Calibrated by: BJ

THERMOCOUPLE ID:

	ICE WATER						ABSOLUTE T DIFF., %			BOILING WATER						ABSOLUTE T DIFF., %			BOILING OIL						ABSOLUTE T DIFF., %		
	REF			TC						REF			TC						REF			TC					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Stainless Steel Probes																											
3-1	32	32	32	32	31	31	0.0	0.2	0.2	212	212	212	213	212	212	-0.1	0.0	0.0	538	538	536	532	535	534	0.6	0.3	0.2
4-2	32	32	32	30	32	32	0.4	0.0	0.0	212	212	212	210	210	210	0.3	0.3	0.3	534	536	534	531	531	531	0.3	0.5	0.3
4-3	32	32	32	32	30	31	0.0	0.4	0.2	212	212	212	208	209	210	0.6	0.4	0.3	546	545	544	540	542	542	0.6	0.3	0.2
4-4	32	32	32	32	30	31	0.0	0.4	0.2	212	212	212	208	209	210	0.6	0.4	0.3	546	545	544	540	542	542	0.6	0.3	0.2
4-5	32	32	32	32	30	31	0.0	0.4	0.2	212	212	212	208	209	210	0.6	0.4	0.3	546	545	544	540	542	542	0.6	0.3	0.2
6-2	32	32	32	30	29	30	0.4	0.6	0.4	212	212	212	208	209	209	0.6	0.4	0.4	540	540	543	536	537	544	0.4	0.3	-0.1
6-3	32	32	32	31	30	30	0.2	0.4	0.4	212	212	212	211	212	210	0.1	0.0	0.3	539	538	538	537	535	534	0.2	0.3	0.4
6-4	32	32	32	29	30	31	0.6	0.4	0.2	212	212	212	210	210	210	0.2	0.3	0.3	539	539	539	533	533	535	0.6	0.6	0.4
A6-5	32	32	32	30	31	31	0.4	0.2	0.2	212	212	212	213	213	212	-0.1	-0.1	0.0	538	539	539	535	535	535	0.3	0.4	0.4
A8-1	31	32	32	30	30	31	0.2	0.4	0.2	212	212	212	209	208	209	0.4	0.6	0.4	546	548	550	540	547	550	0.6	0.1	0.0
A8-2	32	32	32	31	31	31	0.2	0.2	0.2	212	212	212	211	212	210	0.1	0.0	0.3	540	539	540	536	536	536	0.4	0.3	0.4
A8-3	32	32	32	31	30	31	0.2	0.4	0.2	212	212	212	210	210	211	0.3	0.3	0.1	537	537	537	531	532	540	0.6	0.5	-0.3
10-1	32	32	32	32	31	31	0.0	0.2	0.2	212	212	212	211	212	209	0.1	0.0	0.4	537	535	536	534	535	534	0.3	0.0	0.2
M17-1	32	32	32	31	31	32	0.2	0.2	0.0	212	212	212	211	211	211	0.1	0.1	0.1	540	540	541	542	542	541	-0.2	-0.2	0.0
M17-2	32	32	32	32	33	33	0.0	-0.2	-0.2	212	212	212	212	211	210	0.0	0.1	0.3	541	539	539	539	539	540	0.2	0.0	-0.1
M17-3	32	32	32	31	32	31	0.2	0.0	0.2	212	212	212	211	211	212	0.1	0.1	0.0	543	545	545	544	546	547	-0.1	-0.1	-0.2
Inconel																											
10-2 Inc	32	32	32	34	34	34	-0.4	-0.4	-0.4	212	212	212	213	213	213	-0.1	-0.1	-0.1	540	539	538	539	537	538	0.1	0.2	0.0
6-1 Inc	32	32	32	36	36	36	-0.8	-0.8	-0.8	212	212	212	210	210	208	0.3	0.3	0.6	549	550	549	543	540	540	0.6	1.0	0.9
Loose Thermocouple																											
6-5	32	32	32	34	35	34	-0.4	-0.6	-0.4	212	212	212	210	211	211	0.3	0.1	0.1	537	540	536	537	538	537	0.0	0.2	-0.1
6-8	32	32	32	32	32	32	0.0	0.0	0.0	212	212	212	212	210	210	0.0	0.3	0.3	538	539	541	539	539	539	-0.1	0.0	0.2
7-1	32	32	32	34	35	35	-0.4	-0.6	-0.6	212	212	212	210	210	210	0.3	0.3	0.3	543	544	544	546	547	548	-0.3	-0.3	-0.4
8-3	32	32	32	32	33	32	0.0	-0.2	0.0	212	212	212	210	212	213	0.3	0.0	-0.1	548	546	545	543	544	543	0.5	0.2	0.2

Note: If absolute temperature values of the reference thermometer being calibrated and the stack temperature sensors agree within 1.5 percent at each of the three calibration points, no correction is needed.

Magnehelic Gauge Calibration Data

Range:	0 - 0.25"		
Date:	7/24/2007	Calibrated by:	BJ
BAROMETRIC PRESURE:	29.24	Reference:	0.0-0.25 Manometer
SYSTEM LEAK CHECKS (Y/N):	Y		
POINT LEAK CHECK (Y/N):	Y		
Magnahelic Box	1		
Serial #	R010905PW95		

MAG	MAN R1	MAN R2	MAN R3	MEAN	MEAN/MAG
0.05	0.05	0.05	0.05	0.049	0.987
0.10	0.10	0.10	0.10	0.099	0.987
0.15	0.15	0.15	0.15	0.150	1.000
0.20	0.20	0.20	0.20	0.200	1.000
0.25	0.25	0.25	0.25	0.250	0.999

Correction Factor: 0.9944

Magnehelic Gauge Calibration Data

Range: 0 - 0.25"

Date: 1/17/2008

Calibrated by: BJ

BAROMETRIC PRESURE: 29.24

Reference: 0.0-0.25 Manometer

SYSTEM
LEAK CHECKS (Y/N): Y

POINT
LEAK CHECK (Y/N): Y

Magnahelic Box 1

Serial # R010905PW95

MAG	MAN R1	MAN R2	MAN R3	MEAN	MEAN/MAG
0.05	0.05	0.05	0.05	0.049	0.987
0.10	0.10	0.10	0.10	0.099	0.987
0.15	0.15	0.15	0.15	0.150	1.000
0.20	0.20	0.20	0.20	0.200	1.000
0.25	0.25	0.25	0.25	0.250	0.999

Correction Factor: 0.9944

APEX INSTRUMENTS METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING CALIBRATED CRITICAL ORIFICES
5-POINT ENGLISH UNITS

Meter Console Information	
Console Model Number	522/MB07
Console Serial Number	608193
DGM Model Number	S110
DGM Serial Number	1039620

Calibration Conditions			
Date	Time	7-Jan-08	12:20:00 PM
Barometric Pressure		29.2	in Hg
Theoretical Critical Vacuum[1]		13.8	in Hg
Calibration Technician		BJ run#3	

Factors/Conversions		
Std Temp	528	°R
Std Press	29.92	in Hg
K_1	17.647	oR/in Hg

[1]For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.

[2]The Critical Orifice Coefficient, K', must be entered in English units, $(ft^{3}{}^{\circ}R^{1/2})/(in.Hg*min)$.

Calibration Data										
Run Time	Metering Console					Critical Orifice				
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Serial Number	Coefficient	Amb Temp Initial	Amb Temp Final	Actual Vacuum
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})		K'	(t_{amb})	(t_{amb})	
min	in H_2O	cubic feet	cubic feet	°F	°F		see above2	°F	°F	in Hg
20.0	0.3	877.665	883.793	65	64	RN-40	0.2333	63	62	24
15.0	0.6	883.793	890.613	64	64	RN-48	0.3455	62	62	23
20.0	1.1	890.613	902.269	64	65	RN-55	0.4431	62	62	22
15.0	1.9	902.269	914.153	64	67	RN-63	0.6003	62	62	19
13.0	3.2	914.153	927.624	66	70	RN-73	0.7827	62	62	17

Results								
Standardized Data				Dry Gas Meter				
				Calibration Factor		Flowrate	ΔH @	
Dry Gas Meter		Critical Orifice		Value	Variation	Std & Corr	0.75 SCFM	Variation
$(V_{m(std)})$	$(Q_{m(std)})$	$(Vcr_{(std)})$	$(Q_{cr(std)})$	(Y)	(ΔY)	$(Q_{m(std)(corr)})$	(ΔH@)	(ΔΔH@)
cubic feet	cfm	cubic feet	cfm			cfm	in H2O	
6.033	0.302	5.969	0.298	0.989	0.004	0.298	1.619	-0.131
6.726	0.448	6.633	0.442	0.986	0.001	0.442	1.735	-0.015
11.497	0.575	11.342	0.567	0.986	0.001	0.567	1.818	0.068
11.725	0.782	11.524	0.768	0.983	-0.002	0.768	1.796	0.046
13.271	1.021	13.022	1.002	0.981	-0.004	1.002	1.783	0.033
				0.985	Y Average		1.750	ΔH@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.

I certify that the above Dry Gas Meter was calibrated in accordance with USEPA Methods, CFR Title 40, Part 60, Appendix A-3, Method 5, 16.2.3

Signature

Date 1-7-08

PRAXAIR

Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Telephone: (323) 585-2154
Facsimile: (323) 585-0582

10/26/2007
ES

Horizon Air Measurements
996 Lawrence Dr Ste 108
Newbury Park, CA
USA 91320

Praxair Order No.	**04150266-00**	Product Lot/Batch No.	**109725008**
Customer Reference No.	**8A065**	Praxair Part No.	**EV NICDOXP1-AS**
Intended End User:	**Horizon Air Measurements**	P.O No.	**9201**

CERTIFICATE OF ANALYSIS

Primary Standard

Component	Requested Concentration	Certified Concentration	Analytical Principle	Analytical Accuracy
Carbon dioxide	**7 %**	**7.00 %**	**V**	**±1%**
Oxygen	**12 %**	**12.02 %**	**V**	**±1%**
Nitrogen	**balance**	**balance**		

Analytical Instruments: **Mettler~ID5~Gravimetric~Gravimetric**

Cylinder Style:	**AS**	Filling Method:	**Gravimetric**
Cylinder Pressure @70F:	**2000 psig**	Date of Fill:	**9/7/2007**
Cylinder Volume:	**147 ft3**	Expiration Date:	**10/26/2010**
Valve Outlet Connection:	**CGA-590**		
Cylinder No(s).	**CC 86389**		
Comments:	**Values not valid below 150 psig.**		

Analyst: **King Cheung**

QA Reviewer: **Phu Tien Nguyen**

The gas calibration cylinder standard prepared by Praxair Distribution is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST) or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted.

Key to Analytical Techniques:

A	Flame Ionization with Methanizer	B	Gas Chromatography with Discharge Ionization Detector	C	Gas Chromatography with Electrolytic Conductivity Detector	D	Gas Chromatography with Flame Ionization Detector
E	Gas Chromatography with Flame Photometric Detector	F	Gas Chromatography with Helium Ionization Detector	G	Gas Chromatography with Methanizer Carbonizer	H	Gas Chromatography with Photoionization Detector
I	Gas Chromatography with Reduction Gas Analyzer	J	Gas Chromatography with Thermal Conductivity Detector	K	Gas Chromatography with Ultrasonic Detector	L	Infrared - FTIR or NDIR
M	Mass Spectrometry - MS or GC/MS	N	Proprietary	O	Paramagnetic	P	Specific Water Analyzer
Q	Total Hydrocarbon Analyzer	R	Wet Chemical	S	Detector Tube	T	Odor
U	Chemiluminescence	V	Gravimetric	W	Electrolytic Cell/Eletrochemical	X	Photoionization
Y	Pulsed Fluorescence	Z	UV Spectrometry				

IMPORTANT

The information contained herein has been prepared at your request by personnel within Praxair Distribution. While we believe the information is accurate within the limits of the analytical methods employed and is complete to the extent of the specific analyses performed, we make no warranty or representation as to the suitability of the use of the information for any particular purpose. The information is offered with the understanding that any use of the information is at the sole discretion and risk of the user. In no event shall liability of Praxair Distribution, Inc. arising out of the use of the information contained herein exceed the fee established for providing such information.

PRAXAIR

Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Telephone: (323) 585-2154
Facsimile: (714) 542-6689

6/14/2006

Horizon Air
996 Lawrence Dr Ste 108
Newbury Park, CA 91320
USA

Attention: DRF

Praxair Order No.	**558202-00**	Product Lot/Batch No.	**109612303**
Customer Reference No.		Praxair Part No.	**NI CDOXP80-AS**
Intended End User:	**HORIZON AIR MEASUREMENTS**		

CERTIFICATE OF ANALYSIS

Primary Standard

Component	Requested Concentration	Certified Concentration	Analytical Principle	Analytical Accuracy
Carbon dioxide	**12 %**	**11.97 %**	**V**	**±1 %**
Oxygen	**20 %**	**20.05 %**	**V**	**±1 %**
Nitrogen	**balance**	**balance**		

Analytical Instruments: **Mettler~ID5~Gravimetric~Gravimetric**

Cylinder Style:	**AS**	Filling Method:	**Gravimetric**
Cylinder Pressure @70F:	**2000 psig**	Date of Fill:	**5/3/2006**
Cylinder Volume:	**151 ft3**	Expiration Date:	**12/31/2009**
Valve Outlet Connection:	**CGA-590**		
Cylinder No(s).	**CC 181295**		
Comments:	**VALUES NOT VALID BELOW 150 PSIG.**		

Analyst: **Ben Chen**

QA Reviewer: **Phu Tien Nguyen**

The gas calibration cylinder standard prepared by Praxair Distribution is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST) or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted.

Key to Analytical Techniques:

A	Flame Ionization with Methanizer	B	Gas Chromatography with Discharge Ionization Detector	C	Gas Chromatography with Electrolytic Conductivity Detector	D	Gas Chromatography with Flame Ionization Detector
E	Gas Chromatography with Flame Photometric Detector	F	Gas Chromatography with Helium Ionization Detector	G	Gas Chromatography with Methanizer Carbonizer	H	Gas Chromatography with Photoionization Detector
I	Gas Chromatography with Reduction Gas Analyzer	J	Gas Chromatography with Thermal Conductivity Detector	K	Gas Chromatography with Ultrasonic Detector	L	Infrared - FTIR or NDIR
M	Mass Spectrometry - MS or GC/MS	N	Proprietary	O	Paramagnetic	P	Specific Water Analyzer
Q	Total Hydrocarbon Analyzer	R	Wet Chemical	S	Detector Tube	T	Odor
U	Chemiluminescence	V	Gravimetric	W	Electrolytic Cell/Electrochemical	X	Photoionization
Y	Pulsed Fluorescence	Z	UV Spectrometry				

PRAXAIR

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CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

CUSTOMER HORIZON AIR **P.O NUMBER**

REFERENCE STANDARD

COMPONENT	**NIST SRM NO.**	**CYLINDER NO.**	**CONCENTRATION**
NITRIC OXIDE GMIS	vsSRM#2629a	CC 149417	24.2 ppm

ANALYZER READINGS

R=REFERENCE STANDARD ***Z=ZERO GAS*** ***C=GAS CANDIDATE***

1. **COMPONENT** NITRIC OXIDE GMIS **ANALYZER MAKE-MODEL-S/N** Thermo Env. 42C S/N 0518112467

ANALYTICAL PRINCIPLE Chemiluminescence **LAST CALIBRATION DATE** 10/04/07

FIRST ANALYSIS DATE 09/06/07 **SECOND ANALYSIS DATE** 10/29/07

Z	0	**R**	24.2	**C**	12.47	**CONC.**	12.5	**Z**	0	**R**	24.5	**C**	12.64	**CONC.**	12.5
R	24.2	**Z**	0	**C**	12.48	**CONC.**	12.5	**R**	24.5	**Z**	0	**C**	12.64	**CONC.**	12.5
Z	0	**C**	12.48	**R**	24.2	**CONC.**	12.5	**Z**	0	**C**	12.64	**R**	24.5	**CONC.**	12.5
U/M	ppm					**MEAN TEST ASSAY**	12.5	**U/M**	ppm					**MEAN TEST ASSAY**	12.5

VALUES NOT VALID BELOW 150 PSIG.
NOx VALUE FOR REFERENCE USE ONLY.

THIS CYLINDER NO. CC 243704
HAS BEEN CERTIFIED ACCORDING TO SECTION EPA-600/R97/121
OF TRACEABILITY PROTOCOL NO. REV.9/97
PROCEDURE G1
CERTIFIED ACCURACY ± 1 **% NIST TRACEABLE**
CYLINDER PRESSURE 2000 **PSIG**
CERTIFICATION DATE 10/29/07
EXPIRATION DATE 10/29/09 **TERM** 24 MONTHS

CERTIFIED CONCENTRATION

NITRIC OXIDE	12.5 ppm
NITROGEN	BALANCE
NOx	12.5 ppm

ANALYZED BY PHIL KIM

CERTIFIED BY JACK FU

IMPORTANT
Information contained herein has been prepared at your request by qualified experts within Praxair Distribution, Inc. While we believe that the information is accurate within the limits of the analytical methods employed and is complete to the extent of the specific analyses performed, we make no warranty or representation as to the suitability of the use of the information for any particular purpose. The information is offered with the understanding that any use of the information is at the sole discretion and risk of the user. In no event shall liability of Praxair Distribution, Inc. arising out of the use of the information contained herein exceed the fee established for providing such information.

PRAXAIR

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5700 South Alameda Street
Los Angeles, CA 90058
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Facsimile: (714) 542-6689

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

STOCK

CUSTOMER HORIZON AIR MEASUREMENT **P.O NUMBER**

REFERENCE STANDARD

COMPONENT	NIST SRM NO.	CYLINDER NO.	CONCENTRATION
NITRIC OXIDE GMIS	vsSRM#2629a	CC 149417	24.7 ppm

ANALYZER READINGS

R=REFERENCE STANDARD *Z=ZERO GAS* *C=GAS CANDIDATE*

1. **COMPONENT** NITRIC OXIDE GMIS **ANALYZER MAKE-MODEL-S/N** THERMO ENV. 42C S/N 0518112467

ANALYTICAL PRINCIPLE CHEMILUMINESCENCE **LAST CALIBRATION DATE** 05/02/07

FIRST ANALYSIS DATE 09/27/05 **SECOND ANALYSIS DATE** 05/07/07

Z	0.0	**R**	24.9	**C**	23.7	**CONC.**	23.6	**Z**	0.0	**R**	24.8	**C**	23.8	**CONC.**	23.7
R	24.8	**Z**	0.0	**C**	23.8	**CONC.**	23.8	**R**	24.8	**Z**	0.0	**C**	23.8	**CONC.**	23.7
Z	0.0	**C**	23.9	**R**	24.8	**CONC.**	23.9	**Z**	0.0	**C**	23.8	**R**	24.8	**CONC.**	23.7
U/M	ppm					**MEAN TEST ASSAY**	23.8	**U/M**	ppm					**MEAN TEST ASSAY**	23.7

VALUE NOT VALID BELOW 150 PSIG.
NOX VALUE=23.7 ppm FOR REFERENCE USE ONLY.

THIS CYLINDER NO. CC 196609
HAS BEEN CERTIFIED ACCORDING TO SECTION EPA-600/R97/121
OF TRACEABILITY PROTOCOL NO. Rev. 9/97
PROCEDURE G1
CERTIFIED ACCURACY ± 1 **% NIST TRACEABLE**
CYLINDER PRESSURE 2000 **PSIG**
CERTIFICATION DATE 05/07/07
EXPIRATION DATE 05/07/09 **TERM** 24 MONTHS

CERTIFIED CONCENTRATION

NITRIC OXIDE	23.7 ppm
NITROGEN	BALANCE
NOx	23.7 ppm

ANALYZED BY HENRY KOUNG

CERTIFIED BY JOSEPH CHARLES

PRAXAIR

Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Telephone: (323) 585-2154
Facsimile: (714) 542-6689

6/2/2006

HORIZON AIR
455 E WOOLEY RD
OXNARD, CA 93030
USA

Praxair Order No. **410897-00**
Customer Reference No.
Intended End User: **Horizon Air**
Product Lot/Batch No. **109517305**
Praxair Part No. **EV NINX19MP-AS**

CERTIFICATE OF ANALYSIS

Primary Standard

Component	Requested Concentration	Certified Concentration	Analytical Principle	Analytical Accuracy
Nitrogen dioxide (as NOx)	**19 ppm**	**17.9 ppm**	**U**	**±1%**
Nitrogen	**balance**	**balance**		

Analytical Instruments: **Thermo Environmental~42H~S/N 44979-273 ~Chemiluminescence**
Cylinder Style: **AS**
Cylinder Pressure @70F: **2000 psig**
Cylinder Volume: **141 ft3**
Valve Outlet Connection: **CGA-660**
Cylinder No(s). **CC 141408**
Filling Method: **Gravimetric**
Date of Fill: **6/22/2005**
Expiration Date: **6/5/2008**
Comments: **All values not valid below 150 psig.**
NO=0.9 ppm value for reference use only.

Analyst: **Henry Koung**
QA Reviewer: **Phu Tien Nguyen**

The gas calibration cylinder standard prepared by Praxair Distribution is considered a certified standard. It is prepared by gravimetric, volumetric, or partial pressure techniques. The calibration standard provided is certified against Praxair Reference Materials which are either prepared by weights traceable to the National Institute of Standards and Technology (NIST) or by using NIST Standard Reference Materials where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by volume (e.g., ppmv) unless otherwise noted.

Key to Analytical Techniques:

A	Flame Ionization with Methanizer	B	Gas Chromatography with Discharge Ionization Detector	C	Gas Chromatography with Electrolytic Conductivity Detector	D	Gas Chromatography with Flame Ionization Detector
E	Gas Chromatography with Flame Photometric Detector	F	Gas Chromatography with Helium Ionization Detector	G	Gas Chromatography with Methanizer Carbonizer	H	Gas Chromatography with Photoionization Detector
I	Gas Chromatography with Reduction Gas Analyzer	J	Gas Chromatography with Thermal Conductivity Detector	K	Gas Chromatography with Ultrasonic Detector	L	Infrared - FTIR or NDIR
M	Mass Spectrometry - MS or GC/MS	N	Proprietary	O	Paramagnetic	P	Specific Water Analyzer
Q	Total Hydrocarbon Analyzer	R	Wet Chemical	S	Detector Tube	T	Odor
U	Chemiluminescence	V	Gravimetric	W	Electrolytic Cell/Electrochemical	X	Photoionization
Y	Pulsed Fluoroescence	Z	UV Spectrometry				

IMPORTANT
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PRAXAIR

Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Telephone: (323) 585-2154
Facsimile: (323) 585-0582

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

CUSTOMER HORIZON AIR STOCK **P.O NUMBER** 9201

REFERENCE STANDARD

COMPONENT	NIST SRM NO.	CYLINDER NO.	CONCENTRATION
CARBON MONOXIDE GMIS	vs.SRM#1678	GG 12277	53.67 ppm
NITRIC OXIDE GMIS	vs.SRM#1683	CC 211730	50.7 ppm

ANALYZER READINGS

R=REFERENCE STANDARD *Z=ZERO GAS* *C=GAS CANDIDATE*

1. **COMPONENT** CARBON MONOXIDE GMIS **ANALYZER MAKE-MODEL-S/N** HORIBA, VIA-510, S/N 576876015

ANALYTICAL PRINCIPLE NDIR **LAST CALIBRATION DATE** 10/17/07

FIRST ANALYSIS DATE 06/12/07 **SECOND ANALYSIS DATE** 10/29/07

Z 0	**R** 53.7	**C** 50.8	**CONC.** 50.8	**Z** 0	**R** 53.7	**C** 50.9	**CONC.** 50.9
R 53.7	**Z** 0	**C** 50.8	**CONC.** 50.8	**R** 53.7	**Z** 0	**C** 50.9	**CONC.** 50.9
Z 0	**C** 50.8	**R** 53.6	**CONC.** 50.9	**Z** 0	**C** 50.9	**R** 53.7	**CONC.** 50.9
U/M ppm		**MEAN TEST ASSAY**	50.8	**U/M** ppm		**MEAN TEST ASSAY**	50.9

2. **COMPONENT** NITRIC OXIDE GMIS **ANALYZER MAKE-MODEL-S/N** BECKMAN 951A S/N#0101354

ANALYTICAL PRINCIPLE CHEMILUMINESCENCE **LAST CALIBRATION DATE** 10/17/07

FIRST ANALYSIS DATE 06/12/07 **SECOND ANALYSIS DATE** 10/29/07

Z 0	**R** 753	**C** 735	**CONC.** 49.5	**Z** 0	**R** 796	**C** 782	**CONC.** 49.8
R 753	**Z** 0	**C** 734	**CONC.** 49.4	**R** 499	**Z** 0	**C** 784	**CONC.** 49.8
Z 0	**C** 732	**R** 752	**CONC.** 49.4	**Z** 0	**C** 783	**R** 799	**CONC.** 49.7
U/M mV		**MEAN TEST ASSAY**	49.4	**U/M** mV		**MEAN TEST ASSAY**	49.8

VALUES NOT VALID BELOW 150 PSIG
NOX VALUE FOR REFERENCE ONLY

THIS CYLINDER NO.	CC 257767	**CERTIFIED CONCENTRATION**	
HAS BEEN CERTIFIED ACCORDING TO SECTION	EPA-600/R97/121	CARBON MONOXIDE	50.9 ppm
OF TRACEABILITY PROTOCOL NO.	REV 9/97	NITRIC OXIDE	49.6 ppm
PROCEDURE	G1	NITROGEN	BALANCE
CERTIFIED ACCURACY	± 1 **% NIST TRACEABLE**	NOx	50.4 ppm
CYLINDER PRESSURE	2000 **PSIG**		
CERTIFICATION DATE	10/29/07		
EXPIRATION DATE	10/29/09 **TERM** 24 MONTHS		

ANALYZED BY VICTOR DOTAN ***CERTIFIED BY*** HASSAN GHASHAM

PRAXAIR

Praxair
5700 South Alameda Street
Los Angeles, CA 90058
Telephone: (323) 585-2154
Facsimile: (714) 542-6689

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS ES

CUSTOMER HORIZON AIR **P.O NUMBER** 9052

REFERENCE STANDARD

COMPONENT	NIST SRM NO.	CYLINDER NO.	CONCENTRATION
CARBON MONOXIDE GMIS	vs.SRM#1679	GG 12319	103.1 ppm
NITRIC OXIDE GMIS	vs.SRM#1684	CC 119925	103.1 ppm

ANALYZER READINGS

R=REFERENCE STANDARD *Z=ZERO GAS* *C=GAS CANDIDATE*

1. **COMPONENT** CARBON MONOXIDE GMIS **ANALYZER MAKE-MODEL-S/N** HORIBA, VIA-510, S/N 576876015

ANALYTICAL PRINCIPLE NDIR **LAST CALIBRATION DATE** 03/02/07
FIRST ANALYSIS DATE 03/19/07 **SECOND ANALYSIS DATE**

Z	0	**R**	103.1	**C**	79.7	**CONC.**	79.7	**Z**	**R**	**C**	**CONC.**
R	103.1	**Z**	0	**C**	79.8	**CONC.**	79.8	**R**	**Z**	**C**	**CONC.**
Z	0	**C**	79.8	**R**	103.1	**CONC.**	79.8	**Z**	**C**	**R**	**CONC.**
U/M	ppm			**MEAN TEST ASSAY**			79.8	**U/M** ppm			**MEAN TEST ASSAY**

2. **COMPONENT** NITRIC OXIDE GMIS **ANALYZER MAKE-MODEL-S/N** BECKMAN 951A S/N#0101354

ANALYTICAL PRINCIPLE CHEMILUMINESCENCE **LAST CALIBRATION DATE** 03/02/07
FIRST ANALYSIS DATE 03/19/07 **SECOND ANALYSIS DATE**

Z	0	**R**	839	**C**	638	**CONC.**	78.4	**Z**	**R**	**C**	**CONC.**
R	840	**Z**	0	**C**	639	**CONC.**	78.5	**R**	**Z**	**C**	**CONC.**
Z	0	**C**	640	**R**	839	**CONC.**	78.6	**Z**	**C**	**R**	**CONC.**
U/M	mV			**MEAN TEST ASSAY**			78.5	**U/M** mV			**MEAN TEST ASSAY**

VALUES NOT VALID BELOW 150 PSIG
NOX VALUE FOR REFERENCE ONLY

THIS CYLINDER NO. CC 157902
HAS BEEN CERTIFIED ACCORDING TO SECTION EPA-600/R97/121
OF TRACEABILITY PROTOCOL NO. REV 9/97
PROCEDURE G1
CERTIFIED ACCURACY ± 1 **% NIST TRACEABLE**
CYLINDER PRESSURE 1200 **PSIG**
CERTIFICATION DATE 03/19/07
EXPIRATION DATE 03/19/09 **TERM** 24 MONTHS

CERTIFIED CONCENTRATION

CARBON MONOXIDE	79.6 ppm
NITRIC OXIDE	78.8 ppm
NITROGEN	BALANCE
NOx	79.6 ppm

ANALYZED BY Phil K.
PHIL KIM

CERTIFIED BY V. D.
VICTOR DOTAN

APPENDIX H - Permit to Operate

VENTURA COUNTY
AIR POLLUTION CONTROL DISTRICT

669 County Square Drive
Ventura, CA 93003
805/645-1400

PART 70 PERMIT

Number 01395

Permit Term: January 1, 2003 to December 31, 2007

Company Name / Address:	Facility Name / Address:
Waste Management, Inc 2801 Madera Road Simi Valley, CA 93065	Simi Valley Landfill and Recycling Center 2801 Madera Road Simi Valley, CA 93065
Responsible Official:	**Title V Contact:**
Scott Tignac District Manager 805/579-7267	James Riley Environmental Engineer 805/579-7479

The Part 70 permit consists of this page and the tables, attachments and conditions listed in the attached table of contents. The Part 70 permit application is included for reference only and is not a part of the Part 70 permit.

Pursuant to Rule 33.1, the Part 70 permit shall also serve as a permit to operate issued to fulfill the requirements of Rule 10.B.

Christine White

Christine White, Manager Engineering Division	For: Michael Villegas Air Pollution Control Officer

July 12, 2006

\\APCDBULLPEN\DivData\ENG\TITLEV\TV Permits\Po1395\Permit\COVERB-221.doc

If you have any questions regarding this letter or the final permit, please contact John Harader at 805/645-1481 or myself at 805/645-1421.

Sincerely,

Kerby E. Zozula, Supervisor
Engineering Division

c: Scott Tignac, Waste Management, Inc.
Keith Duval, VCAPCD Compliance Division

\\APCDBULLPEN\DivData\ENG\TITLEV\TV Permits\Po1395\Letters\final-221.DOC

PART 70 PERMIT NO. 01395
TABLE OF CONTENTS

Note: The Part 70 permit application is included for reference only and is not a part of the Part 70 permit.

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Application No.	Issue Date	Description	Revised Permit Sections
01395-211	07/18/05	Permit Existing Emergency Engine / Minor Part 70 Permit Modification	• Signature Cover Page • Table of Contents • Permit Revisions Table • Stationary Source Description • Periodic Monitoring Table • Table No. 2 • Applicable Requirement Code Key • Table No. 3 • Table No. 4 • Insignificant Activities Table • *Remove* Attachment 74.6.1N1 • Attachment 74.6(2003) • Attachment ATCM Engine N2 • *Remove* Attachment 52 • *Remove* Attachment 57.B • Attachment 57.1 • *Remove* Attachment 68 • *Remove* Attachment 74.6 • Attachment 74.6(2003)
01395-221	07/12/06	Modifications to Rule 74.17.1 and 40 CFR Part 60 Subpart WWW compliance / Minor Part 70 Permit Modification	• Signature Cover Page • Table of Contents • Permit Revisions Table • Stationary Source Description • Periodic Monitoring Table • Table No. 2 • Applicable Requirements Code Key • Attachment 74.9N7 • Attachment 74.17.1-01395 *replaces Attachment 74.17.1N41395* • Attachment PO1395PC2 • Attachment PO1395PC3

PART 70 PERMIT NO. 01395
PERMIT REVISONS

Application No.	Issue Date	Description	Revised Permit Sections
01395-191	09/03/03	Increase Flares Consumption Limit / Minor Part 70 Permit Modification	• Signature Cover Page • Permit Revisions Table • Periodic Monitoring Table • Table No. 3 • Table No. 4 • Attachment PO1395PC2
01395-201	10/01/04	2 – 1,877 BHP Deutz IC Engines / Minor Part 70 Permit Modification	• Signature Cover Page • Table of Contents • Permit Revisions Table • Stationary Source Description • Periodic Monitoring Table • Table No. 2 • Equipment List Description Key • Applicable Requirement Code Key • Table No. 3 • Table No. 4 • *Remove* Attachment 74.17.1N2 • Attachment 74.17.1N4 • Attachment PO01395PC1 • Attachment PO01395PC2 • Attachment PO01395PC3

1. STATIONARY SOURCE DESCRIPTION AND PERMIT SUMMARY

Waste Management's Simi Valley Landfill and Recycling Center is located in southeastern Ventura County, off of Highway 118 in the city of Simi Valley. This municipal solid waste landfill has been in operation since 1970. The landfill has a Standard Industrial Classification (SIC) Code of 4953, Sanitary Services-Refuse Systems.

The Simi Valley Landfill is subject to Title V permitting as the facility is subject to Ventura County APCD Rule 74.17.1, "Municipal Solid Waste Landfills". Rule 74.17.1 was submitted to EPA as part of the California State Plan to control emissions from existing municipal solid waste landfills as required by 40 CFR Part 60, Subpart Cc, "Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills". EPA approved the California State Plan on November 22, 1999, which required the submittal of a Title V application by February 20, 2001.

As required by Rule 74.17.1, Waste Management submitted a Gas Collection and Control System Design Plan on March 10, 1999. The landfill gas collection system uses a number of gas collection wells that are routed to a common collection header.

The collected landfill gas is combusted in two 1,877 BHP Deutz lean burn internal combustion engines. Each landfill gas-fired engine powers an associated electrical generator that produces up to 1.35 megawatts (MW) of electricity, which is either sold or consumed on site by Waste Management. The engines have BACT (Best Available Control Technology) limits for ROC (Reactive Organic Compounds), NOx (Nitrogen Oxides), and SOx (Sulfur Oxides) and have a CO (Carbon Monoxide) emission limit pursuant to Rule 35, "Elective Emission Limits".

The stationary source also includes a 44 MMBTU/Hr McGill Environmental System enclosed landfill gas flare and a 75 MMBTU/Hr John Zink enclosed landfill gas flare that are used to combust the remaining landfill gas that is not used by the engines.

Rule 74.17.1 limits the emissions of NMOC (non-methane organic compounds), NOx, and CO from the landfill gas flares. The rule also has operational standards and monitoring, reporting, and recordkeeping requirements to make sure that adequate landfill gas is collected such that methane gas does not leak from the surface of the landfill.

The engines are also subject to the emission limits and operational requirements of Rule 74.9, "Stationary Internal Combustion Engines". The stationary source also includes a 105 BHP Caterpillar diesel-fired emergency engine that is exempt from Rule 74.9 but must comply with California Airborne Toxic Control Measure (ATCM) For Stationary Compression Ignition Engines.

Landfill condensate is collected and stored in a 1,500 gallon tank and in a 10,000 gallon tank. The collected condensate is either injected into the landfill or injected into the landfill gas flares. In addition to Rule 74.17.1, these tanks and the landfill gas flares have federally enforceable requirements and permit conditions that are based on Rule 26, "New Source Review".

In addition to the landfill gas collection and control system, the facility has other equipment and activities necessary to support and maintain the refuse and disposal operations. These "insignificant activities" are listed in Section No. 5 of the permit. These activities are exempt from permit pursuant to Rule 23, "Exemptions From Permit", and include storage tanks for diesel fuel, gasoline, and motor oil; small engines for air compressors, light towers, and pumps; and painting and surface coating with aerosol cans. The facility also has an exempt solvent cleaning tank for equipment repair and maintenance that complies with Rule 74.6, "Surface Cleaning and Degreasing".

This stationary source has stated that 40 CFR Part 68, "List of Regulated Substances and Thresholds for Accidental Release Prevention", is not an applicable requirement. Therefore, a risk management plan (RMP), pursuant to section 112(r) of the federal Clean Air Act as amended, is not required.

This permit also shields the source from the compliance assurance monitoring requirements of 40 CFR Part 64. There is an exemption in 40 CFR Part 64 for emission units and activities subject to emission limitations and standards proposed by EPA after November 15, 1990 pursuant to Section 111 or 112 of the Clean Air Act. The District adopted Rule 74.17.1, "Municipal Solid Waste Landfills", to implement the requirements of 40 CFR Part 60, Subpart Cc, "Emissions Guidelines and Compliance Times for Municipal Solid Waste Landfills". The EPA published the original proposal for the Emission Guidelines in the Federal Register on May 30, 1991 (56 FR 33790). The Emission Guidelines implement Section 111 of the Clean Air Act.

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1. PERIODIC MONITORING SUMMARY

This periodic monitoring summary is intended to aid the permittee in quickly identifying key monitoring, recordkeeping, and reporting requirements. It is not intended to be used as a "stand alone" monitoring guidance document that completely satisfies the requirements specifically applicable to this facility. The following tables are included in the periodic monitoring summary:

- Table 1.a - Specific Applicable Requirements
- Table 1.b - Permit-Specific Conditions
- Table 1.c - General Applicable Requirements
- Table 1.d - General Requirements for Short-Term Activities

1a. Specific Applicable Requirements

The Specific Applicable Requirements Table includes a summary of the monitoring requirements, recordkeeping requirements, reporting requirements, and test methods associated with the attachments contained in Section No. 6 of this permit.

Attachment No./ Condition No.	Applicable Rule or Requirement	Monitoring	Recordkeeping	Semi-annual Reports	Test Methods	Comments
74.6(2003)	Rule 74.6	•Annual compliance certification •Maintain current solvent information •Routine surveillance of solvent cleaning activities •Upon request, solvent testing •Measurement of freeboard height and drain hole area for cold cleaners	•Records of current solvent information	None	•ROC content – EPA Test Method 24 •Identity of solvent components: ASTM E168-67, ASTM E169-87, or ASTM E260-85 •True vapor pressure or composite vapor pressure: ASTM D2879-86 or other methods per Rule 74.6.G.5 •Initial boiling point: ASTM 1078-78 or published source •Spray gun active/passive solvent losses: SCAQMD Method (10-3-89)	
74.9N7	Rule 74.9.D.3	•Hours of Operation •Annual compliance certification	•Records of operating hours •Date, time, duration, and reason for emergency operation •Records of engine data	None	None	
ATCM Engine N2	ATCM for Stationary Compression Ignition Engines	•Hours of operation records for maintenance and testing •Fuel type records	•Hours of operation records for maintenance and testing •Fuel type records	None	None	Not federally enforceable

Ia. Specific Applicable Requirements (Continued)

74.17.1-1395	Rule 74.17.1	•Annual compliance certification •Monitor flare gas flow rate and flare temp •Monitor engine operating parameters •Monitor wells and collection header (temperature, pressure, nitrogen, oxygen) •Monitor methane concentration at the surface of the landfill •Source test flare every 2 years (NMOC, NOx, and CO)	•Records of waste in place and annual waste acceptance rate •Records of flare testing •Records of flare temperature and landfill gas flow to the flare •Records of existing wells, newly installed wells, and planned wells •Records of methane concentration at the landfill surface •Records of asbestos-containing or non-degradable waste •Records of exceedances	•Reports of exceedances •Reports of new wells	•NMOC-EPA Test Method 25 or 18 •NOx – EPA Method 7 •CO – EPA Method 10 •Calorific value –ASTM Method D1826-77 •O2 – EPA Method 3A •Exhaust Flow – F Factor EPA Method 19 •Surface Methane – EPA Method 21	

1b. Permit-Specific Conditions

The Permit-Specific Conditions Table includes a summary of the monitoring requirements, recordkeeping requirements, reporting requirements, and test methods associated with the attachments contained in Section No. 7 of this permit.

Attachment No./ Condition No.	Applicable Rule or Requirement	Monitoring	Recordkeeping	Semi-annual Reports	Test Methods	Comments
PO1395PC1 - Condition No. 1	Rule 26 General Recordkeeping	•Annual compliance certification •Monthly records of throughput and consumption	•Monthly records of throughput and consumption	None	None	
PO1395PC1 - Condition No. 2	Rule 29 Solvent Recordkeeping	•Monthly records of solvent purchase and usage	•Records of solvent purchase and usage	None	None	District enforceable only
PO1395PC2 - Condition No. 1	Rule 26 Flare BACT Limits McGill Flare	•Annual compliance certification •Flare temperature •Testing every 2 years (ROC,NOx) •Testing every 4 years (SOx)	•Records of flare temperature •Records of source tests	None	None	
PO1395PC2 - Condition No. 2	Rule 26 Flare BACT Limits John Zink Flare	•Annual compliance certification •Flare temperature •Testing every 2 years (ROC,NOx) •Testing every 4 years (SOx)	•Records of flare temperature •Records of source tests	None	• ROC-EPA Test Method 25 or 18 •NOx – EPA Method 7 •Sulfur Compounds - EPA Test Method 6, 6A, 6C, 8, 15, 16A,16B, or SCAQMD Method 307-94, as appropriate	
PO1395PC2 - Condition No. 3	Rule 52	•Annual compliance certification	None	None	None	Not required based on District EPA emission factor analysis
PO1395PC2 - Condition No. 4	Rule 54	•Annual compliance certification •Source test every 4 years •Modeling upon request	•Records of source tests	None	•Sulfur Compounds - EPA Test Method 6, 6A, 6C, 8, 15, 16A,16B, or SCAQMD Method 307-94, as appropriate	
PO1395PC2 - Condition No. 5	Rule 57.1	•Annual compliance certification	•Records of source tests	None		Not required based on District EPA emission factor analysis

1b. Permit-Specific Conditions (Continued)

Attachment No./ Condition No.	Applicable Rule or Requirement	Monitoring	Recordkeeping	Semi-annual Reports	Test Methods	Comments
PO1395PC2 - Condition No. 6	Rule 26 Flare Equipment Requirements McGill Flare	•Annual compliance certification	•None	None	None	
PO1395PC2 - Condition No. 7	Rule 26 Flare Equipment Requirements John Zink Flare	•Annual Compliance certification	•None	None		
PO1395PC2 - Condition No. 8	Rule 26 Flare Condensate Knockout / Filter Requirements John Zink Flare	•Annual compliance certification	•None	None	None	
PO1395PC2 - Condition No. 9	Rule 51 Flare Dimensions and Exhaust Velocity	•Source Testing	•Records of source tests	None	APCD approved test protocol	District enforceable only
PO1395PC2 - Condition No. 10	Rule 26 and 74.17.1 Calibration Requirements	•Annual compliance certification •Calibration records	•Records of calibration and function checks	None	None	
PO1395PC2 - Condition No. 11	Rule 26 Collection Vessel Emission Requirements	•Annual compliance certification	•None	None	None	
PO1395PC2 - Condition No. 12	Rule 26 Collection Vessel Vacuum Requirements	•Annual compliance certification	•None	None	None	
PO1395PC2 - Condition No. 13	Rule 26 Well Locations	•Annual compliance certification	•None	None	None	
PO1395PC2 - Condition Nos. 14 and 15	Rule 51 Toxics Testing and HRA Requirements	•Source testing	•Records of source tests	None	APCD approved test protocol	District enforceable only
PO1395PC3- Condition Nos. 1, 3, 4, 5, 6, 7, 8	Rules 26, 35, 74.9 Engine Emission Limits	•Annual compliance certification •Biennial source testing •Quarterly emission screening •Operator inspection plan •Emission inspections •Engine identification	•Records of source tests •Records of quarterly screenings •Engine identification •Records of engine emission inspections •Records of corrective action	•Records of source tests •Engine data •Annual usage •Summary of maintenance and testing reports	•ROC-EPA Test Method 25 or 18 •NOx – ARB Method 100 •CO – ARB Method 100 •O2 – ARB Method 100	
PO1395PC3- Condition Nos. 2, 3, 4	Rule 54	•Annual compliance certification •Annual source test •Modeling upon request	•Records of source tests	None	Sulfur Compounds - EPA Test Method 6, 6A, 6C, 8, 15, 16A, 16B, or SCAQMD Method 307-94, as appropriate	

1c. General Applicable Requirements

The General Applicable Requirements Table includes a summary of the monitoring requirements, recordkeeping requirements, reporting requirements, and test methods associated with the attachments contained in Section No. 8 of this permit.

Attachment No./ Condition No.	Applicable Rule or Requirement	Monitoring	Recordkeeping	Semi-annual Reports	Test Methods	Comments
50	Rule 50	•Routine surveillance •Visual inspections •Annual compliance certification, including a formal survey •Opacity readings upon request •Notification required for uncorrectable visible emissions	•All occurrences of visible emissions for periods>3min in any one hour •Annual formal survey of all emissions units	None	•Opacity - EPA Method 9	
54.B.1	Rule 54.B.1	•Annual compliance certification •Follow monitoring requirements under Rule 64 •Upon request, source test for sulfur compounds at point of discharge	None	None	•Sulfur Compounds - EPA Test Method 6, 6A, 6C, 8, 15, 16A,16B, or SCAQMD Method 307-94, as appropriate	•Compliance with Rule 64 ensures compliance with this rule based on District analysis
54.B.2	Rule 54.B.2	•Annual compliance certification •Determine ground or sea level concentrations of SO_2, upon request	•Representative fuel analysis or exhaust analysis and compliance demonstration	None	•SO_2 - BAAQMD Manual of Procedures, Vol.VI, Section 1, Ground Level Monitoring for H_2S and SO_2	
57.1	Rule 57.1	•Annual compliance certification	None	None	CARB Method 5	•Not required based on District analysis
64.B.1	Rule 64.B.1	•Annual compliance certification •None for PUC-quality gas, propane, or butane •Annual test if gas is other than PUC-quality gas, propane, or butane (submit with annual compliance certification)	•Annual fuel gas analysis if gas is other than PUC-quality gas, propane, or butane	None	•SCAQMD Method 307-94	

1c. General Applicable Requirements (Continued)

Attachment No./ Condition No.	Applicable Rule or Requirement	Monitoring	Recordkeeping	Semi-annual Reports	Test Methods	Comments
64.B.2	Rule 64.B.2	•Annual compliance certification •Fuel supplier's certification, or fuel test per each delivery (submit with annual compliance certification)	•Fuel supplier's certification, or fuel test per each delivery	None	•ASTM Method D4294-83 or D2622-87	
74.6(2003)	Rule 74.6	•Annual compliance certification •Maintain current solvent information •Routine surveillance of solvent cleaning activities •Upon request, solvent testing •Measurement of freeboard height and drain hole area for cold cleaners	•Records of current solvent information	None	•ROC content – EPA Test Method 24 •Identity of solvent components: ASTM E168-67, ASTM E169-87, or ASTM E260-85 •True vapor pressure or composite vapor pressure: ASTM D2879-86 or other methods per Rule 74.6.G.5 •Initial boiling point: ASTM 1078-78 or published source •Spray gun active/passive solvent losses: SCAQMD Method (10-3-89)	
74.11.1	Rule 74.11.1	•Annual compliance certification •Maintain identification records of large water heaters and small boilers	•Records of current information of large water heaters and small boilers	None	None	•Rule only applies to future installation of large water heaters and small boilers
74.22	Rule 74.22	•Annual compliance certification •Maintain furnace identification records	•Records of current furnace information	None	None	•Rule only applies to future installation of natural gas-fired, fan-type furnaces

1d. General Requirements for Short-Term Activities

The General Requirements for Short-term Activities Table includes a summary of the monitoring requirements, recordkeeping requirements, reporting requirements, and test methods associated with the attachments contained in Section No. 9 of this permit.

Attachment No./ Condition No.	Applicable Rule or Requirement	Monitoring	Recordkeeping	Semi-annual Reports	Test Methods	Comments
74.1	Rule 74.1	•Annual compliance certification •Routine surveillance and visual inspections of abrasive blasting operation •Abrasive blasting records	•Abrasive blasting records	None	•Visible emission evaluation-Section 92400 of CCR	
74.2	Rule 74.2	•Annual compliance certification •Routine surveillance •Maintain VOC records of coatings used	•Maintain VOC records of coatings used	None	•Rule 74.2.G	
74.4.D	Rule 74.4.D	•Annual compliance certification •Test ROC content of oil sample being proposed for usage	•Records of oil analyses	None	•ASTM D402	
74.28	Rule 74.28	•Annual compliance certification •Visual inspection to ensure proper vapor control during roofing kettle operation	None	None	None	
74.29	Rule 74.29	•Annual compliance certification •Weekly measurements of in-situ soil bioventing or bioremediation •Weekly measurements of soil aeration •Date and quantity of soil aerated •Routine surveillance •Notification required for excavation	•Weekly measurements of soil decontamination operation vapor concentration •Date and quantity of soil aerated	None	•Vapor concentration- EPA Method 21 •Wt. % of contaminant in soil-EPA Method 8015B	
40CFR.61.M	40 CFR Part 61, Subpart M	•Annual compliance certification •See 40 CFR Part 61.145 for inspection procedures	•See 40 CFR Part 61.145 for recordkeeping procedures	•See 40 CFR Part 61.145 for notification procedures	•See 40 CFR Part 61.145 for test methods	

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TABLE NO. 2

VENTURA COUNTY AIR POLLUTION CONTROL DISTRICT

Part 70 Permit No. 01395

Permitted Equipment and Applicable Requirements

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Equipment	Permit Specific Conditions	Rule 74.6	Rule 74.9	ATCM Engine	Rule 74.17.1
1 - Landfill Gas Collection and Control System consisting of:					
1 - 44 MMBTU/Hr McGill Environmental System Landfill Gas Flare	PC1, PC2				X
1 - 75 MMBTU/Hr John Zink (Model ZTOF) Landfill Gas Flare	PC1, PC2				X
2 - 1,877 BHP Deutz Landfill Gas-Fired Lean Burn IC Engines, Model No. TBG 620 V16K, turbocharged and aftercooled, 17.5 MMBTU/hr maximum heat input, associated 1.35 MW electrical generator	PC1, PC3		X		X
1 - 1,500 gal HC condensate tank with vent line connected to LFGCS	PC1, PC2				X
1 - 10,000 gal waste water tank with vent line to the LFGCS	PC1, PC2				X
Condensate injection system					
Electric powered gas blower(s)					
1 - 105 BHP Caterpillar Diesel-Fired Emergency Standby Engine, Model 3304D1, Serial No. 83Z03236, I.D. No. 900235			7	2	
1 - Cold Cleaner (exempt pursuant to Rule 23.F.10.c)		1			

PART 70 PERMIT NO. 01395
TITLE V APPLICABLE REQUIREMENT CODE KEY

Rule 74.9, "Stationary Internal Combustion Engines"

1. Pre-January 1, 2002 emissions limits for rich-burn engines (increments of progress have passed)
2. Pre-January 1, 2002 emissions limits for lean-burn engines (increments of progress have passed)
3. Natural gas-fired rich-burn engines (74.9.B.1 or 74.9.B.2)
4. Natural gas-fired lean-burn engines (74.9.B.1 or 74.9.B.2) with ammonia emission limit, if applicable. (74.9.B.5)
5. Diesel engines. (74.9.B.1 or 74.9.B.2) with ammonia emission limit, if applicable. (74.9.B.5)
6. Exemption from Rule 74.9 for engines operated less than 200 hours per calendar year (74.9.D.2)
7. Exemption from Rule 74.9 for emergency standby engines operated during either an emergency or maintenance operation. (74.9.D.3)
8. Exemption from Rule 74.9 for diesel engines with a permitted capacity factor of less than or equal to 15%. (74.9.D.8)
9. Exemption from Rule 74.9 for diesel engines used to power cranes and welding equipment. (74.9.D.9)
10. Exemption from Rule 74.9 for diesel engines operated on San Nicolas Island. (74.9.D.10)
11. Waste gas-fired lean-burn engines (74.9.B.1)

Section 93115, Title 17, California Code of Regulations California Airborne Toxic Control Measure For Stationary Compression Ignition (CI) Engines

1. In-use emergency fire pump assembly engines
2. In-use emergency engines operated not more than 20 hours per year for maintenance and testing purposes.

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Ventura County Air Pollution Control District
Rule 74.9.D.3 Applicable Requirements
Emergency Standby Stationary Internal Combustion Engines
Operated During Either an Emergency or Maintenance Operation

Rule 74.9, "Stationary Internal Combustion Engines"
Federally-Enforceable Version Adopted 11/14/00
District-Enforceable Version Adopted 11/08/05

This permit attachment lists the requirements for the November 8, 2005 version of the rule. Compliance with this attachment will ensure compliance with both versions of Rule 74.9. The permit conditions below, therefore, are federally enforceable. The District-enforceable version of this rule will become federally enforceable when approved by EPA as part of the SIP.

Applicability:

This attachment applies to emergency standby stationary internal combustion engines rated at 50 or more horsepower, not subject to the provisions of APCD Rule 74.16, "Oilfield Drilling Operations", and operated during an emergency or maintenance operation. Maintenance operation is limited to 50 hours per calendar year. Pursuant to Rule 74.9.D.3, emergency standby stationary internal combustion engines operated during an emergency or during maintenance operation of no more than 50 hours per calendar year are exempt from all provisions of Rule 74.9.

As detailed in Rule 74.9.I.2 an emergency standby engine is defined as an internal combustion engine used only when normal power line or natural gas service fails, or for the emergency pumping of water for either fire protection or flood relief. An emergency standby engine may not be operated to supplement a primary power source when the load capacity or rating of the primary power source has been either reached or exceeded.

Conditions:

1. Pursuant to Section D.3 of Rule 74.9, an applicable emergency standby stationary internal combustion engine shall only be operated during an emergency or during maintenance operation of not more than 50 hours per calendar year.

   Pursuant to Section I.5 of Rule 74.9, a maintenance operation is defined as the use of an emergency standby engine and fuel system during testing, repair and routine maintenance to verify its readiness for emergency standby use.

2. Pursuant to Section D.3 of Rule 74.9, each emergency standby engine shall be equipped with an operating, non-resettable, elapsed hour meter.

3. Pursuant to Section F.1 of Rule 74.9, the Annual Compliance Certification shall include the following records for each emergency standby engine:

    a. Engine manufacturer, model number, operator identification number, and location.

    b. A summary of maintenance reports during the year.

4. Pursuant to Section F.2 of Rule 74.9, the annual engine hours of maintenance operation shall be reported annually. A report shall be provided to the District after every calendar year by February 15.

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Rule 74.17.1 Applicable Requirements
Landfill Gas Collection and Control System
Approved Design Plan - Rule 74.17.1.G.3
Control System includes Internal Combustion Engine and Enclosed Combustor (Flare)

Rule 74.17.1, "Municipal Solid Waste Landfills"
Adopted 02/09/99, Federally-Enforceable

Rule 74.17.1 is federally enforceable as it was included with the EPA approval of the California State Plan for implementing the emissions guidelines (EG) applicable to existing municipal solid waste landfills. This approval was published in the Federal Register (Volume 64, No. 184 Thursday September 23, 1999) as a direct final rule with an effective date of November 22, 1999.

Applicability:

This attachment applies to any municipal solid waste (MSW) landfill that has a District-approved site-specific design plan as required by Rule 74.17.1.G, has installed a gas collection and control system as required by Rule 74.17.1.B.1, and uses an enclosed combustor (enclosed landfill gas flare) or a gas treatment system as required by Rule 74.17.1.B.3.

Rule 74.17.1 implements the requirements of 40 CFR, Part 60, Subpart Cc, "Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills", which requires compliance with specific sections of 40 CFR, Part 60, Subpart WWW, "Standards of Performance for Municipal Solid Waste Landfills".

The terms "Administrator" and "design plan" are defined in Rule 74.17.1. Other specific terms used in this attachment are defined in 40 CFR 60.751. Rule 74.17.1.I.1 defines "Administrator" as the Air Pollution Control Officer (APCO) of the Ventura County Air Pollution Control District, except that the APCO shall not be empowered to approve (a) alternative or equivalent test methods, alternative standards; or (b) work practices unless included in the site-specific design plan as specified in 40 CFR 60.752(b)(2)(i)(B). Rule 74.17.1.I.2 defines "Design plan or plan" as the site-specific design plan for the gas collection and control system submitted under Rule 74.17.1.G.

Conditions:

1. Pursuant to Rule 74.17.1.B.2, the permittee shall:

   a. Operate the landfill gas collection system such that gas is collected from each area, cell, or group of cells in the Municipal Solid Waste (MSW) landfill in which the initial solid waste has been in place for a period of two years or more. The requirements of 40 CFR 60.752(b)(2)(ii)(A)(2)(i), 40 CFR 60.753(a)(1), and 40 CFR 60.755(b)(1) concerning the timing of operation of the gas collection system shall not apply to MSW landfills subject to Rule 74.17.1.

b. As required by 40 CFR 60.752(b)(2)(ii)(A), route all collected gas to an active collection system that:

   (1) Is designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment.

   (2) Collects gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of 2 years or more.

   (3) Collects gas at a sufficient extraction rate.

   (4) Is designed to minimize off-site migration of subsurface gas.

   Pursuant to Rule 74.17.1.B.2 (b), the requirements of 40 CFR 60.752(b)(2)(ii)(B) concerning passive collection systems shall not apply to MSW landfills subject to Rule 74.17.1.

2. Pursuant to Rule 74.17.1.B.3.a, all collected landfill gas shall be routed to a control system that complies with the requirements of 40 CFR 60.752(b)(2)(iii)(B), or (C). All landfill gas shall be routed to the flares {40 CFR 60.752(b)(2)(iii)(B)} or to a gas treatment system {40 CFR 60.752(b)(2)(iii)(C)}.

   a. Pursuant to 40 CFR 60.752(b)(2)(iii)(B), the landfill gas flares shall reduce NMOC (non-methane organic compounds) by 98 weight-percent or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen. The flares shall be operated within the parameter ranges established during the initial or most recent performance test. The operating parameters to be monitored are specified in 40 CFR 60.756 and Condition No. 7 below. The permittee shall demonstrate that each flare meets the NMOC requirements of Rule 74.17.1.B.3.a using the source testing procedures described below. The flares shall be source tested to demonstrate continuing compliance every 24 months.

   b. Pursuant to 40 CFR 60.752(b)(2)(iii)(C), the gas treatment system shall process the collected gas for subsequent sale or use. This treatment system shall consist of compression, de-watering, and landfill gas filtered down to at least 10 microns. This treatment at the Simi Valley Landfill shall be accomplished with the following principal components: 1) two fuel conditioning skids each equipped with a Carrier Aquasnap chiller and 40 HP blower, 2) four (two in each gas stream) coalescing towers and four (two in each gas stream) water knockouts, and 3) one in-line GC (Daniels). This system shall be a closed-loop. There shall be no atmospheric venting at any point in the treatment system.

3. Pursuant to Rule 74.17.1.B.3.b, flares shall meet all of the following additional requirements:

   a. The landfill gas flares shall be of the enclosed ground type with automatic dampers, an automatic shutdown device, a flame arrester and continuous recording temperature sensors. During restart or startup there shall be a sufficient flow of propane or commercial natural gas to the pilot flame to ensure immediate ignition when in contact with landfill gasses.

   b. NO_X emissions from flares shall not exceed 0.06 pounds per million BTUs of heat input.

   c. CO emissions from flares shall not exceed 0.20 pounds per million BTUs of heat input.

   The permittee shall demonstrate that each flare meets the NO_X and CO requirements of Rule 74.17.1.B.3.b using the source testing procedures described below. The flares shall be source tested to demonstrate continuing compliance every 24 months.

OPERATIONAL STANDARDS FOR COLLECTION AND CONTROL SYSTEMS

4. Pursuant to Rule 74.17.1.B.4, the permittee shall meet the operational requirements of 40 CFR 60.753, except as provided in Rule 74.17.1.G.3. Pursuant to 40 CFR 60.753 the permittee shall:

   a. Operate the collection system such that gas is collected from each area, cell, or group of cells in the MSW landfill in which solid waste has been in place for two years or more.

   b. Operate the collection system with negative pressure at each wellhead except under the following conditions:

      (1) A fire or increased well temperature. The permittee shall record instances when positive pressure occurs in efforts to avoid a fire. These records shall be submitted with the annual reports as provided in 40 CFR 60.757(f)(1) as shown in Condition No. 7 below.

      (2) Use of a geomembrane or synthetic cover. The permittee shall develop acceptable pressure limits in the design plan.

      (3) A decommissioned well. A well may experience a static positive pressure after shut down to accommodate for declining flows. All design changes shall be approved by the Administrator.

   c. Operate each interior wellhead in the collection system with a landfill gas temperature less than 55 degrees Centigrade (131 degrees Fahrenheit) and with either a nitrogen level less than 20 percent or an oxygen level less than 5 percent. The permittee may establish a higher operating temperature, nitrogen, or oxygen value at a particular well. A higher operating value demonstration shall show supporting data that the elevated parameter does not cause fires or significantly inhibit anaerobic decomposition by killing methanogens.

(1) The nitrogen level shall be determined using EPA Method 3C, unless an alternative test method is established as allowed by 40 CFR 60.752(b)(2)(i).

(2) Unless an alternative test method is established as allowed by 40 CFR 60.752(b)(2)(i), the oxygen shall be determined by an oxygen meter using EPA Method 3A except that:

(i) The span shall be set so that the regulatory limit is between 20 and 50 percent of the span.
(ii) A data recorder is not required.
(iii) Only two calibration gases are required, a zero and span, and ambient air may be used as the span.
(iv) A calibration error check is not required.
(v) The allowable sample bias, zero drift, and calibration drift are plus or minus10 percent.

d. Operate the collection system so that the methane concentration is less than 500 parts per million above background at the surface of the landfill. To determine if this level is exceeded, the permittee shall conduct surface testing around the perimeter of the collection area and along a pattern that traverses the landfill at 30 meter intervals and where visual observations indicate elevated concentrations of landfill gas, such as distressed vegetation and cracks or seeps in the cover. The permittee may establish an alternative traversing pattern that ensures equivalent coverage. A surface monitoring design plan shall be developed that includes a topographical map with the monitoring route and the rationale for any site-specific deviations from the 30-meter intervals. Areas with steep slopes or other dangerous areas may be excluded from the surface testing.

e. Operate the system such that all collected gases are vented to the landfill gas flares or a gas treatment system designed and operated in compliance with 40 CFR 60.752(b)(2)(iii) as shown in Condition No. 2 above. In the event the collection or control system is inoperable, the gas mover system shall be shut down and all valves in the collection and control system contributing to venting of the gas to the atmosphere shall be closed within 1 hour.

f. Operate the landfill gas flare at all times when the collected gas is routed to the flare.

g. If monitoring demonstrates that the operational requirements in Condition Nos. 4.b, 4.c, and 4.d above (paragraphs (b), (c), or (d) of 40 CFR 60.753) are not met, corrective action shall be taken as specified in Condition Nos. 6.a and 6.b below (40 CFR 60.755(a)(3) through (5)) or Condition No. 6.d below (40 CFR 60.755(c)). If corrective actions are taken as specified in Condition No. 6 (40 CFR 60.755), the monitored exceedance is not a violation of the operational requirements of this Condition (40 CFR 60.753).

TEST METHODS AND PROCEDURES

5. In order to demonstrate compliance with the NMOC, NOx, and CO limits of Condition Nos. 2.a and 3 above, the permittee shall meet the test methods and procedures of Rule 74.17.1.B.4 (40 CFR 60.754) and Rule 74.17.1.F as follows:

For the NMOC performance testing for the flares required in Condition No. 2.a, EPA Method 25, EPA Method 25C, or EPA Method 18 shall be used, unless another method to demonstrate compliance has been approved by the Administrator as provided by the Design Plan. EPA Method 3 or 3A shall be used for determining oxygen for correcting the NMOC concentration as hexane to 3 percent. In cases where the outlet concentration is less than 50 ppm NMOC as carbon (8 ppm NMOC as hexane), EPA Method 25A should be used in place of EPA Method 25. If using EPA Method 18, the minimum list of compounds to be tested shall be those published in the most recent Compilation of Air Pollutant Emission Factors (AP-42).

For the NO_X and CO performance testing required by Condition No. 3, the following methods shall be used:

a. EPA Method 7E for NO_X.

b. EPA Method 10 for CO.

c. ASTM D1826-77 for the gross (higher) calorific value (GCV) of landfill gas.

d. EPA Method 3A for oxygen concentration.

e. The F Factor method contained in 40 CFR 60, Appendix A, Method 19.

A source test plan for complying with the testing outlined above shall be submitted to the District Compliance Division at least 30 days prior to the test for approval. The test plan shall include, but not be limited to, a discussion of the sampling methods, test date, analytical methods, test equipment inventory, and calibration procedures. The District shall be given the opportunity, with sufficient notice of a minimum of 5 working days, to observe the emissions testing.

COMPLIANCE PROVISIONS

6. Pursuant to Rule 74.17.1.B.4, the permittee shall meet the compliance provisions in 40 CFR 60.755. Applicable requirements in 40 CFR 60.755 include the following:

   a. For the purpose of demonstrating whether the gas collection system flow rate is sufficient to determine compliance with Condition No. 1.b (3) above (40 CFR 60.752(b)(2)(ii)(A)(3)), the permittee shall measure gauge pressure in the gas collection header at each individual well on a monthly basis. If a positive pressure exists, action shall be initiated to correct the exceedance within 5 calendar days, except for the three conditions allowed under Condition No. 4.b above (40 CFR 60.753(b)). If negative pressure cannot be achieved without excess air infiltration within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial measurement of positive pressure. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. An alternative timeline for correcting the exceedance may be submitted to the Administrator for approval. Owners and operators are not required to expand the system during the first 180 days after gas collection system start-up.

   b. For the purpose of identifying whether excess air infiltration into the landfill is occurring, the permittee shall monitor each well monthly for temperature and nitrogen or oxygen as required in Condition No. 4.c above (40 CFR 60.753(c)). If a well exceeds one of these operating parameters, action shall be initiated to correct the exceedance within five calendar days. If correction of the exceedance cannot be achieved within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial exceedance. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. An alternative timeline for correcting the exceedance may be submitted to the Administrator for approval.

   c. For purposes of demonstrating compliance with the gas collection requirements of Condition No. 1.a above (40 CFR 60.753(a)), the permittee shall place each well or design component as specified in the approved design plan as provided in Rule 74.17.1.G and 40 CFR 60.752(b)(2)(i). Each well shall be installed no later than 60 days after the date on which the initial solid waste has been in place for a period of two years or more.

   d. The following procedures shall be used for compliance with the surface methane operational standard as provided in Condition No. 4.d, above (40 CFR 60.753(d)).

      (1) After installation of the collection system, the permittee shall monitor surface concentrations of methane along the entire perimeter of the collection area and along a pattern that traverses the landfill at 30 meter

intervals (or a site-specific established spacing) for each collection area on a quarterly basis using an organic vapor analyzer, flame ionization detector, or other portable monitor meeting the specifications provided in Condition No. 6.e below (40 CFR 60.755 (d)).

(2) The background concentration shall be determined by moving the probe inlet upwind and downwind outside the boundary of the landfill at a distance of at least 30 meters from the perimeter wells.

(3) Surface emission monitoring shall be performed in accordance with Section 4.3.1 of Method 21 of Appendix A of 40 CFR, Part 60, except that the probe inlet shall be placed within 5 to 10 centimeters of the ground. Monitoring shall be performed during typical meteorological conditions.

(4) Any reading of 500 parts per million or more above background at any location shall be recorded as a monitored exceedance and the actions specified in (i) through (v) of this condition (below) shall be taken. As long as the specified actions are taken, the exceedance is not a violation of the operational requirements of Condition No. 6.d above (40 CFR 60.753(d)).

(i) The location of each monitored exceedance shall be marked and the location recorded.

(ii) Cover maintenance or adjustments to the vacuum of the adjacent wells to increase the gas collection in the vicinity of each exceedance shall be made and the location shall be re-monitored within 10 calendar days of detecting the exceedance.

(iii) If the re-monitoring of the location shows a second exceedance, additional corrective action shall be taken and the location shall be monitored again within 10 days of the second exceedance. If the re-monitoring shows a third exceedance for the same location, the action specified in Condition No. 6.d (4)(v) below (40 CFR 60.755(d)(4)(v)) shall be taken, and no further monitoring of that location is required until the action specified in Condition No. 6.d(4)(v) below has been taken.

(iv) Any location that initially showed an exceedance but has a methane concentration less than 500 ppm methane above background at the 10-day re-monitoring specified in Condition Nos. 6.d (4)(ii) or (iii) above (40 CFR 60.755 (c)(4)(ii) or (iii)) shall be re-monitored 1 month from the initial exceedance. If the 1-month remonitoring shows a concentration less than 500 parts per million above background, no further monitoring of that location is required until the next quarterly monitoring period. If the 1-month remonitoring shows an exceedance, the actions specified in Condition Nos. 6.d (4)(iii) or (v) (40 CFR 60.755(c)(4)(iii) or (v)) shall be taken.

(v) For any location where the monitored methane concentration equals or exceeds 500 parts per million above background three times within a quarterly period, a new well or other collection device shall be installed within 120 calendar days of the initial exceedance. An alternative remedy to the exceedance, such as upgrading the blower, header pipes or control device, and a corresponding timeline for installation may be submitted to the Administrator for approval.

(5) The permittee shall implement a program to monitor for cover integrity and implement cover repairs as necessary on a monthly basis.

e. When seeking to comply with the surface methane operational standards in Condition No. 6.d above (40 CFR 60.755(c)), the permittee shall comply with the following instrumentation specifications and procedures for surface emission monitoring devices:

(1) The portable analyzer shall meet the instrument specifications provided in Section 3 of Method 21 of Appendix A of 40 CFR, Part 60, except that "methane" shall replace all references to VOC.

(2) The calibration gas shall be methane, diluted to a nominal concentration of 500 parts per million in air.

(3) To meet the performance evaluation requirements in Section 3.1.3 of Method 21 of Appendix A of 40 CFR, Part 60, the instrument evaluation procedures of Section 4.4 of Method 21 of Appendix A of 40 CFR, Part 60 shall be used.

(4) The calibration procedures provided in Section 4.2 of Method 21 of Appendix A of 40 CFR, Part 60 shall be followed immediately before commencing a surface monitoring survey.

f. The provisions of 40 CFR, Part 60, Subpart WWW shall apply at all times, except during periods of start-up, shutdown, or malfunction, provided that the duration of start-up, shutdown, or malfunction shall not exceed 5 days for collection systems and shall not exceed 1 hour for the landfill gas flares. (40 CFR Part 60.755(e))

MONITORING REQUIREMENTS

7. Pursuant to Rule 74.17.1.B.4, the permittee shall meet the monitoring provisions in 40 CFR 60.756, except as provided in Rule 74.17.1.G.3. Pursuant to 40 CFR 60.756 the permittee shall:

   a. Install a sampling port and a thermometer, other temperature measuring device, or an access port for temperature measurements at each wellhead and:

      (1) Measure the gauge pressure in the gas collection header on a monthly basis as provided in Condition No. 6.a above (40 CFR 60.755(a)(3)).

      (2) Monitor nitrogen or oxygen concentration in the landfill gas on a monthly basis as provided in Condition No. 6.b above (40 CFR 60.755(a)(5)).

      (3) Monitor temperature of the landfill gas on a monthly basis as provided in 40 CFR 60.755(a)(5).

   b. Calibrate, maintain, and operate according to the manufacturer's specifications, the following equipment:

      (1) A temperature monitoring device equipped with a continuous recording device that measures and records the temperature of the combustion zone of the enclosed landfill gas flare. The temperature monitoring device shall have a minimum accuracy of ± 1 percent of the temperature being measured expressed in degrees Celsius or ± 0.5 degrees Celsius, whichever is greater.

      (2) A device that records flow to or bypass of the landfill gas flare. The permittee shall either:

         (i) Install, calibrate, and maintain a gas flow rate measuring device that shall record the flow to the landfill gas flare at least every 15 minutes; or

         (ii) Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism shall be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.

   c. When seeking to demonstrate compliance with the surface methane operational standards in Condition No. 6.d above (40 CFR 60.755(c)), the permittee shall monitor surface concentrations of methane according to the instrument specifications and procedures provided in Condition No. 6.e above (40 CFR 60.755(d)). Any closed landfill that has no monitored exceedances of the operational standard in three consecutive quarterly monitoring periods may skip to annual monitoring. Any methane reading of 500 ppm or more above background detected during the annual monitoring returns the frequency for that landfill to quarterly monitoring.

REPORTING REQUIREMENTS

8. Pursuant to Rule 74.17.1.E, the permittee shall meet the following reporting requirements of 40 CFR 60.757, except as provided in Rule 74.17.1.G.3. The permittee shall:

   a. Submit a closure report to the Administrator within 30 days of waste acceptance cessation. The Administrator may request additional information as may be necessary to verify that permanent closure has taken place in accordance with the requirements of 40 CFR 258.60. If a closure report has been submitted to the Administrator, no additional wastes may be placed into the landfill without filing a notification of modification as described under 40 CFR 60.7(a)(4).

   b. Submit an equipment removal report to the Administrator 30 days prior to removal or cessation of operation of the control equipment. The equipment removal report shall contain all of the following items:

      1) A copy of the closure report submitted in accordance with Condition No. 8.a above (paragraph (d) of 40 CFR 60.757).

      2) A copy of the initial performance test report demonstrating that the 15 year minimum control period has expired.

      3) Dated copies of three successive nonmethane organic compound (NMOC) emission rate reports demonstrating that the landfill is no longer producing 50 megagrams or greater of NMOC per year.

   c. Submit other information requested by the Administrator that may be necessary to verify that all of the conditions for removal in 40 CFR 60.752(b)(2)(v) have been met. These conditions are as follows:

      (1) The landfill shall be a closed landfill as defined in 40 CFR 60.751. A closure report shall be submitted to the Administrator as provided in 40 CFR 60.757(d);

      (2) The collection and control system shall have been in operation a minimum of 15 years; and

      (3) Following the procedures specified in 40 CFR 60.754(b), the calculated NMOC gas produced by the landfill shall be less than 50 megagrams per

year on three successive test dates. The test dates shall be no less than 90 days apart; and no more than 180 days apart.

d. Submit to the Administrator annual reports of the recorded information in (1) through (6) below. The initial annual report shall be submitted within 180 days of installation and start-up of the collection and control system, and shall include the initial performance test report required under 40 CFR 60.8. For enclosed flares, reportable exceedances are defined under 40 CFR 60.758(c) as "all 3-hour periods of operation during which the average combustion temperature was more than 28 °C below the average combustion temperature during the most recent performance test at which compliance with 40 CFR 60.752(b)(2)(iii) was determined."

1) Value and length of time for exceedance of applicable parameters monitored under Condition Nos. 7.a , 7.b and 7.c above (40 CFR 60.756(a), (b), and (d)).

2) Description and duration of all periods when the gas stream is diverted from the landfill gas flare through a bypass line or the indication of bypass flow as specified under 40 CFR 60.756.

3) Description and duration of all periods when the landfill gas flare was not operating for a period exceeding 1 hour and length of time the flare was not operating.

4) All periods when the collection system was not operating in excess of 5 days.

5) The location of each exceedance of the 500 parts per million methane concentration as provided in 40 CFR 60.753(d) and the concentration recorded at each location for which an exceedance was recorded in the previous month.

6) The date of installation and the location of each well or collection system expansion added pursuant to Condition Nos. 6.a, 6.c, and 6.d (4) above (Paragraphs (a)(3), (b), and (c)(4) of 40 CFR 60.755).

All reports required by 40 CFR 60.757 shall be submitted to the APCO.

RECORDKEEPING REQUIREMENTS

9. Pursuant to Rule 74.17.1.D, the permittee shall satisfy the recordkeeping requirements of 40 CFR 60.758, as applicable, except that the APCO may approve alternative recordkeeping provisions as provided in Rule 74.17.1G.3. Pursuant to 40 CFR 60.758 the permittee shall:

a. Keep for at least 5 years up-to-date, readily accessible, on-site records of the design capacity report which triggered 40 CFR 60.752(b), the current amount of solid waste in-place, and the year-by-year waste acceptance rate. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.

b. Keep up-to-date, readily accessible records for the life of the control equipment of the data listed below as measured during the initial performance test or compliance determination. Records of subsequent tests or monitoring shall be maintained for a minimum of 5 years. Records of the landfill gas flare vendor specifications shall be maintained until removal.

    (1) The maximum expected gas generation flow rate as calculated in 40 CFR 60.755(a)(1). The permittee may use another method to determine the maximum gas generation flow rate, if the method has been approved by the Administrator.

    (2) The density of wells, horizontal collectors, surface collectors, or other gas extraction devices determined using the procedures specified in 40 CFR 60.759(a)(1).

    (3) The average combustion temperature of each flare measured at least every 15 minutes and averaged over the same time period of the performance test.

    (4) The percent reduction of NMOC determined as specified in 40 CFR 60.752(b)(2)(iii)(B) achieved by the landfill gas flare.

c. Keep for 5 years up-to-date, readily accessible continuous records of the equipment operating parameters specified to be monitored in Condition No. 7 above (40 CFR 60.756) as well as up-to-date, readily accessible records for periods of operation during which the parameter boundaries established during the most recent performance test are exceeded.

    (1) An exceedance for an enclosed flare is any 3-hour period of operation during which the average combustion temperature was more than 28 °C below the average combustion temperature during the most recent performance test at which compliance with 40 CFR 60.752(b)(2)(iii) was determined. All exceedances shall be recorded and reported under Condition No. 8 above (40 CFR 60.757(f)).

    (2) The permittee shall keep up-to-date, readily accessible continuous records of the indication of flow to the landfill gas flares or the indication of bypass flow or records of monthly inspections of car-seals or lock-and-key

configurations used to seal bypass lines, specified under Condition No. 9.b.2 above (40 CFR 60.756).

d. Keep for the life of the collection system an up-to-date, readily accessible plot map showing each existing and planned collector in the system and providing a unique identification location label for each collector.

  (1) Permittee shall keep up-to-date, readily accessible records of the installation date and location of all newly installed collectors as specified under 40 CFR 60.755(b)

  (2) Permittee shall keep readily accessible documentation of the nature, date of deposition, amount, and location of asbestos-containing or nondegradable waste excluded from collection as provided in 40 CFR 60.759(a)(3)(i) as well as any nonproductive areas excluded from collection as provided in 40 CFR 60.759(a)(3)(ii).

e. Keep for at least 5 years up-to-date, readily accessible records of all collection and control system exceedances of the operational standards in Condition No. 6 above (40 CFR 60.753), the reading in the subsequent month whether or not the second reading is an exceedance, and the location of each exceedance.

Any records required to be submitted pursuant to 40 CFR 60.758 shall be submitted to the APCO.

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Ventura County Air Pollution Control District
Additional Requirements
Landfill Gas Collection and Control System - Flares

Rule 26, "New Source Review"
Conditions applied pursuant to Rule 26 are federally enforceable

Rule 51, "Nuisance"
Adopted 10/22/68
Conditions applied pursuant to Rule 51 are District enforceable only

Rule 52, "Particulate Matter - Concentration (Grain Loading)"
Adopted 05/23/72, Federally-Enforceable

Rule 54, "Sulfur Compounds"
Adopted 06/14/94, Federally-Enforceable

Rule 57.1, "Particulate Matter Emissions From Fuel Burning Equipment"
Adopted 01/11/05, District Enforceable
Rule 57.1 will become federally-enforceable when approved by EPA as a part of the SIP.

Rule 74.17.1, "Municipal Solid Waste Landfills"
Adopted 02/09/99, Federally Enforceable

Applicability:

This attachment applies to the landfill gas collection and control system and the associated flares. These requirements are in addition to any other specific or general requirements referenced in this permit.

Conditions:

1. *The following conditions apply to the 44 MMBTU/Hr McGill* Flare:

   a. The landfill gas flare shall be maintained at a minimum temperature of 1600 degrees Fahrenheit (871 degrees Celsius) as indicated by the flare temperature recorder. This condition is applied as BACT (Best Available Control Technology) for ROC (reactive organic compounds).

      The permittee may operate the flare at a temperature below 1600 degrees Fahrenheit during source testing in order to establish a lower minimum operating temperature. The permittee may submit a "Minor Part 70 Permit Modification" application to reduce the minimum flare temperature requirement. The minimum flare temperature shall not be less than 1400 degrees Fahrenheit.

b. Emissions of ROC, as defined in Rule 2, from the landfill gas flare shall not exceed 1.09 pounds per hour. This condition is applied as BACT for ROC.

c. Emissions of oxides of nitrogen (NOx measured as NO2) from the landfill gas flare shall not exceed 0.05 pounds per MMBTU. This condition is applied as BACT for NOx (oxides of nitrogen) and is more stringent than the NOx limit of Rule 74.17.1.

d. Emissions of oxides of sulfur (SOx) from the landfill gas flare shall not exceed 0.02 pounds per MMBTU. This condition is applied as BACT for SOx.

In order to comply with this condition, the flare shall be equipped with a temperature monitoring device with a continuous recorder as required by Rule 74.17.1. In addition the flare shall be source tested every two years (ROC, NOx) as required by Rule 74.17.1 and every four years (SOx) as required by Condition Nos. 4 and 14 below. For the purpose of demonstrating compliance with the ROC limit above, ROC may be assumed to be equal to NMOC. Prior to conducting the source test, the permittee shall notify the APCD Compliance Division. A source test plan for complying with the testing outlined above shall be submitted to the District Compliance Division at least 30 days prior to the test for approval. The test plan shall include, but not be limited to, a discussion of the sampling methods, test date, analytical methods, test equipment inventory, and calibration procedures. The District shall be given the opportunity, with sufficient notice of a minimum of 5 working days, to observe the emissions testing. Additional monitoring, recordkeeping, reporting, and test method requirements for this flare are included in Attachment 74.17.1 in Section No. 6 of this permit and in the following conditions. (Rule 26 and Rule 74.17.1)

2. The following conditions apply to the 75 MMBTU/Hr John Zink Flare:

   a. The landfill gas flare shall be maintained at a minimum temperature of 1600 degrees Fahrenheit (871 degrees Celsius) as indicated by the flare temperature recorder. This condition is applied as BACT for ROC.

   The permittee may operate the flare at a temperature below 1600 degrees Fahrenheit during source testing in order to establish a lower minimum operating temperature. The permittee may submit a "Minor Part 70 Permit Modification" application to reduce the minimum flare temperature requirement. The minimum flare temperature shall not be less than 1400 degrees Fahrenheit.

b. Emissions of ROC, as defined in Rule 2, from the landfill gas flare shall not exceed 1.09 pounds per hour. This condition is applied as BACT for ROC.

c. Emissions of oxides of nitrogen (NOx measured as NO2) from the landfill gas flare shall not exceed 0.05 pounds per MMBTU. This condition is applied as BACT for NOx and is more stringent than the NOx limit of Rule 74.17.1.

d. Emissions of oxides of sulfur (SOx) from the landfill gas flare shall not exceed 1.50 pounds per hour and 0.02 pounds per MMBTU. This condition is applied as BACT for SOx.

In order to comply with this condition, the flare shall be equipped with a temperature monitoring device with a continuous recorder as required by Rule 74.17.1. In addition the flare shall be source tested every two years (ROC, NOx) as required by Rule 74.17.1 and every four years (SOx) as required by Condition Nos. 4 and 14 below. For the purpose of demonstrating compliance with the ROC limit above, ROC may be assumed to be equal to NMOC. To facilitate source testing of the flare, an approved heat shield or sufficiently insulated shroud must be placed around the test ports to permit sampling. The outer skin temperature must be less than 250 degrees Fahrenheit to avoid heat stress on source test personnel. Prior to conducting the source test, the permittee shall notify the APCD Compliance Division. A source test plan for complying with the testing outlined above shall be submitted to the District Compliance Division at least 30 days prior to the test for approval. The test plan shall include, but not be limited to, a discussion of the sampling methods, test date, analytical methods, test equipment inventory, and calibration procedures. The District shall be given the opportunity, with sufficient notice of a minimum of 5 working days, to observe the emissions testing. Additional monitoring, recordkeeping, reporting, and test method requirements for this flare are included in Attachment 74.17.1 in Section No. 6 of this permit and in the following conditions. (Rule 26 and Rule 74.17.1)

3. Each flare shall comply with Rule 52, "Particulate Matter – Concentration (Grain Loading)". Pursuant to Rule 52, the permittee shall not discharge into the atmosphere from any source particulate matter in excess of the concentration listed in the table shown in Rule 52. For the purpose of Rule 52, particulate matter includes any material which would become particulate matter if cooled to standard conditions.

   Periodic monitoring is not necessary to certify compliance with Rule 52. EPA particulate matter emission factors for landfill gas flares indicate that each flare will comply with Rule 52. To certify compliance, a reference to EPA emission factors is sufficient. (Rule 52)

4. Each flare shall comply with Rule 54, "Sulfur Compounds", as follows:

a. Pursuant to Rule 54.B.1, emissions of sulfur compounds, calculated as sulfur dioxide (SO_2), shall not exceed 300 ppm by volume at the point of discharge. All sulfur present in gaseous molecular compounds containing oxygen shall be calculated as SO_2.

b. Pursuant to Rule 54.B.2, emissions of sulfur compounds, calculated as sulfur dioxide (SO_2), shall not result in average ground or sea level concentrations at any point at or beyond the property line in excess of 0.25 ppmv averaged over any one hour period, or 0.04 ppmv averaged over any 24 hour period. All sulfur present in gaseous molecular compounds containing oxygen shall be calculated as SO_2.

c. Pursuant to Rule 54.B.3, emissions of hydrogen sulfide (H_2S) shall not exceed 10 ppm, by volume, at the point of discharge. All reduced sulfur compounds present shall be calculated as H_2S.

d. Pursuant to Rule 54.B.4, emissions of emissions of hydrogen sulfide (H_2S) shall not result in average ground or sea level concentrations at any point at or beyond the property line in excess of 0.06 ppm averaged over any 3 minute period, or 0.03 ppm averaged over any one hour period. All reduced sulfur compounds present shall be calculated as H_2S.

In order to comply with this condition, permittee shall conduct testing as required by this attachment to determine the sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) emissions from each flare to demonstrate compliance with Rule 54.B.1 and 54.B.3. In addition, permittee shall perform dispersion modeling, upon District request, based on the source test results to demonstrate compliance with Rule 54.B.2 and 54.B.4. Source testing and modeling shall be performed in accordance with Rule 54.D. (Rule 54)

5. Each flare shall comply with Rule 57.1, "Particulate Matter Emissions From Fuel Burning Equipment". Pursuant to Rule 57.1, emissions of particulate matter shall not exceed 0.12 pounds per million BTU of fuel input. Particulate matter is defined as any material, except uncombined water, that exists in a finely divided form as a liquid or solid at *standard conditions. Standard conditions are: a gas temperature of 68 degrees Fahrenheit* (20 degrees Celsius) and a gas pressure of 14.7 pounds per square inch (760 mm. Hg) absolute.

   Periodic monitoring is not necessary to certify compliance with Rule 57.1. EPA particulate matter emission factors for landfill gas flares indicate that each flare will comply with Rule 57.1. To certify compliance, a reference to EPA emission factors is sufficient. (Rule 57.1)

6. The 44 MMBTU/Hr McGill flare shall be equipped with a controller that monitors for flame failure. This failure shall initiate isolation of the flare from the landfill gas supply

line by closing the isolation valve. Upon closing of the isolation valve, an alarm shall be activated to notify the operator of a system malfunction. If such failure occurs, the system shall automatically attempt to relight the flare. If the automatic relighting occurs, the isolation valve shall reopen to continue destruction of the landfill gas. (Rule 26)

7. The John Zink flare shall be equipped with a UV flame scanner to ensure that the flare is operating. The John Zink flare shall be equipped with site ports, sampling ports, a safety system to shut off the burner (flame failure alarm, gas shut off valve), inlet flow recorders, a burner assembly and gas pilot or electronic ignitor. All devices shall be maintained, operated, and calibrated according to manufacturer's specifications, or calibrated annually as detailed in Condition No. 10 below. This condition is applied as BACT. (Rule 26)

8. Both the McGill flare and the John Zink flare shall be operated with a condensate knockout / filter vessel. This condition is applied as BACT. (Rule 26)

9. The stack height of the John Zink flare shall be no less than 50 feet. The stack diameter of the John Zink flare shall not exceed 11 feet. The stack gas velocity from the John Zink flare shall be no less than 2.32 feet per second and no more than 65.0 feet per second. In order to comply with this condition, the permittee shall conduct testing as required by this attachment to determine the flare stack exit velocity. (Rule 51)

10. Specific instrumentation used for the control and recording of gas flow and the exhaust temperature of the flare system shall be calibrated annually to demonstrate that the individual devices continue to meet the manufacturer's accuracy specifications. In addition, all safety equipment that protects the landfill gas collection system, condensate system, and flare including the flame detector, high temperature shutdown, landfill gas blower control, and air damper shall be calibrated or function-checked annually to demonstrate that the individual devices continue to meet the manufacturer's accuracy specifications or continue to operate as required. These checks shall be performed in accordance with manufacturer's specifications or, if non-specified, in accordance with acceptable industrial practices. All records of third party calibrations of the gas flow and stack temperature recording devices shall be kept in three-ring binders identifying the contracting company, technician's name and title, date of calibration and a list of calibration techniques. Comments such as, "acceptable as tested", "adjusted", "repaired", or "replaced", shall be noted on the calibration report. All automatic shutdown and safety equipment for the landfill gas collection system, condensate system, and flare may be function-tested by the permittee or their representatives as long as the employee's name, date of test, and comments are recorded in the landfill gas flare operations log book. All other associated gauges, thermometers, and meters not required to ensure operational compliance with this Permit to Operate or VCAPCD Rules and Regulations need not be annually inspected or calibrated. (Rule 26 and Rule 74.17.1)

11. The piping system connecting the vent lines from the 1,500 gallon Hydrocarbon Condensate Tank and the 10,000 gallon Waste Water Storage Tank shall be connected to the Landfill Gas Collection System. The piping system shall contain no venting devices except for emergency relief devices. All of the collected gas from these systems shall be commingled with the landfill gas prior to being metered and incinerated. (Rule 26)

12. The vacuum gauges located on the tanks or associated piping of the 1,500 gallon Hydrocarbon Condensate Tank and the 10,000 gallon Waste Water Storage Tank shall indicate a vacuum at all times the Landfill Gas Collection System gas blower is operating. These gauges shall be maintained in accordance with manufacturers recommendations. (Rule 26)

13. No gas wells shall be installed into the former Class I Area of the landfill, except for three wells (25, 26, 27) installed into the areas of Class I refuse located within 150 feet East, 100 feet South, and 200 feet North of Gas Probe No. 4 (designated GP-4), and three wells (28, 29, 30) installed into the areas of Class I refuse located within 400 feet North and 400 feet West of Gas Probe No. 5 (designated GP-5). (Rule 26)

14. Once every four years, the landfill gas and each landfill gas flare exhaust shall be tested to determine the actual concentrations, by weight, of the toxic/hazardous substances for which carcinogenic unit risk factors have been developed by the Cal EPA Office of Environmental Health Hazard Assessment or the Environmental Protection Agency and substances listed by the California Air Resources Board pursuant to Section 44321 of the California Health and Safety Code (AB 2588 List of Substances). In addition, the analysis shall determine the reactive organic compound (ROC as defined in APCD Rule 2) content in percent by weight in the landfill gas and flare exhaust; and the hydrogen sulfide (H2S) and sulfur dioxide (SO2) emissions in the exhaust of each flare, and the higher heating value of the landfill gas in BTUs per cubic foot and BTUs per pound. Analysis for any compound listed or referenced above which can be demonstrated as not being contained in the landfill gas and/or flare exhaust gas may be requested for removal from the required list, subject to APCD approval. The APCD shall be given the opportunity, with sufficient notice, to observe the emissions testing.

    A source test plan for complying with the above outlined testing shall be submitted 30 days prior to the test for APCD approval. The test plan shall include, but not be limited to, a discussion of sampling methods, test date, analytical methods, test equipment inventory, and calibration procedures.

    Within 60 days after completion of an emissions test, a test report shall be submitted to the APCD detailing the test procedures, quality assurance procedures, and the results of the tests as described above. (Rule 51)

15. If an analysis of a source test indicates that the concentrations of the toxic contaminants

are significantly higher than those toxic contaminants considered in the risk assessment prior to the installation of the gas collection and flare system, then a new screening health risk assessment shall be prepared and submitted within 60 days of the date the test results are available. If this second health risk assessment shows excess cancer risks greater than one in a million to the maximum exposed individual, then a more detailed risk analysis that shows acceptable risk levels based on new data will be prepared and submitted within 90 days of the date the test results are available.

If appropriate, an alternate mitigation measure may be to apply for an Authority to Construct, within 120 days of the date that the results of the second health risk analysis are available, for modifications to the system that adequately reduce the emission impact to acceptable levels. A new health risk assessment, which demonstrates the acceptable risk levels, shall accompany the Authority to Construct application. (Rule 51)

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Ventura County Air Pollution Control District
Additional Requirements
Landfill Gas Collection and Control System - Engines

PO01395PC3

Rule 26, "New Source Review"
Conditions applied pursuant to Rule 26 are federally enforceable

Rule 35, "Elective Emission Limits"
Adopted 11/12/96, Federally-Enforceable

Rule 54, "Sulfur Compounds"
Adopted 06/14/94, Federally-Enforceable

Rule 74.9, "Stationary Internal Combustion Engines"
Federally-Enforceable Version Adopted 11/14/00
District-Enforceable Version Adopted 11/08/05

This permit attachment lists the requirements for the November 8, 2005 version of Rule 74.9. Compliance with this attachment will ensure compliance with both versions of the rule. The permit conditions below, therefore, are federally enforceable. The District-enforceable version of this rule will become federally enforceable when approved by EPA as part of the SIP.

__Applicability:__

This attachment applies to the two 1,877 BHP Deutz landfill gas-fired lean burn internal combustion engines which are a part of the landfill gas collection and control system.

__Conditions:__

1. The two 1,877 BHP Deutz internal combustion engines shall be operated in compliance with the following emission limits:

    a. The emissions of oxides of nitrogen (NOx as nitrogen dioxide) from each engine shall not exceed 35 ppmv on a dry basis, corrected to 15 percent oxygen. Alternatively, the NOx emissions shall not exceed 0.6 grams per BHP-hr. This emission limit is applied as a BACT (Best Available Control Technology) requirement of Rule 26.

    b. The emissions of oxides of nitrogen (NOx as nitrogen dioxide) from each engine shall not exceed 125 ppmv on a dry basis, corrected to 15 percent oxygen. This emission limit is applied pursuant to Rule 74.9.B.1.

    c. The emissions of reactive organic compounds (ROC) from each engine shall not exceed 28 ppmv on a dry basis, corrected to 15 percent oxygen, measured as methane.

This emission limit is applied as a BACT (Best Available Control Technology) requirement of Rule 26.

d. The emissions of reactive organic compounds (ROC) from each engine shall not exceed 750 ppmv on a dry basis, corrected to 15 percent oxygen, measured as methane. This emission limit is applied pursuant to Rule 74.9.B.1.

e. The emissions of carbon monoxide (CO) from each engine shall not exceed 280 ppmv on dry basis, corrected to 15 percent oxygen. This emission limit is more stringent than Rule 74.9.B.1 and is a federally-enforceable emission limit pursuant to Rule 35.C.2.

f. The emissions of oxides of sulfur (SOx as sulfur dioxide) from each engine shall not exceed 0.02 lb/MMBTU. This emission limit is applied as a BACT requirement of Rule 26.

In order to comply with this condition, the permittee shall have each engine's emissions tested no less than once every 24 months.

2. The landfill gas fired engines shall comply with all applicable requirements of Rule 54, "Sulfur Compounds".

   In order to comply with this condition, the permittee shall determine the concentration of sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) from the engines using the test methods outlined in Rule 54.D.

3. Emissions testing shall be conducted on the two 1,877 BHP Deutz internal combustion engines on a biennial basis. The testing shall be conducted by an independent contractor to determine the NOx, ROC, and CO emissions. Emissions of SO_2 and H_2S shall also be determined. The heating value content of the landfill gas shall also be measured. Such testing shall be conducted at the expected maximum operating load of the engines. The test methods specified in Rule 74.9 shall be used. SO_2 and H_2S emissions shall be measured as specified in Rule 54.

   Source test data point intervals for ARB Method 100 tests shall be no greater than 5 minutes and data points shall be averaged over 15 consecutive minutes. A source test shall consist of the average of three (3) runs. Prior to conducting a biennial emissions test, the permittee shall notify the District Compliance Division. Written notification shall be received no less than 15 calendar days prior to the test.

4. Within 60 working days after the completion of the tests required above, a report of the test results shall be submitted to the District.

d. Any additional information required in the Engine Operator Inspection Plan.

8. Pursuant to Rule 74.9.F, Reporting Requirements, the Annual Compliance Certification shall include the following information:

   a. Engine manufacturer, model number, operator identification number, and location.

   b. A summary of maintenance reports, including quarterly screening data.

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